ST. TAMMANY PARISH

MICHAEL B. COOPER
PARISH PRESIDENT

March 6, 2026

Please find the following addendum to the below-mentioned BID.

Addendum No.: 1

Bid#: 26-11-2

Project Name: Tammany Trace Bridge #24

Bid Due Date: Tuesday, March 24, 2026

GENERAL INFORMATION:

1. The following manufacturers are approved for bidding. It is approved in name only, and approval does not waive any requirements of the plans and specifications.
    - Bridge Brothers, Inc.
    - TrueNorth Steel

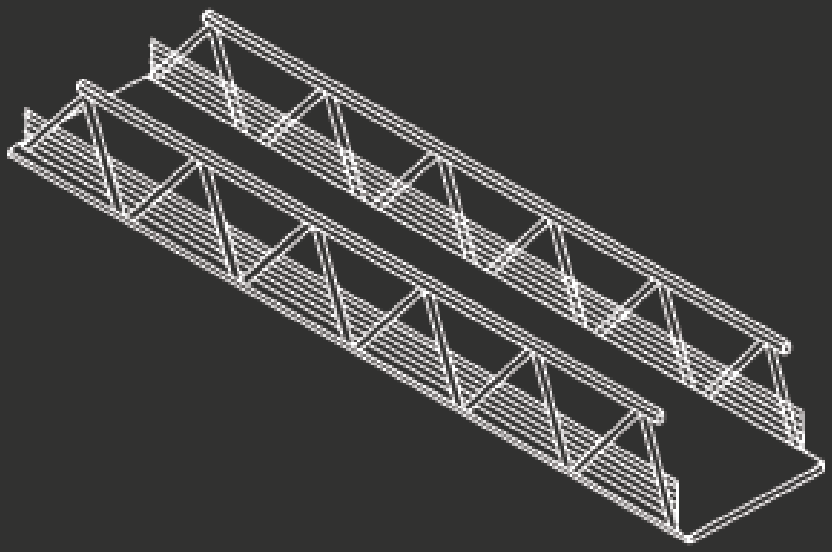
ATTACHMENTS:

1. Bridge Brothers.pdf
2. TrueNorth Steel.pdf

End of Addendum # 1

BRIDGE BROTHERS

TURN KEY PREFABRICATED BRIDGES



QUALIFICATIONS PACKAGE

866.258.3401 sales@bridgebrothers.com www.bridgebrothers.com

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BRIDGE BROTHERS

BRIDGE BROTHERS PROVIDES TURN KEY DELIVERY THROUGH ENGINEERING, FABRICATING, AND INSTALLING CUSTOM BRIDGES AND STRUCTURES

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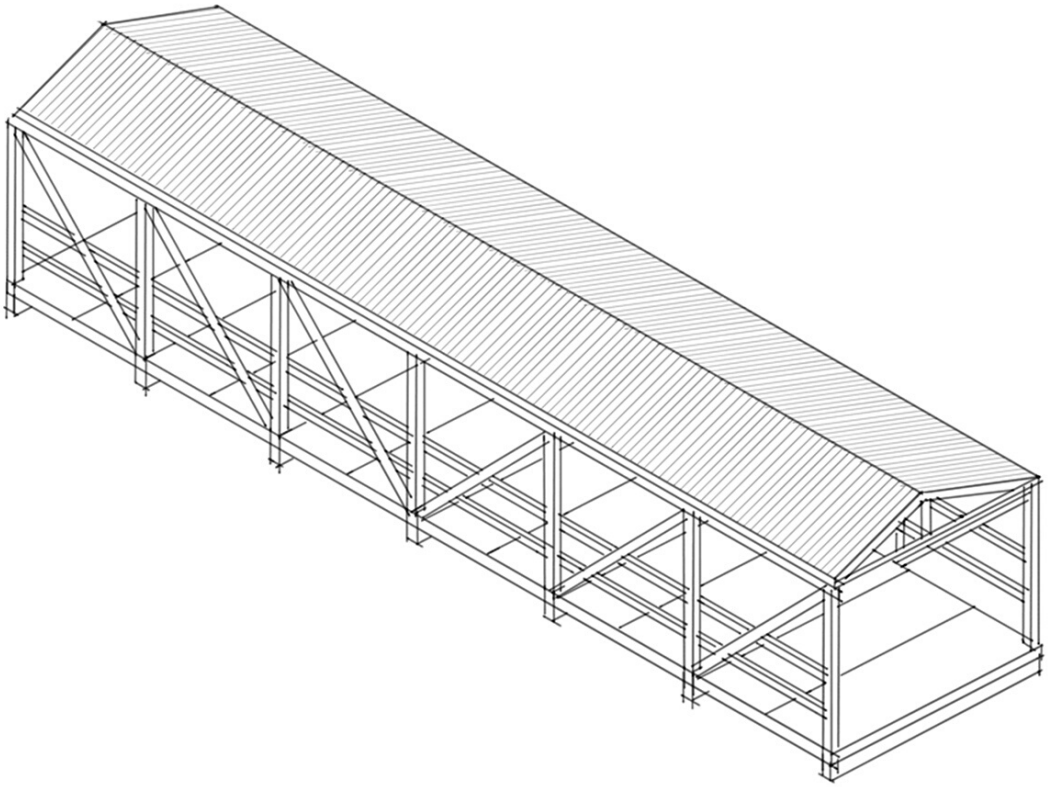


BRIDGE BROTHERS PROCESS

TURN KEY PREFABRICATED BRIDGES

At Bridge Brothers, we offer the quickest turnaround times and the most competitive pricing. Our bridges are custom engineered to fit our clients' applications and specifications. Parks, trails, marine applications, or industrial access, we fabricate bridges for any site. One project consultant shepherds each bridge from concept to installation, making sure any changes minimally impact the timeline or budget. This level of personalized interaction with our clients sets us apart from other firms.

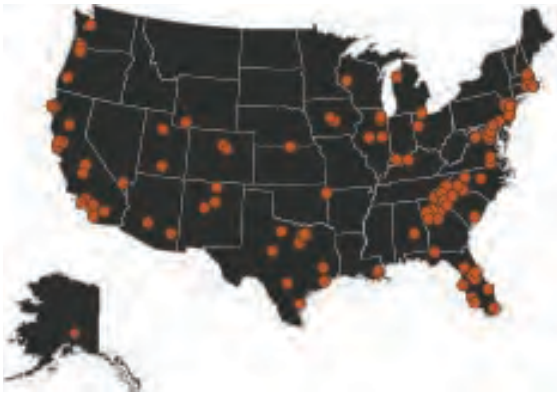
Bridge Brothers was an instrumental partner in the design and fabrication of the Boulder Civic Area park pedestrian bridges. They overcame numerous challenges, and delivered the bridges at an accelerated delivery date which was critical to the entire projects success.

-Cameron, Asst. Superintendent

7 SHOP LOCATIONS

300+ BRIDGES INSTALLED

8 WEEK TURN-KEY SOLUTION



Bridge Brothers provides a variety of services before the project starts to make sure that our clients receive the best value and that the project budget and timeline are within their expectations. These include:

GRANT APPLICATIONS

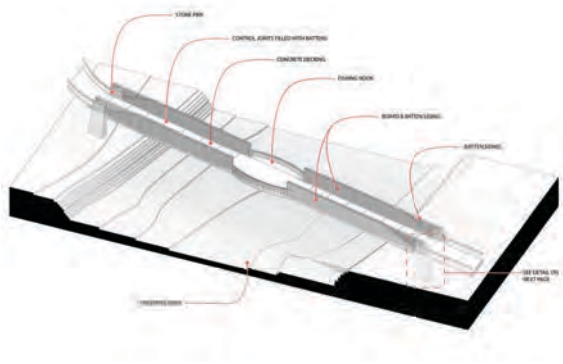
Our team will help determine if a project is eligible for any grants and assist in the application process.

FEASIBILITY STUDY

Before we design, our engineers will analyze each project and make necessary recommendations to improve the bridge.

The City has been very pleased to work with Bridge Brothers in our efforts to put a new bridge in our Lake Park. Their service and quality of the bridge has exceeded our expectations. The bridge was built as ordered, delivered on time and in excellent condition. I would recommend them without hesitation for your bridge needs.

-Joe, City Manager

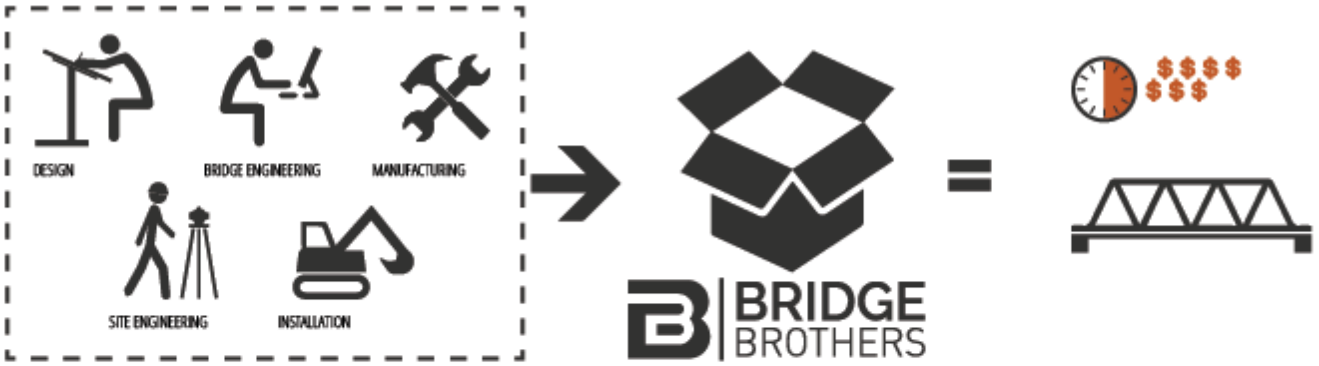


CONCEPT

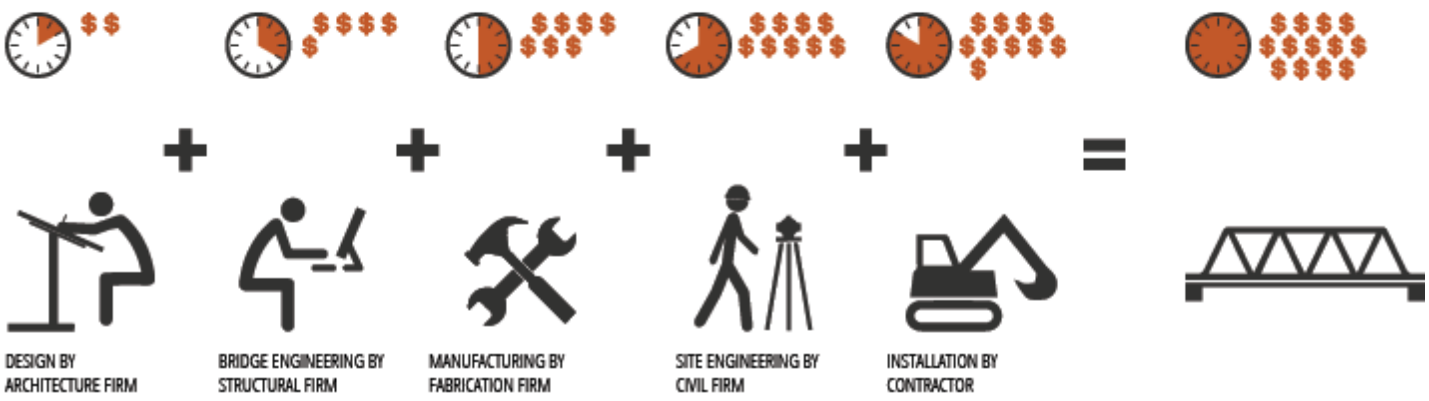
Because Bridge Brothers is a fully integrated engineering, design, manufacturing, and construction firm, we work with our clients to make sure each bridge is well engineered and aesthetically pleasing. Our engineers and architects work hand-in-hand with our clients to bring their vision to life. The Bridge Brothers team takes into consideration how and where a bridge will be used to advise on materials and configurations that would be appropriate. From the project specifications and from conversations with the client team, a unique bridge emerges.

PRECONSTRUCTION • CONCEPT • DESIGN • ENGINEERING • MANUFACTURING • INSTALLATION

BRIDGE BROTHERS PROCESS



TRADITIONAL PROCESS



DESIGN

Once the client team agrees on the conceptual design for the bridge project, our in-house architects create a more detailed rendering. We use the latest technology to develop an image that's a realistic 2D or 3D vision of the project. Depending on the type of visualization, the client team can rotate around the bridge, zoom in to see the finest details, and visualize how well the bridge integrates into its surroundings.

During the design phase, our experts will be able to identify any potential structural or design flaws that may impact fabrication or installation. We value an interactive design process and our architects and engineers enjoy walking client teams through the technical aspects of a project. Design is an integrative process and Bridge Brothers is happy to make modifications on a design.

ENGINEERING

Our civil and structural engineers are certified P.E. licensed in all 50 states. Beyond structural and site engineering solutions, we also provide the following services on every project:

CIVIL ENGINEERING + SITE ENGINEERING

Our on staff civil engineers can provide site design including grading and abutment design.

VE Solutions

We perform value engineering analysis on each project to improve the bridge's quality and life span while reducing costs.

Life Cycle Cost Analysis

Our team looks at all the material and finish options to find the most cost-effective strategy for each project from fabrication to disposal.

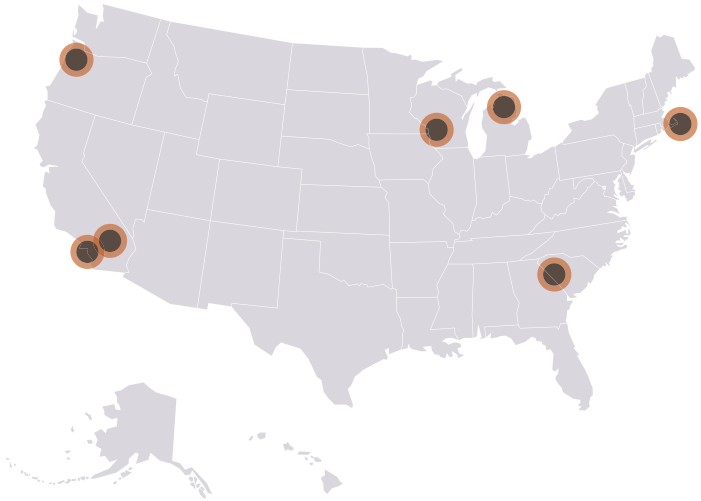
PREFABRICATION

Prefabrication does not mean off-the-shelf. Each bridge is custom manufactured. The prefabrication process means that the bridge is assembled in sections in a controlled environment then these pieces are transported and assembled on site.

There are many benefits to using prefabrication in your bridge project. Building your bridge in dedicated sections helps reduce the need for a large construction project, which in turn will cut down on overall project costs. Bridge Brothers saves you money on your project by hiring a smaller crew and only using the equipment needed for installation. A quick installation process helps clients avoid lengthy shutdowns to a business, industrial factory, or recreational area during construction.

Projects using the prefabrication process tend to be completed faster than bridge projects that are built piece by piece on site. In a controlled environment, the manufacturing team is able to work on multiple aspects of a bridge simultaneously. On a traditional bridge building construction site, workers often need to wait for one part to be completed before moving on to the next. A delay in one area creates a ripple effect and can threaten a deadline and increase costs.

Finally, prefabrication is safer for workers and the environment. With quick construction and a focus on installation, work crews will be spending less time on the job site which means less disruption for you. Prefabrication has a positive impact on the environment by limiting pollution and possible contamination caused by larger construction projects.



OUR SHOPS ARE NATION-WIDE

MANUFACTURING

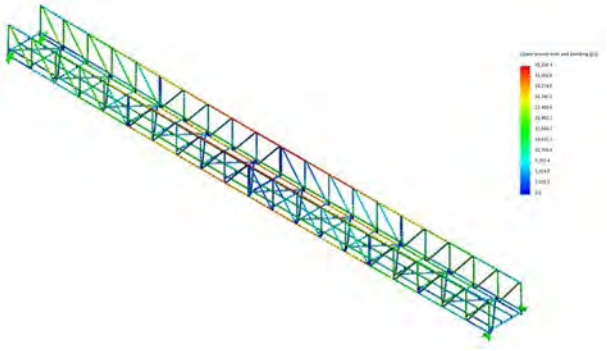
Once a project has gone through several iterations of design and engineering, the custom components of the bridge are manufactured. Bridge Brothers uses prefabrication to keep timelines short and costs low. From the concept phase through manufacturing, we ensure that our clients receive quality materials at competitive prices.

Our manufacturing teams are highly skilled in sourcing and working with high-quality materials and fabricating well-built structures. Bridge Brothers has shops nation-wide which allows us to start work on a project quickly and in any location. Big or small, we provide top of the line manufacturing services for each project.

PREFABRICATION MEANS HIGHER QUALITY + BETTER DESIGN

INSTALLATION

Because Bridge Brothers uses the prefabrication manufacturing method, our installation process is quick and seamless. Building each bridge in prefabricated sections saves time by reducing the onsite construction period and avoiding unforeseen delays. Our team handles the bridge from design to installation. Our bridge consultants are familiar with the bridge and stay in constant communication with the workers to make sure the bridge is installed properly and without incident.



BRIDGE BROTHERS INSTALLS YOUR BRIDGE FOR A TURN KEY SOLUTION

SITE CONSTRUCTION

We offer site construction services. This means one point of ownership. Bridge Brothers is vertically integrated with all in house aspects of the project. We handle the construciton for the site work along with the bridge. If you have Bridge Brothers do the site construction, we will handle the construction and configuration of structural site elements like helical piers, abutments and other elements required to integrate your new bridge into the site.

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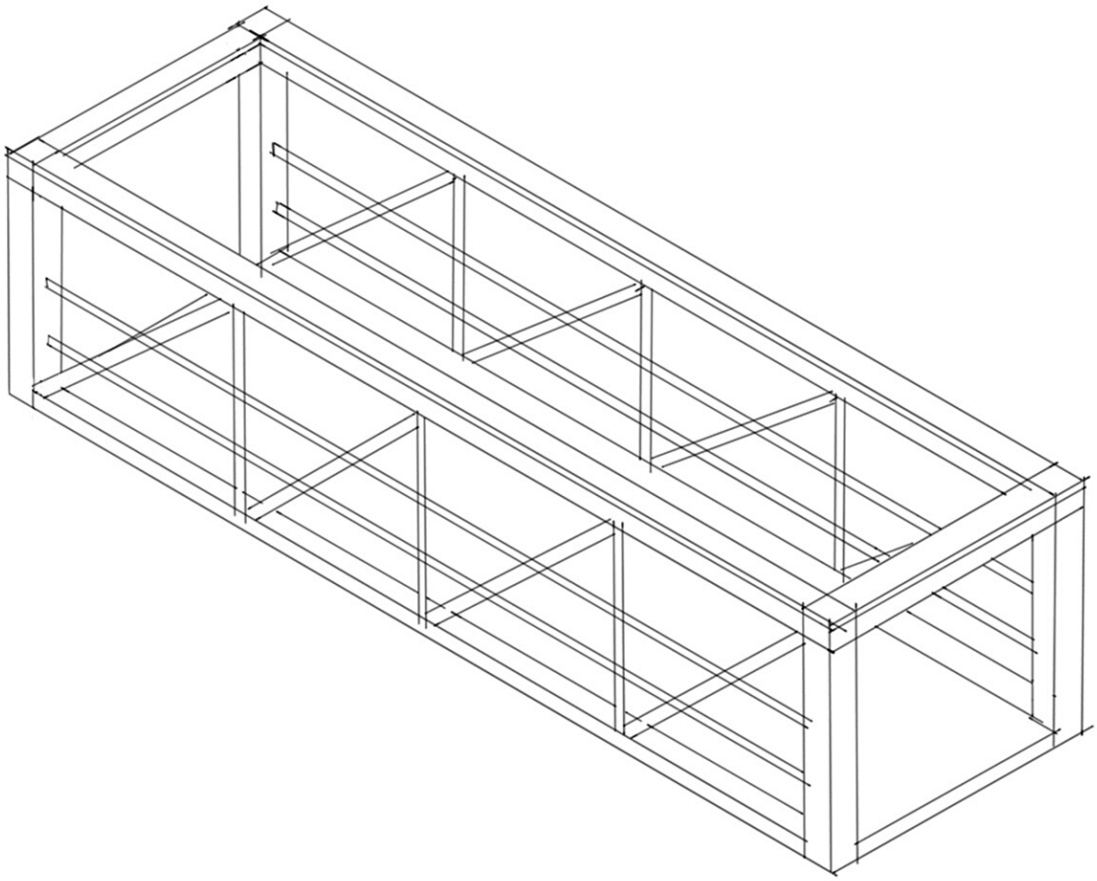
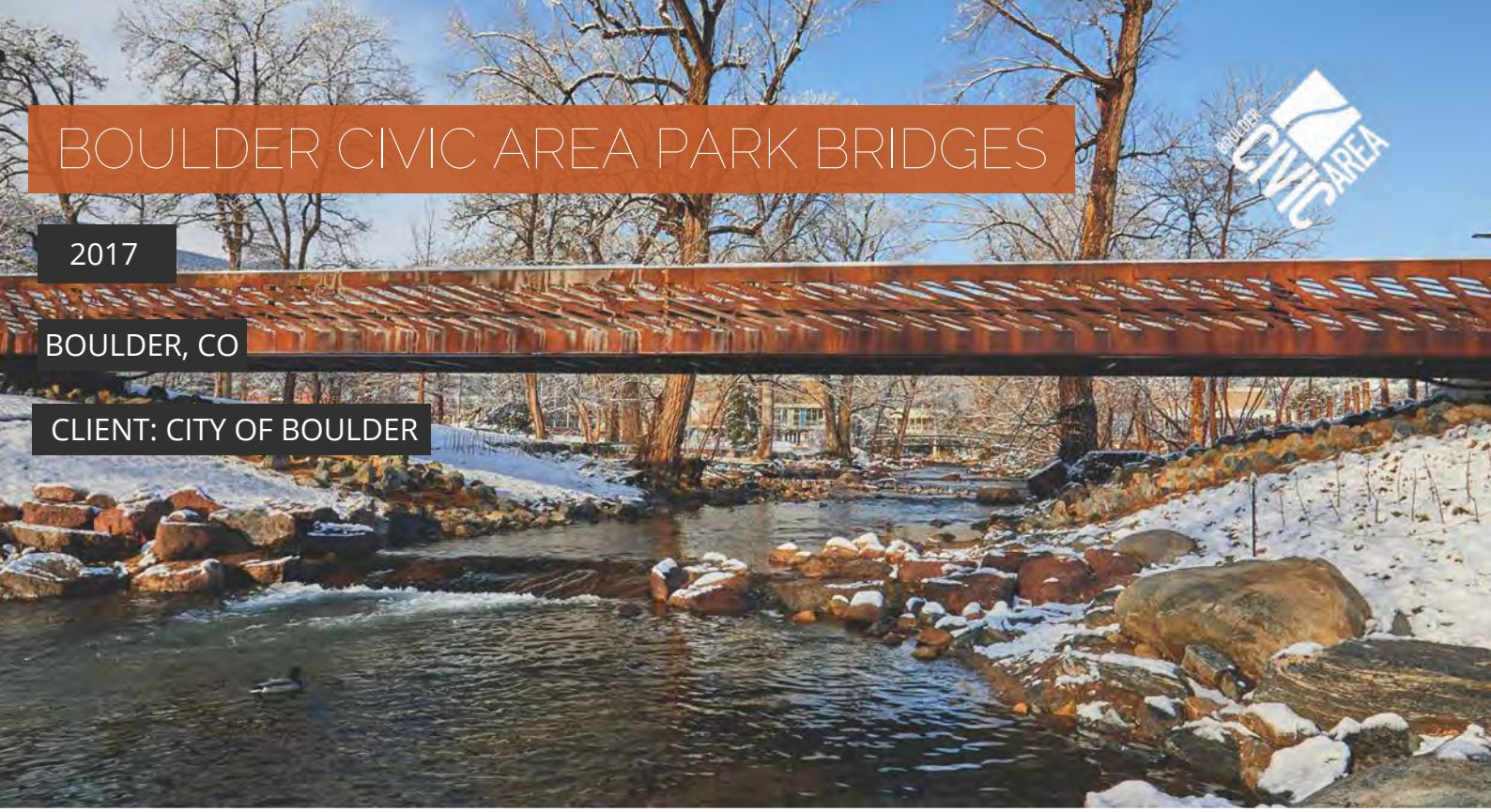


PROJECT BRIEFS

BOULDER CIVIC AREA PARK BRIDGES

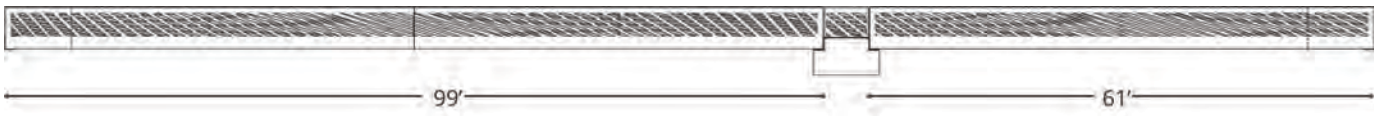


2017

BOULDER, CO

CLIENT: CITY OF BOULDER

PEDESTRIAN BRIDGE • CUSTOM TRUSS • WEATHERED STEEL FINISH • CONCRETE DECKING • CUSTOM RAILING



CONCEPT

These two signature bridges are an icon in the Boulder Civic Area Park in Colorado. The bridge is a custom design that Bridge Brothers fully prefabricated so that it could be installed within one day.

DESIGN

Bridge Brothers worked in close collaboration with the architect throughout the project. In order to avoid future problems, the bridge design incorporated engineering guidance and manufacturing abilities. Working as an in-house team allowed Bridge Brothers to avoid and prevent potential problems.

ENGINEERING

Another engineering challenge Bridge Brothers solved was determining a way to manufacture the bridge so that it would appear as one solid piece with zero indication of welds and plates meeting up.

FABRICATION

The bridge design used Corten Plate steel with a custom CNC design that created a moray pattern throughout the length of the bridge.

INSTALLATION

Because installing the bridge would be very disruptive to this active park, the bridge needed to be designed so that it could be installed in less than one day.

FABRICATION

INSTALLATION

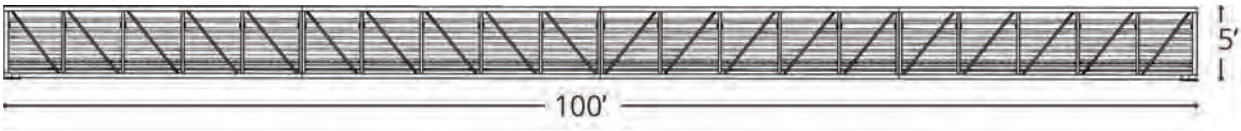
CATAWBA FALLS TRAIL

2016

OLD PORT, NC

CLIENT: US FOREST SERVICE

TRAIL BRIDGE • PRATT TRUSS • WEATHERED STEEL FINISH • PT PINE DECKING • HORIZONTAL RAILING



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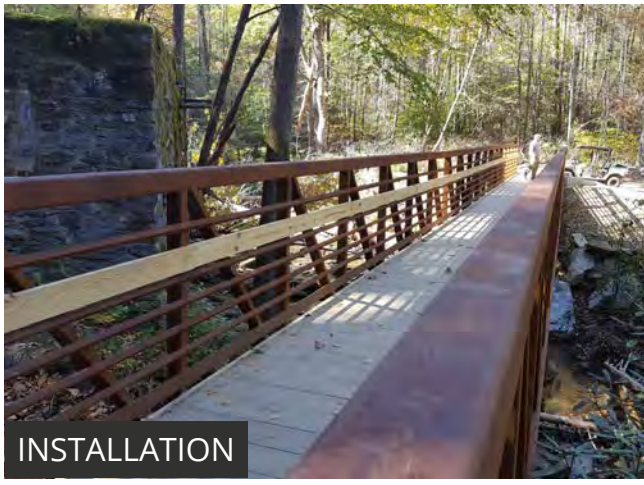


INSTALLATION

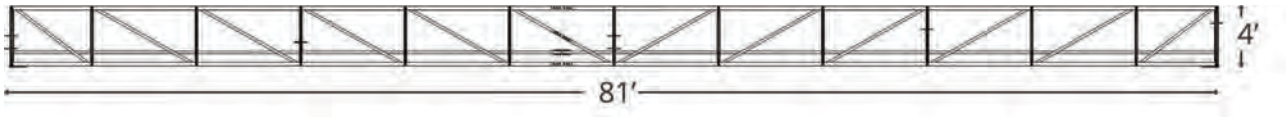
SHELL PIPE RACK

2016

LOCKPORT, IL

CLIENT: SHELL OIL AND GAS

PIPE BRIDGE • PRATT TRUSS • GALVANIZED FINISH



CONCEPT

Shell needed a pipe bridge to carry a utility pipeline over the Des Plaines River in Lockport, Il. The timeline was incredibly short. Bridge Brothers was able to fabricate and deliver a galvanized pipe bridge in four weeks.

DESIGN

Because Shell had such a short timeframe, this bridge was designed to be easy to manufacture and install. For ease of installation, this Shell pipe rack was designed to be installed in two pieces with a mechanically bolted connection. The pipe saddles were integrated into the bridge for complete galvanized coverage. We also prepped for conduit mounted to the side of the truss.

ENGINEERING

This pipe rack needed to be able to withstand constant heavy loads, including ice loads on utility lines and the truss itself, as well as possible flooding and subsequent water pressure. It was also designed and engineered for future expansion for utility lines to be added on top and below the truss.

FABRICATION

All of the pipe supports were prefabricated onto the bridge so that all aspects of the bridge would be dipped as one complete piece to eliminate any areas for potential exposure.

INSTALLATION

Bridge Brothers shipped the bridge on one truck, and Shell was able to receive the delivery, mechanically bolt up the splice connection, and install the bridge in less than four hours.

FABRICATION

INSTALLATION

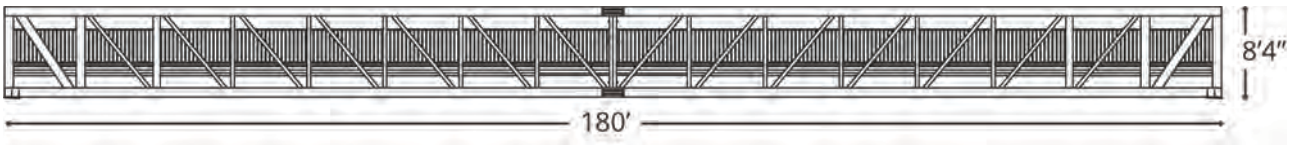
HUMBOLT TRAIL

2016

ARCATA, CA

CLIENT: MCCULLOUGH CONSTRUCTION

TRAIL BRIDGES • BOARDWALK • PRATT TRUSS • MILL FINISH ALUMINUM• ALUMINUM DECKING • VERTICAL PICKET



CONCEPT

Bridge Brothers designed and fabricated two single-span aluminum bridges at 50' and 60', a galvanized steel 180' bridge, and 1,280 linear feet of boardwalk in a sensitive marsh area in northern California.

DESIGN

The boardwalks and bridges were designed to have a low impact on environmentally sensitive areas. Aluminum was used for the entire structure including the decking, railing, and structural elements because it is lightweight and resistant to the corrosion that can occur in the wet marsh environment. Due to the span, the 180' bridge was galvanized steel with a concrete decking.

ENGINEERING

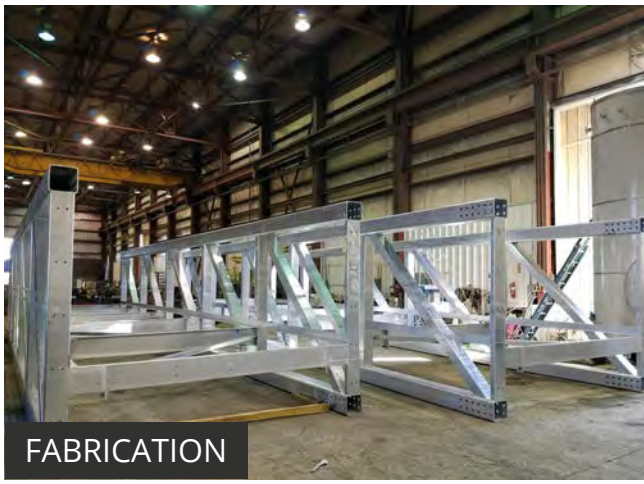
Bridge Brothers designed the boardwalks and aluminum bridges in a way where piles were installed every 20' as opposed to every 12'. This change reduced cost and environmental impact to the marsh.

FABRICATION

The bridges and boardwalks were all prefabricated off-site in a controlled workshop. Because these elements were prefabricated, as opposed to built on site, there was less stress on the sensitive marsh land.

INSTALLATION

We had a limited installation window, but because the bridges and boardwalks were all prefabricated, we were able to install everything in under two months. We used a hybrid crane/excavator. The lighter aluminum boardwalks could be installed with smaller equipment.



FABRICATION

INSTALLATION

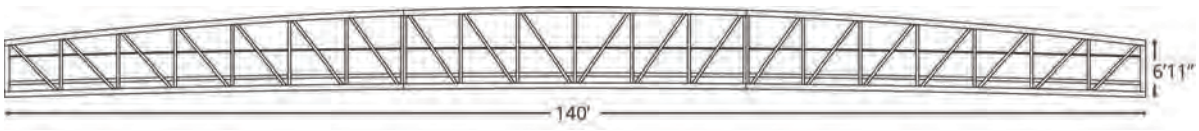
Berkeley Dr Pedestrian Bridge

2016

CLEMSON, SC

CLIENT: CITY OF CLEMSON

PEDESTRIAN BRIDGE • CUSTOM TRUSS • PAINTED FINISH • CONCRETE DECKING • CUSTOM RAILING



CONCEPT

The City of Clemson, S.C., wanted to bring more pedestrian traffic to a new park. The municipality has been growing on both sides of busy U.S. Highway 123. Clemson needed a bridge to connect the trail system on either side.

DESIGN

This was a South Carolina DOT project, and as such, there were a variety of specific regulations and standards Bridge Brother had to adhere to. These included the mesh fencing enclosure which needed to be incorporated into the design and 6-inch toe curbs.

E**NGINEERING**

Our engineers coordinated closely with the South Carolina DOT to make sure we met state engineering and design codes.

FABRICATION

This bridge was entirely prefabricated. This included the mesh railing and the bead decking for the concrete that would be poured.d.

INSTALLATION

This was a single-day install. The bridge was delivered in three pieces and erected on site using a large crane positioned in the median. The concrete deck was poured immediately afterward. Traffic was only rerouted for an hour and a half.

FABRICATION

INSTALLATION

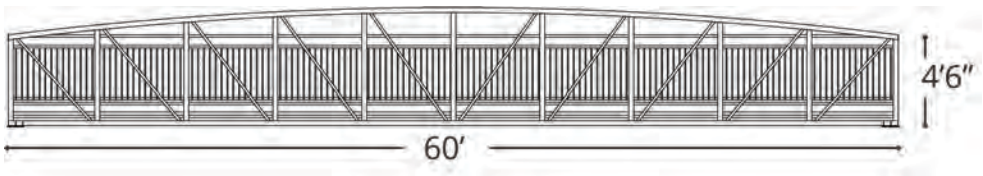
VETERANS MEMORIAL PARKWAY PEDESTRIAN BRIDGE

2016

PORT ST. LUCIA, FL

CLIENT: CITY OF PORT ST. LUCIA

PEDESTRIAN BRIDGE • CUSTOM TRUSS • PAINTED FINISH • CONCRETE DECKING • CUSTOM RAILING



CONCEPT

Bridge Brothers designed two bridges alongside the Veterans Memorial Parkway in Port St. Lucia, Fla. The bridge was designed to blend into the natural surroundings.

DESIGN

We integrated vertical picket to emulate those in the existing park design. A 6-inch concrete decking made the bridges easy to use for pedestrians, bikes and wheelchairs.

ENGINEERING

Our engineers coordinated closely with the Florida DOT to make sure we met state engineering and design codes. Bridge Brothers also designed the bridge abutments.

FABRICATION

Because of the caustic salt air of the coastal environment, we used a high-performance industrial marine environment system that utilizes a zinc primer, epoxy midcoat, and a polyurethane UV protectant top coat. It has an expected lifespan of 20 years. The bridges were prefabricated, sandblasted, and painted in the controlled environment of a workshop.

INSTALLATION

Both bridges were sent to the site on one truck each. They were picked up and set directly off the truck using a crane. The installation was completed in one day, with the concrete decking poured on the next day.

SHIPPING

INSTALLATION

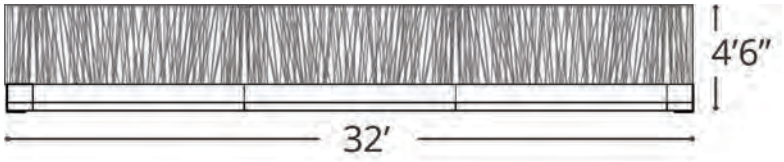
INCYTE PARKWAY PEDESTRIAN BRIDGE

2017

WILMINGTON, DE

CLIENT: INCYTE

PEDESTRIAN BRIDGE • GIRDER STRUCTURE • WEATHERED STEEL FINISH • IPE BRAZILIAN HARDWOOD • CUSTOM RAILING



CONCEPT

This custom bridge was designed to evoke high architectural design. It is a small bridge for a footpath in a rain garden outside of a corporate headquarters in Wilmington, Del. It is supposed to help employees relax, de-stress, and be inspired.

DESIGN

The client had a concept in mind for the unique railing, and Bridge Brothers made the vision come to life. A tropical hardwood decking gave the bridge a high-end finish.

ENGINEERING

The railing needed to feel effortless. Our engineers designed a special plate to hide the railing attachment underneath the bridge. Bridge Brothers also designed and engineered the abutments.

FABRICATION

The bridge was prefabricated and sandblasted in a controlled shop environment for a consistent finish.

INSTALLATION

The bridge was installed in one day. It arrived on a truck in a single piece. Only an excavator was needed to lift the bridge off of the truck and position it into place

FABRICATION

INSTALLED

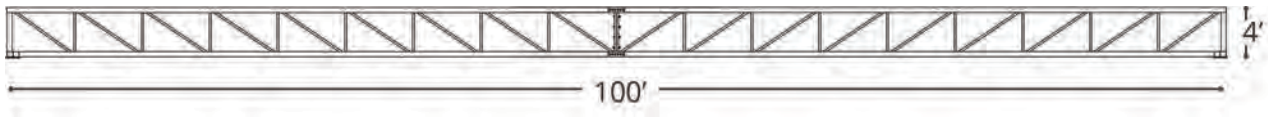
University of Toledo Utility Bridge

2015

TOLEDO, OH

CLIENT: UNIVERSITY OF TOLEDO

UTILITY BRIDGE • PRATT TRUSS • PAINTED FINISH • PREPPED FOR PIPE



CONCEPT

A utility bridge for the University of Toledo had a limited budget. In addition, the bridge needed to be completed in six weeks. Bridge Brothers delivered on both counts.

DESIGN

This utility bridge was designed to have primary utilities run down the center of the bridge. It was also engineered for scalability. In the future, the client can attach pipes to the sides if needed.

ENGINEERING

Along with engineering the bridge, Bridge Brothers designed and engineered the abutments.

FABRICATION

This bridge was fabricated in a controlled shop. The saddles were welded to the frame in the shop as well. Then, everything was sandblasted and painted. Because the bridge was going to run over water, we used a high-performance industrial marine environment system that utilizes a zinc primer, epoxy midcoat, and a polyurethane UV protectant top coat. .

INSTALLATION

The bridge was mechanically bolted up on site. There was no hot work such as on site welding and no disruption of the painted coated system.

FABRICATION

INSTALLATION

BYERS PEDESTRIAN BRIDGE

2017

BYERS LAKE, AK

CLIENT: STATE OF ALASKA DEPARTMENT OF NATURAL RESOURCES

TRAIL BRIDGE • CABLE STAY TRUSS • GALVANISED FINISH • GRATE DECKING • PICKET RAILING

CONCEPT

Due to the span and remote location over a gorge in Denali National Park in Alaska at the base of Mt. McKinley, the State of Alaska asked Bridge Brothers to design a suspension bridge along a trailway.

DESIGN

The cable stayed truss kept this bridge thin, lightweight, and efficient. Because of the site constraints, another bridge type was not possible. We also worked closely with the Alaska DOT to make sure we met state codes and regulations.

ENGINEERING

This bridge was designed to be mechanically spliced in multiple sections. Bridge Brothers designed and engineered the abutments in collaboration with a cable bridge company.

FABRICATION

There was a very tight window for fabrication. The bridge was prefabricated then galvanized in sections. These sections were then shipped on a barge from Seattle to Anchorage.

INSTALLATION

Due to the weather, there was a tight window for installation. A nearby lake needed to be frozen to transport the bridge pieces. Each piece was then transported up the mountain. This bridge was installed in the middle of winter over the course of several days—no easy feat, but Bridge Brothers made it possible!

FABRICATION

FIT-UP

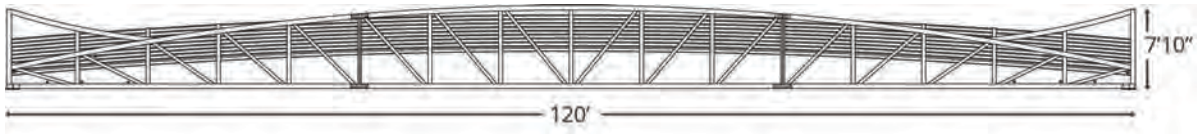
CITY OF SPARTANBURG PEDESTRIAN BRIDGE

2017

SPARTANBURG, SC

CLIENT: CITY OF SPARTANBURG

PEDESTRIAN BRIDGE • CUSTOM TRUSS • PAINTED FINISH • CONCRETE DECKING • HORIZONTAL RAILING



CONCEPT

This bridge was designed to evoke the wings of a monarch butterfly. It's fitting because this bridge connects stretches of the Monarch Trail. We worked with the City of Spartanburg to finesse the design and to bring the project within its budget.

DESIGN

Bridge Brothers worked closely with the city's landscape architects to design and engineer this bridge. It was designed so that the camber of the decking would match the camber of the bridge.

ENGINEERING

The soil conditions were poor in this area. Bridge Brother was able to design and engineer the site, piers, and abutments to support the bridge.

FABRICATION

This bridge was prefabricated in a controlled shop off-site. The camber of the bridge decking matched the profile of the top chord.

INSTALLATION

Bridge Brothers did the site construction including pouring the concrete abutments and driving piles. The bridge was delivered and installed within a day. Then, the concrete decking was poured. The bridge was painted blue after the installation at the request of the owner.

FABRICATION

INSTALLATION

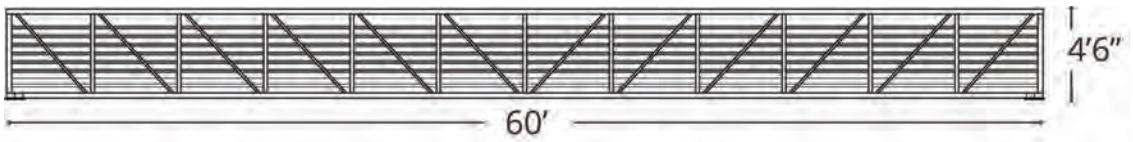
EAST RICHARDSON & SOUTH GUM ST. PEDESTRIAN BRIDGE

2015

SUMMERVILLE, SC

CLIENT: TOWN OF SUMMERVILLE

PEDESTRIAN BRIDGE • PRATT TRUSS • PAINT FINISH • CONCRETE DECKING • HORIZONTAL RAILING



CONCEPT

One of Bridge Brothers' first bridge projects, this bridge was designed for a Summerville, S.C. elementary school for use by school children.

DESIGN

The owner asked for a classical pedestrian bridge with a timeless quality. The project also needed it to be done relatively quickly and economically.

ENGINEERING

This area has high seismic activity, and our engineers had to account for this in the design.

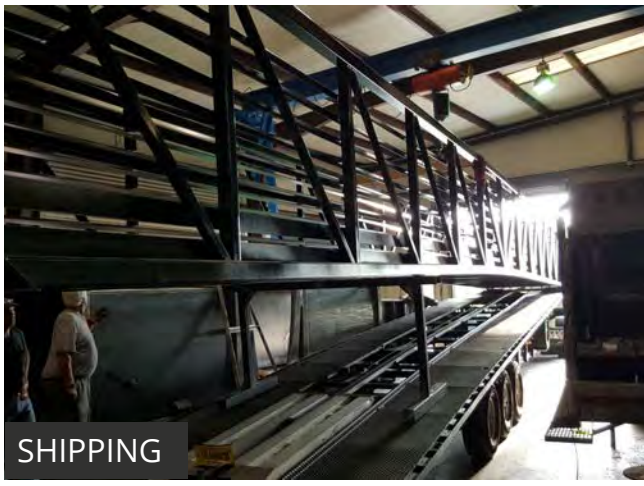
FABRICATION

Due to the coastal location, we used a high-performance industrial marine environment system that utilizes a zinc primer, epoxy midcoat, and a polyurethane UV protectant top coat. It has an expected lifespan of 20 years. The bridge was prefabricated, sandblasted, and painted in the controlled environment of a workshop.

INSTALLATION

The bridge was manufactured in a single piece. It was brought to the site and installed in a single day. The concrete decking was poured after the bridge was installed.

FABRICATION



SHIPPING

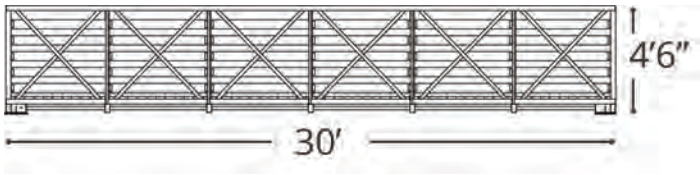
BROOKHAVEN PEDESTRIAN BRIDGE

2017

BROOKHAVEN, GA

CLIENT: CITY OF BROOKHAVEN

TRAIL BRIDGE • LONG TRUSS • PAINT FINISH • PT PINE DECKING • WOOD RAILING



CONCEPT

The City of Brookhaven, Ga., wanted a custom bridge with a traditional style. They specifically requested this unique truss design. The bridge was designed to emulate other bridges that Bridge Brothers designed especially for the City of Brookhaven to create one cohesive brand for their parks and trails.

DESIGN

Bridge Brothers worked with the city's landscape architect on the bridge design. The design integrated timber in the decking and railing to bring the language of the existing boardwalk into the bridge. The goal was to have the trail feel like one cohesive unit.

ENGINEERING

This project had a very quick 7-week timeline, and Bridge Brothers' streamlined engineering process made it possible to deliver a bridge within this timeframe. Bridge Brothers also designed the piers and abutments.

FABRICATION

This bridge was prefabricated in a closed environment.

INSTALLATION

This bridge was installed in a day.

FABRICATION

SHIPPING

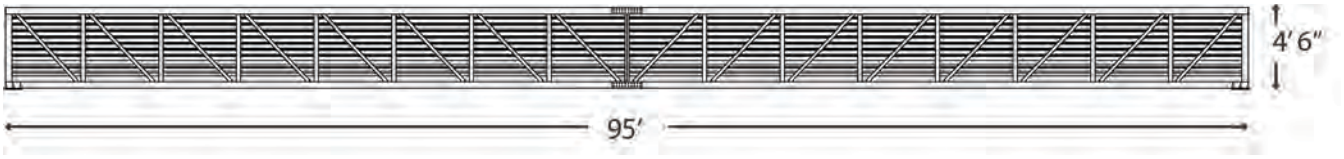
BOBBY JONES GOLF CLUB

2018

ATLANTA, GA

CLIENT: BOBBY JONES FOUNDATION

PEDESTRIAN & VEHICULAR BRIDGE • PRATT TRUSS • WEATHERING STEEL FINISH • CONCRETE DECKING • HORIZONTAL RAILING



CONCEPT

This unique urban golf course was undergoing a renovation and needed four bridges. The Bobby Jones Golf Course in Atlanta is a historic site, along a picturesque waterway. It was important that the bridge blend with the natural environment.

DESIGN

Because it is located on an active golf course, these four bridges needed to accommodate, golf cart, pedestrian, and maintenance vehicle traffic. We used a weathering steel with concrete deck for functionality and timelessness.

ENGINEERING

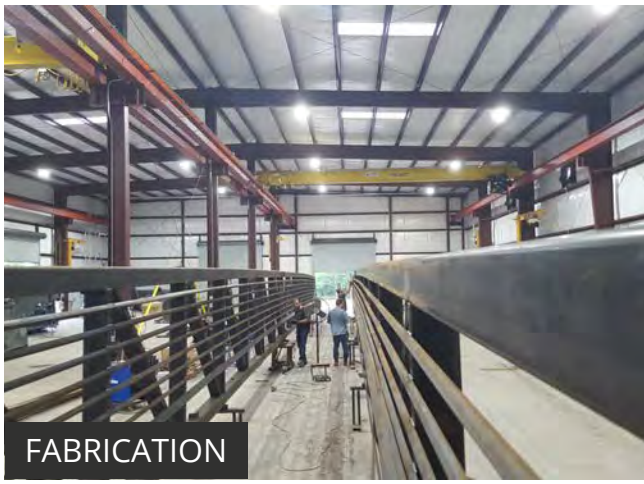
Along with the bridge design and engineering, we worked with the owner on the site design and engineering. Previously, the owner had assumed they would spend a hefty sum on structural piles. Bridge Brothers was able to re-engineer the supports. We reduced the project budget by taking on the civil engineering and construction. We did all of the civil and structural engineering, site construction, manufacturing, bridge erection, and concrete decking.

FABRICATION

The bridge was prefabricated off-site in several pieces. These were sandblasted for a cohesive finish.

INSTALLATION

While the bridge was being prefabricated, we completed all of the site work including the construction and installation of the abutments and piers. The bridges were brought to the site on trucks and installed on multiple days.


FABRICATION

INSTALLATION

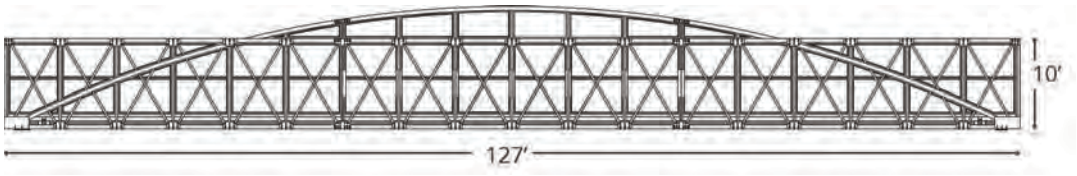
ACWORTH SKYWAY BRIDGE

2017

AKWORTH, GA

CLIENT: CITY OF ACWORTH

SKYWAY BRIDGE • BOWSTRING TRUSS • WEATHERED STEEL FINISH • CONCRETE DECKING • MESH RAILING



CONCEPT

Located in historic downtown Acworth, Ga., this skyway bridge took pedestrians safely over an active freight rail right-of-way that split the downtown.

DESIGN

The city tasked us with maintaining the historic character and architectural quality of the area. We used weathered steel and faux rivet-bolted connections for a historic railway infrastructure impression. Due to the location over an active rail, we used a mesh enclosure to protect users. This mesh had to meet the CSX specifications.

ENGINEERING

We worked closely with CSX representatives to ensure that we met their requirements and codes. We also worked closely with the architects of the stair and elevator tower that our bridge would connect to.

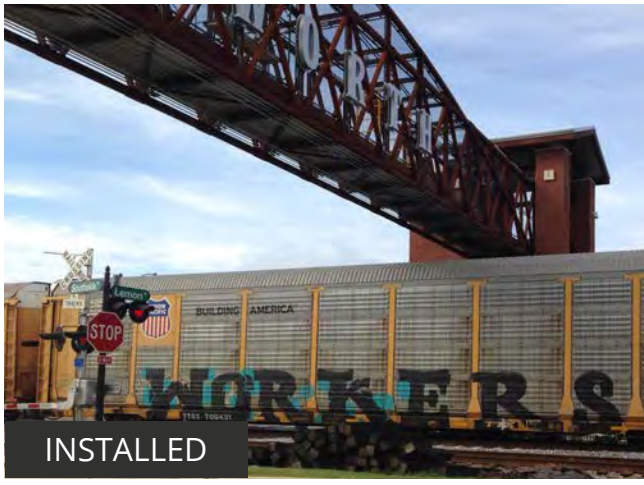
FABRICATION

The bridge was prefabricated off site and sandblasted for a cohesive finish. The mesh enclosure was also prefabricated and attached in the shop.

INSTALLATION

Because the bridge was prefabricated, we limited the amount of dangerous track exposure for workers and the amount of actual work that took place above the track. The bridge was mechanically spliced in three sections. It was bolted up and erected in one day..

SHIPPING

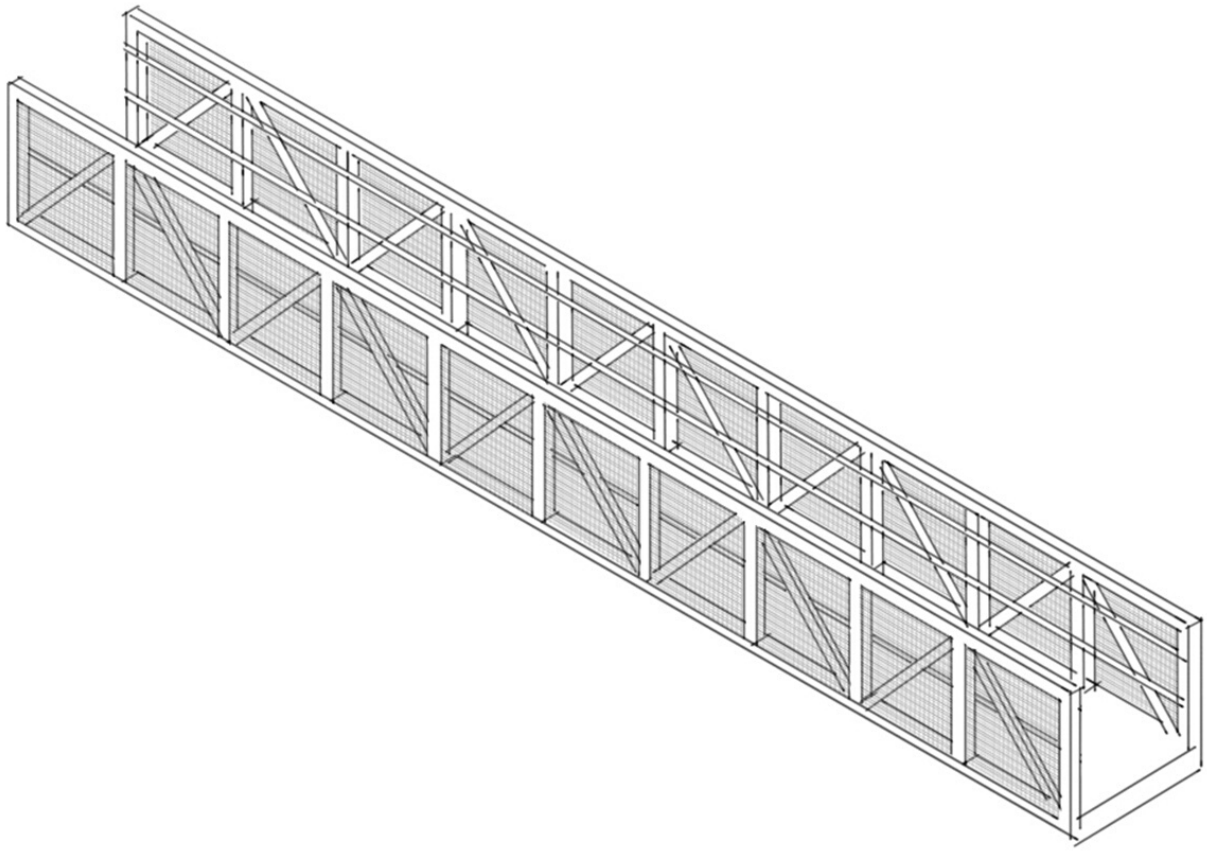


INSTALLED

BRIDGE BROTHERS

BRIDGE BROTHERS PROVIDES TURN KEY DELIVERY THROUGH ENGINEERING, FABRICATING, AND INSTALLING CUSTOM BRIDGES AND STRUCTURES

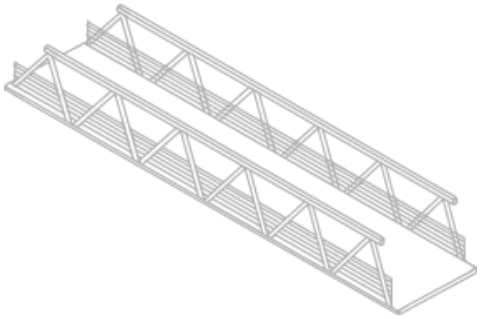
T: 866.258.3401 E: sales@bridgebrothers.com www.bridgebrothers.com



PROJECT REFERENCES

PROJECT REFERENCES

At Bridge Brothers, we have a new integrated approach to bridge projects. Through integrated design that lets us design and build turn key, prefabricated bridges, we've been able to bring our client's visions to life and create inspiring bridges that stand the testament of time.



Along the way, we've completely redesigned the way a building company brings value to clients. Our integrated, full-services approach enables us to provide real estate services—from financing to leasing—and a truly collaborative design and construction process that fast-tracks our clients' most riskiest, complex and iconic projects.

It's the intersection of creativity, design, execution, with an eye on the practical considerations of timing and budgets. When this is all owned by a single integrated team that operates without functional silos, the results are projects that fully meet the dreams, desires and expectations of clients.

EAST RICHARDSON & SOUTH GUM ST. PEDESTRIAN BRIDGE

Owner : Town of Summerville, SC

Location : Summerville, SC

Contact : Russell Cornette 843.851.4226

Size : 6' x 60'

QUESTA UTILITY BRIDGE

Owner : Entacta

Location : Questa, NM

Contact : Michael Cincirpini 412.417.84608

Size : 9' x 126'

BRADY'S RUN TRAIL BRIDGE

Owner : Beaver County, PA

Location : Brady's Run PA

Contact : Todd Phillips 330.507.2925

Size : 55′ x 8′

MCCORMICK PARK PEDESTRIAN BRIDGE

Owner : City of St. Helens

Location : City of St. Helens, OR

Contact : Jenny Dimsho 503.366.8207

Size : 8′ x 60′

SOUTHERN HILLS HOA PARKS + RECREATION BRIDGE

Owner : Southern Hills HOA

Location : Phoenix, AZ

Contact : Patti Trites 402.213.7126

Size : 5′ x 50′

BRISTOL TRAIL BRIDGE

Owner : Town of Summerville, SC

Location : Summerville, SC

Contact : Russell Cornette

843.851.4226

Size : 4′ x 100′

ASH WOODS
PEDESTRIAN BRIDGE

Owner : City of McKinney, TX

Location : McKInney, TX

Contact : Don Simms 682.552.1792

Size : 8′ x 70′

CATAWBA TRAIL BRIDGE
PEDESTRIAN BRIDGE

Owner :US Forestry Service

Location : Old Fort, NC

Contact : Don Cable 828.226.1640

Size : 6′ x 100′

SHELL PIPE BRIDGE

Owner : Shell Oil

Location : Lockport, IL

Contact : Paul Bellizaire - Paul.Bellizaire@shell.com

Size : 4’ x 81’

HUMBOLT

PEDESTRIAN BRIDGE + BOARDWALK

Owner : Humbolt County

Location : Arcata Marsh, Arcata, CA

Contact : Dena McCullough 707-499-1471

Size : 180’ x 8’, 50’ x 8’, 60’ x 8’, 1,280 linear feet of boardwalk

FPL INDUSTRIAL BRIDGE

Owner : Florida Power & Light

Location : Palmetto Bay, FL

Contact : Tony Pou 305.469.3556

Size : 5’ x 145’

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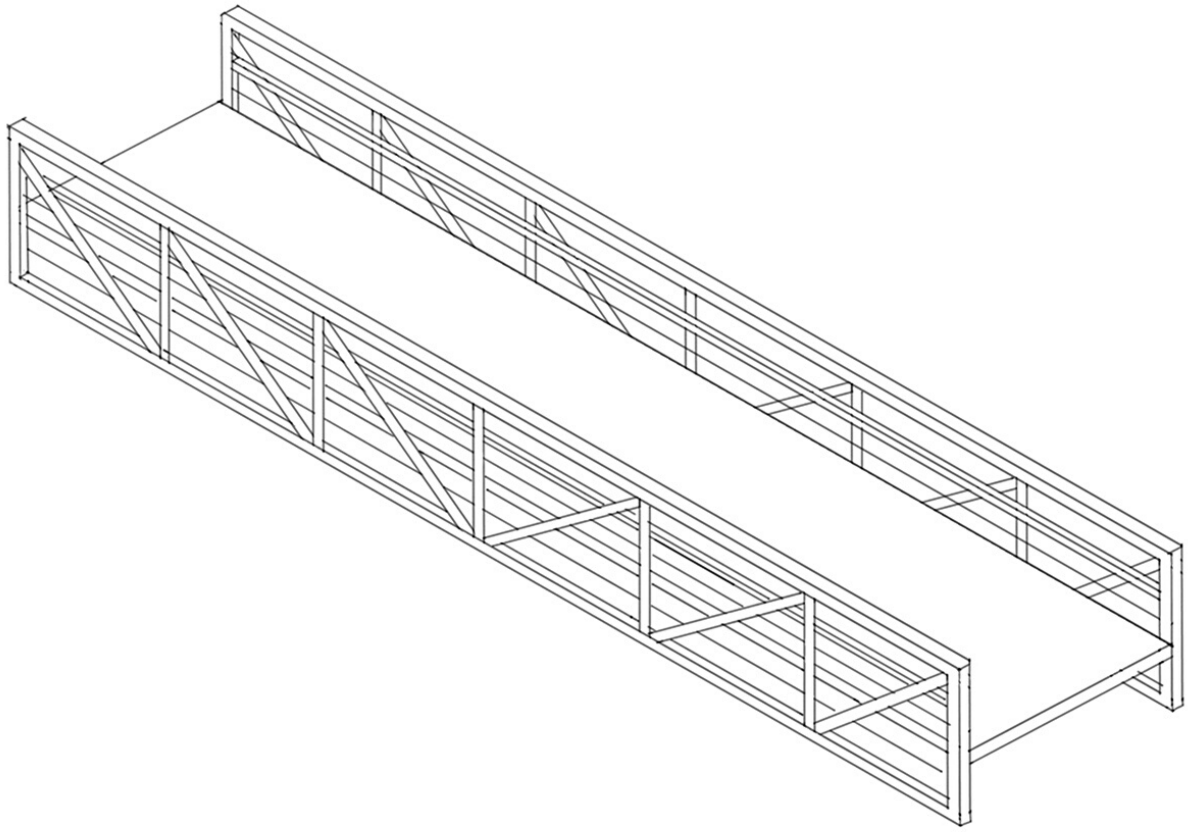

RESUMES

ELI ANGELL

PROJECT MANAGER

T: (404) 664-9691 E: eangell@bridgebrothers.com

FAVORITE FOOTBALL TEAM:

Clemson Tigers

BUCKET LIST

Kayak the Danube River
Hang glide over Interlaken
Sail the Atlantic to Portugal

PROFILE

Business Development and Project Manager with eight years of experience in the construction and manufacturing industry. Comprehensive knowledge of aluminum and steel structural design standards and codes, as well as industry manufacturing best practices and analysis. Cross coordinate design and engineering teams with manufacturing and site construction to meet expedited project timelines successfully.

EDUCATION

Clemson University, Clemson, SC

Bachelor of Science, Business Management

EXPERIENCE

Project Manager |Bridge Brothers Inc | January 2015 - Present

Responsible for all project execution & management for successful deliverables.

RECENT PROJECT EXPERIENCE

East Richardson Avenue & South Gum Street Sidewalk Improvements
Summerville, SC

We designed/engineered/ prefabricated the bridge and coordinated with Greenwave Contracting on installation and erection procedures to ensure a safe and efficient process.

Cherokee / Scotland Capital Improvement Project *Charlotte, NC*

The project was a storm drainage improvement with limited access to the site by the contractor Onsite Development. We provided engineered and calculation package on two bridges and associated abundments as well as prefabricated the bridges to be installed using limited equipment with minimal impact to the environment.

Milton Creek Pedestrian Bridge *St. Helens, OR*

Project with unique challenge in budgeting and available equipment. We provided engineered abutment and prefabricated bridge drawings and calculations to carry the necessary loading required of their maintenance vehicle. To save time and cost the prefabricated bridge was shipped up and installed using their equipment and a on-site contractor.

"I ENJOY THE WEEKENDS ON LAKE LANIER WITH MY SON, GRILLING AND CATCHING FISH"

BUCKET LIST

Skydiving
Catch a Swordfish
Climb Mt. Everest

AARON GENTILLUCI

BUSINESS DEVELOPMENT MANAGER

T: (404) 664-9691 E: agentilluci@bridgebrothers.com

PROFILE

Aaron is responsible for business development of prefabricated bridge structures across the United States. He has a proven history of B2B growth, is team-oriented and a uses a hand-on approach to reach personal and team goals. Aaron is skilled in negotiation, procurement, and logistics.

EDUCATION

Roanoke College, Salem, Virginia

Bachelors in Business Administration/ Business Leadership

EXPERIENCE

Business Development Manager | Bridge Brothers | Jan 2018 - Present Vice
Foundation Sales Representative | Ryerson| July 2016- Jan 2018
Inisght Sales Associate | Infra-Metals | August 2010- July 2016

SKILLS

Logistics
Inventory Management
Inventory Control
Six Sigma
Auto Cad
Sales Management
Kaizen
Account Management
Enmark systems

JARROD SOLOMON

PLANT MANAGER

T: (404) 664-9691 E: jsolomon@bridgebrothers.com

"WHATEVER YOUR LIFE'S WORK IS, DO IT WELL. A MAN SHOULD DO HIS JOB SO WELL THAT THE LIVING, THE DEAD, AND THE UNBORN COULD DO IT NO BETTER."

~MARTIN LUTHER KING, JR.

BUCKET LIST

Travel the World

PROFILE

Exceptional leader and Production Manager with fifteen years of experience. Past work experience as a helper, Lead man/Foreman, Manager, QC, Production Supervisor and Director of Manufacturing. Outstanding relationship building, training, and presentation skills. Intelligent and driven to succeed. Consistently meeting and exceeding goals

SKILLS

- Able to train employee on required skill.
- Capable to manage money and services for production.
- Good knowledge of raw materials, production processes, quality control, costs, and other techniques.
- Strong experience as production supervisor.
- Excellent knowledge of machines and tools. Ability to solve mathematical problem.

EXPERIENCE

Production Manager |Bridge Brothers |Nov 2018- Present

Responsible for planning, organizing and managing the daily operations of the shop; Supervises, trains and develops staff; Provides advice to management and staff; Creates employee work schedules, trains subordinates, and oversees work product to verify effective performance. Verifies equipment works properly, makes repairs as needed, and ensures both the environment and the employee practices focus on a safe, clean, and professional workplace.

Production Manager | Conecraft Incorporated | Apr 2017- Nov 2018

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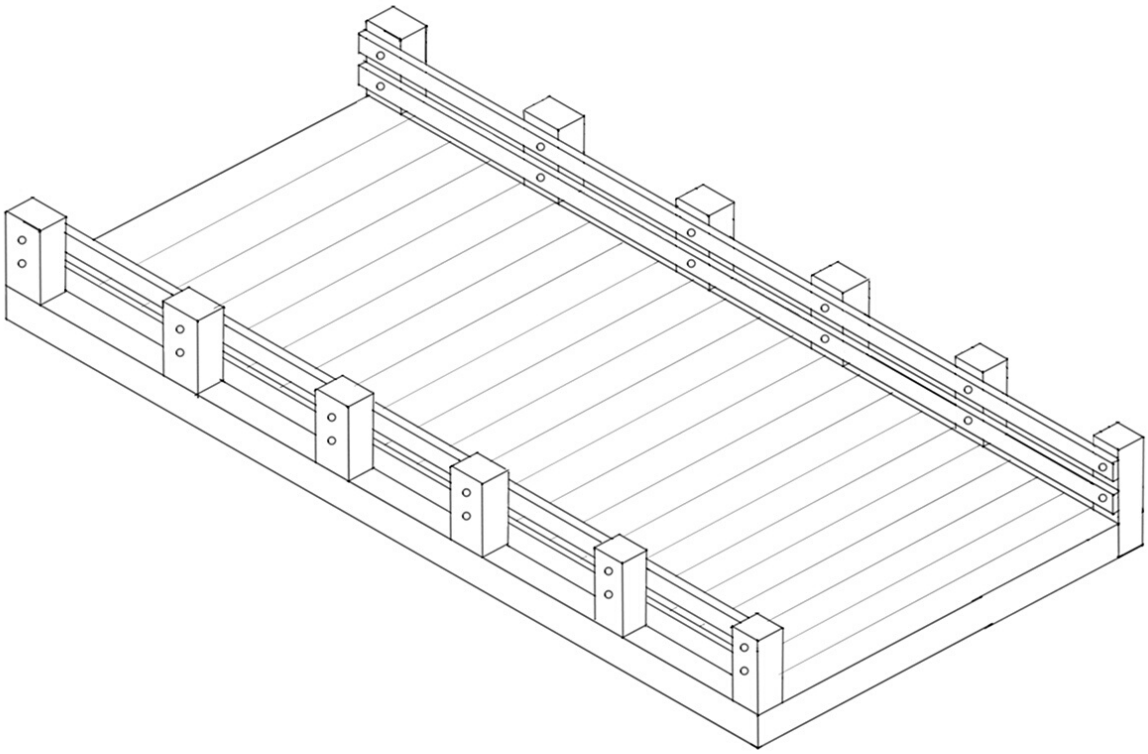


TECHNICAL DOCUMENTS

Bridge Brothers
Certification of Warranty

Bridge Brothers Inc. warrants their steel structure(s) to be free of design, material and workmanship defects for a period of one - ten years from date of delivery per project specifics.
This warranty does not cover defects in the structure(s) caused by improper use, overloading, intentional damage or casualty, improper maintenance, alteration or any other cause not the result of defective design, material or workmanship by Bridge Brothers Inc. This warranty excludes all damage resulting from, or relating to, the use of any kind of de-icing material on the structure(s).

This warranty shall be null and void unless the customer provides records that verify compliance with minimum guidelines specified in the structure(s) inspection and maintenance procedures.

Any claim under this warranty shall be made promptly and directly to Bridge Brothers Inc. who shall have the option, at its sole discretion, to repair, replace or adjust any covered defect without charge to the original purchaser. This warranty is only applicable where customer has paid all amounts due and payable for the structure(s).

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, ANY WARRANTY OF MERCHANTABILITY OR ANY WARRANTY FOR A PARTICULAR FITNESS OR USE. UNDER NO CIRCUMSTANCES SHALL BRIDGE BROTHERS INC. BE LIABLE FOR INCIDENTAL, SPECIAL, PUNITIVE OR CONSEQUENTIAL DAMAGES OR FOR LOST PROFITS OR GOODWILL, ARISING FROM OR RELATING TO ANY BREACH OF THIS AGREEMENT REGARDLESS OF ANY NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

FAILURE TO GIVE NOTICE OF ANY CLAIM WITHIN THIRTY (30) DAYS AFTER THE DATE THE DEFECT IS RECOGNIZED, OR SHOULD HAVE BEEN RECOGNIZED, SHALL RENDER THIS LIMITED WARRANTY NULL AND VOID.

INSPECTION + MAINTENANCE RECOMMENDATIONS

The purpose of this set of recommendations is to suggest some minimum guidelines for inspection and maintenance of BRIDGE BROTHERS INC. Pedestrian Bridges. These procedures are not inclusive and more detailed procedures may be warranted depending upon bridge location, environment, and usage. Establishing the requirements for, and verifying the performance of, all field inspection and maintenance is the responsibility of the owner.

INSPECTION

I. USER SAFETY

A. Each bridge should be inspected at regular intervals (at least once per year) to ensure that all items of user safety are accounted for and performing properly. Those areas of special concern should be as follows:

1. Safety rails, handrails, rubrails, fencing or other types of safety features should be in place with complete structural integrity and capacity. Pay particular attention to handrail and fencing attachments. Check for any sharp edges or protrusions that could produce bodily harm or be a hazard to the user.

2. Deck surfaces should be without excessive gaps, cracks or projections that could create a trip hazard or interfere with the user in any way. Special consideration should be given to any smooth deck surface that could also create a possible slip hazard. For concrete decks, some form of a roughened surface or broom finish or other means of providing a non-skid surface is recommended.

The owner and/or specifier should be aware that most pedestrian bridge liability claims are statistically slip and fall claims.

II. STRUCTURAL INTEGRITY

A. Each bridge should be inspected at regular intervals not to exceed one (1) year. The American Association of State Highway and Transportation Officials (AASHTO) Manual for Maintenance Inspection of Bridges provides an excellent guide for this inspection (pages 5-13 in the current edition). This visual inspection should include, but not be limited to the following:

1. Check the decking to ensure it is in satisfactory condition. Pay special attention to timber decks at their contact surfaces where they bear on stringers.

2. Steel surfaces should be inspected to ensure that they are performing satisfactorily. Check for any excessive corrosion on weathering steel bridges, or paint and caulk integrity on painted bridges, paying special attention to the following areas:

a. Steel below the deck, particularly the top of stringers supporting wood decks.

b. Truss or floor system joints where debris or water may accumulate.

c. Anywhere vegetation or other material may have come in contact with the steel.

NOTE: Any weathering steel surface not "boldly exposed" to the atmosphere should be checked to ensure it has formed its protective oxide layer.

3. Check all steel surfaces and welded and bolted connections for cracks. Pay special attention to the welded truss and floor beam joints in vehicular or material handling bridges subject to fatigue stresses.

4. Check the ends of the bridge for any damage which may have been caused by vehicular impact.

5. Check the integrity of concrete abutments and/or piers for scour due to water flow if applicable, etc., per AASHTO's Manual for Maintenance Inspection or the foundation engineer's recommendations.

Check for any settlement of the abutments which may be warping or twisting the bridge.

6. Check anchor bolts for damage and see that they are secure. Examine all bearings to ascertain that they are functioning properly. Expansion bearings and the expansion joints at the ends of the bridge must be checked to see that they are moving freely and are clear of all foreign material. Check for creeping of teflon pads, if present.

7. Spliced Bridges:

a. Check the bolted splices for any excessive corrosion or cracking of the steel fasteners.

b. Make sure all weep holes are open and clear of debris to allow for complete drainage of any moisture which may collect on the interior tube surfaces. See the original shop drawings for locations of weep holes.

8. If problems are seen during the inspection procedure, cleaning and repair or replacement of weathering steel bridge components may be necessary; painted bridges may require cleaning and repainting or replacement of some or all members. Contact BRIDGE BROTHERS INC. or the foundation

MAINTENANCE FOR PAINTED BRIDGES

Painted bridges, like any painted structure, require periodic inspections and painting. The following steps will help increase the life span of your bridge:

A. After inspections, or any time loss or damage of the paint coat is noticeable, problem areas should be repaired as follows:

1. Select a maintenance coating system based on the following:
   a. Inspection report findings
   b. Environment (identify any corrosives)
   c. Degree of surface preparation attainable
   d. Current paint compatibility

   NOTES:

- Generic type compatibility is a major factor in the selection of a system (some coating systems are not recommended over a particular type of existing material.)
- Depending upon the surface performance, an upgrade in the coating system may be necessary.

2. Clean all applicable surfaces as dictated by the repair system chosen (i.e. pressure wash, brush off, blast clean, etc.)
3. Apply repair coats per the coating manufacturer's recommendations.
4. Caulk all unwelded seams which are in need of repair with a good quality clear silicone caulk suitable for exterior use.

B. The entire bridge structure will require periodic repainting dependent upon varying factors such as the existing paint system, bridge usage, atmospheric environment, etc. Repainting will typically be required every 2-20 years. The frequency of painting will need to be determined by the inspector. The following steps should be followed when repainting the bridge structures:

1. Remove wood decking or grating, fencing, wood rubrails, and any other non-painted items which will not be receiving new paint. Obviously, concrete and asphalt decked bridges will be painted with the deck in place, unless these decks have deteriorated to the point of replacement. If this is the case, remove the deck prior to painting, if not, special care should be exercised to ensure problem areas below deck are cleaned and painted properly.

2. Select a coating system based on parameters similar to those outlined in the repair painting section (A, above), paying attention to the following items:

- Environment, specifically any corrosives identified during inspections
- Substrate condition
- Surface preparation limitations

3. After selecting a system compatible with all existing surface conditions and site limitations, clean all surfaces and apply according to the manufacturer's recommendations. After the coating system has properly cured, caulk all unwelded seams with a good quality clear silicon caulk suitable for exterior use and replace the decking, fencing, etc., which were removed prior to cleaning and repainting the structure. This is also an excellent time to replace the wood rubrail which may have shown excessive deterioration.

MAINTENANCE FOR WEATHERING BRIDGES

Weathering steel is a maintenance free material only if protected from harmful conditions and environments. The following steps will help increase the life span of your bridge:

A. Do not use de-icing salts for snow removal as they can severely damage weathering steel.

B. Avoid retention of debris on the steel surfaces. Flush bridges at areas which accumulate debris (including salt or sand) on a regular basis.

C. Prevent weathering steel from contact with soil, vegetation, masonry, or other materials so that the weathering process can proceed on a natural basis.

D. If excessive corrosion is encountered due to salts from adjacent roadways or roadways beneath an overpass structure, or for any other reason, it may be wise to blast clean and paint the truss joints, steel beneath the deck, or any area which exhibits excessive corrosion. Steel Structures Painting Council's Report 92-08, Maintenance Coating of Weathering Steel: Field Evaluation and Guidelines, provides recommendations for remedial painting of weathering steel bridges.

MAINTENANCE FOR DECKING

I. WOOD DECKS

Unless specifically noted on shop drawings, wood planks are installed in contact with each other so that no gaps appear between planks. However, wood naturally exhibits large volume changes with variations in moisture content and time, particularly in the width direction, which can cause gaps to form between the planks. Splits and checks are a normal part of the aging and weathering of wood. Excessively split and checked wood should be replaced.

An assessment of these hazards during the User Safety Inspection with remedial action is recommended as follows:

A. Replace all planks that have deteriorated past a useful and safe life.

B. Where applicable, eliminate gaps between the planks which might be large enough for a highheeled shoe to become lodged. Eliminating the gaps should be done as follows:

1. Remove all deck bolts.
2. Remove plank holddown angles. Be sure to mark their locations for ease of reinstallation.
3. Slide wood planks together.
4. Add new plank or planks to fill up the excess space.
5. Reinstall plank holddown angles.
6. Drill new holes in wood planks.
7. Install new deck bolts (see shop drawings for size and material).

C. Replacement planks may be purchased through BRIDGE BROTHERS IN.

D. Over time and with exposure to the environment, wood may become smooth, particularly when wet with rain, dew, snow, sleet, ice, etc. Periodically it may be necessary to "roughen" the surface of the decking with large grit sandpaper. There are also commercially available non-skid coatings which may be applied.

NOTE: It is the owner's responsibility to keep the wood deck free from excessive cupping, splits, gaps and smooth surfaces. Remember, most pedestrian bridge liability claims are statistically slips and falls.

II. GRATING DECKS

A. Repair or replace any grating which shows damage, corrosion, or deterioration.

B. If galvanized, wire brushing any deteriorated areas is recommended prior to the use of either sprayed zinc metalizing or organic zinc rich paint for repair.

C. For weathering steel grating, if excessive corrosion is encountered, it may be wise to blast clean and paint the grating.

III. CONCRETE AND ASPHALT

For asphalt decks, a steel form deck is the main load carrying member. For concrete decks, this steel form may or may not be integral to the deck design (as in a composite deck). Check with the design engineer.

During inspection, the asphalt or concrete covering should be checked for excessive cracking and deterioration. At the same time, the steel form decks should be checked for excessive rusting and/or damage. If the coverings are deemed to require replacement, the steel forms may be reused if they are not damaged or do not show excessive corrosion. Structural form decks may require replacement if deteriorated regardless of the deck surface condition.

Concrete and asphalt decks are usually not designed to accept the added dead weight of an overlay. Therefore, the only remedy is repair of the cracking or replacement of the concrete or asphalt covering.

See the shop drawings for recommended concrete strength, reinforcing size, slab and asphalt thickness, control joint and surface finish information. If there are any questions, please contact the BRIDGE BROTHERS INC. Engineering Department: (866) 258-3401 or engineering@bridgebrothersinc.com

MAINTENANCE FOR DECKING

I. SOIL CLEARANCE

Soil or dirt must not be left in contact with bare weathering or painted steel surfaces. In addition, adequate clearance for ventilation must be maintained between the ground and weathering steel surfaces to allow the steel to dry after wetting, forming its protective rust “patina” coating.

If the initial construction of abutments and back slopes did not allow for adequate ventilation (approximately 18”-24”), enough soil, debris, and/or vegetation should be removed and kept cut back to allow for adequate airflow. If this is not possible, a coating designed for “ground contact” protection of steel may be applied to the members in the affected area.

I. SNOW REMOVAL

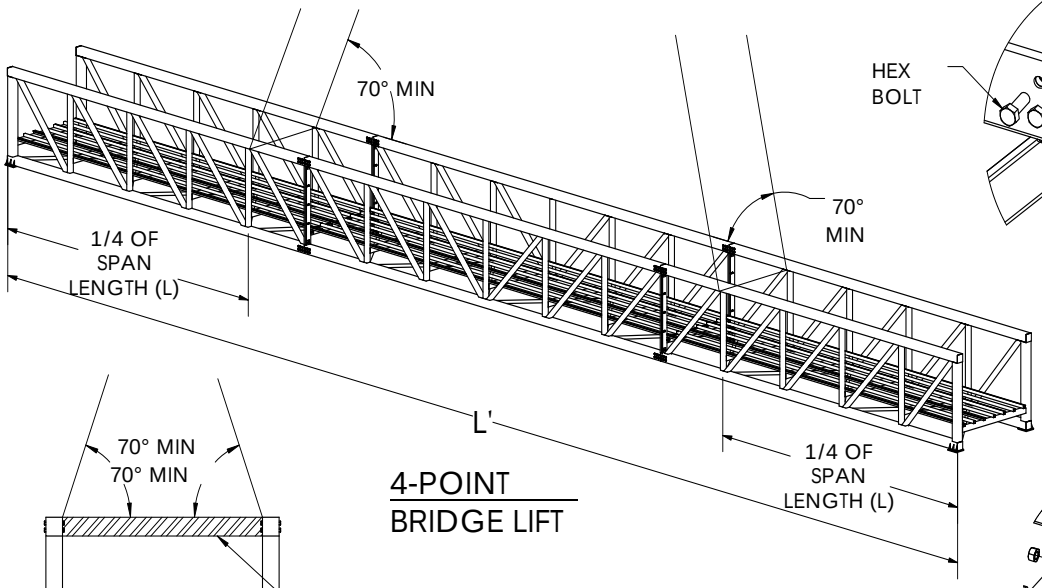
Because of possible accumulation of chlorides at truss joints, in the gaps between planks on structures with timber decks, on below deck members, and/or along the edges of decks where runoff occurs, the use of de-icing salts should be avoided on these structures, especially on weathering steel bridges (see Item A in the “Maintenance for Weathering Bridges” section). The best and safest way to remove snow from these bridges, as far as the issue of steel corrosion is concerned, is by shoveling or plowing snow from the bridge deck. Non-corrosive traction aids such as sand may be used on the deck surfaces; however, any sand or dirt accumulation should be removed immediately after the snow season. If corrosive de-icing agents are used on the structure; accelerated corrosion of members which are exposed to the agent will take place, voiding the bridge warranty and necessitating repair or replacement of affected members.

Remember: Maintenance of the bridge decking, including keeping it free from slip or trip hazards, is the owner’s responsibility. Most pedestrian bridge liability claims are statistically slips and falls.

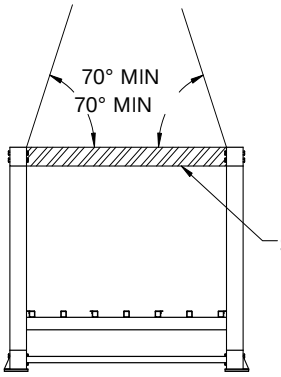
De-icing salts have been used on structures where more aggressive measures were taken to protect the steel, such as galvanizing the steel members or utilizing a concrete deck with curbs to channel water away from steel surfaces. In the later case, care must still be taken to protect, or maintain by cleaning or rinsing, areas where water drains or salt gets thrown onto non-galvanized steel surfaces by wheel traffic, spreading, etc. If not, the warranty shall again be voided and replacement of some members or possibly the entire structure may be required.

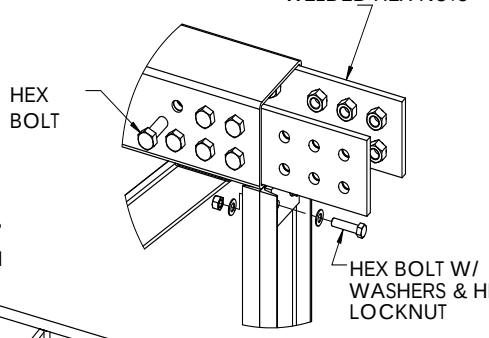
For further information, any questions, or to report any safety concerns call the BRIDGE BROTHERS INC. Engineering department.

*RIGGING SHOULD BE CONFIGURED SUCH THAT LIFTING ANGLES ARE NO LESS THAN 70 DEGREES FROM HORIZONTAL IN ANY DIRECTION WITHOUT CONSULTING THE MANUFACTURER.

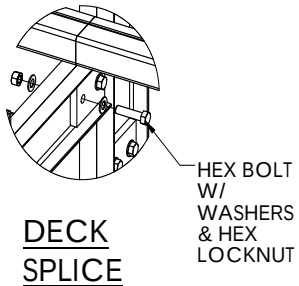


4-POINT BRIDGE LIFT

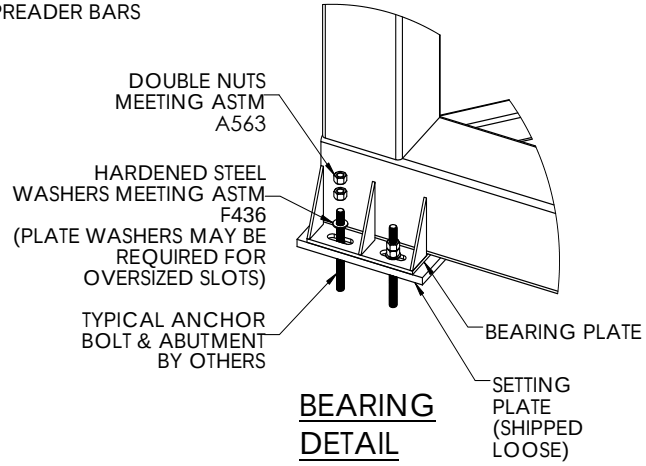




TRUSS SPLICE



DECK SPLICE



BEARING DETAIL

PRE-INSTALLATION:

1. THE BRIDGE INSTALLER SHALL BE RESPONSIBLE FOR THE INSPECTION OF THE BRIDGE AND ITS COMPONENTS FOR DAMAGE AND MISSING COMPONENTS UPON ARRIVAL TO PROJECT LOCATION. IN THE EVENT OF ANY DAMAGED OR MISSING COMPONENTS, BRIDGE BROTHERS SHOULD BE NOTIFIED IMMEDIATELY TO PREVENT ANY CONSTRUCTION DELAYS.
2. THE BRIDGE INSTALLER SHALL BE RESPONSIBLE FOR ENSURING ALL LOCAL, STATE, AND FEDERAL REGULATIONS ARE MET WITH REGARD TO SAFETY OF WORKERS DURING THE UNLOADING AND INSTALLATION OF THE BRIDGE AND BRIDGE COMPONENTS.
3. THE BRIDGE INSTALLER SHALL BE RESPONSIBLE FOR THE SELECTION OF THE CRANE(S) BASED ON WEIGHTS PROVIDED BY THE MANUFACTURER IN THE SUBMITTAL DRAWING PACKAGE; CONSIDERATION SHOULD BE GIVEN TO ADDITIONAL WEIGHT FOR COMPONENTS BOLTED OR OTHERWISE ATTACHED TO THE BRIDGE PRIOR TO INSTALLATION.

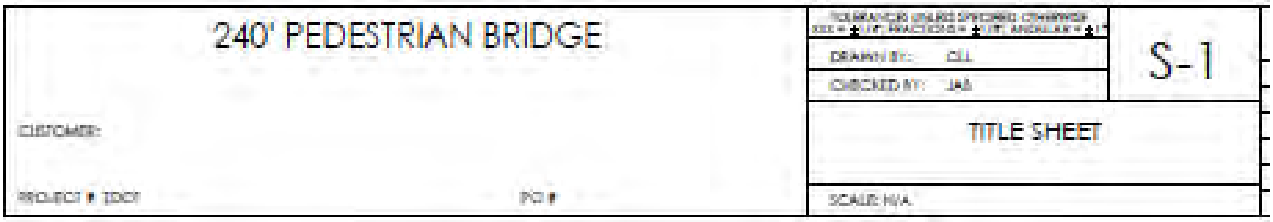
INSTALLATION

1. THE BRIDGE INSTALLER SHALL BE RESPONSIBLE FOR THE SELECTION AND INSTALLATION OF ANCHOR BOLTS, NUTS, AND WASHERS. DRILL-IN ANCHOR BOLTS ARE TYPICALLY RECOMMENDED AND SHOULD BE INSTALLED AND CHECKED DIMENSIONALLY FOR CORRECT LOCATION PRIOR TO BRIDGE INSTALLATION.
2. AFTER INSTALLATION AND DIMENSIONAL VERIFICATION OF THE ANCHOR BOLTS, THE SETTING PLATES MUST BE PROPERLY FITTED IN PLACE ACCORDING TO BOLT HOLE LOCATIONS PROVIDED IN DRAWINGS. THE SETTING PLATES SHOULD ALIGN WITH THE BRIDGE BEARING PLATES UNLESS OTHERWISE NOTED.
3. ANY BRIDGE SPLICE COMPONENTS MUST BE BOLTED TOGETHER AS SHOWN ON THE SPLICE DETAIL DRAWING USING THE PLATES AND FASTENERS SUPPLIED WITH THE BRIDGE. BOLTS SHOULD BE TIGHTENED TO SNUG TIGHT CONDITIONS. ALL JOINTS SHOULD BE INSPECTED PRIOR TO BRIDGE INSTALLATION TO ENSURE PROPER CONTACT BETWEEN COMPONENTS.
4. LIFTING SHOULD TAKE PLACE ON BOTH TRUSS SIDES ON THE TOP CHORD CLOSEST TO ONE-FOURTH OF THE BRIDGE SPAN FROM EACH END. SPREADER BARS SHOULD BE USED TO KEEP TRUSS IN PLANE. ADDITIONAL SAFETY SHOULD BE CONSIDERED WHEN STRAPPING AROUND MEMBERS THAT MAY BUCKLE OR MEMBERS WITH SHARP EDGES OR CORNERS TO PREVENT FAILURE.
5. DOUBLE NUTS MEETING ASTM A563 AND HARDENED STEEL WASHERS MEETING ASTM F436 ARE RECOMMENDED FOR USE ON ALL ANCHOR BOLTS. ALL FIXED END NUTS SHOULD BE TIGHTENED TO SNUG TIGHT. EXPANSION END BOTTOM NUTS SHOULD BE TIGHTENED, LOOSENED 1/4 TURN, AND TOP NUTS TIGHTENED SNUG TO BOTTOM NUTS.
6. FOR PAINTED BRIDGES: THE BRIDGE INSTALLER SHALL BE RESPONSIBLE FOR ANY TOUCH UP PAINTING OF DAMAGED SURFACES RESULTING FROM SHIPPING, UNLOADING, AND INSTALLATION. TOUCH UP PAINT SHALL BE THE BRIDGE INSTALLERS RESPONSIBILITY TO PROVIDE AND SHALL BE APPLIED IN ACCORDANCE WITH THE PAINT MANUFACTURERS INSTRUCTIONS.
7. FOR CONCRETE DECKED BRIDGES: THE BRIDGE INSTALLER SHALL BE RESPONSIBLE FOR ALL CONCRETE MATERIAL AND REINFORCEMENTS AS REQUIRED OR SPECIFIED FOR THE PROJECT.
8. PROPER GAPS SHOULD BE ALLOWED AT THE ABUTMENT BACK WALLS TO ALLOW EXPANSION OF THE BRIDGE. ALL EXPANSION JOINTS ARE THE BRIDGE INSTALLER'S RESPONSIBILITY UNLESS OTHER ARRANGEMENTS HAVE BEEN MADE WITH THE BRIDGE MANUFACTURER.
9. REFER TO THE INSPECTION AND MAINTENANCE MANUAL FOR MORE INFORMATION RELATED TO BRIDGE INSTALLATION, INSPECTION AND MAINTENANCE.

BRIDGE BROTHERS

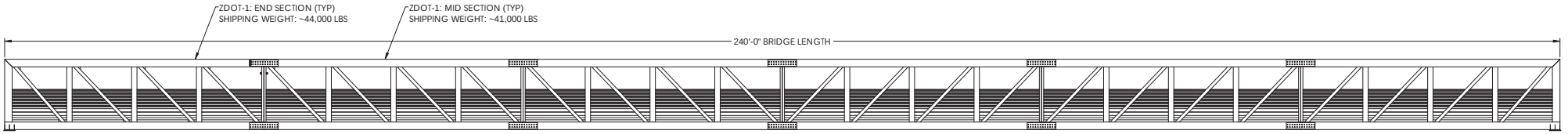
BRIDGE BROTHERS PROVIDES TURN KEY DELIVERY THROUGH ENGINEERING, FABRICATING, AND INSTALLING CUSTOM BRIDGES AND STRUCTURES

T: 866.258.3401 E: sales@bridgebrothers.com

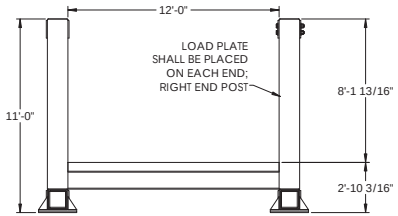


SAMPLE

DRAWING PACKAGE



ELEVATION VIEW



FRONT VIEW

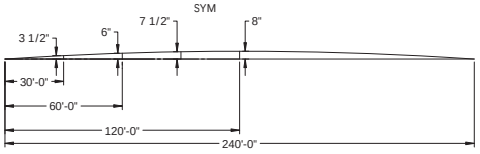
BRIDGE UNFACTORED REACTIONS			
	Z (LBS)	Y (LBS)	X (LBS)
DEAD LOAD	---	-99,342	---
VEHICLE LOAD* (@20,000 PSF)	---	-10,000	---
LIVE LOAD (@90 PSF)	---	-64,800	---
WIND (@140 PSF)	50,562	39391 -39391	---
OVERTURNING WIND (@20 PSF)	---	25800 8600	---
SEISMIC LOAD	83,546	65088 -65088	---
THERMAL (0.2 COEFF OF FRICTION)	---	---	19,868

BRIDGE INSTALLED WEIGHT = ~397,367 LBS
THERMAL EXPANSION (BASED ON A SEASONAL TEMPERATURE VARIATION OF 120 °F)
Y = VERTICAL LOAD @ EACH BEARING PLATE (4 TOTAL)
Z = HORIZONTAL LOAD @ EACH BEARING PLATE (4 TOTAL)
X = LONGITUDINAL LOAD @ EACH FIXED BEARING PLATE (2 PER BRIDGE)
* = ASSUMES VEHICLE LOAD ACTING ON ONE BRIDGE END

NO.	DESCRIPTION
S-1	TITLE SHEET
S-2	SCHEDULE OF MEMBERS
S-3	ELEVATION VIEW W/ DETAIL
S-4	PLAN & SECTION VIEW W/ DETAIL
S-5	SPLICE DETAIL
S-6	CONCRETE DECK

GENERAL NOTES:
1. THE PRIMARY FUNCTION OF THIS STRUCTURE IS TO CARRY PEDESTRIANS, BICYCLISTS, & EQUESTRIANS AS SPECIFIED IN AASHTO'S LRFD GUIDE SPECIFICATION FOR THE DESIGN OF PEDESTRIAN BRIDGES.
2. USE OF DE-ICING AGENTS ON BRIDGE STRUCTURES IS HIGHLY DISCOURAGED
3. BRIDGE BEARINGS SHALL BE CONSTRUCTED AT SAME LEVEL
4. BRIDGE SHALL BE SHIPPED WITH RECOMMENDED ANCHOR HARDWARE
5. SETTING PLATES SHALL BE SHIPPED LOOSE FROM BRIDGE
6. BRIDGE SHALL BE SHIPPED UNSPLICED; SITE FIT-UP SHALL BE PERFORMED BY BRIDGE ERECTOR
7. BRIDGE SHALL BE SHIPPED W/ SPLICE CONNECTIONS UNBOLTED
8. ALL ELECTRICAL AND LIGHT HARDWARE INSTALLATION & DESIGN BY OTHERS
9. BRIDGE OFF-LOADING FROM FREIGHT TRUCK AND INSTALLATION BY BRIDGE ERECTOR
10. BRIDGE SHALL BE CAMBERED 8" AS PER THE CAMBER DIAGRAM
11. HSS SQUARE & RECTANGULAR TUBING SHALL BE A847
12. ALL PLATE AND OPEN SHAPES SHALL BE A588
13. SHOP WELDING SHALL CONFORM TO AWS D1.1-STEEL
14. DEBUR ALL EXPOSED WELDS WHICH MAY COME IN CONTACT WITH PEDESTRIANS
15. ALL EXPOSED SURFACES OF TRUSS & DECK FRAME SHALL BE BLAST CLEANED IN ACCORDANCE WITH SSPC-SP6
16. EXISTING ABUTMENT STRENGTH/DESIGN SHALL BE PERFORMED BY OTHERS; SUPPLY OF ANCHORS & EPOXY BY OTHERS

LOADINGS & DESIGN CRITERIA:
1. AASHTO LRFD GUIDE SPECIFICATIONS FOR THE DESIGN OF PEDESTRIAN BRIDGES, 2009
2. AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 2017, 8TH EDITION
3. AASHTO LRFD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 2015, 1ST EDITION
4. AASHTO GUIDE SPECIFICATIONS FOR LRFD SEISMIC BRIDGE DESIGN, 2011, 2ND EDITION
5. 2008 VULCRAFT STEEL ROOF & FLOOR DECK DESIGN GUIDE
6. AISC 360-16 SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS
7. AISC 303-16 CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES
8. ASCE 7-16, MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES
9. AWS D1.1 STRUCTURAL STEEL WELDING CODE – STEEL, 2015
10. GUIDE TO STABILITY DESIGN CRITERIA FOR METAL STRUCTURES, 2010, 6TH EDITION
11. THIS STRUCTURE HAS NOT BEEN DESIGNED FOR FLOOD LOADINGS
12. SEE CALCULATION PACKAGE FOR COMPLETE DESIGN CRITERIA
    - 90 PSF LIVE LOAD
    - 20,000 LBS VEHICLE LOAD (H10)
    - 50 PLF RAIL LIVE LOAD, 200 LB POINT LOAD
    - 170 MPH WIND LOAD; 20 PSF OVERTURNING WIND



THIS TABLE FOR INTERNAL USE ONLY								
FINISH	DECK	SPLICE	RAIL	GRAB	SET PLT	ABTMN	ANCHR	INSTL
WETHR	CNCR	5	HRZ-L	NO	UHMW	NO	NO	NO

*BRIDGE BROTHERS INC ACCEPTS NO RESPONSIBILITY FOR WORK PERFORMED BY OTHERS. BRIDGE BROTHERS INC RESERVES THE RIGHT TO MODIFY THIS STRUCTURE DURING FABRICATION, WITH CUSTOMER APPROVAL. NO MODIFICATIONS TO THIS STRUCTURE SHALL BE PERMITTED WITHOUT WRITTEN CONSENT FROM BRIDGE BROTHERS INC.

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240' PEDESTRIAN BRIDGE

CUSTOMER:

PROJECT # ZDOT

PO #

TOLERANCES UNLESS SPECIFIED OTHERWISE
XXX = ±1/4"; FRACTIONS = ±1/8"; ANGULAR = ±1°

DRAWN BY: CLL

CHECKED BY: JAB

S-1

TITLE SHEET

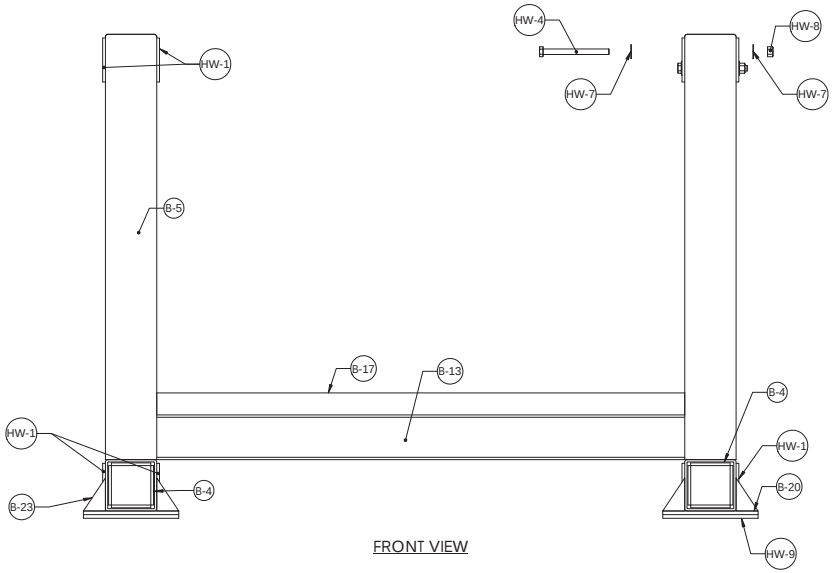
SCALE: N/A

REV	DATE	DESCRIPTION

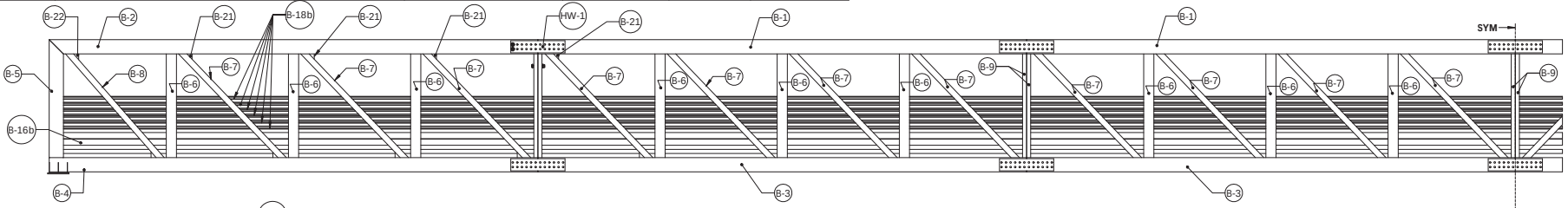
CUSTOMER SIGNATURE DATE

SIGN AND DATE ABOVE TO INDICATE ACCEPTANCE AND APPROVAL FOR BRIDGE BROTHERS TO PROCEED WITH FABRICATION.

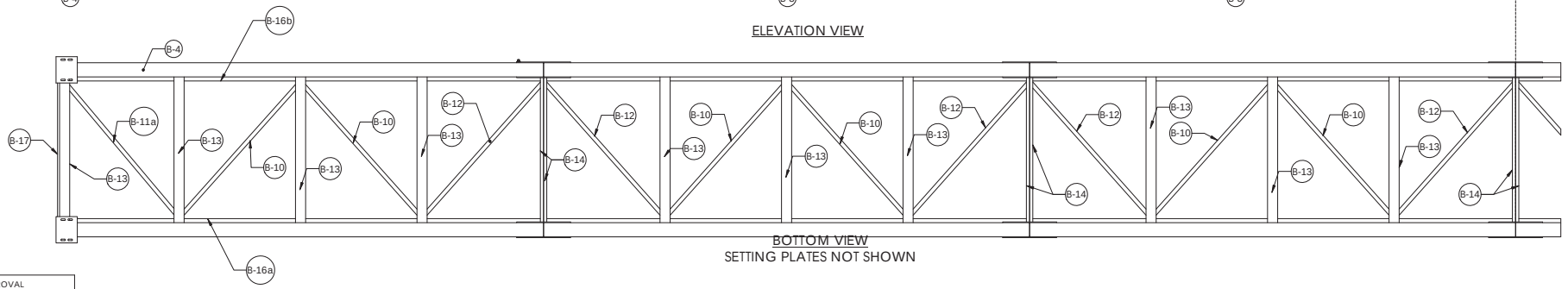
ITEM#	PIECE MARK	QTY.	MATERIAL TYPE	DESCRIP	LENGTH	MILL MARK	GRADE
ZDOT-B-1	TRUSS TOP CHORD	8	HSS	14X14X3/4	40'-0"		A847
ZDOT-B-2	TRUSS END TOP CHORD	4	HSS	14X14X3/4	40'-0"		A847
ZDOT-B-3	TRUSS BOTTOM CHORD	8	HSS	14X14X3/4	40'-0"		A847
ZDOT-B-4	TRUSS END BOTTOM CHORD	4	HSS	14X14X3/4	40'-0"		A847
ZDOT-B-5	TRUSS END POST	4	HSS	14X14X3/4	9'-8"		A847
ZDOT-B-6	TRUSS VERTICAL	36	HSS	10X10X1/2	8'-6"		A847
ZDOT-B-7	TRUSS DIAGONAL	44	HSS	10X6X3/8	12'-3"		A847
ZDOT-B-8	TRUSS END DIAGONAL	4	HSS	10X6X3/8	11'-8 5/8"		A847
ZDOT-B-9	TRUSS SPLICE VERTICAL	20	HSS	10X4X1/4	8'-6"		A847
ZDOT-B-10	FLOOR BRACING	12	HSS	4X4X1/4	15'-4 1/8"		A847
ZDOT-B-11A	FLOOR END BRACING 1	1	HSS	4X4X1/4	14'-11 5/8"		A847
ZDOT-B-11B	FLOOR END BRACING 2	1	HSS	4X4X1/4	14'-11 1/2"		A847
ZDOT-B-12	FLOOR SPLICE BRACING	10	HSS	4X4X1/4	15'-3 7/8"		A847
ZDOT-B-13	FLOOR BEAM	20	W	12X58	12'-4"		A588
ZDOT-B-14	FLOOR SPLICE BEAM	10	C	12X30	12'-4"		A588
ZDOT-B-15	SIDE DECK FORM	8	L	6X4X5/16	40'-0"		A588
ZDOT-B-16A	SIDE DECK FORM END 1	2	L	6X4X5/16	40'-0"		A588
ZDOT-B-16B	SIDE DECK FORM END 2	2	L	6X4X5/16	40'-0"		A588
ZDOT-B-17	END DECK FORM	2	L	6X4X5/16	12'-0"		A588
ZDOT-B-18A	HORIZONTAL RAIL	48	L	2X2X1/8	40'-0"		A588
ZDOT-B-18B	END HORIZONTAL RAIL	24	L	2X2X1/8	38'-10"		A588
ZDOT-B-19A	TOE RAIL	8	BAR	6X1/4	40'-0"		A588
ZDOT-B-19B	END TOE RAIL	4	BAR	6X1/4	38'-10"		A588
ZDOT-B-20	BEARING PLATE	4	P	1" X 1'-4"	2'-0"		A588
ZDOT-B-21	DIAGONAL GUSSET	16	P	1/4" X 5"	5 1/4"		A588
ZDOT-B-22	END DIAGONAL GUSSET	4	P	1/4" X 5"	5 3/4"		A588
ZDOT-B-23	BEARING GUSSET.	24	P	1/4" X 6"	9"		A588
ZDOT-HW-1	EXTERNAL SPLICE PLATE.	40	P	3/4" X 12"	4'-5 1/4"		A588
ZDOT-HW-2	INTERNAL SPLICE PLATE	40	P	3/4" X 11"	4'-5 1/4"		A588
ZDOT-HW-3	INTERNAL PLATE	40	P	3/4" X 11"	4'-5 1/4"		A588
ZDOT-HW-4	1 1/2" X 1'-6" HEAVY HEX BOLT	480	BLT	1 1/2"	1'-6"		A325-TYPE3
ZDOT-HW-5	1 1/2" X 10 1/2" HEAVY HEX BOLT	50	BLT	1 1/2"	10 1/2"		A325-TYPE3
ZDOT-HW-6	1 1/2" X 3 1/2" HEAVY HEX BOLT	25	BLT	1 1/2"	3 1/2"		A325-TYPE3
ZDOT-HW-7	1 1/2" WASHER	1110	WSH	1/2"			F436 TYPE3
ZDOT-HW-8	1 1/2" HEAVY HEX NUT	555	NUT	1 1/2"			A563-TYPE3
ZDOT-HW-9	SETTING PLATE	4	P	1" X 1'-10"	2'-0"		UHMW



FRONT VIEW



ELEVATION VIEW



BOTTOM VIEW
SETTING PLATES NOT SHOWN

APPROVAL INITIALS:

BRIDGE BROTHERS

CERTIFIED FABRICATOR

AISC MCWF CERTIFIED WELDING FABRICATION

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240' PEDESTRIAN BRIDGE

CUSTOMER:

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PO #

TOLERANCES UNLESS SPECIFIED OTHERWISE
XXX = ±1/4"; FRACTIONS = ±1/8"; ANGULAR = ±1°

DRAWN BY: CLL

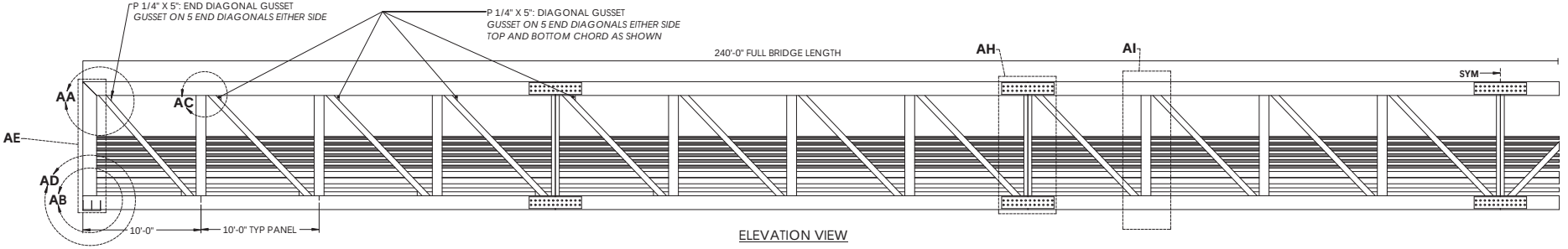
CHECKED BY: JAB

SCHEDULE OF MEMBERS

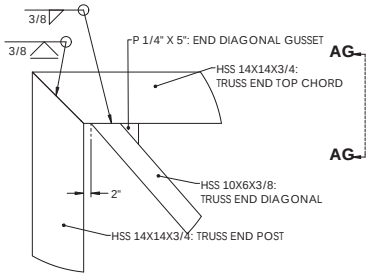
SCALE: N/A

S-2

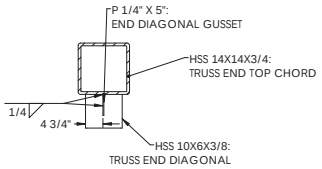
REV	DATE	DESCRIPTION



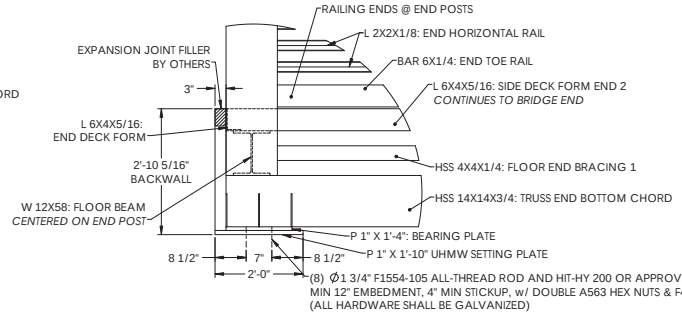
ELEVATION VIEW



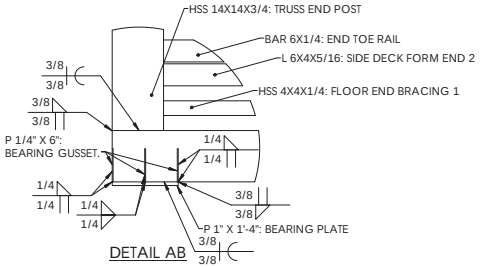
DETAIL AA



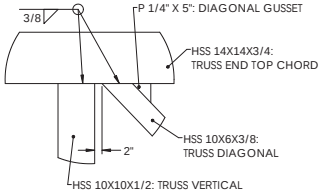
SECTION AG-AG
TYP DIAGONAL GUSSETS



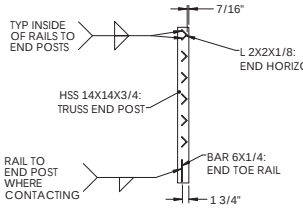
DETAIL AD



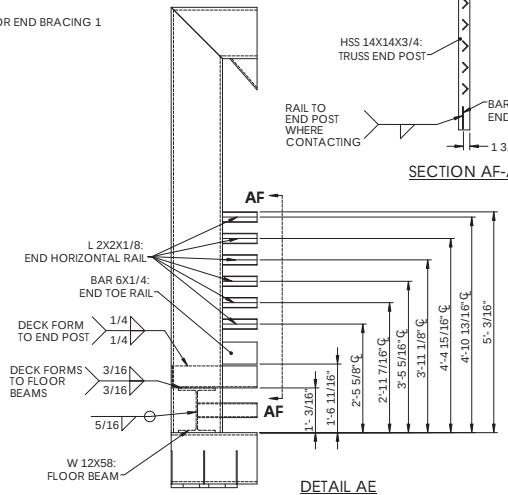
DETAIL AB



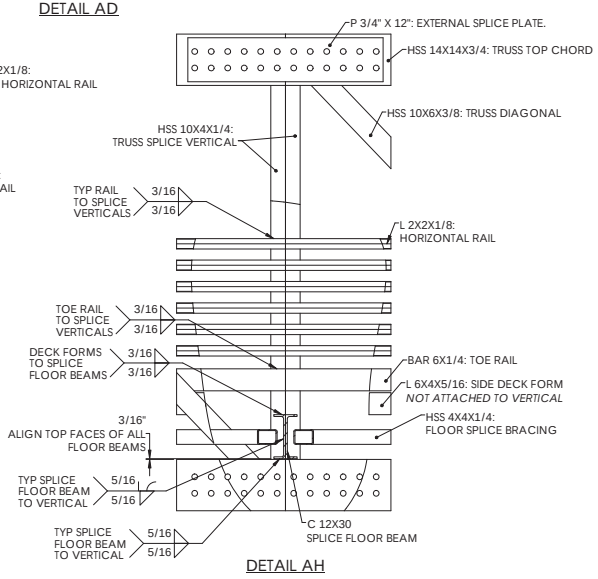
DETAIL AC



SECTION AF-AF



DETAIL AE
RAILING DIM TYP



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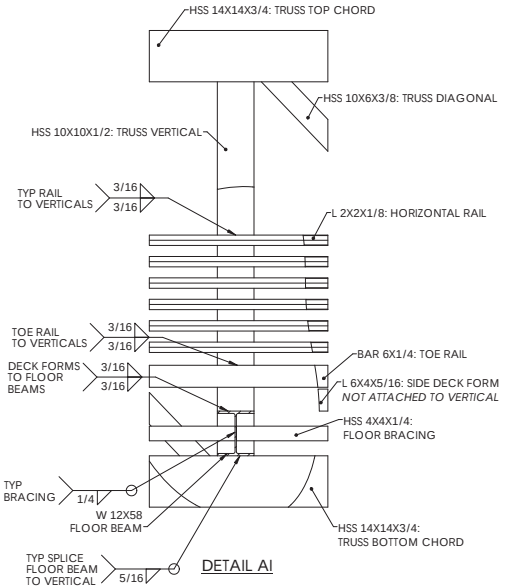

DETAIL AI

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240' PEDESTRIAN BRIDGE

CUSTOMER:

PROJECT # ZDOT

PO #

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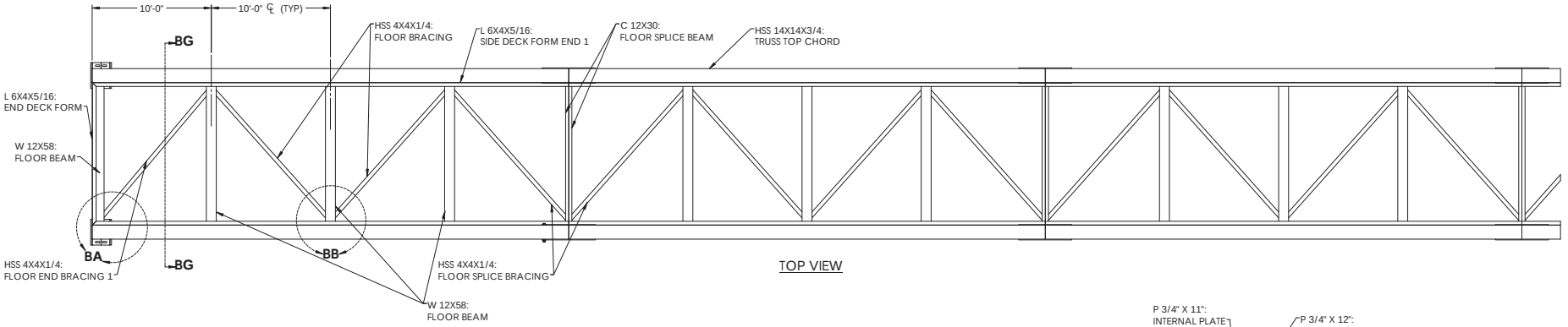
ELEVATION VIEW W/ DETAIL

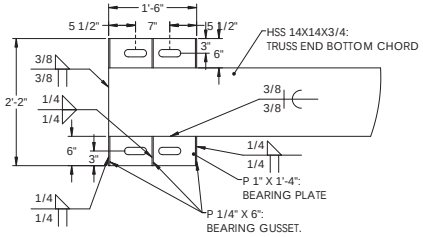
SCALE: N/A

S-3

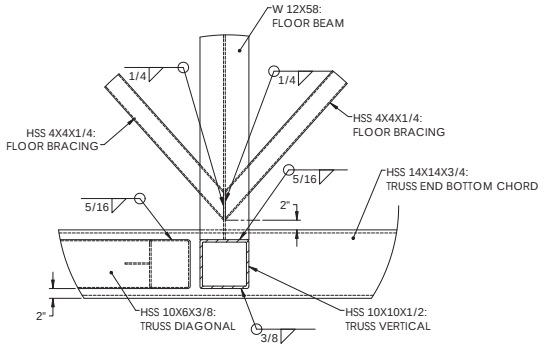
REV	DATE	DESCRIPTION



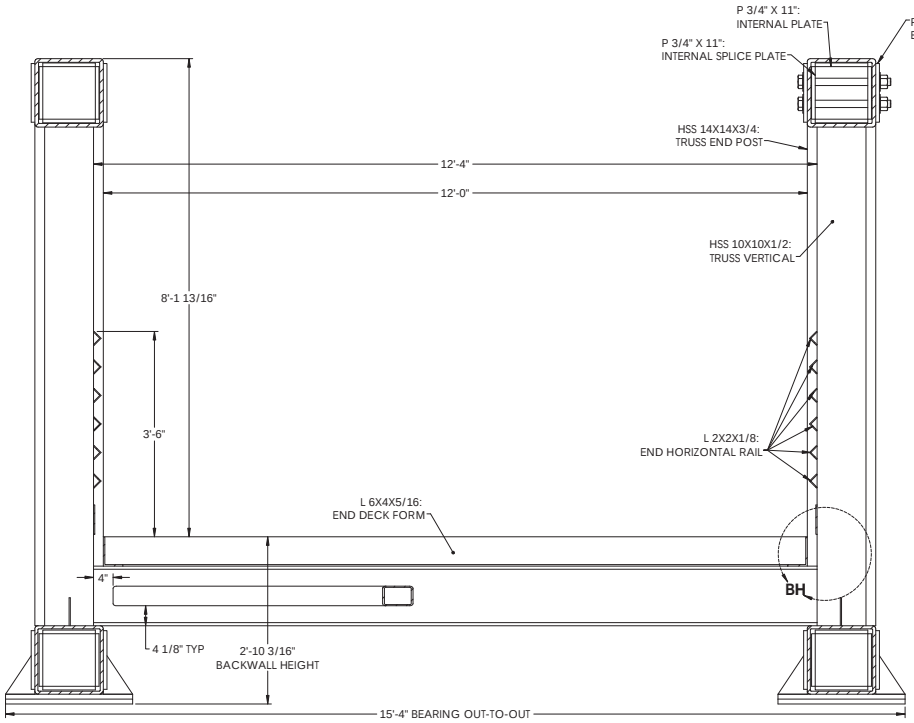
TOP VIEW



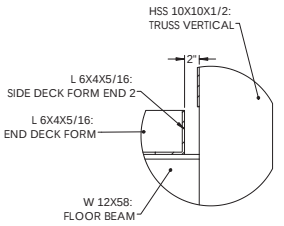
DETAIL BA
ONLY BEARING PLATE, GUSSETS,
& BOTTOM CHORD SHOWN



DETAIL BB
RAILING & DECK FORMS NOT SHOWN



SECTION BG-BG
TYP SECTION; END POSTS & DIAGONALS NOT SHOWN



DETAIL BH
END POST NOT SHOWN

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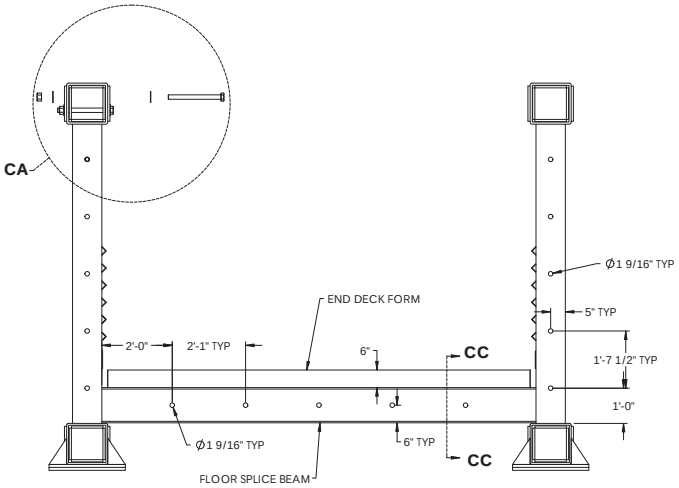
S-4

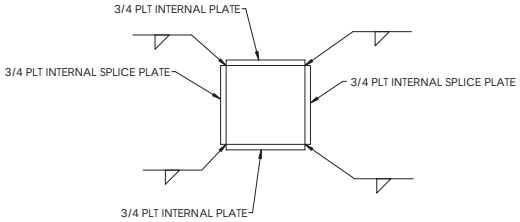
PLAN SECTION VIEW W/ DETAIL

SCALE: N/A

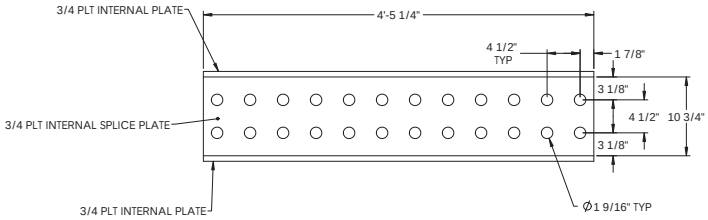
REV	DATE	DESCRIPTION

ALL SPLICE BOLTS SHALL BE HEAVY ASTM A325 HEX BOLTS
ALL SPLICE NUTS SHALL BE HEAVY ASTM A563 HEX NUTS
ALL SPLICE WASHERS SHALL BE STANDARD F436 WASHERS
ALL HARDWARE SHALL BE TYPE 3 WEATHERING

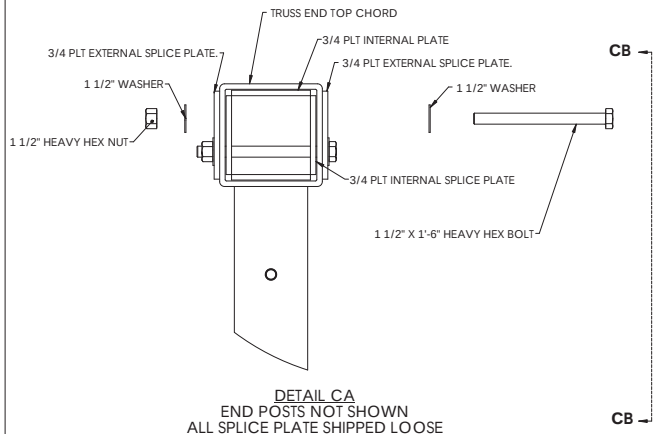




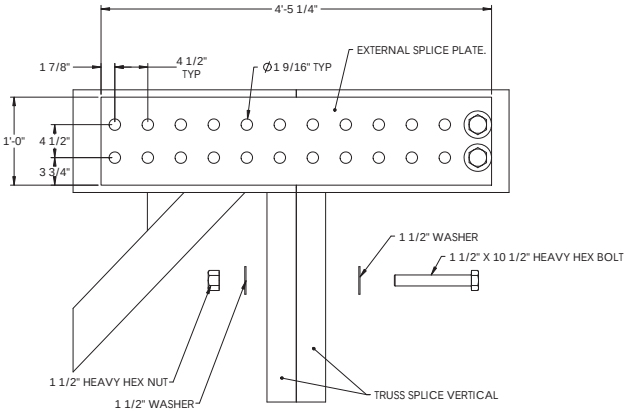
INTERNAL SPLICE BOX DETAIL
SHIPPED LOOSE



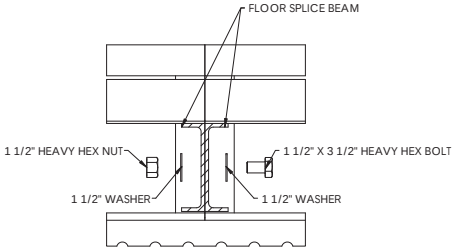
INTERNAL SPLICE BOX DETAIL- SIDE VIEW
SHIPPED LOOSE



DETAIL CA
END POSTS NOT SHOWN
ALL SPLICE PLATE SHIPPED LOOSE



SECTION CB-CB



SECTION CC-CC

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240' PEDESTRIAN BRIDGE

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SCALE: N/A

S-5

SPLICE DETAIL

REV	DATE	DESCRIPTION

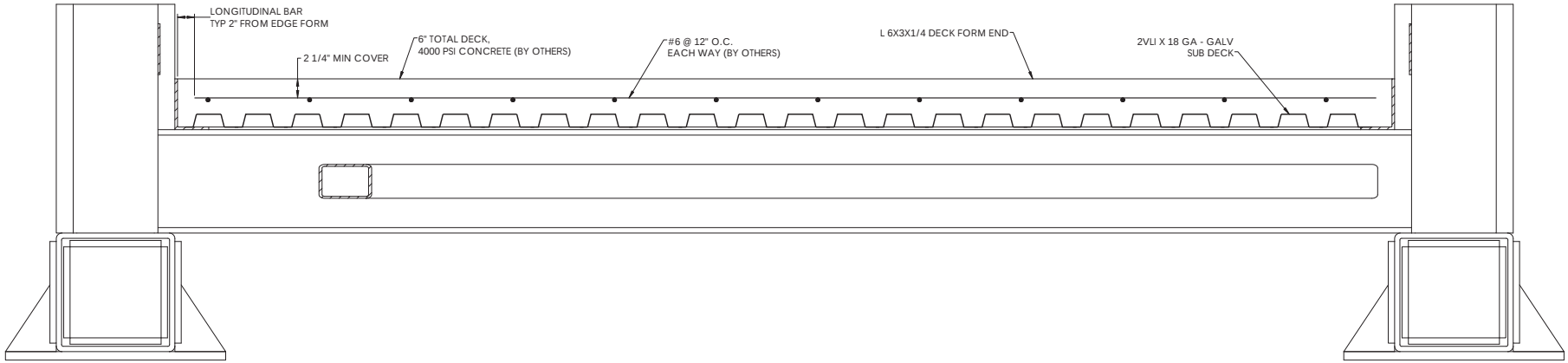
GENERAL NOTES

DECK PAN NOTES:

1. COMPOSITE DECK PAN ENDS SHALL NOT BE OVERLAPPED; TRIM TO EACH FLOOR BEAM CENTER
2. DECK PAN ATTACHMENT SHALL BE AS FOLLOWS:
   a. SIMPSON STRONGTIE PDPAW-75 @ 12" O.C. TO EACH FLOOR BEAM; ALTERNATE TO DRILL & INSTALL USING #14 TEK SCREW OR PLUG WELD
   b. MINIMUM #10x3/4 SELF DRILLING SCREW @ 12" O.C. AT SIDE OVERLAP CONNECTIONS

CONCRETE:

1. ALL PHASES OF WORK PERTAINING TO THE CONCRETE CONSTRUCTION SHALL CONFORM TO THE "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" (ACI 318 LATEST APPROVED EDITION) WITH MODIFICATIONS AS NOTED IN THE DRAWINGS AND SPECIFICATIONS.
2. REINFORCED CONCRETE DESIGN IS BY THE "ULTIMATE STRENGTH DESIGN METHOD", ACI 318-(LATEST EDITION)
3. ALL STRUCTURAL CONCRETE SHALL HAVE A MINIMUM 28-DAY STRENGTH OF 4,000 PSI.
4. CONCRETE MIX DESIGN SHALL MEET THE FOLLOWING REQUIREMENTS:
   a. COMPRESSIVE STRENGTH AT AGE 28 DAYS AS SPECIFIED ABOVE.
   b. LARGE AGGREGATE-HARDROCK, 3/4" MAXIMUM SIZE CONFORMING TO ASTM C-33
   c. CEMENT-ASTM C-150, TYPE I OF II PORTLAND CEMENT
   d. MAXIMUM SLUMP 5-INCHES, MAX WATER CEMENT RATIO: 0.50
5. CONCRETE MIXING OPERATIONS, ETC. SHALL CONFORM TO ASTM C-94
6. PLACEMENT OF CONCRETE SHALL CONFORM TO ACI STANDARD 514 AND PROJECT SPECIFICATIONS.
7. LAP SPLICING AND PLACEMENT OF REINFORCEMENT BARS SHALL BE WELL SECURED IN POSITION PRIOR TO PLACING CONCRETE PER CRSI MANUAL OF STANDARD PRACTICE AND ACI 315.
8. REINFORCING BARS SHALL CONFORM TO ASTM A615 GRADE 60.
9. FINISHED CONCRETE DECK SHALL BE GIVEN A SKID RESISTANT TEXTURE BY EITHER BURLAP OR CARPET DRAGGING, BROOMING, TINING, OR A COMBINATION OF THESE METHODS AS APPROVED BY THE OWNER AND AS SPECIFIED BY AASHTO. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTION OF THE BRIDGE COMPONENTS FROM CONCRETE SPLATTER AND REQUIRED CLEANING OF THE STRUCTURE RESULTING FROM SPILLS.



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240' PEDESTRIAN BRIDGE

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DRAWN BY: CLL

CHECKED BY: JAB

CONCRETE DECK

SCALE: N/A

S-6

REV	DATE	DESCRIPTION

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SAMPLE

DESIGN CALCULATIONS

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Design Notes:

All design criteria are in accordance with the following where applicable.

- AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, 2009
- AASHTO LRFD Bridge Design Specifications, 2017, 8th Edition
- AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 2015, 1st Edition
- AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2011, 2nd Edition
- 2008 Vulcraft Steel Roof & Floor Deck Design Guide
- AISC 360-16 Specification For Structural Steel Buildings
- AISC 303-16 Code of Standard Practice for Steel Buildings and Bridges
- ASCE 7-16, Minimum Design Loads for Buildings and Other Structures
- AWS D1.1 Structural Steel Welding Code – Steel, 2015
- Guide to Stability Design Criteria for Metal Structures, 2010, 6th Edition

The primary function of this structure is to carry pedestrians, bicyclists, equestrians, & vehicles as specified in AASHTO's LRFD Guide Specification for the Design of Pedestrian Bridges. This structure has NOT been designed for Flood loadings.

Materials:

HSS Square & Rectangular Tubing shall be ASTM A847

- Yield Strength = 50ksi
- Ultimate Strength = 70ksi

Plate, Angle, & W Shapes shall be ASTM A588

- Yield Strength = 50ksi
- Ultimate Strength = 70ksi

Decking shall be 4000psi-150pcf Concrete

General Notes:

1. The Contractor shall verify dimensions, conditions, and elevations before starting work. The engineer shall be notified immediately if any discrepancies are found.
2. The typical notes and details shall apply in all cases unless specifically detailed elsewhere. Where no detail is shown, the construction shall be as shown for other similar work and as required by the building code.
3. These calculations are limited to the structural members shown in these calculations only. The connection of the members shown in these calculations to the existing structure shall be provided by the abutment design engineer in charge of the project.
4. The contractor shall be responsible for compliance with local construction safety orders. Approval of shop drawings by the architect or structural engineer shall not be construed as accepting this responsibility.
5. All structural framing members shall be adequately shored and braced during erection and until full lateral and vertical support is provided by adjoining members.

12x240 PEDESTRIAN BRIDGE

Geometry

Outside Truss Width (ft)	14.3
Clear Width (ft)	12.0
Bridge Span (ft)	240.0
Truss Height (ft)	11.17
Max Unsupported Deck Length (in)	120.0
Max Unsupported Stringer Length (in)	0.0
# of Stringers	0
# of Panels	24
Panel Spacing (in) CL-CL	120.0

LOADINGS:

Dead Loads (DL)

4000psi-145pcf Concrete 6 in.	63.4	psf
Total Deck Load	182,592	lbs
2x2x1/8 Angle	1.66	plf
Horizontal Rail Quantity per side	6	
6"x1/4" Flat Bar	5.11	plf
Total Rail Load	7,234	lbs

Point Load (PL)

Point Load per 4 sq in (lbs)	1000	*(AASHTO Pedestrian, 3.3)*
	Design	
Mmax - Floor Beam (in-lb)	18,000	*simple beam; fixed ends

Vehicle Loads (VL)

Total Vehicle Load (lbs)	20000	
Wheel Spacing (ft)	14.0	*(AASHTO LRFD, 3.6.1.2.2)*
Front Axle Load - 20% (lbs)	4000	
Rear Axle Load - 80% (lbs)	16000	
Max Wheel Load (lbs)	8000	*10"x20" wheel print (AASHTO LRFD, 3.6.1.2.5)
	Design	
Mmax - Floor Beam (in-lb)	192,000	*simple beam; fixed ends

Pedestrian Rail Loads (RL)	**Uniform (lb/ft)**	**Point (lb)**
Horizontal Pedestrian Live Load	50	200
Vertical Pedestrian Live Load	50	
Total Pedestrian Live Load	70.7	
Horizontal Rail Height from Deck (in)	42	
	Design	
Mmax - Vertical posts (lb-in)	29,400	*simple beam; fixed cantilever
Mmax - Horizontal Rail (lb-in)	1,500	*simple beam; fixed ends

Snow Loads (SL)

Ground Snow Load (psf)	0.0	
Total Snow Load (lbs)	0	***per AASHTO 3.9.6, SL neglible*

Pedestrian Live Load (LL)

Pedestrian Load (psf)	90	*(AASHTO Pedestrian, 3.1)*
Total Live Load (lbs)	259200	

Wind Loads (WL)

Ultimate Wind Speed, V (mph)	170	*(AASHTO Signs, Figure 3.8.3b)*
Wind Importance Factor, I_r	1.15	*(AASHTO Pedestrian, 3.4)*
Wind Directionality Factor, K_d	0.85	*(AASHTO Signs, 3.8.5)* **Round = 0.95
Gust Effect Factor, G	1.14	*(AASHTO Signs, 3.8.6)*
Bridge Height Above Ground, z (ft)	15.0	*midpoint of truss section
Height and Exposure Factor, K_z	0.85	*Based on 3-s Gust Wind Speeds & Exposure C *(AASHTO Signs, 3.8.4)*
Wind Drag Coefficient, C_d	2.00	*Two trusses *(AASHTO Signs, Table 3.8.7-1)*
Wind Pressure, P_z (psf)	140.0	*(AASHTO Signs, 3.8.1)*
Fatigue Importance Factor, I_F	1.00	*Category I, Natural Wind Gusts *(AASHTO Signs, Table 11.6-1)*
Fatigue Wind Pressure, P_{NW} (psf)	10.4	*(AASHTO Signs, 11.7.1.2);* Truck-Induced Gust Loading shall be excluded unless required by Owner *(AASHTO Signs, 11.7.1.3)*

Component Wind Loading	Horz. Rail	Toerail	Chord	End Post	Splice Post	Vertical	Diagonal	Deck
Depth of Face to Wind, d (in.)	2.12	6	16	16	2.6	10	8	6
Member Length (ft)	240.0	240.0	240.0	8.5	8.5	8.5	11.6	240.0
Load on Member, w (lbs)	5934.8	16796.5	44790.7	1586.3	257.8	991.5	1078.6	8398.3
Fatigue Load on Member, w (lbs)	441.0	1248.0	3328.0	117.9	19.2	73.7	80.1	624.0

Overturning Wind Loads (OW)

Wind Uplift Load (psf)	20	
Total Wind Uplift Load (lbs)	68800.0	*Applied at the Windward Quarter Point of the Deck

Seismic Loads (E)

Site Class	D	*(AASHTO Seismic, Table 3.4.2.1-1)
Design Spectral Response Acceleration, S_{DS}	1.484	*(US Design Summary Report)
Mapped Spectral Acceleration, S_S	2.227	*(US Design Summary Report)
Peak Seismic Ground Accel. Coeff., PGA	0.841	*(US Design Summary Report)
Design Category (SDC)	D	*(AASHTO Seismic, 3.5)
Site Coefficient, F_a	1.0	*(AASHTO Seismic, Table 3.4.2.3-1)
Seismic Design Force, F_p (lbs)	328,958.2	*(AASHTO Seismic, Section 4.5)

INPUTS:

Applied Loads (Horizontal)

Rail Live Load per Top Chord (lbs)	12000.0

Windward Loads (Horizontal)	Quantity	Load (lb)	
Chords	2	44790.7	
End Posts	2	2678.1	*includes tertiary load from rail components
Splice Posts	0	0.0	*includes tertiary load from rail components
Verticals	23	3175.0	*includes tertiary load from rail components
Diagonals	24	1078.6	
Deck	1	8398.3	
Total		**202246.3**	

Fatigue Applied Loads (Horizontal)	Quantity	Load (lb)	
Chords	2	3328.0	
End Posts	2	199.0	*includes tertiary load from rail components
Splice Posts	0	0.0	*includes tertiary load from rail components
Verticals	23	235.9	*includes tertiary load from rail components
Diagonals	24	80.1	
Deck	1	624.0	
Total		**15027.1**	

Applied Loads (Vertical)

Decking Load per Floor Beam (lbs)	7608.0
Decking Load per End Floor Beam (lbs)	3804.0
Rail Load per Truss Vertical (lbs)	150.7
Rail Load per Truss End Post (lbs)	75.4
Snow Load per Floor Beam (lbs)	0.0
Snow Load per End Floor Beam Stringer (lbs)	0.0
Live Load per Floor Beam (lbs)	10800.0
Live Load per End Floor Beam (lbs)	5400.0
Wind Uplift per Windward Truss (lbs)	51600
Wind Uplift per Leeward Truss (lbs)	17200
Front Vehicle per Floor Beam (lbs)	4000
Rear Vehicle per Floor Beam (lbs)	16000

Load Combinations and Load Factors: *(AASHTO Pedestrian, 3.7)*

Limit State:	Gravity	$DL_{(decking\ \&\ rail)}$	SL**	RL&LL, VL*	WL	OW
Strength I	1.25	1.25	---	1.75	---	---
Strength III	1.25	1.25	---	---	1.00	1.00
Service I	1.00	1.00	---	1.00	1.00	1.00
Fatigue I	---	---	---	---	1.00	---
Displacement_DL	1.00	1.00	---	---	---	---
Displacement_LL	---	---	---	1.00	---	---
Displacement_VL	---	---	---	1.00	---	---
Displacement_WL	---	---	---	---	0.60	0.60

*Vehicular load shall not be placed in combination with the pedestrian load

**per AASHTO 3.9.6, SL neglible

Fatigue Resistance Design:

Fatigue Design Category	D	
Number of Cycles	Infinite	
Fatigue Resistance (ksi)	7.000	*(LRFD 2013 Table 6.6.1.2.5-3)*

Summary:

Axial Compressive Resistance

Load Condition	Design Assumptions	ASTM A588 Compressive Yield (psi)	Resistance Factor	Factor	Maximum Resistance (psi)	Maximum Induced Stress (psi)	Status	Notes
Top Chord	Member to member connections considered Rigid Negligable fatigue effects	45,501	0.95	100%	**43,226**	**38,030**	OK	---
End Post	Member to member connections considered Rigid Negligable fatigue effects	49,261	0.95	100%	**46,798**	**5,880**	OK	---
Vertical	Member to member connections considered Rigid Negligable fatigue effects	48,596	0.95	100%	**46,166**	**12,060**	OK	---
Floor Bracing	Member to member connections considered Rigid Negligable fatigue effects	28,249	0.95	100%	**26,837**	**24,579**	OK	---

Combined Bending & Axial Resistance

Load Condition	Design Assumptions	ASTM A588 Tensile Yield (psi)	Resistance Factor	Factor	Maximum Resistance (psi)	Maximum Induced Stress (psi)	Status	Notes
Strength I-LL	Support conditions considered Pinned-Sliding Negligable fatigue effects	50,000	0.95	100%	**47,500**	**46,300**	OK	---
Strength I-VL	Support conditions considered Pinned-Sliding Negligable fatigue effects	50,000	0.95	100%	**47,500**	**27,470**	OK	---
Strength III	Support conditions considered Pinned-Sliding Negligable fatigue effects	50,000	0.95	100%	**47,500**	**35,900**	OK	---
Service I	Support conditions considered Pinned-Sliding Negligable fatigue effects	50,000	0.95	100%	**47,500**	**39,650**	OK	---
Fatigue I	Support conditions considered Pinned-Sliding Fatigue Considered - Infinite cycles - D type	7,000	1	100%	**7,000**	**2,873**	OK	---

Other Components Resistance

Load Condition	Design Assumptions	Unsupported Length* (in)	Member Category	Member	Maximum Resistance (in-lb)	Factored Induced Moment* (in-lb)	Status	Notes
Rail Load	Member to member connections considered Rigid	**42.0**	Vertical Posts	**10x10x1/2**	**2,402,400**	**51,450**	OK	---
Rail Load	Member to member connections considered Rigid	**120.0**	Horizontal Rail	**2x2x1/8 Angle**	**5,029**	**2,625**	OK	---
Wheel/Point Load	Member to member connections considered Rigid Weld Affected	**144.0**	Floor Beam	**W12x58**	**2,563,682**	**336,000**	OK	---

12x240 PEDESTRIAN BRIDGE

Bridge Deflections

Load Condition	Design Assumptions	Deflection Limit (L/X)	Bridge Length* (in)	Factor	Maximum Deflection (in)	Maximum Induced Deflection (in)	Status	Notes
DL - Y	Member to member connections considered Rigid	360	2880	100%	**8.00**	**7.90**	**OK**	MAX Induced Deflection in Truss
VL - Y	Member to member connections considered Rigid	360		100%	**8.00**	**0.72**	**OK**	MAX Induced Deflection in Truss
LL - Y	Member to member connections considered Rigid	360		100%	**8.00**	**5.79**	**OK**	MAX Induced Deflection in Truss
WL - Z	Member to member connections considered Rigid	360		100%	**8.00**	**2.33**	**OK**	MAX Induced Deflection in Floor

Floor Deflections

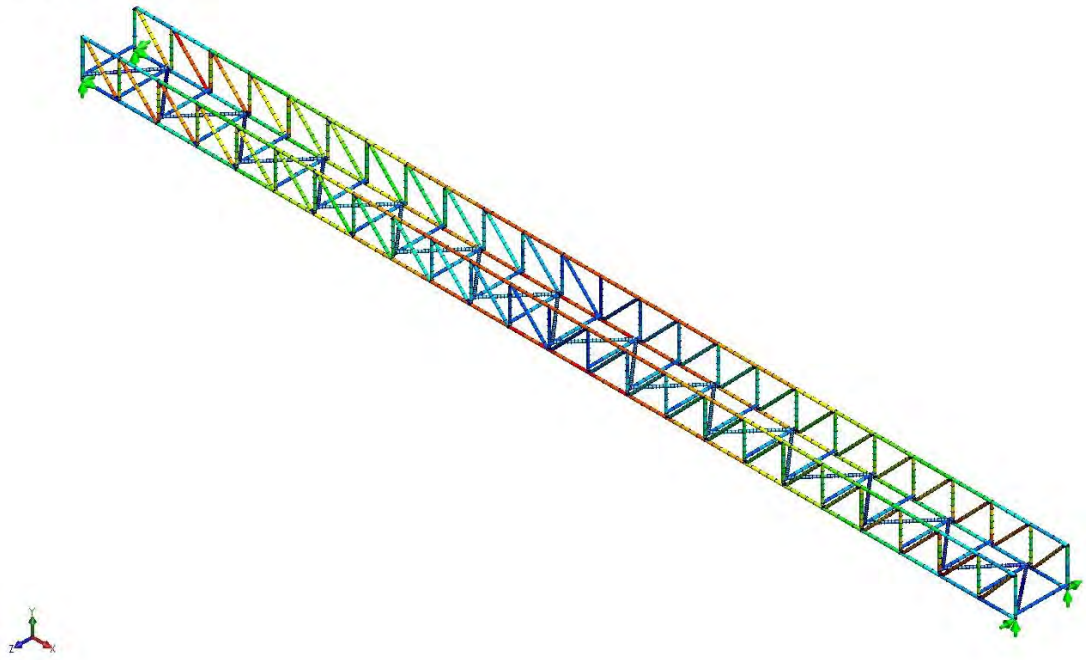
Load Condition	Design Assumptions	Deflection Limit (L/X)	Floor Beam Length (in)	Factor	Maximum Deflection (in)	Maximum Induced Deflection (in)	Status	Notes
VL - Y	Member to member connections considered Rigid	360	144.0	100%	**0.40**	**0.03**	**OK**	MAX Induced Deflection in Floor Beams
LL - Y	Member to member connections considered Rigid	360		100%	**0.40**	**0.00**	**OK**	MAX Induced Deflection in Floor Beams

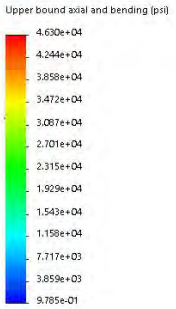
Buckling/U-Frame Stiffness

Load Condition	Design Assumptions	Resistance Factor-Buckling	Transverse Frame Spring Constant - C (from FEA)	Buckling Coefficient - K	Maximum Resistance (kips)	Maximum Induced Compressive Load (kips)	Status	Notes
DL+LL	Member to member connections considered Rigid	1.33	9.75	1.60	**1,655.6**	**1,393.0**	**OK**	---

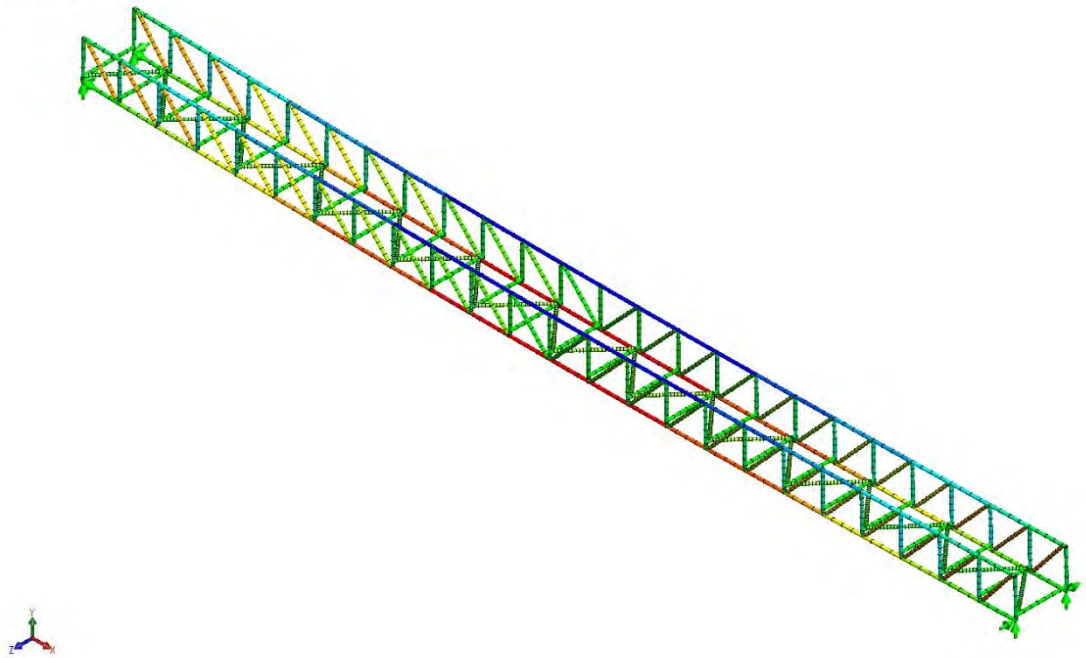
Induced Stresses:

Model name:12x200-Frame REVO-sim
Study name:Strength I-LL(-Simulation-)
Plot type: Upper bound axial and bending Stress1



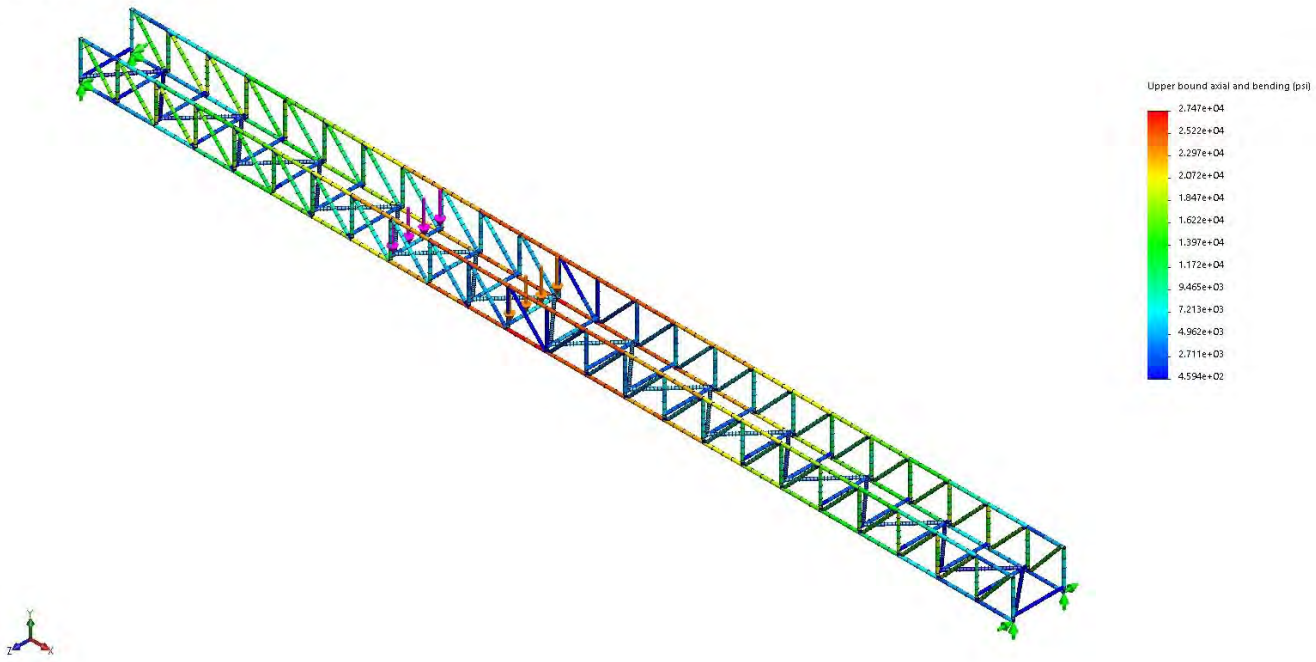


Model name:12x200-Frame REVO-sim
Study name:Strength I-LL(-Simulation-)
Plot type: Axial stress (P/A) Stress1
Deformation scale: 1

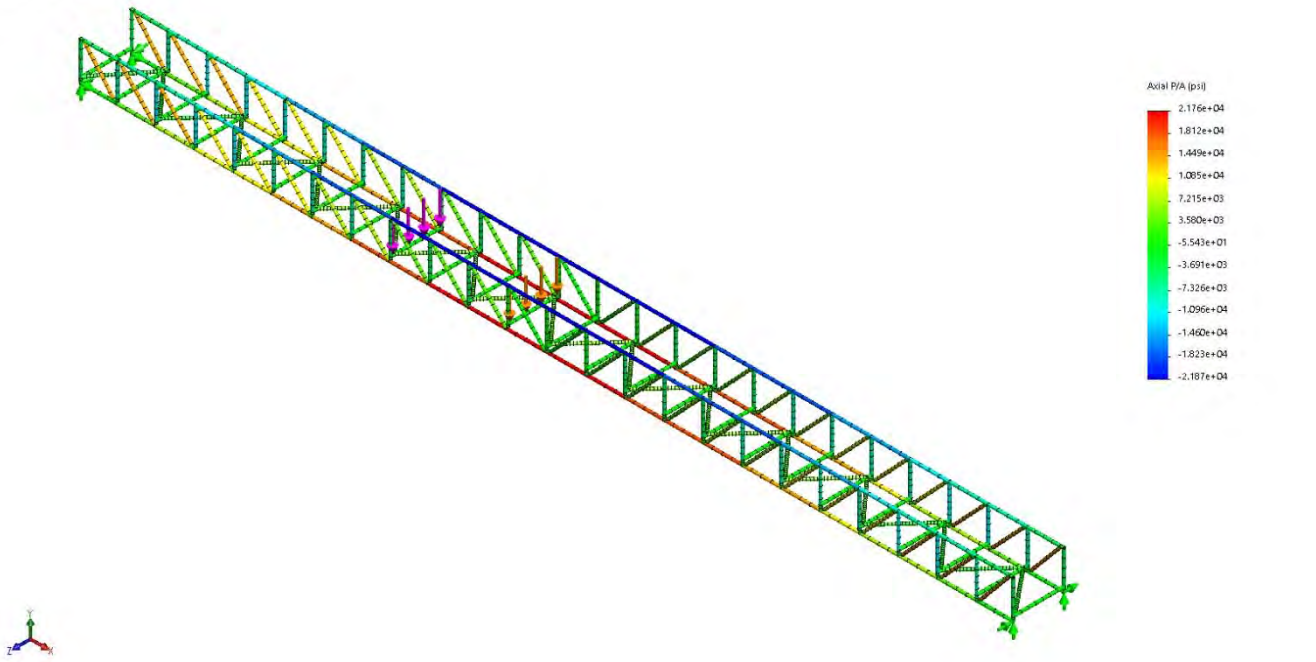


12x240 PEDESTRIAN BRIDGE

Model name:12x200-Frame REVO-sim
Study name:Strength I-V(-)-Simulation-)
Plot type: Upper bound axial and bending Stress1

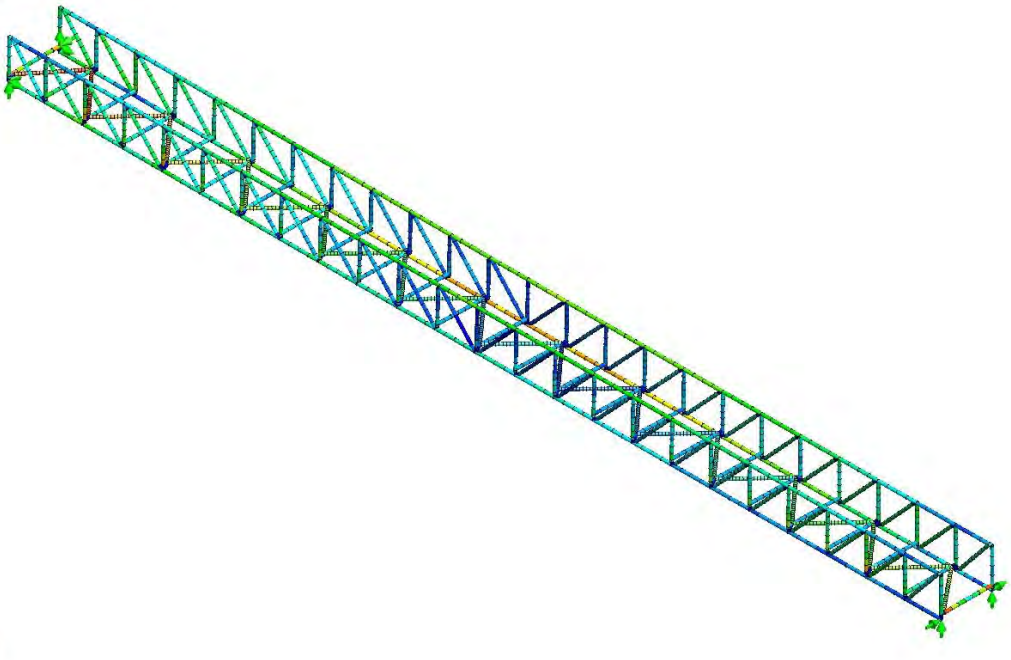


Model name:12x200-Frame REVO-sim
Study name:Strength I-V(-)-Simulation-)
Plot type: Axial stress (P/A) Stress1



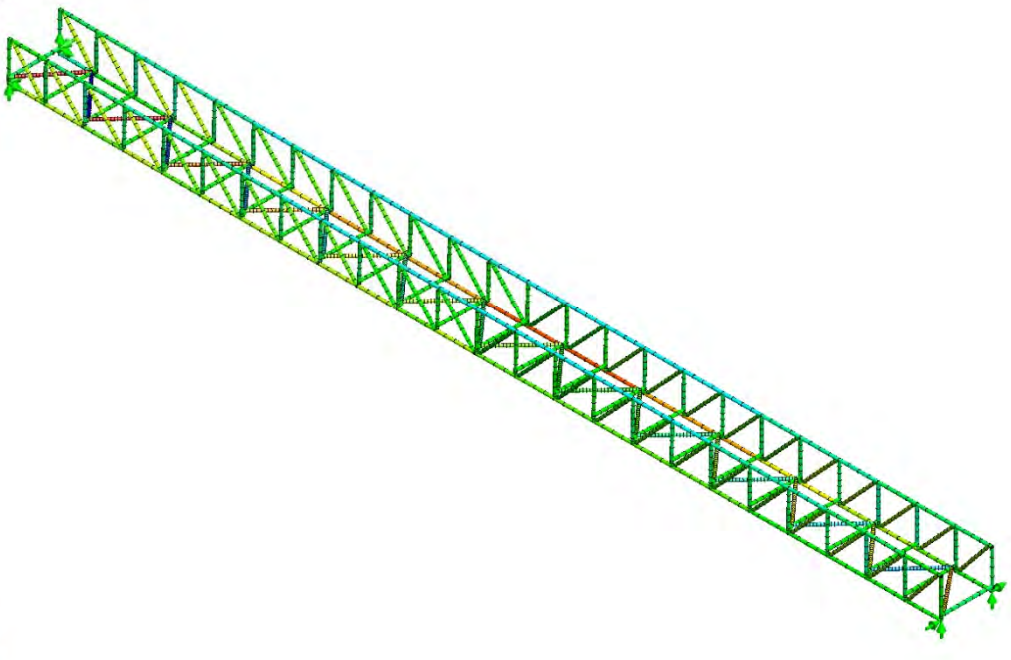
12x240 PEDESTRIAN BRIDGE

Model name:12x200-Frame REVO-sim
Study name:Strength III(-Simulation-)
Plot type: Upper bound axial and bending Stress1
Deformation scale: 1



Upper bound axial and bending (psi)
3.590e+04
3.291e+04
2.992e+04
2.693e+04
2.394e+04
2.094e+04
1.795e+04
1.496e+04
1.197e+04
8.976e+03
5.984e+03
2.992e+03
4.676e-01

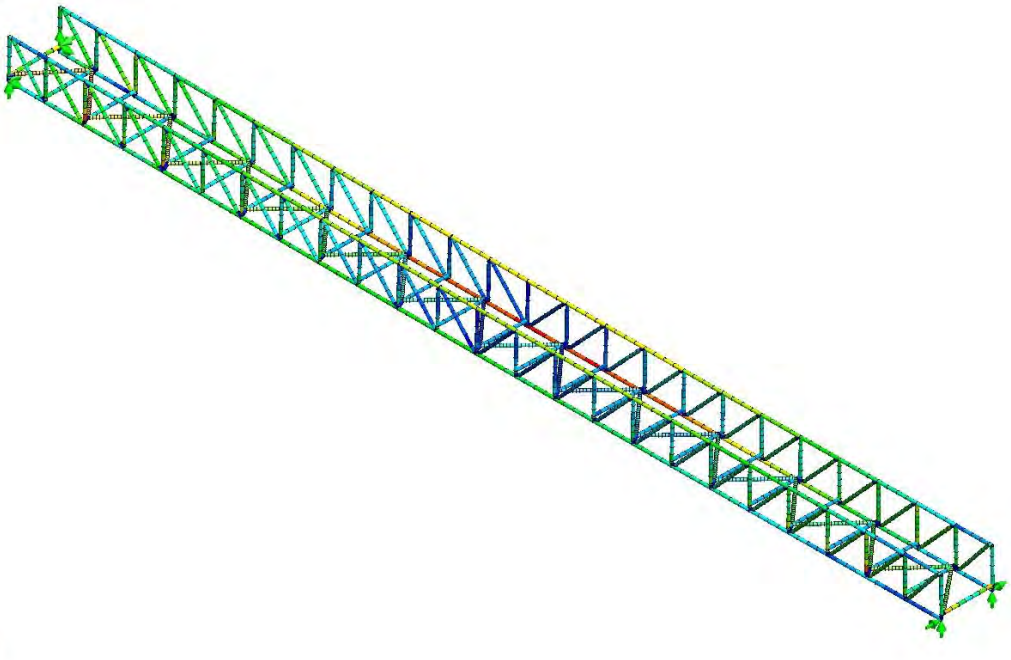
Model name:12x200-Frame REVO-sim
Study name:Strength III(-Simulation-)
Plot type: Axial stress (P/A) Stress2
Deformation scale: 1



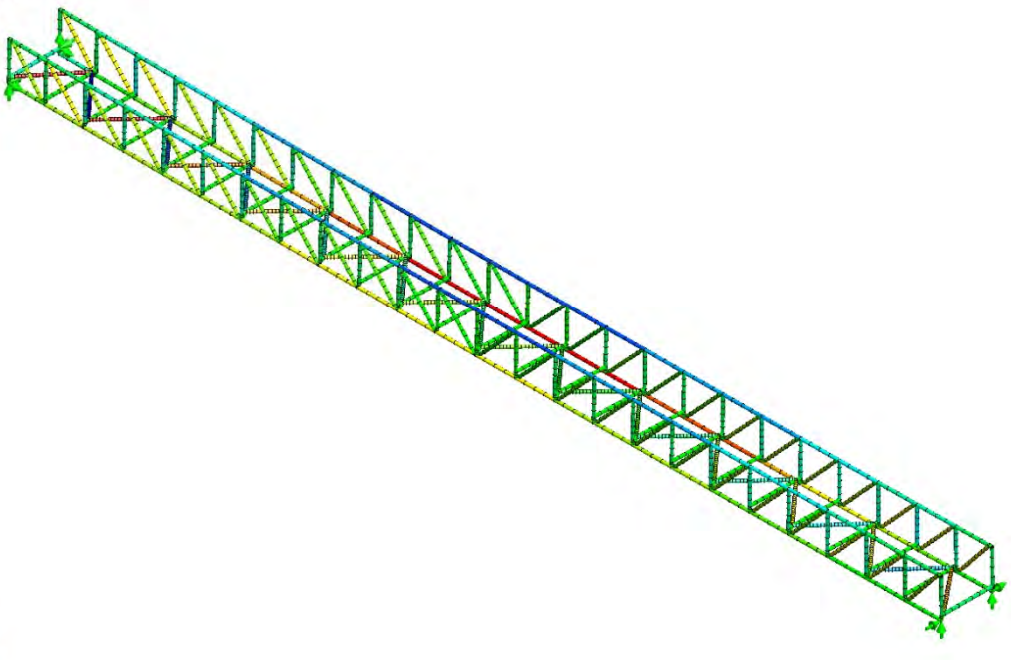
Axial P/A (psi)
3.201e+04
2.672e+04
2.143e+04
1.613e+04
1.084e+04
5.544e+03
2.504e+02
-5.044e+03
-1.034e+04
-1.563e+04
-2.093e+04
-2.622e+04
-3.151e+04

12x240 PEDESTRIAN BRIDGE

Model name:12x200-Frame REVO-sim
Study name:Service I(-Simulation-)
Plot type: Upper bound axial and bending Stress1
Deformation scale: 1

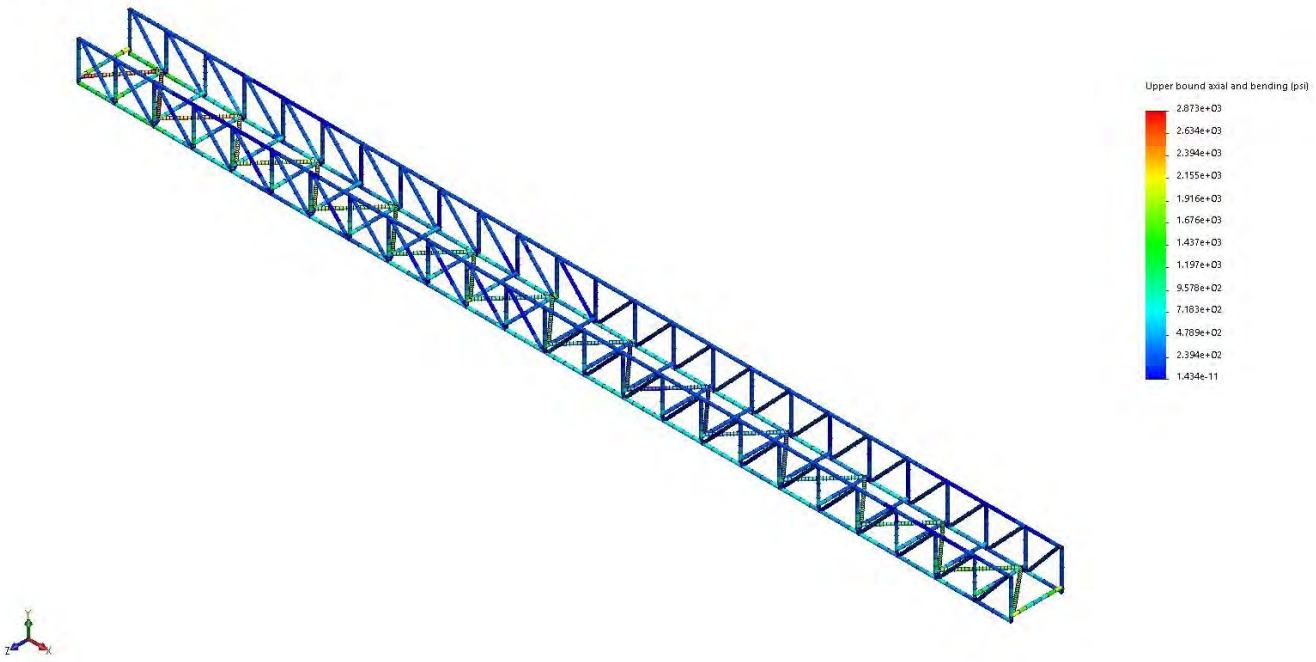


Model name:12x200-Frame REVO-sim
Study name:Service I(-Simulation-)
Plot type: Axial stress (P/A) Stress2
Deformation scale: 1

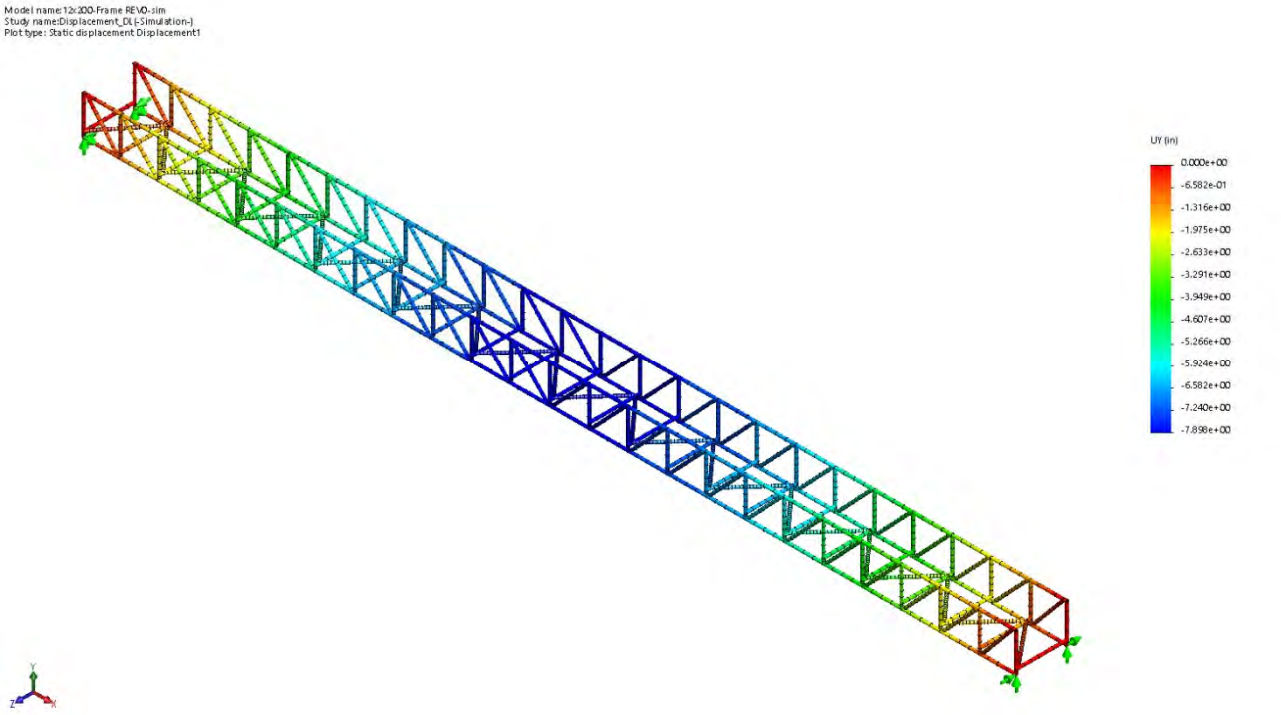


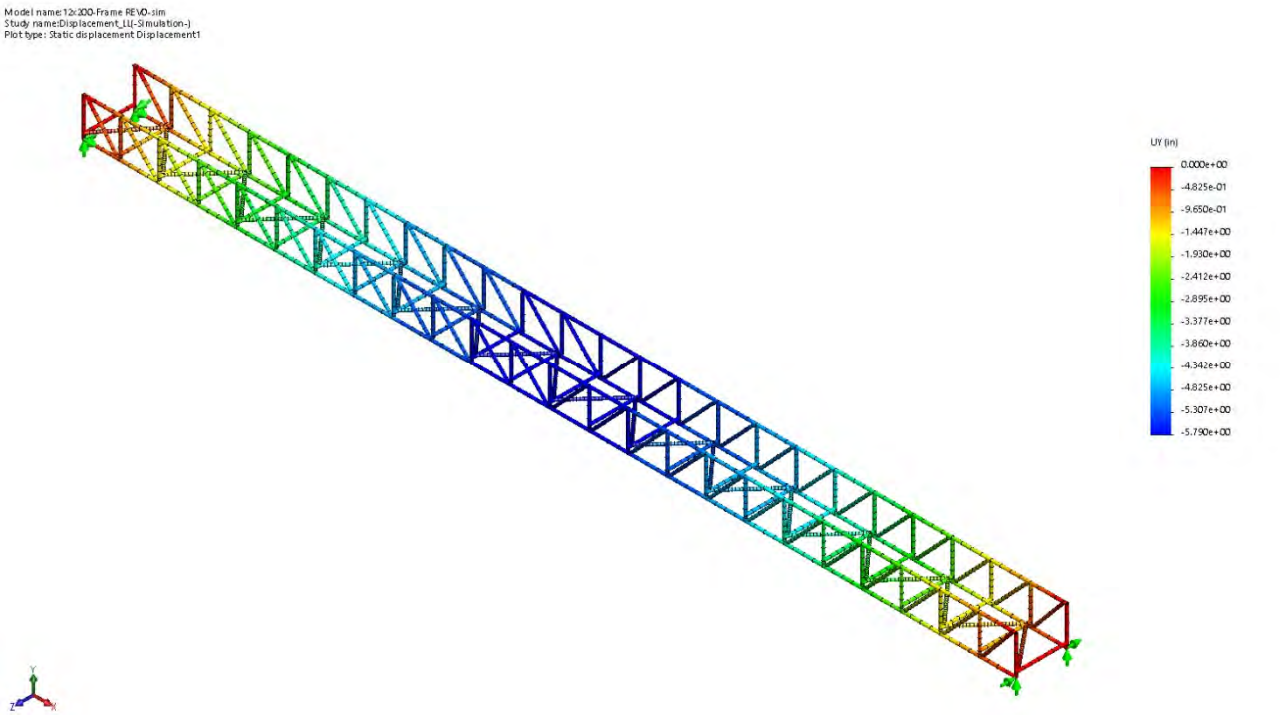
12x240 PEDESTRIAN BRIDGE

Model name:12x200-Frame REVD-sim
Study name:Fatigue I (-Simulation-)
Plot type: Upper bound axial and bending Stress1



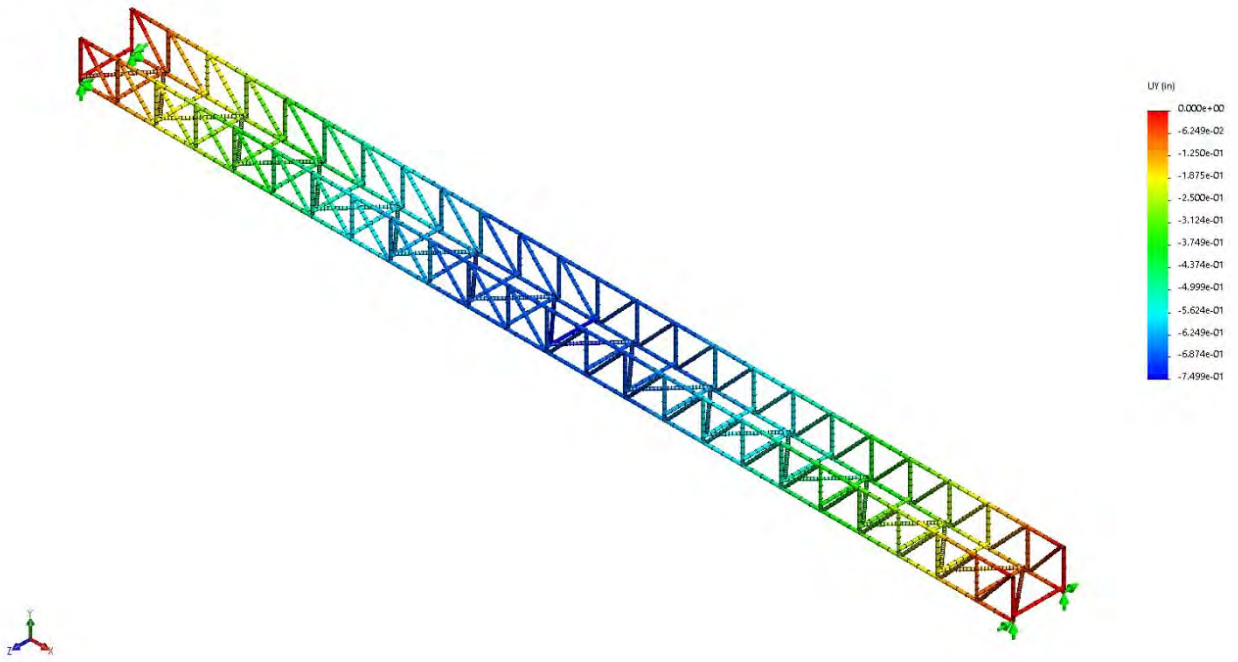
Induced Deflections:



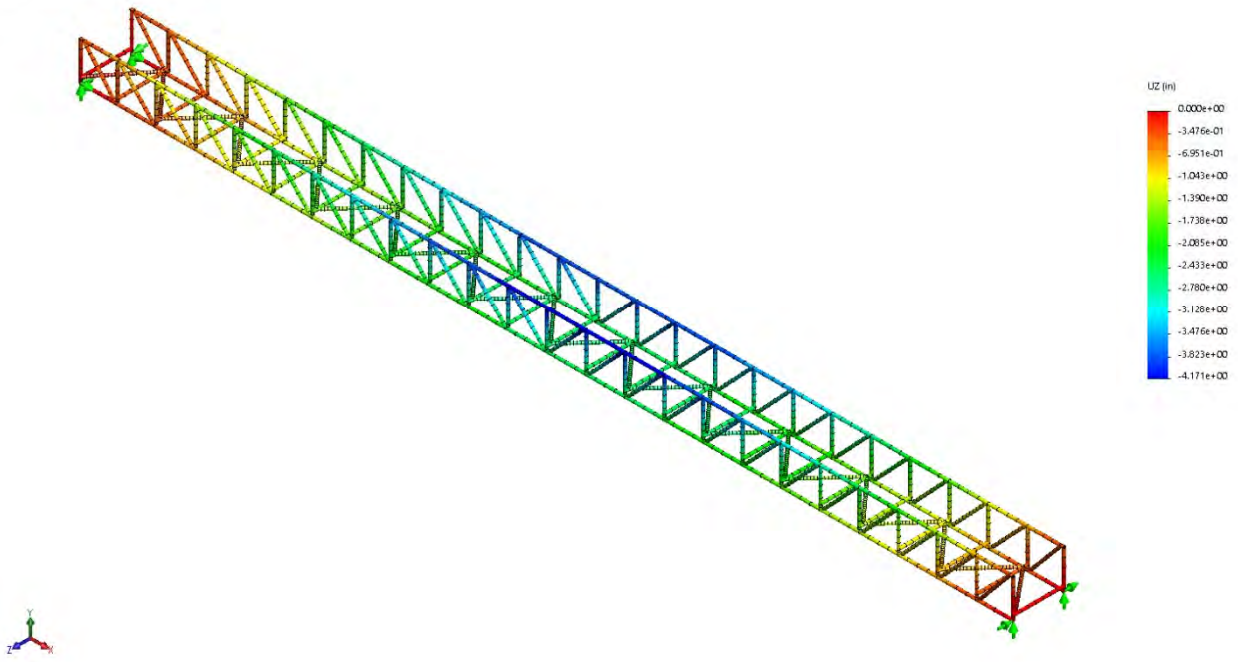


12x240 PEDESTRIAN BRIDGE

Model name: 12x200-Frame REVO-sim
Study name: Displacement_VVL(-Simulation-)
Plot type: Static displacement Displacement1



Model name: 12x200-Frame REVO-sim
Study name: Displacement_VVL(-Simulation-)
Plot type: Static displacement Displacement2



Buckling/U-Frame Stiffness:

Top Chord Induced Axial Comp. (kips)	1393.0
End Post Induced Axial Comp. (kips)	208.9
End Post Induced Moment (kip-in)	2103.0
Interior Vertical Induced Moment (kip-in)	1037.0

Half-Through Truss U-Frame Stiffness

F.S.	1.33	*Factor of Safety, 2.0 for unfactored loads or 1.33 for factored loads
b (in)	156.0	*Floor Beam Span, from centerline to centerline of truss verticals
h (in)	103.0	*Effective Height, from centerline of top chord to centerline of beam
L_d (in)	138.7	*Effective Length of Diagonal
I_b (in^4)	475.00	*Moment of Inertia of Floor Beam
I_c (in^4)	256.00	*Moment of Inertia of Truss Vertical
I_d (in^4)	96.90	*Moment of Inertia of Truss Diagonal
n	24	*Number of Panels
C *(Galambos - 15.6c)*	9.75	*Transverse Frame Spring Constant
CL/[P_c(F.S.)]	0.63	
1/K	0.62	*Interpolation from Table 7.1.2-1 of *Specification*
K	1.60	

Lateral Force to be Resisted by Interior Verticals

Verify Limit, 0.01/K > 0.003	0.006	**OK**
Min. Lateral Force, H_f = 0.01/K*P_c (kips)	8.686	*To be applied as lateral force to top of truss verticals

	Design	Resistance	
Mmax - Interior vertical posts (kip-in)	1922.969	2402.400	**OK**

Lateral Force to be Resisted by End Posts

Min. Lat. Force, 0.01*End Post Axial (kips)	2.089	*To be applied as lateral force to top of truss end posts

	Design	Resistance	
Mmax - End posts (kip-in)	2316.078	7877.500	**OK**

Mechanical Properties

Steel ASTM:	A588
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

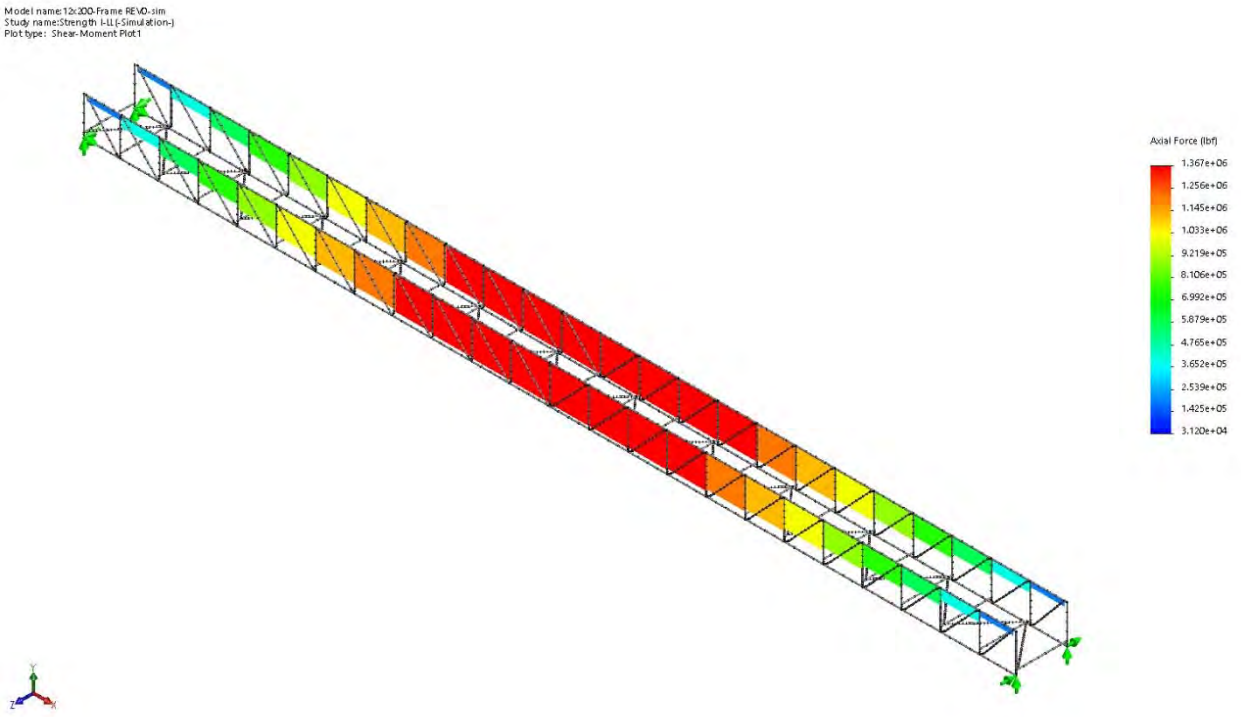
Top Chord Geometry

Depth (in)	14.00
Width (in)	14.00
Thickness (in)	0.70
Area (in^2), Gross & Net Sections	38.30
I_x (in^4)	1100.00
I_y (in^4)	1100.00
S_y (in^3)	157.14
r_x	5.359
r_y	5.359
Unsupported Length L_b (in)	120.0

Axial-Compression (Gross)

K (from U-Frame Stiffness)	1.60	*minimum 0.75 per LRFD 2013 4.6.2.5
KL/r (<=120) (LRFD 2017 6.9.3)	35.9	
P_e (ksi) (LRFD 2017 6.9.2.1)	221.954	
Q (LRFD 2017 6.9.4.1.1)	1.000	
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000	
ϕ (LRFD 2017 6.5.4.2)	0.95	
Resistance (kips)	1655.6	
Unity Check	**0.84**	**OK**

12x240 PEDESTRIAN BRIDGE



Mechanical Splice Analysis:

Tension

Tension required (lb)	1,376,000

Fasteners

Fasteners	1 1/2"-Bolts
Bolt material (ASTM A325)	min 120 ksi
Nominal diameter (in)	1.500
Resistance Factor (AASHTO LRFD 6.5.4.2)	0.8
Shear Resistance of Bolt (lb) (AASHTO LRFD 6.13.2.7)	95,426

Splice Plate (ASTM A588)	***Do Not Weld***
Tensile yield (psi)	50,000
Tensile ultimate strength (psi)	70,000
Shear ultimate (psi)	42,000
ϕ_y	0.95
φ_u	0.80

	Minimum	Actual	
Bolt edge distance -normal to force (in) - [LRFD Table 6.13.2.6.6-1]	1.88	3.75	OK
Bolt edge distance -direction of force (in) - [LRFD Table 6.13.2.6.6-1]	1.88	1.875	OK
Bolt Spacing (in) - [LRFD 6.13.2.6.1]	4.50	4.5	OK
Number of columns [per chord splice]	6		
Number of rows [per chord splice]	2		
Total Splice Plate Thickness (in) [across chord]	3.00		
Total Bottom Chord Tube Thickness (in) [across chord]	1.40		
Splice Plate Depth (in)	12.00		
Splice Plate Length (in)	52.50	52.50	OK
Gross Tensile Area of Splice Plate (in^2) [per chord]	42.00		
Net Tensile Area of Splice Plate (in^2) [per chord]	33.00		
Tensile Capacity of Splice (lb) [per chord]	1,376,000	1,512,000	OK
Tear Out - Pattern (lb) [per chord]	1,376,000	1,976,400	OK
Bottom Chord Bearing (lb) [per bolt] - [LRFD 6.13.2.9-3]	114,667	234,360	OK
Splice Bearing (lb) [per bolt] - [LRFD 6.13.2.9-3]	114,667	504,000	OK

Number of Shear Planes per bolt	4		
Minimum Bolts Required [per chord splice]	5	12	OK

-Calculations per chord splice

Shear

Vreq (lb) [Strength I]	712,765	*factored from Reactions

Fasteners

Fasteners	1 1/2"-Bolts
Bolt material (ASTM A325)	min 120 ksi
Nominal diameter (in)	1.500
Resistance Factor (AASHTO LRFD 6.5.4.2)	0.8
Working shear force (lb)	95,426

Minimum Bolts required [total]	10	
Bolts - Actual [total]	12	OK

Compression

Bearing force required (lb)	1,393,000

Top Chord Bearing (lb) [per bolt]	58,042	234,360	OK
Splice Bearing (lb) [per bolt]	58,042	504,000	OK

Minimum Bolts Required [per chord splice]	5	12	OK

-Calculations per chord splice

Chord Slip-Critical Connection Check (AASHTO)

K_h, Hole Factor	1.00		
K_s, Surface Factor for Class A or C Surface	0.50		
P_t, AASHTO LRFD Table 6.13.2.8-1 (kips)	118.0		
N_s, number of slip planes	2.0		
R_n, AASHTO LRFD 6.13.2.8 (kips/bolt)	118.0		
Number of Bolts Required, n_b	12	12	OK

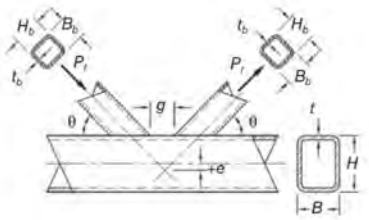
HSS to HSS Connection Analysis – Top Chord:

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{lb} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cv} (ksi)	50.0
F_{su} (ksi)	42.0
F_{sy} (ksi)	30.0

Induced Loads

Top Chord - Axial Load (kips)	409.7	*at joint which creates most critical connection
Top Chord - Moment (in-kips)	442.3	*at joint which creates most critical connection



Truss Diagonal: HSS-to-HSS Connection Analysis

Geometry, *AISC Specifications Table K2.2*

eccentricity, e	9.7	
Branch Angle, θ (must be >= 30°)	50.1	*OK
Chord Thickness, t (in)	0.6975	
Chord Width, B (in)	14	
Chord Height, H (in)	14	
Chord Slenderness Ratio, γ: B/2t	10.0	
Branch Thickness, t_b (in)	0.349	
Branch Width, B_b (in)	10	
Branch Height, H_b (in)	6	
Length of chord contact with branch, l_b (in)	7.8	
Load Length Parameter, η	0.6	
U, Strength Ratio	0.27	*modify Z for rect chords
Q_f (chord connecting surface)	1.00	
Chord Connecting Surface	C	*(T or C)
Gap Spacing, g (in)	2.0	

Limits of Applicability, *AISC Specifications Table K2.2A*

Joint eccentricity: -0.55 <= e/H <=0.25	0.69	*NOT OK for K Connection Analysis; Treat as separate Y connection
Chord Wall Slenderness: B/t <= 35	20	*OK
Chord Wall Slenderness: H/t <= 35	20	*OK
Branch Wall Slenderness: B_b/t <= 35	29	*OK
Branch Wall Slenderness: H_b/t <= 35	17	*OK
Width Ratio, β: B_b/B >= 0.25	0.71	*OK
Width Ratio: H_b/B >= 0.25	0.43	*OK
Branch Aspect Ratio: 0.5 <= H_b/B_b <= 2.0	0.60	*OK
Chord Aspect Ratio: 0.5 <= H/B <= 2.0	1.00	*OK
Material Strength: Fy <= 52ksi	50	*OK
Ductility: Fy/Fu <= 0.8	0.71	*OK

T-, Y- and Cross-Connections

Chord Wall Plastification, when β <= 0.85

Check β <= 0.85	YES
ϕ	1.00
P_n*sinθ *(AISC Specifications K2-7)*	277.2
P_n	361.56

Shear Yielding (Punching), when 0.85 < β <= 1 - 1/γ or B/t < 10

Check 0.85 < β <= 1 - 1/γ or B/t < 10	N/A
ϕ	0.95
$\beta_{min} = 5*\beta/\gamma <= \beta$	0.4
P_n*sinθ *(AISC Specifications K2-8)*	---
P_n	---

Local Yielding of Chord Sidewalls, when β = 1.0

Check β = 1.0	N/A	
ϕ	1.00	
l_b (H_b/sinθ)	7.83	
k *(AISC Specifications J10-2)*	0.90	*chord outside corner radius
P_n*sinθ *(AISC Specifications K2-9)*	---	
P_n	---	

Local Crippling of Chord Sidewalls, when β = 1.0 and Branch in Compression

Check β = 1.0 and Branch in Compression	N/A
ϕ	0.75
P_n*sinθ *(AISC Specifications K2-10)*	---
P_n	---

Local Yielding of Branch Due to Uneven Load Distribution, when β > 0.85

Check β > 0.85	N/A	
ϕ	0.95	
b_{eo} *(AISC Specifications K2-13)* (<=B_b)	9.96	---
P_n *(AISC Specifications K2-12)*	---	
P_n	---	

Capacity Check

Connection demand, P_u (kips)	273.1	
Controlling P_n	361.56	
Unity Check <= 1.0	**0.76**	*OK

Truss Vertical: HSS-to-HSS Connection Analysis

Geometry, *AISC Specifications Table K2.2*

eccentricity, e	9.7	
Branch Angle, θ (must be >= 30°)	90.0	*OK
Chord Thickness, t (in)	0.6975	
Chord Width, B (in)	14	
Chord Height, H (in)	14	
Chord Slenderness Ratio, γ: B/2t	10.0	
Branch Thickness, t_b (in)	0.465	
Branch Width, B_b (in)	10	
Branch Height, H_b (in)	10	
Length of chord contact with branch, l_b (in)	10.0	
Load Length Parameter, η	0.7	
U, Strength Ratio	0.27	*modify Z for rect chords
Q_f (chord connecting surface)	1.00	
Chord Connecting Surface	C	*(T or C)
Gap Spacing, g (in)	2.0	

Limits of Applicability, *AISC Specifications Table K2.2A*

Joint eccentricity: -0.55 <= e/H <=0.25	0.69	*NOT OK for K Connection Analysis; Treat as separate T connection
Chord Wall Slenderness: B/t <= 35	20	*OK
Chord Wall Slenderness: H/t <= 35	20	*OK
Branch Wall Slenderness: B_b/t <= 35	22	*OK
Branch Wall Slenderness: H_b/t <= 35	22	*OK
Width Ratio, β: B_b/B >= 0.25	0.71	*OK
Width Ratio: H_b/B >= 0.25	0.71	*OK
Branch Aspect Ratio: 0.5 <= H_b/B_b <= 2.0	1.00	*OK
Chord Aspect Ratio: 0.5 <= H/B <= 2.0	1.00	*OK
Material Strength: Fy <= 52ksi	50	*OK
Ductility: Fy/Fu <= 0.8	0.71	*OK

T-, Y- and Cross-Connections

Chord Wall Plastification, when β <= 0.85

Check β <= 0.85	YES
ϕ	1.00
P_n*sinθ *(AISC Specifications K2-7)*	303.7
P_n	303.66

Shear Yielding (Punching), when 0.85 < β <= 1 - 1/γ or B/t < 10

Check 0.85 < β <= 1 - 1/γ or B/t < 10	N/A
ϕ	0.95
$\beta_{min} = 5*\beta/\gamma <= \beta$	0.4
P_n*sinθ *(AISC Specifications K2-8)*	---
P_n	---

Local Yielding of Chord Sidewalls, when β = 1.0

Check β = 1.0	N/A	
ϕ	1.00	
l_b (H_b/sinθ)	10.00	
k *(AISC Specifications J10-2)*	0.90	*chord outside corner radius
P_n*sinθ *(AISC Specifications K2-9)*	---	
P_n	---	

Local Crippling of Chord Sidewalls, when β = 1.0 and Branch in Compression

Check β = 1.0 and Branch in Compression	N/A
ϕ	0.75
P_n*sinθ *(AISC Specifications K2-10)*	---
P_n	---

Local Yielding of Branch Due to Uneven Load Distribution, when β > 0.85

Check β > 0.85	N/A	
ϕ	0.95	
b_{eo} *(AISC Specifications K2-13)* (<=B_b)	7.47	---
P_n *(AISC Specifications K2-12)*	---	
P_n	---	

Capacity Check

Connection demand, P_u (kips)	205.7	
Controlling P_n	303.66	
Unity Check <= 1.0	**0.68**	*OK

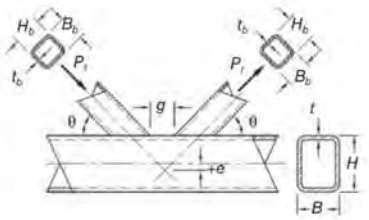
HSS to HSS Connection Analysis – Bottom Chord:

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{ib} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cv} (ksi)	50.0
F_{su} (ksi)	42.0
F_{sv} (ksi)	30.0

Induced Loads

Bottom Chord - Axial Load (kips)	223.2	*at joint which creates most critical connection
Bottom Chord - Moment (in-kips)	236.1	*at joint which creates most critical connection



Truss Diagonal: HSS-to-HSS Connection Analysis

Geometry, *AISC Specifications Table K2.2*

eccentricity, e	9.7	
Branch Angle, θ (must be >= 30°)	50.1	*OK
Chord Thickness, t (in)	0.6975	
Chord Width, B (in)	14	
Chord Height, H (in)	14	
Chord Slenderness Ratio, γ: B/2t	10.0	
Branch Thickness, t_b (in)	0.349	
Branch Width, B_b (in)	10	
Branch Height, H_b (in)	6	
Length of chord contact with branch, l_b (in)	7.8	
Load Length Parameter, η	0.6	
U, Strength Ratio	0.15	*modify Z for rect chords
Q_f (chord connecting surface)	1.00	
Chord Connecting Surface	T	*(T or C)
Gap Spacing, g (in)	2.0	

Limits of Applicability, *AISC Specifications Table K2.2A*

Joint eccentricity: -0.55 <= e/H <=0.25	0.69	*NOT OK for K Connection Analysis; Treat as separate Y connection
Chord Wall Slenderness: B/t <= 35	20	*OK
Chord Wall Slenderness: H/t <= 35	20	*OK
Branch Wall Slenderness: B_b/t <= 35	29	*OK
Branch Wall Slenderness: H_b/t <= 35	17	*OK
Width Ratio, β: B_b/B >= 0.25	0.71	*OK
Width Ratio: H_b/B >= 0.25	0.43	*OK
Branch Aspect Ratio: 0.5 <= H_b/B_b <= 2.0	0.60	*OK
Chord Aspect Ratio: 0.5 <= H/B <= 2.0	1.00	*OK
Material Strength: Fy <= 52ksi	50	*OK
Ductility: Fy/Fu <= 0.8	0.71	*OK

T-, Y- and Cross-Connections

Chord Wall Plastification, when β <= 0.85

Check β <= 0.85	YES
ϕ	1.00
P_n*sinθ *(AISC Specifications K2-7)*	277.2
P_n	361.56

Shear Yielding (Punching), when 0.85 < β <= 1 - 1/γ or B/t < 10

Check 0.85 < β <= 1 - 1/γ or B/t < 10	N/A
ϕ	0.95
β_{min} = 5*β/γ <= β	0.4
P_n*sinθ *(AISC Specifications K2-8)*	---
P_n	---

Local Yielding of Chord Sidewalls, when β = 1.0

Check β = 1.0	N/A	
ϕ	1.00	
l_b (H_b/sinθ)	7.83	
k *(AISC Specifications J10-2)*	0.90	*chord outside corner radius
P_n*sinθ *(AISC Specifications K2-9)*	---	
P_n	---	

Local Crippling of Chord Sidewalls, when β = 1.0 and Branch in Compression

Check β = 1.0 and Branch in Compression	N/A
ϕ	0.75
P_n*sinθ *(AISC Specifications K2-10)*	---
P_n	---

Local Yielding of Branch Due to Uneven Load Distribution, when β > 0.85

Check β > 0.85	N/A	
ϕ	0.95	
b_{eo} *(AISC Specifications K2-13)* (<=B_b)	9.96	---
P_n *(AISC Specifications K2-12)*	---	
P_n	---	

Capacity Check

Connection demand, P_b (kips)	272.9	
Controlling P_n	361.56	
Unity Check <= 1.0	**0.75**	*OK

Truss Vertical: HSS-to-HSS Connection Analysis

Geometry, *AISC Specifications Table K2.2*

eccentricity, e	9.7	
Branch Angle, θ (must be >= 30°)	90.0	*OK
Chord Thickness, t (in)	0.6975	
Chord Width, B (in)	14	
Chord Height, H (in)	14	
Chord Slenderness Ratio, γ: B/2t	10.0	
Branch Thickness, t_b (in)	0.465	
Branch Width, B_b (in)	10	
Branch Height, H_b (in)	10	
Length of chord contact with branch, l_b (in)	10.0	
Load Length Parameter, η	0.7	
U, Strength Ratio	0.15	*modify Z for rect chords
Q_f (chord connecting surface)	1.00	
Chord Connecting Surface	T	*(T or C)
Gap Spacing, g (in)	2.0	

Limits of Applicability, *AISC Specifications Table K2.2A*

Joint eccentricity: -0.55 <= e/H <=0.25	0.69	*NOT OK for K Connection Analysis; Treat as separate T connection
Chord Wall Slenderness: B/t <= 35	20	*OK
Chord Wall Slenderness: H/t <= 35	20	*OK
Branch Wall Slenderness: B_b/t <= 35	22	*OK
Branch Wall Slenderness: H_b/t <= 35	22	*OK
Width Ratio, β: B_b/B >= 0.25	0.71	*OK
Width Ratio: H_b/B >= 0.25	0.71	*OK
Branch Aspect Ratio: 0.5 <= H_b/B_b <= 2.0	1.00	*OK
Chord Aspect Ratio: 0.5 <= H/B <= 2.0	1.00	*OK
Material Strength: Fy <= 52ksi	50	*OK
Ductility: Fy/Fu <= 0.8	0.71	*OK

T-, Y- and Cross-Connections

Chord Wall Plastification, when β <= 0.85

Check β <= 0.85	YES
ϕ	1.00
P_n*sinθ *(AISC Specifications K2-7)*	303.7
P_n	303.66

Shear Yielding (Punching), when 0.85 < β <= 1 - 1/γ or B/t < 10

Check 0.85 < β <= 1 - 1/γ or B/t < 10	N/A
ϕ	0.95
β_{min} = 5*β/γ <= β	0.4
P_n*sinθ *(AISC Specifications K2-8)*	---
P_n	---

Local Yielding of Chord Sidewalls, when β = 1.0

Check β = 1.0	N/A	
ϕ	1.00	
l_b (H_b/sinθ)	10.00	
k *(AISC Specifications J10-2)*	0.90	*chord outside corner radius
P_n*sinθ *(AISC Specifications K2-9)*	---	
P_n	---	

Local Crippling of Chord Sidewalls, when β = 1.0 and Branch in Compression

Check β = 1.0 and Branch in Compression	N/A
ϕ	0.75
P_n*sinθ *(AISC Specifications K2-10)*	---
P_n	---

Local Yielding of Branch Due to Uneven Load Distribution, when β > 0.85

Check β > 0.85	N/A	
ϕ	0.95	
b_{eo} *(AISC Specifications K2-13)* (<=B_b)	7.47	---
P_n *(AISC Specifications K2-12)*	---	
P_n	---	

Capacity Check

Connection demand, P_b (kips)	205.7	
Controlling P_n	303.66	
Unity Check <= 1.0	**0.68**	*OK

Member Design:

14x14x3/4	Truss Top Chord
Depth (in)	14.00
Width (in)	14.00
Thickness (in)	0.698
Area (in^2), Gross & Net Sections	38.30
I_x (in^4)	1100.00
I_y (in^4)	1100.00
S_x (in^3)	157.14
Z (in^3)	188.00
r_x	5.359
r_y	5.359
Unbraced Length L_b (in)	120.0

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	1819.250
Axial Compressive (kips)	1655.556
Bending (in-kips)	7857.143
Shear (kips)	479.517

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	22.4
Fty*A (kips) (LRFD 2017 6.8.2.1)	1915.000
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	2681.000
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	1.60
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	35.9
P_e (ksi) (LRFD 2017 6.9.4.1.2)	221.954
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**43.226**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	479.517
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**479.517**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.2)	9400.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Flange Local Buckling

λ_f (LRFD 2017 6.12.2.2.2)	17.1
λ_{pf} (LRFD 2017 6.12.2.2.2)	27.0
λ_{rf} (LRFD 2017 6.12.2.2.2)	33.7
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	11667.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**74.245**

Flexure-Web Local Buckling

λ_w (LRFD 2017 6.12.2.2.2)	17.1
λ_{pw} (LRFD 2017 6.12.2.2.2)	58.3
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	10205.058
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**64.941**

12x240 PEDESTRIAN BRIDGE

14x14x3/4 Truss Bottom Chord

Depth (in)	14.00
Width (in)	14.00
Thickness (in)	0.698
Area (in^2), Gross & Net Sections	38.30
I_x (in^4)	1100.00
I_y (in^4)	1100.00
S_x (in^3)	157.14
Z (in^3)	188.00
r_x	5.359
r_y	5.359
Unbraced Length L_b (in)	120.0

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	1819.250
Axial Compressive (kips)	1782.119
Bending (in-kips)	7857.143
Shear (kips)	479.517

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	22.4
Fty*A (kips) (LRFD 2017 6.8.2.1)	1915.000
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	2681.000
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	16.8
P_e (ksi) (LRFD 2017 6.9.4.1.2)	1014.861
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**46.531**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	479.517
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**479.517**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.2)	9400.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Flange Local Buckling

λ_f (LRFD 2017 6.12.2.2.2)	17.1
λ_{pf} (LRFD 2017 6.12.2.2.2)	27.0
λ_{rf} (LRFD 2017 6.12.2.2.2)	33.7
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	11667.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**74.245**

Flexure-Web Local Buckling

λ_w (LRFD 2017 6.12.2.2.2)	17.1
λ_{pw} (LRFD 2017 6.12.2.2.2)	58.3
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	10205.058
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**64.941**

12x240 PEDESTRIAN BRIDGE

14x14x3/4	Truss End Post
Depth (in)	14.00
Width (in)	14.00
Thickness (in)	0.698
Area (in^2), Gross & Net Sections	38.30
I_x (in^4)	1100.00
I_y (in^4)	1100.00
S_x (in^3)	157.14
Z (in^3)	188.00
r_x	5.359
r_y	5.359
Unbraced Length L_b (in)	102.0

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	1819.250
Axial Compressive (kips)	1792.346
Bending (in-kips)	7857.143
Shear (kips)	479.517

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	19.0
Fty*A (kips) (LRFD 2017 6.8.2.1)	1915.000
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	2681.000
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	14.3
P_e (ksi) (LRFD 2017 6.9.4.1.2)	1404.652
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**46.798**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	479.517
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**479.517**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.2)	9400.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Flange Local Buckling

λ_f (LRFD 2017 6.12.2.2.2)	17.1
λ_{pf} (LRFD 2017 6.12.2.2.2)	27.0
λ_{rf} (LRFD 2017 6.12.2.2.2)	33.7
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	11667.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**74.245**

Flexure-Web Local Buckling

λ_w (LRFD 2017 6.12.2.2.2)	17.1
λ_{pw} (LRFD 2017 6.12.2.2.2)	58.3
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	10205.058
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**64.941**

10x10x1/2	Truss Vertical
Depth (in)	10.00
Width (in)	10.00
Thickness (in)	0.465
Area (in^2), Gross & Net Sections	17.39
I_x (in^4)	261.13
I_y (in^4)	261.13
S_x (in^3)	52.23
Z (in^3)	60.70
r_x	3.875
r_y	3.875
Unbraced Length L_b (in)	102.0

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	826.025
Axial Compressive (kips)	802.818
Bending (in-kips)	2611.260
Shear (kips)	231.017

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	26.3
Fty*A (kips) (LRFD 2017 6.8.2.1)	869.500
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	1217.300
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	19.7
P_e (ksi) (LRFD 2017 6.9.4.1.2)	734.388
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**46.166**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	231.017
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**231.017**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.2)	3035.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Flange Local Buckling

λ_f (LRFD 2017 6.12.2.2.2)	18.5
λ_{pf} (LRFD 2017 6.12.2.2.2)	27.0
λ_{rf} (LRFD 2017 6.12.2.2.2)	33.7
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	3567.6
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**68.311**

Flexure-Web Local Buckling

λ_w (LRFD 2017 6.12.2.2.2)	18.5
λ_{pw} (LRFD 2017 6.12.2.2.2)	58.3
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	3248.412
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**62.200**

10x4x1/4	Truss Splice Post
Depth (in)	10.00
Width (in)	4.00
Thickness (in)	0.233
Area (in^2), Gross & Net Sections	6.17
I_x (in^4)	74.70
I_y (in^4)	17.70
S_x (in^3)	14.94
Z (in^3)	19.00
r_x	3.480
r_y	1.694
Unbraced Length L_b (in)	101.0

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	293.075
Axial Compressive (kips)	253.200
Bending (in-kips)	747.000
Shear (kips)	125.119

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	59.6
Fty*A (kips) (LRFD 2017 6.8.2.1)	308.500
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	431.900
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	44.7
P_e (ksi) (LRFD 2017 6.9.4.1.2)	143.094
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**41.037**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	125.119
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**125.119**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.2)	950.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Flange Local Buckling

λ_f (LRFD 2017 6.12.2.2.2)	14.2
λ_{pf} (LRFD 2017 6.12.2.2.2)	27.0
λ_{rf} (LRFD 2017 6.12.2.2.2)	33.7
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	1335.7
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**89.403**

Flexure-Web Local Buckling

λ_w (LRFD 2017 6.12.2.2.2)	39.9
λ_{pw} (LRFD 2017 6.12.2.2.2)	58.3
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	997.188
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**66.746**

10x6x3/8	Truss Diagonal
Depth (in)	10.00
Width (in)	6.00
Thickness (in)	0.349
Area (in^2), Gross & Net Sections	10.40
I_x (in^4)	137.00
I_y (in^4)	61.80
S_x (in^3)	27.40
Z (in^3)	33.80
r_x	3.629
r_y	2.438
Unbraced Length L_b (in)	141.2

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	494.000
Axial Compressive (kips)	430.326
Bending (in-kips)	1370.000
Shear (kips)	180.399

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	57.9
Fty*A (kips) (LRFD 2017 6.8.2.1)	520.000
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	728.000
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	43.4
P_e (ksi) (LRFD 2017 6.9.4.1.2)	151.656
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**41.377**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	180.399
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**180.399**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.2)	1690.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Flange Local Buckling

λ_f (LRFD 2017 6.12.2.2.2)	14.2
λ_{pf} (LRFD 2017 6.12.2.2.2)	27.0
λ_{rf} (LRFD 2017 6.12.2.2.2)	33.7
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	2296.8
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**83.825**

Flexure-Web Local Buckling

λ_w (LRFD 2017 6.12.2.2.2)	25.7
λ_{pw} (LRFD 2017 6.12.2.2.2)	58.3
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	1822.197
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**66.504**

12x240 PEDESTRIAN BRIDGE

W12x58	Floor Beams
Depth (in)	12.20
Width (in)	10.00
Web Thickness (in)	0.360
Flange Thickness (in)	0.640
Area (in^2), Gross & Net Sections	17.00
I_x (in^4)	475.00
I_y (in^4)	107.00
S_x (in^3)	77.87
S_y (in^3)	21.40
Z_y (in^3)	32.50
J (in^4)	2.10
G (ksi)	11165
C_w (in^6)	3570.00
r_x	5.286
r_y	2.509
Unbraced Length L_b (in)	148.0

Mechanical Properties

Steel ASTM:	A588
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	807.500
Axial Compressive (kips)	781.880
Bending (in-kips)	2563.682
Shear (kips)	115.562

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	28.0
Fty*A (kips) (LRFD 2017 6.8.2.1)	850.000
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	1190.000
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	21.0
P_e (ksi) (LRFD 2017 6.9.4.1.2)	649.077
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**45.993**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	115.562
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**115.562**

Flexure-Yielding

λ_f (LRFD 2017 6.12.2.2.1)	7.8
λ_{pf} (LRFD 2017 6.12.2.2.1)	9.2
λ_{rf} (LRFD 2017 6.12.2.2.1)	20.0
$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.1)	1070.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**32.923**

Web Bend-Buckling Resistance

k (LRFD 2017 6.10.1.9.1)	12.7
β (LRFD 2017 6.10.1.10.1)	0.6
ρ (LRFD 2017 6.10.1.10.1)	1.0
R_h (LRFD 2017 6.10.1.10.1)	12.1
F_{crw} = (ksi) (LRFD 2017 6.10.1.9.1)	71.4
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**71.429**

Web-Crippling

N (LRFD 2017 7.11.2.1)	N/A
ϕ_w (LRFD 2017 6.5.4.2)	0.80
R_u (kips) (LRFD 2017 D6.5.3)	N/A

C12x30 Channel	Floor Splice Beam
Depth (in)	12.00
Width (in)	3.17
Web Thickness (in)	0.510
Flange Thickness (in)	0.501
Area (in^2), Gross & Net Sections	8.81
I_x (in^4)	162.00
I_y (in^4)	5.12
S_x (in^3)	27.00
Z (in^3)	33.80
J (in^4)	0.86
C_w (in^6)	151.00
r_o (in)	4.54
H	0.92
h_o (in)	11.50
r_{ts} (in)	1.01
r_x	4.288
r_y	0.762
Unbraced Length L_b (in)	144.0

Mechanical Properties

Steel ASTM:	A588
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	418.475
Axial Compressive (kips)	313.211
Bending (in-kips)	904.068
Shear (kips)	154.144

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	33.6
Fty*A (kips) (LRFD 2017 6.8.2.1)	440.500
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	616.700
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	25.2
P_{ey} (ksi) (LRFD 2017 6.9.4.1.3-4)	451.221
P_{ez} (ksi) (LRFD 2017 6.9.4.1.3-5)	73.344
P_e (ksi) (LRFD 2017 6.9.4.1.2)	72.229
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**35.552**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	154.144
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**154.144**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.5)	1690.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Lateral Torsional

L_p (LRFD 2017 6.12.2.2.5)	32.3
L_r (LRFD 2017 6.12.2.2.5)	138.8
M_n (kip-in) (LRFD 2017 6.12.2.2.5)	904.1
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**33.484**

Web-Crippling

N (LRFD 2017 7.11.2.1)	N/A
ϕ_w (LRFD 2017 6.5.4.2)	0.80
R_u (kips) (LRFD 2017 D6.5.3)	N/A

12x240 PEDESTRIAN BRIDGE

4x4x1/4	Floor Bracing
Depth (in)	4.00
Width (in)	4.00
Thickness (in)	0.233
Area (in^2), Gross & Net Sections	3.37
I_x (in^4)	7.80
I_y (in^4)	7.80
S_x (in^3)	3.90
Z (in^3)	4.69
r_x	1.521
r_y	1.521
Unbraced Length L_b (in)	179.3

Mechanical Properties

Steel ASTM:	A847
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	160.075
Axial Compressive (kips)	90.441
Bending (in-kips)	195.000
Shear (kips)	44.406

Axial-Tension (Gross)

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	117.8
Fty*A (kips) (LRFD 2017 6.8.2.1)	168.500
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	235.900
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression (Gross)

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	88.4
P_e (ksi) (LRFD 2017 6.9.4.1.2)	36.654
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**26.837**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	44.406
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**44.406**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2.2)	234.5
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Flexure-Flange Local Buckling

λ_f (LRFD 2017 6.12.2.2.2)	14.2
λ_{pf} (LRFD 2017 6.12.2.2.2)	27.0
λ_{rf} (LRFD 2017 6.12.2.2.2)	33.7
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	309.5
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**79.371**

Flexure-Web Local Buckling

λ_w (LRFD 2017 6.12.2.2.2)	14.2
λ_{pw} (LRFD 2017 6.12.2.2.2)	58.3
M_n (kip-in) (LRFD 2017 6.12.2.2.2)	256.564
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**65.786**

2x2x1/8 Angle45	Horizontal Rail
Depth (in)	2.00
Width (in)	2.00
Thickness (in)	0.125
Area (in^2), Gross & Net Sections	0.49
I_x (in^4)	0.08
I_y (in^4)	0.30
S_x (in^3)	0.10
r_x	0.399
r_y	0.789
Unbraced Length L_b (in)	120.0

Mechanical Properties

Steel ASTM:	A588
E (ksi)	29000
F_{tu} (ksi)	70.0
F_{ty} (ksi)	50.0
F_{cy} (ksi)	50.0
F_{su} (ksi)	40.4
F_{sy} (ksi)	28.9

Strength Summary

Axial Tensile (kips)	23.138
Axial Compressive (kips)	8.940
Bending (in-kips)	5.029
Shear (kips)	5.864

Axial-Tension

U (LRFD 2017 6.8.2.1)	1.0
L_b/r <= 200 Prim., 240 Sec. (LRFD 2017 6.8.4)	152.1
Fty*A (kips) (LRFD 2017 6.8.2.1)	24.356
Ftu/kt*A (kips) (LRFD 2017 6.8.2.1)	34.098
ϕy (LRFD 2017 6.5.4.2)	0.95
ϕu (LRFD 2017 6.5.4.2)	0.80
Resistance (ksi)	**47.500**

Axial-Compression

K (LRFD 2017 4.6.2.5)	0.75
KL/r <=120 Prim., 140 Sec. (LRFD 2017 6.9.3)	114.0
P_e (ksi) (LRFD 2017 6.9.4.1.2)	22.006
Q (LRFD 2017 6.9.4.1.1)	1.0
P_o (ksi) (LRFD 2017 6.9.4.1)	50.000
ϕ (LRFD 2017 6.5.4.2)	0.95
Resistance (ksi)	**18.352**

Shear Resistance

k (LRFD 2017 6.10.9.2)	5.0
C (LRFD 2017 6.10.9.2)	1.0
V_n (kips) (LRFD 2017 6.10.9.2)	5.864
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (kips)	**5.864**

Flexure-Yielding

$M_n = M_p$ (kip-in) (LRFD 2017 6.12.2.2)	5.0
ϕ (LRFD 2017 6.5.4.2)	1.00
Resistance (ksi)	**50.000**

Bearing Plate Analysis:

Steel Base Plate

# of Bolts	4	
Hole/Slot Diameter (in)	1 3/4	
Base Plate Length (in)	16	
Reaction (R_z)	**50,562**	*factored from Reactions
Slot Length (in)	1.500	(Does not include slot end radii)
Edge Distance (in)	2.250	*Direction of slot (Includes slot end radius)
Edge Distance (in)	2.500	*Normal to direction of slot (To center of slot)
D between Slots	8.500	(Distance of Material between Slots; does not include slot end radii)

Bearing Failure (AASHTO LRFD 6.13.2.9) ϕ_u = 0.80

Plate Thickness (in)	Ultimate Tensile (psi)	Bearing Resistance (lbs) (bolts in slots)	
1	70,000	140,000	**OK**

Single Bolt Tear Out - Block Shear (AASHTO LRFD 6.13.4)

(For a single bolt with e >= 2D, only Bearing needs to be checked since Bearing Strength is less than Tear Out Strength.)

Multiple Bolt Tear Out - Block Shear (AASHTO LRFD 6.13.4)

(For multiple bolts with e = 2D) ϕ_u = 0.80

Plate Thickness (in)	Ultimate Tensile (psi)	Yield Tensile (psi)	Allowable Tear Out Load (lbs)	
1	70,000	36,000	680,184	**OK**

Minimum Support Length Requirements (AASHTO Seismic, 4.12)

Bridge Length, L (ft)	Support Skew, S (°)	Abutment Height, H (ft)	Support Length, N (in)	
240.0	0	2.0	13	**OK**

Weld Analysis

Load Condition	Design Assumptions	Ultimate Shear (psi)	Ultimate Tensile (psi)	Resistance Factor	Factor	Fillet - Max Factored Shear Stress (psi)	Groove - Max Factored Tensile Stress (psi)
Strength I	Negligable fatigue effects	42,000	70,000	0.8	100%	**33,600**	**56,000**
Strength III	Negligable fatigue effects	42,000	70,000	0.8	100%	**33,600**	**56,000**
Service I	Negligable fatigue effects	42,000	70,000	0.8	100%	**33,600**	**56,000**
Fatigue I	Fatigue Considered - Infinite cycles - C types	10,000	10,000	1	100%	**10,000**	**10,000**

Vertical Truss Welds		Member Thickness (in)	Nominal Weld Size (in)	Effective Fillet Throat Thickness (in)	Induced Axial Force (lbf)	Available Fillet Weld Length (in)	Available Groove Weld Length (in)	Weld Resistance (lbf)	Weld Type	Gussets: Gusset Thickness (in)	Gussets: Nominal Weld Size (in)	Gussets: Effective Throat Thickness (in)	Gussets: Required Gusset Fillet Weld Length (in)
End Post	14x14x3/4	0.698	10/16	0.449	208,400	16.0	48.0	1,948,269	Full		10/16	0.449	N/A
Diagonal	10x6x3/8	0.349	5/16	0.203	272,900	36.0	0.0	245,015	Full + Gusset	0.250	4/16	0.177	4.69
Vertical	10x10x1/2	0.465	6/16	0.285	205,700	40.0	0.0	382,516	Full		6/16	0.285	N/A

Gussets to be used on truss diagonals for the first 5 panels, each end 20 diagonals total.

Target Member

Chord	14x14x3/4	0.698

Floor Bracing Welds		Member Thickness (in)	Nominal Weld Size (in)	Effective Fillet Throat Thickness (in)	Induced Axial Force (lbf)	Available Fillet Weld Length (in)	Available Groove Weld Length (in)	Weld Resistance (lbf)	Weld Type	Gussets: Gusset Thickness (in)	Gussets: Nominal Weld Size (in)	Gussets: Effective Throat Thickness (in)	Gussets: Required Gusset Fillet Weld Length (in)
Floor Diagonal	4x4x1/4	0.233	4/16	0.177	113,800	20.2	0.0	119,946	Full		4/16	0.165	N/A
Floor Bracing Welds (Fatigue I)		Member Thickness (in)	Nominal Weld Size (in)	Effective Fillet Throat Thickness (in)	Induced Axial Force (lbf)	Available Fillet Weld Length (in)	Available Groove Weld Length (in)	Weld Resistance (lbf)	Weld Type	Gussets: Gusset Thickness (in)	Gussets: Nominal Weld Size (in)	Gussets: Effective Throat Thickness (in)	Gussets: Required Gusset Fillet Weld Length (in)
Floor Diagonal	4x4x1/4	0.233	4/16	0.165	9,075	20.2	0.0	33,271	Full		4/16	0.165	N/A

Target Member

Floor Beams	W12x58	0.360

Floor Beam Welds		Member Thickness (in)	Nominal Weld Size (in)	Effective Fillet Throat Thickness (in)	Induced Axial Force (lbf)	Available Fillet Weld Length (in)	Available Groove Weld Length (in)	Weld Resistance (lbf)	Weld Type	Gussets: Gusset Thickness (in)	Gussets: Nominal Weld Size (in)	Gussets: Effective Throat Thickness (in)	Gussets: Required Gusset Fillet Weld Length (in)
Floor Beam	W12x58	0.360	5/16	0.210	75,540	60.2	0.0	425,508	Full		5/16	0.210	N/A
Floor Beam Welds (Fatigue I)		Member Thickness (in)	Nominal Weld Size (in)	Effective Fillet Throat Thickness (in)	Induced Axial Force (lbf)	Available Fillet Weld Length (in)	Available Groove Weld Length (in)	Weld Resistance (lbf)	Weld Type	Gussets: Gusset Thickness (in)	Gussets: Nominal Weld Size (in)	Gussets: Effective Throat Thickness (in)	Gussets: Required Gusset Fillet Weld Length (in)
Floor Beam	W12x58	0.360	5/16	0.210	4,620	60.2	0.0	126,639	Full		5/16	0.210	N/A

Target Member

Truss Vertical	10x10x1/2	0.465

Floor Beam Welds		Member Thickness (in)	Nominal Weld Size (in)	Max Induced Moment (lb-in)	Section Modulus of Weld Group (in^3)	Induced Weld Stress (psi)	Weld Type
Floor Beam	W12x58	0.360	5/16	1,571,000	80.9	19,421	OK
Floor Beam Welds (Fatigue I)		Member Thickness (in)	Nominal Weld Size (in)	Max Induced Moment (lb-in)	Section Modulus of Weld Group (in^3)	Induced Weld Stress (psi)	Weld Type
Floor Beam	W12x58	0.360	5/16	108,800	80.9	1,345	OK

Target Member

Truss Vertical	10x10x1/2	0.465

Reactions for Abutment Design

Anchor Locations (Qty)	4
Total Height (ft)	11.17
Outside Truss Width (ft)	14.33
Total Length (ft)	240.00
Coefficient of Expansion (1/F)	6.50E-06
Design Temperature Range	120

	Unfactored Loads (lbf)	
Dead Load (DL)	397,367	*Includes Weight of Concrete Deck
Vehicle Load (VL)	20,000	
Snow Load (SL)	0	
Live Load (LL)	259,200	
Wind Load (WL)	202,246	
Overturning Wind (OW)	68,800	
Seismic Load (E)	334,185	

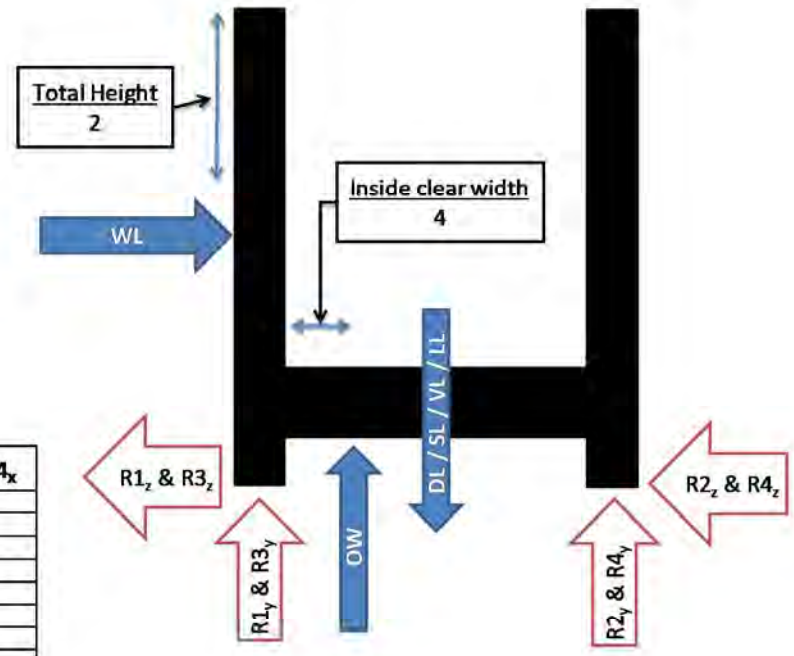
Minimum Expansion Range (in)	2.25

	$R1_zR3_z$	$R1_yR3_y$	$R1_xR3_x$	$R2_zR4_z$	$R2_yR4_y$	$R2_xR4_x$
DL	—	-99,342	—	—	-99,342	—
VL *	—	-10,000	—	—	-10,000	—
LL	—	-64,800	—	—	-64,800	—
WL	50,562	39,391	—	50,562	-39,391	—
OW	—	25,800	—	—	8,600	—
E	83,546	65,088	—	83,546	-65,088	—
1.2*DL + 1.6*LL (ACI 318-14, 5.3.1b)	—	-222,890	—	—	-222,890	—
1.2*DL + 1.0*WL + 1.0*LL (ACI 318-14, 5.3.1d)	50,562	-144,619	—	50,562	-223,401	—
1.2*DL + 1.0*E + 1.0*LL (ACI 318-14, 5.3.1e)	83,546	-118,922	83,546	83,546	-249,098	83,546
0.9*DL + 1.0*WL (ACI 318-14, 5.3.1f)	50,562	-50,017	—	50,562	-128,799	—
0.9*DL + 1.0*E (ACI 318-14, 5.3.1g)	83,546	-24,319	83,546	83,546	-154,496	83,546
Expansion/Contraction	—	—	19,868	—	—	19,868

Positive Y values represent uplift

Assume even distribution across all anchor locations

*Assumes vehicle load acting on 2 anchor locations



DESIGN CRITERIA (Deck-as-a-Form):

(SDI C-2017 Standard, 2.4.A)

Geometry and Induced Loads:

Dead Load, w_{dl} (psf) = 63.4

Uniform Construction Live Load, w_{ll} (psf) = 20

Ponding Allowance (psf) = 4

Concentrated Construction Live Load, P (lbs) = 150

Span, L (ft) = 10

Slab Depth, h (in) = 6

Material Properties, B-Deck:

Modulus of Elasticity, E (ksi) = 29,500

Yield Stress, F_y (ksi) = 50

Deck Pan Guage 18ga

Deck Pan Depth, d_d (in) = 2

Effective Section Modulus, S_{eff} (in^3/ft) = 0.471

Moment of Inertia, I_d (in^4/ft) = 0.564

ASD Allowable Moment:

$$M_n \text{ (ft-lb)} = \frac{F_y}{\Omega_b} * S_{eff} = 1{,}175.1$$

Ω_b = 1.67

Induced Moments (single span):

$$M \text{ (ft-lb)} = \frac{w_{dl}*L^2}{8} + \frac{P*L}{4} = 1{,}167.5 \quad \textbf{OK}$$

$$M \text{ (ft-lb)} = \frac{(w_{dl}+w_{ll})}{8} * L^2 = 1{,}092.5 \quad \textbf{OK}$$

Allowable Deflection:

$$\Delta \text{ (in)} = \frac{L}{1000} = 0.12$$

Induced Deflection (single span):

$$\Delta \text{ (in)} = \frac{5}{384} * \frac{w_{dl}*L^2}{E*I} = 0.0091 \quad \textbf{OK}$$

Effective Wheel Load Area, Concentrated Loads:

(SDI C-2017 Standard, 2.4.B.11)

$b_e = b_m + 2*(1-x/L)*x$ = **88** *Effective Width of Concentrated Load (in)

$W = L/2 + b_3$ = **70** *Effective Length of Concentrated Load (in)

$b_m = b_2 + 2*t_c + 2*t_t$ = 28

L (in) =	120	*deck span length
x (in) =	60	*midspan distance (center of concentrated load)
b_2 (in) =	20	*per AASHTO LRFD, 3.6.1.2.5
b_3 (in) =	10	*per AASHTO LRFD, 3.6.1.2.5
t_c (in) =	4	*thickness of concrete above steel deck
t_t (in) =	0	*thickness of rigid topping above concrete

Induced Loads:

Total Vehicle Load (lbs)	20000
Wheel Spacing (ft)	14.0
Front Axle Load - 20% (lbs)	4000
Rear Axle Load - 80% (lbs)	16000
Max Wheel Load (lbs)	8000
Effective Wheel Load Area (ft^2)	42.8
Induced Wheel Load (psf)	187.0

DESIGN CRITERIA (Composite):

(SDI C-2017 Standard, 2.4.B)

Geometry and Induced Loads:

Dead Load, w_{dl} (psf) = 63.4

Uniform Live Load, w_{ll} (psf) = 187.013

Concentrated Live Load, P (lbs) = 1000

Span, L (ft) = 10

Material & Section Properties, B-Deck:

Modulus of Elasticity, E (ksi) = 29,500

Yield Stress, F_y (ksi) = 50

Deck Pan Guage 18ga

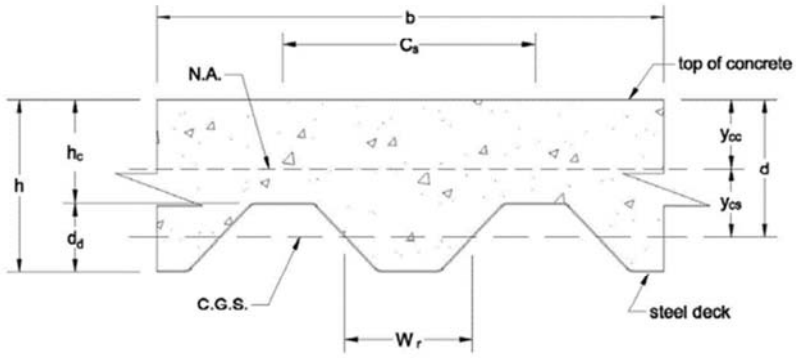
Deck Pan Depth, d_d (in) = 2

Moment of Inertia, I_{sf} (in^4/ft) = 0.564

Area of Steel Deck per Unit Slab Width, A_s (in^2) = 0.792254

Pitch, C_s (in) = 12

Average Rib Width, W_r (in) = 6



Cracked Composite Neutral Axis Distance, y_{cc} (in) = 1.87

Cracked Composite Neutral Axis Distance, y_{cs} (in) = 3.13

Cracked Section Moment of Inertia, I_{cr} (in^4/ft) = 11.422

Cracked Section Modulus, S_{cr} (in^3/ft) = 2.765

A_s/bd, ρ = 0.013

Unit Slab Width, b (in) = 12

Centroidal Axis of Steel Deck from Top, d (in) = 5

Modular Ratio, n = 8.45

Cracked Modulus of Elasticity, E_c (ksi)= 3,492.1

Uncracked Composite Neutral Axis Distance, y_{cc} = 2.84

Uncracked Composite Neutral Axis Distance, y_{cs} = 2.16

Uncracked Section Moment of Inertia, I_u (in^4/ft) = 22.947

Material Properties, Concrete:

Slab Depth, h (in) = 6

Concrete density, γ (pcf) = 145

Concrete Strength, f'_c (ksi) = 4

Composite Moment of Inertia, I_d (in^4/ft) = 17.184

SDI Resisting Moment:

$$M_n \text{ (ft-lb)} = \frac{F_y}{\Omega_b} * S_{cr} = 6{,}898.3$$

Ω_b = 1.67

Induced Moments:

$$M_{wa} \text{ (ft-lb)} = \frac{12}{15} * \frac{P_w * b_e}{W} = 670.5 \quad \textbf{OK}$$

$$M \text{ (ft-lb)} = \frac{w_{dl} * L^2}{8} + \frac{P * L}{4} = 3{,}292.5 \quad \textbf{OK}$$

$$M \text{ (ft-lb)} = \frac{(w_{dl} + w_{ll})}{8} * L^2 = 3{,}130.2 \quad \textbf{OK}$$

Allowable Deflection:

$$\Delta \text{ (in)} = \frac{L}{1000} = 0.12$$

Induced Deflection:

$$\Delta \text{ (in)} = \frac{5}{384} * \frac{w_{dl} * L^3}{E * I_d} = 0.0003 \quad \textbf{OK}$$

Concrete Strength Design

Calculated Loads:

Wheel Live Load	187.0	psf
Factored Uniform Load (Ped.)	220.1	psf
Factored Uniform Load (Vehicle)	375.3	psf

Max Moments and Shear Forces

Pedestrian		
Max Moment	2.45	kip*ft
Max Shear	1.27	kips
Vehicle		
Max + Moment	3.80	kip*ft
Max - Moment	1.88	kip*ft
Max Shear	2.06	kips

Vehicle Load Controls

As	0.38	in

CONCRETE SLAB (ACI 318)

DESCRIPTION: 4in. Reinforced Slab above 2in. Composite-Deck

FLEXURE & SHEAR INPUT:

f'c	= 4	ksi
fy	= 60	ksi
b	= 12	"
d	= 2.5	"
Mu	= 3.80	kip-ft
Vu	= 2.06	kip

Lt wt conc factor (λ):
(NW=1, LW=.75) = 1.00

CRACK CONTROL INPUT:

Ma	= 2.54	kip-ft
Clr cover	= 2.25	in

TORSION & DEFLECTION INPUT:

Tu	= 0	kip-ft
h	= 4	"

NEGLECT TORSION
Dist to CL Tie = 0 "

BENDING

As	= 0.38	in2	p=	0.01269
As(min) =	0.10	in2	p=	0.00333
As(max) =	0.62	in2	p max=	0.02064

SHEAR

ϕVc	= 2.85	k	Av/s	= 0.00 in2
Vs(req'd)=	0.00	k	Av/s(min)=	0.01 in2

TORSION

Tcr	= 1.14	'k
At/s	= 0.00	in2
Av+2At/s =	0.00	in2
Av+2At(m)=	0.01	in2
Al/4	= 0.00	in2 (Torsion steel all 4 faces)
Total As	= 0.38	in2 (As plus Al/4)

BEAM REINFORCING

FLEXURAL REINFORCING

# of bars	As	
2 #4	0.39 in2	
2 #5	0.61 in2	
1 #6	0.44 in2	
1 #7	0.60 in2	
1 #8	0.79 in2	**
1 #9	1.00 in2	**
1 #10	1.27 in2	**
1 #11	1.56 in2	**

Max Rebar Spacing for crack control = 11.03 in

STIRRUPS

Size	2 legs	4 legs
#3 @	1.2 in	1.2 in
#4 @	1.2 in	1.2 in
#5 @	1.2 in	1.2 in
#6 @	1.2 in	1.2 in

**TOO MUCH STEEL - tensile strain exceeds 0.004.
ADD COMPRESSION STEEL OR INCREASE DEPTH.

LONGITUDINAL TORSION

SLAB REINFORCING

Spacing	As
#3 @ 3.5	0.38 in2
#4 @ 6.2	0.38 in2
#5 @ 9.7	0.38 in2
#6 @ 13.9	0.38 in2
#7 @ 18.9	0.38 in2
#8 @ 24.7	0.38 in2

Max Rebar Spacing for crack control = 11.03 in

ϕVc = 2.85 k
SHEAR : OK

DEFLECTION COEFFICIENTS

Actual As	= 0.38	in2
Conc wt	= 150	pcf
Ma	= 2.5	'k
Mcr	= 1.3	'k
Ig	= 64.0	in4
Icr	= 10.3	in4

Ec = 3834 ksi
Ie = 17 in4

AMERICAN INSTITUTE OF STEEL CONSTRUCTION

CERTIFICATION PROGRAMS

PROUDLY RECOGNIZE THAT

Bridge Brothers Inc.

2019-4-11-000501F

MAINTAINS OPERATIONS LOCATED AT

225 Pumpkin Town Hwy, Bldg 19
Pickens, SC 29671 United States

THAT SUCCESSFULLY MEET THE QUALITY CERTIFICATION REQUIREMENTS FOR

Bridge Fabricator - Intermediate

Fracture Control Endorsement

Complex Coating Endorsement 1 - Enclosed

CERTIFICATION NUMBER	C-00027267
ISSUED	July 1, 2025
VALID THROUGH	August 31, 2026

PRESIDENT

American Welding Society

Certifies that

Bridge Brothers Inc.

has complied with the requirements of the AWS B5.17 and QC17 Standards for the Qualification and Certification of AWS Welding Fabricators.

240801F
Certificate Number

August 1, 2025
Expiration Date

AWS President

Chair, Certification Programs

AWS CWF
CERTIFIED WELDING FABRICATOR®

BRIDGE BROTHERS

225 Pumpkintown Hwy, Pickens, SC 29671

Quality Manual

Revision & Approval Date: 05/29/2024

Manual Approval: Elias Angell

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Quality Policy

We are committed to fabricating quality products and to meeting all contract requirements. The quality management system has been established with the following goal, which shall be communicated throughout the company and reviewed accordingly.

1. Goal: Reduce drawing errors found by the customer to one or less per month for a period of one year.

The level of achievement of this goal will be measured & documented on a consistent basis, then evaluated during the annual Periodic Management Review. A new goal shall be set to demonstrate commitment to continuous improvement as the quality goal is achieved.

Periodic Management Review

Purpose:

This procedure is to ensure the quality management system is reviewed annually by executive management.

Responsibility: Management Representative for Quality

Procedure:
The following items are to be reviewed and assessed by executive management.

Quality Goal Review and Evaluation.

A summary of previous management reviews.

Results of any internal and external audits conducted since the previous management review.

An assessment of customer feedback and feedback mechanisms, identifying opportunities for improving quality.

An assessment of product or work non conformances. Both the number and severity of non conformances shall be assessed.

An assessment of process non conformances, including compliance with the documented procedures comprising the quality management systems.

An assessment of the effectiveness of the corrective actions taken.

An assessment of the results of equipment inspections, including the adequacy of equipment resources.

An assessment of the adequacy of the training program with respect to the levels of qualification required as appropriate.

An assessment of any proposed or required modifications to the quality management system.

Record the decisions and actions required for implementation of:

- Improvement of the effectiveness of the quality management system and its processes
- Improvement of product quality
- Resource needs

Records: Periodic Management Review Record

Control of the Quality Manual

Purpose:

This procedure provides for control of the quality manual and procedures.

Responsibility: Management Representative for Quality

Procedure:

- The quality manual shall be reviewed annually by the Management Representative for Quality and approved by the highest ranking individual responsible for the facility.
- Any changes shall be recorded on the Quality Manual Revision Record on the last page of this Quality Manual, along with a brief summary of the change.
- QC Manual revisions shall be underlined.
- A new revision date shall be placed on the cover of the manual.
- Obsolete manuals will be collected and destroyed or marked void.

Access

Documents shall be available and readily accessible to all personnel responsible for performing functions affecting the quality of the completed work.

Communication

Changes and revisions shall be clearly communicated to all personnel responsible for performing functions affecting the quality of the completed work.

Records: Quality Manual Change Record

Construction Document Review and Communication

Purpose:

This procedure requires the review of the contract documents and referenced standards to ensure awareness of the contract requirements.

Responsibility: Project Manager

Procedure:

Each project shall be reviewed.

The review shall begin at the acceptance of responsibility for performing the work.

When the customer furnishes designs and specifications, the project requirements are identified, reviewed, planned and recorded.

Referenced standards shall be reviewed to ensure awareness of the contract requirements.

The review will consider any issue that affects the capability to perform the work.

The review shall consider critical project requirements that, if missed, will have a major impact on project quality.

The job requirements will be distributed to the appropriate departments.

Any revised contract documents that are received through RFI's or directly from the customer, shall be reviewed by the Project Manager.

Records: Project Info Sheet, RFI, Design Changes

Preparation of Shop and Erection Drawings

Purpose:

This procedure is to ensure all project requirements are reviewed and incorporated into shop and erection drawings.

Responsibility: Detailing Manager

Procedure:

All customer requirements and specifications shall be reviewed in accordance with the Construction Document Review and Communication procedure.

Drawings shall be prepared by the in-house engineer and draftsman.

Drawings shall incorporate all customer requirements, specifications, codes, and relevant standards to adequately procure materials, fabricate the structure, and erect the Structure.

Design shall be recorded when they are received from the customer.

All drawings that are produced in-house shall be recorded.

When revisions to drawings are made, the revisions shall be distributed to the appropriate personnel and obsolete drawings shall be collected and marked void or destroyed.

RFI emails are used to track information with the customer.

Records: Designs, Design Changes, Drawings, RFIs

Checking of Shop and Erection Drawings

Purpose:

This procedure is to ensure shop and erection drawings are compliant with contract documents.

Responsibility: Detailing Manager

Procedure:

- All shop drawings shall be checked and initialed in the "checked by" box. The drafter checking the drawing shall not be the same one who produced the drawing.

- A Checker shall perform a detailed review of all sketches and dimensions on Shop Drawings, digital Manufacturing Models, and Erection Drawings and compare them to the following project requirements:
    - Geometry
    - Use of the correct connections
    - Proper notes
    - Proper material usage
    - Assignment of complete welding symbols
    - Proper coatings and preparation
    - Proper representation on Erection Drawings including the notation of any necessary instructions and depiction of details necessary to conduct the work in the field

Computer-Generated Drawings

- The accuracy of input shall be verified prior to the spot checking of random dimensions of computer-generated drawings to verify software accuracy.

Subcontract Details

- Detailing management shall review the checked by box of drawings received from subcontracted detailers to verify the drawings were checked by a qualified checker.

- The title box shall be checked for compliance with the company's detailing standard.

Owner Approval

- All shop and erection drawings shall be sent to the Owner's Designated Representative(s) for Design and Construction for approval before release for fabrication. The Owner's Designated Representative(s) for Design and Construction shall stamp or sign the drawings as "approved" or "approved as noted".

Records: Checked Drawing, Owner Approval

Procedure For Shop Drawings Supplied by Others

Purpose:

This procedure is to ensure receipt, revision and control of shop drawings supplied by others.

Responsibility: Detailing Manager

Procedure:

All shop drawings & revisions to shop drawings, which are received from others shall be recorded.

The revisions shall be distributed to the appropriate personnel and obsolete drawings shall be collected and marked obsolete or destroyed.

The fabrication facility shall neither be responsible for the completeness or accuracy of shop and erection drawings furnished by the customer, nor for the general fit-up of the members that are fabricated from them.

If there are issues with completeness or general fit-up, the Owner's Designated Representative(s) for Design and Construction shall be issued an RFI.

Records: Drawings, RFIs

Laydown, Assembly & Matchmarking

Purpose:

To ensure sections can be re-assembled in the field in the same manner as they were in the shop.

Responsibility:

Detailing Manager & Fabrication Foreman

Procedure:

- Structural steel members that are too large or too heavy to ship in one section shall be shipped in smaller sections (knocked down).

Provisions for control of accuracy of drilling and reaming of field connections

- Prior to shipment, these smaller sections shall be assembled in the shop for fitting or reaming of field connections.

Documented procedures, including reference drawings, for match-marking shop-assembled pieces

- Each field splice is matchmarked while assembled so that the sections can be reassembled in the field in the same manner as they were in the shop.
- Match-marking will have a numerical or alphabetical mark for field bolted connections, and linear mark with numerical or alphabetical identification for field welded connection.
- Marks may be welded or stamped with low-stress dies.
- On the appropriate erection drawing the steel detailer shall draw a diagram of the entire member, noting thereon the location of each splice and its matchmark identification.
- To assist the erector a brief note shall accompany the diagram to explain the system.
- A standard location of the welded or stamped mark shall be established for each job so the erector can minimize the time spent looking for the mark.

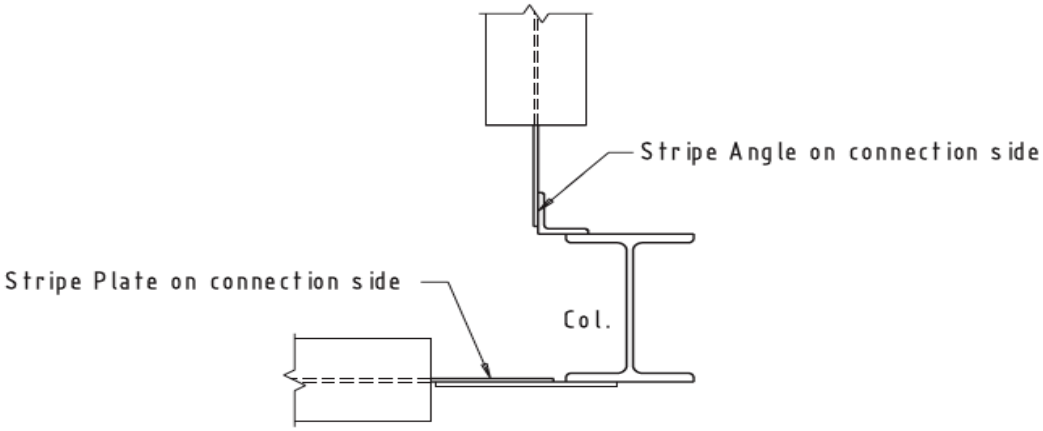
Provisions for assuring the accuracy of numerically controlled equipment, if contract documents permit the use of such equipment in lieu of physical assembly

- No numerically controlled equipment shall be used.

Provisions for control of assembled dimensions for both vertical and horizontal geometry

- Overall vertical and horizontal dimensions shall be maintained in accordance with the drawings during assembly.

Records:
Drawings



Control of Management System Documents and Project Documents

Purpose: This procedure is to control all management system documents and all project documents.

Responsibility: Management Representative for Quality

Management System Documents

Review and Approval

All documents affecting quality, all revisions to the Quality Manual and other quality management system documents shall be reviewed for adequacy by the Management Representative for Quality and approved by the same function and level that authorized the original document.

All documents affecting quality will be reviewed annually when completing an internal audit.

Revision Control

Revisions to the quality manual will be maintained in accordance with Control of the Quality Manual procedure.

The revision shall be clearly identifiable on all documents and data.

The Management Representative for Quality shall monitor and identify the latest revision and that changes are identified from the previous revision with revision dates or numbers.

Revisions shall be reviewed for adequacy and approved by the same function and authority level that authorized the original document.

Access

Access to the quality manual will be in accordance with the Control of the Quality Manual procedure.

Documents shall be available and readily accessible to all personnel responsible for performing functions affecting the quality of the completed work.

Communication

Changes and revisions shall be clearly communicated to all personnel responsible for performing for inspecting or overseeing the work prior to releasing the product to the floor for fabrication, in response to quality hold, non-Conformance or other Quality Control determined resolution as defined in this Manual.

Project Documents

Tracking

Contract documents, revised contract documents, change orders, RFI's, owner requirements and general contractor requirements, are received, recorded and tracked.

Tracking information shall indicate as applicable:

- Date of receipt
- Summary of issue
- Ultimate disposition of the change
- Distribution of the final decision to the appropriate parties

Record shall show as applicable:

- receipt of change data
- incorporation
- issue
- distribution of approved and revised approval documents to:
  - all necessary departments and personnel at the facility and
  - necessary external organizations
  - subcontractors or suppliers.

Revision Control

The revision shall be clearly identifiable on all documents and data. All drawing revisions shall be clouded. QC Manual revisions shall be underlined.

The Management Representative for Quality shall monitor and identify the location, latest revision and that changes are identified from the previous revision with revision dates or numbers.

Obsolete documents will be collected and destroyed or marked void to prevent use.

Documents shall remain legible and easily identifiable.

Access

Documents shall be available and readily accessible to all personnel responsible for performing functions affecting the quality of the completed work.

Communication

Changes and revisions shall be clearly communicated to all personnel responsible for performing functions affecting the quality of the completed work.

Records: Contract documents, revised contract documents, change orders, RFI's, owner requirements and general contractor requirements

Control of Quality Records

Purpose:

This procedure establishes the requirements for the identification, collection, storage, maintenance, retention and disposition of quality records.

Responsibility: Management Representative for Quality

Retention:

- Records shall be retained for a minimum period of 7 year after contract completion, unless the contract requires retention for a longer period of time.

- At the end of the retention period, records may be stored electronically indefinitely.

Storage:

- Quality records shall be stored and retained in a way that enables retrieval and provides a suitable environment to prevent damage, deterioration or loss.

- All quality records shall be collected by the QC Inspector or designee, stored and maintained in the job file or office file.

Retrieval:

- Quality records (NDE Results, QC Traveler, Revised Drawing) shall be accessible in a reasonable time frame.
- FLDOT: Documents will be turned over within 48 hrs. or hold point will be implemented to hold material to allow for verification. Any process which hinders verification will be returned to a condition that is amenable to inspection.
- Quality records (MTRs, WPS, NDE procedures) shall be accessible to a third-party, prior to fabrication or otherwise incorporated into a project. This includes cutting material, fit up, welding, and bolting.

Records:

The following records are controlled by this procedure:

Certificates of conformance
Corrective action requests
Drawing logs
Equipment maintenance records
Inspection records
Internal and external quality management system audits
Mill and consumable purchase orders
MTRs
NDT reports
Coating Application reports

Records cont'd:

- Personnel certifications
- Records or summaries of nonconformance reports
- Revisions to the contract documents
- RFIs and related documentation
- Subcontractor and supplier evaluations
- Training records
- Calibration records
- Project Info Sheet

Purchasing

Purpose:

This procedure is to ensure that subcontractors, purchased products, materials, and services conform to project requirements.

Responsibility: Purchasing Manager

Procedure:

Purchase documents will clearly describe all subcontracted work, purchased product, materials and services required by the project.

Purchase documents will include the following information:

- The type of service, material, class, grade and other unique identification.
- The applicable specifications, drawings, process requirements, inspection instructions and any witness points.
- Delivery instructions and date
- Certificate of Compliance/Conformance, mill test reports and/or NDT reports required.

Records: Purchase Documents, MTRs, CofCs

Verification of Purchased Product, Materials, and Services

Purpose:

This procedure is to ensure purchased product, materials and services conform to project requirements.

Responsibility: Management Representative for Quality

Procedure:

All purchased products and materials, which are received, shall be compared to purchase order requirements.

The Receiving Inspection procedure shall be followed. All documentation shall be provided for review prior to shipment.

Services

All services acquired to meet project requirements shall be verified as follows:

Galvanizing

A certificate of compliance shall be required from the galvanizer with the shipment.

Coating & Surface Preparation

A certificate of compliance shall be required from the painter with the shipment.

Fabrication

A certificate of compliance shall be required from the fabricator with the shipment.

Engineering Services

Verification of services shall be by the Professional Engineer's signature and/or stamp.

Records: MTR's, CofC's

Evaluation of Subcontractors & Suppliers

Purpose:

This procedure is to ensure subcontractors & suppliers conform to the subcontract requirements, the requirements of the Quality Management System, the requirements of the AISC Standard, project requirements, and any specific inspection requirements.

Responsibility: Purchasing Manager

Procedure:

Initial Evaluation

New subcontractors & suppliers shall be evaluated through references and/or possible phone audit before being added to the Subcontractors & Suppliers Qualification Record.

Ongoing Evaluations

Current subcontractors & suppliers shall be evaluated based on the following criteria:

- Their past performance for the quality of finished product
- Timely, proper delivery
- Ability to meet the subcontract requirements, project requirements & specific inspection requirements.

The performance of all subcontractors & suppliers shall be graded on an A-F scale.

Ongoing evaluations shall be recorded annually at a minimum.

Resumes of subcontract detailers and checkers shall be included in the evaluation and kept on file.

The evaluations shall be recorded on the Subcontractors & Suppliers Qualification Record.

Subcontractor Qualifications

Any subcontractor shall have a current AISC Certification for the type of work that is being subcontracted when required by contract unless written permission is given by the owner, the owner's designated representative for design, or the owner's designated representative for construction. In the event that a qualified subcontractor cannot be found, this will be communicated to the previously stated party(ies) for their approval before proceeding.

Records: Subcontractors & Suppliers Qualification Record

Material Identification and Traceability

Purpose:

This procedure is to ensure material is identified in accordance with the Code of Standard Practice.

Responsibility: Fabrication Foreman

Procedure:

Material Purchased For Job

- All material ordered for a job shall be marked with Job # on the material when the material is received.

Fully Traceable Material (Refer to COSP 6.1.1 (c))

- Material ordered in accordance with an ASTM supplement or other special material requirements in the Contract Documents, shall be tagged or marked with shape designation, size, material grade and heat #.

Assembly of Fully Traceable Material (Refer to COSP 6.1.2 (c))

- From the point of receipt and during the course of manufacture, materials shall maintain traceability to corresponding MTRs maintained when specifically required by contract.

- During fabrication, up to the point of assembling members, each piece of material that is ordered to special material requirements shall be traceable to the Heat # via the piecemark.

- The MTR shall be available prior to the start of fabrication for the owner's designated representative for construction, the building-code authority and the inspector.

Drop Material

- Material drops are scrapped or for miscellaneous use only.

Uncontrolled Material

- Unidentified material or material that is not marked as stated above is for miscellaneous use only.

Welding Consumables

- Welding consumables shall be identified by the appropriate ANSI/AWS specification.

Metallic Coatings

- Metallic coatings for components shall be identified by composition and the appropriate ASTM specification, including hot dip or mechanical galvanizing and metalizing.

Fasteners

- Fasteners for components shall be stored in containers clearly identified by type, grade, size and lot number.

Coating Materials

- Coating materials (excluding metallic coating) shall be identified on the container by, at a minimum:
    - color (pigment description and federal standard number, or manufacturer's number)
    - lot/batch number
    - ID/stock number
    - quantity of coating in container
    - date of manufacture
    - date of expiration
    - and manufacturer's name and address

Records: MTRs, CofCs

Control of Customer Furnished Material

Purpose:

This procedure is to ensure customer furnished material is received, marked and stored properly.

Responsibility: Fabrication Foreman

Procedure:

- Material received directly from the customer shall be verified and that it is the material required by the project, and the material meets the requirements of contract documents.
- Material will be marked with job #.
- Customer furnished material shall be protected to prevent use other than its intended purpose.
- Any material that is lost, damaged or unsuitable for use will be reported to the customer in writing.
- Material drops returned to stock will be marked according to the Material Identification procedure.

Records: Bill of Lading

Control of Welding Procedure and Qualification of Welders

Purpose:

This procedure provides for control and issue of WPS and Welder Qualification.

Responsibility: Management Representative for Quality

Procedure:

Welding Procedure Specifications (WPS)

- All welding procedures will be filed in the office with a binder in the shop.
- All WPS will be reviewed and authorized by a competent individual.
- Approved WPSs shall be in close proximity to and used by all welders and tack welders.
- The WPS shall be recorded in accordance with AWS D1.1 or applicable code.

Procedure Qualification Records (PQR)

- Whenever possible a prequalified WPS shall be used.
- If a PQR is required the testing shall be outsourced to a qualified testing firm.

Welder Performance Qualification Records (WPQR)

- Welders shall be initially qualified in accordance to AWS D1.1 or applicable code.
- At a maximum interval of six months, the continuity record for each qualified welder shall be updated to show they have been welding without a lapse of more than 6 months per welding process and satisfactory performance has been consistently achieved.
- The WPQR shall be recorded in accordance with AWS D1.1 or applicable code.

Records: WPS, PQR, WPQR, Continuity Log

Welding Process & Consumable Control

Purpose: To control the welding process & consumables.

Responsibility: Fabrication Foreman

Welding Process Control

- Only FCAW and GMAW welding processes on Group II steel shall be used in the shop. (Reference AWS D1.1 Table 5.8 below.)
- If other material is required by the project, a revised WPS shall be written.
- All welding processes shall comply with a written Welding Procedure Specification (WPS) meeting all of the requirements of AWS D1.1 or applicable code.
- WPS shall be in close proximity and used by all welders and tack welders.
- Preheats shall be as follows:
    - 1/8" to ¾" = 32° F to 50° F - When Below 50° F, preheat to 50° F
    - over ¾" to 1-1/2" = 50° F
    - over 1 ½" thru 2 ½" = 150° F
    - over 2 ½" = 225° F
- Welders shall be identified by noting the Weld Map with the welder's initials.
- **AWS D1.1 Table 5.3 Group II Steel Specifications**

ASTM A36	All thicknesses
ASTM A131	Grades AH32, DH32, EH32 Grades AH36, DH36, EH36
ASTM A501	Grade B
ASTM A516	Grade 65 Grade 70
ASTM A529	Grade 50 Grade 55
ASTM A537 Class 1	≤ 2 ½ in [≤ 65 mm] > 2 ½ [65 mm] ≤ 4 in [100 mm]
ASTM A572	Grade 42 Grade 50 Grade 55
ASTM A588[b]	≤ 4 in [100 mm] > 4 in [100 mm] ≤ 5 in [125 mm] > 5 in [125 mm] ≤ 8 in [200 mm] All Shapes
ASTM A595	Grade A Grades B and C
ASTM A606[b]	Cold-rolled Grade 45 Hot-rolled Grade 50 (AR) Hot-rolled Grade 50 (A or N)
ASTM A618	Grades Ib, II wall ≤ ¾ in [19 mm] Grades Ib, II wall > ¾ in ≤ 1-1/2 in [> 19 mm ≤ 38 mm] Grade III
ASTM A633	Grade A Grades C, D ≥ 2-1/2 in [65 mm]
ASTM A709	Grade 36 Plates ≤ 4 in [100 mm] Grade 36 Shapes ≤ 3 in [75 mm] Grade 36 Shapes > 3 in [75 mm] Grade 50 Grade 50W[b] Grade 50S Grade HPS 50W[b]
ASTM A710	Grade A, Class 2 > 2 in ≤ 4 in [> 50 mm ≤ 100 mm] > 4 in [100 mm]
ASTM A847	
ASTM A913	Grade 50
ASTM A992	
ASTM A1008 HSLAS	Grade 45 Class 1 Grade 45 Class 2 Grade 50 Class 1 Grade 50 Class 2 Grade 55 Class 1 Grade 55 Class 2
ASTM A1008 HSLAS-F	Grade 50
ASTM A1011 HSLAS	Grade 45 Class 1 Grade 45 Class 2 Grade 50 Class 1 Grade 50 Class 2 Grade 55 Class 1 Grade 55 Class 2
ASTM A1011 HSLAS-F	Grade 50
ASTM A1011 SS	Grade 50 Grade 55
ASTM A1018 HSLAS	Grade 45 Class 1 Grade 45 Class 2 Grade 50 Class 1 Grade 50 Class 2 Grade 55 Class 1 Grade 55 Class 2
ASTM A1018 HSLAS-F	Grade 50
ASTM A1066	Grade 50
ASTM A1085	
API 2H	Grade 42 Grade 50
API 2MT1	Grade 50
API 2W	Grade 42 Grade 50 Grade 50T
API 2Y	Grade 42 Grade 50 Grade 50T
API 5L	Grade X52
ABS	Grades AH32, DH32, EH32 Grades AH36, DH36, EH36[b]

Consumable Control
FCAW & GMAW

- All weld wire is to be stored in closed boxes or bags when not in use.

SMAW

- Under no condition shall SMAW rod be used for a job in the shop. It is strictly for maintenance. AWS D1.5 Clause 9.5.5 state studs may be welded by SMAW in lieu of an automatically timed stud welding machine that we currently don't have. Additionally, only SMAW may be used to repair stud welds.

- Low Hydrogen electrodes shall be from 5 lb. cans when ovens are not available in the shop. Excess rod shall be disposed of at the end of the allowable atmospheric exposure time period.

- When larger cans of electrodes are used and ovens are available in the shop, the following shall apply:

AWS D1.1-section 7.3.2.1 Low-Hydrogen Electrode Storage Conditions

- All electrodes having low hydrogen coverings conforming to AWS A5.1 and AWS A5.5 shall be purchased in hermetically sealed containers or shall be baked by the user in conformance with 7.3.2.4 prior to use. After opening the hermetically sealed container, electrodes not immediately issued for use shall be stored in ovens held at a temperature of at least 250°F [120°C]. Electrodes shall be re-baked no more than once. Electrodes that have been wet shall not be used.

AWS D1.1-section 7.3.2.2 Approved Atmospheric Time Periods

- After hermetically sealed containers are opened or after electrodes are removed from baking or storage ovens, the electrode exposure to the atmosphere shall not exceed the values shown in column A, Table 7.1, for the specific electrode classification with optional supplemental designators, where applicable. Electrodes exposed to the atmosphere for periods less than those allowed by column A, Table 7.1 may be returned to a holding oven maintained at 250°F (120°C) min; after a minimum hold period of four hours at 250°F min. the electrodes may be reissued.

AWS D1.1-section 7.3.2.4 Baking Electrodes

- Electrodes exposed to the atmosphere for periods greater than those allowed in Table 7.1 shall be baked as follows:
    - All electrodes having low-hydrogen coverings conforming to AWS A5.1 shall be baked for at least two hours between 500°F and 800°F [260°C and 430°C], or
    - All electrodes having low-hydrogen coverings conforming to AWS A5.5 shall be baked for at least one hour at temperatures between 700°F and 800°F [370°C and 430°C].

All electrodes shall be placed in a suitable oven at a temperature not exceeding one half the final baking temperature for a minimum of one half hour prior to increasing the oven temperature to the final baking temperature. Final baking time shall start after the oven reaches final baking temperature.

Additions for Fracture Critical are found in the following bridge Brothers Inc. SOPs: *SOP 15 Fracture Control Plan, SOP 16 Distortion Control Plan, SOP 17 Weld Repair Procedure, and SOP 18 CAC-A WRP*

Table 7.1
Allowable Atmospheric Exposure of Low-Hydrogen Electrodes
(See 7.3.2.2 and 7.3.2.3)

Electrode	Column A (hours)	Column B (hours)
A5.1		
E70XX	4 max.	
E70XXR	9 max.	Over 4 to 10 max.
E70XXHZR	9 max.	
E7018M	9 max.	
A5.5		
E70XX-X	4 max.	Over 4 to 10 max.
E80XX-X	2 max.	Over 2 to 10 max.
E90XX-X	1 max.	Over 1 to 5 max.
E100XX-X	1/2 max.	Over 1/2 to 4 max.
E110XX-X	1/2 max.	Over 1/2 to 4 max.

Notes:
1. Column A: Electrodes exposed to atmosphere for longer periods than shown shall be baked before use.
2. Column B: Electrodes exposed to atmosphere for longer periods than those established by testing shall be baked before use.
3. Electrodes shall be issued and held in quivers, or other small open containers. Heated containers are not mandatory.
4. The optional supplemental designator, R, designates a low-hydrogen electrode which has been tested for covering moisture content after exposure to a moist environment for 9 hours and has met the maximum level allowed in AWS A5.1/A5.1M, *Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding*.

Equipment Maintenance

Purpose:

This procedure is to establish the requirements to assure that equipment necessary to meet product or work quality and delivery requirements receive regular service and maintenance.

Responsibility: Fabrication Foreman

Procedure:

- Selected equipment necessary to meet product or work quality and delivery requirements will receive regular evaluation and preventative maintenance.

- The below listed equipment is considered necessary to meet product or work quality and delivery requirements and will be maintained as follows:

    - Welding Machines – Quarterly
    - Band saw – Quarterly
    - Forklifts - Quarterly
    - Overhead Cranes – Annually

- The person performing the checks and service shall initial and note what was done on the Equipment Maintenance Record.

Records: Equipment Maintenance Records

Surface Prep and Coating Application

Reference: ***SOP 11 - Sophisticated Coatings***

Purpose: This procedure is to ensure that surface preparation and coating application are in compliance with contract documents.

Responsibility: Fabrication Foreman, Coating Inspector

Procedure:

- Purchasing shall receive and maintain the manufacturer's product information and C of C's for all paint in stock and used on projects.

- The following label information shall be clearly visible on all paint in stock;
    - color (pigment description and federal standard number, or manufacturer's number)
    - lot/batch number
    - ID/stock number
    - quantity of coating in container
    - date of manufacture
    - date of expiration
    - manufacturer's name and address

- Paint shall be stored in protected areas under conditions per manufacturers' recommendations, including temperature.

Surface Preparation:

- Surfaces to be painted shall be prepared in accordance with the coating manufacturer recommendations, product data sheets, and contract documents.

- Open nozzle abrasive blasting and other airborne materials shall be controlled to the degree that the quality of other paint application and/or curing operations are not affected.

- Production shall receive coating manufacturer recommendations, product data sheets and contract requirements for surface preparation and profile from Management. This shall be verified by the Coating Inspector.

Coating Application:

- The application of paint shall be in accordance with the coating manufacturer recommendations, product data sheets, and contract documents.

- The painter and coating inspector shall verify;

    - Manufacturer's required conditions are maintained during application.

  - Painting areas are free of air-blown dust, blast media, or other debris that can be detrimental to the quality of the coating during application.

  - Required areas are masked to protect no-paint areas.

- Production shall receive coating manufacturer recommendations, product data sheets and contract requirements from Management.

- Pertinent piece marks or heat numbers shall be properly transferred as required by contract documents.

- Painted products shall be stored, loaded and prepared for shipment to prevent damage and deterioration.

Paint Inspection

Dry Film Thickness

- No less than 2 pieces per application, shift or project shall be inspected for Dry Film Thickness and recorded.

- Dry film thickness measurements shall be in accordance with SSPC-PA 2, when specified in the contract documents.

- If the required quality is not met for the DFT measurement, the inspection frequency shall be 100% until the Coating Inspector has the confidence that the problem will not reoccur.

DFT gauge accuracy verification

- DFT gauge accuracy verification shall be recorded in accordance with SSPC-PA 2.

Records: Paint Inspection Record, Environmental Conditions Log

Installation of High Strength Bolts

Purpose:

Confirm the suitability of the complete fastener assembly, including lubrication, for pretensioned installation, and confirm the procedure and proper use by the bolting crew of the pretensioning method to be used. Install bolts per the RCSC "Specification for Structural Joints using High Strength Bolts" latest edition. For all FDOT Projects please refer to Section 460-5 of the FDOT specification. (latest edition)

Responsibility: Fabrication Foreman

Storage of Fastener Components

- Fastener components shall be protected from dirt and moisture in closed containers at the site of installation.
- Only as many fastener components as are anticipated to be installed during the work shift shall be taken from protected storage.
- Fastener components that are not incorporated into the work shall be returned to protected storage at the end of the work shift.
- Fastener components shall not be cleaned or modified from the as-delivered condition.
- Fastener components that accumulate rust or dirt shall not be incorporated into the work unless they are requalified as specified in Section 7.
- ASTM F1852 and F2280 twist-off-type tension-control bolt assemblies and alternative-design fasteners that meet the requirements in Section 2.8 shall not be relubricated, except by the *manufacturer*.

Pre-Installation Verification

- Pre-installation verification shall be done at the site of installation and prior to placement of bolting assemblies of lots in the work, a sample of not fewer than three complete bolting assemblies of each combination of diameter, length, grade, and lot to be used in the work. Using bolting assemblies that are representative of the condition of those that will be pretensioned in the work, using ASTM-F436 washers positioned in accordance with Section 6.2; and in accordance with the test procedure in section 7.2.
- If the actual pretension developed in any of the fastener assemblies is less than that specified in table 7.1, the cause(s) shall be determined and resolved before the fastener assemblies are used in the work.

- Cleaning, lubrication and retesting of these fastener assemblies, except ASTM F1852 or F2280 twist-off-type tension-control bolt assemblies, (see Section 2.2) are permitted, provided that all assemblies are treated in the same manner.

- Impact wrenches, if used, shall be of adequate capacity and supplied with sufficient air to perform the required pretensioning of each bolt within approximately 10 seconds for bolts to 1-1/4-in. diameter, and within approximately 15 seconds for larger bolts.

Table 7.1
Minimum Bolt Pretension for Pre-Installation Verification

Nominal Bolt Diameter, d_b, in.	Minimum Bolt Pretension for Pre-Installation Verification, kips	
	Group 120	Group 144 and Group 150
½	13	16
⅝	20	25
¾	29	37
⅞	41	51
1	54	67
1⅛	67	84
1¼	85	107
1⅜	102	127
1½	124	155

Pretensioning

Procedure:

Snug Tight

- All bolt holes shall be aligned to permit insertion of the bolts without undue damage to the threads. Bolts shall be placed in all holes with washers positioned as required in Section 6.1 of the RCSC "Specification for Structural Joints Using High Strength Bolts" latest edition, and nuts threaded to complete the assembly. Compacting the joint to the snug-tight condition shall progress systematically from the most rigid part of the joint. The snug tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the plies into firm contact.

Pretensioned Joints and Slip-Critical Joints

- One of the pre tensioning methods below shall be used, except when alternative-design fasteners that meet the requirements of the RCSC "Specification for Structural Joints Using High Strength Bolts" latest edition, or alternative washer-type indicating devices that meet the requirements of the RCSC "Specification for Structural Joints Using High Strength Bolts" latest edition, are used, in which case, installation instructions provided by the manufacturer and approved by the Engineer of Record shall be followed, which shall also meet the requirements of the RCSC "Specification for Structural Joints Using High Strength Bolts" latest edition.
- When it is impractical to turn the nut, pretensioning by turning the bolt head is permitted while rotation of the nut is prevented, provided that the washer requirements RCSC "Specification for Structural Joints Using High Strength Bolts" latest edition are met.
- The pre-installation verification procedures specified above shall be performed using fastener assemblies that are representative of the condition of those that will be pretensioned in the work.
- Pre-installation testing shall be performed for each fastener assembly lot prior to the use of that assembly lot in the work. The testing shall be done at the start of the work.

Turn-of-Nut

- All bolts shall be installed in accordance with the requirements in Section 8.1, (Snug Tight) of the RCSC "Specification for Structural Joints using High Strength Bolts" latest edition with washers positioned as required in Section 6.2. of the RCSC Specification for Structural Joints Using High Strength Bolts" latest edition. Subsequently, the nut or head rotation specified in Table 8.1 shall be applied to all *fastener assemblies* in the *joint*, progressing systematically from the most rigid part of the *joint* in a manner that will minimize relaxation of previously pretensioned bolts. The part not turned by the wrench shall be prevented from rotating during this operation. Upon completion of the application of the required nut rotation for pre tensioning, it is not permitted to turn the nut in the loosening direction except for the purpose of complete removal of the individual fastener assembly. Such fastener assemblies shall not be reused except as permitted in Section 2.11 of the RCSC Specification for Structural Joints Using High Strength Bolts" latest edition.

Table 8.1
Nut Rotation from Snug-Tight Condition for Turn-of-Nut Method Pretensioning[a,b]

Bolt Length[c]	Disposition of Outer Faces of Bolted Parts		
	Both Faces Normal to Bolt Axis	One Face Normal to Bolt Axis, Other Sloped Not More Than 1:20[d]	Both Faces Sloped Not More Than 1:20 from Normal to Bolt Axis[d]
Not more than $4d_b$	⅓ turn	½ turn	⅔ turn
More than $4d_b$ but not more than $8d_b$	½ turn	⅔ turn	⅚ turn
More than $8d_b$ but not more than $12d_b$	⅔ turn	⅚ turn	1 turn

a Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. For all required nut rotations, the tolerance is plus 60 degrees (⅙ turn) and minus 0 degrees.
b Applicable only to joints in which all material within the *grip* is steel.
c When the bolt length exceeds $12d_b$, the required nut rotation shall be determined by actual testing in a suitable *bolt tension measurement device*; see *turn-of-nut* Commentary.
d Beveled washer not used.

Bolting Inspection

All point numbers refer to the RCSC "Specification for Structural Joints Using High Strength Bolts" latest edition.

Procedure:
Prior to the *start of work*, it shall be ensured that all bolting components to be used in the work meet the following requirements

2.9. Test Reports
Test reports documenting conformance to the applicable specifications for all bolting components and matched bolting assemblies shall be available to the *Engineer of Record* and *Inspector* prior to assembly or erection of structural steel.

2.10. Storage and Lubrication
Bolting components shall be kept in a protected storage at the site of installation. Only as many bolting components as are anticipated to be installed during the work shift shall be taken from *protected storage*. Bolting components that are not incorporated into the work shall be returned to *protected storage* at the end of the work shift. Bolting components shall not be cleaned or modified from the as-delivered condition. Fastener components that accumulate rust or dirt shall not be incorporated into the work unless they are requalified as specified in Section 7. ASTM F1852 and F2280 twist-off-type tension-control bolt assemblies and alternative-design fasteners that meet the requirements in Section 2.8 shall not be relubricated, except by the *manufacturer*.

2.11. Reuse:
ASTM A490 bolts, ASTM F1852 and F2280 twist-off-type tension- control bolt assemblies, and galvanized or Zn/Al Inorganic coated ASTM A325 bolts shall not be reused. When approved by the Engineer of Record, black ASTM A325 bolts are permitted to be reused. Touching up or re-tightening bolts that may have been loosened by the installation of adjacent bolts shall not be considered to be a reuse.

3.1. Connected Plies
Unless otherwise approved by the *Engineer of record*, all connected plies in a joint that are within the grip of the bolt and any materials that are used under the bolt head or nut shall be steel with faying surfaces that are uncoated, coated or galvanized as defined in Section 3.2. Compressible materials shall not be placed within the grip of the bolt. The slope of the surfaces of parts in contact with the bolt head and nut shall be equal to or less than 1:20 with respect to a plane that is normal to the bolt axis.

3.3. Bolt Holes
The nominal dimensions of standard, oversized, short-slotted and long-slotted holes for *high-strength bolts* shall be equal to or less than those shown in Table 3.1. Holes larger than those shown in Table 3.1 are permitted when specified or approved by the Engineer of Record.

Table 3.1
Nominal Bolt Hole Dimensions

Nominal Bolt Diameter, d_b, in.	Nominal Bolt Hole Dimensions[a,b], in.			
	Standard (diameter)	Oversized (diameter)	Short-Slotted (width × length)	Long-Slotted (width × length)
½	9/16	5/8	9/16 × 11/16	9/16 × 1¼
5/8	11/16	13/16	11/16 × 7/8	11/16 × 1 9/16
¾	13/16	15/16	13/16 × 1	13/16 × 1 7/8
7/8	15/16	1 1/16	15/16 × 1 1/8	15/16 × 2 3/16
1	1 1/8	1¼	1 1/8 × 1 5/16	1 1/8 × 2½
≥ 1 1/8	d_b + 1/8	d_b + 5/16	(d_b + 1/8) × (d_b + 3/8)	(d_b + 1/8) × (2.5d_b)

[a] The detailed hole dimension shall not exceed the nominal. The fabricated hole dimension shall not exceed the nominal +1/32 in. Exception: In the width of slotted holes, gouges not more than 1/16 in. deep are permitted.
[b] The slightly conical hole that naturally results from punching operations with properly matched punches and dies is acceptable.

Punched, Drilled or Thermally Cut Bolt Holes
All Punched, Drilled or Thermally cut holes produced by mechanically guided means are permitted in statically loaded joints. Punched, Drilled or Thermally cut holes produced mechanically or free hand shall be permitted in statically loaded joints if approved by the Engineer of Record. For cyclically loaded joints, Punched, Drilled or Thermally cut holes shall be permitted if approved by the Engineer of Record. Indication of cut hole method shall be listed on fabrication prints. Where Punched or Drilled holes are required they must be +/- 1/16" of their detailed location. Where thermally cut holes are permitted, the surface roughness profile of the hole shall not exceed 1,000 microinches as defined in ASME B46.1. Occasional gouges not more than 1/16 in. in depth are permitted.

3.3.1. Standard Holes
Standard holes are permitted to be used in all plies of bolted *joints*.

3.3.2. Oversized Holes
Snug-tightened or pretensioned joints subject to shear or combined shear and tension, oversized holes are not permitted. In such joints subject to tension only, oversized holes are permitted upon approval by the *Engineer of Record. Slip-critical joints,* oversized holes are permitted in any or all plies upon approval by the *Engineer of Record.*

3.3.3. Short-Slotted Holes
When approved by the *Engineer of Record*, short-slotted holes are permitted in one or all plies of *snug-tightened joints* as defined in Section 4.1, and *pretensioned joints* as defined in Section 4.2, provided the applied load is approximately perpendicular (between 80 and 100 degrees) to the axis of the slot. When approved by the *Engineer of Record*, short-slotted holes are permitted in any or all plies of *slip-critical joints* as defined in Section 4.3 without regard for the direction of the applied load.

3.3.4. Long-Slotted Holes

For snug-tightened or pretensioned joints, upon approval by the *Engineer of Record*, long-slotted holes are permitted in only one ply at any individual *faying surface,* provided the applied load is approximately perpendicular (between 80 and 100 degrees) to the axis of the slot. For slip-critical joints, upon approval by the *Engineer of Record,* long-slotted holes are permitted in only one ply at any individual *faying surface,* without regard for the direction of the applied load. Fully inserted finger shims between the *faying surfaces* of load-transmitting elements of bolted *joints* are not considered a long-slotted element of a *joint*; nor are they considered to be a ply at any individual *faying surface*. However, for slip-critical joints, finger shims shall have the same surface preparation as the rest of the plies.

3.4. Burrs

Burrs less than or equal to 1/16 in. in height are permitted to remain on faying surfaces of all joints. Burrs larger than 1/16 in. in height shall be removed or reduced to 1/16 in. or less from the faying surfaces of all joints.

9.1. Snug-Tightened Joints

Prior to the start of work, it shall be verified that all bolting components to be used in the work meet the requirements in Section 2. Subsequently, it shall be verified that all connected plies meet the requirements in Section 3.1 and all bolt holes meet the requirements in Sections 3.3 and 3.4. After the connections have been assembled to the requirements of Section 8.1, it shall be visually verified that the plies of the connected elements have been brought into firm contact and that washers have been used as required in Section 6. No further evidence of conformity is required for snug- tightened joints.

9.2 Pretensioned Joints

For pretensioned joints, the following inspection shall be performed in addition to that required in Section 9.1.

9.2.1 Turn-of-Nut Pretensioning

The inspector shall observe the pre-installation verification testing required above. Verify by routine observation that the snug-tight condition has been achieved in accordance with section 8.1; and verify by routine observation that the bolting crew subsequently rotates the turned element relative to the unturned element by the amount specified in Table 8.1 Alternatively, when bolting assemblies are match-marked after snug-tightening of the joint but prior to pretensioning, visual inspection after pretensioning is permitted in lieu of routine observation. No further evidence of conformity is required. A pretension that is greater than the value specified in Table 5.2 shall not be cause for rejection. A rotation that exceeds the required values, including tolerance, specified in Table 8.1 shall not be cause for rejection.

9.3 Slip-Critical Joints

Prior to assembly, it shall be visually verified that the faying surfaces of slip-critical joints meet the requirements in Section 3.2.2. Subsequently, the inspection required in Section 9.2 shall be performed.

3.2.2 Slip-Critical Joints

The faying surfaces of slip-critical joints, including those of filler plates and finger shims, shall meet the following requirements:

(a) Uncoated Faying Surfaces

Uncoated faying surfaces shall be free of scale (except tight mill scale), coatings, and overspray in areas closers than one bolt diameter but not less than 1 in. from the edge of any hole and in all areas within the bolt pattern or shall be blast cleaned prior to assembly.

(b) Coated Faying Surfaces

Coated faying surfaces shall first be blast cleaned and subsequently coated with a coating that is qualified in accordance with the requirements in Appendix A as a Class A or Class B coating as defined in Section 5.4. Alternatively, when approved by the Engineer of Record, coatings that provide a mean slip coefficient that differs from Class A or Class B are permitted when:

(1) The mean slip coefficient μ is established by testing in accordance with the requirements in Appendix A; and,

(2) The design slip resistance is determined in accordance with Section 5.4 using this coefficient, except that, for design purposes, a value of μ greater than 0.50 shall not be used.

The plies of slip-critical joints with coated faying surfaces shall not be assembled before the coating has fully cured and in case before the minimum time that was used in the qualifying tests or provided in the coating manufacturer's application instructions.

On members coated with non-qualified coatings, the faying surfaces shall be free of coating and overspray (1) in areas closer than one bolt dimeter but not less than 1 in. from the edge of any hole, and (2) in all areas within the bolt pattern.

(c) Galvanized Faying Surfaces

Galvanized faying surfaces shall first be hot dip galvanized in accordance with the requirements of ASTM A123. Power or hand wire brushing is not permitted. Galvanized faying surface is designated as Class A for design.

Records: Pre-Installation Verification Record

Rotational Capacity Testing on ASTM A325 & A490 Bolts

Purpose:

To ensure bolts do not exceed the required maximum torque per AASHTO and contract requirements.

Responsibility: Management Representative for Quality

Equipment Required:

- Calibrated bolt tension measuring device of the size required for the bolts to be tested.
- Calibrated torque wrench and spud wrenches.
- Spacers with holes 1/16 larger than bolt to be tested or nominal diameter washers.
- Steel section to mount the tension calibrator.

Procedure:

- Rotational capacity test shall consist of 2 bolt assemblies.
- Measure the bolt length, the distance from the end of the bolt to the washer face at the bolt head to shank interface.
- Install the bolt in the tension calibrator with the required spacers or washers so that the bolt stick-out is flush with the nut to a maximum of three threads. This will typically provide three to five threads within the grip, the distance between the bolt head and the inside face of the nut. This same stick-out requirement applies during installation.
- Tighten the fastener assembly using a spud wrench to the tensions listed below -0 / +2 kips.

ASTM A325 Bolts

Bolt Dia. (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Initial Tension (kips)	1	2	3	4	5	6	7	9	10

ASTM A490 Bolts

Bolt Dia. (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Initial Tension (kips)	2	2	4	5	6	8	10	12	15

- Match mark the bolt, nut and face plate of the calibrator.

- Using the calibrated torque wrench, tighten the fastener assembly to at least the minimum installation tension listed below and record both the tension and torque.

- Torque shall be read with the nut rotating.

- The torque value from the test shall not exceed T= .25 PD. P= tension in pounds. D= Dia. (in.)/12 = bolt diameter in feet.

ASTM A325 Bolts

Bolt Dia. (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 ½
Tension (kips)	12	19	28	39	51	56	71	85	103

ASTM A490 Bolts

Bolt Dia. (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 ½
Tension (kips)	15	24	35	49	64	80	102	121	148

- Further tighten the bolt to the rotation listed below.

- The rotation is measured from the initial marking in step 4.

ASTM A325 & A490 Bolts

Bolt Length (from step 1)	4X bolt dia. Or less	Greater than 4 dia. But no more than 8 dia.	Greater than 8 bolt dia.
Required Rotation	2/3	1	1 1/6

- Record the tension at the completion of the rotation in Step 6.

- The tension shall equal or exceed 1.15 x the minimum installation tension. The minimum required values are listed in the table below.

ASTM A325 Bolts

Bolt Dia (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 ½
Tension (kips)	14	22	32	45	59	64	82	98	118

ASTM A490 Bolts

Bolt Dia (in.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 ½
Tension (kips)	17	28	40	56	74	92	117	139	170

- Loosen and remove the nut.

- There shall be no signs of thread shear failure, stripping or torsional failure. The nut shall turn, with your fingers, on the bolt threads to the position it was in during the test.

- The nut does not need to run the full length of the threads.

- If you cannot turn the nut with your fingers it is considered thread failure.

Failure:

- The following constitute a failure of the rotational capacity test.
    - Exceeding the maximum allowable torque in the torque/tension comparison.
    - Failure to achieve the required rotation.
    - Failure to achieve the required tension at the required rotation.
    - Thread failure.
- Failure of any one of these items on either assembly constitutes a failure of the rotational capacity test.
- When a failure occurs, the subject lot of fasteners is rejected.
- The contractor is given the option to clean and re-lubricate as necessary and then retest the fastener assemblies.

Records: Rotational capacity record

Heat Camber Procedure

Purpose:

This procedure is to ensure the heat cambering meets drawings.

Responsibility: Fabrication Foreman

Procedure:

- In order to attain the required tolerance and to prevent excessive movement while being cambered, the beam is braced in the vertical (I) position: concave or cambered side up.
- Triangular areas are marked off along the beam, where heat is applied as deemed necessary for the specific amount of camber.
- Within the triangular regions a continuous U pattern is outlined.
- The heating torch is fitted with a rosebud tip, and the steel is heated to a temperature between 1000°F - 1150°F.
- The torch traces the pattern at various locations, as deemed necessary for the specified amount of camber.
- Heating is performed from both ends of the flange with 2 torches.
- The torches make only one pass along the length of the beam. Heat is never applied to any previously heated areas.
- Heating torches are moved rapidly to guard against general and surface overheating.
- Laser thermometer is used to verify and monitor the temperature.
- The beam is allowed to cool naturally.
- All pre-rolled cambered beams are inspected before assembly to verify that they have the correct amount of camber and do not have any areas of damage.

Records: Inspection Record

Receiving Inspection

Purpose:

This procedure is to ensure that material and supplies conform to Purchase Order Requirements.

Responsibility: Receiver

Procedure:

- All materials received shall be compared to the purchase order requirements.
- MTRs shall be used to verify that the material is as ordered.
- The receiver shall identify the material, grade and quantity and look for visible shipping damages.
- If the material is not marked, it shall be verified against the Bill of Lading and the MTR and marked appropriately. If material is a mixed load or there are multiple MTRs, receivers will get QCI to verify material.
- The receiver shall inspect shapes and plates for obvious deviations from purchase order specifications.
- QCI will verify all material meets the contract documents (ASTM,AASHTO,Drawing) prior to releasing to fabrication.
- The receiver shall sign the Bill of Lading indicating acceptance or note the deficiency and the material is on hold for further review.
- The BOL shall be signed to indicate the receiving process is complete.

Records: PO / Bill of Lading / MTR's

Assignment of QC Inspections and Monitoring

Purpose:

To ensure the product is fabricated to project requirements.

Responsibility: Quality Control Inspector

Procedure:

- Qualification requirements for Quality Control Inspectors shall be defined and documented in their Job Description.

Inspection by Production Personnel

- When Production personnel are assigned Quality Control Inspection duties, they shall be knowledgeable in proper inspection methods and acceptance criteria specified for the material or products they are inspecting and hold the required certification as applicable.
- Production personnel shall be aware of their responsibilities and are given time to perform them.
- Production personnel shall not inspect their own work.
- Quality Control Inspectors shall monitor inspections by production personnel.

Records: Shop Drawings

In Process Inspection, AWS D1.1 & Chapter N

Purpose:

This procedure is to ensure the product is fabricated & inspected to Contract Documents, AWS D1.1 and the Specification for Structural Steel Buildings.

Responsibility: Quality Control Inspector

Procedure:

- All members shall be inspected prior to fabrication & assembly, during assembly prior to welding, during welding, and after welding.
- The acceptance or rejection of all welded members shall be documented on the Weld Map.
- For inspections listed as "random observations", operations need not be delayed pending these inspections.
- If the required quality is not met, the inspection frequency shall be 100% until the Quality Control Inspector has confidence that the problem will not recur.

Inspection Prior to Assembly

Observe The Following On A Random, But Suitable Basis

- Materials shall be inspected for job # before the work begins.

Inspection Tasks During Assembly and Prior to Welding

Perform On All Members

- Welding procedure specifications (WPSs) available
- Manufacturer certifications for welding consumables available

Observe The Following On A Random, But Suitable Basis

- Material identification (type/grade) - Observe on a random, but suitable basis.
- Welder identification system - Observe on a random, but suitable basis.
- Fit-up of groove welds (including joint geometry) - Observe on a random, but suitable basis:
    - Joint preparation
    - Dimensions (alignment, root opening, root face, bevel)
    - Cleanliness (condition of steel surfaces)
    - Tacking (tack weld quality and location)
    - Backing type and fit (if applicable)

- Configuration and finish of access holes - Observe on a random, but suitable basis.

- Fit-up of fillet welds - Observe on a random basis:
    - Dimensions (alignment, gaps at root)
    - Cleanliness (condition of steel surfaces)
    - Tacking (tack weld quality and location)

- **Inspection Tasks During Welding**

Observe The Following On A Random, but suitable Basis

- Use of qualified welders - Observe on a random, but suitable basis.

- Control and handling of welding consumables - Observe on a random, but suitable basis:
    - Packaging
    - Exposure control

- No welding over cracked tack welds - Observe on a random, but suitable basis.

- Environmental conditions - Observe on a random, but suitable basis:
    - Wind speed within limits
    - Precipitation and temperature

- WPS followed - Observe on a random, but suitable basis:
    - Settings on welding equipment
    - Travel speed
    - Selected welding materials
    - Shielding gas type/flow rate
    - Preheat applied
    - Interpass temperature maintained (min./max.)
    - Proper position (F, V, H, OH)

- Welding techniques - Observe on a random, but suitable basis:
    - Interpass and final cleaning
    - Each pass within profile limitations
    - Each pass meets quality requirements

Inspection Tasks After Welding

Perform On All Members

- Welds shall be inspected before being hidden or out of reach.

- Welds cleaned .

- Size, length and location of welds.

- Welds meet visual acceptance criteria:
    - Crack prohibition
    - Weld/base-metal fusion
    - Crater cross section
    - Weld profiles
    - Weld size
    - Undercut
    - Porosity

- Arc strikes.

- k-area - When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 in.

- Backing removed and weld tabs removed. (if required)

- Repair activities.

Inspection Documentation

- Document acceptance or rejection of the member on the Weld Map.

Records: Weld Map

In Process Inspection, AWS D1.5

Purpose:

This procedure is to ensure the product is fabricated & inspected to Contract Documents & AWS D1.5.

Responsibility: Quality Control Inspector

Procedure: (Reference AWS D1.5 Clause 6)

Visual Inspection

- 100% of all welds shall be visually inspected. A weld shall be acceptable by visual inspection if it conforms to the following requirements:
    - The weld shall have no cracks.
    - Thorough fusion shall exist between adjacent layers of weld metal and between weld metal and base metal.
    - All craters are to be filled to the full cross section of the weld, except for the ends of intermittent fillet welds outside of their effective length when such welds are allowed in the design.
    - 6.26.1.4 Weld profiles shall be in conformance with 3.6.
    - In primary members undercut shall be no more than .25mm, 0.01 inch when the weld is transverse to tensile stress under any design loading condition. Undercut shall be no more than 1 mm -1/32 inch deep for all other cases.
    - Per engineering approval, -1/32" undercut allowance for all welded joints on all material types.
    - 6.26.1.6 The frequency of piping porosity in the sur- face of fillet welds shall not exceed one in 100 mm [4in.] or six in 1200mm [4ft] of weld length and the maximum diameter shall not exceed 2.4mm [3/32in.]
    - (i) A subsurface inspection for porosity shall be per- formed whenever piping porosity 2.4mm [3/32in.] or larger in diameter extends to the surface at intervals of 300 mm [12in.] or less over a distance of 1200 mm [4ft], or when the condition of electrodes, flux, base metal, or the presence of weld cracking indicates that there may be a problem with piping or gross porosity.
    - (2)This subsurface inspection shall be a visual inspection of 300mm [12in.] exposed lengths of the fillet weld throat after it has been ground or removed by air carbon arc gouging to a depth of ½ the design throat. When viewed at mid-throat of the weld, the sum of the diameters of all porosity shall not exceed 10

mm [3/8in.] in any 25 mm [i in.] length of weld or 20 mm [3/4in.] in any 300mm [12in.] length of weld.

- 6.26.1.7 A fillet weld in any single continuous weld may underrun the nominal fillet weld size specified by 2 mm [U16in.] without correction, provided that the undersize portion of the weld does not exceed 10 percent of the length of the weld. On the web-to-flange welds on girders, underrun shall be prohibited at the ends for a length equal to twice the width of the flange.

- 6.26.1.8 CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the frequency of piping porosity shall not exceed one in 100 mm [4in.] of length, and the maximum diameter shall not exceed 2.4mm [3/32in.].

- 6.26.1.9 Visual inspection of welds in all steels may begin immediately after the completed welds have cooled to ambient temperature. Acceptance criteria for M270M (M270)Grades 690/690W(iOO/iOOW) (A 709M [A7091Grades690/690W[lOO/iOOW]) steels shall be based on visual inspection performed not less than 48 hours after completion of the weld.

MT (Magnetic Particle Testing)

- Shall be performed by an inspector qualified to a written practice in accordance with SNT-TC-1A. The scope of Magnetic Particle Testing shall be in accordance with the approved drawings.

Inspection Documentation

- Document acceptance or rejection of the member on the Weld Map.

Records: Weld Map, NDT Report

Final Inspection

Purpose:

This procedure is to ensure the product has been fabricated to project requirements.

Responsibility: AWS CWI, AMPP Coatings Inspector

Procedure:

- All pieces shall be final inspected.
- Final inspection will occur after welding and coating prior to shipping.
- All weld inspection shall be controlled by the applicable In Process Inspection procedure.
- All final inspections shall be performed by quality control inspectors and recorded.
- All in process inspections shall be verifiable at final inspection.
- The inspector shall look for obvious deviation from customer requirements.
- If nonconformances are found the nonconformance procedure shall be followed.

Inspection of Galvanized Structural Steel Main Members

- Exposed cut surfaces of galvanized structural steel main members and exposed corners of rectangular HSS shall be visually inspected for cracks after galvanizing.
- Cracks shall be repaired or the member shall be rejected.

Records: Final Inspection Record

Calibration of Inspection, Measuring and Testing Equipment

Purpose:
This procedure is to ensure that inspection, measuring and testing equipment used to demonstrate the conformance of product & process to specified requirements is adequately calibrated.

Responsibility: Quality Control Inspector

Procedure:
- This procedure shall apply to the inspector's tape measures, weld gauges, squares, DFT indicators, V&A meters used to verify welding parameters and bolt tension measuring device.
  - All equipment that is calibrated shall be listed on an equipment list & marked with its identification or serial #.
  - The service use and the precision required shall be listed in the individual equipment's calibration procedure below.
  - The precision required of any piece of equipment shall be sufficient to satisfy the acceptance standards of the project specifications or industry standards.
  - All equipment shall be stored and handled to maintain accuracy and fitness for use.
  - For equipment that is damaged, dropped, knocked over or functioning improperly, the equipment shall be prominently marked or tagged to preclude usage of the equipment and it shall be removed from service until it can be recalibrated, adjusted or repaired.
  - Whenever the accuracy of inspection, measuring and test equipment is in question, proactive calibration shall occur, regardless of manufacturer's recommendations.
  - Equipment shall be calibrated to a national standard or the manufacturers' recommendation.
  - Calibration or adjustment instructions shall be in accordance with the manufacturer's recommendations.
  - The tracking of calibrations, adjustments and repairs shall be maintained.
  - Equipment that does not meet calibration requirements shall be removed from service. Quality Control and production shall determine the severity of the calibration error and impact on the quality of the product. If necessary, products inspected with this equipment shall be re-inspected or recalled.
  - Records of calibration shall be maintained for each piece of equipment.
  - Equipment that is not calibrated will not be marked with serial # to prevent inadvertent use of the equipment where calibrated equipment is required.
  - Rented or borrowed equipment must be accompanied by a valid calibration certificate and is subject to the requirements of this Section.

Certified Master Tape
- The certified master tape is a "calibration standard" and shall not be used for inspections. The certified master tape shall be checked for wear annually. It shall be replaced if the wear is sufficient.

Inspector's Tape Measures

- Tapes used for final inspection are checked at 25' intervals to an accuracy of ±1/16" against a certified master tape annually. Tapes not meeting this accuracy are removed from use.

Inspector's Weld Gauges

- Weld gauges will be checked against the certified master tape to an accuracy of ±1/32" annually. Weld gauges not meeting this accuracy are removed from use.

Welding Machine Meters

- Each welding machine will be checked every three months using calibrated amperage and voltage meters to ensure that it is operating correctly and that the displays or gages on the machines are operating within +/-5% of the readings on the calibrated amperage and voltage meters used in the verification of the gages on the welding equipment. The meters will be placed on the welding equipment and the welding equipment will then be operated in the normal manner for welding and the gage readings on the welding equipment will be verified by the readings on the test equipment at this time. If any deviation between the meter and machines greater than +/-5% that cannot be adjusted into compliance at that time, the machine will be tagged and taken out of service for repair. Machines will be recalibrated before being placed back into service.

Paint Thickness Gauge

- Calibration – The DFT shall be initially calibrated by the manufacturer or an outside testing lab to an accuracy stated by the manufacturer.
- Verification of Accuracy- shall be in accordance with the instructions of the manufacturer.
- DFT gauge accuracy shall be verified at the beginning and end of each work shift.
- Prior to verification, the gauge shall be checked for cleanliness.
- If the gauge is dropped or suspected of giving erroneous readings during the work shift, its accuracy shall be rechecked.
- Verification shall be recorded on the DFT Gauge Calibration Log in accordance with SSPC-PA 2 when inspecting coatings.
- DFT gauges not meeting this accuracy are removed from use and sent to an outside lab for calibration.

Inspector's Squares

- Squares are checked according to the 3-4-5 method to an accuracy of ± 1/16" against a certified master tape annually. Squares not meeting this accuracy are removed from use.

Bolt Tension Measuring Device

- An outside testing lab shall be used to calibrate the bolt tension measuring device to an accuracy of ± 1 KIP annually when bolts are being pretensioned in the shop. If it does not meet this accuracy, it shall be adjusted or removed from use.

Records: Calibration Records

Control of Nonconformance

Purpose:

This procedure is to ensure that product and work that does not conform to specified requirements is prevented from reaching the customer.

Responsibility: Management Representative for Quality

Procedure:

Nonconforming Process

- Nonconformances related to the performance of the Quality Management System shall be documented on the Nonconformance Report. These nonconformances may be discovered in day-to-day operations or during the internal audit.

Nonconforming Product and Work

- Nonconformances that are identified during inspection shall be clearly marked and segregated immediately.
- The nonconformance shall be documented. A record shall be kept of the pieces affected, the nature of the nonconformance, the treatment selection, authorization and inspection results.
- The responsibility for review and evaluation remains with the Quality Control Manager.
- The Management Representative for Quality has the authority for selecting the treatment of the part.
- A treatment (the fix) for the part will be provided to the functions concerned with the re-work needed.
- The Quality Control Inspector's qualifications are on file in the office.
- Nonconforming product that violates code or specifications is marked as drop and can't be used for a given project.
- Any repaired or reworked material shall be re-inspected per project requirements by the QC Inspector.

Records: Non Conformance / Corrective Action Report

Corrective Action

Purpose: This procedure is to ensure the implementation of corrective actions.

Responsibility: Management Representative for Quality

Procedure:

- Customer complaints, summaries of nonconformances, along with internal and external audit reports will be reviewed to determine if a corrective action should be initiated.

- A corrective action shall be initiated anytime the Management Representative for Quality deems necessary.

- Corrective action shall be applied when:
    - There is a nonconformance that is repetitive in nature as identified by periodically reviewing nonconformance reports or summaries for negative trends.
    - Process nonconformities are found during the internal and external quality audits indicating that the quality management system may not be implemented and functioning as stated in the quality manual.
    - Nonconformance with the quality management system is found during the day-to-day execution of the system.
    - Nonconformance is unacceptable as determined by management.
    - A customer complaint has been investigated and corrective action has been determined necessary.

- The following steps shall be addressed:
    - Only the Management Representative for Quality can issue a CAR and initiate the corrective action process.
    - A timeframe for the response to a CAR will be established & the responsibility shall be assigned.
    - The Management Representative for Quality shall investigate and document the scope of the nonconformance, requirement not met, root causes, Corrective Measures taken, and list the actions to be taken to prevent recurrence.
    - The CAR shall be communicated to the management team and shall be reviewed during the annual Periodic Management Review.
    - The corrective action shall be followed up and periodically monitored for implementation and effectiveness.

Records: Non Conformance / Corrective Action Report

Handling, Storage and Delivery of Product and Materials

Purpose:

This procedure is to ensure that product and material are handled, stored and delivered appropriately.

Responsibility: Fabrication Foreman

Procedure:

- Materials shall be stored, loaded and shipped avoiding damage and deterioration.
- Material will be marked with its identification and listed on the Bill of Lading.
- Bridge sections shall be loaded and shipped in accordance with the shipping diagram.
- Shipping according to erection sequence shall be followed.
- Bolt assemblies and loose bolts, nuts and washers shall be shipped in separate closed containers according to length and diameter, as applicable.
- Pins and other small parts and packages of bolts, nuts and washers shall be shipped in boxes, crates, kegs or barrels.
- A list and description of the material shall appear on the outside of each closed container.
- Material will be shipped in accordance to contract requirements.
- All material shipped from subcontractor locations shall be coordinated & monitored for compliance with shipping instructions.
- Products and materials shall be protected to prevent use in other than its intended purpose.
- Any such material that is lost, damaged, or otherwise unsuitable for use shall be recorded and reported as appropriate.

Records: Bill of Lading, Shipping Diagram

Training

Purpose:

This procedure is to ensure that personnel are trained.

Responsibility: Management Representative for Quality

Procedure:

- All personnel with positions affecting quality shall receive initial and periodic documented training.
- Personnel receiving initial and periodic training shall include: project managers, detailers, inspectors, welding personnel, fitters, painters, shop supervisors, riggers, signal persons, and crane operators.
- Training shall provide necessary information for personnel to perform their assigned tasks in a manner that will result in a quality product.
- Records of training shall list the following:
    - Name of Trainer
    - Course Topic Outline, including subject and main points.
    - Date
    - Attendees
- Periodic training shall be used to inform personnel of changes to their assigned tasks.

Records: Training Records

Certifying & Updating NDT Personnel

Purpose:

This procedure provides for control of certifying & updating NDT personnel.

Responsibility: Management Representative for Quality

Procedure:

- When NDT is required by contract, it shall be performed by a qualified inspector or subcontracted to a qualified NDT firm.
- The qualification process for the NDT firm shall include obtaining & filing qualification documents for all level 2 personnel who perform work and the qualification documents for all level 3 personnel in the subcontracted NDT firm.
- Personnel qualifications shall be in accordance with ASNT Recommended Practice No. SNT-TC-1A, latest edition, and ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel (ANSI/ASNT CP-105, latest edition)
- A copy of ASNT Recommended Practice No. SNT-TC-1A, latest edition, and ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel (ANSI/ASNT CP-105, latest edition) shall be kept on file.

Records: NDT Certifications

Internal Audit

Purpose:

This procedure is to ensure the quality management system is audited.

Responsibility: Management Representative for Quality

Procedure:

- An internal audit on each section of the quality management system shall be conducted annually to evaluate compliance and the effectiveness of implementation.
- The Management Representative, or a qualified individual independent of the function being audited, shall perform the audit.
- Any nonconformances found or corrective actions that are initiated shall be recorded.

Records: Internal Audit Record, Non Conformance / Corrective Action Report

Reference Standards

Purpose:

This procedure is to ensure appropriate codes, specifications and standards are available.

Responsibility: Management Representative for Quality

Procedure:

The current edition of the following standards and specification shall be maintained in the library.

- AISC Steel Construction Manual
    - AISC Specification for Structural Steel Buildings
    - RCSC Specification for Structural Joints Using High Strength Bolts
    - AISC Code of Standard Practice for Steel Buildings and Bridges
- ASTM Standards (Relevant to job specification)
- Recommended Practice No. SNT-TC-1A and ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel (ANSI/ASNT CP-105)
- SSPC Volume 2
    - SSPC-PA 1 Shop, Field, and Maintenance Coating of Metals
    - SSPC-PA- 2 Paint Application Standard No. 2
- AASHTO/NSBA Steel Bridge Collaboration - Steel Bridge Fabrication QC/QA Guide Specification AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges
- AASHTO LRFD Bridge Design Specifications
- AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals
- AASHTO Guide Specifications for LRFD Seismic Bridge Design
- AASHTO M 133 Standard Specification for Preservatives and Pressure Treatment Processes for Timber
- AASHTO S4.1 Steel Bridge Collaboration - Steel Bridge Fabrication QC/QA Guide Specification
- AISC Detailing For Steel Construction
- ASCE 7, Minimum Design Loads for Buildings and Other Structures
- AWS D1.1 Structural Welding Code – Steel
- AWS D1.2 Structural Welding Code - Aluminum
- AWS D1.5 Bridge Welding Code
- AWS A2.4 Symbols
- AWS A3.0 Terms and Definitions
- Guide to Stability Design Criteria for Metal Structures
- NDS Supplement – Design Values for Wood Construction
- Report No. FHWA-SA-91-031 High-Strength Bolts for Bridges for Rotational Capacity Testing
- FDOT Standard Specifications Ebook

Quality Manual Revision Record

Revision Date	Summary of Revisions
5/16/19	Original Issue
6/9/19	Clarified records, Removed Shop Standard Material From Material ID procedure
6/20/19	Reference Standards, Handling, Storage and Delivery of Product and Materials - Added requirement for Shipping Diagram
6/28/19	Laydown, Assembly & Match-marking - revised requirement for welded vs bolted splices , Added procedure for Heat Camber Procedure
7/31/19	Laydown, Assembly & Match-marking – added Laydown/Assembly process controls Control of Management System Documents and Project Documents – Revision control clouding & underlining added Material Identification and Traceability – Incorporated tagged marking Control of the Quality Manual - Revision underlining added
1/1/20	Updated title logos
1/15/20	Revised Chapter 9 allowing punch & drilling of cut holes based on Fabrication Drawings
3/11/20	Assignment of QC Inspections and Monitoring - added
6/8/20	Replaced manual reference dates with "latest edition"
9/2/20	Undercut allowance of -1/32" on all welded joints on all material types added under visual inspection criteria per engineering approval. pg.45
10-6-20	AISC physical plant address change. pg.1
11-05-20	Added Reference: **SOP 11 - Sophisticated Coatings** pg. 26
11-20-20	Added Reference for Fracture Critical: SOP 15 Fracture Control Plan, SOP 16 Distortion Control Plan, SOP 17 Weld Repair Procedure, and SOP 18 CAC-A WRP pg. 23
12-2-20	Change from *"All"* to *"A minimum of 10% of all"* under **Visual Inspection** pg.45; Addition of "**MT (Magnetic Particle Testing)** Shall be performed on all CJP welds if required by contract documents." pg. 46
12- 11-20	*Changed* - "**MT (Magnetic Particle Testing)**Shall be performed on all CJP (complete joint penetration) welds." pg. 46. *to* "**MT (Magnetic Particle Testing)** Shall be performed by a 3rd party inspector on CJP welds if required by contract documents." pg. 46

5/25/2022	Changed- All documents affecting quality will be reviewed annually when completing internal audit page 6
8/30/2022	Added - Control Quality records section. Time Frame changed to read Quality records (NDE Results, QC Traveler, Revised Drawing) shall be accessible in a reasonable time frame. • Quality records (MTRs, WPS,NDE procedures) shall be accessible prior to fabrication.
8/30/2022	Added- Verification of purchased product, material and services section All documentation shall be provided for review prior to shipment.
8/30/2022	Added- Installation of high strength bolts For all FDOT Projects please refer to Section 460-5 of the FDOT specification.(latest edition)
8/30/2022	Added- Receiving inspection Section • If material is a mixed load or there are multiple MTRs, receivers will get QCI to verify material.
8/31/2022	Added- In Process Inspection Section Added But suitable to on random basis
8/31/2022	Changed- Final Inspection Responsibility to AWS CWI

8/31/2022	Added- Control of nonconformance • Nonconformances that are identified during inspection shall be clearly marked and segregated immediately. • Nonconforming product that violate code or specification, the material is marked as drop and it can't be used for project.
8/31/2022	Added- Reference standards FDOT standard specifications ebook
12/20/2022	• QCI will verify all material meets the contract documents (ASTM,AASHTO,Drawing) prior to releasing to fabrication.
12/20/2022	to a third-party upon request, This includes cutting material, fit up, welding, and bolting.
1/25/2023	Update section Installation of High Strength Bolts RCSC "Specification for Structural Joints Using High Strength Bolts" latest edition.
8/22/23	Quality records (MTRs, WPS, NDE procedures) shall be accessible to a third-party ~~upon request~~, prior **to** fabrication, or otherwise

	incorporated into a project. This includes cutting material, fit up, welding, and bolting.
8/22/23	**Welding Machine Meters** • An outside testing lab shall be used to calibrate all tool used for testing the welding machines. Both of the readings of the machine and meter shall be recorded. Weld machines not meeting an accuracy of ± 5% annually are adjusted or removed from use
8/22/23	Changes and revisions shall be clearly communicated to all personnel responsible for inspecting or overseeing the work prior to releasing the product to the floor for fabrication, in response to quality issued hold, non-conformance or other Quality Control determined resolution as defined in this Manual.
3/7/24	Updated verbiage and references to match current welding codes. Updated responsible parties for several SOPs to be in-line with current company roles and responsibilities. Changed NDT inspection requirements to reflect new company capabilities.
4/9/24	Updated AWS D1.1 Table for pre-approved base metals
5/29/24	Updated RCSC tables, calibration tolerances, removed skidmore from our list of calibrated instruments and changed it to bolt tensioning device, added subcontractor qualification requirements

Organizational Chart **See Admin Folder**

Job Descriptions **See Admin Folder**

Biographical Information **See Admin Folder**

Facility Plan **See Admin Folder**

Equipment List **See Admin Folder**

BRIDGE BROTHERS

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INSPECTION + MAINTENANCE RECOMMENDATIONS

The purpose of this set of recommendations is to suggest some minimum guidelines for inspection and maintenance of BRIDGE BROTHERS INC. Pedestrian Bridges. These procedures are not inclusive and more detailed procedures may be warranted depending upon bridge location, environment, and usage. Establishing the requirements for, and verifying the performance of, all field inspection and maintenance is the responsibility of the owner.

INSPECTION

I. USER SAFETY

A. Each bridge should be inspected at regular intervals (at least once per year) to ensure that all items of user safety are accounted for and performing properly. Those areas of special concern should be as follows:

1. Safety rails, handrails, rubrails, fencing or other types of safety features should be in place with complete structural integrity and capacity. Pay particular attention to handrail and fencing attachments. Check for any sharp edges or protrusions that could produce bodily harm or be a hazard to the user.
2. Deck surfaces should be without excessive gaps, cracks or projections that could create a trip hazard or interfere with the user in any way. Special consideration should be given to any smooth deck surface that could also create a possible slip hazard. For concrete decks, some form of a roughened surface or broom finish or other means of providing a non-skid surface is recommended.

The owner and/or specifier should be aware that most pedestrian bridge liability claims are statistically slip and fall claims.

II. STRUCTURAL INTEGRITY

A. Each bridge should be inspected at regular intervals not to exceed one (1) year. The American Association of State Highway and Transportation Officials (AASHTO) Manual for Maintenance Inspection of Bridges provides an excellent guide for this inspection (pages 5-13 in the current edition). This visual inspection should include, but not be limited to the following:

1. Check the decking to ensure it is in satisfactory condition. Pay special attention to timber decks at their contact surfaces where they bear on stringers.
2. Steel surfaces should be inspected to ensure that they are performing satisfactorily. Check for any excessive corrosion on weathering steel bridges, or paint and caulk integrity on painted bridges, paying special attention to the following areas:
    a. Steel below the deck, particularly the top of stringers supporting wood decks.
    b. Truss or floor system joints where debris or water may accumulate.
    c. Anywhere vegetation or other material may have come in contact with the steel.

    NOTE: Any weathering steel surface not "boldly exposed" to the atmosphere should be checked to ensure it has formed its protective oxide layer.
3. Check all steel surfaces and welded and bolted connections for cracks. Pay special attention to the welded truss and floor beam joints in vehicular or material handling bridges subject to fatigue stresses.
4. Check the ends of the bridge for any damage which may have been caused by vehicular impact.

5. Check the integrity of concrete abutments and/or piers for scour due to water flow if applicable, etc., per AASHTO's Manual for Maintenance Inspection or the foundation engineer's recommendations. Check for any settlement of the abutments which may be warping or twisting the bridge.
6. Check anchor bolts for damage and see that they are secure. Examine all bearings to ascertain that they are functioning properly. Expansion bearings and the expansion joints at the ends of the bridge must be checked to see that they are moving freely and are clear of all foreign material. Check for creeping of teflon pads, if present.
7. Spliced Bridges:
    a. Check the bolted splices for any excessive corrosion or cracking of the steel fasteners.
    b. Make sure all weep holes are open and clear of debris to allow for complete drainage of any moisture which may collect on the interior tube surfaces. See the original shop drawings for locations of weep holes.

B. If problems are seen during the inspection procedure, cleaning and repair or replacement of weathering steel bridge components may be necessary; painted bridges may require cleaning and repainting or replacement of some or all members. Contact BRIDGE BROTHERS INC. or the foundation engineer for recommendations if necessary.

MAINTENANCE FOR PAINTED BRIDGES

Painted bridges, like any painted structure, require periodic inspections and painting. The following steps will help increase the life span of your bridge:

A. After inspections, or any time loss or damage of the paint coat is noticeable, problem areas should be repaired as follows:
    1. Select a maintenance coating system based on the following:
        a. Inspection report findings
        b. Environment (identify any corrosives)
        c. Degree of surface preparation attainable
        d. Current paint compatibility

        NOTES:

        - Generic type compatibility is a major factor in the selection of a system (some coating systems are not recommended over a particular type of existing material.)
        - Depending upon the surface performance, an upgrade in the coating system may be necessary.
    2. Clean all applicable surfaces as dictated by the repair system chosen (i.e. pressure wash, brush off, blast clean, etc.)
    3. Apply repair coats per the coating manufacturer's recommendations.
    4. Caulk all unwelded seams which are in need of repair with a good quality clear silicone caulk suitable for exterior use.

B. The entire bridge structure will require periodic repainting dependent upon varying factors such as the existing paint system, bridge usage, atmospheric environment, etc. Repainting will typically be required every 2-20 years. The frequency of painting will need to be determined by the inspector. The following steps should be followed when repainting the bridge structures:
    1. Remove wood decking or grating, fencing, wood rubrails, and any other non-painted items which will not be receiving new paint. Obviously, concrete and asphalt decked bridges will be painted with the deck in place, unless these decks have deteriorated to the point of replacement. If this is the case, remove the deck prior to painting, if not, special care should be exercised to ensure problem areas below deck are cleaned and painted properly.

2. Select a coating system based on parameters similar to those outlined in the repair painting section (A, above), paying attention to the following items:
    - Environment, specifically any corrosives identified during inspections
    - Substrate condition
    - Surface preparation limitations

3. After selecting a system compatible with all existing surface conditions and site limitations, clean all surfaces and apply according to the manufacturer's recommendations.
4. After the coating system has properly cured, caulk all unwelded seams with a good quality clear silicon caulk suitable for exterior use and replace the decking, fencing, etc., which were removed prior to cleaning and repainting the structure. This is also an excellent time to replace the wood rubrail which may have shown excessive deterioration.

MAINTENANCE FOR WEATHERING BRIDGES

Weathering steel is a maintenance free material only if protected from harmful conditions and environments. The following steps will help increase the life span of your bridge:

A. Do not use de-icing salts for snow removal as they can severely damage weathering steel.

B. Avoid retention of debris on the steel surfaces. Flush bridges at areas which accumulate debris (including salt or sand) on a regular basis.

C. Prevent weathering steel from contact with soil, vegetation, masonry, or other materials so that the weathering process can proceed on a natural basis.

D. If excessive corrosion is encountered due to salts from adjacent roadways or roadways beneath an overpass structure, or for any other reason, it may be wise to blast clean and paint the truss joints, steel beneath the deck, or any area which exhibits excessive corrosion. Steel Structures Painting Council's Report 92-08, Maintenance Coating of Weathering Steel: Field Evaluation and Guidelines, provides recommendations for remedial painting of weathering steel bridges.

MAINTENANCE FOR DECKING

I. WOOD DECKS

Unless specifically noted on shop drawings, wood planks are installed in contact with each other so that no gaps appear between planks. However, wood naturally exhibits large volume changes with variations in moisture content and time, particularly in the width direction, which can cause gaps to form between the planks. Splits and checks are a normal part of the aging and weathering of wood. Excessively split and checked wood should be replaced.

An assessment of these hazards during the User Safety Inspection with remedial action is recommended as follows:

A. Replace all planks that have deteriorated past a useful and safe life.

B. Where applicable, eliminate gaps between the planks which might be large enough for a highheeled shoe to become lodged. Eliminating the gaps should be done as follows:

   1. Remove all deck bolts.
   2. Remove plank holddown angles. Be sure to mark their locations for ease of reinstallation.
   3. Slide wood planks together.
   4. Add new plank or planks to fill up the excess space.
   5. Reinstall plank holddown angles.
   6. Drill new holes in wood planks.
   7. Install new deck bolts (see shop drawings for size and material).

C. Replacement planks may be purchased through BRIDGE BROTHERS IN.

D. Over time and with exposure to the environment, wood may become smooth, particularly when wet with rain, dew, snow, sleet, ice, etc. Periodically it may be necessary to "roughen" the surface of the decking with large grit sandpaper. There are also commercially available non-skid coatings which may be applied.

NOTE: It is the owner's responsibility to keep the wood deck free from excessive cupping, splits, gaps and smooth surfaces. Remember, most pedestrian bridge liability claims are statistically slips and falls.

II. GRATING DECKS

A. Repair or replace any grating which shows damage, corrosion, or deterioration.

B. If galvanized, wire brushing any deteriorated areas is recommended prior to the use of either sprayed zinc metalizing or organic zinc rich paint for repair.

C. For weathering steel grating, if excessive corrosion is encountered, it may be wise to blast clean and paint the grating.

III. CONCRETE AND ASPHALT

For asphalt decks, a steel form deck is the main load carrying member. For concrete decks, this steel form may or may not be integral to the deck design (as in a composite deck). Check with the design engineer.

During inspection, the asphalt or concrete covering should be checked for excessive cracking and deterioration. At the same time, the steel form decks should be checked for excessive rusting and/or damage. If the coverings are deemed to require replacement, the steel forms may be reused if they are not damaged or do not show excessive corrosion. Structural form decks may require replacement if deteriorated regardless of the deck surface condition.

Concrete and asphalt decks are usually not designed to accept the added dead weight of an overlay. Therefore, the only remedy is repair of the cracking or replacement of the concrete or asphalt covering.

See the shop drawings for recommended concrete strength, reinforcing size, slab and asphalt thickness, control joint and surface finish information. If there are any questions, please contact the BRIDGE BROTHERS INC. Engineering Department: (866) 258-3401 or engineering@bridgebrothersinc.com

MAINTENANCE FOR DECKING

I. SOIL CLEARANCE

Soil or dirt must not be left in contact with bare weathering or painted steel surfaces. In addition, adequate clearance for ventilation must be maintained between the ground and weathering steel surfaces to allow the steel to dry after wetting, forming its protective rust "patina" coating.

If the initial construction of abutments and back slopes did not allow for adequate ventilation (approximately 18"-24"), enough soil, debris, and/or vegetation should be removed and kept cut back to allow for adequate airflow. If this is not possible, a coating designed for "ground contact" protection of steel may be applied to the members in the affected area.

I. SNOW REMOVAL

Because of possible accumulation of chlorides at truss joints, in the gaps between planks on structures with timber decks, on below deck members, and/or along the edges of decks where runoff occurs, the use of de-icing salts should be avoided on these structures, especially on weathering steel bridges (see Item A in the "Maintenance for Weathering Bridges" section). The best and safest way to remove snow from these bridges, as far as the issue of steel corrosion is concerned, is by shoveling or plowing snow from the bridge deck. Non-corrosive traction aids such as sand may be used on the deck surfaces; however, any sand or dirt accumulation should be removed immediately after the snow season. If corrosive de-icing agents are used on the structure; accelerated corrosion of members which are exposed to the agent will take place, voiding the bridge warranty and necessitating repair or replacement of affected members.

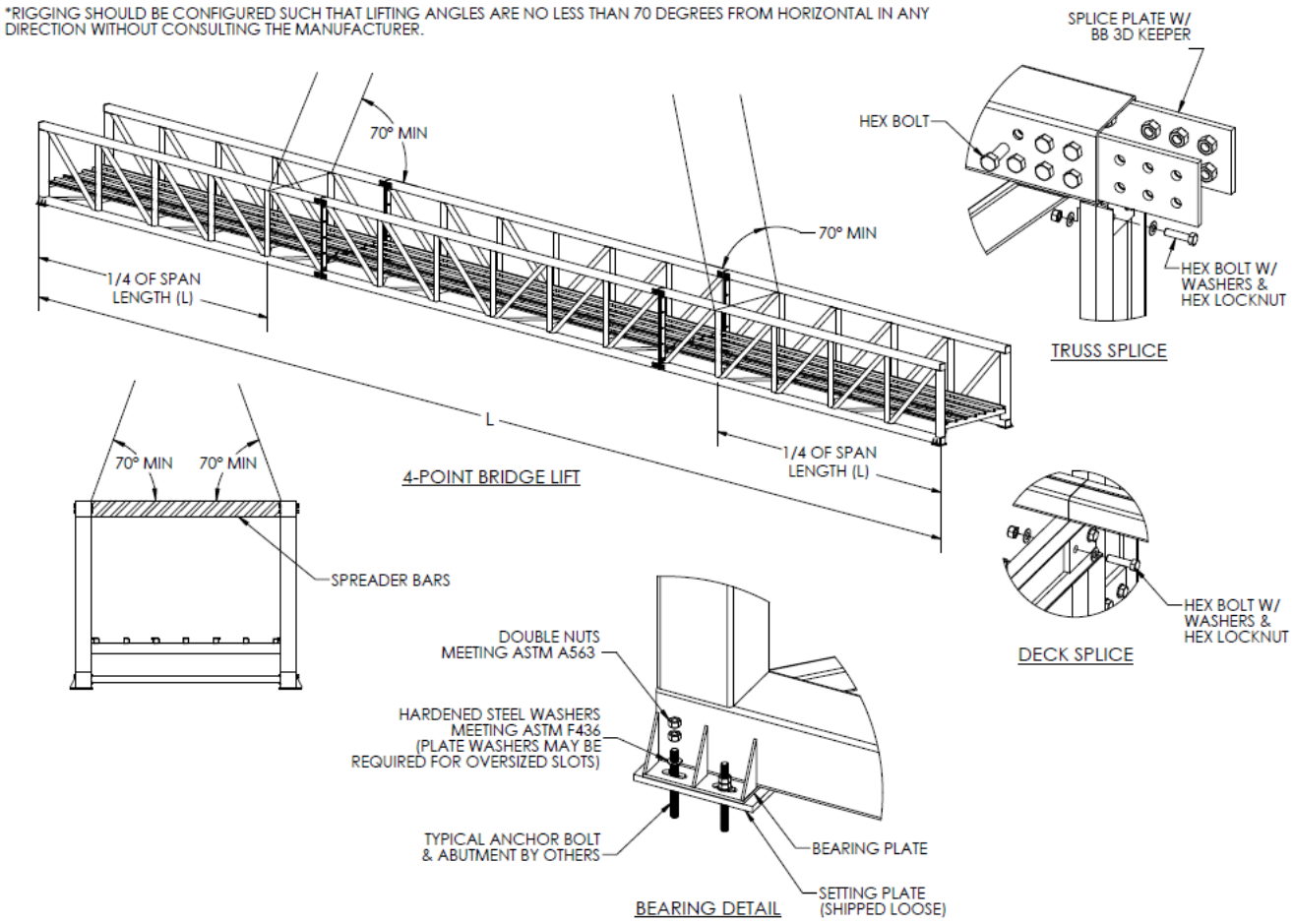
> **Remember: Maintenance of the bridge decking, including keeping it free from slip or trip hazards, is the owner's responsibility. Most pedestrian bridge liability claims are statistically slips and falls.**

De-icing salts have been used on structures where more aggressive measures were taken to protect the steel, such as galvanizing the steel members or utilizing a concrete deck with curbs to channel water away from steel surfaces. In the later case, care must still be taken to protect, or maintain by cleaning or rinsing, areas where water drains or salt gets thrown onto non-galvanized steel surfaces by wheel traffic, spreading, etc. If not, the warranty shall again be voided and replacement of some members or possibly the entire structure may be required.

For further information, any questions, or to report any safety concerns call the BRIDGE BROTHERS INC. Engineering department.

T: 866.258.3401
E: sales@bridgebrothers.com

e: sales@bridgebrothers.com
t: 866.258.3401
www.bridgebrothers.com



PRE-INSTALLATION:

1. The bridge installer shall be responsible for the inspection of the bridge and its components for damage and missing components upon arrival to project location. In the event of any damaged or missing components, bridge brothers should be notified immediately to prevent any construction delays.
2. The bridge installer shall be responsible for ensuring all local, state, and federal regulations are met with regard to safety of workers during the unloading and installation of the bridge and bridge components.
3. The bridge installer shall be responsible for the selection of the crane(s) based on weights provided by the manufacturer in the submittal drawing package; consideration should be given to additional weight for components bolted or otherwise attached to the bridge prior to installation.

INSTALLATION:

1. The bridge installer shall be responsible for the selection and installation of anchor bolts, nuts, and washers. drill-in anchor bolts are typically recommended and should be installed and checked dimensionally for correct location prior to bridge installation.
2. After installation and dimensional verification of the anchor bolts, the setting plates must be properly fitted in place according to bolt hole locations provided in drawings. the setting plates should align with the bridge bearing plates unless otherwise noted.
3. any bridge splice components must be bolted together as shown on the splice detail drawing using the plates and fasteners supplied with the bridge. bolts should be tightened to 100 ft-lb. all joints should be inspected prior to bridge installation to ensure proper contact between components.
4. lifting should take place on both truss sides on the top chord closest to one-fourth of the bridge span from each end. spreader bars should be used to keep trusses in plane. Additional safety should be considered when strapping around members that may buckle or members with sharp edges or corners to prevent failure.
5. double nuts meeting astm a563 and hardened steel washers meeting astm f436 are recommended for use on all anchor bolts. all fixed end nuts should be tightened to 15 ft-lbs. expansion end bottom nuts should be tightened, loosened 1/4 turn, and top nuts tightened snug to bottom nuts.
6. for painted bridges: the bridge installer shall be responsible for any touch up painting of damaged surfaces resulting from shipping, unloading, and installation. touch up paint shall be the bridge installers responsibility to provide and shall be applied in accordance with the paint manufacturers instructions.
7. for concrete decked bridges: the bridge installer shall be responsible for all concrete material and reinforcements as required or specified for the project.
8. proper gaps should be allowed at the abutment back walls to allow expansion of the bridge. All expansion joints are the bridge installer's responsibility unless other arrangements have been made with the bridge manufacturer.
9. refer to the inspection and maintenance manual for more information related to bridge installation, inspection and maintenance.

BB3D KEEPER PLATES:

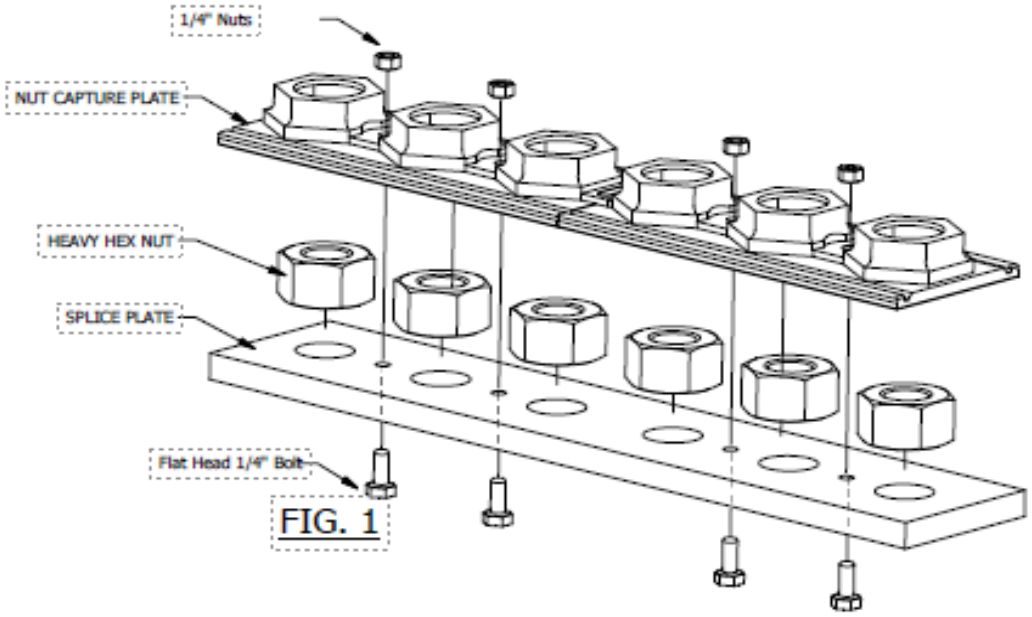


FIG. 1

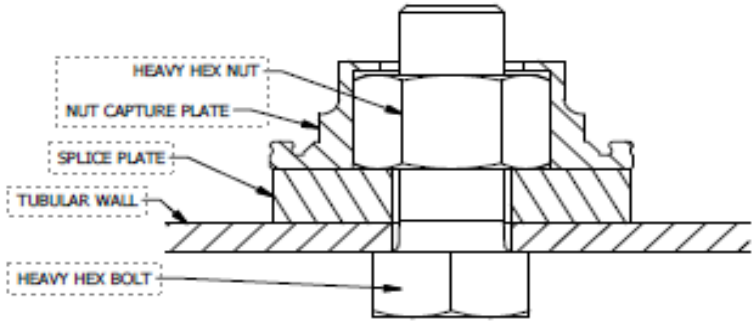


FIG. 2

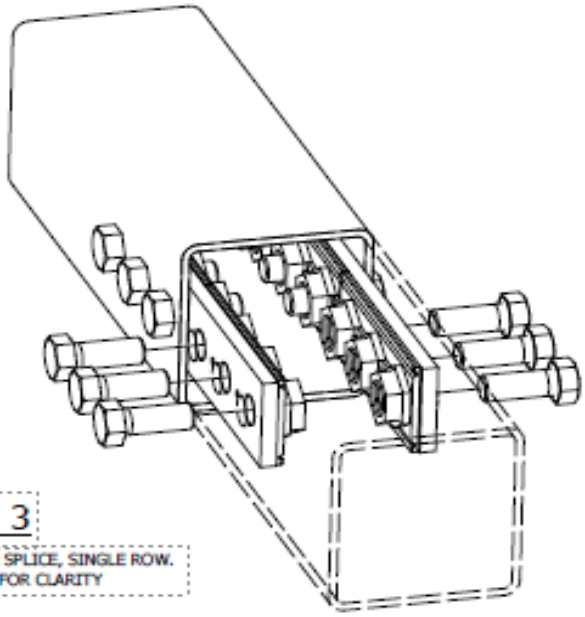


FIG. 3

*EXAMPLE OF A TUBULAR SPLICE, SINGLE ROW. ONE SIDE TRANSPARENT FOR CLARITY

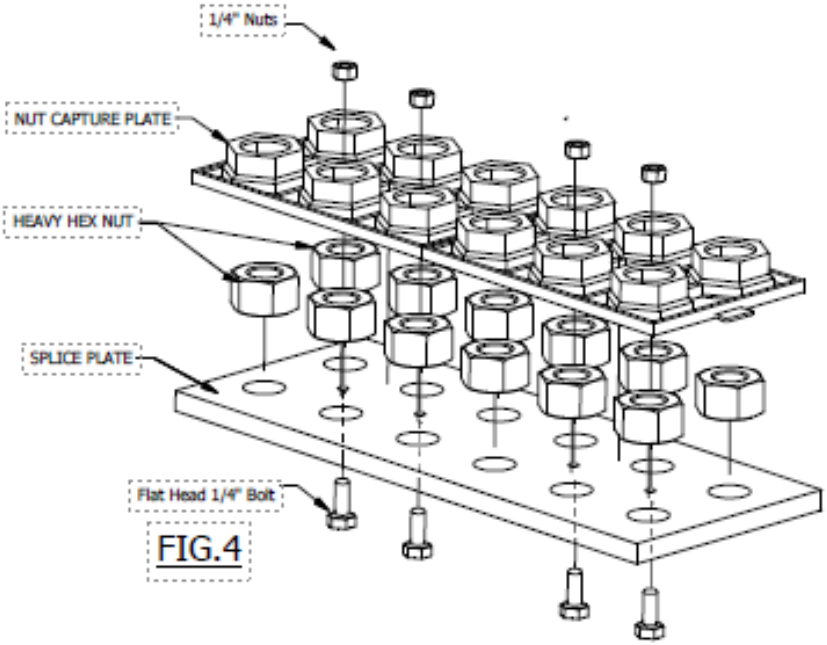


FIG.4

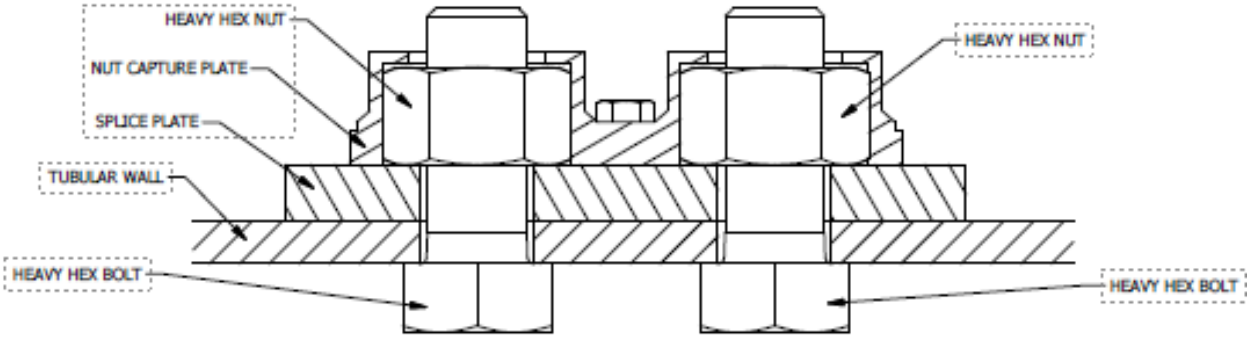


FIG. 5

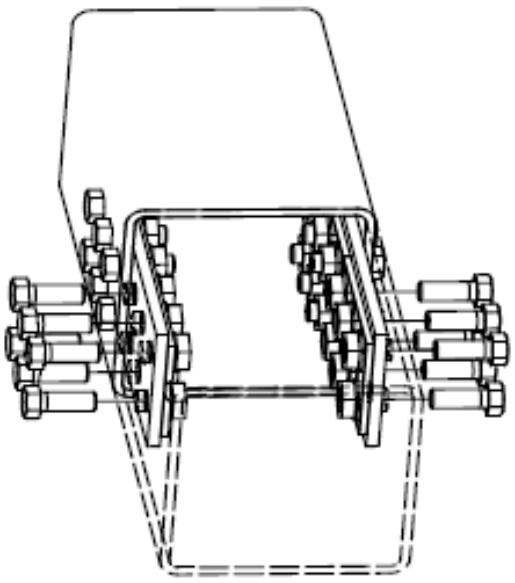
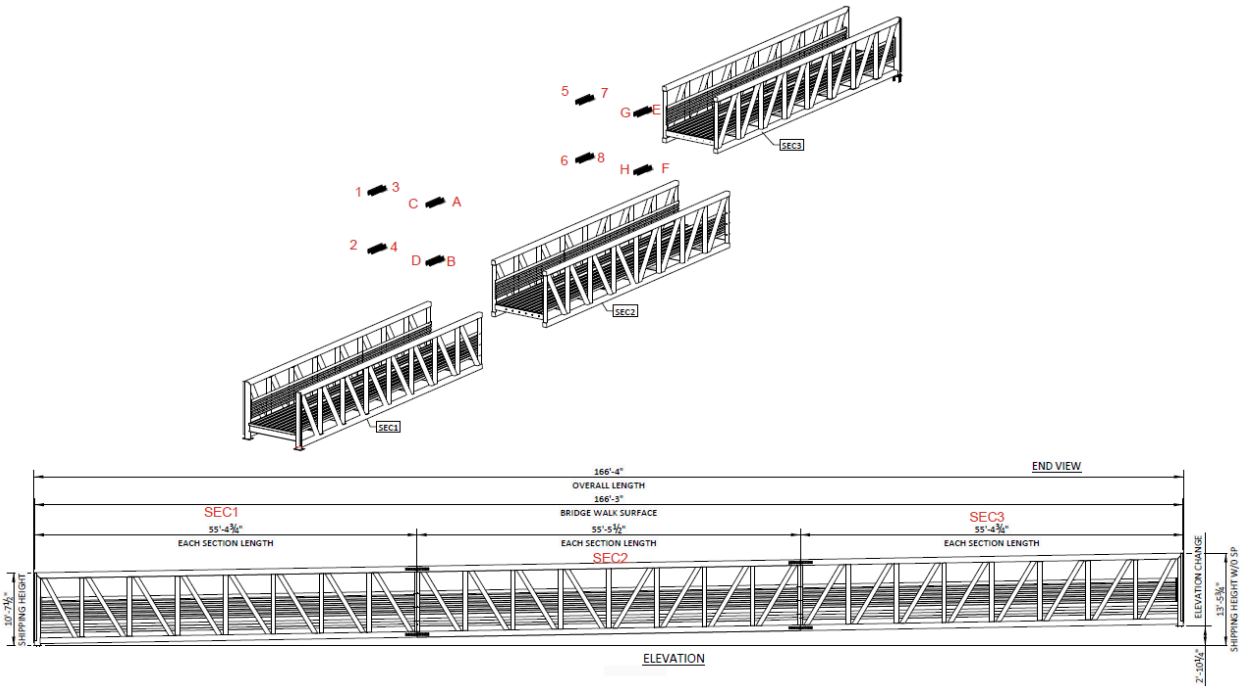


FIG. 6

*EXAMPLE OF A TUBULAR SPLICE, TWO ROWS. ONE SIDE TRANSPARENT FOR CLARITY

Installation Phase:

1. Use the stickers to follow the bridge orientation and location of the splice packages.
2. The face of the plate that has the stickers must go against the internal wall of the beam.



AMERICAN INSTITUTE OF STEEL CONSTRUCTION

CERTIFICATION PROGRAMS

PROUDLY RECOGNIZE THAT

Bridge Brothers Inc.

2019-4-11-000501F

MAINTAINS OPERATIONS LOCATED AT

225 Pumpkin Town Hwy, Bldg 19
Pickens, SC 29671 United States

THAT SUCCESSFULLY MEET THE QUALITY CERTIFICATION REQUIREMENTS FOR

Bridge Fabricator - Intermediate

Fracture Control Endorsement

Complex Coating Endorsement 1 - Enclosed

CERTIFICATION NUMBER	C-00027267
ISSUED	July 1, 2025
VALID THROUGH	August 31, 2026

PRESIDENT

AWS

erican Welding Society®

CWI

Andrew G. Shields

Has complied with the requirements of AWS QC1, Standard for AWS Certification of Welding Inspectors.

12040053

Exp. Apr/01/2027

Without Correction

Not Color Blind

AMERICAN WELDING SOCIETY INCORPORATED 1932 NEW YORK

AWS President

AWS Q&C Committee Chair

CHAD S. McDONALD, PE, LEED AP

SENIOR STRUCTURAL ENGINEER chadm@trilogyse.com

Chad holds a Bachelor of Engineering degree from the Georgia Institute of Technology, accredited by the Engineering Accreditation Commission of ABET and has been working in the engineering field since 1998. He also holds a Masters in Business Administration from Kennesaw State University. As President and Senior Structural Engineer at Trilogy Engineering, LLC he has been the lead engineer and EOR for Bridge Brothers since their beginning, completing over 300 pedestrian and industrial bridge projects since then.

As a licensed professional engineer in California (PE 73479) since 2008, and an additional 40 other states, Chad has worked on projects across multiple markets including commercial, mixed-use, religious, educational, residential, and industrial facilities. He has served as President of Trilogy Engineering since 2010 and continues to work on projects across the Southeast and nationwide.

EXPERIENCE

Trilogy Engineering (Marietta, GA) 2010 - Present
President – Senior Structural Engineer

Foreman Seeley Fountain Architecture (Norcross, GA) 2015-2016
Senior Structural Engineer

McVeigh & Mangum Engineering, (Atlanta, GA) 2005 - 2014
Executive Vice President - Managing Director Atlanta Office

McVeigh & Mangum Engineering (Jacksonville, FL) 2002-2005
Structural Project Engineer

Jones, Edmunds and Associates (Jacksonville, FL) 2000 - 2002
Engineer-in-Training

Bennett & Pless – 1998-99
(Atlanta, GA)
Engineer Intern

To confirm the information on this card, scan the QR code, visit www.aws.org/certification/search, or call 800-443-9353 ext. 273.

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AWS
American Welding Society

CWE

Matthew D. Gelardi

Has complied with the requirements of AWS QC5, Standard for Certification of Welding Educators.

2201000E
Exp. Jan/01/2026
Not Required

AWS President

AWS Certification Chair

CERTIFIED WELDING EDUCATOR

AWS
American Welding Society

CWI

Matthew D. Gelardi

Has complied with the requirements of AWS QC1, Standard for AWS Certification of Welding Inspectors.

21085391
Exp. Aug/01/2027
Without Correction
Not Color Blind

AWS President

CERTIFIED WELDING INSPECTOR

TrueNorth Steel Bridge™

PEDESTRIAN BRIDGES

TRUENORTH STEEL

Steel has been the foundation of our business since 1945, and that commitment and experience has shaped our company into one of the most trusted and knowledgeable bridge manufacturers in North America. Whether we're replacing a trail bridge for a park or supplying an 80-foot county vehicular bridge, TrueNorth Steel brings dedication and mastery to every project. Our prefabricated and modular bridge products are pre-engineered with weather-protected, galvanized or painted steel construction and offer the benefits of fast installation, low maintenance and affordability.

WHY PREFABRICATED?

TrueNorth Steel prefabricated pedestrian bridges simplify construction yet deliver robust design and quality details.

We fabricate our bridges in our AISC-certified facilities, where we use only the highest quality materials and proven welding techniques. Our pre-engineered system shortens production timelines while ensuring a hassle-free and cost effective installation.

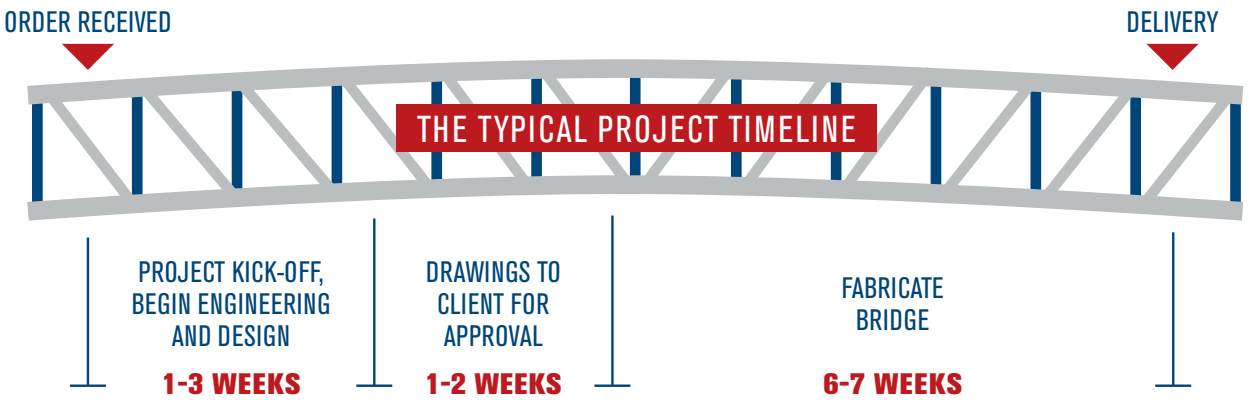
OUR BRIDGE TEAM

Quality, safety and on-time delivery are always our top priorities. Our team, including project managers and expert bridge product specialists, will assist from design kick-off through installation and ensure that expectations are not just met but exceeded.

TRUST IN OUR EXPERTISE. WE OFFER QUALITY, SAFETY, ON-TIME DELIVERY, HASSLE-FREE INSTALLATION

CONSULTATION TO INSTALLATION IN 12 WEEKS*

*Timeline may vary by application



FULL SPECTRUM SERVICES

TrueNorth Steel has worked with public agencies, local engineers and contractor partners throughout North America to provide unsurpassed project delivery. From the first conversations to the last bolt placement, we provide the guidance and support to ensure your bridge project is a success. We'll handle:

- **Concept:** Determine the best bridge type to suit the application.
- **Budget/value assessment:** Determine cost savings using prefabricated components.
- **Engineering consultation:** Superstructure/substructure designs by licensed engineers including abutments.
- **Bridge design:** Stamped by a professional engineer.
- **Fabrication:** Expert fabrication in strategically located AISC-certified facilities.
- **Pre-construction meeting** and on-site erection support.
- **Delivery:** Our in-house logistics company will transport or coordinate time-saving delivery logistics.
- **Installation:** Partnering with trusted contractors and consultants.

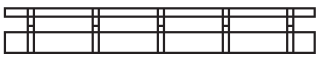
TRUENORTH STEEL PREFABRICATED PEDESTRIAN BRIDGES CAN BE SET IN AS LITTLE AS ONE DAY

PEDESTRIAN BRIDGE DESIGN

Whether it's for an urban or rural setting, park or busy highway overpass, TrueNorth Steel designs every pedestrian bridge to fit and enhance the surrounding landscape both aesthetically and environmentally. Our skilled fabricators and welders handcraft each bridge to stand the test of time.

TRUSS TYPES

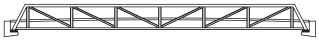
ARCH TRUSS

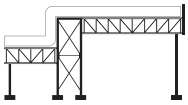

BEAM STRINGER

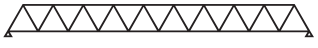
BOWSTRING

BROWN TRUSS

MODIFIED BOWSTRING


PRATT TRUSS


PIPELINE SUPPORT

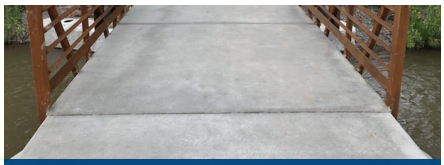

WARREN TRUSS

CUSTOM BUILT TO FIT YOUR NEEDS

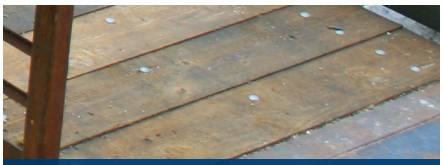
TrueNorth Steel pedestrian bridges seamlessly tie together efficiency and aesthetics. Our durable, high-quality designs are cost effective and meet state and local bridge design requirements. We coordinate closely with all stakeholders to ensure production, delivery and installation stay on track.

DECKING

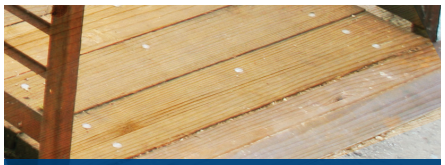
Our pedestrian bridges can accommodate a variety of deck options to best suit load limits, weather conditions, or simply to increase aesthetic appeal.



CONCRETE

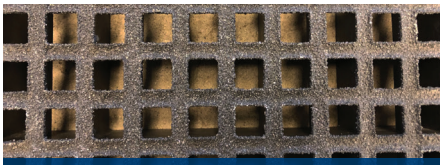


HARDWOODS



SOFTWOODS

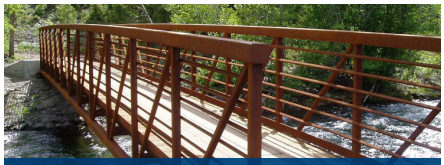
STEEL GRATING



FIBER REINFORCED POLYMER

FINISHES

TrueNorth Steel offers finish options that add functionality and timeless beauty to the bridge. Our design professionals will help you select options that will work best for the bridge application and region of installation.



WEATHERING STEEL

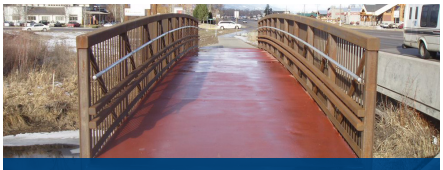
PAINTED

GALVANIZED

RAILINGS

Design options for functional, safe and decorative railings are almost endless.

HORIZONTAL RAILS

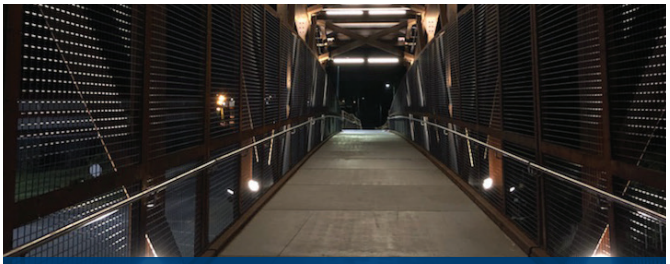


VERTICAL PICKETS

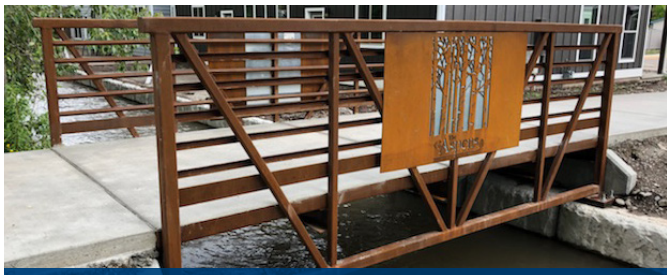
MESH PANELS

ADDITIONAL OPTIONS

ARCHITECTURAL ACCENTS



LIGHTING



CUSTOM DECORATIVE PANELS

ROOF ENCLOSURES

PEDESTRIAN BRIDGE APPLICATIONS

- TRAIL SYSTEMS
- EDUCATIONAL CAMPUSES
- STATE & NATIONAL PARKS
- COMMERCIAL & RESIDENTIAL DEVELOPMENTS
- GOLF COURSES
- RESORTS
- FISH ENHANCEMENT AREAS
- BUILDING TO BUILDING

ADVANCE YOUR PROJECT WITH EASE OF INSTALLATION

TrueNorth Steel prefabricated pedestrian bridges are built to stand the test of time, and are able to be shipped and installed quickly. Installation often takes less than a day, by utilizing readily available equipment. The ability to offer quick and hassle-free installation saves money on the need for additional subcontractors, equipment, and materials and also ensures your project stays on time. TrueNorth Steel succeeds when you succeed.

TRUENORTH STEEL PEDESTRIAN BRIDGE KEY BENEFITS

- CAN BUILD TO VIRTUALLY ANY WIDTH
- CUSTOMIZABLE TO ANY DESIGN LOAD
- ONE DAY INSTALLATION
- LOW-MAINTENANCE
- DESIGNED TO STATE, LOCAL, AND AASHTO CODES
- CUSTOMIZABLE AESTHETICS

Full Spectrum Steel Solutions Since 1945

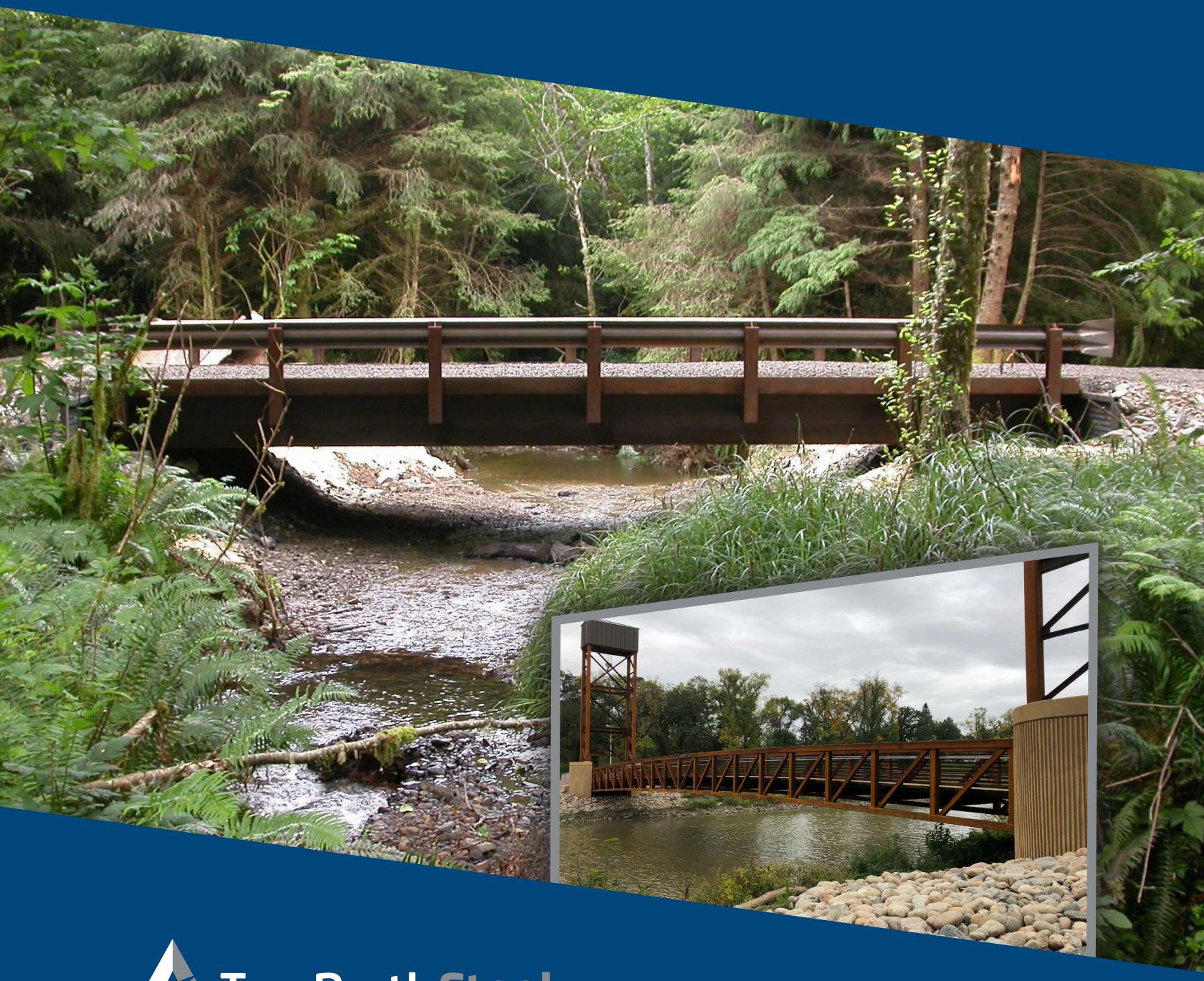
TrueNorth Steel Bridge™

TrueNorthSteel.com / Bridge@TrueNorthSteel.com

0622

Modular Bridges

Pedestrian and Vehicular



TrueNorth Steel Bridge™

TrueNorth Steel Bridge™

Steel has been the foundation of our business since 1945, and that commitment and experience has shaped our company into one of the most passionate, trusted and knowledgeable pedestrian and vehicular bridge providers in the industry. Whether we're developing a trail bridge for a park or replacing an 80-foot county vehicular bridge, we bring dedication and excitement to every project. Our products are pre-engineered/pre-fabricated, modular, weathering, galvanized and painted steel construction, offering fast installation, low maintenance and affordability.

OUR BRIDGE TEAM

Our bridge specialists work closely with each customer to ensure we don't just meet expectations but exceed them. Safety, quality, on-time delivery as well as rapid and trouble-free installation are always our top priorities, and we guarantee them on every project.

SAFETY, QUALITY, ON-TIME DELIVERY, TROUBLE-FREE INSTALLATION

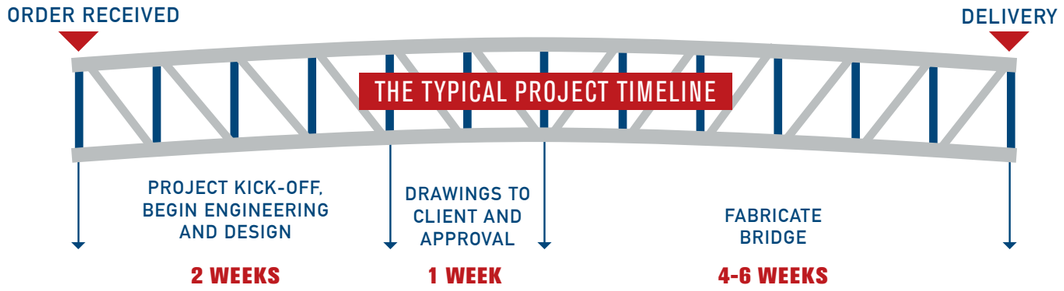
WHY MODULAR?

TrueNorth Steel bridges feature simple, lightweight modular construction but deliver big on aesthetics and quality details. We pre-manufacture components in our AISC-certified facilities, where we use only the highest quality materials and welding procedures. This process shortens lengthy production timelines while ensuring you get easy and fast, bolt-together installation at a low cost.

WHERE YOU'LL FIND OUR BRIDGES

- COUNTY ROADS
- FISH ENHANCEMENT AREAS
- GOLF COURSES
- COMMERCIAL AND RESIDENTIAL DEVELOPMENT
- PRIVATE PROPERTIES
- TRAIL SYSTEMS
- PUBLIC WORKS, GOVERNMENT & MUNICIPALITY PROJECTS
- RESORTS
- STATE AND NATIONAL PARKS
- TIMBER DEVELOPMENT LOCATIONS
- EDUCATIONAL CAMPUSES

CONSULTATION TO INSTALLATION IN AS LITTLE AS 7 WEEKS



FULL SPECTRUM SERVICES

Quality from Start to Finish

We work with local engineers and contractor partners throughout the U.S. to provide fast and cost-effective installations. From the first conversations to the last bolt placement, TrueNorth Steel provides the guidance and support to ensure your bridge project is a success. We'll handle:

- Bridge design stamped by a professional engineer
- Engineering counsel
- Abutment design
- Pre-construction meeting
- Delivery/logistics

Certifications

We don't just talk about quality, we train in it and certify to it, so every bridge comes with peace of mind. AISC-certified manufacturing facilities ensure the highest quality construction and fabrication.

Manufacturing and Material Standards Include:

- AISC-Certified Simple & Intermediate (major) Bridge Fabricator
- Fracture Critical Endorsement to meet the most stringent bridge fabrication demands
- Sophisticated Paint Endorsement
- Designed and fabricated to applicable AASHTO/ASTM Standards
- AWS Certified Welding Fabricator

AISC CERTIFIED FABRICATOR

AWS CWF CERTIFIED WELDING FABRICATOR®

AS MUCH AS **50% FASTER** THAN ON-SITE FIELD-FABRICATED CONSTRUCTION

PEDESTRIAN BRIDGES

Whether it's an urban or rural setting, park or busy highway overpass, we design every pedestrian bridge to enhance the landscape both aesthetically and environmentally. Our skilled fabricators and welders handcraft each bridge to deliver a design that stands the test of time.

- AERIAL SPANS OVER HIGHWAYS & RAILWAYS
- BIKING, HIKING & RECREATIONAL TRAILS
- RAILS-TO-TRAILS APPLICATIONS
- SKI IN-AND-OUT STRUCTURES

- **CLEAR SPANS UP TO 250 FEET**
- **ANY LOAD RATING**
- **LOW-MAINTENANCE**
  Weathering steel & painted structures

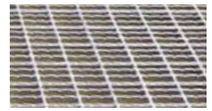
DECKS

FIBER REINFORCED POLYMER

CONCRETE

HARDWOODS

SOFTWOODS


STEEL GRATING

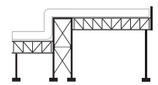
BRIDGE STYLES

ARCH TRUSS

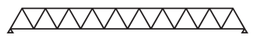
BOWSTRING

BROWN TRUSS

MODIFIED BOWSTRING

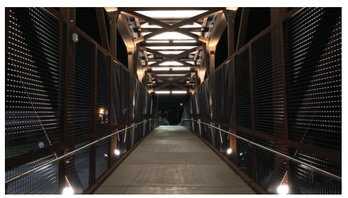

PIPELINE SUPPORT

PRATT TRUSS


WARREN TRUSS

OPTIONS

ARCHITECTURAL ACCENTS


LIGHTING

ROOF ENCLOSURES

SATISFIED CUSTOMERS

"Our experience with TrueNorth Steel was awesome from start to finish. The support staff communicated with us each step of the way — from design through production. Delivery was flawless and early, which allowed us ample time to set the bridge in time. We are looking forward to our next project with TrueNorth Steel!

– Fredco Inc., Purgatorie Pedestrian Bridge, Trinidad, CO

VEHICULAR BRIDGES

TrueNorth Steel vehicular bridges seamlessly tie together aesthetics, low installed cost and shortened installation time. Our durable, pre-fabricated, high-quality modular designs and meet state and local bridge design requirements. We ship them directly to the project so they can easily be assembled and installed by contractors or county crews, resulting in minimal road closure times.

- COUNTY ROADS
- PUBLIC WORKS, GOVERNMENT & MUNICIPALITY PROJECTS
- STATE AND NATIONAL PARKS
- TIMBER DEVELOPMENT LOCATIONS
- ENERGY, MINING, INDUSTRIAL

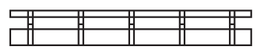
Our bridges can accommodate asphalt, concrete, gravel or treated timber driving surfaces. Prefabricated steel back walls, pre-engineered SuperSill® abutments, and abutment design services ensure a smooth transition from our products to existing roadway materials, simplifying installation and reducing cost.

- **VIRTUALLY ANY WIDTH**
- **CLEAR SPANS UP TO 240 FEET**
  Install up to 50-feet with excavators
- **MULTIPLE LOAD DESIGNS**
  from highway to heavy logging loads
- **LOW-MAINTENANCE**
  Weathering steel & painted structures
- **DESIGNED TO AASHTO CODE**
  State & local
- **HEAVY-DUTY DECKING**
  Galvanized corrugated
- **GUARD RAIL**
  Rated for test-levels 1-5

BRIDGE STYLES

Multiple guard rail optional available, including weathering steel & galvanized.

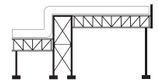
ARCH TRUSS


BEAM STRINGER

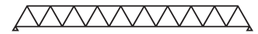
BOWSTRING

BROWN TRUSS

MODIFIED BOWSTRING


PIPELINE SUPPORT

PRATT TRUSS


WARREN TRUSS

ACCOMMODATES MULTIPLE SURFACES

PRE-ENGINEERED SUPERSILL® ABUTMENTS

HEAVY-DUTY GALVANIZED CORRUGATED DECKING

TrueNorth Steel Bridge™

Bridge@TrueNorthSteel.com | 406.532.7103
TrueNorthSteel.com

TrueNorth Steel

At TrueNorth Steel, we are proud to provide steel-based solutions for customers' projects in a variety of industries. With more than 75 years of manufacturing, engineering and project management experience, we deliver high-quality construction and storage solutions across the United States.

We work with local engineers and contractor partners throughout the U.S. to provide fast and safe installations. From the first conversations to last bolt placement, TrueNorth Steel provides guidance and support to ensure your bridge project is a success. TrueNorth Steel bridges feature simple, lightweight modular construction but deliver big on aesthetics and quality details.

We pre-manufacture components in our AISC-certified facilities, where we use only the highest quality materials and welding procedures. This process shortens lengthy production timelines while ensuring you get easy and fast, bolt-together installation at a low cost. We ship them directly to the project so they can easily be assembled and installed by contractors or county crews, resulting in minimal road closure times.

Whether it's an urban or rural setting, city park or busy highway overpass, we design every pedestrian bridge to enhance the landscape both aesthetically and environmentally. We can help you find that perfect balance of utility and eye pleasing appeal.

Our skilled fabricators and welders handcraft each bridge to deliver a design that will stand the test of time. Our steel pedestrian bridges are pre-engineered and prefabricated making the entire process simple, fast and reliable.

Fabricated from low maintenance weathering steel, galvanized or painted steel and long-lasting deck materials, TrueNorth Steel pedestrian bridges will provide years of trouble- free service.

Bridge Engineering Manager: Michael Philpot, PE

- In steel fabrication since 2009
- Experienced in structural design and fabrication of pedestrian and vehicular bridges. Engineer of Record on over 400 bridges.
- 2009 graduate of University of Wyoming with a B.S. in Civil Engineering
- 2015 graduate of California Coast University with a Master's in Business Management
- Licensed Professional Engineer in 39 states
- FHA Licensed Bridge Inspector
- Phone: (307) 871-4537 Email: michael.philpot@truenorthsteel.com

TrueNorth Steel Website: www.truenorthsteel.com

Pedestrian Bridges

Installation Guide

TrueNorth Steel Bridge™

TrueNorth Steel recommends that the installing contractor conduct a preconstruction meeting in advance of bridge delivery to ensure that all parties are prepared and equipped with appropriate tools to unload, assemble, and set the bridge. This guide is meant to assist the installing contractor but is not necessarily inclusive of all steps, nor is it meant to address site conditions.

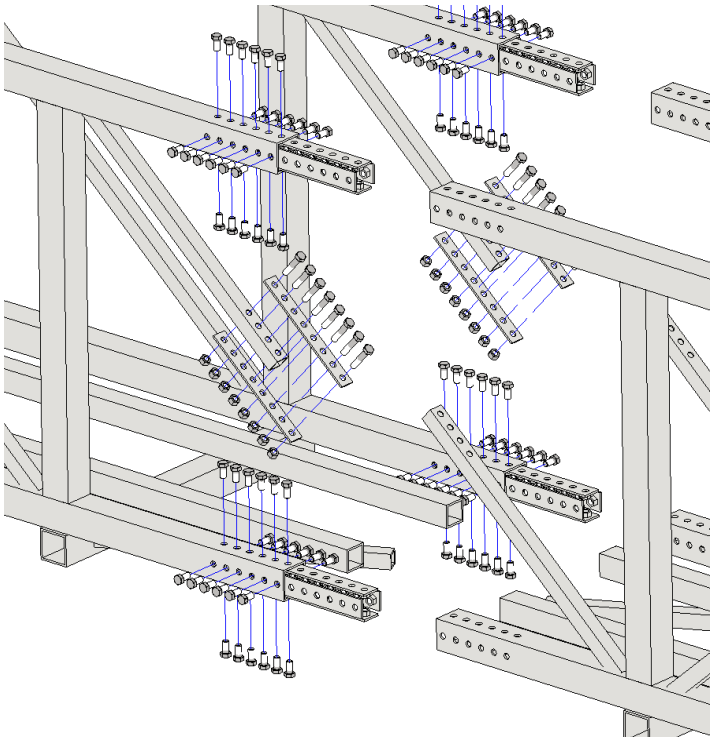
The installing contractor is responsible for all aspects of safety including setting and positioning of lifting equipment. Estimated lifting weights are shown on bridge shop drawings.

UNLOADING

The bridge will be delivered to the jobsite by highway accessible tractor trailer and the installing contractor will be responsible for location of the truck and lifting equipment as well as unloading the bridge at the site.

Care must be taken to locate loose items such as bearing assemblies and bolts that will arrive with the bridge. The contractor should immediately ensure all loose items are unloaded, accounted for, and placed in a secure location. Refer to the bill of lading.

SPLICING OF BRIDGE SECTIONS *(IF REQUIRED)*



Bridges are supplied utilizing two types of bolted splice connections. Additional splice details may be utilized and these would be noted on the shop drawings.

Vertical truss diagonals and horizontal brace diagonals will be joined with splice plates on the outside of the truss members utilizing pass through bolts. Each hole will receive one bolt and one nut. Vertical truss diagonal and horizontal brace diagonal plates will arrive loose or wired and bolted to the bridge. Identical plates are interchangeable. Refer to the shop drawings for plate locations and bolt size.

Chord splice plates will arrive loose or attached to the bridge by wire and shipping bolts.

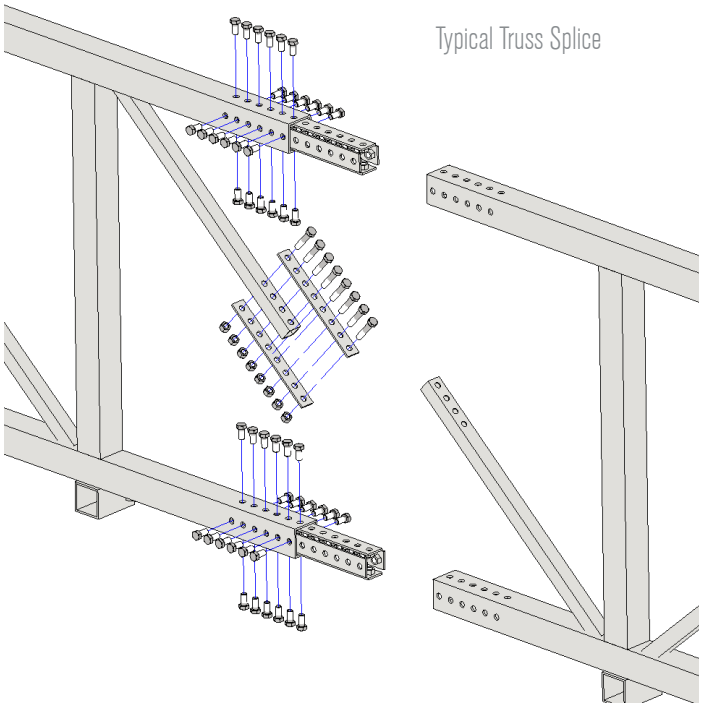
The chord splice plates will arrive with all nuts welded to the plate or will be included with the loose items. The plates will be installed inside of the chord member. Identical plates are interchangeable.

Place one bolt in each hole location. For the bolted splice details refer to the shop drawings.

Bolts utilized in shipping and handling are to be removed and discarded.

Plates are then to be held in the proper location for the diagonal splices and bolts installed. All bolts should be loosely installed before any bolts are tensioned.

For plate locations, bolt sizes, and additional splice details refer to the shop drawings.



Typical Truss Splice

There are three common procedures for splicing bridge sections together:

1. When spliced bridges arrive in multiple sections, place one section on a relatively flat surface with the spliced end elevated approximately 2' and securely supported. This will allow for easier fit up and allows room to work under the bridge. The other section should be lifted with a crane or other equipment with sufficient capacity. When the chord splices are lined up, the section will be moved carefully into place. It may be necessary to use come-a-longs to pull the sections together. When the bolted splice(s) are complete (all sections, if multiple), the entire bridge may be lifted as one piece and set on the foundations.
2. Supported mid-air splicing can be accomplished when utilizing separate cranes to safely lift each section.
3. One section may be placed on it's foundation, while its spliced end is supported on temporary supports. Once the first section is set and supported, the second section is lifted into place to allow the splice connection to be completed.

BOLTING

Bolts supplied for assembly are high strength structural bolts. Common bolt sizes are 3/4'', 7/8", and 1" diameters with respective socket sizes are 1 1/4 ", 1 7/16", and 1 5/8". All bolts should be installed loose and then tightened from the center of the splice, working to the ends of the splice.

Bolt tightening shall be in accordance with the Research Council on Structural Connections (RCSC) "Specification for Structural Joints using ASTM A325 or A490 Bolts" by using the turn-of-nut procedure described in the table below.

All bolts should be brought to a snug tight condition to ensure the individual plies of the splice joint are brought into contact with each other. According to RCSC, snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a ironworker using an ordinary spud wrench. Once all bolts are brought to a snug tight condition, all remaining bolts shall then be tightened by the applicable amount of nut rotation as specified in the table below. During this operation, there shall be no rotation of the part not turned by the wrench.

Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance should be plus or minus 30 degreess. For bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45 degrees.

If bolts do not smoothly engage to snug-tight there may be an obstruction within the threads. In this case, the bolt should be removed, the threads on the bolt and nut cleaned and retapped as needed, to allow smooth installation of the bolts.

Bolt Length	Flat Surfaces Under Bolt Head & Nut
$\leq$ 4D	1/3 Turn
4D $\leq$ 8D	1/2 Turn
8D $\leq$ 12D	2/3 Turn

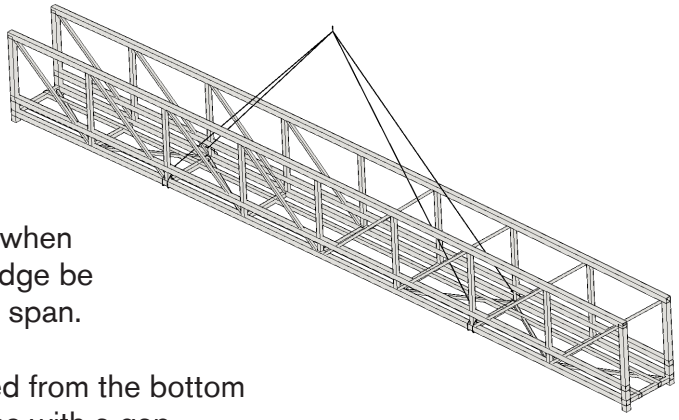
SPLICING & DECKING

Splicing and Decking Considerations

Wood decking - It is allowable for the installing contractor, but not required, to remove 2-3 wood deck planks from each side of the splice to make room for bolting the floor diagonal and stringers below the deck. It is recommended that boards be placed back in their original location for fastener and hole alignment.

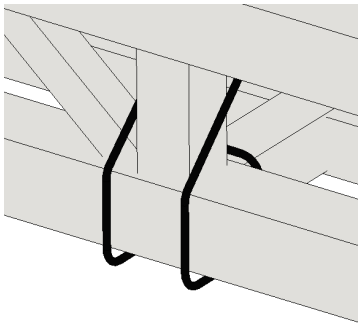
Concrete deck - Galvanized concrete form decking will be shipped factory installed except for the pieces that directly cover the splice. Upon completion of splicing, the contractor shall install the remaining form decking connected to the floor beams utilizing self-tapping screws. Pre-drill all holes prior to installing the screws. Screws will be provided as loose items with the bridge. Bridges spliced lengthwise will have all decking shipped loose for field install by contractor.

LIFTING INSTRUCTIONS

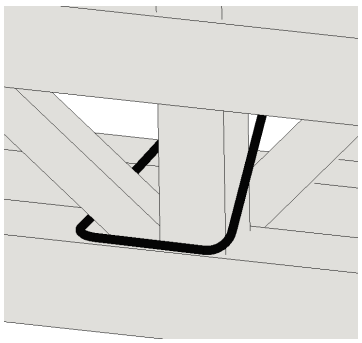


A minimum of four (4) lifting points are required when lifting any bridge. It is recommended that the bridge be lifted from the end to the 1/3 point of the bridge span.

Underhung and H-section bridges are to be lifted from the bottom chord or floor beams only. For underhung bridges with a gap between deck and chord face; wrap the chain, cable, or sling over the top of floor beam, under the bottom chord, up and inside of truss over the deck. For H-section bridges, wrap chain, cable or sling inside the vertical below the floor beam, around the vertical crossing over on the outside of the vertical, up and inside the truss over the deck.



Alternatively, bridges may be lifted from the top chord if a spreader bar is used to keep any tangential forces from being applied to the bridge. The top chords should never be pulled towards each other during the lifting process. When an underhung bridge has a concrete deck that extends all the way to the chord face, lifting may be done by wrapping cable, choker or sling around a diagonal and vertical member where they meet on the top of the bottom chord at deck level. Box truss bridges may be lifted by wrapping chain, choker, or sling around the top chord at the joint of a vertical, diagonals, and top strut.



BEARING PREPARATION

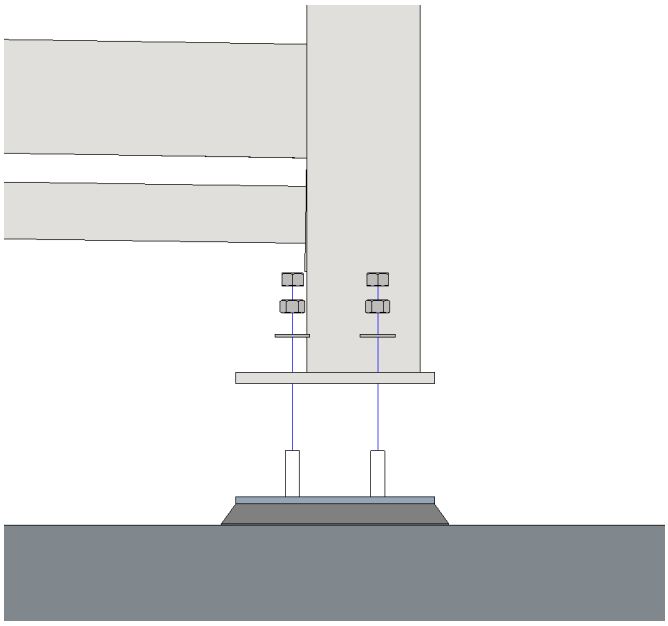
Setting plates need to be installed with 3/4” steel shims under the center, unless directed differently on bridge plans.

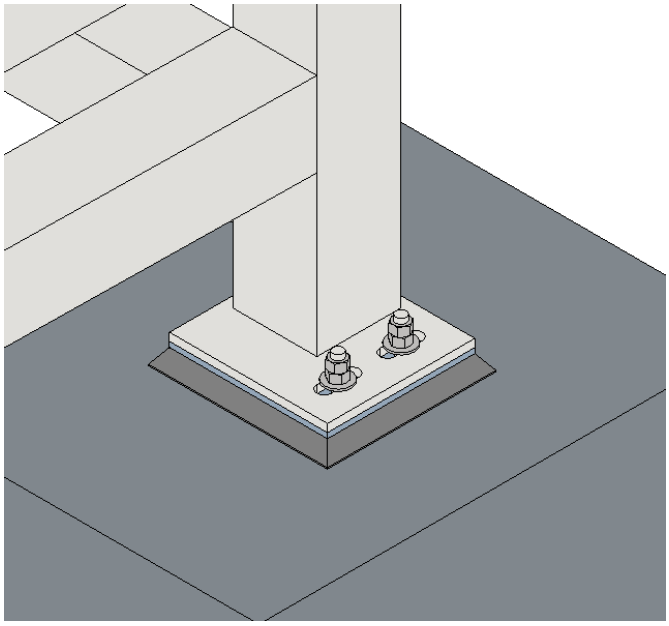
Lightly apply grease to tops of all base plates except Teflon/stainless steel bearings.

All Teflon/stainless bearing assemblies will be factory supplied and welded to bearing plates. Make certain that the setting plate (lower bearing that sits on the foundation) has the teflon facing up and the top bearing (physically welded to the bridge) has the stainless facing down. Remove any protective coatings from the teflon and stainless surfaces.

After the bridge is set, shims can be adjusted to make the deck flush with the backwall and to obtain full contact between the setting plate and the bearing plate.

After all adjustments are made, place high strength non-shrink grout under setting plate to create full contact between the setting plate and the foundation seat.





SETTING INSTRUCTIONS

Bridge shall be set as directed in notes on the shop drawings. Note: If the bridge foundations have an elevation difference, be sure to set the high end of the bridge on the higher foundation per the shop drawings. Refer to the shop drawings for correct alignment.

Bridges with an elevation difference will have a welded mark (H) for high, (L) for low, located on the outside face of the corresponding end floor beam.

Each anchor bolt will receive one (1) washer and two (2) nuts. One end of the bridge is designed to be fixed and the nuts are to be installed tight. The expansion end of the bridge will have the first nut tightened finger tight to the washer placed on the bearing plate. The second nut will be installed tight to the first. Refer to the shop drawings to determine which end of the bridge is to be the fixed and which is to be the expansion end. Teflon/stainless steel bearings will always be on the expansion end. TrueNorth Steel recommends destroying the threads on the anchor bolt, after bridge is fully installed.

When handling and installating painted bridges, the installating contractor must be careful to minimize damage to the painted finish. Padding should be used to protect the paint from chain, choker, or sling. It will be the responsibility of the installing contractor to perform any and all touch up painting from delivery, unloading, assembly, and setting, as necessary.

A nominal amount of touch up paint will be supplied. If additional paint is needed, TrueNorth Steel will assist contractor in locating a local supplier, for contractor purchase.

This is often an epoxy system and attention will need to be given to mixing and applying the paint products. Touch up must be applied to blend with factory application as much as possible. Please follow manufacturers latest recommendations found online.

TrueNorth Steel Bridge™

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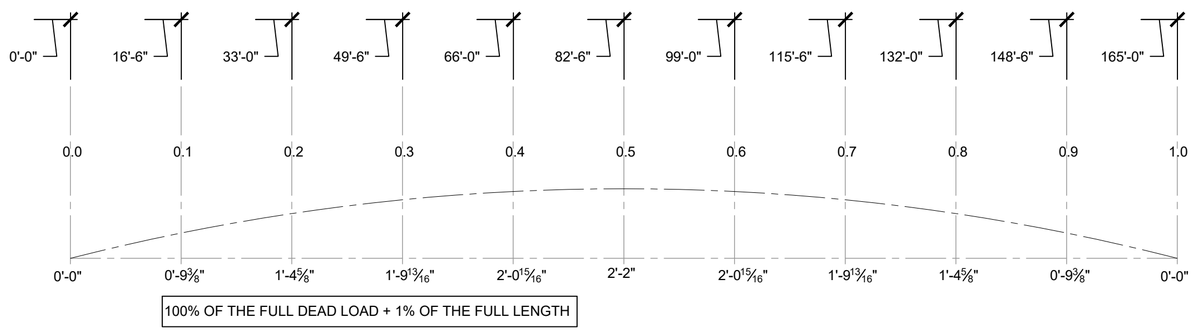
TrueNorthSteel.com

1120

STRUCTURAL GENERAL NOTES

1. ALL STRUCTURAL STEEL SHAPES AND PLATES SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M 270 GRADE 50W (ASTM A709 / ASTM A588 WEATHERING STEEL), HSS STRUCTURAL TUBING SHALL CONFORM TO THE REQUIREMENTS OF (ASTM A847 / ASTM A588 WEATHERING STEEL), UNLESS NOTED OTHERWISE. PIPE SHALL BE GALVANIZED A53 GRB
2. EXTERIOR SURFACES SHALL BE CLEANED PER SSPC-SP 6 PRIOR TO SHIPMENT TO ASSURE UNIFORM WEATHERING IN ACCORDANCE WITH OWNER REQUIREMENTS.
3. CONCRETE FOUNDATIONS BY OTHERS. FOUNDATION MUST BE CAPABLE OF SUPPORTING BRIDGE WEIGHT AND DESIGN LOADS, ALL LOADS CAN BE FOUND ON THESE DRAWINGS.
4. ALL WOOD DECK CONNECTIONS SHALL BE MADE WITH GALVANIZED CARRIAGE BOLTS, NUTS AND WASHERS, UNLESS NOTED OTHERWISE
5. ALL STRUCTURAL STEEL CONNECTIONS SHALL BE MADE WITH HIGH STRENGTH BOLTS (ASTM A325X TYPE 3), NUTS (ASTM A563 GR DH3), AND WASHERS (ASTM F436 TYPE 3) CONFORMING TO AASHTO M 164, UNLESS NOTED OTHERWISE. TYPICAL CONNECTIONS ARE "SNUG TIGHT" BEARING CONNECTIONS WITH STANDARD WASHERS. USE LOAD INDICATOR WASHERS AT ALL BOLTED SPLICE CONNECTIONS (NOTED AS TCB) OR CONNECTIONS LISTED AS FULLY TENSIONED OR SLIP CRITICAL. LOAD INDICATING DEVICES, DTI'S OR SQUIRTER DTI'S, SHALL CONFORM TO ASTM F959. ANCHOR RODS SHALL CONFORM TO ASTM F1554 GR 36.
6. CERTIFIED MILL TEST REPORTS SHALL BE FURNISHED FOR THE STEEL STRINGERS, STRUCTURAL STEEL PLATES AND SHAPES, HIGH STRENGTH BOLTS, PLAIN ELASTOMERIC PADS (PEP).
7. ALL WELDING SHALL BE IN ACCORDANCE WITH AWS D1.1, BRIDGE WELDING CODE. ALL WIDE FLANGE WELDING SHALL BE IN ACCORDANCE WITH AWS D1.1, STRUCTURAL WELDING CODE - STEEL. ALL ELECTRODES SHALL BE E70XX.
10. STEEL REINFORCED ELASTOMERIC BEARING PAD CONSIST OF STEEL REINFORCING PL FY = 50 KSI AND PLAIN ELASTOMERIC LAYERS AND SHALL BE HARDNESS (SHORE A) 50 MEETING THE REQUIREMENTS OF LOW TEMPERATURE GRADE 4 AND SHALL CONFORM TO AASHTO M 251 AND ASTM D4014.
11. EPOXY SHALL BE PER MIL A 81236 (OS), BOND BEARING PAD TO ANCHOR PLATE.
12. WOOD BRIDGE DECK SHALL BE ACQ WITH .040 RETENTION, PRESSURE TREATED DOUGLAS FIR #2 OR BETTER.

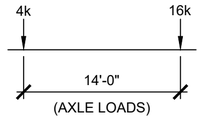


100% OF THE FULL DEAD LOAD + 1% OF THE FULL LENGTH

1 CAMBER DIAGRAM

SCALE: NTS

DESIGN NOTES



(AXLE LOADS)

1. DESIGN VEHICLE LOAD: AASHTO H10 (GVW 10 TONS).
   DESIGN PEDESTRIAN LIVE LOAD: 90 PSF.
   WIND SPEED: 100MPH.
2. PEDESTRIAN DESIGN CODE: AASHTO GUIDE SPECIFICATIONS FOR DESIGN OF PEDESTRIAN BRIDGES & LRFD BRIDGE DESIGN SPECIFICATIONS.
3. LIVE LOAD DEFLECTION AT MIDSPAN IS L/900.
4. TOTAL BRIDGE WEIGHT: APPROX 107,163 LB.
   MODULE 1 WEIGHT: APPROX 53,582 LB PER MODULE.
   MODULE 2 WEIGHT: APPROX 53,582 LB PER MODULE.

THE OWNER OR OWNER'S REPRESENTATIVE (SITE ENGINEER OF RECORD) IS RESPONSIBLE FOR THE REVIEW OF BRIDGE STRUCTURE DIMENSIONS AND LAYOUT SHOWN HEREIN. ANY DISCREPANCIES BETWEEN REQUIRED FIELD DIMENSIONS AND THOSE SHOWN HEREIN ARE NOT THE RESPONSIBILITY OF TRUENORTH STEEL OR DCI-BCE ENGINEERS, INC. UNLESS THE DISCREPANCIES HAVE BEEN SPECIFICALLY NOTED WITHIN THIS REVIEW SET OR PREVIOUSLY CONVEYED IN WRITING. YOUR SIGNATURE BELOW ACKNOWLEDGES THIS RESPONSIBILITY AND SERVES AS NOTICE TO PROCEED WITH BRIDGE FABRICATION.

OWNER OR REPRESENTATIVE NAME:

OWNER OR REPRESENTATIVE SIGNATURE:

DATE:

SHEET INDEX

SHT NO	SHEET TITLE
S0	STRUCTURAL GENERAL NOTES
S1	BRIDGE PLAN & ELEVATION
S2	BRIDGE SECTIONS & DETAILS
S3	DETAILS
S4	DETAILS
S5	SPLICE DETAILS
S6	SPREADER BEAM
S-BOM1	BILL OF MATERIALS

S/N
165TB10H10-PFS0198

TrueNorth Steel

REGISTERED PROFESSIONAL ENGINEER
JAMI LORENZ
PE-8854
DATE 07/18/2018
NORTH DAKOTA

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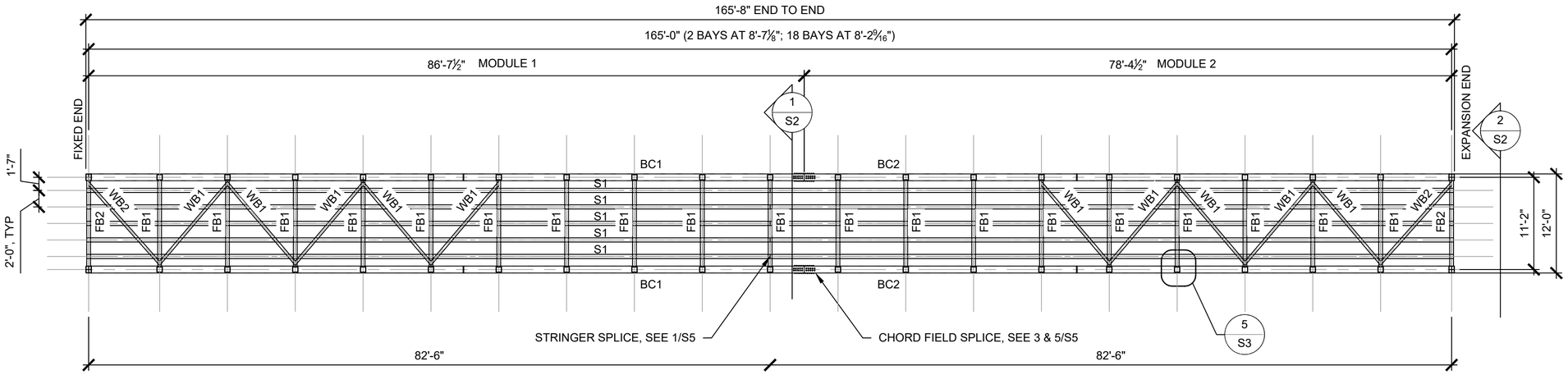
PROJECT IDEN.
165'L x 10'W H10, OAK GROVE PEDESTRIAN LIFT BRIDGE, FARGO, ND

ISSUE BLOCK	
FIN	07/18/2018 FINAL 3
FIN	07/03/2018 FINAL 2
FIN	04/25/2018 FINAL
APP	03/29/2018 FOR APPROVAL 4
APP	03/20/2018 FOR APPROVAL 3
APP	03/08/2018 FOR APPROVAL 2
APP	02/19/2018 FOR APPROVAL
CHK	02/14/2018 CHECK PRINT

MANAGEMENT	
JOB NO.:	PFS0198
PROJECT NO.:	18161-0006
DRAWN BY:	ARH
CHECKED BY:	BJS

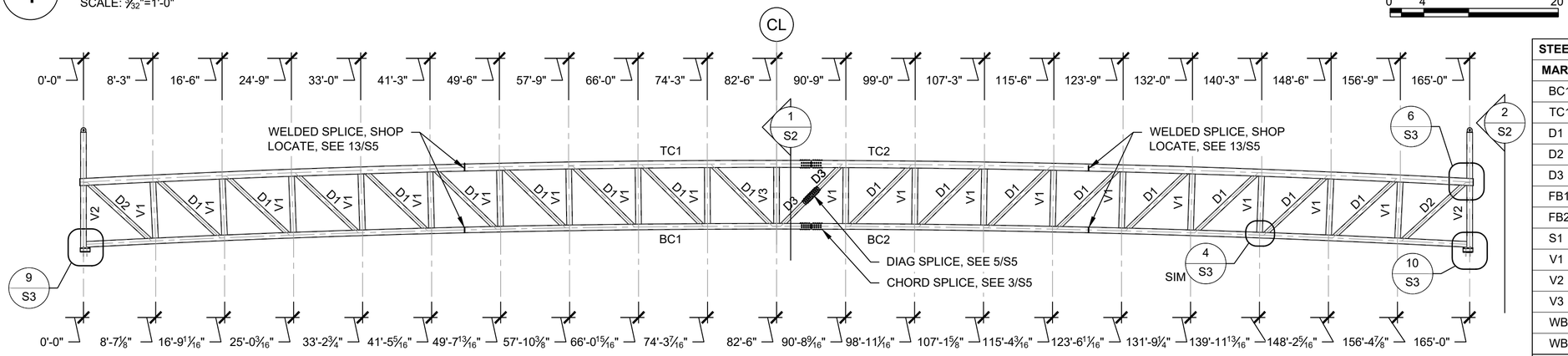
SHEET TITLE
STRUCTURAL GENERAL NOTES

SHEET IDENTIFICATION
S0
1 OF 8



1 BRIDGE FRAMING PLAN

SCALE: ³⁄₃₂"=1'-0"



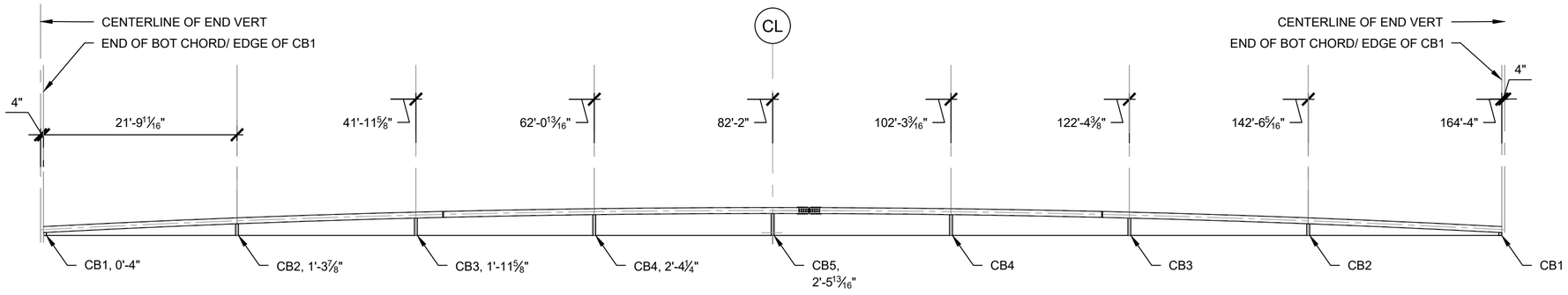
NOTE: SAFETY RAIL NOT SHOWN FOR CLARITY

NOTE: SEE LEGEND THIS SHEET FOR SIZES & SHEET S3 FOR MEMBER DETAILING, TYPICAL

STEEL MEMBER LEGEND	
MARK	STL MEMBER
BC1/2	HSS10x8x3/8
TC1/2	HSS10x10x1/2
D1	HSS6x6x5⁄16
D2	HSS6x6x5⁄16
D3	HSS6x6x5⁄16
FB1	W16x26
FB2	W16x26
S1	W6x15
V1	HSS8x8x3⁄8
V2	HSS10x8x3⁄8
V3	HSS8x8x3⁄8
WB1	HSS4x4x1⁄4
WB2	HSS4x4x3⁄8
SEE S4 FOR ADDITIONAL INFO	

2 BRIDGE ELEVATION

SCALE: ³⁄₃₂"=1'-0"



NOTE: CAMBER AT C.L. = 2'-0" + DL DEFLECTION = 2'-2"

3 CHORD CAMBER ELEVATION

SCALE: ³⁄₃₂"=1'-0"

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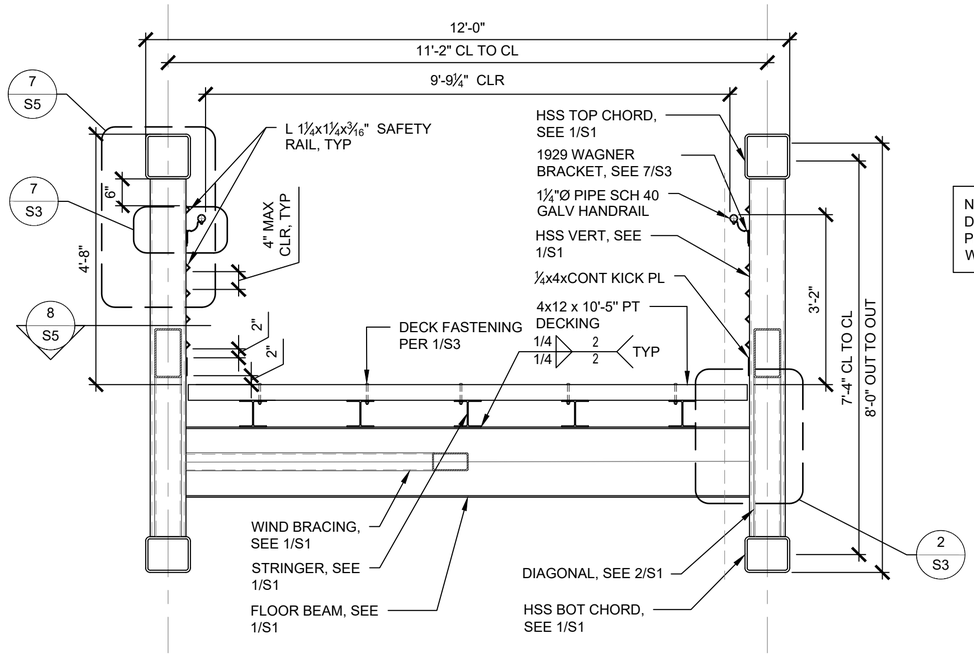
MANAGEMENT	
JOB NO.:	PFS0198
PROJECT NO.:	18161-0006
DRAWN BY:	ARH
CHECKED BY:	BJS

SHEET TITLE
BRIDGE PLAN & ELEVATION

SHEET IDENTIFICATION
S1
2 OF 8

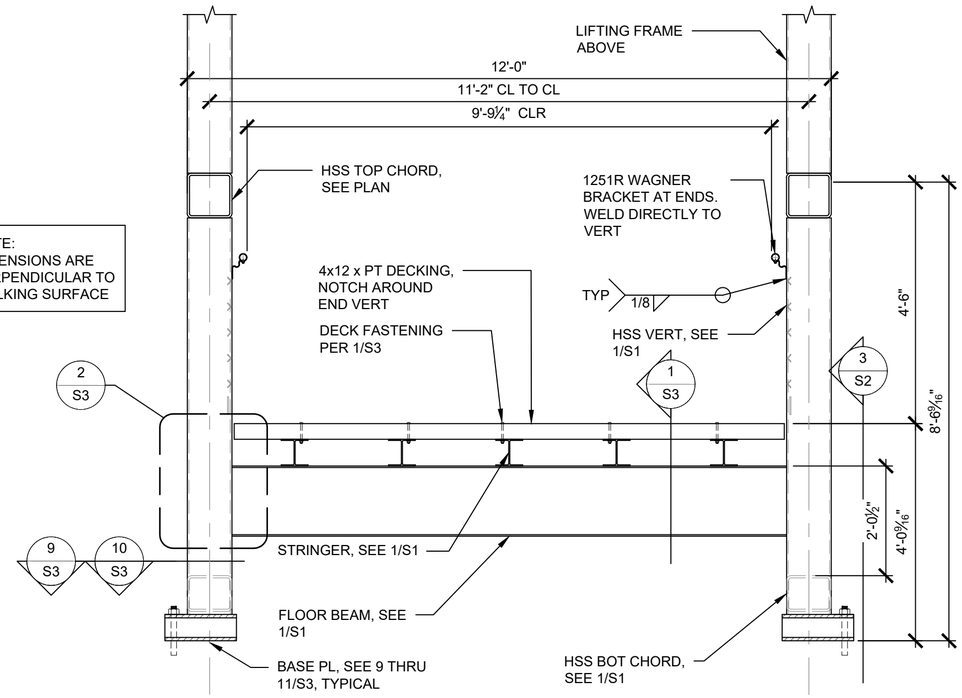


1 MID-SPAN TYPICAL SECTION

SCALE: ½"=1'-0"

0' 1' 2' 4'

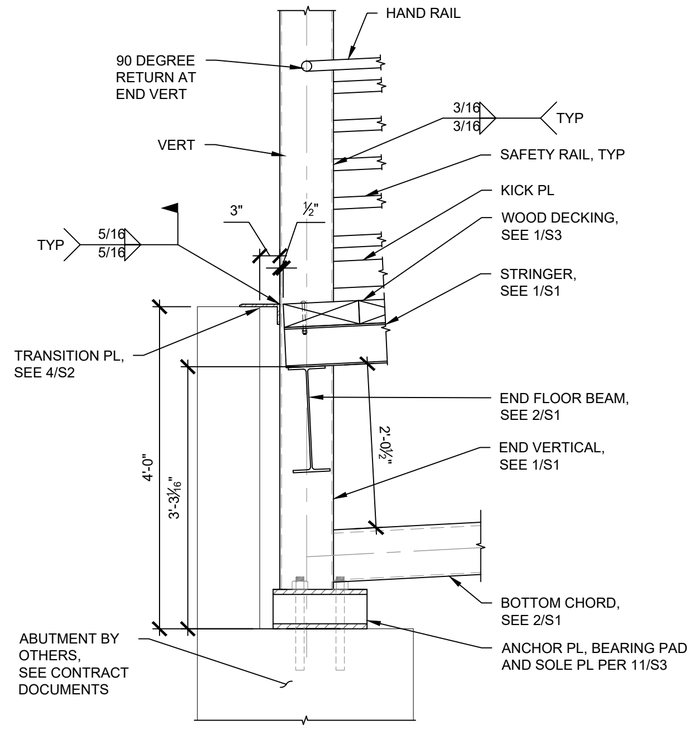
NOTE:
DIMENSIONS ARE
PERPENDICULAR TO
WALKING SURFACE



2 ABUTMENT SECTION

SCALE: ½"=1'-0"

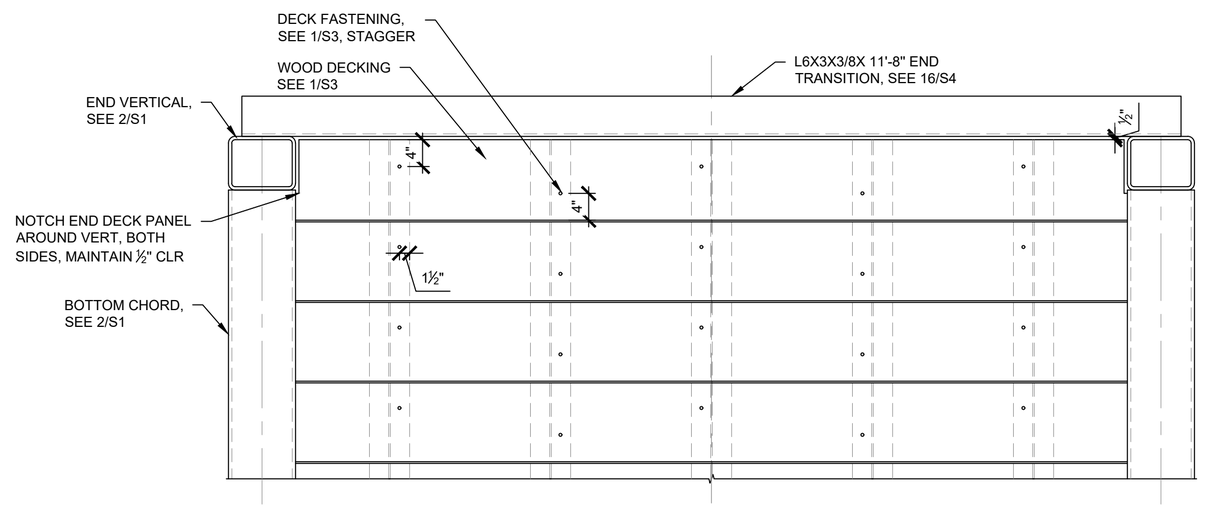
0' 1' 2' 4'



3 ABUTMENT DETAIL

SCALE: ¾"=1'-0"

0" 8" 16" 32"



4 DECK END - PLAN

SCALE: ¾"=1'-0"

0" 8" 16" 32"

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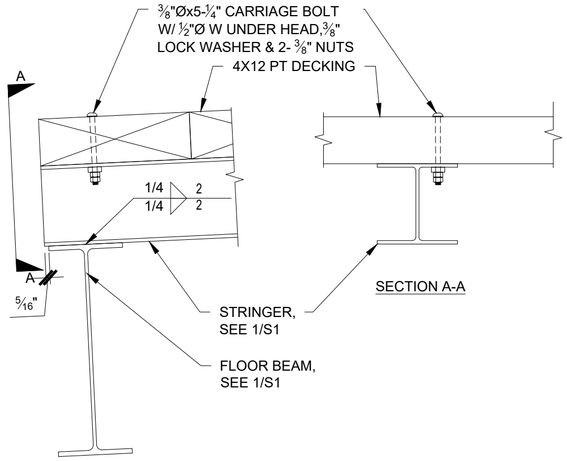
MANAGEMENT	
JOB NO.:	PFS0198
PROJECT NO.:	18161-0006
DRAWN BY:	ARH
CHECKED BY:	BJS

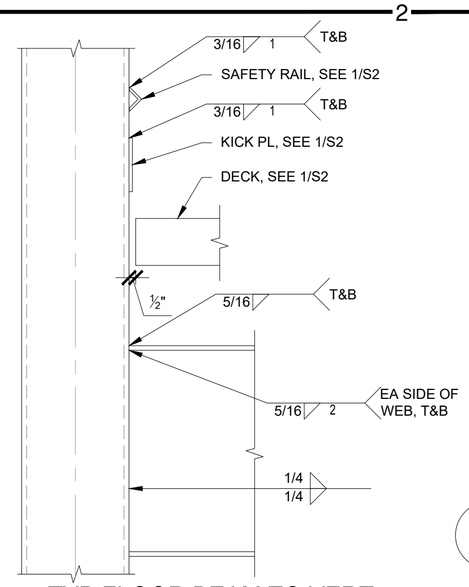
SHEET TITLE
BRIDGE SECTION & DETAILS

SHEET IDENTIFICATION
S2
3 OF 8



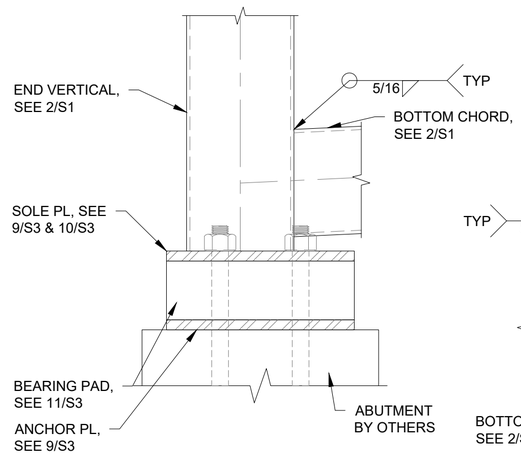
1 TYP DECK END DECKING

SCALE: 1½"=1'-0" 0" 4" 8" 16"



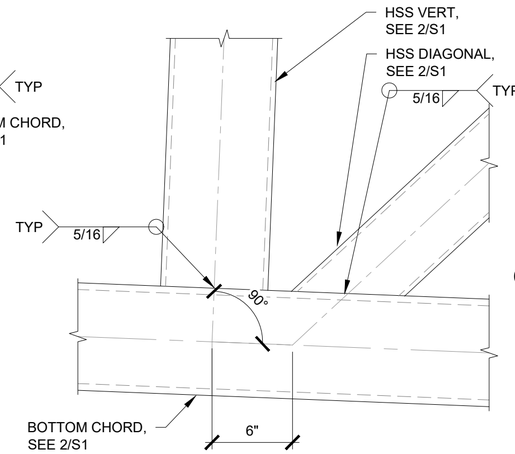
2 TYP FLOOR BEAM TO VERT

SCALE: 1½"=1'-0" 0" 4" 8" 16"



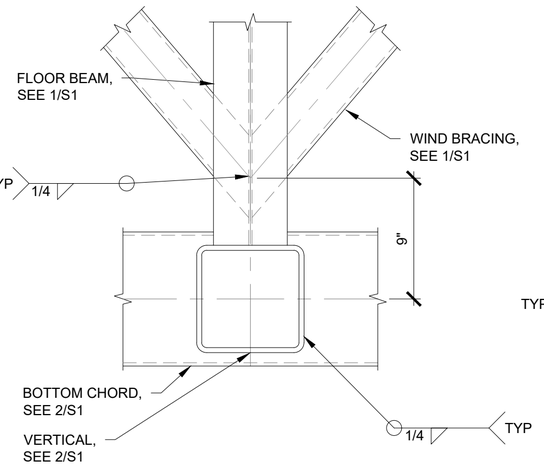
3 FIXED BEARING CONDITION

SCALE: 1½"=1'-0" 0" 4" 8" 16"



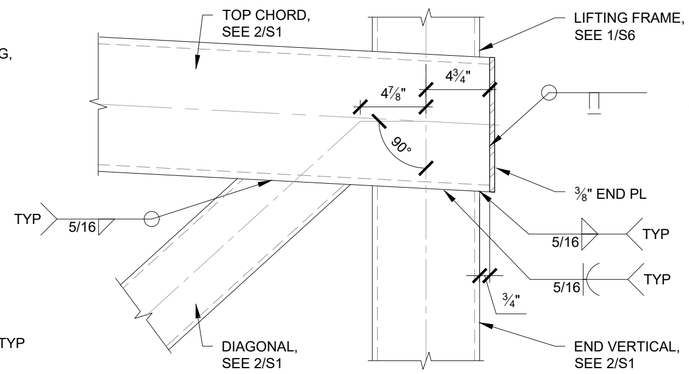
4 TYP TOP & BTM CHORD TO WEBS

SCALE: 1½"=1'-0" 0" 4" 8" 16"



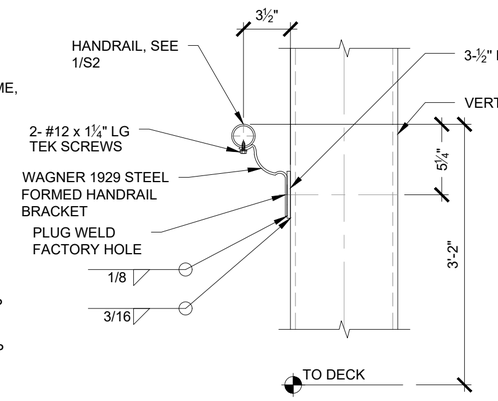
5 TYP FLR BM & WIND BRACING TO VERT

SCALE: 1½"=1'-0" 0" 4" 8" 16"



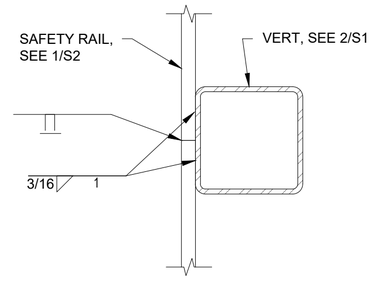
6 TYP TOP CHORD @ END

SCALE: 1½"=1'-0" 0" 4" 8" 16"



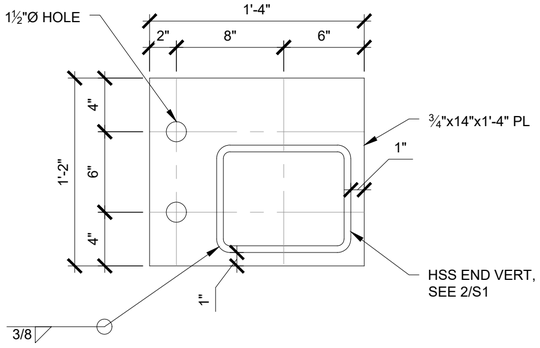
7 HANDRAIL DETAIL

SCALE: 1½"=1'-0" 0" 4" 8" 16"



8 TYP SAFETY RAIL SPLICE

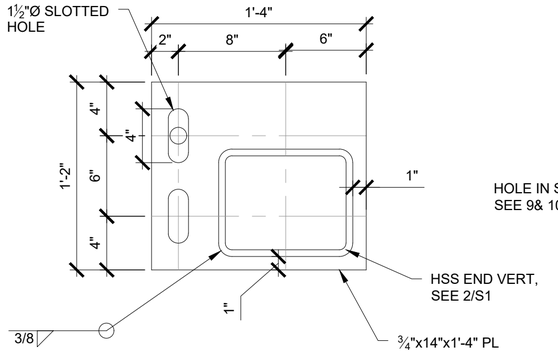
SCALE: 1½"=1'-0" 0" 4" 8" 16"



9 BP1- FIXED BASE PLATE

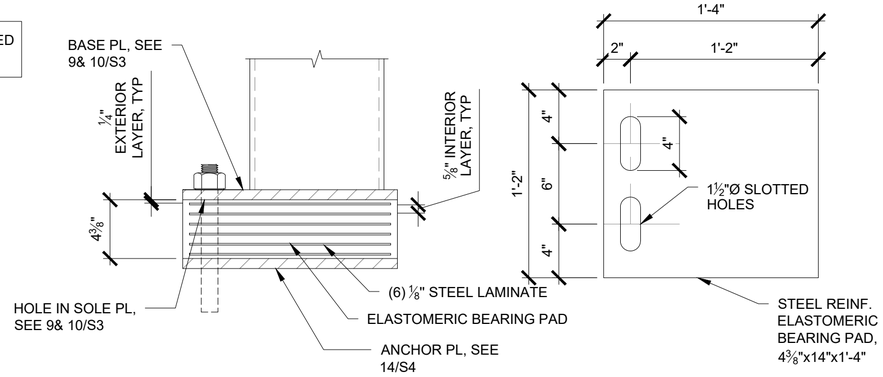
SCALE: 1½"=1'-0" 0" 4" 8" 16"

NOTE: ANCHOR BOLTS SHALL BE 1¼"Ø HAS-E, DRILLED AND EPOXIED INTO CONCRETE ABUTMENT WITH MIN 14" EMBED



10 BP2- EXPANSION BASE PLATE

SCALE: 1½"=1'-0" 0" 4" 8" 16"



11 ELASTOMERIC PAD - EACH END

SCALE: 1½"=1'-0" 0" 4" 8" 16"

S/N
165TB10H10-PFS0198

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APP	02/19/2018 FOR APPROVAL
CHK	02/14/2018 CHECK PRINT

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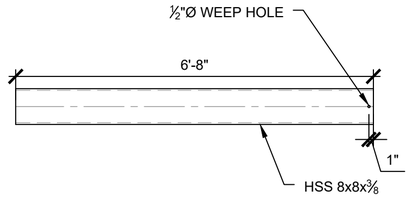
JOB NO.:	PFS0198
PROJECT NO.:	18161-0006
DRAWN BY:	ARH
CHECKED BY:	BJS

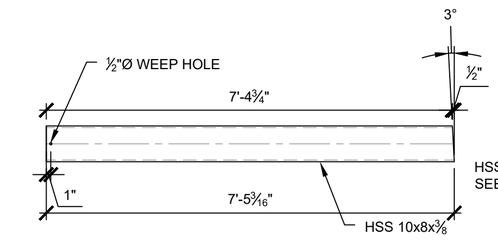
SHEET TITLE
DETAILS

SHEET IDENTIFICATION
S3
4 OF 8



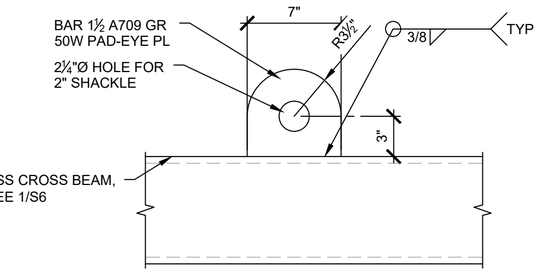
1 TYP VERTICAL (V1)

SCALE: ½"=1'-0" 0' 1' 2' 4'



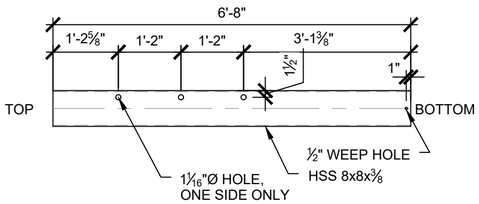
2 END VERTICAL (V2)

SCALE: ½"=1'-0" 0' 1' 2' 4'



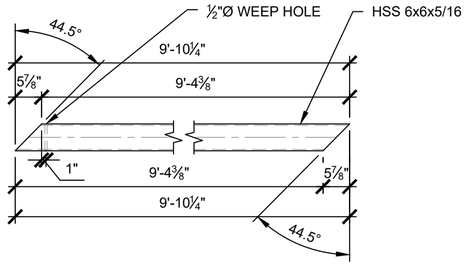
3 PAD-EYE DETAIL

SCALE: 1½"=1'-0" 0" 4" 8" 16"



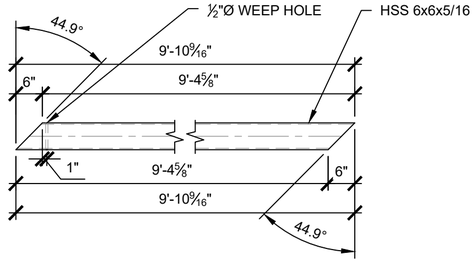
4 SPLICE VERTICAL (V3)

SCALE: ½"=1'-0" 0' 1' 2' 4'



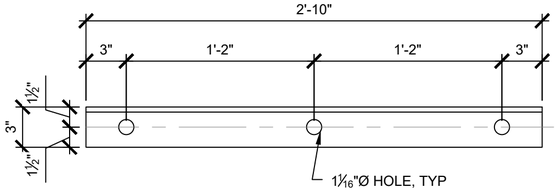
5 TYP DIAGONAL (D1)

SCALE: NTS



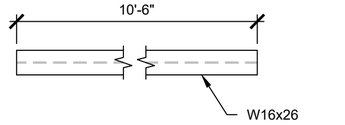
6 END DIAGONAL (D2)

SCALE: NTS



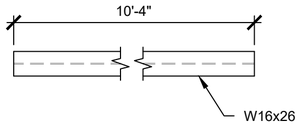
7 SAFETY RAIL SPLICE ANGLE - L3x3x1/4

SCALE: 1½"=1'-0" 0" 4" 8" 16"



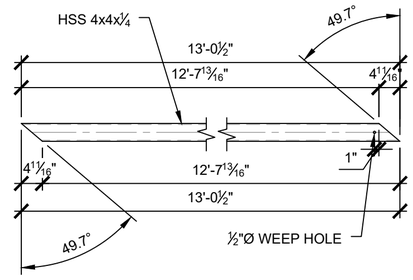
8 TYP FLOOR BEAM (FB1)

SCALE: ½"=1'-0" 0' 1' 2' 4'



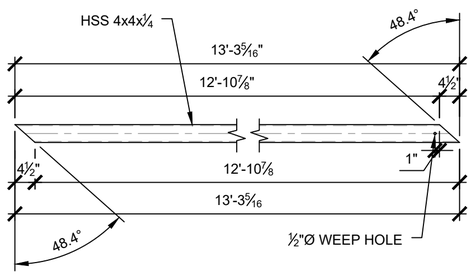
9 END FLOOR BEAM (FB2)

SCALE: NTS



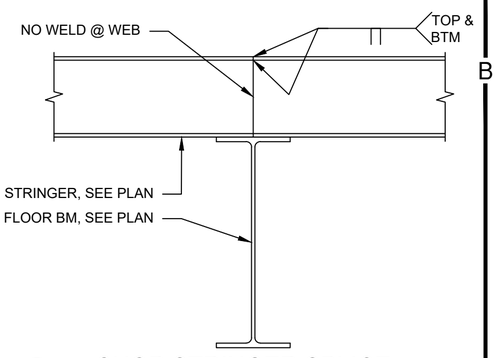
10 TYP WIND BRACE (WB1)

SCALE: NTS



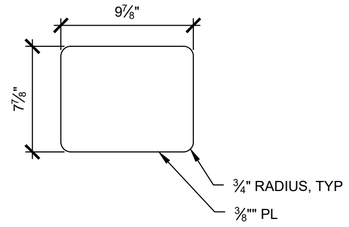
11 END TYP WIND BRACE (WB2)

SCALE: NTS



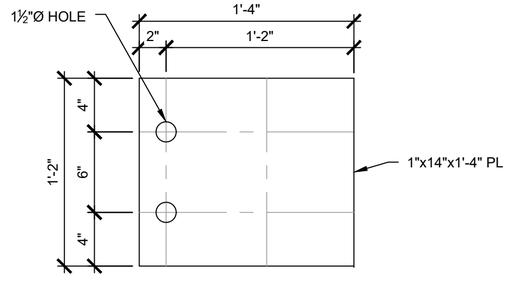
12 SHOP STRINGER SPLICE

SCALE: 1½"=1'-0" 0" 4" 8"



13 TYP CHORD END PLATE

SCALE: 1½"=1'-0" 0" 4" 8" 16"

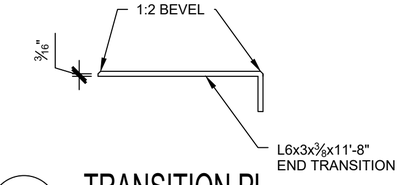


14 ANCHOR PLATE PLAN

SCALE: 1½"=1'-0" 0" 4" 8" 16"

15 HANDRAIL END CAP

SCALE: 1½"=1'-0" 0" 4" 8" 16"



16 TRANSITION PL

SCALE: 1½"=1'-0" 0" 4" 8" 16"

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165'L x 10'W
H10, OAK
GROVE
PEDESTRIAN
LIFT BRIDGE,
FARGO, ND

ISSUE BLOCK

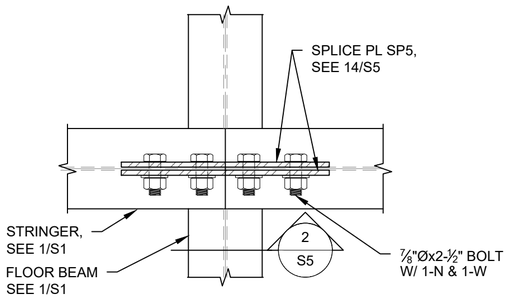
FIN	07/18/2018	FINAL 3
FIN	07/03/2018	FINAL 2
FIN	04/25/2018	FINAL
APP	03/29/2018	FOR APPROVAL 4
APP	03/20/2018	FOR APPROVAL 3
APP	03/08/2018	FOR APPROVAL 2
APP	02/19/2018	FOR APPROVAL
CHK	02/14/2018	CHECK PRINT

MANAGEMENT

JOB NO.:	PFS0198
PROJECT NO.:	18161-0006
DRAWN BY:	ARH
CHECKED BY:	BJS

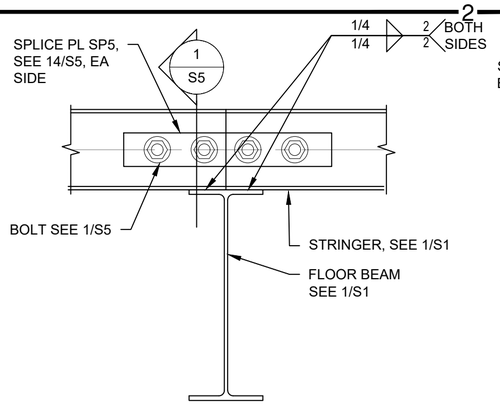
SHEET TITLE
DETAILS

SHEET IDENTIFICATION
S4
5 OF 8



1 STRINGER SPLICE - PLAN

SCALE: 1½"=1'-0" 0" 4" 8" 16"



2 FIELD STRINGER SPLICE - SECTION

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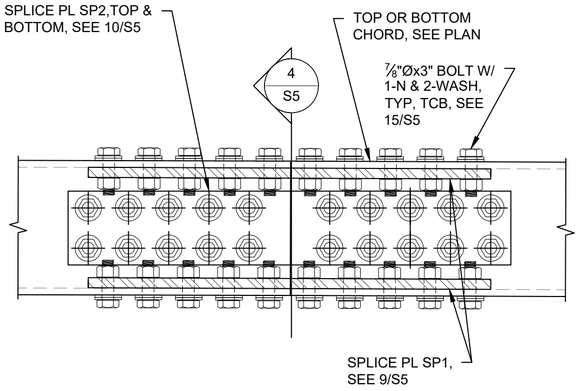

3 CHORD SPLICE - SECTION

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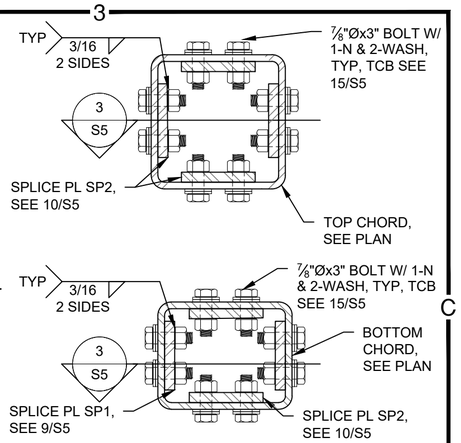

4 CHORD SPLICE - SECTION

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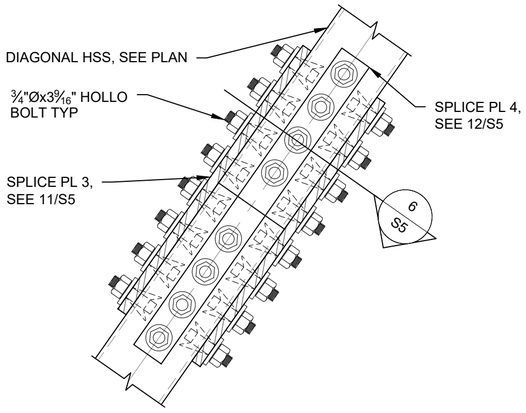
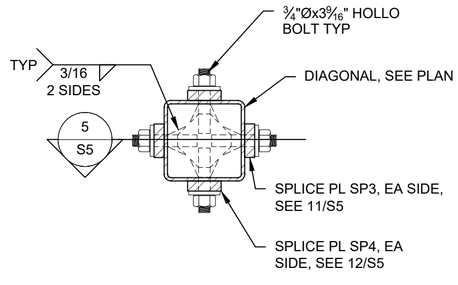


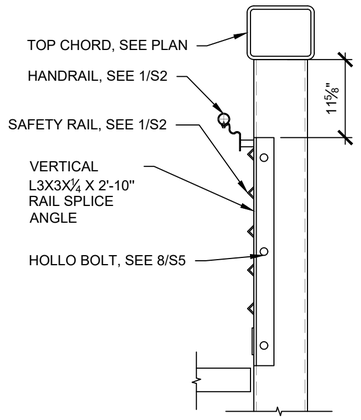
5 DIAGONAL SPLICE - SECTION

SCALE: 1½"=1'-0" 0" 4" 8" 16"



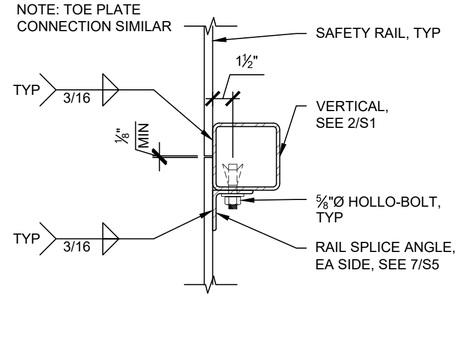
6 DIAGONAL SPLICE - SECTION

SCALE: 1½"=1'-0" 0" 4" 8" 16"



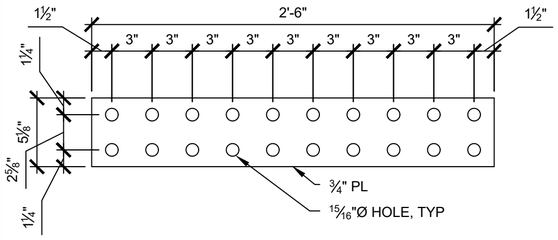
7 RAILING SPLICE SECTION

SCALE: ¾"=1'-0" 0" 8" 16" 32"



8 SAFETY RAIL SPLICE PLAN

SCALE: 1½"=1'-0" 0" 4" 8" 16"



9 CHORD SPLICE PLATE- SP1

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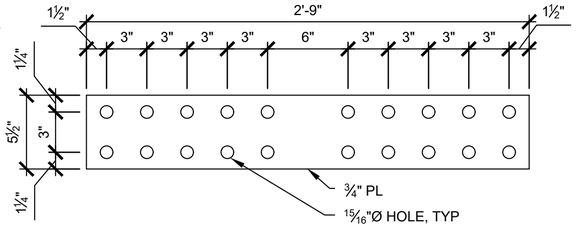
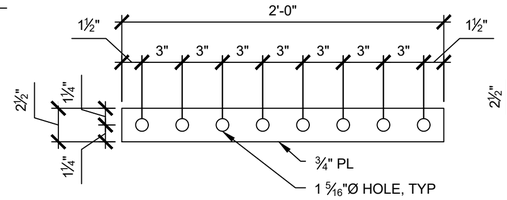


10 CHORD SPLICE PLATE- SP2

SCALE: 1½"=1'-0" 0" 4" 8" 16"



11 DIAGONAL SPLICE PLATE - SP3

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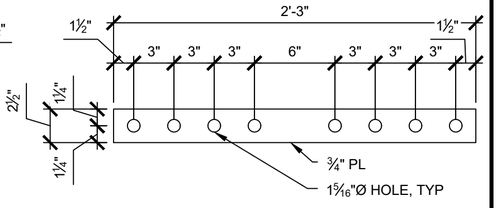

12 DIAGONAL SPLICE PLATE - SP4

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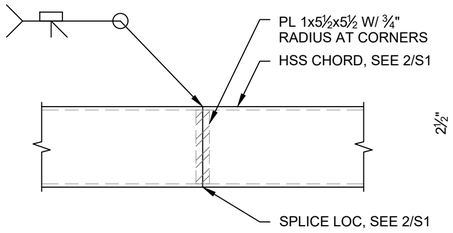
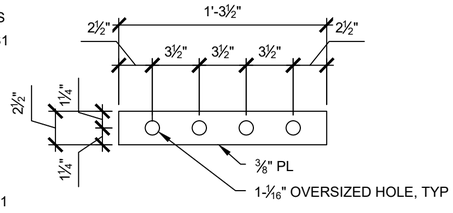


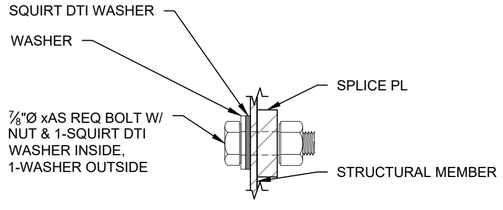
13 CHORD WELD SPLICE

SCALE: 1½"=1'-0" 0" 4" 8" 16"



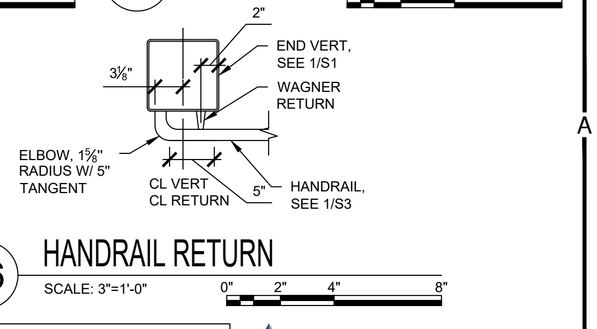
14 STRINGER SPLICE PLATE SP5

SCALE: 1½"=1'-0" 0" 4" 8" 16"



15 TCB SQUIRT DTI WASHER DETAIL

SCALE: 3"=1'-0" 0" 2" 4" 8"



16 HANDRAIL RETURN

SCALE: 3"=1'-0" 0" 2" 4" 8"

S/N
165TB10H10-PFS0198

TrueNorth Steel

REGISTERED PROFESSIONAL ENGINEER
JAMI LORENZ
PE-8854
DATE 07/18/2018
NORTH DAKOTA

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PROJECT IDEN.
165'L x 10'W H10, OAK GROVE PEDESTRIAN LIFT BRIDGE, FARGO, ND

ISSUE BLOCK	
FIN	07/18/2018 FINAL 3
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FIN	04/25/2018 FINAL
APP	03/29/2018 FOR APPROVAL 4
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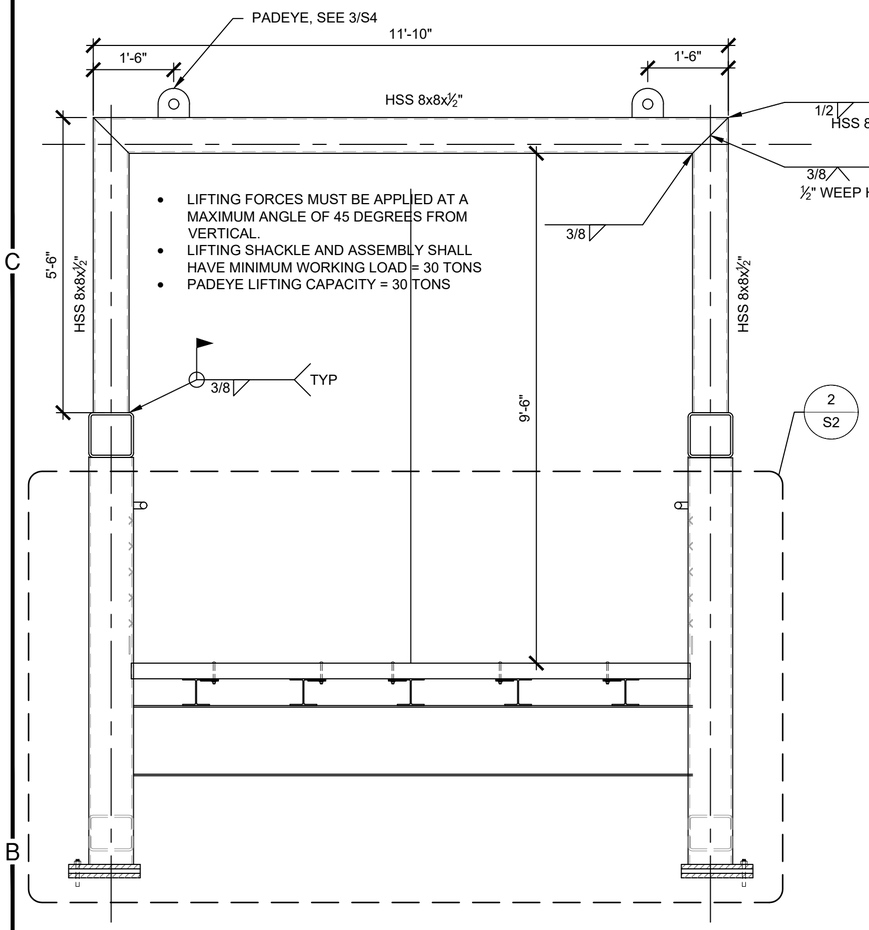
APP	02/19/2018 FOR APPROVAL
CHK	02/14/2018 CHECK PRINT

MANAGEMENT	
JOB NO.:	PFS0198
PROJECT NO.:	18161-0006
DRAWN BY:	ARH
CHECKED BY:	BJS

SHEET TITLE
SPLICE DETAILS

SHEET IDENTIFICATION
S5
6 OF 8

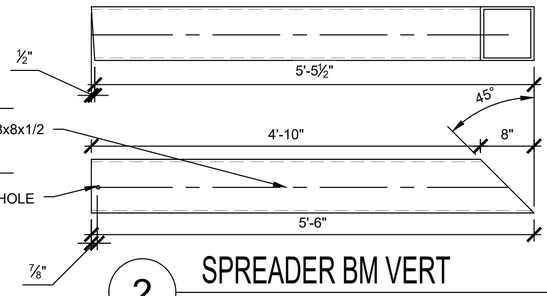


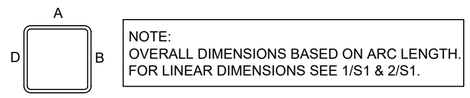
1 SPREADER BEAM ELEVATION

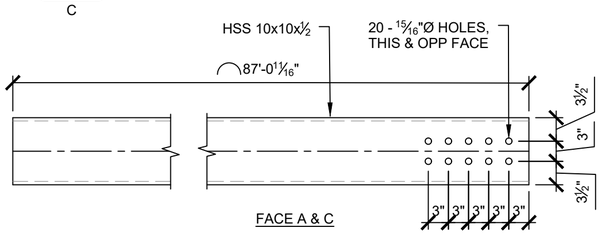
SCALE: ½"=1'-0"

2 SPREADER BM VERT

SCALE: NTS

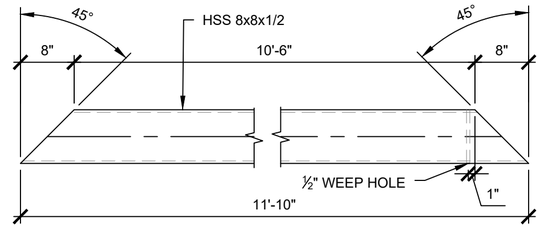


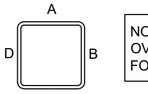


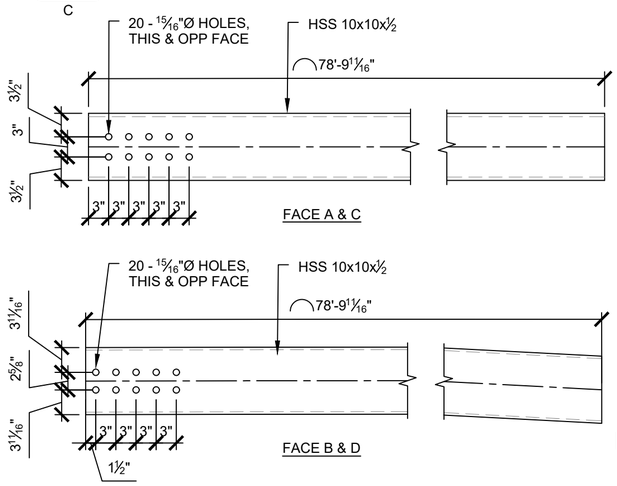


3 SPREADER BM HORIZ

SCALE: NTS

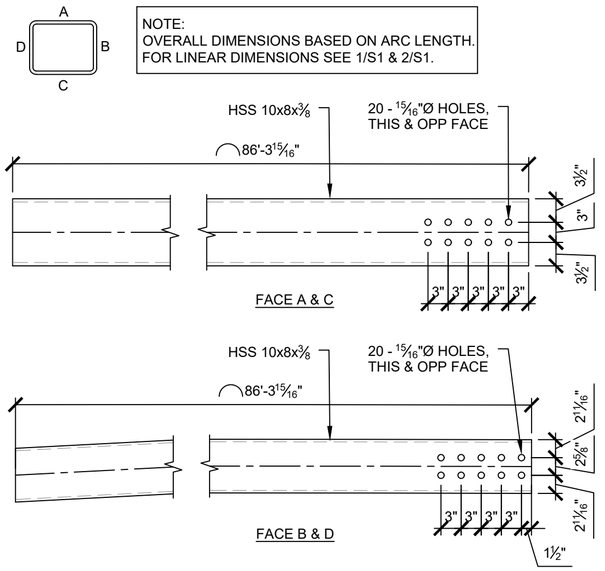






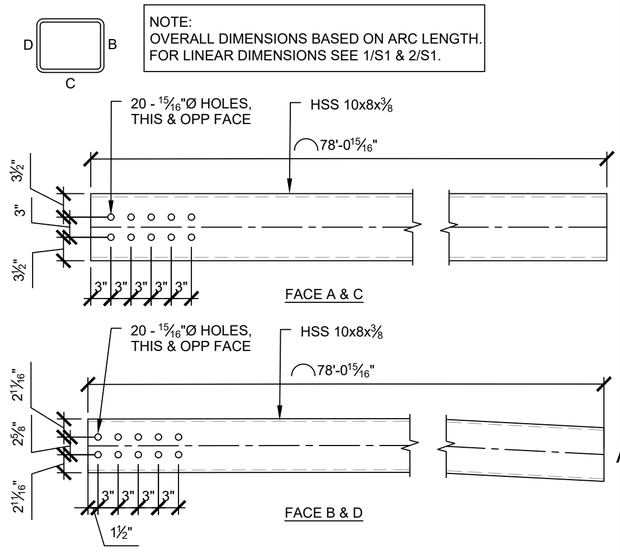
4 TOP CHORD W/ SPLICE (TC1)

SCALE: NTS



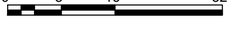
5 TOP CHORD W/ SPLICE (TC2)

SCALE: NTS



6 DIAGONAL W/ SPLICE (D3)

SCALE: ¾"=1'-0"



7 BOT CHORD W/ SPLICE (BC1)

SCALE: NTS

8 BOT CHORD W/ SPLICE (BC2)

SCALE: NTS

S/N
165TB10H10-PFS0198

TrueNorth Steel

REGISTERED PROFESSIONAL ENGINEER
JAMI LORENZ
PE-8854
DATE 07/18/2018
NORTH DAKOTA

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PROJECT IDEN.
165'L x 10'W H10, OAK GROVE PEDESTRIAN LIFT BRIDGE, FARGO, ND

ISSUE BLOCK	
FIN	07/18/2018 FINAL 3
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APP	03/29/2018 FOR APPROVAL 4
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CHK	02/14/2018 CHECK PRINT

MANAGEMENT	
JOB NO.:	PFS0198
PROJECT NO.:	18161-0006
DRAWN BY:	ARH
CHECKED BY:	BJS

SHEET TITLE
SPREADER BEAM

SHEET IDENTIFICATION
S6
7 OF 8

Trail Bridge Design Calculations

Project Name: Oak Grove Pedestrian Lift Bridge
Fargo, ND

Serial Number: 165TB10H10-PFS0198

Owner: City Of Fargo
Fargo, North Dakota

Fabricator: TrueNorth Steel
5405 Momont Road
Missoula, MT 59808
(406) 532-7122

Design Engineer: DCI Engineers, Inc.
450 Corporate Dr, Suite 112
Kalispell MT 59901
(406) 752-5675

REGISTERED PROFESSIONAL ENGINEER
JAMI LORENZ
PE-8854
DATE 07/18/2018
NORTH DAKOTA

Bridge Design Code: AASHTO GUIDE SPECIFICATIONS FOR DESIGN OF PEDESTRIAN BRIDGES AND LRFD BRIDGE DESIGN SPECIFICATIONS

Date: July 18, 2018

GENERAL LAYOUT AND LOADS

DESIGN NARRATIVE:

This calculation package is for a new 165' long x 10' wide pedestrian truss located in Fargo, North Dakota. This pedestrian truss crosses the Red River and will have a frame and hoist system capable of lifting the bridge up during flooding.

Design is in accordance with AASHTO LRFD Bridge Design Specifications and the LRFD Guide Specifications for Design of Pedestrian Bridges.

The Pedestrian Bridge Specifications provide guidelines for Half-Through truss design. The truss was also modeled in RAM Elements to find force effects for design.

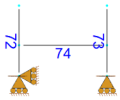
LOADS AND MODEL SETUP

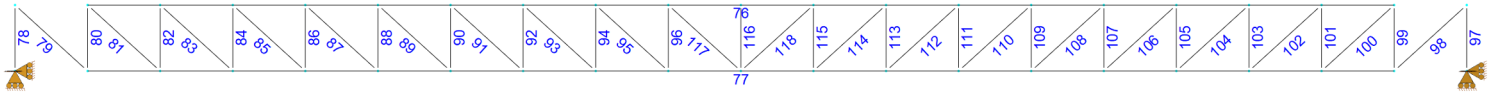
07/02/2018

REVISION LATER IN PROJECT TO
USE 10X10X1/2 TOP CHORD
10X8X3/8 BOTTOM CHORD.
OK BY INSPECTION EXCEPT MEMBER
CHECK FOR BOTTOM CHORD. SEE
ADDITIONAL CALCULATION CHECK

STEEL MEMBER LEGEND	
MEMBER	**SIZE**
TOP CHORD	HSS10X8X1/2
BOTTOM CHORD	HSS10X8X1/2
VERTICAL	HSS8X8X3/8
DIAGNAL	HSS6X6X5/16
FLOOR BEAM	W16x26
LONG BEAM	W6x15
MATERIAL	A500 GR B

STRINGER

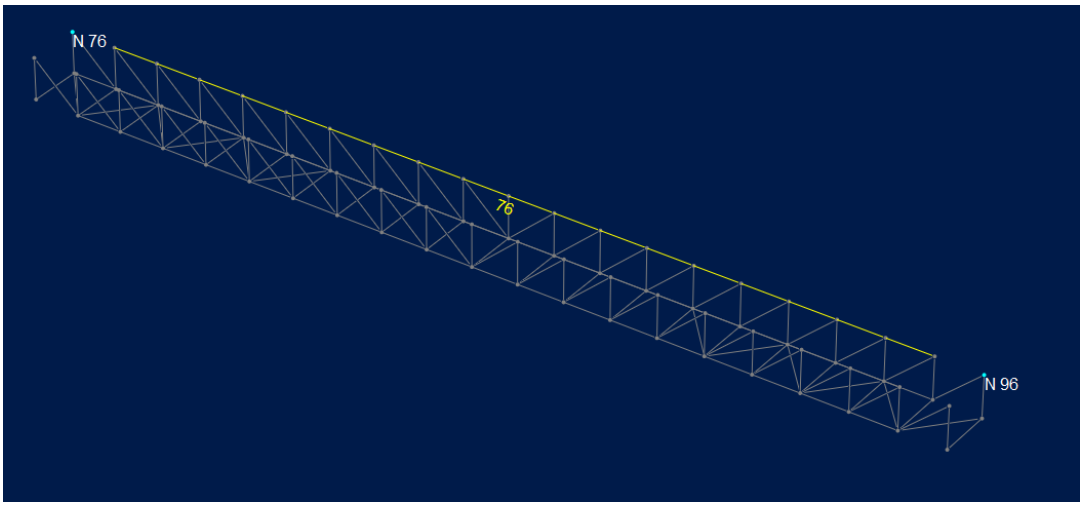


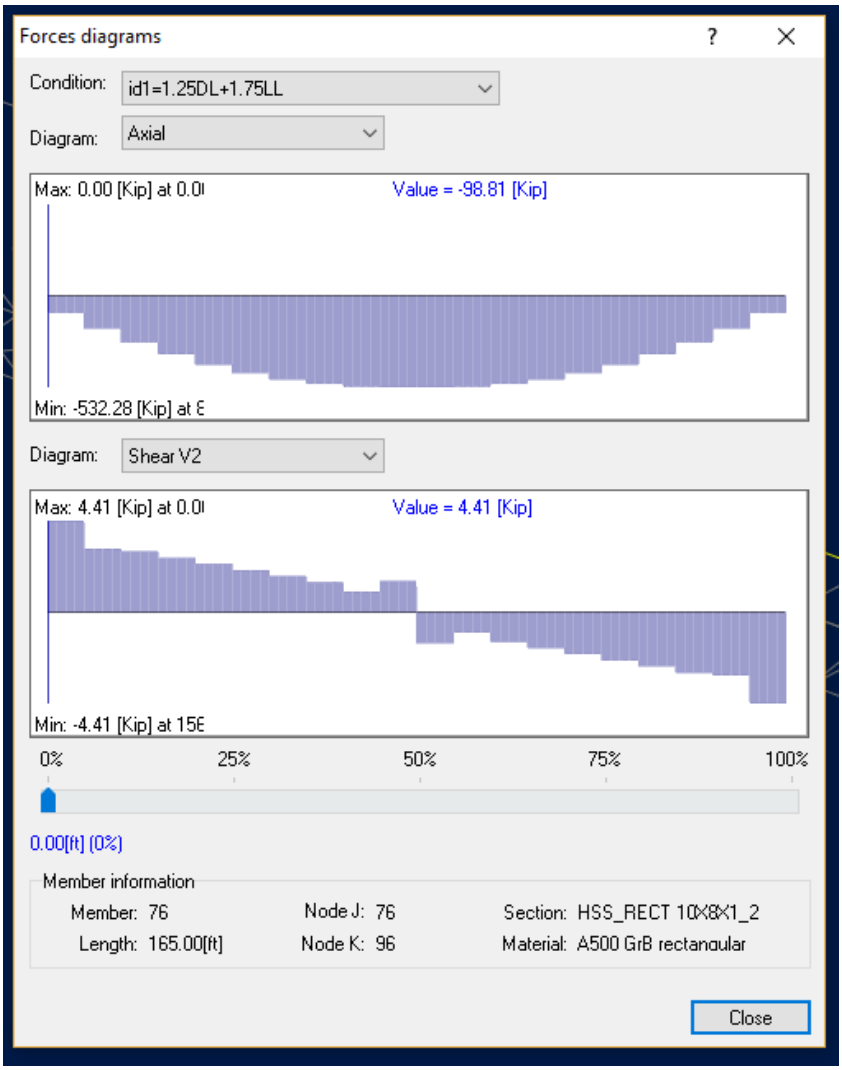


165' (N = 20)

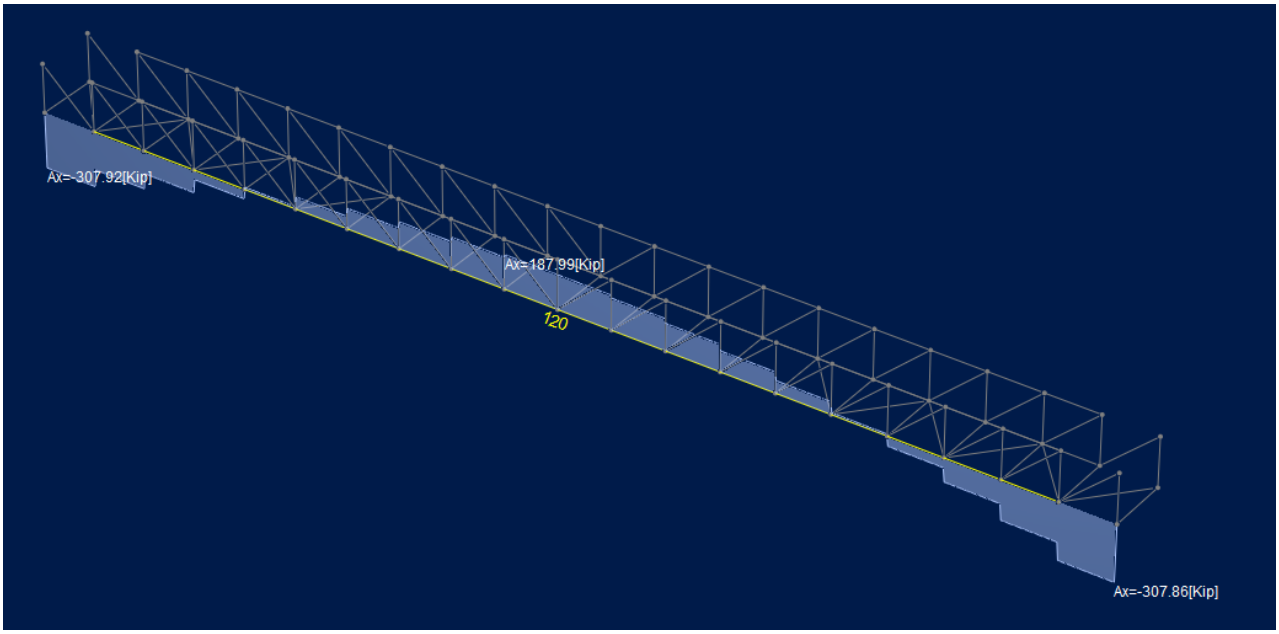
TOTAL STEEL VOLUME=	553.4 ft³
TOTAL STEEL WEIGHT=	77577.05 lbs
Uniform Chord DL=	171.47 plf
Concentrated DL on Truss Verts from Floor=	945.99 lbs
Concentrated LL on Truss Verts from Floor=	3712.50 lbs

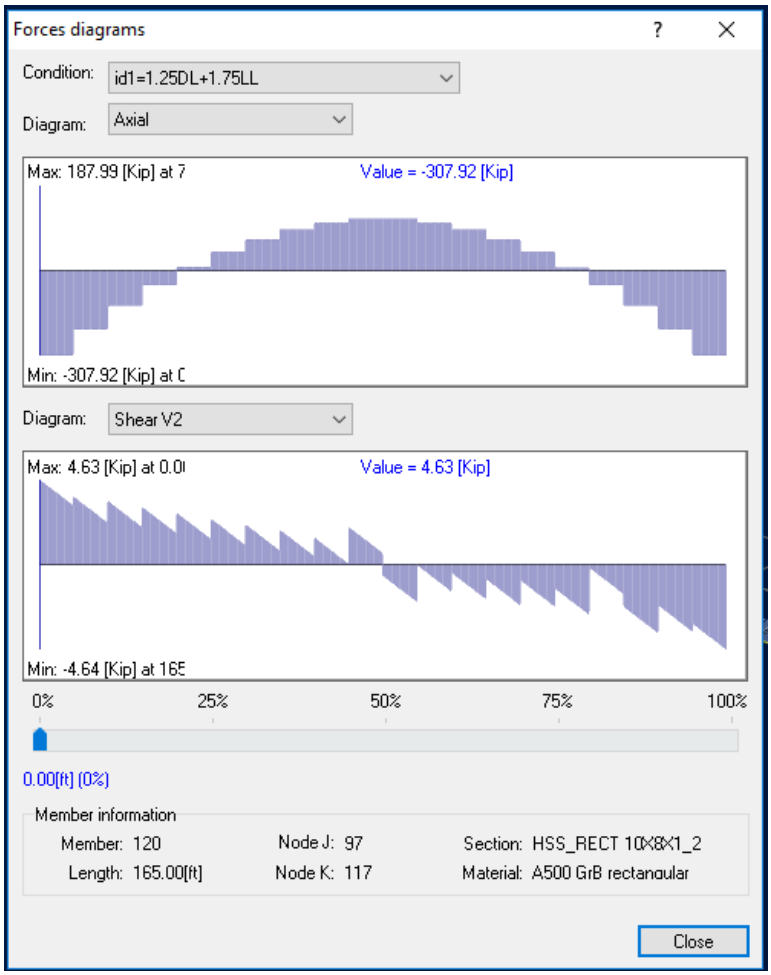
TOP CHORD MODEL OUTPUT:
(NOTE BEGIN AND END NODE)





BOTTOM CHORD
AXIAL LOAD





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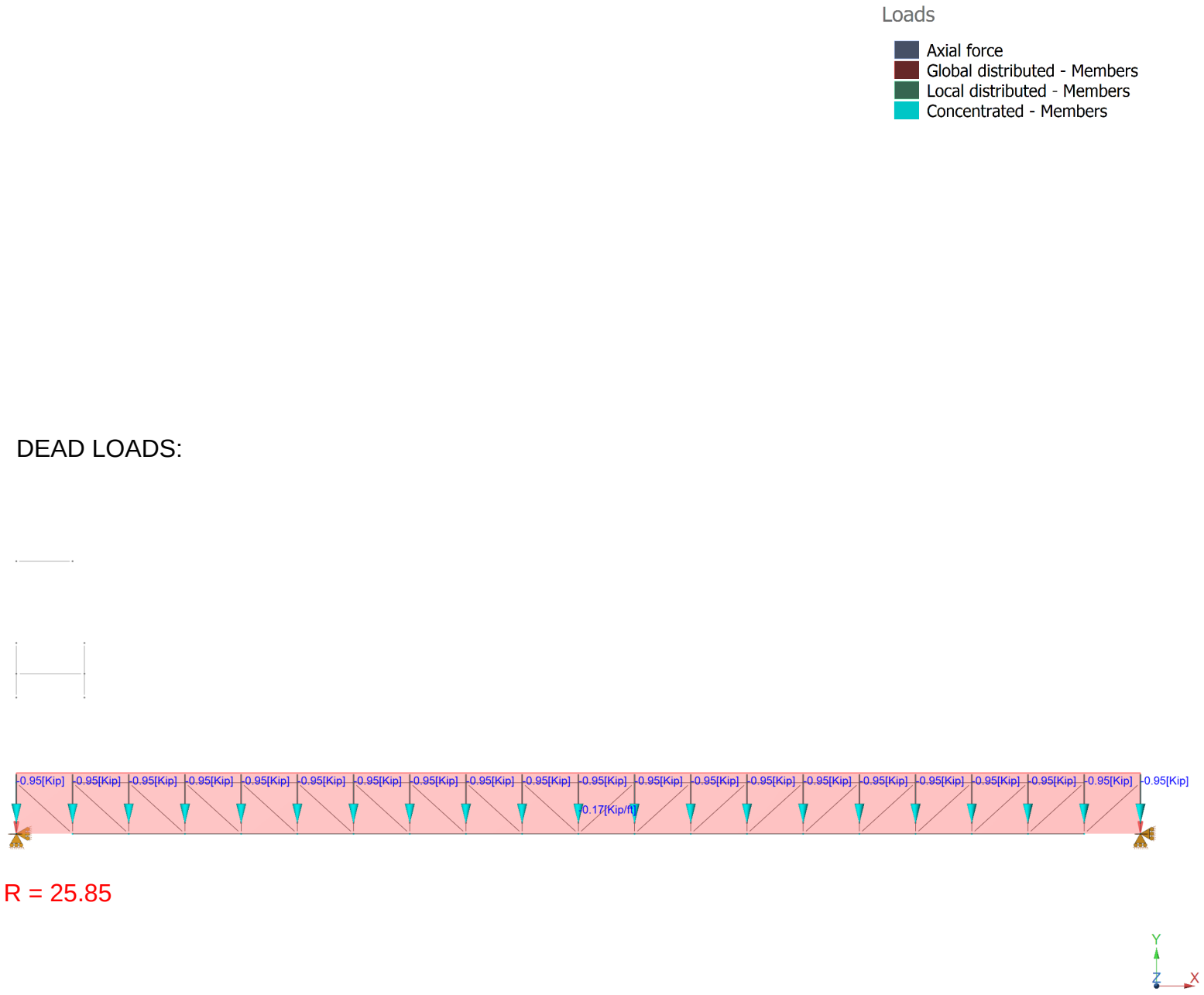
Load condition: DL=Dead Load



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Units system: English
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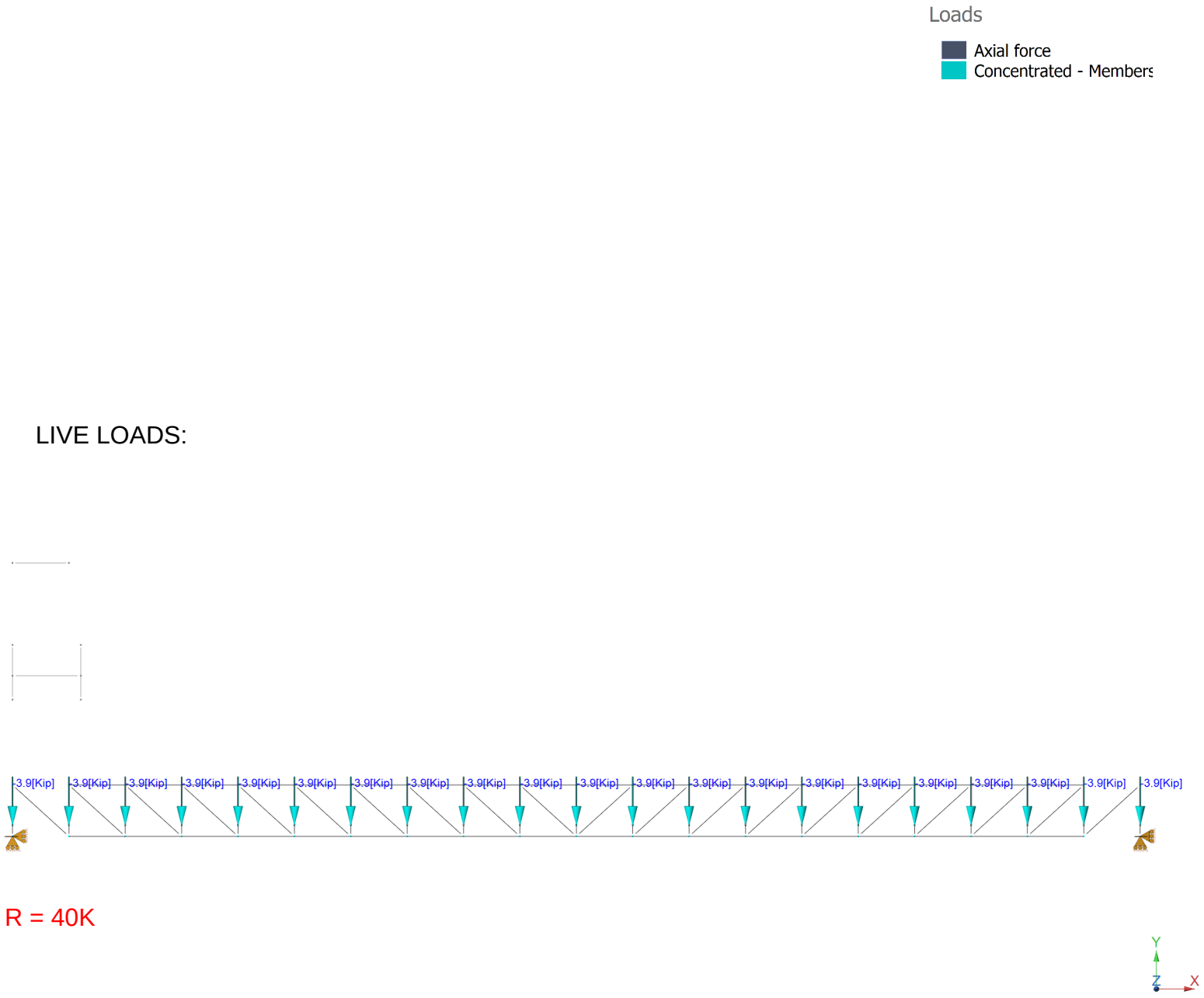
Load condition: LL=Live Load



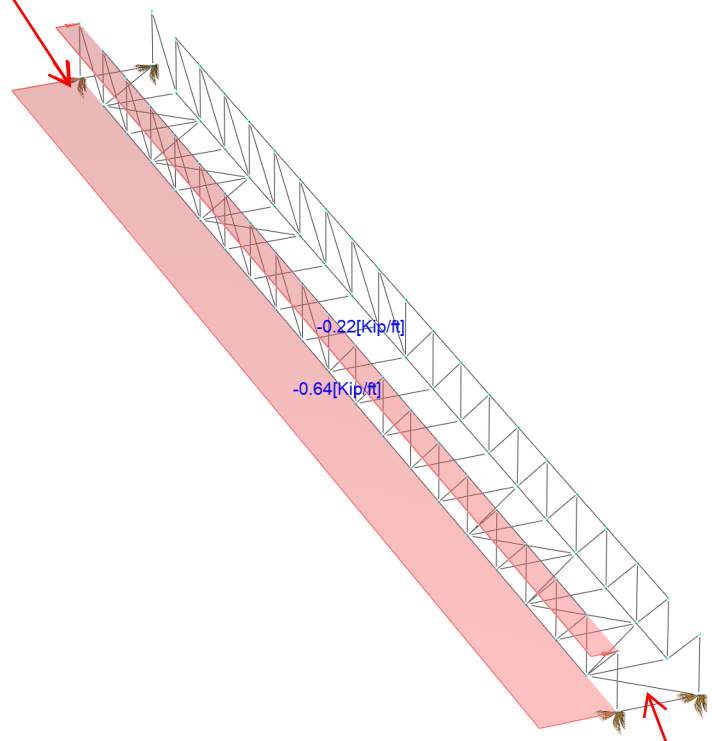
Loads

Global distributed - Members
Local distributed - Members

BASE WIND VELOCITY = 100MPH (AASHTO 3.8)
BASE WIND PRESSURE P = 0.05KSF (3.8.1.2.1)

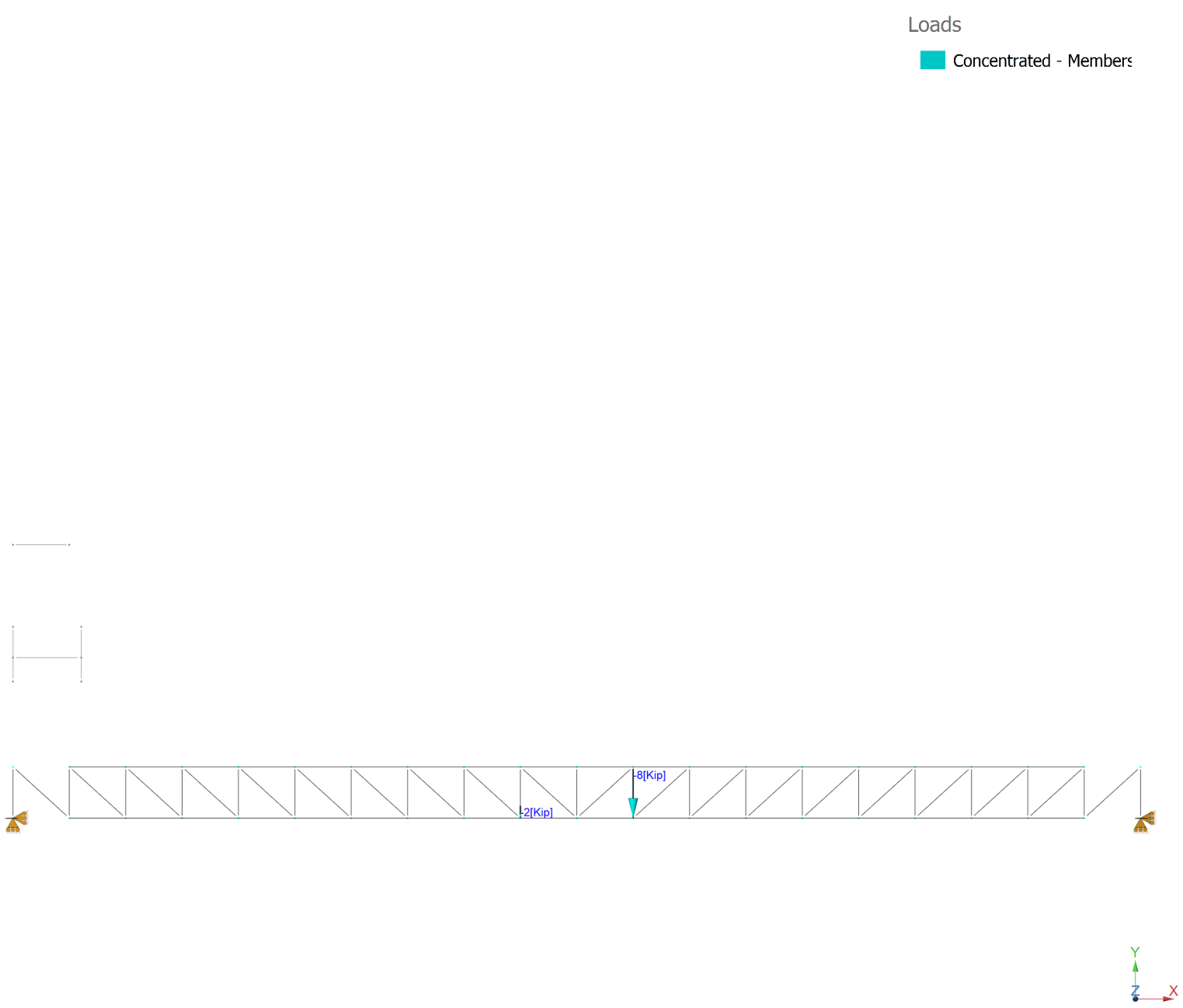
AREA OF PANEL = 15SF
WIND LOAD = 0.05KSF*15SF*1.15 = 0.86K/FT
(APPLIED AS 0.64K/FT BOTTOM AND 0.22K/FT TOP)

REACTION =
086klf*165ft/2 = 71k



AXIAL LOAD IN
FLOOR BEAM = 92K,

Current Date: 2/19/2018 1:53 PM
Units system: English
File name: J:\1610-Kalispell\2018 Projects\18161-0006 TrueNorth Bridge 165TB10H10-PFS0198\4- Calculations\Bridge Calcs\FARGO PED TRUSS N20.etz\
Load condition: LL2=LIVE LOAD2



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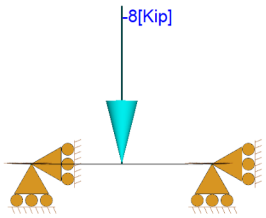
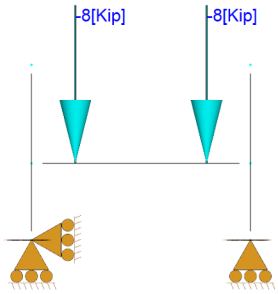
Load condition: LL2=LIVE LOAD2

Loads

Axial force
Concentrated - Members





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Analysis result

Nodal displacements envelope

Note.- **Ic** is the controlling load condition
Nodal displacements envelope for :
DL2=SELF WT

Node		Translation						Rotation					
		X [in]	**Ic**	**Y** [in]	**Ic**	**Z** [in]	**Ic**	**Rx** [Rad]	**Ic**	**Ry** [Rad]	**Ic**	**Rz** [Rad]	**Ic**
65	Max	0.000	DL2	-1.135	DL2	0.000	DL2	0.00000	DL2	0.00000	DL2	0.00000	DL2
	Min	0.000	DL2	-1.135	DL2	0.000	DL2	0.00000	DL2	0.00000	DL2	0.00000	DL2

ABOVE IS THE DL DEFLECTION RESULTS:
SEE SPREADSHEET CALCS DEFLECTION CHECK

Current Date: 2/6/2018 2:02 PM
Units system: English
File name: J:\1610-Kalispell\2018 Projects\18161-0006 TrueNorth Bridge 165TB10H10-PFS0198\4- Calculations\Bridge Calcs\FARGO PED TRUSS N20.etz\

Analysis result

Nodal displacements envelope

Note.- **lc** is the controlling load condition
Nodal displacements envelope for :
DL=Dead Load
LL=Live Load

		Translation						Rotation					
Node		**X** [in]	**lc**	**Y** [in]	**lc**	**Z** [in]	**lc**	**Rx** [Rad]	**lc**	**Ry** [Rad]	**lc**	**Rz** [Rad]	**lc**
65	Max	0.000	LL	-2.041	DL	0.000	DL	0.00000	DL	0.00000	DL	0.00000	LL
	Min	0.000	DL	-3.247	LL	0.000	DL	0.00000	DL	0.00000	DL	0.00000	DL

ABOVE IS THE LL DEFLECTION RESULTS:
SEE SPREADSHEET CALCS DEFLECTION CHECK

PRELIMINARY TRUSS CHECK AND QUANTITIES

DCI+bce ENGINEERS	Project:		Page:	
	Client:	TrueNorth Steel	Design By:	TMB
	Job #:		Review By:	
	Description:		Date:	06/29/18

Pedestrian Thru-Truss Bid Spreadsheet

Span	165.00 ft	
Traveled Way	10.00 ft	Inside Face of Chord to Inside face of Chord
Spacing b/t Verts	10.31 ft	
Height	8.00 ft	Top of Top Chord To Bottom of Bottom Chord
Total Num of Longit Floor Beam	5	
Pedestrian Live Load	90.00 psf	
Vehicular Load		
Top Chord Mem	HSS10X10X1/2	Flatwise if Rectangular
Bottom Chord Mem	HSS10X8X3/8	Flatwise if Rectangular
Vertical Mem	HSS8X8X3/8	07/02/2018
Diagonal Mem	HSS6X6X5/16	
Trans Floor Beam Mem Type	Wbeam	
TransFloor Beam Mem	W16X26	
Longit Floor Beam MemType	Wbeam	
Longit Floor Beam Mem	W4X13	
Floor Frame Dia Bracing Mem	HSS4X4X1/4	
Decking	3x Timber	

Model Output:

HSS Chord Factored Comp. Force	550.00 k	
HSS Vert Factored Comp. Force	110.00 k	
Dead Load Deflection (Service)	1.30 in	
Live Load Deflection (Service)	3.30 in	

Deflection Check:

Max f (DL Deflection)	3.00 Hz	
Max LL Deflection (l/360)	5.50 in	OK
Actual f	3.10 in	OK

HSS Chord Design:

HSS MOE, E	29000 k/in²
HSS Yield Strength, Fy	50 k/in²
HSS Chord Unbraced Length, L	123.75 in
Effective Height of Vertical, h	78.00 in
HSS Chord Area, A	17.2 in²
HSS Chord MOI, I	256.00 in^4
HSS Chord Section, S	51.20 in³
HSS Chord, r_x	3.86 in
HSS Chord, r_y	0.00 in
HSS Vertical Area, A	10.4 in²
HSS Vertical MOI, I	100.00 in^4
HSS Vertical Section, S	24.90 in³
HSS Vertical, r	3.10 in

Transverse Floor Beam MOI, I	301.00 in^4			
DCI+bce engineers	Project:	TrueNorth Steel	Page:	
	Client:		Design By:	TMB
	Job #:		Review By:	
	Description:		Date:	06/29/18

Pedestrian Thru-Truss Bid Spreadsheet

C	9.55 k/in	
CL/Pc	1.615	
n	16.000	
1/K	0.833	
K	1.20	
KL/r	38.50	OK, KL/r<120
λ	0.26	
Pn	772.30 k	
ϕPn	695.07 k	**OK 79.13%**
Transverse Floor Beam Design Check:		
γ_{DL}	1.25	
γ_{LL}	1.75	
ϕ_b	0.9	
ϕ_v	0.9	
Es	29000.00 ksi	
Fy	50.00 ksi	
Deflection Criteria, L/MAX?	500	
Vehicular Loading	H 10-44	
w_{DL} (unfactored)	848.62 plf	
Vmax (DL-Factored	4243.08 lbs	
Mmax (DL - Factored)	13259.62 lb-ft	
w_{LL} (Pedestiran unfactored)	928.13 plf	
Vmax (Ped LL-Factored)	4640.63 lbs	
Mmax (Ped LL -Factored)	20302.73 lb-ft	
r_{LL} (Unfactored Veh Rxn on Trans Be	39400.00 lbs	
Vmax (Veh LL - Factored)	19700.00 lbs	
Mmax (Veh LL -Factored)	86187.50 lb-ft	
V_u	23943.08 lbs	
M_u	99447.12 lb-ft	
h/t_w	56.80	
$k_v E/F_y$	2900.00	
A_w	3.93	
C_v	1.00	
$\phi_v V_n$	105975.00 lbs	OK 23% CAPACITY
$\phi_v M_n$	165750.00 lb-ft	**OK 60% CAPACITY**
I (Moment of Inertia)	301.00 in4	
Δ (Service Deflection)	0.12 in	
Δ (Service Deflection)	**L/972.19**	OK
Minimum I_{req}	154.80 in4	

DCI+bce ENGINEERS	Project:		Page:
	Client:		Design By:
	Job #:		Review By:
	Description:		Date:

Pedestrian Thru-Truss Bid Spreadsheet

	Top Chord	Bottom Chord	Truss Vert	Truss Dia Web	Transverse Floor Beam	Long Floor Beam	Floor Frame Dia	Deck
Member	HSS10X10X1/2	HSS10X8X3/8	HSS8X8X3/8	HSS6X6X5/16	W16X26	W4X13	HSS4X4X1/4	3x Timber
Length	330.00 ft	330.00 ft	221.00 ft	372.21 ft	204.00 ft	825.00 ft	253.16 ft	N/A
Volume	39.4 ft³	27.0 ft³	16.0 ft³	16.6 ft³	130.6 ft³	263.3 ft³	5.9 ft³	N/A
Weight	20569.44 lbs	14097.04 lbs	8312.72 lbs	8667.08 lbs	5304.00 lbs	10725.00 lbs	3083.67 lbs	12028.50 lbs
Cost								

TOTAL STEEL VOLUME=	498.8 ft³
TOTAL STEEL WEIGHT=	70758.95 lbs

Uniform Chord DL=	156.50 plf
Concentrated DL on Truss Verts from Floor=	973.16 lbs
Concentrated LL on Truss Verts from Floor=	4640.63 lbs

BRIDGE LIFTING LOADS

Total Bridge Weight Plus Impact (2.0)=	165575 lbs
Weight per End=	82787 lbs
Load at Each Padeye=	41394 lbs

HALF THROUGH TRUSS CALCS

DCI ENGINEERS	Project:	10x165 TB	Page:	1
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

10X10X1/2 OK BY INSPECTION

HSS Member Design

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS10X8X1/2	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.59 k		
HSS Member Shear V_{uWeak} (k)	18.72 k		
HSS Member Compression P_u (k)	531.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	7.07 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	15.30 in²		AASHTO 6.12.2.2.2
HSS Member S_x (in^)	42.70 in³		AASHTO 6.12.2.2.2
HSS Member I_y (in^)	151.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	176.20 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	9.07 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	15.30 in²		AASHTO 6.12.2.2.2
HSS Member S_y (in^)	37.80 in³		AASHTO 6.12.2.2.2
HSS Member I_x (in^)	214.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	156.22 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	9.07 in		
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	244.62 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness $\lambda_w=D_{Strong}$	19.51		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	244.62 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.59 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	244.62 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	7.07 in		
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	190.68 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness $\lambda_w=D_{Weak}$	15.20		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	190.68 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	18.72 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	190.68 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	8.250 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	15.30 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	14.200			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	18.500			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.300		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	23.89			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	40.99			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.293			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	531.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	609.46 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	531.00 k			
HSS Member Compression ϕ_cP_n (k)	609.46 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	176.20 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	156.22 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.87			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.87	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	15.30 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	726.75 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	15.30 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	856.80 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	726.75 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	176.20 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	156.22 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.00	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.413 in	**OK**		

Pedestrian Bridge Half-Through Truss Design

Note: See Sheet EST 1/1 For Input

Pedestrian Bridge Top Chord Lateral Support Calculations

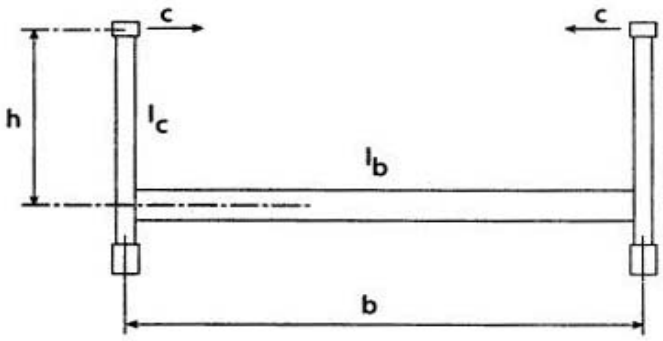
Truss Floor Beam Section	W16X26		
Truss Vertical Section	HSS8X8X3/8		
Truss Vertical Transverse Orientation	Strong Axis Bending		
Truss Floor Beam Span b (ft)	11.20 ft	Floor Beam Span From Truss Chord CL	
Truss Vertical Effective Height h (ft)	5.63 ft	Top Chord CL To Floor Beam CL	
Truss Steel E (ksi)	29000 ksi		AASHTO 6.4.1
Truss Floor Beam I_b (in^4)	301.00 in4		AASHTO 6.4.1
Truss Vertical I_c (in^4)	100.00 in4		AASHTO 6.4.1
Transverse Frame Spring Constant C (k/ir	14.199 k/in		Galambos 1968
Truss Comp Chord Unbraced L (ft)	8.25 ft		
Truss Comp Chord Factored P_u (k)	532.91 k	Factored Comp Force From Analysis	
Truss Comp Chord Critical Buckling P_c (k)	1065.82 k		Specification 7.1.2
Truss Ratio CL/P_c	1.319		Specification 7.1.2
Truss Number Of Panels n	20		
Truss Value 1/K	0.771		Specification Table 7.1.2-1
Truss Comp Chord Eff Length Factor K	1.297		

Pedestrian Bridge Lateral Frame Design Force Verticals Calculations Forces Applied In Combination With Other Loads

Average Design Comp Top Chord P_{avg} (k)	550.00 k	Factored Comp Force From Analysis	
Factor 0.01/K	0.008		Specification 7.1.1
Factor 0.01/K Limit	0.003 **OK**		Specification 7.1.1
Minimum Lateral Force H_f (k)	4.24 k	Force Applied Inward Top Each Vertical	Specification 7.1.1
Minimum Lateral Moment M_f (ft*k)	23.85 ft*k	Force Applied Inward Top Each Vertical	Specification 7.1.1

Pedestrian Bridge Lateral Frame Design Force End Posts Calculations Forces Applied In Combination With Other Loads

End Post Design Axial Load P_u (k)	110.00 k	Factored Comp Force From Analysis	
End Post Lateral Force C (k)	1.10 k	Force Applied Inward Top Each End Post	Specification 7.1.1



Pedestrian Bridge Deflection Calculations

Pedestrian Bridge Deflection Miscellaneous Input

Truss Clear Span L_{Truss} (ft)	165.00 ft	Note: See Sheet EST 1/1 For Input

Pedestrian Bridge Vertical LL Deflection Calculations

Truss LL Vertical Deflection δ_{LL} (in)	3.300 in	Service LL Vertical Deflection From Analysis May Be User Defined
Truss LL Vertical Deflection Criteria	L/360	
Truss LL Vertical Deflection $\delta_{LLAllow}$ (in)	5.500 in **OK**	

Pedestrian Bridge Lateral LL Deflection Calculations

Truss LL Lateral Deflection δ_{LL} (in)	2.175 in	Service LL Lateral Deflection From Analysis
Truss LL Lateral Deflection Criteria	L/180	
Truss LL Lateral Deflection $\delta_{LLAllow}$ (in)	11.000 in **OK**	

Pedestrian Bridge Vibration Calculations

Pedestrian Bridge Vertical 1st Harmonic Vibration Calculations

Service Dead Load Vertical Deflection From Analysis

Truss Dead Load Vert Deflection δ_{DL} (in)	1.300 in	May Be User Defined	
Acceleration Due To Gravity g (ft/s²)	32.2 ft/s²		Specification Design Example
Truss Fundamental Frequency f_{Vert1} (Hz)	3.10 Hz		Specification Design Example
Truss Fundamental Freq Min f_{Vert1} (Hz)	3.00 Hz **OK**		Specification 6

Pedestrian Bridge Vertical 2nd Harmonic Vibration Calculations

Higher Harmonics Concern	Yes		
Bridge Total Dead Load Weight (k)	100.00 k		
Truss Fundamental Frequency f_{Vert2} (Hz)	3.10 Hz		Specification Design Example
Truss 2nd Harmonic Min f_{Vert2} (Hz)	1.68 Hz **OK**		Specification 6

Pedestrian Bridge Lateral 1st Harmonic Vibration Calculations

Service Dead Load Lateral Deflection From Analysis

Truss Dead Load Lat Deflection δ_{DL} (in)	1.150 in		
Acceleration Due To Gravity g (ft/s²)	32.2 ft/s²		Specification Design Example
Truss Fundamental Frequency f_{Lat} (Hz)	3.30 Hz		Specification Design Example
Truss Fundamental Freq Min f_{Lat} (Hz)	1.30 Hz **OK**		Specification 6

HSS Truss Connection Design

BOTTOM CHORD TRUSS CONNECTION CHECK

HSS Truss Connection Miscellaneous Input

Design Assumes N-Type Gapped K-Connection With Vertical

Truss Member Grade	A847		AASHTO 6.4.1
Truss Vertical Branch Section	HSS8X8X3/8		
Truss Vertical Transverse Orientation	Strong Axis Bending		
Truss Diagonal Branch Section	HSS6X6X5/16		Diagonal Branch For All Calcs
Truss Diagonal Transverse Orientation	Strong Axis Bending		
Truss Chord Branch Section	HSS10X8X3/8		
Truss Chord Branch Orientation	Strong Axis Bending		
Truss Vertical Compression P_u (k)	110.00 k		Factored Force From Analysis
Truss Diagonal Tension P_u (k)	150.00 k		Factored Force From Analysis
Truss Chord Tension Or Comp P_u (k)	550.00 k		Positive Tension, Negative Compression
Truss Chord Moment $M_{uStrong}$ (ft*k)	13.00 ft*k		Factored Force From Analysis
Truss Vertical Angle θ (°)	90.00 °		Measured From Chord Centerline To Vertical Branch Centerline
Truss Diagonal Angle θ (°)	44.60 °		Measured From Chord Centerline To Diaganol Branch Centerline
Truss Joint Eccentricity e (in)	2.00 in		Measure Vertically, Chord Centerline To WorkPoint, Positive Away From
Truss Joint Gap g (in)	0.75 in		Measure Horizontally, Edge Vertical To Edge Diagonal At
Truss Vertical Width B_b (in)	8.00 in		
Truss Vertical Height H_b (in)	8.00 in		
Truss Vertical Thickness t_b (in)	0.349 in		
Truss Diagonal Width B_b (in)	6.00 in		
Truss Diagonal Height H_b (in)	6.00 in		
Truss Diagonal Thickness t_b (in)	0.291 in		
Truss Chord Width B (in)	8.00 in		
Truss Chord Height H (in)	10.00 in		
Truss Chord Thickness t (in)	0.349 in		

HSS Truss Gapped K-Connection Limits Of Applicability Calculations

Express As Force In Branch, Compression And Tensi

Truss Connection e/H Factor	0.200		AISC 360-05 K2.3a.1
Truss Connection e/H Factor Min Limit	-0.55	**OK**	AISC 360-05 K2.3a.1
Truss Connection e/H Factor Max Limit	0.25	**OK**	AISC 360-05 K2.3a.1
Truss Vertical Branch Angle θ (°)	90.00 °		Measured From Chord Centerline To Vertical Branch Centerline
Truss Vertical Branch Angle Limit θ (°)	30.00 °	**OK**	AISC 360-05 K2.3a.2
Truss Diagonal Branch Angle θ (°)	44.60 °		Measured From Chord Centerline To Diaganol Branch Centerline
Truss Diagonal Branch Angle Limit θ (°)	30.00 °	**OK**	AISC 360-05 K2.3a.2
Truss Chord Slenderness B/t	22.92		
Truss Chord Slenderness H/t	28.65		
Truss Chord Slenderness Limit	35.00	**OK**	AISC DG 24 8-2A
Truss Diagonal Slenderness B_b/t_b	20.62		
Truss Diagonal Slenderness H_b/t_b	20.62		
Truss Diagonal Slenderness Limit	35.00	**OK**	AISC DG 24 8-2A
Truss Vertical Slenderness B_b/t_b	22.92		
Truss Vertical Slenderness H_b/t_b	22.92		
Truss Vertical Slenderness Limit	30.10	**OK**	AISC DG 24 8-2A
Truss Width Ratio B_b/B	0.75		
Truss Width Ratio H_b/B	0.75		
Truss Width Ratio Factor γ	11.46		AISC DG 24 8-2A
Truss Width Ratio Limit	0.33	**OK**	AISC DG 24 8-2A
Truss Vertical Aspect Ratio H_b/B_b	1.00		
Truss Diagonal Aspect Ratio H_b/B_b	1.00		
Truss Chord Aspect Ratio H/B	1.25		
Truss Aspect Ratio Min Limit	0.50	**OK**	AISC DG 24 8-2A
Truss Aspect Ratio Max Limit	2.00	**OK**	AISC DG 24 8-2A
Truss Material Strength F_y (ksi)	50 ksi		AASHTO 6.4.1
Truss Material Strength Limit (ksi)	52 ksi	**OK**	AISC DG 24 8-2A
Truss Material Ductility F_y/F_u	0.71		
Truss Material Ductility Limit	0.80	**OK**	AISC DG 24 8-2A
Truss Connection Gap Ratio ξ	0.09		
Truss Connection β_{eff}	0.88		
Truss Connection Gap Ratio Limit	0.06	**OK**	AISC DG 24 8-2A
Truss Connection Gap g (in)	0.75 in		
Truss Connection Gap Limit (in)	0.64 in	**OK**	AISC DG 24 8-2A
Truss Connection Branch Size B_b (in)	6.00 in		
Truss Connection Branch Size Limit	5.04 in	**OK**	AISC DG 24 8-2A

HSS Truss Gapped K-Connection Chord Wall Plastification Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.349 in			
Truss Connection β_{eff}	0.88			
Truss Width Ratio Factor γ	11.46			AISC DG 24 8-2A
Truss Chord U	1.02			AISC K.2.3
Truss Chord Q_f	1.00			AISC K.2.3
Truss Plastification ϕ	0.90			AISC K.2.3c.a
Truss Vertical Compression P_u (k)	110.00 k			
Truss Chord Wall Plastification (C) ϕP_n (k)	159.12 k	**OK**		AISC K.2.3c.a
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Chord Wall Plastification (T) ϕP_n (k)	226.61 k	**OK**		AISC K.2.3c.a
HSS Truss Gapped K-Connection Shear Yielding (Punching) Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.349 in			
Truss Chord Width B (in)	8.00 in			
Truss Vertical η	1.00			
Truss Diagonal η	1.07			
Truss Vertical β	1.00			
Truss Diagonal β	0.75			
Truss Width Ratio Factor γ	11.46			AISC DG 24 8-2A
Truss Vertical β_{eop}	0.44			AISC K.2.3c
Truss Diagonal β_{eop}	0.33			AISC K.2.3c
Truss Shear Yielding (Punching) ϕ	0.95			AISC K.2.3c.b
Truss Vertical Compression P_u (k)	110.00 k			
Truss Shear Yielding (Punching) (C) ϕP_n (k	287.82 k	**OK**		AISC K.2.3c.b
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Shear Yielding (Punching) (T) ϕP_n (k	383.34 k	**OK**	Not Controlling Square	AISC K.2.3c.b
HSS Truss Gapped K-Connection Shear Yielding Of Chord Sidewalls Calculations				
Shear Yielding Of Chord Sidewalls In Gap			Not Controlling Square	AISC K.2.3c.c
HSS Truss Gapped K-Connection Local Yielding Tension Branch Calculations				
Local Yielding Tension Branch			Not Controlling Square	AISC K.2.3c.d
HSS Truss Gapped K-Connection Local Yielding Compression Branch Calculations				
Local Yielding Compression Branch			Not Controlling Square	AISC K.2.3c.d

TOP CHORD TRUSS CONNECTION CHECK

HSS Truss Connection Design

HSS Truss Connection Miscellaneous Input

Design Assumes N-Type Gapped K-Connection With Vertical

Truss Member Grade	A847		AASHTO 6.4.1
Truss Vertical Branch Section	HSS8X8X3/8		
Truss Vertical Transverse Orientation	Strong Axis Bending		
Truss Diagonal Branch Section	HSS6X6X5/16	Diagonal Branch For All Calcs	
Truss Diagonal Transverse Orientation	Strong Axis Bending		
Truss Chord Branch Section	HSS10X10X1/2		
Truss Chord Branch Orientation	Strong Axis Bending		
Truss Vertical Compression P_u (k)	110.00 k	Factored Force From Analysis	
Truss Diagonal Tension P_u (k)	150.00 k	Factored Force From Analysis	
Truss Chord Tension Or Comp P_u (k)	550.00 k	Positive Tension, Negative Compression	
Truss Chord Moment $M_{uStrong}$ (ft*k)	13.00 ft*k	Factored Force From Analysis	
Truss Vertical Angle θ (°)	90.00 °	Measured From Chord Centerline To Vertical Branch Centerline	
Truss Diagonal Angle θ (°)	45.00 °	Measured From Chord Centerline To Diaganol Branch Centerline	
Truss Joint Eccentricity e (in)	2.00 in	Measure Vertically, Chord Centerline To WorkPoint, Positive Away From	
Truss Joint Gap g (in)	0.75 in	Measure Horizontally, Edge Vertical To Edge Diagonal At	
Truss Vertical Width B_b (in)	8.00 in		
Truss Vertical Height H_b (in)	8.00 in		
Truss Vertical Thickness t_b (in)	0.349 in		
Truss Diagonal Width B_b (in)	6.00 in		
Truss Diagonal Height H_b (in)	6.00 in		
Truss Diagonal Thickness t_b (in)	0.291 in		
Truss Chord Width B (in)	10.00 in		
Truss Chord Height H (in)	10.00 in		
Truss Chord Thickness t (in)	0.465 in		

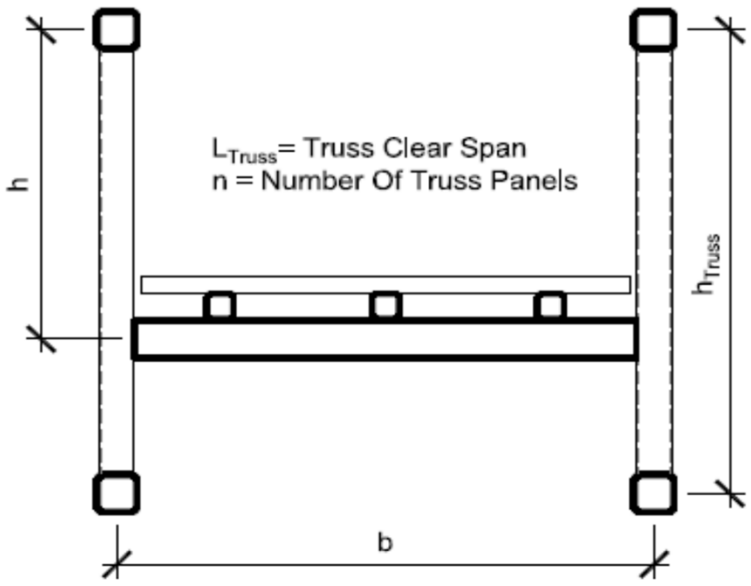
HSS Truss Gapped K-Connection Limits Of Applicability Calculations

Express As Force In Branch, Compression And Tensi

Truss Connection e/H Factor	0.200			AISC 360-05 K2.3a.1
Truss Connection e/H Factor Min Limit	-0.55	**OK**		AISC 360-05 K2.3a.1
Truss Connection e/H Factor Max Limit	0.25	**OK**		AISC 360-05 K2.3a.1
Truss Vertical Branch Angle θ (°)	90.00 °		Measured From Chord Centerline To Vertical Branch Centerline	
Truss Vertical Branch Angle Limit θ (°)	30.00 °	**OK**		AISC 360-05 K2.3a.2
Truss Diagonal Branch Angle θ (°)	45.00 °		Measured From Chord Centerline To Diaganol Branch Centerline	
Truss Diagonal Branch Angle Limit θ (°)	30.00 °	**OK**		AISC 360-05 K2.3a.2
Truss Chord Slenderness B/t	21.51			
Truss Chord Slenderness H/t	21.51			
Truss Chord Slenderness Limit	35.00	**OK**		AISC DG 24 8-2A
Truss Diagonal Slenderness B_b/t_b	20.62			
Truss Diagonal Slenderness H_b/t_b	20.62			
Truss Diagonal Slenderness Limit	35.00	**OK**		AISC DG 24 8-2A
Truss Vertical Slenderness B_b/t_b	22.92			
Truss Vertical Slenderness H_b/t_b	22.92			
Truss Vertical Slenderness Limit	30.10	**OK**		AISC DG 24 8-2A
Truss Width Ratio B_b/B	0.60			
Truss Width Ratio H_b/B	0.60			
Truss Width Ratio Factor γ	10.75			AISC DG 24 8-2A
Truss Width Ratio Limit	0.32	**OK**		AISC DG 24 8-2A
Truss Vertical Aspect Ratio H_b/B_b	1.00			
Truss Diagonal Aspect Ratio H_b/B_b	1.00			
Truss Chord Aspect Ratio H/B	1.00			
Truss Aspect Ratio Min Limit	0.50	**OK**		AISC DG 24 8-2A
Truss Aspect Ratio Max Limit	2.00	**OK**		AISC DG 24 8-2A
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Material Strength Limit (ksi)	52 ksi	**OK**		AISC DG 24 8-2A
Truss Material Ductility F_y/F_u	0.71			
Truss Material Ductility Limit	0.80	**OK**		AISC DG 24 8-2A
Truss Connection Gap Ratio ξ	0.08			
Truss Connection β_{eff}	0.70			
Truss Connection Gap Ratio Limit	0.15		Recommended Limit Only, Use Judgement	AISC DG 24 8-2A
Truss Connection Gap g (in)	0.75 in			
Truss Connection Gap Limit (in)	0.64 in	**OK**		AISC DG 24 8-2A
Truss Connection Branch Size B_b (in)	6.00 in			
Truss Connection Branch Size Limit	5.04 in	**OK**		AISC DG 24 8-2A

HSS Truss Gapped K-Connection Chord Wall Plastification Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.465 in			
Truss Connection β_{eff}	0.70			
Truss Width Ratio Factor γ	10.75			AISC DG 24 8-2A
Truss Chord U	0.70			AISC K.2.3
Truss Chord Q_f	1.00			AISC K.2.3
Truss Plastification ϕ	0.90			AISC K.2.3c.a
Truss Vertical Compression P_u (k)	110.00 k			
Truss Chord Wall Plastification (C) ϕP_n (k)	218.88 k	**OK**		AISC K.2.3c.a
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Chord Wall Plastification (T) ϕP_n (k)	309.54 k	**OK**		AISC K.2.3c.a
HSS Truss Gapped K-Connection Shear Yielding (Punching) Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.465 in			
Truss Chord Width B (in)	10.00 in			
Truss Vertical η	0.80			
Truss Diagonal η	0.85			
Truss Vertical β	0.80			
Truss Diagonal β	0.60			
Truss Width Ratio Factor γ	10.75			AISC DG 24 8-2A
Truss Vertical β_{eop}	0.37			AISC K.2.3c
Truss Diagonal β_{eop}	0.28			AISC K.2.3c
Truss Shear Yielding (Punching) ϕ	0.95			AISC K.2.3c.b
Truss Vertical Compression P_u (k)	110.00 k			
Truss Shear Yielding (Punching) (C) ϕP_n (k	386.69 k	**OK**		AISC K.2.3c.b
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Shear Yielding (Punching) (T) ϕP_n (k	508.21 k	**OK**	Not Controlling Square	AISC K.2.3c.b
HSS Truss Gapped K-Connection Shear Yielding Of Chord Sidewalls Calculations				
Shear Yielding Of Chord Sidewalls In Gap			Not Controlling Square	AISC K.2.3c.c
HSS Truss Gapped K-Connection Local Yielding Tension Branch Calculations				
Local Yielding Tension Branch			Not Controlling Square	AISC K.2.3c.d
HSS Truss Gapped K-Connection Local Yielding Compression Branch Calculations				
Local Yielding Compression Branch			Not Controlling Square	AISC K.2.3c.d

HSS Diagonal Tension Weld Fastening Calculations			Treat Welds As Lines
Truss Diagonal Angle θ (°)	44.60 °		
Truss Diagonal Tension P_u (k)	150.00 k		
Truss Diagonal Min Fillet Weld Size (in)	4/16 in		AASHTO 6.13.3.4
Truss Diagonal Max Fillet Weld Size (in)	4/16 in		AASHTO 6.13.3.4
Truss Diagonal Fillet Weld Size (in)	1/4 in	**OK**	
ϕ_{e2}	0.80		AASHTO 6.5.4.2
Truss Diagonal Fillet Weld Shear Cap $\phi_{e2}F$	5.94 k/in		AASHTO 6.13.3.2.4b-1
Truss Diagonal Fillet Weld Length $L_{WeldReq}$	25.26 in		AASHTO 6.13.3.5
Truss Diagonal Weld L_{eff} (in)	29.09 in	**OK**	CIDECT Design Guide 3 2.7
$t_{MinDiagonalChord}$ Match Weld Rupture (in)	0.177 in	**OK**	AISC 13th Ed. Page 9-5
HSS Vertical Compression Weld Fastening Calculations			Treat Welds As Lines
Truss Vertical Angle θ (°)	90.00 °		
Truss Vertical Compression P_u (k)	110.00 k		
Truss Vertical Min Fillet Weld Size (in)	4/16 in		AASHTO 6.13.3.4
Truss Vertical Max Fillet Weld Size (in)	5/16 in		AASHTO 6.13.3.4
Truss Vertical Fillet Weld Size (in)	1/4 in	**OK**	
ϕ_{e2}	0.80		AASHTO 6.5.4.2
Truss Vertical Fillet Weld Shear Cap $\phi_{e2}R_r$	5.94 k/in		AASHTO 6.13.3.2.4b-1
Truss Vertical Fillet Weld Length $L_{WeldReq}$ (	18.52 in		AASHTO 6.13.3.5
Truss Vertical Weld L_{eff} (in)	30.79 in	**OK**	CIDECT Design Guide 3 2.7
$t_{MinVerticalChord}$ Match Weld Rupture (in)	0.177 in	**OK**	AISC 13th Ed. Page 9-5



Pedestrian Bridge Top Chord Estimate Calculations Design Currently Based Upon AASHTO LRFD And Ped Specification

Pedestrian Bridge Miscellaneous Input

Truss Clear Span L_{Truss} (ft)	165.00 ft	End Vertical CL To End Vertical CL	
Optimum Truss Height h_{Truss} (ft)	11.00 ft	Optimum Truss Height = Span / 15	DG3 2.1
Truss Height h_{Truss} (ft)	7.33 ft	Top Chord CL To Bottom Chord CL	
Pedestrian Live Load LL (psf)	90.00 psf	May Be User Defined	Specification 1.2.1.1
Design Deck Width W_{Deck} (ft)	10.53 ft		
Design Pedestrian Live Load LL w (psf)	65.00 psf		Specification 1.2.1.1
Snow Load Ground SL (psf)	60.00 psf		
Wind Pressure Horizontal W_{Horz} (psf)	50.00 psf	May Be User Defined	Specification 1.2.2
Design Deck Dead Load DL (psf)	10.30 psf	3x Timber Deck = 7.3 psf, 4x Timber Deck = 10.3 psf, 2"x12GA Steel Gr	
Number Stringers	5		
Number Railing L1-1/4x1-1/4x3/16	12		
Number Kick PL 1/4x4	2		

Pedestrian Bridge Top Chord Lateral Support Input Note: See Sheet TC 1/1 For Printout

Truss Floor Beam Section	W16X26	Note: This Input Linked To Sheet TC 1/1 And Will Change Both Loc
Truss Vertical Section	HSS8X8X3/8	Note: This Input Linked To Sheet TC 1/1 And Will Change Both Loc
Truss Vertical Transverse Orientation	Strong Axis Bending	Note: This Input Linked To Sheet TC 1/1 And Will Change Both Loc
Truss Floor Beam Span b (ft)	11.20 ft	Floor Beam Span From Truss Chord CL
Truss Vertical Effective Height h (ft)	5.63 ft	Top Chord CL To Floor Beam CL
Truss Comp Chord Unbraced L (ft)	8.25 ft	
Truss Comp Chord Factored P_u (k)	532.91 k	May Be User Defined
Truss Number Of Panels n	20	
Truss Comp Chord Eff Length Factor K	1.300	

Pedestrian Bridge Member Input

Truss Diagonal Branch Section	HSS6X6X5/16	Note: This Input Linked To Sheet CN 1/3 And Will Change Both Loc
Truss Wind Brace Section	HSS4X4X1/4	
Truss Stringer Section	HSS6X4X1/4	
Truss Top Chord Grade	A847	Note: This Input Linked To Sheet ST 1/2 And Will Change Both Loc
Truss Top Chord Section	HSS10X8X1/2	Note: This Input Linked To Sheet ST 1/2 And Will Change Both Loc
Truss Chord Orientation	Strong Axis Bending	Reference Chord Orientation To Truss In Plane Bending
Truss Top Chord Moment $M_{uStrong}$ (ft*k)	0.61 ft*k	
Truss Top Chord Moment M_{uWeak} (ft*k)	0.00 ft*k	
Truss Top Chord Compression P_u (k)	532.91 k	
Truss Top Chord Unbraced Length l_{Strong} (f	8.250 ft	
Truss Top Chord Unbraced Length l_{Weak} (ft	8.250 ft	
Truss Top Chord Compression Length (ft)	8.250 ft	
Truss Top Chord Effective L Factor Strong	0.900	Welded End K = 0.75, In Plane Chord K = AASHTO 4.6.2.5, DG3 2.3.1
Truss Top Chord Effective L Factor Weak	1.300	Welded End K = 0.75, In Plane Chord K = AASHTO 4.6.2.5, DG3 2.3.1
Truss Top Chord Combined Compression	0.87 **OK**	AASHTO 6.9.2.2

Pedestrian Bridge Vertical LL Deflection Estimate Calculations

Truss Chord Composite I_g (in*)	50673 in4	Top & Bot Chords, AISC Table 17-27 Pg 17-38, Utilize $I_g = 0.85I_x$
Truss LL Vertical Deflection δ_{LL} (in)	3.885 in	Assume Top And Bottom Chord Same Size
Truss LL Vertical Deflection Criteria	L/360	Note: This Input Linked To Sheet DF 1/1 And Will Change Both Loc
Truss LL Vertical Deflection $\delta_{LLAllow}$ (in)	5.500 in **OK**	
Truss Vertical Camber Req δ_{CAMBER} (in)	23.335 in	1% Truss Span Plus DL Deflection

Pedestrian Bridge Weight Estimate Calculations Not Including Bearing Assembly, Transition PL, Splice Hardware, Fasteners

Bridge Weight Estimate (k)	102.80 k

Pedestrian Bridge Vertical 1st Harmonic Vibration Calculations Service Dead Load Vertical Deflection From Analysis

Truss Dead Load Vert Deflection δ_{DL} (in)	3.535 in	
Acceleration Due To Gravity g (ft/s²)	32.2 ft/s²	Specification Design Example
Truss Fundamental Frequency f_{Vert} (Hz)	3.10 Hz	Specification Design Example
Truss Fundamental Freq Min f_{Vert} (Hz)	3.00 Hz **OK**	Specification 6

MEMBER CHECKS

DCI ENGINEERS	Project:	10x165 TB	Page:	1
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	07/18/18

Pedestrian Bridge Design AASHTO LRFD Bridge Design Specification ST 1/2

HSS Member Design

BOTTOM CHORD

07/18/2018

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS10X8X3/8	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	1.40 k		
HSS Member Shear V_{uWeak} (k)	4.63 k		
HSS Member Compression P_u (k)	308.00 k	May Be User Defined	
HSS Member Tension T_u (k)	188.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	7.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	11.80 in^2		AASHTO 6.12.2.2.2
HSS Member S_x (in^3)	33.90 in^3		AASHTO 6.12.2.2.2
HSS Member I_y (in^4)	120.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	139.40 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	9.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	11.80 in^2		AASHTO 6.12.2.2.2
HSS Member S_y (in^3)	30.00 in^3		AASHTO 6.12.2.2.2
HSS Member I_x (in^4)	169.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	123.62 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	9.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	188.29 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	26.65		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	188.29 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	1.40 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	188.29 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	7.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	147.81 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	20.92		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	147.81 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	4.63 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	147.81 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	8.250 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	11.80 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	19.900			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	25.700			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.300		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	23.51			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	40.34			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.284			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	308.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	471.83 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	308.00 k			
HSS Member Compression ϕ_cP_n (k)	471.83 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	139.40 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	123.62 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.65			AASHTO 6.9.2.2
HSS Member Combined Compression Int	0.80	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	11.80 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	188.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	560.50 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	11.80 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	188.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	660.80 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	188.00 k			
HSS Member Tension ϕP_n (k)	560.50 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	139.40 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	123.62 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.34			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.48	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.413 in	**OK**		

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HSS Member Design DIAGONAL DESIGN

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS6X6X5/16	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.20 k		
HSS Member Shear V_{uWeak} (k)	0.15 k		
HSS Member Compression P_u (k)	0.00 k	May Be User Defined	
HSS Member Tension T_u (k)	125.00 k		

HSS Member Strong Axis Flexural Calculations

HSS Member Unbraced Length l_{Strong} (ft)	11.150 ft	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	5.42 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	6.43 in^2		AASHTO 6.12.2.2.2
HSS Member S_x (in^3)	11.40 in^3		AASHTO 6.12.2.2.2
HSS Member I_y (in^4)	34.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	46.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

HSS Member Unbraced Length l_{Weak} (ft)	11.150 ft	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	5.42 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	6.43 in^2		AASHTO 6.12.2.2.2
HSS Member S_y (in^3)	11.40 in^3		AASHTO 6.12.2.2.2
HSS Member I_x (in^4)	34.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	46.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	5.42 in		
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	91.45 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	18.62		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	91.45 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.20 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	91.45 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	5.42 in		
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	91.45 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	18.62		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	91.45 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.15 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	91.45 k **OK**		AASHTO 6.10.9.1-1

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Description:	S/N 165TB10H10- PFS0198		Date:	03/05/18

Pedestrian Bridge Design AASHTO LRFD Bridge Design Specification — **ST 2/2**

HSS Member Compression Calculations

HSS Member Compression Length (ft)	11.150 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	6.43 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	17.600			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	17.600			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.300		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	52.13			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	75.30			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.990			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	0.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	191.73 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	0.00 k			
HSS Member Compression ϕ_cP_n (k)	191.73 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.03	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	6.43 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	125.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_{n}	305.43 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	6.43 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	125.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	360.08 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	125.00 k			
HSS Member Tension ϕP_n (k)	305.43 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.41			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.44	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.558 in	**OK**		

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VERTICAL DESIGN

HSS Member Design

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS8X8X3/8	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	5.72 k		
HSS Member Shear V_{uWeak} (k)	0.25 k		
HSS Member Compression P_u (k)	96.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	7.750 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	7.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	10.40 in^2		AASHTO 6.12.2.2.2
HSS Member S_x (in^3)	24.90 in^3		AASHTO 6.12.2.2.2
HSS Member I_y (in^4)	100.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	102.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	7.750 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	7.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	10.40 in^2		AASHTO 6.12.2.2.2
HSS Member S_y (in^3)	24.90 in^3		AASHTO 6.12.2.2.2
HSS Member I_x (in^4)	100.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	102.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	7.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	147.81 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	20.92		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	147.81 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	5.72 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	147.81 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	7.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	147.81 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	20.92		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	147.81 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.25 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	147.81 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	7.750 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	10.40 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	19.900			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	19.900			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.000		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	27.00			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	30.00			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.157			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	96.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	438.40 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	96.00 k			
HSS Member Compression ϕ_cP_n (k)	438.40 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.22			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.43	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	10.40 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	494.00 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	10.40 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	582.40 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	494.00 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.23	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.388 in	**OK**		

DCI ENGINEERS	Project:	10x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

HSS Member Design — END WIND BRACE DESIGN

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS4X4X3/8	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		
HSS Member Shear V_{uWeak} (k)	0.00 k		
HSS Member Compression P_u (k)	92.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	12.600 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	3.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	4.78 in²		AASHTO 6.12.2.2.2
HSS Member S_x (in^)	5.13 in³		AASHTO 6.12.2.2.2
HSS Member I_y (in^)	10.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	21.01 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	12.600 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	3.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	4.78 in²		AASHTO 6.12.2.2.2
HSS Member S_y (in^)	5.13 in³		AASHTO 6.12.2.2.2
HSS Member I_x (in^)	10.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	21.01 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	3.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	66.84 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	9.46		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	66.84 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	66.84 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	3.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	66.84 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	9.46		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	66.84 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.00 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	66.84 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	12.600 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	4.78 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	8.460			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	8.460			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	0.650		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	92.57			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	66.86			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	1.497			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	92.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	115.48 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	92.00 k			
HSS Member Compression ϕ_cP_n (k)	115.48 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.80			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.88	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	4.78 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	227.05 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	4.78 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	267.68 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	227.05 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.10	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.630 in	**OK**		

DCI ENGINEERS	Project:	10x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

HSS Member Design — TYP WIND BRACE DESIGN

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS4X4X1/4	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		
HSS Member Shear V_{uWeak} (k)	0.00 k		
HSS Member Compression P_u (k)	75.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

HSS Member Unbraced Length l_{Strong} (ft)	12.600 ft	May Be User Defined	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	3.53 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	3.37 in²		AASHTO 6.12.2.2.2
HSS Member S_x (in^)	3.90 in³		AASHTO 6.12.2.2.2
HSS Member I_y (in^)	7.80 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	15.81 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

HSS Member Unbraced Length l_{Weak} (ft)	12.600 ft	May Be User Defined	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	3.53 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	3.37 in²		AASHTO 6.12.2.2.2
HSS Member S_y (in^)	3.90 in³		AASHTO 6.12.2.2.2
HSS Member I_x (in^)	7.80 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	15.81 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	3.53 in		
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	47.76 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	15.17		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	47.76 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	47.76 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	3.53 in		
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	47.76 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	15.17		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	47.76 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.00 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	47.76 k **OK**		AASHTO 6.10.9.1-1

Project:	10x165 TB		Page:	
Client:	TrueNorth Steel		Design By:	BJS
Job #:	18161-0006		Review By:	MS
Description:	S/N 165TB10H10- PFS0198		Date:	03/05/18

Pedestrian Bridge Design AASHTO LRFD Bridge Design Specification — **ST 2/2**

HSS Member Compression Calculations				
HSS Member Compression Length (ft)	12.600 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	3.37 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	14.200			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	14.200			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.7	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	0.650		May Be User Defined, Welded End K = 0.7	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	89.53			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	64.66			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	1.400			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	75.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	84.76 k	**OK**		AASHTO 6.9.4.1
HSS Member Combined Axial Compression And Flexure Calculations				
HSS Member Compression P_u (k)	75.00 k			
HSS Member Compression ϕ_cP_n (k)	84.76 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.88			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	1.00	**OK**		AASHTO 6.9.2.2
HSS Member Tension Calculations				
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	3.37 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	160.08 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	3.37 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	188.72 k	**OK**		AASHTO 6.8.2.1-2
HSS Member Combined Tension And Flexure Calculations				
HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	160.08 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.13	**OK**		AASHTO 6.8.2.3
HSS Member Strong Axis Deflection Calculations				
HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.630 in	**OK**		

Steel Beam Design - Per AASHTO LRFD Bridge Design Specification

Project: 0006 OAK GROVE

Girder description: Non-Composite Plate Girder

TRANSVERSE BEAM DESIGN

Bridge Span Length	9.5	ft
Unbraced Length L_b	9.5	ft
Moment Magnification Factor		
(6.9.2.2) & (4.5.3.2.2b) Moment Magnification Factor δ_b =	1.00	
C_m =	1.0	
Strong Axis k =	1.0	
Strong Axis Euler Buckling Load $P_{e,x}$ =	6868	
Factored Loads		
(Factored axial & lateral pipeline + wind + braking load) = P_u	0	kips
(Factored axial load on bottom flange from Anchor HSM) = P_u	0	kips
$V_{u,y}$	16	kips
$V_{u,x}$	0	kips
T	0	kip-ft
Factored Design Forces		
Design Moment Mu (+)	33	kip-ft
Magnified Noncomposite Dead Load $M_{u,x}$ (+)	33	kip-ft
Capacity Checks		
Non-Composite Flexural Capacity (ΦMnx)	166	kip-ft
Axial Capacity (ΦPn)	170	kip-ft
Shear Capacity (ΦVn)	108	kip
Combined Moment and Axial	-	

Compactness and Proportion Limits

148.003833

Interior Web Panel:	UNSTIFFENED
Flange:	COMPACT
Flange Proportions:	OK
Web:	COMPACT
Web Proportions:	OK

I Section Properties

	W16x26:	
D (Total Depth)	15.7	in
b_f (Flange width)	5.5	in
t_f	0.375	in
t_w	0.25	in
F_{yw}:	50,000	psi
F_{yf}	50,000	psi
Web depth D	15.0	in
D/t_w	59.8	
J	0.3	in^4
Girder only I_x	312	in^4
I_y	10	in^4
Top flange girder only S_x	40	in^3
Bottom flange girder only S_x	40	in^3
S_y	4	in^3
I_{yc}	5	in^4
I_{yt}	5	in^4
Area	7.86	in^2
Web A_w	3.74	in^2
One flange A_f	2.06	in^2
r_x	6.30	in
r_y	1.15	in
M_{yc}	166	kip-ft
M_{yt}	166	kip-ft
Plastic Section Properties		
Z_x	46	in^3
Z_y	29	in^3
M_p	190	kip-ft

Weights

I Girder	**27**	plf

Stiffeners

Longitudinal Web Stiffeners Present (yes/no)?:	no	
Transverse Web Stiffeners Present (yes/no)?	no	
Stiffener Spacing (d_0)	0	in
Longitudinal stiffener spacing ds	0	in
1.5D	22.425	in
3D	44.85	in
INTERIOR WEB PANEL	**UNSTIFFENED**	

6.10.1.9 Web Bend-Buckling Resistance

D_c	7.5	in
(w/out long.) k	36.0	
(with long.) k	46.6	
F_{crw}	262.7	ksi
F_{crw}	50.0	ksi
F_{crw}	71.4	ksi
Use F_{crw}	50.0	ksi

6.10.1.10 Flange-strength reduction factors

Hybrid Factor R_h	1.00	
a_{wc}	1.81	
R_b	1.00	
R_b	1.00	

6.10.2 Cross Section Proportion Limits

D/t_w	59.80	**OK**
		N/A
$b_f/2t_f$	7.33	**OK**
D/6	2.49	**OK**
$1.1t_w$	0.28	**OK**
I_{yc} / I_{yt}	1.00	**OK**

6.10.6.2.3 Composite section in Negative Flexure and Non-composite sections Provisions for Appendix A or 6.10.8

F_{yf}	50,000	**OK**
D_{cp}	7	in
$2*D_c/t_w$	59.80	
$5.7*\sqrt{(E/F_{yc})}$	137.27	**OK**
I_{yc} / I_{yt}	1.00	**OK**
	APPENDIX A MAY BE USED	

Appendix A Composite section in Negative Flexure and Non-composite sections
A6.2 Web Plastification Factors

Web Elastic Moment slenderness ratio λ_w	59.80	
$\lambda_{pw(Dcp)}$	85.89	
$\lambda_{pw(Dc)}$	85.89	
λ_{rw}	137.27	
WEB :	**COMPACT**	
Web plastication factor R_{pc}	1.15	
Web plastication factor R_{pt}	1.15	
Plastic Moment ϕM_n	190	k-f

6.10.8 Flexural Resistance - Noncomposite Sections

6.10.8.2.2 Local Buckling Resistance

Compression flange slenderness ratio λ_f	7.33		
λ_{pf}	9.15		
λ_{rf}	16.12		
FLANGE :	**COMPACT**		
F_{nc}	50	ksi	
F_{yr}	35	ksi	
F_{nc}	54	ksi	
Use F_{nc}	50	ksi	

6.10.8.2.3 Lateral Torsional Buckling Resistance

L_b	114	in	
r_t	1.39	in	
L_p	33.5	in	
L_r	126	in	
C_b	1.0		
F_{nc}	50	ksi	
F_{nc}	37	ksi	
$F_{nc} = F_{cr}$	43	ksi	
Use F_{nc}	37	ksi	
F_{nc}	37	ksi	
ΦM_{nc}	**122**	k-ft	
R_pM_y	**190**	k-ft	

6.10.8.3 Tension-Flange Flexural Resistance

F_{nt}	50	ksi
ΦM_{nt}	**166**	k-ft

Shear Resistance

6.10.9.3 Nominal Resistance of <u>Stiffened</u> Webs

<u>Interior Panels</u>		
D/t_w	59.80	
d_o/D	0.00	
k	5.00	
$1.12\sqrt{(Ek/F_{yw})}$	60.31	
$1.4\sqrt{(Ek/F_{yw})}$	75.39	
C	1.00	D/tw<=1.12 √(Ek/Fyw)
C	1.01	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)
C	1.27	D/tw>1.4 √(Ek/Fyw)
Use: C	1.000	
V_p	108	kips
Interior Web Proportion Coefficient	1.8 1.0	
ΦV_n	108	kips
ΦV_n	108	kips
Use: ΦV_n	108	kips
<u>End Panels</u>		
ΦV_n	108	kips

6.10.9.2 Nominal Resistance of <u>Unstiffened</u> Webs

<u>Interior and End Panels</u>		
k	5.00	
C	1.00	D/tw<=1.12 √(Ek/Fyw)
C	1.01	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)
C	1.27	D/tw>1.4 √(Ek/Fyw)
Use: C	1.000	
ΦV_n	108	kips

6.10.11 Transverse Web Stiffeners

6.10.11.1.2 Projecting Width

Thickness of projecting stiffener t_p	0.5	in
Width of projecting stiffener b_t	6	in
Stiffener F_y	50000	psi
2.0+D/30	2.50	**OK, bt > 2.0 +D/30**
16*t_p	8.00	**OK, bt < 16*tp**
b_f/4	1.5	**OK, bt > bf/4**
b_t/t_p	12.00	

6.10.11.1.3 Moment of Inertia

Stiffener bending rigidity parameter J	#DIV/0!	in^2
Stiffener Moment of Inertia I_t	36.0	in^4
Stiffener Moment of Inertia I_t	72.0	in^4
b	0.0	in^4
Minimum I_{t1}	#DIV/0!	in^4
ρ_t	1.0	
F_{crs}	50.0	ksi
Minimum I_{t2}	0.1	in^4
When longitudinal stiffener present, Minimum I_t	#DIV/0!	in^4

6.10.11.3 Longitudinal Stiffeners

Thickness of stiffener t_s	0.75	in
Width of projecting stiffener b_t	5	in
Stiffener F_{ys}	50000	psi
effective web width	4.5	in
stiffener area	3.75	in^2
web effective area	1.13	in^2
x(bar)	2.14	in
0.48*t_p*SQRT(E/F_{ys})	8.7	
Long. Stiffener I_l	13.78	in^4
	0.0	in^4
Long. Stiffener r_l	1.68	in
	0.00	in

Axial Resistance - Per AASHTO LRFD Bridge Design Specifications 4th Ed. 2007 - 2009 Interim

Unbraced length L	9.50	ft
Unbraced length L	114.00	in

Girder Noncomposite Properites

D(total)	15.7	in
Web depth D	15	in
tw	0.25	in
bf	5.5	in
tf	0.375	in
F_y	50	ksi
SQRT(E/Fy)	24.08	
As	7.86	in^2
rx	6.30	in
ry	1.15	in
K	1.0	

6.9.3 Limiting Slenderness Ratios

Slenderness ratio	99.04
Primary members K*L / r <= 120	**OK**
Secondary members K*L / r <= 140	**OK**

Steel Beam Design - Per AASHTO LRFD Bridge Design Specification

Project: 0006 OAK GROVE

Girder description: Non-Composite Plate Girder

STRINGER DESIGN

Bridge Span Length		9.5	ft
	Unbraced Length L_b	9.5	ft
Moment Magnification Factor			
(6.9.2.2) & (4.5.3.2.2b) Moment Magnification Factor δ_b =		1.00	
C_m =		1.0	
Strong Axis k =		1.0	
Strong Axis Euler Buckling Load $P_{e,x}$ =		636	
Factored Loads			
(Factored axial & lateral pipeline + wind + braking load) = P_u		0	kips
(Factored axial load on bottom flange from Anchor HSM) = P_u		0	kips
$V_{u,y}$		16	kips
$V_{u,x}$		0	kips
T		0	kip-ft
Factored Design Forces			
Design Moment Mu (+)		31	kip-ft
Magnified Noncomposite Dead Load $M_{u,x}$ (+)		31	kip-ft
Capacity Checks			
Non-Composite Flexural Capacity (ΦMnx)		40	kip-ft
Axial Capacity (ΦPn)		127	kip-ft
Shear Capacity (ΦVn)		37	kip
Combined Moment and Axial		-	

Compactness and Proportion Limits

49.03102126

Interior Web Panel: UNSTIFFENED

Flange: NON-COMPACT

Flange Proportions: OK

Web: COMPACT

Web Proportions: OK

I Section Properties

	W6x15:	
D (Total Depth)	6	in
b_f (Flange width)	6	in
t_f	0.26	in
t_w	0.23	in
F_{yw}:	50,000	psi
F_{yf}	50,000	psi
Web depth D	5.5	in
D/t_w	23.8	
J	0.1	in^4
Girder only I_x	29	in^4
I_y	9	in^4
Top flange girder only S_x	10	in^3
Bottom flange girder only S_x	10	in^3
S_y	3	in^3
I_{yc}	5	in^4
I_{yt}	5	in^4
Area	4.38	in^2
Web A_w	1.26	in^2
One flange A_f	1.56	in^2
r_x	2.57	in
r_y	1.46	in
M_{yc}	40	kip-ft
M_{yt}	40	kip-ft
Plastic Section Properties		
Z_x	11	in^3
Z_y	35	in^3
M_p	45	kip-ft

Weights

I Girder	**15**	plf

Stiffeners

Longitudinal Web Stiffeners Present (yes/no)?:	no	
Transverse Web Stiffeners Present (yes/no)?	no	
Stiffener Spacing (d_0)	0	in
Longitudinal stiffener spacing ds	0	in
1.5D	8.22	in
3D	16.44	in
INTERIOR WEB PANEL	**UNSTIFFENED**	

6.10.1.9 Web Bend-Buckling Resistance

D_c	2.7	in
(w/out long.) k	36.0	
(with long.) k	46.6	
F_{crw}	1655.2	ksi
F_{crw}	50.0	ksi
F_{crw}	71.4	ksi
Use F_{crw}	50.0	ksi

6.10.1.10 Flange-strength reduction factors

Hybrid Factor R_h	1.00	
a_{wc}	0.81	
R_b	1.00	
R_b	1.00	

6.10.2 Cross Section Proportion Limits

D/t_w	23.83	**OK**
		N/A
$b_f/2t_f$	11.54	**OK**
D/6	0.91	**OK**
$1.1t_w$	0.25	**OK**
I_{yc} / I_{yt}	1.00	**OK**

6.10.6.2.3 Composite section in Negative Flexure and Non-composite sections Provisions for Appendix A or 6.10.8

F_{yf}	50,000	**OK**
D_{cp}	3	in
$2*D_c/t_w$	23.83	
$5.7*\sqrt{(E/F_{yc})}$	137.27	**OK**
I_{yc} / I_{yt}	1.00	**OK**
	APPENDIX A MAY BE USED	

Appendix A Composite section in Negative Flexure and Non-composite sections
A6.2 Web Plastification Factors

Web Elastic Moment slenderness ratio λ_w	23.83	
$\lambda_{pw(Dcp)}$	92.83	
$\lambda_{pw(Dc)}$	92.83	
λ_{rw}	137.27	
WEB :	**COMPACT**	
Web plastication factor R_{pc}	1.11	
Web plastication factor R_{pt}	1.11	
Plastic Moment ϕM_n	45	k-f

6.10.8 Flexural Resistance - Noncomposite Sections

6.10.8.2.2 Local Buckling Resistance

Compression flange slenderness ratio λ_f	11.54		
λ_{pf}	9.15		
λ_{rf}	16.12		
FLANGE :	**NON-COMPACT**		
F_{nc}	50	ksi	
F_{yr}	35	ksi	
F_{nc}	45	ksi	
Use F_{nc}	45	ksi	

6.10.8.2.3 Lateral Torsional Buckling Resistance

L_b	114	in	
r_t	1.63	in	
L_p	39.2	in	
L_r	147	in	
C_b	1.0		
F_{nc}	50	ksi	
F_{nc}	40	ksi	
$F_{nc} = F_{cr}$	50	ksi	
Use F_{nc}	40	ksi	
F_{nc}	40	ksi	
ΦM_{nc}	**32**	k-ft	
R_pM_y	**45**	k-ft	

6.10.8.3 Tension-Flange Flexural Resistance

F_{nt}	50	ksi
ΦM_{nt}	**40**	k-ft

Shear Resistance

6.10.9.3 Nominal Resistance of <u>Stiffened</u> Webs

	<u>Interior Panels</u>		
D/t_w	23.83		
d_o/D	0.00		
k	5.00		
$1.12\sqrt{(Ek/F_{yw})}$	60.31		
$1.4\sqrt{(Ek/F_{yw})}$	75.39		
C	1.00	D/tw<=1.12 √(Ek/Fyw)	
C	2.53	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)	
C	8.02	D/tw>1.4 √(Ek/Fyw)	
Use: C	1.000		
V_p	37	kips	
Interior Web Proportion	0.8		
Coefficient	1.0		
ΦV_n	37	kips	
ΦV_n	37	kips	
Use: ΦV_n	37	kips	
	<u>End Panels</u>		
ΦV_n	37	kips	

6.10.9.2 Nominal Resistance of <u>Unstiffened</u> Webs

	<u>Interior and End Panels</u>		
k	5.00		
C	1.00	D/tw<=1.12 √(Ek/Fyw)	
C	2.53	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)	
C	8.02	D/tw>1.4 √(Ek/Fyw)	
Use: C	1.000		
ΦV_n	37	kips	

Current Date: 2/19/2018 2:04 PM
Units system: English
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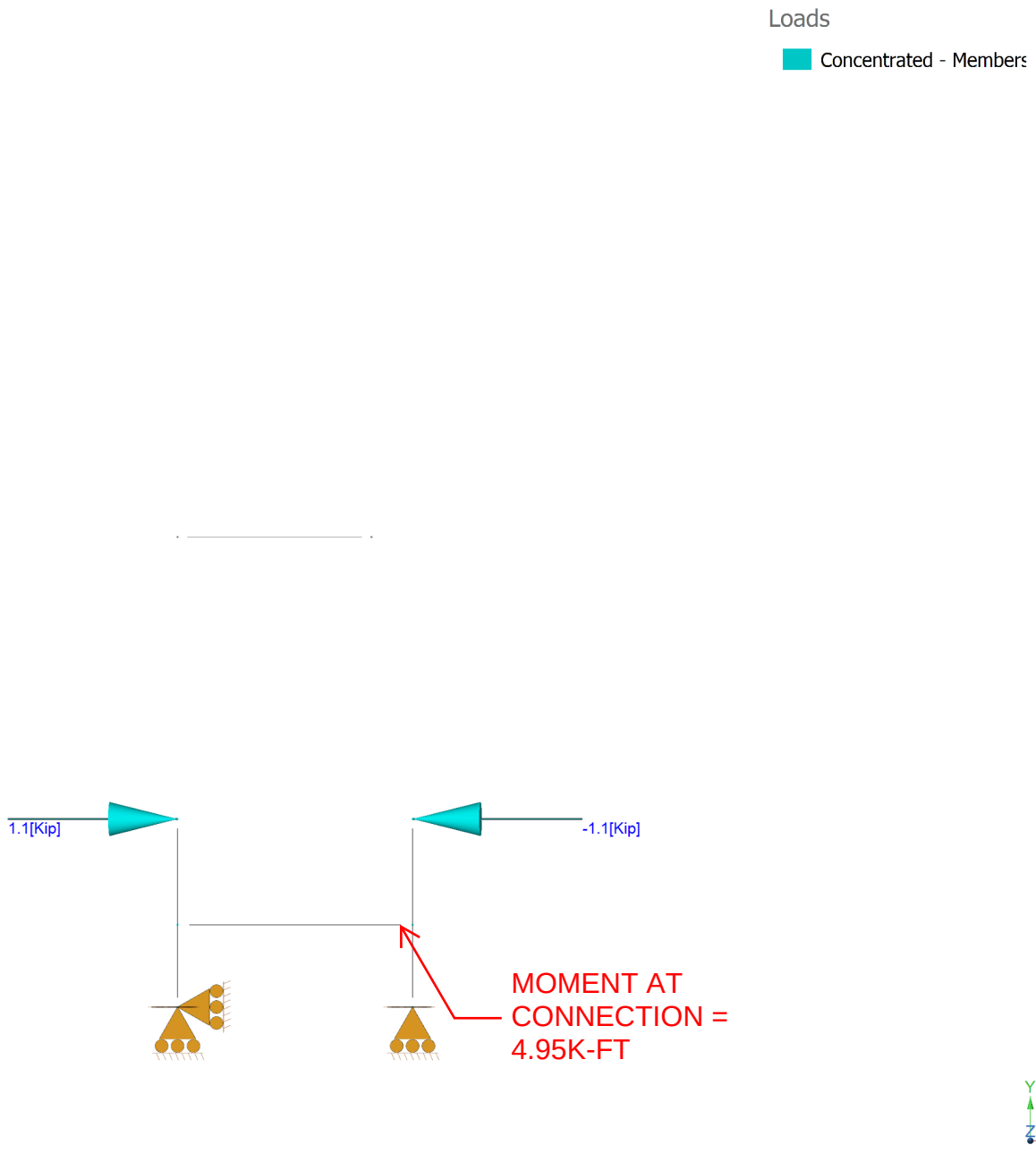
Load condition: LL=Live Load



T →

C ←

CHECK WELD:

ASSUME TOP AND BOTTOM FLANGE WELDED ONLY,
T = C = 4.95K-FT/1.33FT = 3.72K

R = 0.6*F*0.707*D/16*L = 0.6*70*0.707*5/16*5.5 =51K (OK)

W16X26 FLANGE

DCI ENGINEERS	Project:	12x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB12H10-PFS0198	Date:	03/19/18

Transverse Wood Plank Deck Design

Transverse Wood Plank Miscellaneous Input

Wood Plank Size	4x12 Dim	Assume Weak Axis Bending Orientation	
Lumber Grade	Douglas Fir-Larch No. 2 Dimension		
Wood Plank Continuity	Continuous Over 3 Or More Spans		
Load Duration Type	2 Months (Vehicle Live Load)		AASHTO Table 13.5.5A
Repetitive Member Factor	Considered		
Wet Service Condition	Moisture Content Less Than 19%		
Incising Condition	Not Considered		
Spacing Of Beams S (ft)	2.00 ft		
Beam Flange Width (in)	6.00 in		
$F_{bo(y)}$ (psi)	900 psi		AASHTO 8.4.1.1.4-1
$F_{vo(y)}$ (psi)	180 psi		AASHTO 8.4.1.1.4-1
$F_{co(Parallel)}$ (psi)	1350 psi		AASHTO 8.4.1.1.4-1
$E_{co(y)}$ (psi)	1600000 psi		AASHTO 8.4.1.1.4-1
Design Wheel Load (lb)	8000 lb	Utilize 12000 lb For H15, HS15, H20, HS20	
Wheel Load Distribution Width b_t (in)	10.00 in		AASHTO 3.6.1.2.5
Wheel Load Distribution Length b_d (in)	20.00 in		AASHTO 3.6.1.2.5
Load Factor Case	Service Load I		AASHTO 3.4.1-1
γ	1.00		AASHTO 3.4.1-3
β_D	1.00		CALTRANS 3.22.1A
β_L	1.00		CALTRANS 3.22.1A

Transverse Wood Plank Design Loading Input

w_{Plank} (psf)	10.3 psf	3x Timber Deck = 7.3 psf, 4x Timber Deck = 10.3 psf
$w_{Ballast}$ (psf)	0.0 psf	8" Side Dam, Deck 12x4-1/4", Ballast = 80 psf (140 pcf)
$w_{Wearing}$ (psf)	0.0 psf	2" Wearing Surface = 23.3 psf, Municipality 3" Asphalt = 35.0 psf
w_{DL} (lb/in)	0.80 lb/in	

Transverse Wood Plank Flexural Calculations

Wood Plank Design Thickness t_{Deck} (in)	3.50 in		
Design Wood Plank Span s (ft)	1.50 ft		CALTRANS 3.25.1.2
Wood Plank Continuity Factor	0.80		CALTRANS 3.25.1.2
M_{DL} (in*lb)	26 in*lb		FS Timber Bridge DM 7-53
M_{LL} (in*lb)	22414 in*lb		FS Timber Bridge DM 7-53
M_{TOT} (in*lb)	22440 in*lb		
C_F	1.10		
C_M	1.00		
C_D	1.15		
C_r	1.15		
C_{fu}	1.10		
C_i	1.00		
f_b (psi)	977 psi		
F'_b (psi)	1440 psi	**OK**	

Transverse Wood Plank Shear Calculations

Design Wood Plank Span s (ft)	1.50 ft		
V_{DL} (lb)	4 lb		FS Timber Bridge DM 7-59
V_{LL} (lb)	4222 lb	AISC Table 3-23.5 & 3-23.4	FS Timber Bridge DM 7-141
V_{TOT} (lb)	4227 lb		
C_M	1.00		
C_D	1.15		
C_i	1.00		
f_v (psi)	161 psi		
F'_v (psi)	207 psi	**OK**	

Transverse Wood Plank Deflection Calculations

Design Wood Plank Span (ft)	1.50 ft		CALTRANS 3.25.1.2
Wood Plank Continuity Factor	0.80		CALTRANS 3.25.1.2
Wood Plank Deflection Criteria	L/425		
C_M	1.00		
C_i	1.00		
E'_o (psi)	1600000 psi		
Wood Plank Deflection δ_{LMax} (in)	0.012 in		FS Timber Bridge DM 7-56
Wood Plank LL Deflection Span Ratio	L / 1530	**OK**	

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:45AM

Wood Beam

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ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING

ADDITIONAL WOOD DECK CHECK:

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-10

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

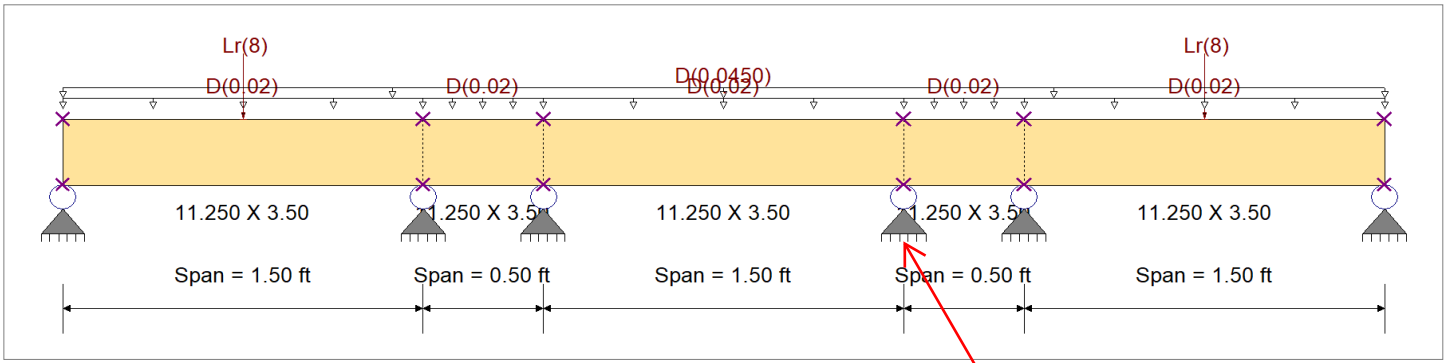
Beam Bracing : Completely Unbraced

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.20 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Loads on all spans...
Uniform Load on ALL spans : D = 0.0450 k/ft

REPRESENT FLANGE LOCATIONS

Load for Span Number 1
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Point Load : Lr = 8.0 k @ 0.750 ft

Load for Span Number 2
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Load for Span Number 4
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Load for Span Number 5
Point Load : Lr = 8.0 k @ 0.750 ft

Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:45AM

Wood Beam

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ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 — **Licensee : DCI ENGINEERS**

Description : WOOD DECKING

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.783 : 1	Maximum Shear Stress Ratio	=	0.877 : 1
Section used for this span		11.250 X 3.50	Section used for this span		11.250 X 3.50
fb : Actual	=	1,114.26 psi	fv : Actual	=	197.41 psi
FB : Allowable	=	1,423.13 psi	Fv : Allowable	=	225.00 psi
Load Combination		+D+Lr+H	Load Combination		+D+Lr+H
Location of maximum on span	=	0.741 ft	Location of maximum on span	=	1.215 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.009 in	Ratio =	2018	>=360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360
Max Downward Total Deflection	0.009 in	Ratio =	2001	>=180
Max Upward Total Deflection	0.000 in	Ratio =	0	<180

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
+D+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.04	1.68	162.00
Length = 0.50 ft	2	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.03	1.68	162.00
Length = 1.50 ft	3	0.005	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1024.65	0.03	1.68	162.00
Length = 0.50 ft	4	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.04	1.68	162.00
Length = 1.50 ft	5	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.04	1.68	162.00
+D+L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.04	1.68	180.00
Length = 0.50 ft	2	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.03	1.68	180.00
Length = 1.50 ft	3	0.005	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1138.50	0.03	1.68	180.00
Length = 0.50 ft	4	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.04	1.68	180.00
Length = 1.50 ft	5	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.04	1.68	180.00
+D+Lr+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.783	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	2.13	1,114.26	1423.13	5.18	197.41	225.00
Length = 0.50 ft	2	0.632	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.72	899.49	1423.13	3.73	197.41	225.00
Length = 1.50 ft	3	0.061	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.17	86.46	1423.13	3.71	197.41	225.00
Length = 0.50 ft	4	0.632	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.72	899.49	1423.13	5.18	197.41	225.00
Length = 1.50 ft	5	0.783	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	2.13	1,114.26	1423.13	5.18	197.41	225.00
+D+S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 0.50 ft	2	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.03	1.68	207.00
Length = 1.50 ft	3	0.004	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1309.28	0.03	1.68	207.00
Length = 0.50 ft	4	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 1.50 ft	5	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
+D+0.750Lr+0.750L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.588	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1423.13	3.90	148.48	225.00
Length = 0.50 ft	2	0.475	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1423.13	2.80	148.48	225.00
Length = 1.50 ft	3	0.047	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.13	66.20	1423.13	2.78	148.48	225.00
Length = 0.50 ft	4	0.475	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1423.13	3.90	148.48	225.00
Length = 1.50 ft	5	0.588	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1423.13	3.90	148.48	225.00
+D+0.750L+0.750S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 0.50 ft	2	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.03	1.68	207.00
Length = 1.50 ft	3	0.004	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1309.28	0.03	1.68	207.00
Length = 0.50 ft	4	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 1.50 ft	5	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
+D+0.60W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666
Licensee : DCI ENGINEERS

Description : WOOD DECKING

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
+D+0.70E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
+D+0.750Lr+0.750L+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.460	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1821.60	3.90	148.48	288.00
Length = 0.50 ft	2	0.371	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1821.60	2.80	148.48	288.00
Length = 1.50 ft	3	0.036	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.13	66.20	1821.60	2.78	148.48	288.00
Length = 0.50 ft	4	0.371	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1821.60	3.90	148.48	288.00
Length = 1.50 ft	5	0.460	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1821.60	3.90	148.48	288.00
+D+0.750L+0.750S+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
+0.60D+0.60W+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 0.50 ft	2	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.02	1.01	288.00
Length = 1.50 ft	3	0.002	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	3.25	1821.60	0.02	1.01	288.00
Length = 0.50 ft	4	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 1.50 ft	5	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
+0.60D+0.70E+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 0.50 ft	2	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.02	1.01	288.00
Length = 1.50 ft	3	0.002	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	3.25	1821.60	0.02	1.01	288.00
Length = 0.50 ft	4	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 1.50 ft	5	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+Lr+H	1	0.0090	0.703		0.0000	0.000
	2	0.0000	0.703	+D+Lr+H	-0.0007	0.209
+D+Lr+H	3	0.0013	0.759		0.0000	0.209
	4	0.0000	0.759	+D+Lr+H	-0.0007	0.297
+D+Lr+H	5	0.0089	0.816		0.0000	0.297

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5	Support 6
Overall MAXimum	2.907	8.954	-3.724	-3.724	8.954	2.907
Overall MINimum	2.862	8.862	0.065	0.065	8.862	2.862
+D+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+L+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+Lr+H	2.907	8.954	-3.659	-3.659	8.954	2.907
+D+S+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.750Lr+0.750L+H	2.192	6.739	-2.728	-2.728	6.739	2.192
+D+0.750L+0.750S+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.60W+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.70E+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.750Lr+0.750L+0.450W+H	2.192	6.739	-2.728	-2.728	6.739	2.192
+D+0.750L+0.750S+0.450W+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.750L+0.750S+0.5250E+H	0.045	0.092	0.065	0.065	0.092	0.045
+0.60D+0.60W+0.60H	0.027	0.055	0.039	0.039	0.055	0.027

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

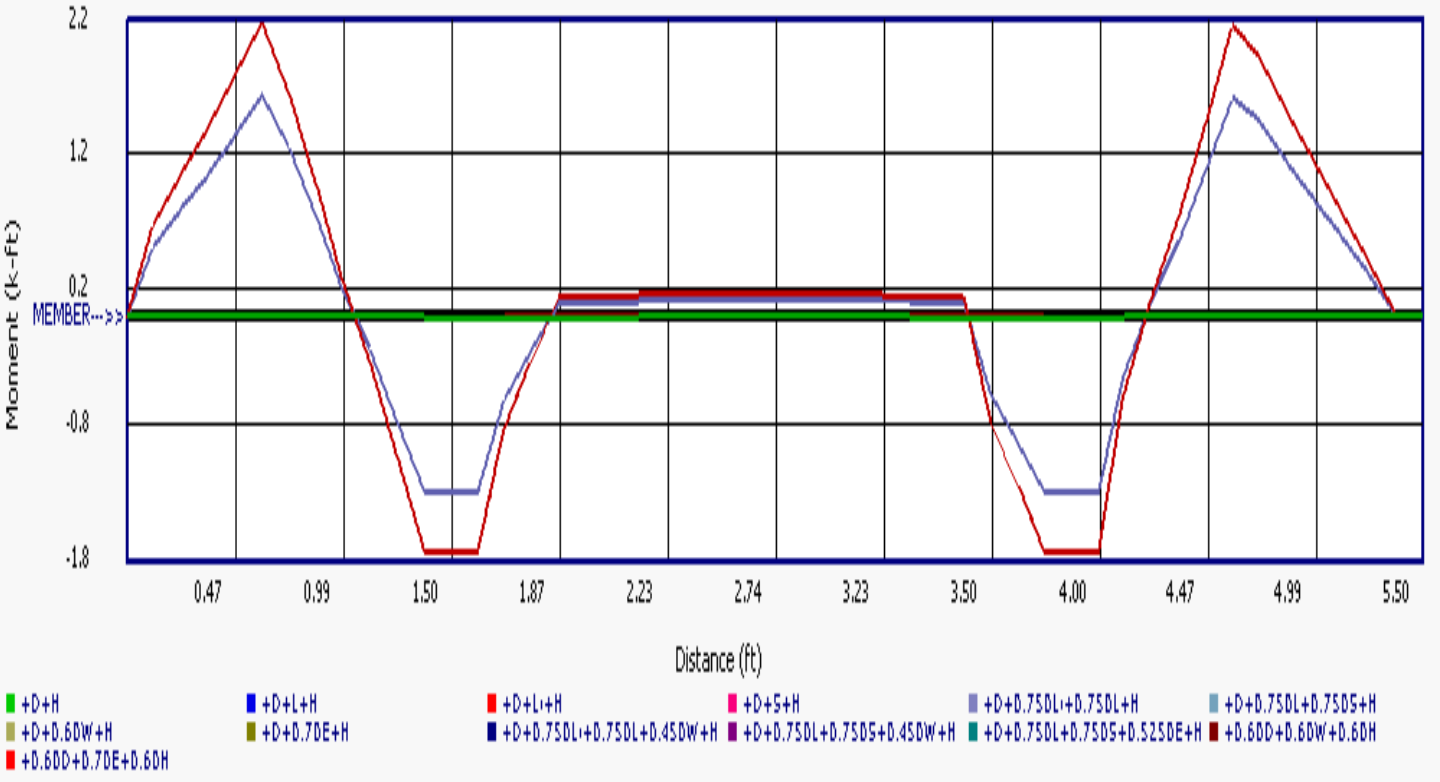
Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5	Support 6
+0.60D+0.70E+0.60H	0.027	0.055	0.039	0.039	0.055	0.027
D Only	0.045	0.092	0.065	0.065	0.092	0.045
Lr Only	2.862	8.862	-3.724	-3.724	8.862	2.862
L Only						
S Only						
W Only						
E Only						
H Only						

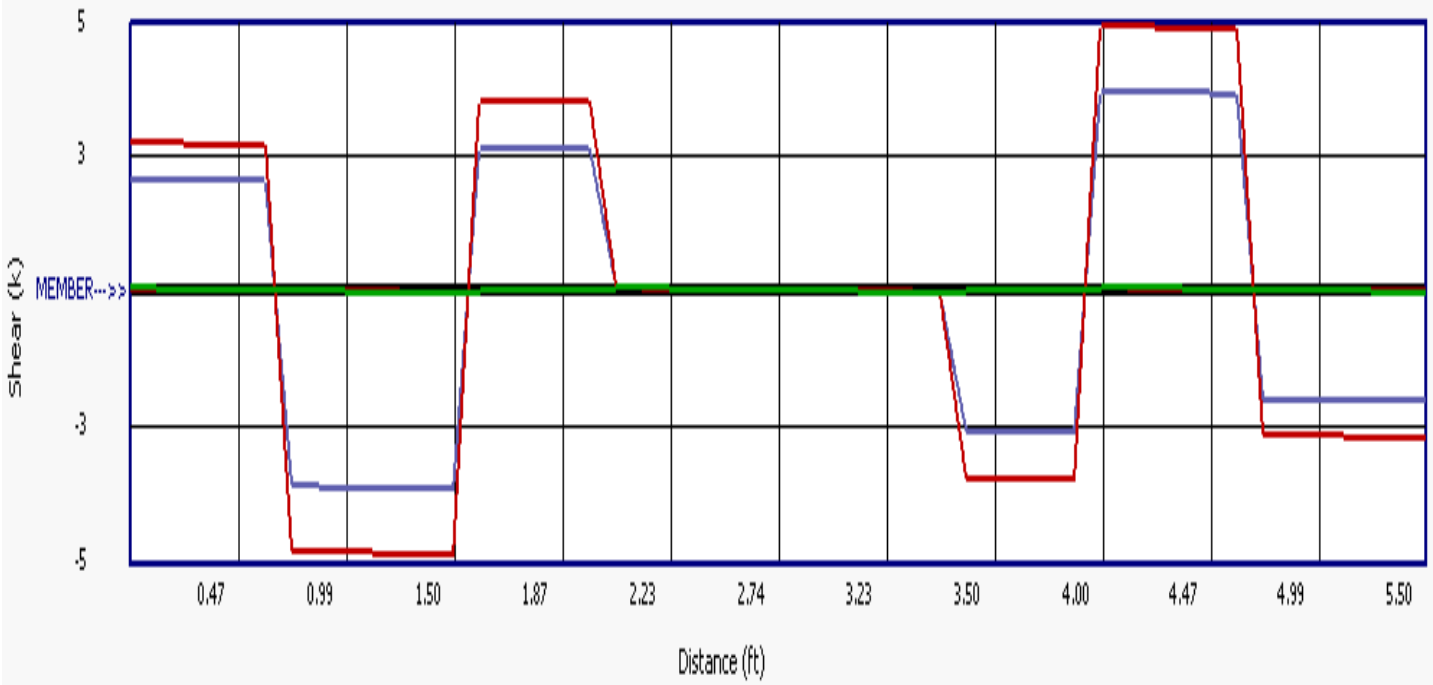


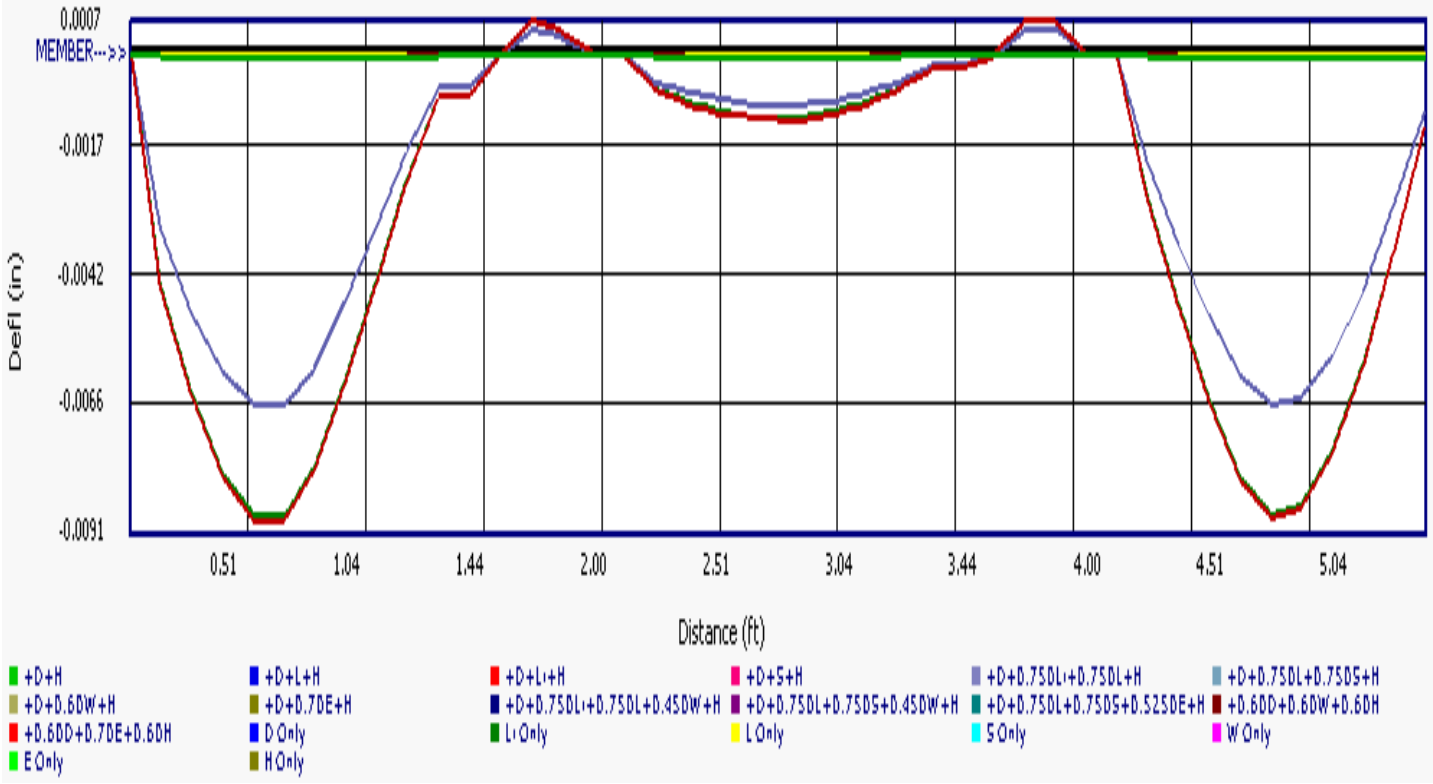
Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666
Licensee : DCI ENGINEERS

Description : WOOD DECKING





Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:50AM

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER

TIRE LOAD CANNOT EXTEND INTO CANTILVER, THEREFORE WE ARE USING 90PSF

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-10

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

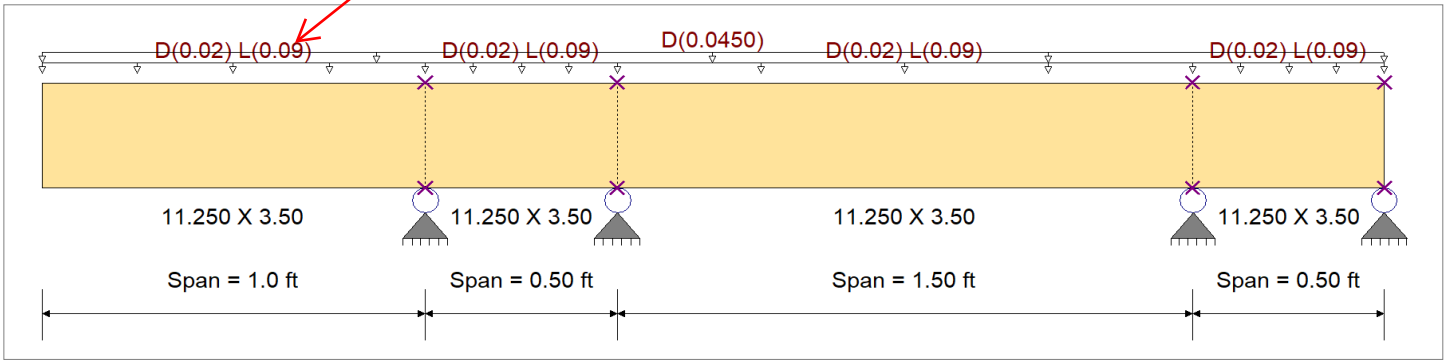
Beam Bracing : Completely Unbraced

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.20 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Loads on all spans...
Uniform Load on ALL spans : D = 0.0450 k/ft

Load for Span Number 1
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Load for Span Number 4
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:50AM

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 — **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.038 : 1	Maximum Shear Stress Ratio	=	0.027 : 1
Section used for this span		11.250 X 3.50	Section used for this span		11.250 X 3.50
fb : Actual	=	42.72 psi	fv : Actual	=	4.90 psi
FB : Allowable	=	1,138.50 psi	Fv : Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.000 ft	Location of maximum on span	=	1.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0 <360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.001 in	Ratio =	25842 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
+D+H													0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.019	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1024.65	0.06	2.20	162.00
Length = 0.50 ft	2	0.019	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1024.65	0.06	2.20	162.00
Length = 1.50 ft	3	0.007	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1024.65	0.04	2.20	162.00
Length = 0.50 ft	4	0.007	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1024.65	0.02	2.20	162.00
+D+L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.038	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.08	42.72	1138.50	0.13	4.90	180.00
Length = 0.50 ft	2	0.038	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.08	42.72	1138.50	0.13	4.90	180.00
Length = 1.50 ft	3	0.014	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.03	15.92	1138.50	0.09	4.90	180.00
Length = 0.50 ft	4	0.014	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.03	15.92	1138.50	0.05	4.90	180.00
+D+Lr+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.013	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1423.13	0.06	2.20	225.00
Length = 0.50 ft	2	0.013	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1423.13	0.06	2.20	225.00
Length = 1.50 ft	3	0.005	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1423.13	0.04	2.20	225.00
Length = 0.50 ft	4	0.005	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1423.13	0.02	2.20	225.00
+D+S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.015	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1309.28	0.06	2.20	207.00
Length = 0.50 ft	2	0.015	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1309.28	0.06	2.20	207.00
Length = 1.50 ft	3	0.005	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1309.28	0.04	2.20	207.00
Length = 0.50 ft	4	0.005	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1309.28	0.02	2.20	207.00
+D+0.750Lr+0.750L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.026	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1423.13	0.11	4.22	225.00
Length = 0.50 ft	2	0.026	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1423.13	0.11	4.22	225.00
Length = 1.50 ft	3	0.010	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1423.13	0.08	4.22	225.00
Length = 0.50 ft	4	0.010	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1423.13	0.05	4.22	225.00
+D+0.750L+0.750S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.028	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1309.28	0.11	4.22	207.00
Length = 0.50 ft	2	0.028	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1309.28	0.11	4.22	207.00
Length = 1.50 ft	3	0.010	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1309.28	0.08	4.22	207.00
Length = 0.50 ft	4	0.010	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1309.28	0.05	4.22	207.00
+D+0.60W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 0.50 ft	2	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 1.50 ft	3	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.04	2.20	288.00
Length = 0.50 ft	4	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.02	2.20	288.00
+D+0.70E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 0.50 ft	2	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 1.50 ft	3	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.04	2.20	288.00
Length = 0.50 ft	4	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.02	2.20	288.00
+D+0.750Lr+0.750L+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:50AM

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	fb	F'b	Shear Values V	fv	F'v
Length = 0.50 ft	2	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 1.50 ft	3	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.08	4.22	288.00
Length = 0.50 ft	4	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.05	4.22	288.00
+D+0.750L+0.750S+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 0.50 ft	2	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 1.50 ft	3	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.08	4.22	288.00
Length = 0.50 ft	4	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.05	4.22	288.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 0.50 ft	2	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 1.50 ft	3	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.08	4.22	288.00
Length = 0.50 ft	4	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.05	4.22	288.00
+0.60D+0.60W+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 0.50 ft	2	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 1.50 ft	3	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.02	1.32	288.00
Length = 0.50 ft	4	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.01	1.32	288.00
+0.60D+0.70E+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 0.50 ft	2	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 1.50 ft	3	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.02	1.32	288.00
Length = 0.50 ft	4	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.01	1.32	288.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0009	0.000		0.0000	0.000
	2	0.0000	0.000	+D+L+H	-0.0000	0.222
+D+L+H	3	0.0001	0.722		0.0000	0.222
	4	0.0000	0.722	+D+L+H	-0.0000	0.203

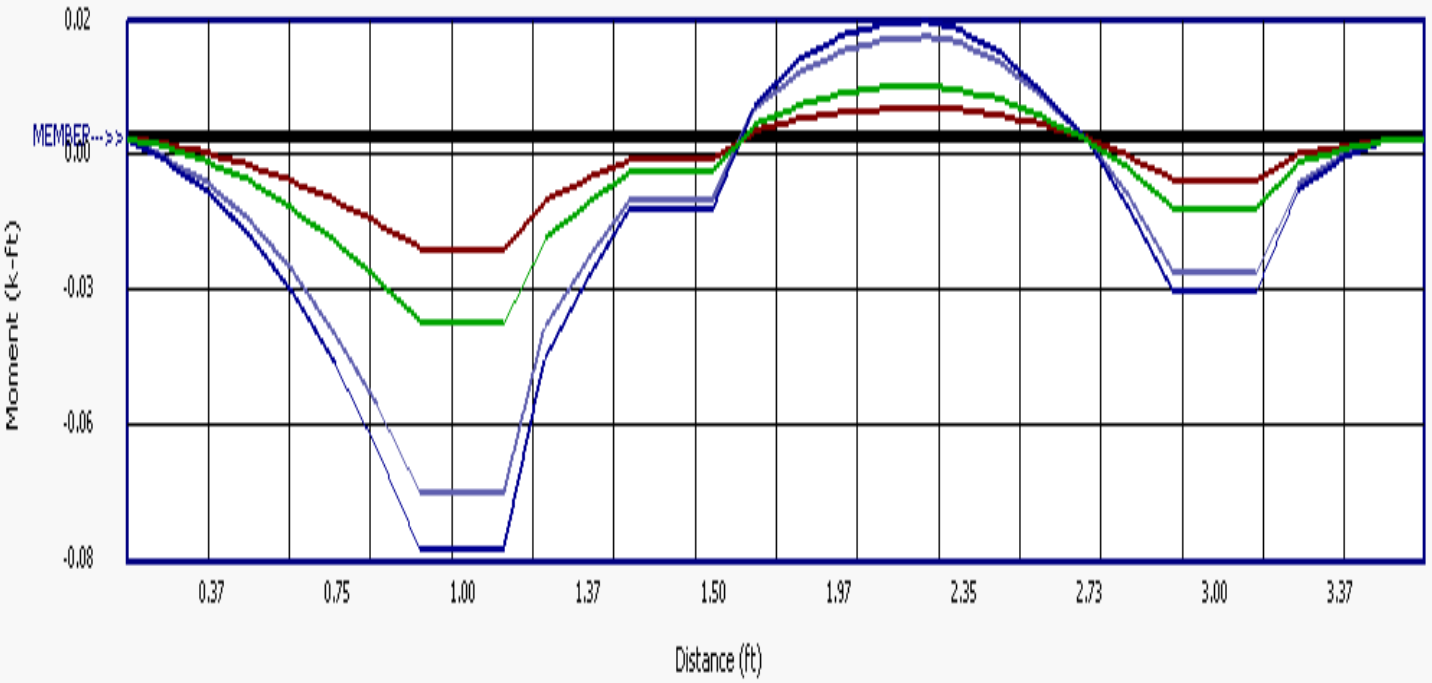
Vertical Reactions

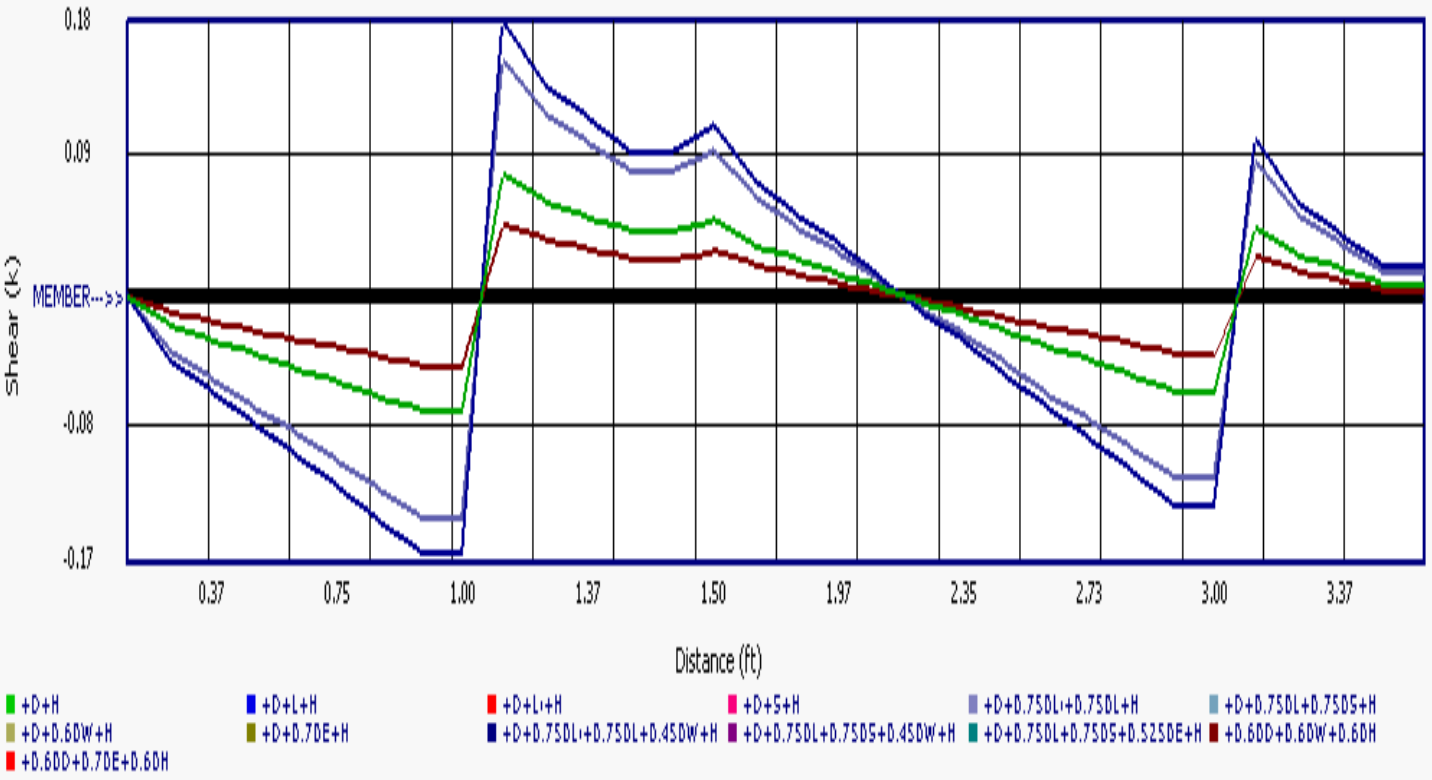
Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5
Overall MAXimum		0.340	0.017	0.235	-0.020
Overall MINimum		0.187	0.010	0.130	-0.009
+D+H		0.153	0.008	0.106	-0.009
+D+L+H		0.340	0.017	0.235	-0.020
+D+Lr+H		0.153	0.008	0.106	-0.009
+D+S+H		0.153	0.008	0.106	-0.009
+D+0.750Lr+0.750L+H		0.293	0.015	0.203	-0.017
+D+0.750L+0.750S+H		0.293	0.015	0.203	-0.017
+D+0.60W+H		0.153	0.008	0.106	-0.009
+D+0.70E+H		0.153	0.008	0.106	-0.009
+D+0.750Lr+0.750L+0.450W+H		0.293	0.015	0.203	-0.017
+D+0.750L+0.750S+0.450W+H		0.293	0.015	0.203	-0.017
+D+0.750L+0.750S+0.5250E+H		0.293	0.015	0.203	-0.017
+0.60D+0.60W+0.60H		0.092	0.005	0.064	-0.005
+0.60D+0.70E+0.60H		0.092	0.005	0.064	-0.005
D Only		0.153	0.008	0.106	-0.009
Lr Only					
L Only		0.187	0.010	0.130	-0.011
S Only					
W Only					
E Only					
H Only					

Wood Beam

Description : WOOD DECKING - CANTILEVER





Wood Beam

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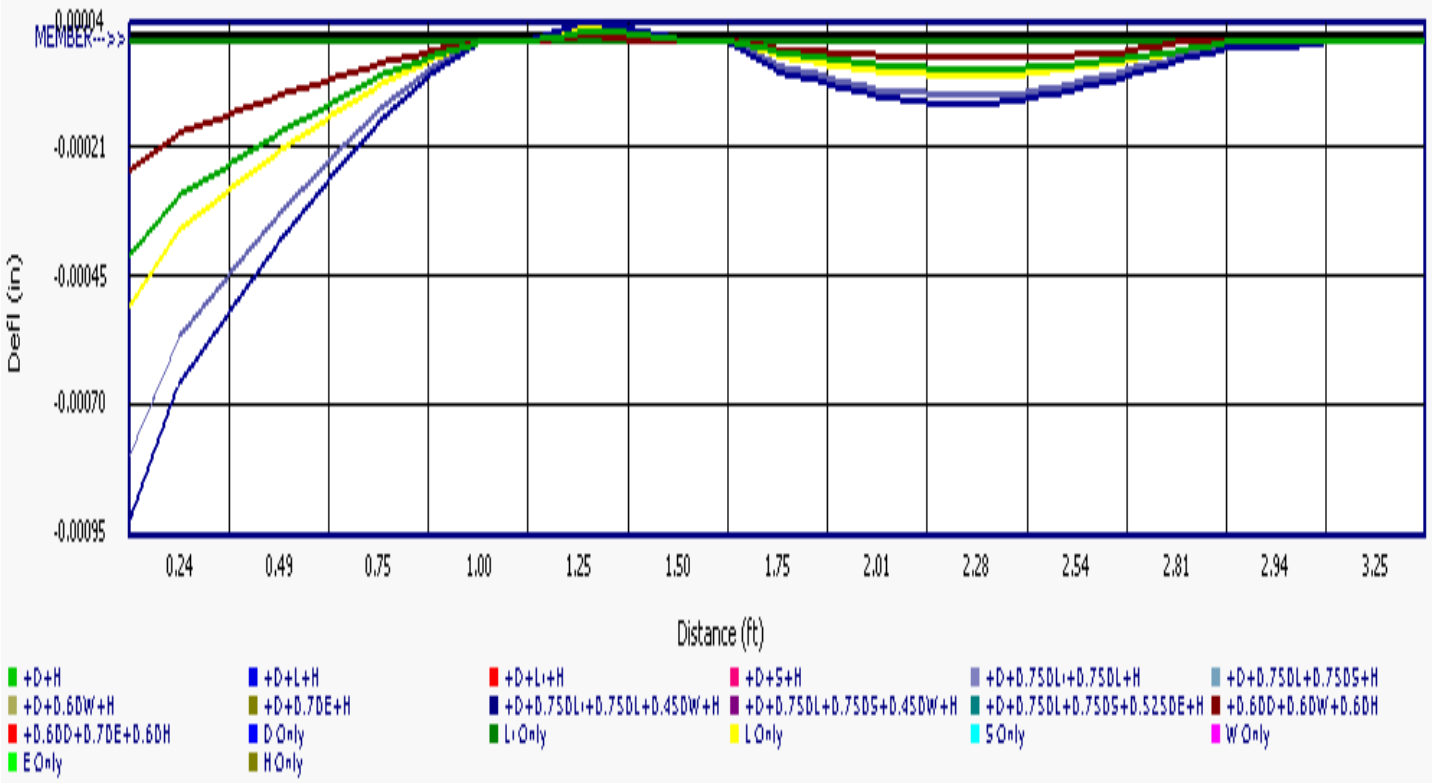
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER



Summary of Values per Beam Span

Beam Span Moments & Shears at Incremental Locations

Load Type/ Combination	Span Location (ft)	Span ID	Shear (k)	Moment (ft-k)
+D+H	0.00	Span 1	0.000	0.000
+D+H	0.11	Span 1	-0.008	-0.000
+D+H	0.23	Span 1	-0.017	-0.002
+D+H	0.34	Span 1	-0.025	-0.004
+D+H	0.46	Span 1	-0.034	-0.008
+D+H	0.57	Span 1	-0.042	-0.012
+D+H	0.68	Span 1	-0.050	-0.017
+D+H	0.80	Span 1	-0.059	-0.023
+D+H	0.91	Span 1	-0.067	-0.031
+D+H	1.01	Span 2	0.079	-0.036
+D+H	1.06	Span 2	0.075	-0.032
+D+H	1.12	Span 2	0.070	-0.028
+D+H	1.18	Span 2	0.066	-0.024
+D+H	1.23	Span 2	0.062	-0.020
+D+H	1.29	Span 2	0.058	-0.017
+D+H	1.35	Span 2	0.054	-0.014
+D+H	1.41	Span 2	0.049	-0.011
+D+H	1.46	Span 2	0.045	-0.008
+D+H	1.54	Span 3	0.047	-0.004
+D+H	1.71	Span 3	0.035	0.003

ADDITIONAL CALCS

DCI ENGINEERS	Project:	12x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB12H10-PFS0198	Date:	07/18/18

Padeye Design

Padeye Miscellaneous Input

Padeye Plate Grade	A709 Grade 50			AASHTO Table 6.4.1-1
Padeye Plate Thickness t_p (in)	1.50 in			
Padeye Plate Length L_p (in)	7.00 in			
Padeye Plate Height H_p (in)	6.50 in			
Padeye Hole Diameter d_{hole} (in)	2.25 in			
Padeye Horizontal Edge Distance a (in)	2.375 in	**OK**		
Padeye Vertical Edge Distance e (in)	2.250 in	**OK**		
Padeye Demand P (k)	60.00 k			Vertical Service Level Load
Padeye Demand P Load Angle θ (°)	45.00 °		From Horizontal, 90° Is Vertical Load, Acts Through Centerline Hole	

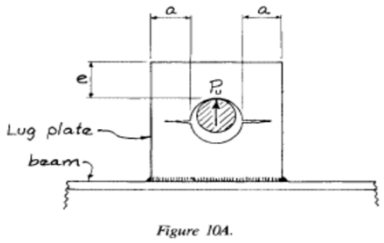


Figure 10A.

Padeye Tension Failure Calculations

Padeye Ultimate Stress F_u (ksi)	65 ksi			AASHTO 6.4.1
Tension Failure Safety Factor $FS_{Tension}$	5.00			Ricker Page 157
Tension Failure P_n (k)	92.63 k			Ricker Page 157

Padeye Snug Fit Calculations

Padeye Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
Padeye Allowable Stress F_b (ksi)	33 ksi			
Snug Fit Crushing Failure P_n (k)	151.88 k			Ricker Page 152
Less Than Snug Fit Tearout P_n (k)	186.00 k			Ricker Page 152

Padeye Shear Failure Calculations

Padeye Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
Shear Failure Safety Factor FS_{Shear}	1.50			AISC 360-05 G2.1.a
Shear Failure V_n (k)	135.00 k			AISC 360-05 G2.1

Padeye Dishing Calculations

Minimum Padeye Plate Thickness t_{pmin} (in)	0.56 in			Ricker Page 157, AISC 360-05
Padeye Plate Thickness t_p (in)	1.50 in	**OK**		

Padeye Weld Calculations

Treat Weld Group As Line

Deck To Beam Min Fillet Weld Size (in)	5/16 in			AASHTO 6.13.3.4
Deck To Beam Max Fillet Weld Size (in)	23/16 in			AASHTO 6.13.3.4
Padeye Fillet Weld Size (in)	3/8 in	**OK**		
Ω	1.88			AISC 360-05 Table J2.5
Padeye Fillet Weld Shear Cap R_n (k/in)	11.85 k/in		Fillet Weld Each Side Of Padeye	AASHTO 6.13.3.2.4b-1
Padeye Fillet Weld Group S_w (in²/in)	8.17 in³/in			
Padeye Fillet Weld Group M_u (in*k)	132.58 in*k			
Padeye Fillet Weld Group P_{uV} (k)	42.43 k			
Padeye Fillet Weld Group P_{uH} (k)	42.43 k			
Padeye Fillet Weld Group f_{1M} (k/in)	16.23 k/in			
Padeye Fillet Weld Group f_{2V} (k/in)	6.06 k/in			
Padeye Fillet Weld Group f_{3H} (k/in)	6.06 k/in			
Padeye Fillet Weld Group f_{peak} (k/in)	23.10 k/in			
Padeye Fillet Weld Group f_{avg} (k/in)	17.47 k/in			
Padeye Fillet Weld Group $R_{nWeldReq}$ (k/in)	11.55 k/in	**OK**	Minimum Weld Length Shall Be 1.5 in	AASHTO 6.13.3.5
$t_{MinPadeye}$ Match Weld Rupture (in)	0.571 in	**OK**		AISC 13th Ed. Page 9-5

Padeye Design Summary

Padeye Demand P (k)	60.00 k	
Padeye Controlling Capacity P_n (k)	92.63 k	**OK**

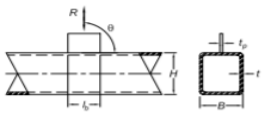
HSS Plastificaiton Check

Width of HSS member, B	8.00 in	
Thickness of HSS Member, t	0.47 in	
Width of Plate, Bp	7.00 in	
Thickness of Plate, tp	1.50 in	
Qf	1	TENSION

Longitudinal Plate:

HSS Wall Plastification, Rn/Ω=	67.20 k	**OK**

Connection Type	Connection Available Strength
Longitudinal Plate T-, Y- and Cross-Connections, Under Plate Axial Load	Limit State: HSS Plastification



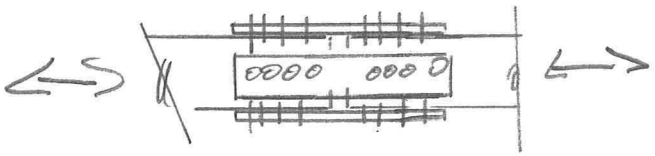
$$R_n \sin\theta = \frac{F_y t^2}{1-\frac{t_p}{B}}\left(\frac{2l_b}{B}+4\sqrt{1-\frac{t_p}{B}Q_f}\right) \quad \text{(K1-12)}$$

$\phi = 1.00$ (LRFD) $\quad \Omega = 1.50$ (ASD)

EDCI ENGINEERS	Project No.	Sheet No.
Project 165x10 TB, Fargo		Date
Subject Calcs		By

Chord Splice Design:

Loads:



STR I

C = 526 k (Top chord)

T = 190 k (Bot chord)

Serv II

C = 400k

T = 145k

↳ 6.13.2.1.1 - Slip critical joints shall prevent slip under Serv II

Bolt Spacing: Ref 6.13.2.6 → Try 7/8" ϕ Bolt A325

Min Spacing = 3D = 3x 7/8 = 2.63 in

Min Clear = 2D = 1.75 in

Min End = 1.125"

~~Min Clear End~~ =

Min Edge = 1.125"

Spacing = 3*D = 2.63in

DCI ENGINEERS	Project No.	Sheet No.
Project 165 x 10 TB		Date
Subject Calcs		By

Shear Resistance of Bolts:

* Threads excluded

$$\phi R_n = \phi_s \times 0.48 \times A_b \times F_{ub} \times N$$

↳ $\phi_s = 0.8$ (0.6)

$A_b = 0.442\ in^2$

$F_{ub} = 125\ ksi$

$N = 1$ shear plane

$$= 0.8 \times 0.48 \times 0.442 \times 125 \times 1 = 21.2\ k/bolt$$

$$\#\ of\ Bolts = \frac{526\ k}{21.2\ k} = 24\ Bolts$$

VERIFY 100% BENDING CAPACITY:
HSS BENDING CAPACITY = 160 K-FT
RESULTS IN T=C = 192K PER SIDE.
PER SPEC 1.00*192K = 192K
10*21.2 = 212K > 192K OK

Bearing Resistance:

3/4" shear PL

$\phi R_n = \phi_b \cdot 2.4 \times d \times t \times F_u$ clear Dist > 2d

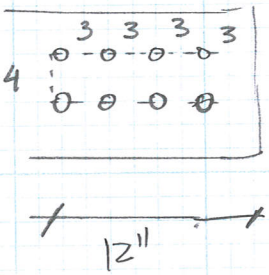
$= 0.8 \times 2.4 \times 0.75 \times \frac{3}{8} \times 70\ ksi$ (0.75 (OK BY INSPECTION))

$= 37.8\ k \Rightarrow 24\ Bolts\ ok$

DCI ENGINEERS

Project	165x10 TB	Project No.	Sheet No.
Subject		Date	
		By	

Block Shear:



$A_t = \frac{1}{2} \times 12" = 6 in^2$

(Neglegable shear)

=

$\phi R_r = \phi \times F_u A_t = 0.8 \times 70 \times 6 = 336 k$

Four sides => $336k \times 4 = 1344 k$ ✓ ok

Slip Resistance:

$\phi R_n = \phi K_n \times K_s \times N_s \times P_t$

$K_n = 1$

$K_s = 0.5$ Class B

$N_s = 1$

$P_t = 39 k$

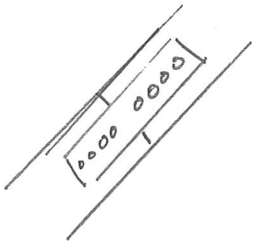
$\phi R_n = 1.0 \times 1 \times 0.5 \times 1 \times 39 = 19.5 k/bolt$

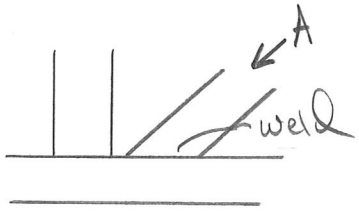
$\frac{400}{19.5} = 20$ bolts ✓ ok

DCI ENGINEERS	Project No. 0006	Sheet No.
Project 165x10 TB Fargo		Date
Subject Calcs		By

Diagonal Design

Axial Load from RAM = 127 k factored





* see RAM steel code check. HSS 6x6x1/4 ok in axial compression
* 7/8" ϕ Bolts

↳ Shear Resistance of Bolts:

$$\phi R_n = \phi_s \times 0.48 \times A_b \times F_{ub} \times N$$

$\phi_s = 0.8$ (0.6 OK BY INSP)
$A_b = 0.442$
$F_{ub} = 125$ ksi A325
$N = 1$

3/4"HOLLO-BOLT = 8992#
127/8.992=14
16 BOLTS PROVIDED

VERIFY 75% BENDING CAPACITY:
HSS BENDING CAPACITY = 50K-FT
RESULTS IN T=C = 100K PER SIDE.
PER SPEC 0.75*100K = 75K
4*21.2 = 84.8K > 75K OK

$= 0.8 \times 0.48 \times 0.442 \times 125 \times 1 = 21.2$ k/bolt

$$\#\text{ of bolts Req} = \frac{127\text{k}}{21.2\text{k/bolt}} = 6 \text{ bolts ok}$$

(16 bolts provided)

↳ Weld Resistance

- weld All around w/ 5/16 Fillet

$$\phi R_n = 0.6 F_{Exx} \times \sqrt{2}/2 \times D/16 \times \ell$$

$= 0.6 \times 70\text{ksi} \times \sqrt{2}/2 \times 5/16 \times (6 \times 4) = 223$ k ok

STEEL LAMINATED ELASTOMERIC BEARINGS by LRFD
An Excel spreadsheet for the design of rectangular expansion bearing pads (or fixed bearings with laminated pads)

Spreadsheet meets AASHTO LRFD Specifications
The spreadsheet is applicable only for typical rectangular bearings with up to one translation and up to one rotation about weak axis.

Adjust shaded items 1k through 1u to design the bearing. See Documentation for item by item documentation.

Today's date: 7-Mar-18

Item	Description	Input/Computed	Units	Allowable	Min/Max	Check	Comment, [AASHTO LRFD Article]
1	**Design data**						**Enter values for shaded cells. Resolve any NGs.**
1a	Project name	Fargo Lift Bridge					
1b	Project number	18161-0006					
1c	Designer	BJS					
1d	P_D	26.00	kips				Use DC1+DC2+DW.
1e	$P_{Live,\ maximum}$	40.00	kips				Use LL without IM. [14.4.1]
1f	P_{TL}, Service I vertical	66.00	kips	450.00	max	OK	Check with supervising section leader if NG.
1g	P_{sd}	26.00	kips				Minimum vertical force due to permanent loads.
1h	V_l, Service I lateral	5.00	kips				
1i	Theta required	0.00500	radians	0.00500	min	OK	Minimum is for construction inaccuracies. [C14.4.2]
1j	Delta required	0.950	inches	2.500	max	OK	Check with supervising Section Leader if NG.
1k	Elastomer hardness	50	durometer	50 or 60		OK	50 durometer is preferred; 60 is an option. ***Correct if NG!***
1l	Exterior layer thickness	0.250	inches	0.438	max	OK	0.250 inches is preferred. Exterior layer <= 0.7h_{ri}. [14.7.6.1]
1m	Exterior layer credit	0					Credit will apply for typical Iowa bearings. [14.7.6.3.5d]
1n	Interior layer, h_{ri}	0.625	inches				0.500 inches is preferred. Usual range is 0.375 to 0.75 inches.
1o	Number of interior layers	5					n is the total of number of interior layers plus exterior layer credit.
1p	Elastomer thickness, h_{rt}	3.625	inches				
1q	Steel grade	50	ksi				Usually ASTM A570 Grade 36 is sufficient.
1r	Steel laminate, h_s	0.1250	inches				0.125 inches is preferred.
1s	Coefficient of friction	0.300					Coefficient is for clean concrete. [C14.8.3.1]
1t	Bearing length, L	14.000	inches				For rotation capacity L typically will be less than W.
1u	Bearing width, W	16.000	inches				
1v	Shape factor, S_i	5.973					[14.7.5.1]
1w	Compressive stress	0.295	ksi				Use S_i and this stress to determine compressive strain.
1x	Compr. Strain: automatic	1.753	per cent				Strain automatically computed. **See Aashto Lrfd Fig. C14.7.5.3.3-1**
1y	Compr. Strain: user entry	4.6	per cent				User value for compr strain. **for "Stress Strain Curves".**
1z	Total thickness	4.375	inches	5.00	max	OK	This dimension establishes elevations. Check if NG.
2	**Design checks**						**Ensure that checks are OK or otherwise approved.**
2a	S_i^2/n (See comment.)	7.14		16	max	OK	Check for excessive shear strain at large rotations [14.7.6.1, C14.7.6.1]. Limits: 16 for square or nearly square pad, 20 for rectangular pad with n ≥ 3, 22 for rectangular pad with n = 2
2b	Compression	0.295	ksi	1.250	max	OK	Increase W and/or L if NG. [14.7.6.3.2]
2c	Compression, shape	0.295	ksi	0.709	max	OK	Adjust W, L, or h_{ri} if NG. [14.7.6.3.2]
2d	Deflection, interior layer	0.0285	inches	0.0563	max	OK	Increase W and/or L and/or durometer if NG. [14.7.6.3.3]
2e	Rotation	0.00500	radians	0.02000	max	OK	Check for Method A assumption. Add curved sole plate if NG.
2f	Stability height for L	4.375	inches	4.667	max	OK	Increase L and/or decrease thickness if NG. [14.7.6.3.6]
2g	Stability height for W	4.375	inches	5.333	max	OK	Increase W and/or decrease thickness if NG. [14.7.6.3.6]
2h	Shear deformation	0.950	inches	1.813	max	OK	Increase h_{rt} if NG. [14.7.6.3.4]
2i	Reinforcement, yield	0.1250	inches	0.0110	min	OK	Increase h_s if NG. [14.7.6.3.7, 14.7.5.3.5]
2j	Reinforcement, fatigue	0.1250	inches	0.0093	min	OK	Increase h_s if NG. [14.7.6.3.7, 14.7.5.3.5, 6.6.1.2.3]
2k	Longitudinal anchorage	7.63	kips	7.80	max	OK	Lower durometer and/or increase h_{rt} if NG. [C14.8.3.1]
2l	Transverse anchorage	5.00	kips	7.80	max	OK	Add steel guide or restrainer if NG. [C14.8.3.1]
3	**Additional information**						**Usually this information will not be needed.**
3a	Shear at required delta	7.63	kips				
3b	Shear at max delta	14.56	kips				
3c	Steel volume	0.0940	cubic feet				
3d	Neoprene volume	0.4731	cubic feet				
3e	Bearing weight	81.54	pounds				Densities are 490 pcf for steel and 75 pcf for neoprene.
3f	Compression strain	4.6	per cent				
3g	Initial LL deflection	0.100	inches				Live load deflections are based on strain for total load.
3h	Initial TL load deflection	0.166	inches				
3i	Long-term LL deflection	0.125	inches	0.125	max	OK	This check is only advisory and is not office policy.
3j	Long-term TL deflection	0.207	inches				

USE 14X16X4.375" DURO 50 ELASTOMERIC BEARING PAD
WITH 6 LAYERS OF STEEL REINF

Loads

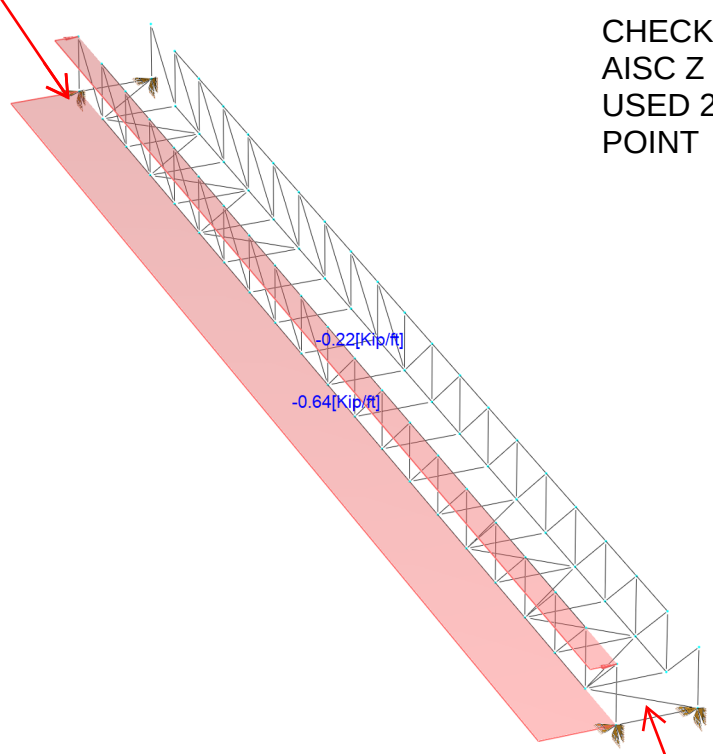
Global distributed - Members
Local distributed - Members

BASE WIND VELOCITY = 100MPH (AASHTO 3.8)
BASE WIND PRESSURE P = 0.05KSF (3.8.1.2.1)

AREA OF PANEL = 15SF
WIND LOAD = 0.05KSF*15SF*1.15 = 0.86K/FT
(APPLIED AS 0.64K/FT BOTTOM AND 0.22K/FT TOP)

REACTION =
086klf*165ft/2 = 71k

CHECK ANCHOR BOLT SHEAR:
AISC Z = 44K PER 1-1/4" BOLT
USED 2 BOLTS AT EACH BEARING POINT



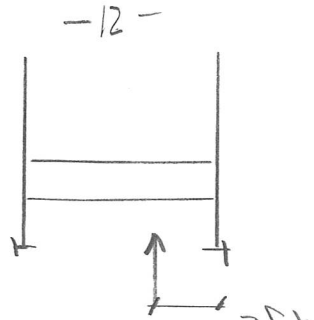
AXIAL LOAD IN
FLOOR BEAM = 92k

DCI ENGINEERS	Project No. 18161-0006	Sheet No.
Project: Fargo Lift Bridge		Date
Subject: wind uplift		By

Vertical Wind

Per AASHTO 3.8.2:

Total uplift $0.02\,ksf \times 12\,ft \times 165\,ft = 39.6\,k$



$OM = 20k \times 9ft = 180\,k\text{-}ft$

$RM = \frac{105k}{2} \times 6ft = 315\,k\text{-}ft$ (DL)

$uplift = (180 - 315)^{k\text{-}ft} \times \frac{1}{12ft} = -11.3$

No Net uplift

Additional overturning from wind Load at top chord:

$22plf \times 165/2 = 1.82k$

$R = 1.82k \times (8.5/11.17) = 1.4k$ up/down

$R_{min} = -11.3k - 1.4k = -9.9k$ ∴ No net uplift

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Railing System Load/Deflection Testing

Test Type:	Horizontal Load to 365 lbs per ASTM 985 per section 7.1.5	Submitted By:	JM	Date	07/31/12
Test Focus (Part #s):	1929				
Railing Type:	Handrail Brackets, Slip-fit Components, 1.66 Schedule 40 pipe				
Railing Specifications:	42" TOR 48" C2C of Brackets				
Test Method:	Pull to Ultimate test load, record deflections.				

Test Specifications per ASTM E985:		**Results:**				
Safety Factor of 2.0	**System Calculations:**	**Load (lbf)**	**Displacement (in.)**			**Test AVG**
			Trial #1	**Trial #2**	**Trial #3**	
Pre Load	**180 (lbf)**	Preload	0.137	0.134	0.103	0.125
Released Test Load	**90 (lbf)**	RTL	0.000	0.000	0.000	0.000
		150	0.027	0.039	0.035	0.034
Ultimate Test Load	**365 (lbf)**	200	0.077	0.088	0.065	0.077
		250	0.123	0.134	0.099	0.119
Deflection Specifications Per ASTM E985		300	0.198	0.203	0.162	0.188
Max Deflection	**(h/24)+(l/96) @ mid = 2.25 in (h/12) @ post = 3.50 in**	ULT	0.340	0.362	0.245	0.316
		RD	0.066	0.076	0.054	0.065
		500	0.736	0.750	0.450	0.645
Residual Deflection (At RTL)	**20% of MD or 0.5 in if less @ mid = 0.45 in @ post = 0.70 in**					

NOTES:

Trial #1 at 0 lbf = 3.787 in

Trial #2 at 0 lbf = 3.881 in

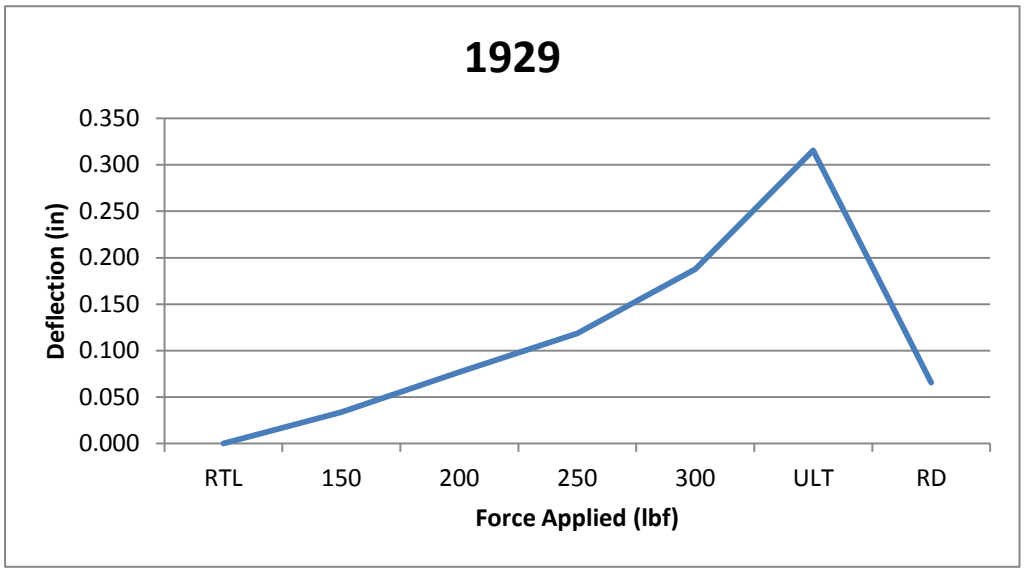
Trial #3 at 0 lbf = 3.952 in

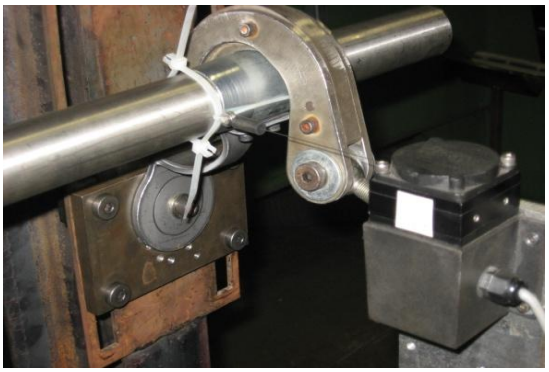
Potentiometer cannot be zeroed, so calculations are done manually

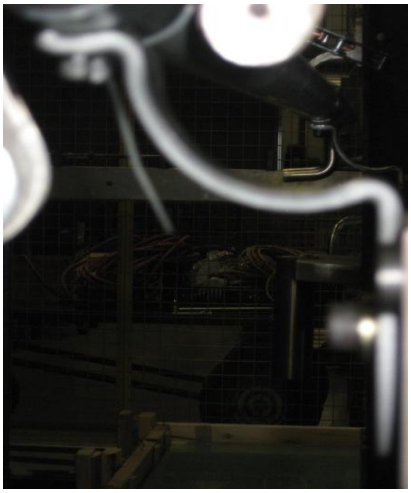
CONCLUSIONS:

1929 bracket passed ASTM deflection standards for horizontal testing.

The 1929 bracket was able to withstand 500lbf horizontal pull; therefore it has a safety factor of at least two.







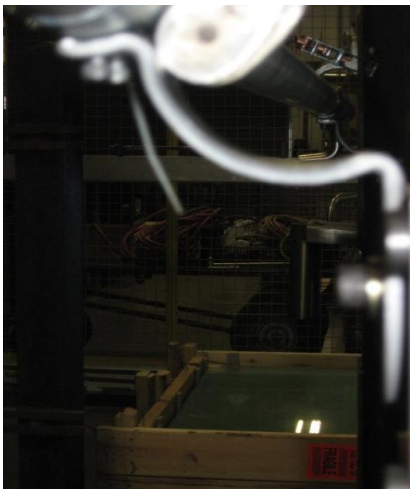
Initial Setup, Trial #1

Preload of 180 lbf
(Actual Deflection of 0.137 in)

Release Test Load of 90 lbf

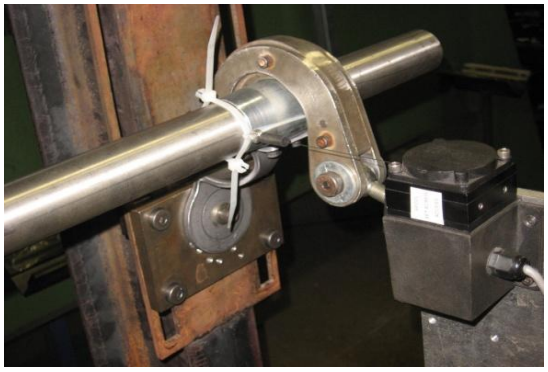
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.34 in)

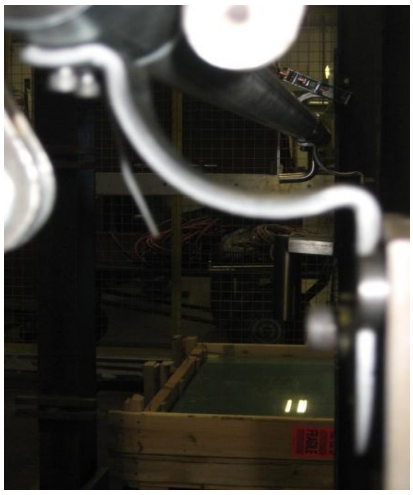
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.066 in)

Achieved 500 lbf





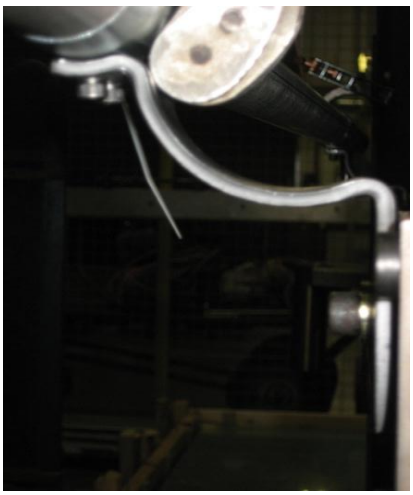
Initial Setup, Trial #2

Preload of 180 lbf
(Actual Deflection of 0.134 in)

Release Test Load of 90 lbf

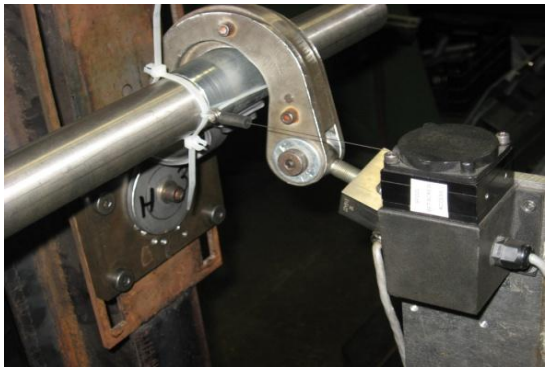
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.362 in)

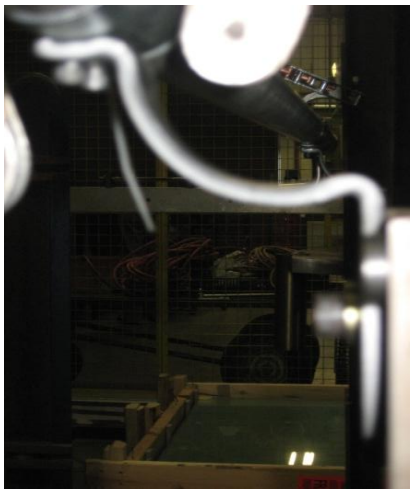
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.076 in)

Achieved 500 lbf





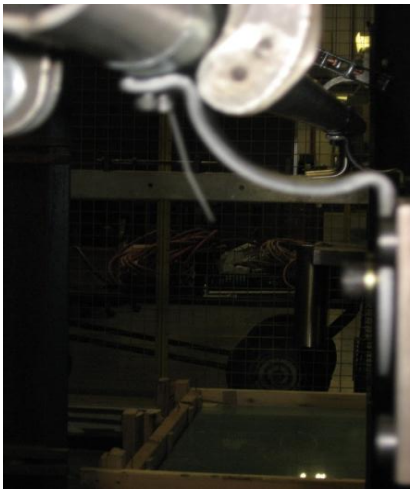
Initial Setup, Trial #3

Preload of 180 lbf
(Actual Deflection of 0.103 in)

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.245 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.054 in)

Achieved 500 lbf

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Railing System Load/Deflection Testing

Test Type:	Vertical Load to 356 lbf per ASTM E985 per section 7.1.5	Submitted By:	JM	Date	07/10/12
Test Focus (Part #s):	1970R				
Railing Type:	Handrail Brackets, Slip-fit Components, 1.66 Schedule 40 pipe				
Railing Specifications:	42" TOR 48" C2C of Brackets				
Test Method:	Pull to Ultimate test load, record deflections.				

Test Specifications per ASTM E935:	
Safety Factor of 2.0	**System Calculations:**
Pre Load	**180 (lbf)**
Released Test Load	**90 (lbf)**
Ultimate Test Load	**365 (lbf)**
Deflection Specifications Per ASTM E985	
Max Deflection	**(1/96) @ mid= 0.5 in**
Residual Deflection (At RTL)	**20% of MD @ mid = N/A**

Results:

Load (lbf)	Displacement (in.)			Test AVG
	1	2	3	
Preload	0.031	0.031	0.038	0.0333
RTL	0	0	0	0.0000
150	0.004	0.004	0.006	0.0047
200	0.014	0.013	0.018	0.0150
250	0.025	0.028	0.037	0.0300
300	0.038	0.041	0.044	0.0410
UTL	0.059	0.063	0.066	0.0627
RD	0.002	0.007	0.008	0.0057

NOTES:

Trial 1 at 0 lbf = 3.781 in

Trial 2 at 0 lbf = 3.787 in

Trial 3 at 0 lbf = 3.759 in

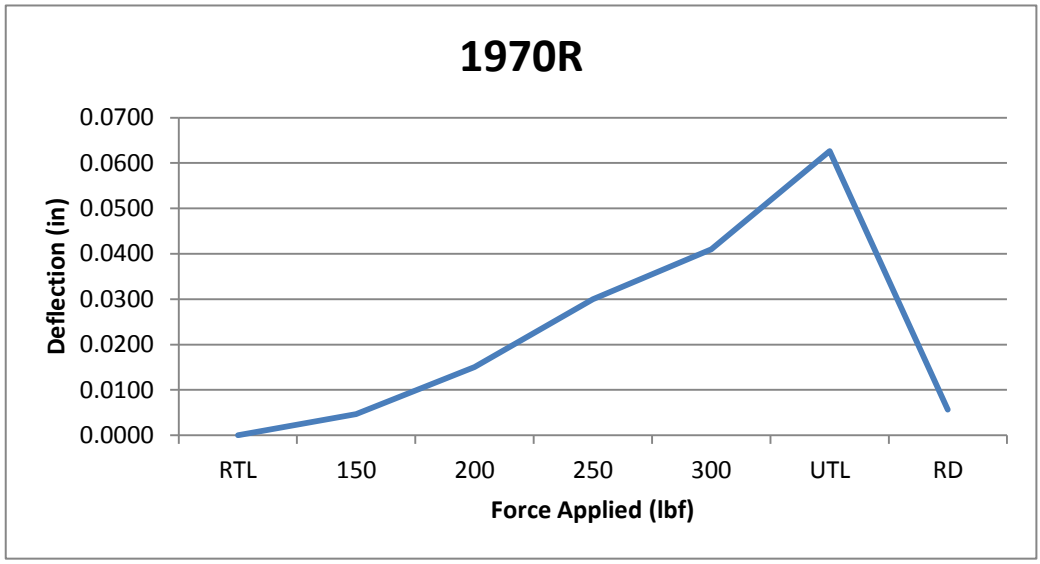
Potentiometer cannot be zeroed, so calculations are done manually

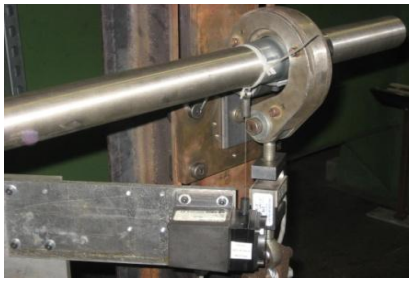
CONCLUSIONS:

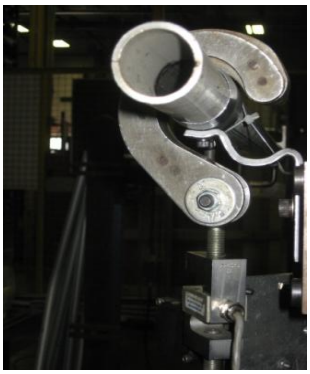
1970R bracket passed ASTM deflection standards for vertical testing.

The 1970R bracket was able to withstand 500lbf vertical pull; therefore it has a safety factor of at least two.

50PLF*8.25FT = 412#
500/412 = 1.2 SAFETY FACTOR







Initial Setup, Trial 1

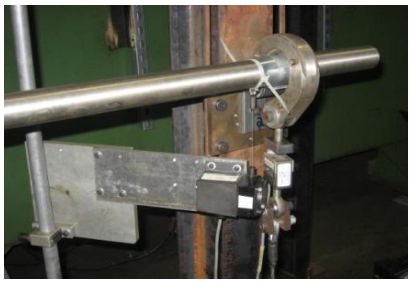
Preload of 180 lbf
(Actual Deflection of 0.031 in)

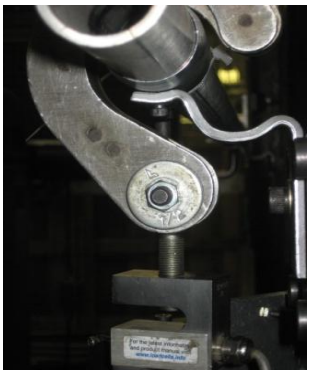
Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.059 in)

Deflection at UTL

Residual Deflection at 90 lbf
(Actual Deflection of 0.002 in)





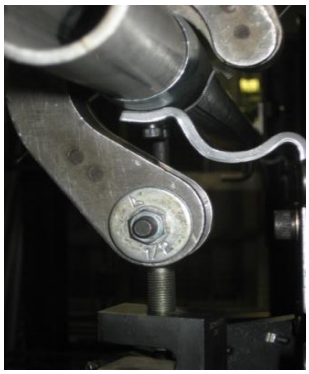
Initial Setup, Trial 2

Preload of 180 lbf
(Actual Deflection of 0.031 in)

Release Test Load of 90 lbf

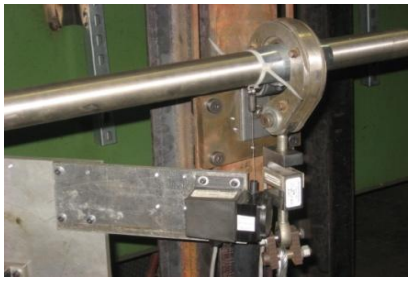
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.063 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.007 in)

500 lbf Achieved



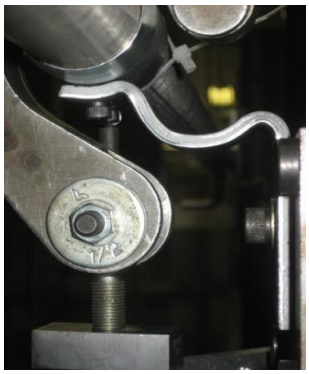
Initial Setup, Trial 3

Preload of 180 lbf
(Actual Deflection of 0.038 in)

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.066 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.008 in)

500 lbf Achieved

R & B WAGNER, INC.
PO BOX 423 | BUTLER, WI | 53007
10600 W BROWN DEER ROAD | MILWAUKEE, WI | 53224
PH 414.214.0444 FAX 414.214.8326

Railing System Load/Deflection Testing

Test Type:	Horizontal Load to 365 lbs per ASTM 985 per section 7.1.5	Submitted By:	JM	Date	07/31/12
Test Focus (Part #s):	1970R				
Railing Type:	Handrail Brackets, Slip-fit Components, 1.66 Schedule 40 pipe				
Railing Specifications:	42" TOR 48" C2C of Brackets				
Test Method:	Pull to Ultimate test load, record deflections.				

Test Specifications per ASTM E985:		**Results:**				
Safety Factor of 2.0	**System Calculations:**	**Load (lbf)**	**Displacement (in.)**			**Test AVG**
			Trial #1	**Trial #2**	**Trial #3**	
Pre Load	**180 (lbf)**	Preload	0.097	0.088	0.075	0.087
Released Test Load	**90 (lbf)**	RTL	0.000	0.000	0.000	0.000
		150	0.034	0.028	0.025	0.029
Ultimate Test Load	**365 (lbf)**	200	0.077	0.070	0.059	0.069
		250	0.111	0.112	0.096	0.106
Deflection Specifications Per ASTM E985		300	0.163	0.154	0.143	0.153
Max Deflection	**(h/24)+(l/96) @ mid = 2.25 in (h/12) @ post = 3.50 in**	ULT	0.258	0.263	0.252	0.258
		RD	0.015	0.021	0.011	0.016
		500	0.464	0.469	0.490	0.474
Residual Deflection (At RTL)	**20% of MD or 0.5 in if less @ mid = 0.45 in @ post = 0.70 in**					

NOTES:

Trial #1 at 0 lbf = 4.519 in

Trial #2 at 0 lbf = 4.532 in

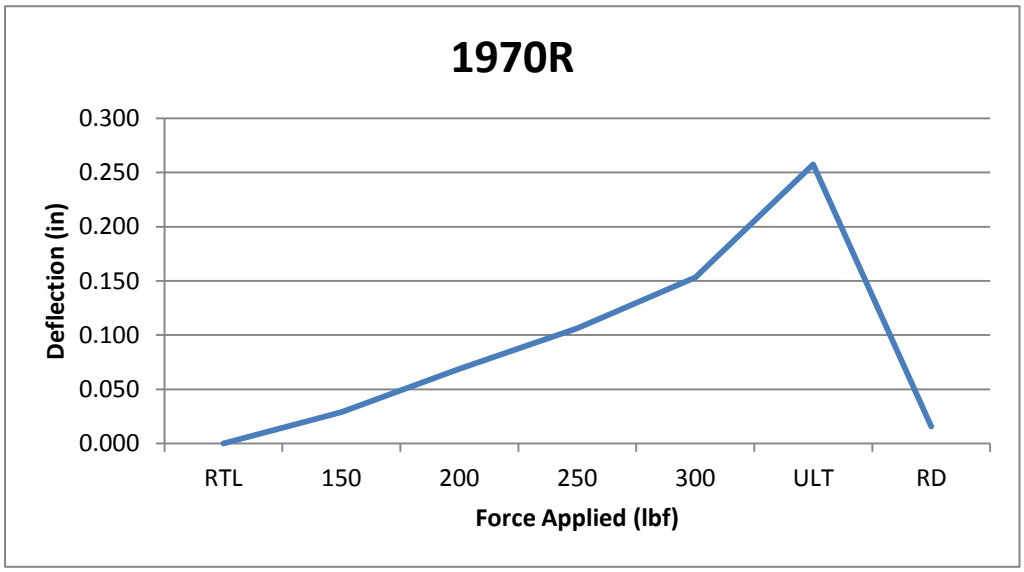
Trial #3 at 0 lbf = 4.515 in

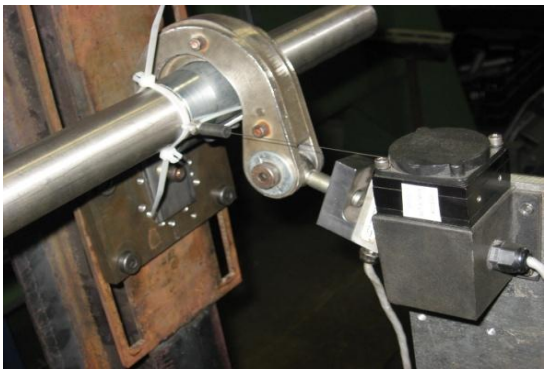
Potentiometer cannot be zeroed, so calculations are done manually

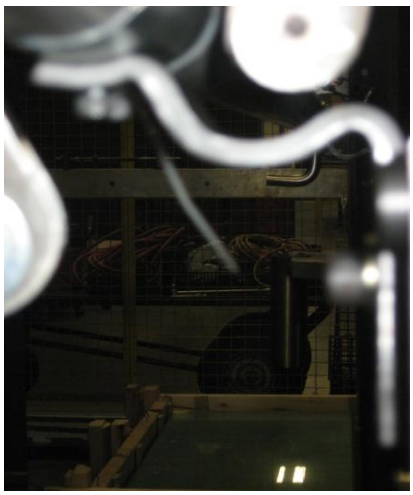
CONCLUSIONS:

1970R bracket passed ASTM deflection standards for horizontal testing.

The 1970R bracket was able to withstand 500lbf horizontal pull; therefore it has a safety factor of at least two.







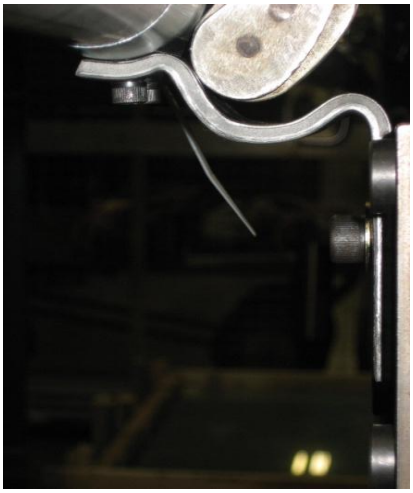
Initial Setup, Trial #1

Preload of 180 lbf
(Actual Deflection of 0.097 in)

Release Test Load of 90 lbf

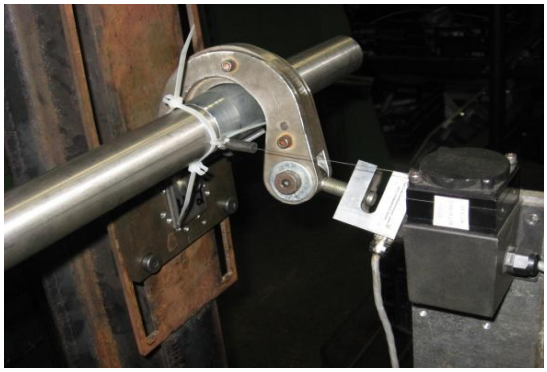
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.258 in)

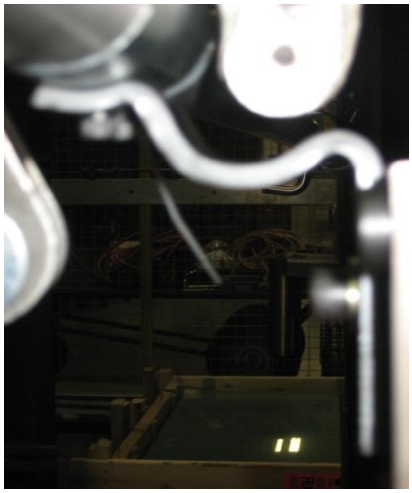
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.015 in)

Achieved 500 lbf





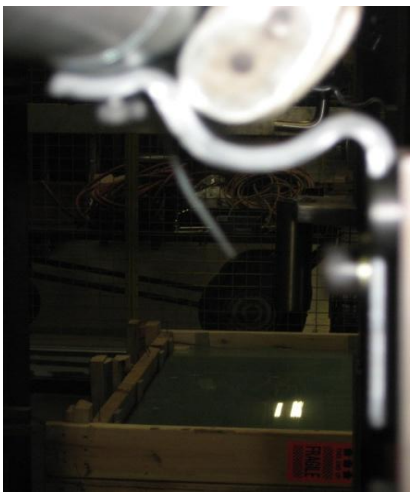
Initial Setup, Trial #2

Preload of 180 lbf
(Actual Deflection of 0.088 in)

Release Test Load of 90 lbf

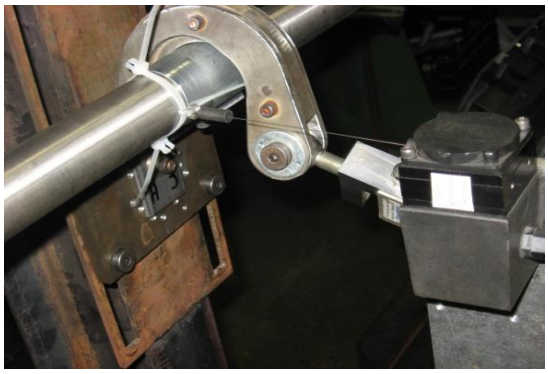
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.263 in)

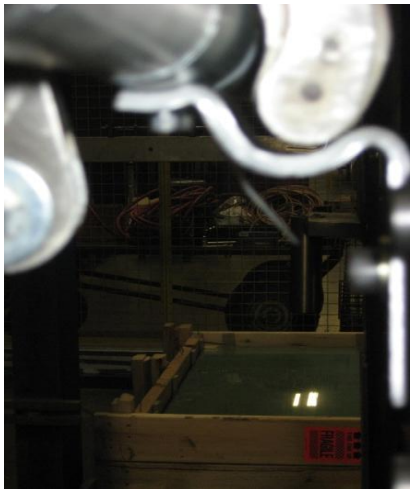
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.021 in)

Achieved 500 lbf





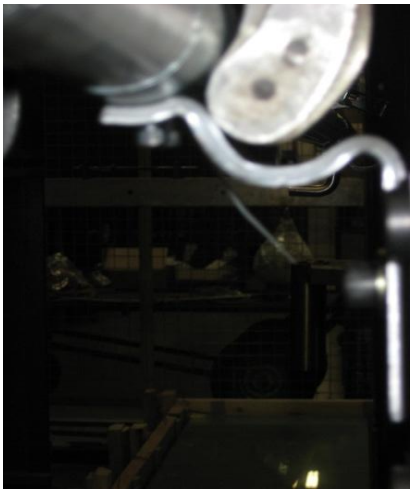
Initial Setup, Trial #3

Preload of 180 lbf
(Actual Deflection of 0.075 in)

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.252 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.011 in)

Achieved 500 lbf

Trail Bridge Design Calculations

Project Name: Oak Grove Pedestrian Lift Bridge
Fargo, ND

Serial Number: 165TB10H10-PFS0198

Owner: City Of Fargo
Fargo, North Dakota

Fabricator: TrueNorth Steel
5405 Momont Road
Missoula, MT 59808
(406) 532-7122

Design Engineer: DCI Engineers, Inc.
450 Corporate Dr, Suite 112
Kalispell MT 59901
(406) 752-5675

REGISTERED PROFESSIONAL ENGINEER
JAMI LORENZ
PE-8854
DATE 07/18/2018
NORTH DAKOTA

Bridge Design Code: AASHTO GUIDE SPECIFICATIONS FOR DESIGN OF PEDESTRIAN BRIDGES AND LRFD BRIDGE DESIGN SPECIFICATIONS

Date: July 18, 2018

GENERAL LAYOUT AND LOADS

DESIGN NARRATIVE:

This calculation package is for a new 165' long x 10' wide pedestrian truss located in Fargo, North Dakota. This pedestrian truss crosses the Red River and will have a frame and hoist system capable of lifting the bridge up during flooding.

Design is in accordance with AASHTO LRFD Bridge Design Specifications and the LRFD Guide Specifications for Design of Pedestrian Bridges.

The Pedestrian Bridge Specifications provide guidelines for Half-Through truss design. The truss was also modeled in RAM Elements to find force effects for design.

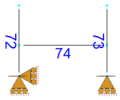
LOADS AND MODEL SETUP

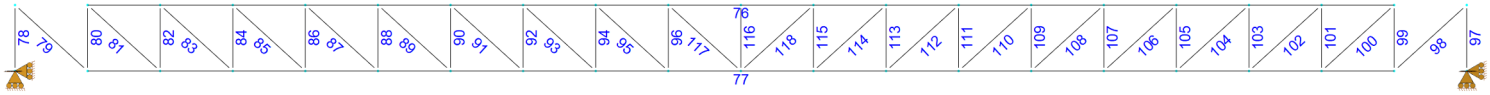
07/02/2018

REVISION LATER IN PROJECT TO
USE 10X10X1/2 TOP CHORD
10X8X3/8 BOTTOM CHORD.
OK BY INSPECTION EXCEPT MEMBER
CHECK FOR BOTTOM CHORD. SEE
ADDITIONAL CALCULATION CHECK

STEEL MEMBER LEGEND	
MEMBER	**SIZE**
TOP CHORD	HSS10X8X1/2
BOTTOM CHORD	HSS10X8X1/2
VERTICAL	HSS8X8X3/8
DIAGNAL	HSS6X6X5/16
FLOOR BEAM	W16x26
LONG BEAM	W6x15
MATERIAL	A500 GR B

STRINGER

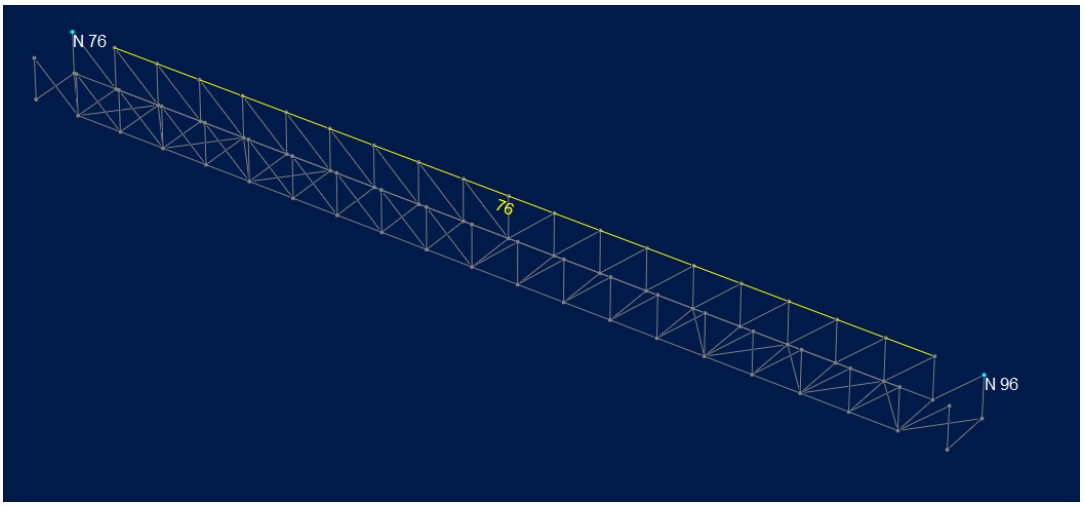


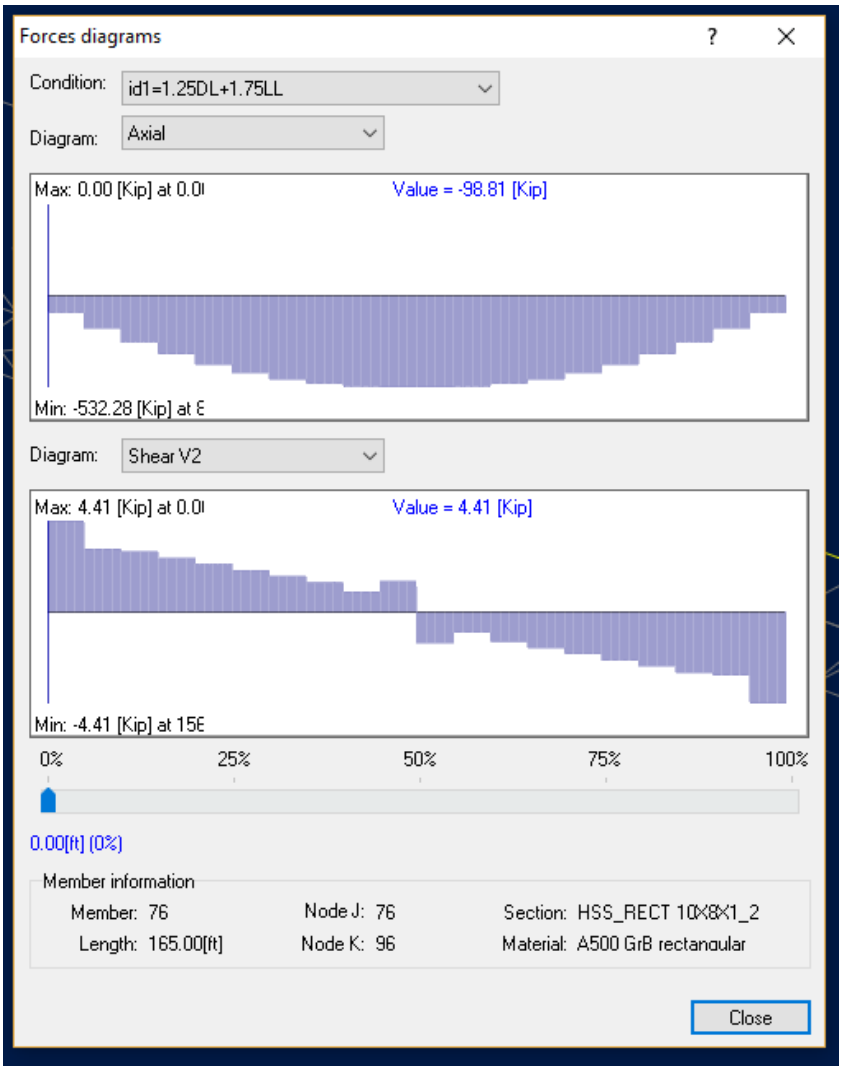


165' (N = 20)

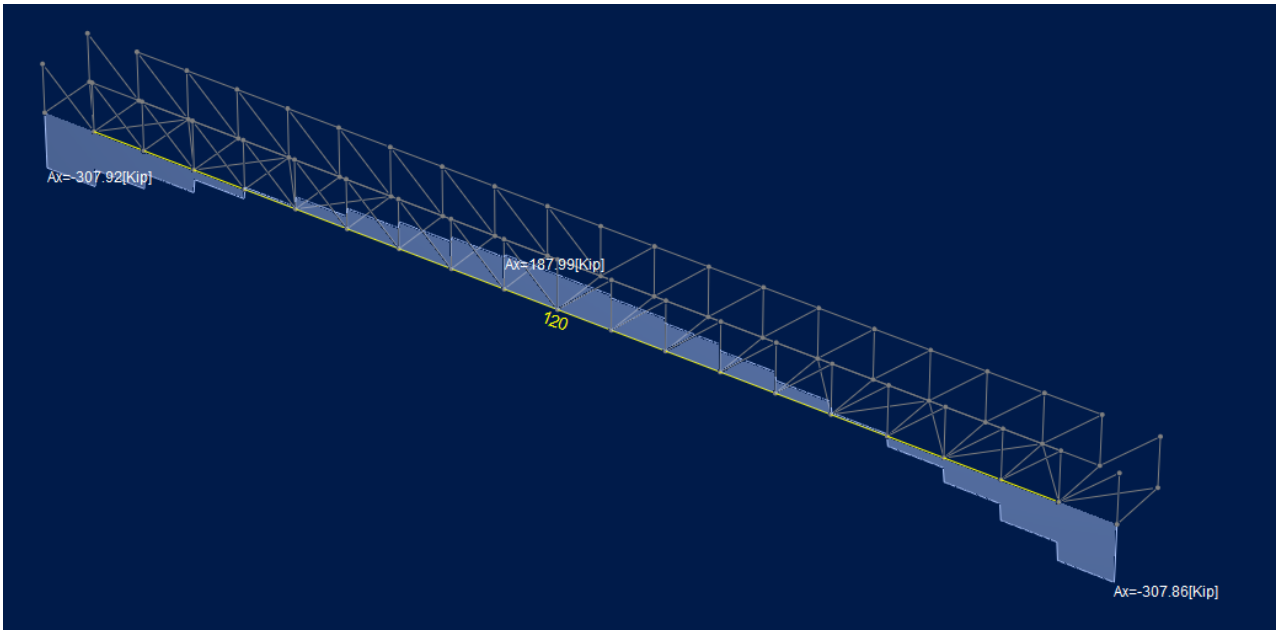
TOTAL STEEL VOLUME=	553.4 ft³
TOTAL STEEL WEIGHT=	77577.05 lbs
Uniform Chord DL=	171.47 plf
Concentrated DL on Truss Verts from Floor=	945.99 lbs
Concentrated LL on Truss Verts from Floor=	3712.50 lbs

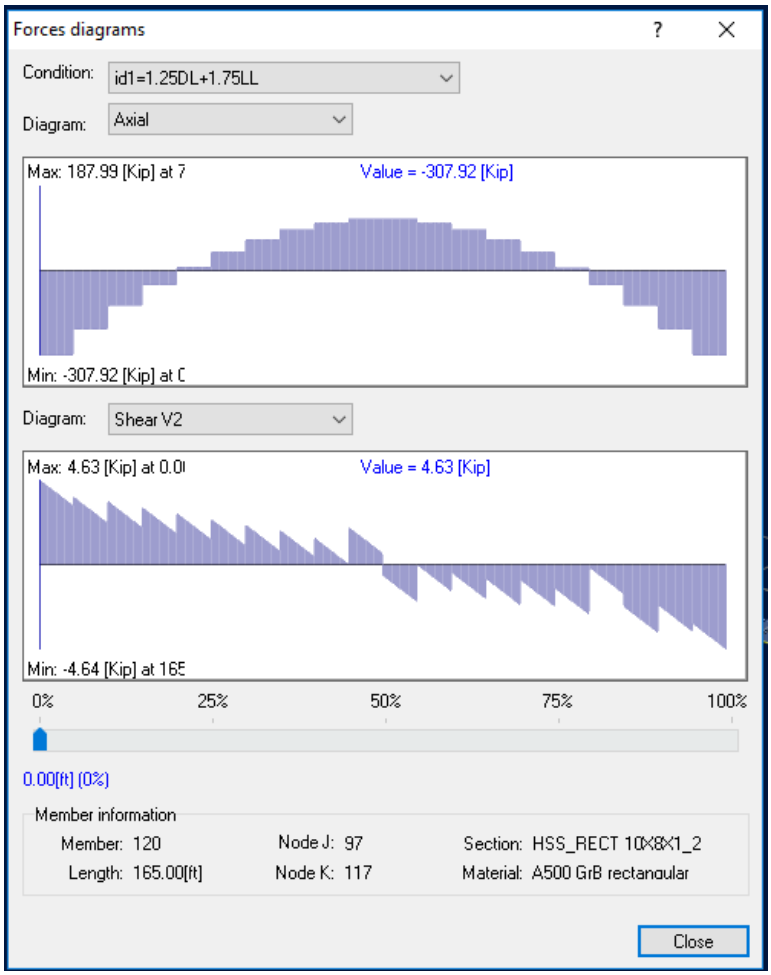
TOP CHORD MODEL OUTPUT:
(NOTE BEGIN AND END NODE)





BOTTOM CHORD
AXIAL LOAD





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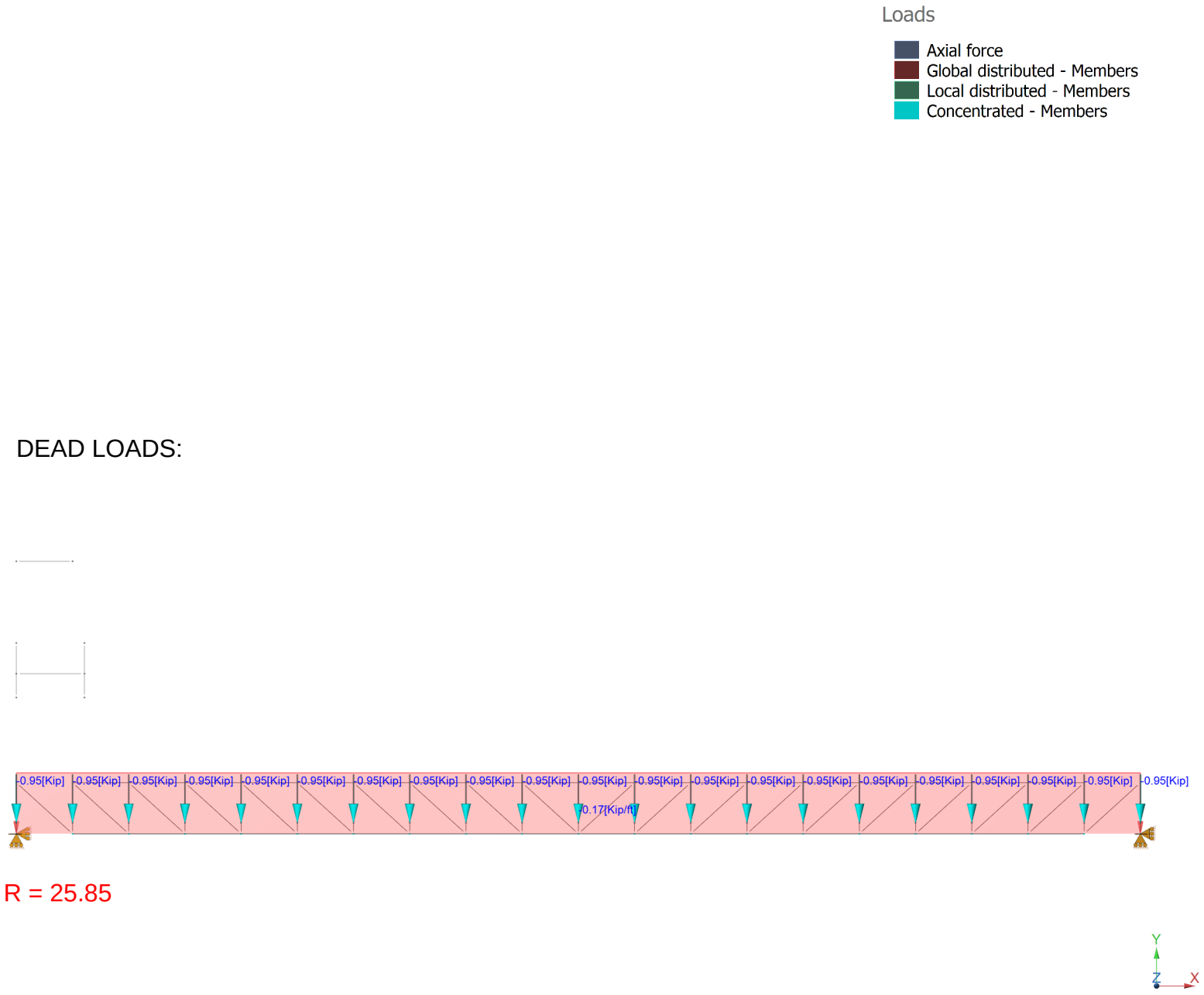
Load condition: DL=Dead Load



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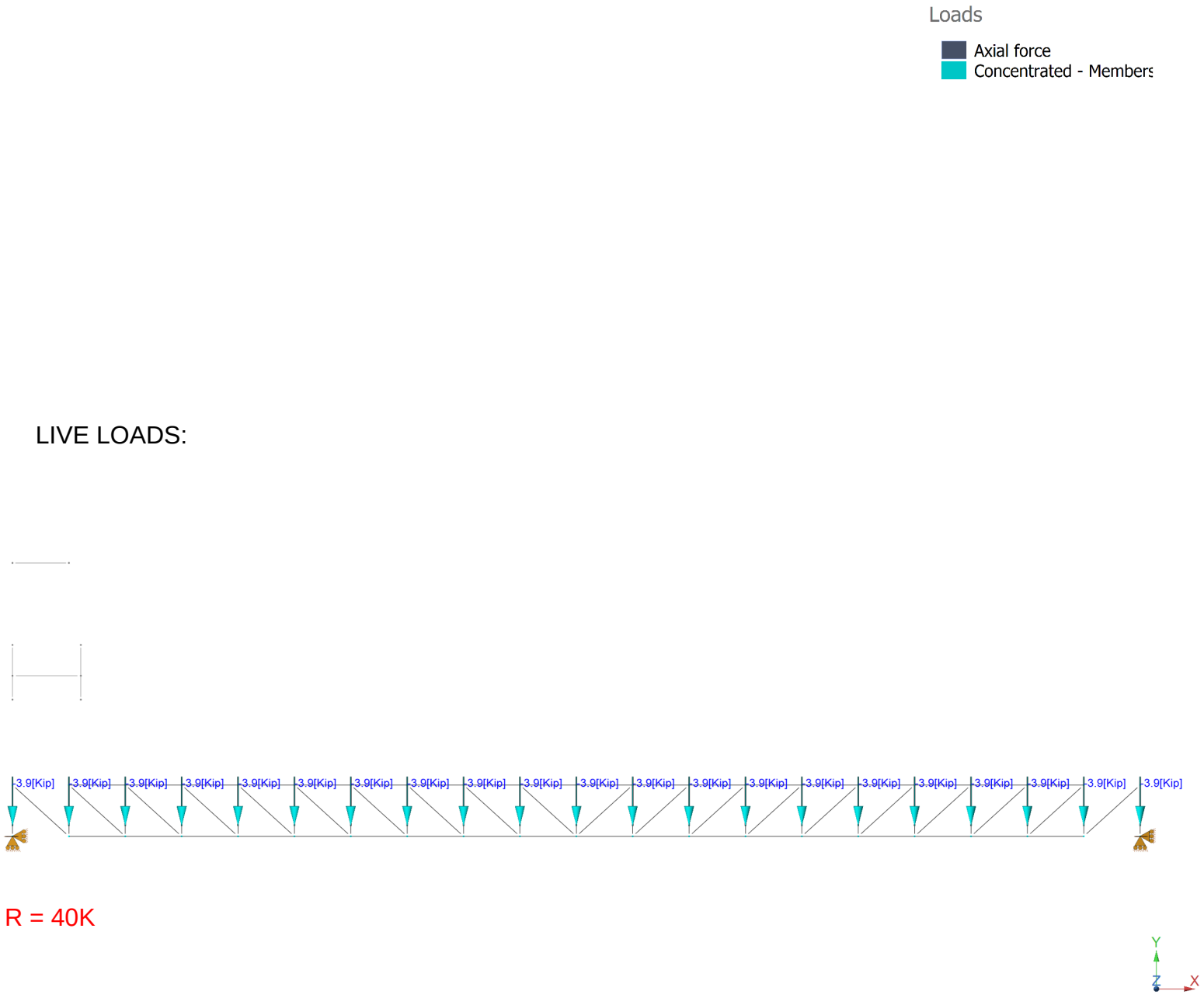
Load condition: LL=Live Load



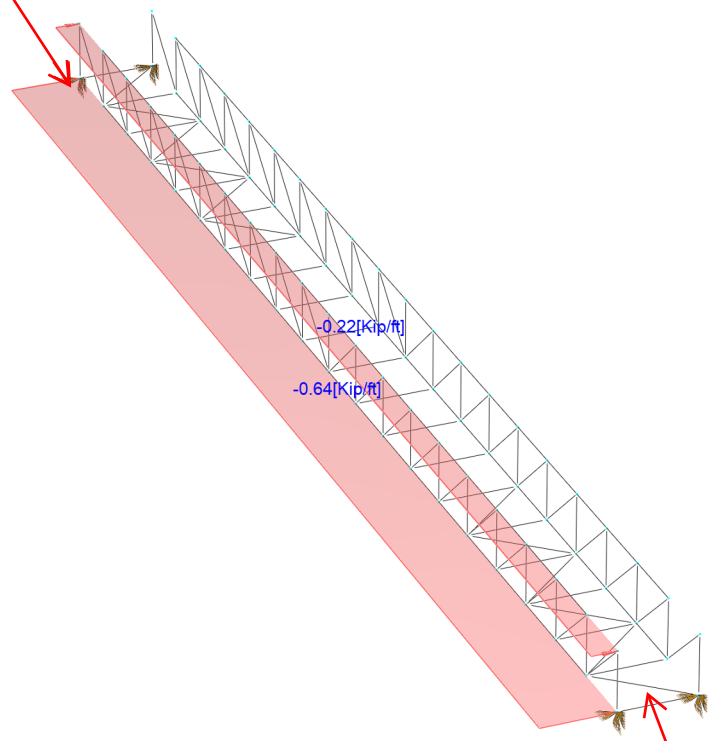
Loads

Global distributed - Members
Local distributed - Members

BASE WIND VELOCITY = 100MPH (AASHTO 3.8)
BASE WIND PRESSURE P = 0.05KSF (3.8.1.2.1)

AREA OF PANEL = 15SF
WIND LOAD = 0.05KSF*15SF*1.15 = 0.86K/FT
(APPLIED AS 0.64K/FT BOTTOM AND 0.22K/FT TOP)

REACTION =
086klf*165ft/2 = 71k



AXIAL LOAD IN
FLOOR BEAM = 92K,

Current Date: 2/19/2018 1:53 PM
Units system: English
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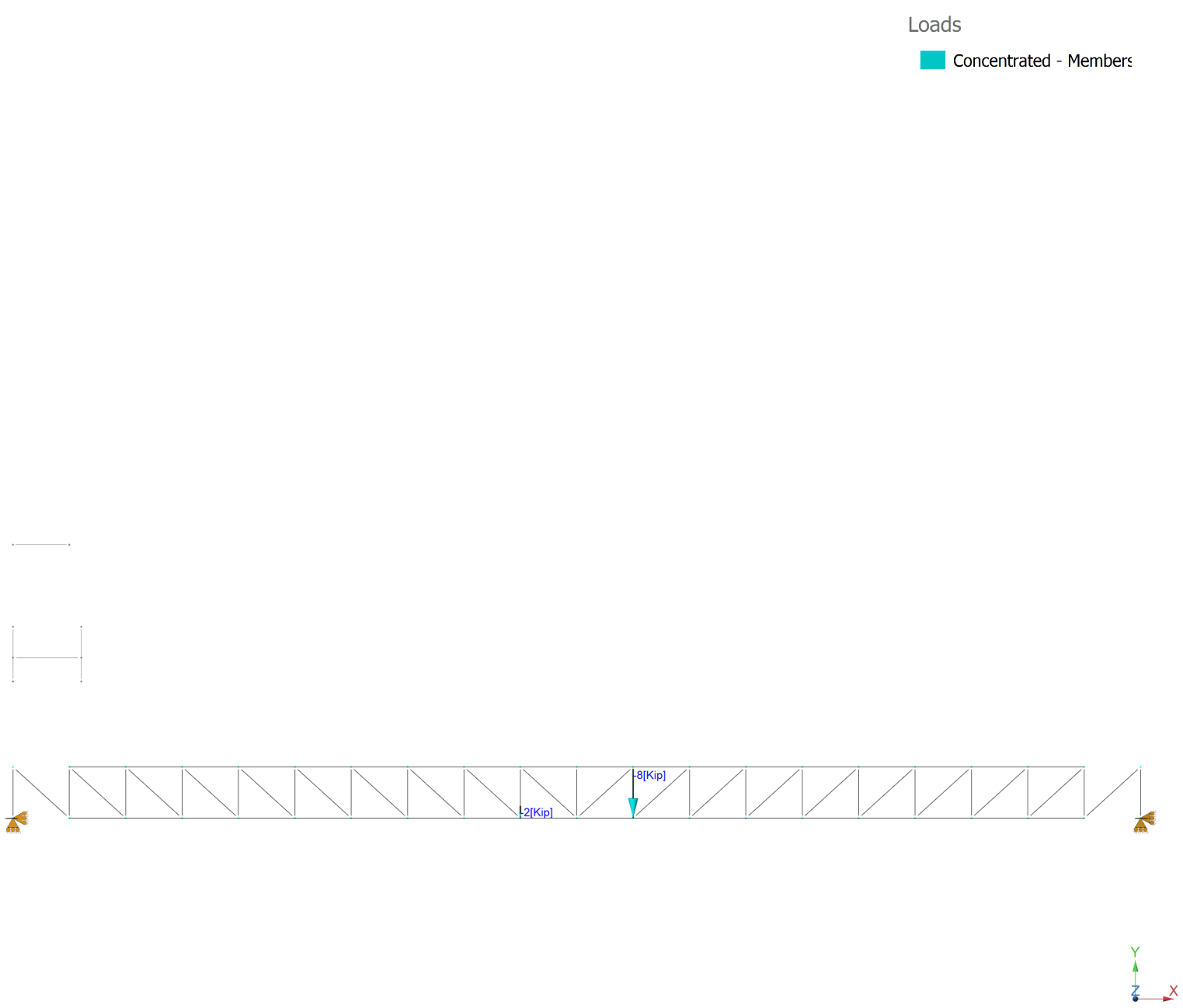
Load condition: LL2=LIVE LOAD2



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Units system: English
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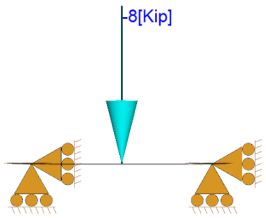
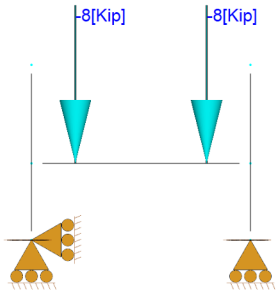
Load condition: LL2=LIVE LOAD2

Loads

Axial force
Concentrated - Members





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File name: J:\1610-Kalispell\2018 Projects\18161-0006 TrueNorth Bridge 165TB10H10-PFS0198\4- Calculations\Bridge Calcs\FARGO PED TRUSS N20.etz\

Analysis result

Nodal displacements envelope

Note.- **Ic** is the controlling load condition
Nodal displacements envelope for :
DL2=SELF WT

Node		Translation						Rotation					
		X [in]	**Ic**	**Y** [in]	**Ic**	**Z** [in]	**Ic**	**Rx** [Rad]	**Ic**	**Ry** [Rad]	**Ic**	**Rz** [Rad]	**Ic**
65	Max	0.000	DL2	-1.135	DL2	0.000	DL2	0.00000	DL2	0.00000	DL2	0.00000	DL2
	Min	0.000	DL2	-1.135	DL2	0.000	DL2	0.00000	DL2	0.00000	DL2	0.00000	DL2

ABOVE IS THE DL DEFLECTION RESULTS:
SEE SPREADSHEET CALCS DEFLECTION CHECK

Current Date: 2/6/2018 2:02 PM
Units system: English
File name: J:\1610-Kalispell\2018 Projects\18161-0006 TrueNorth Bridge 165TB10H10-PFS0198\4- Calculations\Bridge Calcs\FARGO PED TRUSS N20.etz\

Analysis result

Nodal displacements envelope

Note.- **lc** is the controlling load condition
Nodal displacements envelope for :
DL=Dead Load
LL=Live Load

		Translation						Rotation					
Node		**X** [in]	**lc**	**Y** [in]	**lc**	**Z** [in]	**lc**	**Rx** [Rad]	**lc**	**Ry** [Rad]	**lc**	**Rz** [Rad]	**lc**
65	Max	0.000	LL	-2.041	DL	0.000	DL	0.00000	DL	0.00000	DL	0.00000	LL
	Min	0.000	DL	-3.247	LL	0.000	DL	0.00000	DL	0.00000	DL	0.00000	DL

ABOVE IS THE LL DEFLECTION RESULTS:
SEE SPREADSHEET CALCS DEFLECTION CHECK

PRELIMINARY TRUSS CHECK AND QUANTITIES

DCI+bce ENGINEERS	Project:		Page:	
	Client:	TrueNorth Steel	Design By:	TMB
	Job #:		Review By:	
	Description:		Date:	06/29/18

Pedestrian Thru-Truss Bid Spreadsheet

Span	165.00 ft	
Traveled Way	10.00 ft	Inside Face of Chord to Inside face of Chord
Spacing b/t Verts	10.31 ft	
Height	8.00 ft	Top of Top Chord To Bottom of Bottom Chord
Total Num of Longit Floor Beam	5	
Pedestrian Live Load	90.00 psf	
Vehicular Load		
Top Chord Mem	HSS10X10X1/2	Flatwise if Rectangular
Bottom Chord Mem	HSS10X8X3/8	Flatwise if Rectangular
Vertical Mem	HSS8X8X3/8	07/02/2018
Diagonal Mem	HSS6X6X5/16	
Trans Floor Beam Mem Type	Wbeam	
TransFloor Beam Mem	W16X26	
Longit Floor Beam MemType	Wbeam	
Longit Floor Beam Mem	W4X13	
Floor Frame Dia Bracing Mem	HSS4X4X1/4	
Decking	3x Timber	

Model Output:

HSS Chord Factored Comp. Force	550.00 k	
HSS Vert Factored Comp. Force	110.00 k	
Dead Load Deflection (Service)	1.30 in	
Live Load Deflection (Service)	3.30 in	

Deflection Check:

Max f (DL Deflection)	3.00 Hz	
Max LL Deflection (l/360)	5.50 in	OK
Actual f	3.10 in	OK

HSS Chord Design:

HSS MOE, E	29000 k/in²
HSS Yield Strength, Fy	50 k/in²
HSS Chord Unbraced Length, L	123.75 in
Effective Height of Vertical, h	78.00 in
HSS Chord Area, A	17.2 in²
HSS Chord MOI, I	256.00 in^4
HSS Chord Section, S	51.20 in³
HSS Chord, r_x	3.86 in
HSS Chord, r_y	0.00 in
HSS Vertical Area, A	10.4 in²
HSS Vertical MOI, I	100.00 in^4
HSS Vertical Section, S	24.90 in³
HSS Vertical, r	3.10 in

Transverse Floor Beam MOI, I	301.00 in^4			
DCI+bce engineers	Project:	TrueNorth Steel	Page:	
	Client:		Design By:	TMB
	Job #:		Review By:	
	Description:		Date:	06/29/18

Pedestrian Thru-Truss Bid Spreadsheet

C	9.55 k/in	
CL/Pc	1.615	
n	16.000	
1/K	0.833	
K	1.20	
KL/r	38.50	OK, KL/r<120
λ	0.26	
Pn	772.30 k	
ϕPn	695.07 k	**OK 79.13%**
Transverse Floor Beam Design Check:		
γ_{DL}	1.25	
γ_{LL}	1.75	
ϕ_b	0.9	
ϕ_v	0.9	
Es	29000.00 ksi	
Fy	50.00 ksi	
Deflection Criteria, L/MAX?	500	
Vehicular Loading	H 10-44	
w_{DL} (unfactored)	848.62 plf	
Vmax (DL-Factored	4243.08 lbs	
Mmax (DL - Factored)	13259.62 lb-ft	
w_{LL} (Pedestiran unfactored)	928.13 plf	
Vmax (Ped LL-Factored)	4640.63 lbs	
Mmax (Ped LL -Factored)	20302.73 lb-ft	
r_{LL} (Unfactored Veh Rxn on Trans Be	39400.00 lbs	
Vmax (Veh LL - Factored)	19700.00 lbs	
Mmax (Veh LL -Factored)	86187.50 lb-ft	
V_u	23943.08 lbs	
M_u	99447.12 lb-ft	
h/t_w	56.80	
$k_v E/F_y$	2900.00	
A_w	3.93	
C_v	1.00	
$\phi_v V_n$	105975.00 lbs	OK 23% CAPACITY
$\phi_v M_n$	165750.00 lb-ft	**OK 60% CAPACITY**
I (Moment of Inertia)	301.00 in4	
Δ (Service Deflection)	0.12 in	
Δ (Service Deflection)	**L/972.19**	OK
Minimum I_{req}	154.80 in4	

DCI+bce ENGINEERS	Project:		Page:
	Client:		Design By:
	Job #:		Review By:
	Description:		Date:

Pedestrian Thru-Truss Bid Spreadsheet

	Top Chord	Bottom Chord	Truss Vert	Truss Dia Web	Transverse Floor Beam	Long Floor Beam	Floor Frame Dia	Deck
Member	HSS10X10X1/2	HSS10X8X3/8	HSS8X8X3/8	HSS6X6X5/16	W16X26	W4X13	HSS4X4X1/4	3x Timber
Length	330.00 ft	330.00 ft	221.00 ft	372.21 ft	204.00 ft	825.00 ft	253.16 ft	N/A
Volume	39.4 ft³	27.0 ft³	16.0 ft³	16.6 ft³	130.6 ft³	263.3 ft³	5.9 ft³	N/A
Weight	20569.44 lbs	14097.04 lbs	8312.72 lbs	8667.08 lbs	5304.00 lbs	10725.00 lbs	3083.67 lbs	12028.50 lbs
Cost								

TOTAL STEEL VOLUME=	498.8 ft³
TOTAL STEEL WEIGHT=	70758.95 lbs

Uniform Chord DL=	156.50 plf
Concentrated DL on Truss Verts from Floor=	973.16 lbs
Concentrated LL on Truss Verts from Floor=	4640.63 lbs

BRIDGE LIFTING LOADS

Total Bridge Weight Plus Impact (2.0)=	165575 lbs
Weight per End=	82787 lbs
Load at Each Padeye=	41394 lbs

HALF THROUGH TRUSS CALCS

DCI ENGINEERS	Project:	10x165 TB	Page:	1
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

10X10X1/2 OK BY INSPECTION

HSS Member Design

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS10X8X1/2	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.59 k		
HSS Member Shear V_{uWeak} (k)	18.72 k		
HSS Member Compression P_u (k)	531.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	7.07 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	15.30 in²		AASHTO 6.12.2.2.2
HSS Member S_x (in^)	42.70 in³		AASHTO 6.12.2.2.2
HSS Member I_y (in^)	151.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	176.20 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	9.07 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	15.30 in²		AASHTO 6.12.2.2.2
HSS Member S_y (in^)	37.80 in³		AASHTO 6.12.2.2.2
HSS Member I_x (in^)	214.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	156.22 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	9.07 in		
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	244.62 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness $\lambda_w=D_{Strong}$	19.51		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	244.62 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.59 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	244.62 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	7.07 in		
HSS Member Thickness t (in)	0.465 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	190.68 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness $\lambda_w=D_{Weak}$	15.20		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	190.68 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	18.72 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	190.68 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	8.250 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	15.30 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	14.200			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	18.500			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.300		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	23.89			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	40.99			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.293			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	531.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	609.46 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	531.00 k			
HSS Member Compression ϕ_cP_n (k)	609.46 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	176.20 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	156.22 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.87			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.87	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	15.30 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	726.75 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	15.30 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	856.80 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	726.75 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	0.61 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	176.20 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	156.22 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.00	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.413 in	**OK**		

Pedestrian Bridge Half-Through Truss Design

Note: See Sheet EST 1/1 For Input

Pedestrian Bridge Top Chord Lateral Support Calculations

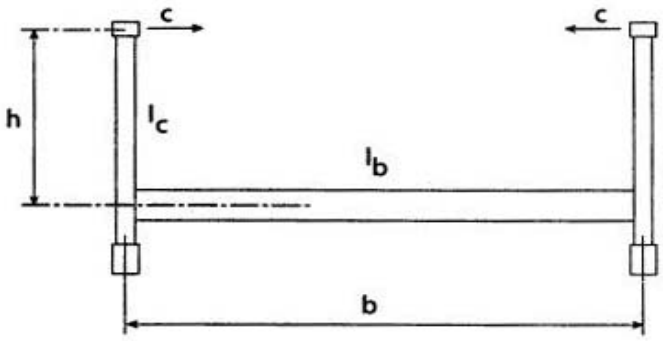
Truss Floor Beam Section	W16X26		
Truss Vertical Section	HSS8X8X3/8		
Truss Vertical Transverse Orientation	Strong Axis Bending		
Truss Floor Beam Span b (ft)	11.20 ft	Floor Beam Span From Truss Chord CL	
Truss Vertical Effective Height h (ft)	5.63 ft	Top Chord CL To Floor Beam CL	
Truss Steel E (ksi)	29000 ksi		AASHTO 6.4.1
Truss Floor Beam I_b (in^4)	301.00 in4		AASHTO 6.4.1
Truss Vertical I_c (in^4)	100.00 in4		AASHTO 6.4.1
Transverse Frame Spring Constant C (k/ir	14.199 k/in		Galambos 1968
Truss Comp Chord Unbraced L (ft)	8.25 ft		
Truss Comp Chord Factored P_u (k)	532.91 k	Factored Comp Force From Analysis	
Truss Comp Chord Critical Buckling P_c (k)	1065.82 k		Specification 7.1.2
Truss Ratio CL/P_c	1.319		Specification 7.1.2
Truss Number Of Panels n	20		
Truss Value 1/K	0.771		Specification Table 7.1.2-1
Truss Comp Chord Eff Length Factor K	1.297		

Pedestrian Bridge Lateral Frame Design Force Verticals Calculations Forces Applied In Combination With Other Loads

Average Design Comp Top Chord P_{avg} (k)	550.00 k	Factored Comp Force From Analysis	
Factor 0.01/K	0.008		Specification 7.1.1
Factor 0.01/K Limit	0.003 **OK**		Specification 7.1.1
Minimum Lateral Force H_f (k)	4.24 k	Force Applied Inward Top Each Vertical	Specification 7.1.1
Minimum Lateral Moment M_f (ft*k)	23.85 ft*k	Force Applied Inward Top Each Vertical	Specification 7.1.1

Pedestrian Bridge Lateral Frame Design Force End Posts Calculations Forces Applied In Combination With Other Loads

End Post Design Axial Load P_u (k)	110.00 k	Factored Comp Force From Analysis	
End Post Lateral Force C (k)	1.10 k	Force Applied Inward Top Each End Post	Specification 7.1.1



Pedestrian Bridge Deflection Calculations

Pedestrian Bridge Deflection Miscellaneous Input

Truss Clear Span L_{Truss} (ft)	165.00 ft	Note: See Sheet EST 1/1 For Input

Pedestrian Bridge Vertical LL Deflection Calculations

Truss LL Vertical Deflection δ_{LL} (in)	3.300 in	Service LL Vertical Deflection From Analysis May Be User Defined
Truss LL Vertical Deflection Criteria	L/360	
Truss LL Vertical Deflection $\delta_{LLAllow}$ (in)	5.500 in **OK**	

Pedestrian Bridge Lateral LL Deflection Calculations

Truss LL Lateral Deflection δ_{LL} (in)	2.175 in	Service LL Lateral Deflection From Analysis
Truss LL Lateral Deflection Criteria	L/180	
Truss LL Lateral Deflection $\delta_{LLAllow}$ (in)	11.000 in **OK**	

Pedestrian Bridge Vibration Calculations

Pedestrian Bridge Vertical 1st Harmonic Vibration Calculations

Service Dead Load Vertical Deflection From Analysis

Truss Dead Load Vert Deflection δ_{DL} (in)	1.300 in	May Be User Defined	
Acceleration Due To Gravity g (ft/s²)	32.2 ft/s²		Specification Design Example
Truss Fundamental Frequency f_{Vert1} (Hz)	3.10 Hz		Specification Design Example
Truss Fundamental Freq Min f_{Vert1} (Hz)	3.00 Hz **OK**		Specification 6

Pedestrian Bridge Vertical 2nd Harmonic Vibration Calculations

Higher Harmonics Concern	Yes		
Bridge Total Dead Load Weight (k)	100.00 k		
Truss Fundamental Frequency f_{Vert2} (Hz)	3.10 Hz		Specification Design Example
Truss 2nd Harmonic Min f_{Vert2} (Hz)	1.68 Hz **OK**		Specification 6

Pedestrian Bridge Lateral 1st Harmonic Vibration Calculations

Service Dead Load Lateral Deflection From Analysis

Truss Dead Load Lat Deflection δ_{DL} (in)	1.150 in		
Acceleration Due To Gravity g (ft/s²)	32.2 ft/s²		Specification Design Example
Truss Fundamental Frequency f_{Lat} (Hz)	3.30 Hz		Specification Design Example
Truss Fundamental Freq Min f_{Lat} (Hz)	1.30 Hz **OK**		Specification 6

HSS Truss Connection Design

BOTTOM CHORD TRUSS CONNECTION CHECK

HSS Truss Connection Miscellaneous Input

Design Assumes N-Type Gapped K-Connection With Vertical

Truss Member Grade	A847		AASHTO 6.4.1
Truss Vertical Branch Section	HSS8X8X3/8		
Truss Vertical Transverse Orientation	Strong Axis Bending		
Truss Diagonal Branch Section	HSS6X6X5/16		Diagonal Branch For All Calcs
Truss Diagonal Transverse Orientation	Strong Axis Bending		
Truss Chord Branch Section	HSS10X8X3/8		
Truss Chord Branch Orientation	Strong Axis Bending		
Truss Vertical Compression P_u (k)	110.00 k		Factored Force From Analysis
Truss Diagonal Tension P_u (k)	150.00 k		Factored Force From Analysis
Truss Chord Tension Or Comp P_u (k)	550.00 k		Positive Tension, Negative Compression
Truss Chord Moment $M_{uStrong}$ (ft*k)	13.00 ft*k		Factored Force From Analysis
Truss Vertical Angle θ (°)	90.00 °		Measured From Chord Centerline To Vertical Branch Centerline
Truss Diagonal Angle θ (°)	44.60 °		Measured From Chord Centerline To Diaganol Branch Centerline
Truss Joint Eccentricity e (in)	2.00 in		Measure Vertically, Chord Centerline To WorkPoint, Positive Away From
Truss Joint Gap g (in)	0.75 in		Measure Horizontally, Edge Vertical To Edge Diagonal At
Truss Vertical Width B_b (in)	8.00 in		
Truss Vertical Height H_b (in)	8.00 in		
Truss Vertical Thickness t_b (in)	0.349 in		
Truss Diagonal Width B_b (in)	6.00 in		
Truss Diagonal Height H_b (in)	6.00 in		
Truss Diagonal Thickness t_b (in)	0.291 in		
Truss Chord Width B (in)	8.00 in		
Truss Chord Height H (in)	10.00 in		
Truss Chord Thickness t (in)	0.349 in		

HSS Truss Gapped K-Connection Limits Of Applicability Calculations

Express As Force In Branch, Compression And Tensi

Truss Connection e/H Factor	0.200		AISC 360-05 K2.3a.1
Truss Connection e/H Factor Min Limit	-0.55	**OK**	AISC 360-05 K2.3a.1
Truss Connection e/H Factor Max Limit	0.25	**OK**	AISC 360-05 K2.3a.1
Truss Vertical Branch Angle θ (°)	90.00 °		Measured From Chord Centerline To Vertical Branch Centerline
Truss Vertical Branch Angle Limit θ (°)	30.00 °	**OK**	AISC 360-05 K2.3a.2
Truss Diagonal Branch Angle θ (°)	44.60 °		Measured From Chord Centerline To Diaganol Branch Centerline
Truss Diagonal Branch Angle Limit θ (°)	30.00 °	**OK**	AISC 360-05 K2.3a.2
Truss Chord Slenderness B/t	22.92		
Truss Chord Slenderness H/t	28.65		
Truss Chord Slenderness Limit	35.00	**OK**	AISC DG 24 8-2A
Truss Diagonal Slenderness B_b/t_b	20.62		
Truss Diagonal Slenderness H_b/t_b	20.62		
Truss Diagonal Slenderness Limit	35.00	**OK**	AISC DG 24 8-2A
Truss Vertical Slenderness B_b/t_b	22.92		
Truss Vertical Slenderness H_b/t_b	22.92		
Truss Vertical Slenderness Limit	30.10	**OK**	AISC DG 24 8-2A
Truss Width Ratio B_b/B	0.75		
Truss Width Ratio H_b/B	0.75		
Truss Width Ratio Factor γ	11.46		AISC DG 24 8-2A
Truss Width Ratio Limit	0.33	**OK**	AISC DG 24 8-2A
Truss Vertical Aspect Ratio H_b/B_b	1.00		
Truss Diagonal Aspect Ratio H_b/B_b	1.00		
Truss Chord Aspect Ratio H/B	1.25		
Truss Aspect Ratio Min Limit	0.50	**OK**	AISC DG 24 8-2A
Truss Aspect Ratio Max Limit	2.00	**OK**	AISC DG 24 8-2A
Truss Material Strength F_y (ksi)	50 ksi		AASHTO 6.4.1
Truss Material Strength Limit (ksi)	52 ksi	**OK**	AISC DG 24 8-2A
Truss Material Ductility F_y/F_u	0.71		
Truss Material Ductility Limit	0.80	**OK**	AISC DG 24 8-2A
Truss Connection Gap Ratio ξ	0.09		
Truss Connection β_{eff}	0.88		
Truss Connection Gap Ratio Limit	0.06	**OK**	AISC DG 24 8-2A
Truss Connection Gap g (in)	0.75 in		
Truss Connection Gap Limit (in)	0.64 in	**OK**	AISC DG 24 8-2A
Truss Connection Branch Size B_b (in)	6.00 in		
Truss Connection Branch Size Limit	5.04 in	**OK**	AISC DG 24 8-2A

HSS Truss Gapped K-Connection Chord Wall Plastification Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.349 in			
Truss Connection β_{eff}	0.88			
Truss Width Ratio Factor γ	11.46			AISC DG 24 8-2A
Truss Chord U	1.02			AISC K.2.3
Truss Chord Q_f	1.00			AISC K.2.3
Truss Plastification ϕ	0.90			AISC K.2.3c.a
Truss Vertical Compression P_u (k)	110.00 k			
Truss Chord Wall Plastification (C) ϕP_n (k)	159.12 k	**OK**		AISC K.2.3c.a
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Chord Wall Plastification (T) ϕP_n (k)	226.61 k	**OK**		AISC K.2.3c.a
HSS Truss Gapped K-Connection Shear Yielding (Punching) Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.349 in			
Truss Chord Width B (in)	8.00 in			
Truss Vertical η	1.00			
Truss Diagonal η	1.07			
Truss Vertical β	1.00			
Truss Diagonal β	0.75			
Truss Width Ratio Factor γ	11.46			AISC DG 24 8-2A
Truss Vertical β_{eop}	0.44			AISC K.2.3c
Truss Diagonal β_{eop}	0.33			AISC K.2.3c
Truss Shear Yielding (Punching) ϕ	0.95			AISC K.2.3c.b
Truss Vertical Compression P_u (k)	110.00 k			
Truss Shear Yielding (Punching) (C) ϕP_n (k	287.82 k	**OK**		AISC K.2.3c.b
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Shear Yielding (Punching) (T) ϕP_n (k	383.34 k	**OK**	Not Controlling Square	AISC K.2.3c.b
HSS Truss Gapped K-Connection Shear Yielding Of Chord Sidewalls Calculations				
Shear Yielding Of Chord Sidewalls In Gap			Not Controlling Square	AISC K.2.3c.c
HSS Truss Gapped K-Connection Local Yielding Tension Branch Calculations				
Local Yielding Tension Branch			Not Controlling Square	AISC K.2.3c.d
HSS Truss Gapped K-Connection Local Yielding Compression Branch Calculations				
Local Yielding Compression Branch			Not Controlling Square	AISC K.2.3c.d

TOP CHORD TRUSS CONNECTION CHECK

HSS Truss Connection Design

HSS Truss Connection Miscellaneous Input

Design Assumes N-Type Gapped K-Connection With Vertical

Truss Member Grade	A847		AASHTO 6.4.1
Truss Vertical Branch Section	HSS8X8X3/8		
Truss Vertical Transverse Orientation	Strong Axis Bending		
Truss Diagonal Branch Section	HSS6X6X5/16	Diagonal Branch For All Calcs	
Truss Diagonal Transverse Orientation	Strong Axis Bending		
Truss Chord Branch Section	HSS10X10X1/2		
Truss Chord Branch Orientation	Strong Axis Bending		
Truss Vertical Compression P_u (k)	110.00 k	Factored Force From Analysis	
Truss Diagonal Tension P_u (k)	150.00 k	Factored Force From Analysis	
Truss Chord Tension Or Comp P_u (k)	550.00 k	Positive Tension, Negative Compression	
Truss Chord Moment $M_{uStrong}$ (ft*k)	13.00 ft*k	Factored Force From Analysis	
Truss Vertical Angle θ (°)	90.00 °	Measured From Chord Centerline To Vertical Branch Centerline	
Truss Diagonal Angle θ (°)	45.00 °	Measured From Chord Centerline To Diaganol Branch Centerline	
Truss Joint Eccentricity e (in)	2.00 in	Measure Vertically, Chord Centerline To WorkPoint, Positive Away From	
Truss Joint Gap g (in)	0.75 in	Measure Horizontally, Edge Vertical To Edge Diagonal At	
Truss Vertical Width B_b (in)	8.00 in		
Truss Vertical Height H_b (in)	8.00 in		
Truss Vertical Thickness t_b (in)	0.349 in		
Truss Diagonal Width B_b (in)	6.00 in		
Truss Diagonal Height H_b (in)	6.00 in		
Truss Diagonal Thickness t_b (in)	0.291 in		
Truss Chord Width B (in)	10.00 in		
Truss Chord Height H (in)	10.00 in		
Truss Chord Thickness t (in)	0.465 in		

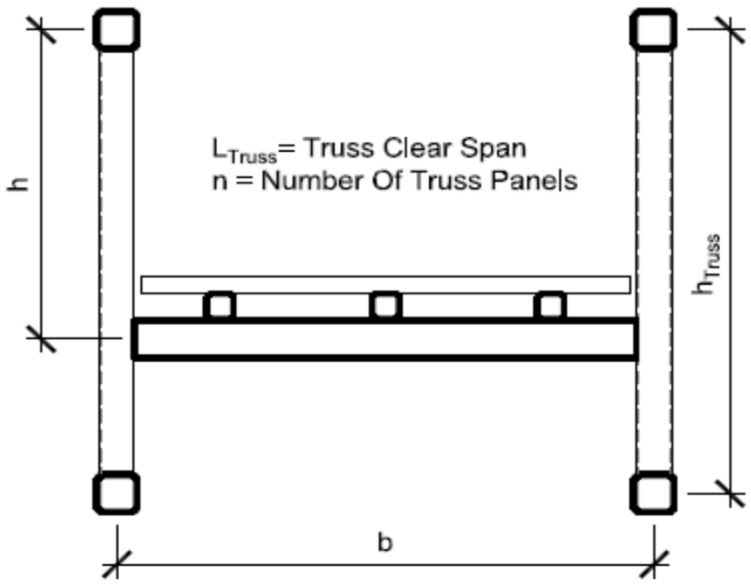
HSS Truss Gapped K-Connection Limits Of Applicability Calculations

Express As Force In Branch, Compression And Tensi

Truss Connection e/H Factor	0.200			AISC 360-05 K2.3a.1
Truss Connection e/H Factor Min Limit	-0.55	**OK**		AISC 360-05 K2.3a.1
Truss Connection e/H Factor Max Limit	0.25	**OK**		AISC 360-05 K2.3a.1
Truss Vertical Branch Angle θ (°)	90.00 °		Measured From Chord Centerline To Vertical Branch Centerline	
Truss Vertical Branch Angle Limit θ (°)	30.00 °	**OK**		AISC 360-05 K2.3a.2
Truss Diagonal Branch Angle θ (°)	45.00 °		Measured From Chord Centerline To Diaganol Branch Centerline	
Truss Diagonal Branch Angle Limit θ (°)	30.00 °	**OK**		AISC 360-05 K2.3a.2
Truss Chord Slenderness B/t	21.51			
Truss Chord Slenderness H/t	21.51			
Truss Chord Slenderness Limit	35.00	**OK**		AISC DG 24 8-2A
Truss Diagonal Slenderness B_b/t_b	20.62			
Truss Diagonal Slenderness H_b/t_b	20.62			
Truss Diagonal Slenderness Limit	35.00	**OK**		AISC DG 24 8-2A
Truss Vertical Slenderness B_b/t_b	22.92			
Truss Vertical Slenderness H_b/t_b	22.92			
Truss Vertical Slenderness Limit	30.10	**OK**		AISC DG 24 8-2A
Truss Width Ratio B_b/B	0.60			
Truss Width Ratio H_b/B	0.60			
Truss Width Ratio Factor γ	10.75			AISC DG 24 8-2A
Truss Width Ratio Limit	0.32	**OK**		AISC DG 24 8-2A
Truss Vertical Aspect Ratio H_b/B_b	1.00			
Truss Diagonal Aspect Ratio H_b/B_b	1.00			
Truss Chord Aspect Ratio H/B	1.00			
Truss Aspect Ratio Min Limit	0.50	**OK**		AISC DG 24 8-2A
Truss Aspect Ratio Max Limit	2.00	**OK**		AISC DG 24 8-2A
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Material Strength Limit (ksi)	52 ksi	**OK**		AISC DG 24 8-2A
Truss Material Ductility F_y/F_u	0.71			
Truss Material Ductility Limit	0.80	**OK**		AISC DG 24 8-2A
Truss Connection Gap Ratio ξ	0.08			
Truss Connection β_{eff}	0.70			
Truss Connection Gap Ratio Limit	0.15		Recommended Limit Only, Use Judgement	AISC DG 24 8-2A
Truss Connection Gap g (in)	0.75 in			
Truss Connection Gap Limit (in)	0.64 in	**OK**		AISC DG 24 8-2A
Truss Connection Branch Size B_b (in)	6.00 in			
Truss Connection Branch Size Limit	5.04 in	**OK**		AISC DG 24 8-2A

HSS Truss Gapped K-Connection Chord Wall Plastification Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.465 in			
Truss Connection β_{eff}	0.70			
Truss Width Ratio Factor γ	10.75			AISC DG 24 8-2A
Truss Chord U	0.70			AISC K.2.3
Truss Chord Q_f	1.00			AISC K.2.3
Truss Plastification ϕ	0.90			AISC K.2.3c.a
Truss Vertical Compression P_u (k)	110.00 k			
Truss Chord Wall Plastification (C) ϕP_n (k)	218.88 k	**OK**		AISC K.2.3c.a
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Chord Wall Plastification (T) ϕP_n (k)	309.54 k	**OK**		AISC K.2.3c.a
HSS Truss Gapped K-Connection Shear Yielding (Punching) Calculations				
Truss Material Strength F_y (ksi)	50 ksi			AASHTO 6.4.1
Truss Chord Thickness t (in)	0.465 in			
Truss Chord Width B (in)	10.00 in			
Truss Vertical η	0.80			
Truss Diagonal η	0.85			
Truss Vertical β	0.80			
Truss Diagonal β	0.60			
Truss Width Ratio Factor γ	10.75			AISC DG 24 8-2A
Truss Vertical β_{eop}	0.37			AISC K.2.3c
Truss Diagonal β_{eop}	0.28			AISC K.2.3c
Truss Shear Yielding (Punching) ϕ	0.95			AISC K.2.3c.b
Truss Vertical Compression P_u (k)	110.00 k			
Truss Shear Yielding (Punching) (C) ϕP_n (k	386.69 k	**OK**		AISC K.2.3c.b
Truss Diagonal Tension P_u (k)	150.00 k			
Truss Shear Yielding (Punching) (T) ϕP_n (k	508.21 k	**OK**	Not Controlling Square	AISC K.2.3c.b
HSS Truss Gapped K-Connection Shear Yielding Of Chord Sidewalls Calculations				
Shear Yielding Of Chord Sidewalls In Gap			Not Controlling Square	AISC K.2.3c.c
HSS Truss Gapped K-Connection Local Yielding Tension Branch Calculations				
Local Yielding Tension Branch			Not Controlling Square	AISC K.2.3c.d
HSS Truss Gapped K-Connection Local Yielding Compression Branch Calculations				
Local Yielding Compression Branch			Not Controlling Square	AISC K.2.3c.d

HSS Diagonal Tension Weld Fastening Calculations			Treat Welds As Lines
Truss Diagonal Angle θ (°)	44.60 °		
Truss Diagonal Tension P_u (k)	150.00 k		
Truss Diagonal Min Fillet Weld Size (in)	4/16 in		AASHTO 6.13.3.4
Truss Diagonal Max Fillet Weld Size (in)	4/16 in		AASHTO 6.13.3.4
Truss Diagonal Fillet Weld Size (in)	1/4 in	**OK**	
ϕ_{e2}	0.80		AASHTO 6.5.4.2
Truss Diagonal Fillet Weld Shear Cap $\phi_{e2}F$	5.94 k/in		AASHTO 6.13.3.2.4b-1
Truss Diagonal Fillet Weld Length $L_{WeldReq}$	25.26 in		AASHTO 6.13.3.5
Truss Diagonal Weld L_{eff} (in)	29.09 in	**OK**	CIDECT Design Guide 3 2.7
$t_{MinDiagonalChord}$ Match Weld Rupture (in)	0.177 in	**OK**	AISC 13th Ed. Page 9-5
HSS Vertical Compression Weld Fastening Calculations			Treat Welds As Lines
Truss Vertical Angle θ (°)	90.00 °		
Truss Vertical Compression P_u (k)	110.00 k		
Truss Vertical Min Fillet Weld Size (in)	4/16 in		AASHTO 6.13.3.4
Truss Vertical Max Fillet Weld Size (in)	5/16 in		AASHTO 6.13.3.4
Truss Vertical Fillet Weld Size (in)	1/4 in	**OK**	
ϕ_{e2}	0.80		AASHTO 6.5.4.2
Truss Vertical Fillet Weld Shear Cap $\phi_{e2}R_r$	5.94 k/in		AASHTO 6.13.3.2.4b-1
Truss Vertical Fillet Weld Length $L_{WeldReq}$ (	18.52 in		AASHTO 6.13.3.5
Truss Vertical Weld L_{eff} (in)	30.79 in	**OK**	CIDECT Design Guide 3 2.7
$t_{MinVerticalChord}$ Match Weld Rupture (in)	0.177 in	**OK**	AISC 13th Ed. Page 9-5



Pedestrian Bridge Top Chord Estimate Calculations Design Currently Based Upon AASHTO LRFD And Ped Specification

Pedestrian Bridge Miscellaneous Input

Truss Clear Span L_{Truss} (ft)	165.00 ft	End Vertical CL To End Vertical CL	
Optimum Truss Height h_{Truss} (ft)	11.00 ft	Optimum Truss Height = Span / 15	DG3 2.1
Truss Height h_{Truss} (ft)	7.33 ft	Top Chord CL To Bottom Chord CL	
Pedestrian Live Load LL (psf)	90.00 psf	May Be User Defined	Specification 1.2.1.1
Design Deck Width W_{Deck} (ft)	10.53 ft		
Design Pedestrian Live Load LL w (psf)	65.00 psf		Specification 1.2.1.1
Snow Load Ground SL (psf)	60.00 psf		
Wind Pressure Horizontal W_{Horz} (psf)	50.00 psf	May Be User Defined	Specification 1.2.2
Design Deck Dead Load DL (psf)	10.30 psf	3x Timber Deck = 7.3 psf, 4x Timber Deck = 10.3 psf, 2"x12GA Steel Gr	
Number Stringers	5		
Number Railing L1-1/4x1-1/4x3/16	12		
Number Kick PL 1/4x4	2		

Pedestrian Bridge Top Chord Lateral Support Input Note: See Sheet TC 1/1 For Printout

Truss Floor Beam Section	W16X26	Note: This Input Linked To Sheet TC 1/1 And Will Change Both Loc
Truss Vertical Section	HSS8X8X3/8	Note: This Input Linked To Sheet TC 1/1 And Will Change Both Loc
Truss Vertical Transverse Orientation	Strong Axis Bending	Note: This Input Linked To Sheet TC 1/1 And Will Change Both Loc
Truss Floor Beam Span b (ft)	11.20 ft	Floor Beam Span From Truss Chord CL
Truss Vertical Effective Height h (ft)	5.63 ft	Top Chord CL To Floor Beam CL
Truss Comp Chord Unbraced L (ft)	8.25 ft	
Truss Comp Chord Factored P_u (k)	532.91 k	May Be User Defined
Truss Number Of Panels n	20	
Truss Comp Chord Eff Length Factor K	1.300	

Pedestrian Bridge Member Input

Truss Diagonal Branch Section	HSS6X6X5/16	Note: This Input Linked To Sheet CN 1/3 And Will Change Both Loc
Truss Wind Brace Section	HSS4X4X1/4	
Truss Stringer Section	HSS6X4X1/4	
Truss Top Chord Grade	A847	Note: This Input Linked To Sheet ST 1/2 And Will Change Both Loc
Truss Top Chord Section	HSS10X8X1/2	Note: This Input Linked To Sheet ST 1/2 And Will Change Both Loc
Truss Chord Orientation	Strong Axis Bending	Reference Chord Orientation To Truss In Plane Bending
Truss Top Chord Moment $M_{uStrong}$ (ft*k)	0.61 ft*k	
Truss Top Chord Moment M_{uWeak} (ft*k)	0.00 ft*k	
Truss Top Chord Compression P_u (k)	532.91 k	
Truss Top Chord Unbraced Length l_{Strong} (f	8.250 ft	
Truss Top Chord Unbraced Length l_{Weak} (ft	8.250 ft	
Truss Top Chord Compression Length (ft)	8.250 ft	
Truss Top Chord Effective L Factor Strong	0.900	Welded End K = 0.75, In Plane Chord K = AASHTO 4.6.2.5, DG3 2.3.1
Truss Top Chord Effective L Factor Weak	1.300	Welded End K = 0.75, In Plane Chord K = AASHTO 4.6.2.5, DG3 2.3.1
Truss Top Chord Combined Compression	0.87 **OK**	AASHTO 6.9.2.2

Pedestrian Bridge Vertical LL Deflection Estimate Calculations

Truss Chord Composite I_g (in*)	50673 in4	Top & Bot Chords, AISC Table 17-27 Pg 17-38, Utilize $I_g = 0.85I_x$
Truss LL Vertical Deflection δ_{LL} (in)	3.885 in	Assume Top And Bottom Chord Same Size
Truss LL Vertical Deflection Criteria	L/360	Note: This Input Linked To Sheet DF 1/1 And Will Change Both Loc
Truss LL Vertical Deflection $\delta_{LLAllow}$ (in)	5.500 in **OK**	
Truss Vertical Camber Req δ_{CAMBER} (in)	23.335 in	1% Truss Span Plus DL Deflection

Pedestrian Bridge Weight Estimate Calculations Not Including Bearing Assembly, Transition PL, Splice Hardware, Fasteners

Bridge Weight Estimate (k)	102.80 k

Pedestrian Bridge Vertical 1st Harmonic Vibration Calculations Service Dead Load Vertical Deflection From Analysis

Truss Dead Load Vert Deflection δ_{DL} (in)	3.535 in	
Acceleration Due To Gravity g (ft/s²)	32.2 ft/s²	Specification Design Example
Truss Fundamental Frequency f_{Vert} (Hz)	3.10 Hz	Specification Design Example
Truss Fundamental Freq Min f_{Vert} (Hz)	3.00 Hz **OK**	Specification 6

MEMBER CHECKS

DCI ENGINEERS	Project:	10x165 TB	Page:	1
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	07/18/18

Pedestrian Bridge Design AASHTO LRFD Bridge Design Specification ST 1/2

HSS Member Design

BOTTOM CHORD

07/18/2018

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS10X8X3/8	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	1.40 k		
HSS Member Shear V_{uWeak} (k)	4.63 k		
HSS Member Compression P_u (k)	308.00 k	May Be User Defined	
HSS Member Tension T_u (k)	188.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	7.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	11.80 in^2		AASHTO 6.12.2.2.2
HSS Member S_x (in^3)	33.90 in^3		AASHTO 6.12.2.2.2
HSS Member I_y (in^4)	120.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	139.40 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	8.250 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	9.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	11.80 in^2		AASHTO 6.12.2.2.2
HSS Member S_y (in^3)	30.00 in^3		AASHTO 6.12.2.2.2
HSS Member I_x (in^4)	169.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	123.62 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	9.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	188.29 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	26.65		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	188.29 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	1.40 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	188.29 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	7.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	147.81 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	20.92		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	147.81 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	4.63 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	147.81 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	8.250 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	11.80 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	19.900			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	25.700			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.300		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	23.51			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	40.34			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.284			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	308.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	471.83 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	308.00 k			
HSS Member Compression ϕ_cP_n (k)	471.83 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	139.40 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	123.62 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.65			AASHTO 6.9.2.2
HSS Member Combined Compression Int	0.80	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	11.80 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	188.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	560.50 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	11.80 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	188.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	660.80 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	188.00 k			
HSS Member Tension ϕP_n (k)	560.50 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	16.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	139.40 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	6.50 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	123.62 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.34			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.48	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.413 in	**OK**		

DCI ENGINEERS	Project:	10x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

HSS Member Design DIAGONAL DESIGN

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS6X6X5/16	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.20 k		
HSS Member Shear V_{uWeak} (k)	0.15 k		
HSS Member Compression P_u (k)	0.00 k	May Be User Defined	
HSS Member Tension T_u (k)	125.00 k		

HSS Member Strong Axis Flexural Calculations

HSS Member Unbraced Length l_{Strong} (ft)	11.150 ft	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	5.42 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	6.43 in^2		AASHTO 6.12.2.2.2
HSS Member S_x (in^3)	11.40 in^3		AASHTO 6.12.2.2.2
HSS Member I_y (in^4)	34.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	46.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

HSS Member Unbraced Length l_{Weak} (ft)	11.150 ft	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	5.42 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	6.43 in^2		AASHTO 6.12.2.2.2
HSS Member S_y (in^3)	11.40 in^3		AASHTO 6.12.2.2.2
HSS Member I_x (in^4)	34.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	46.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	5.42 in		
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	91.45 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	18.62		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	91.45 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.20 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	91.45 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	5.42 in		
HSS Member Thickness t (in)	0.291 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	91.45 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	18.62		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	91.45 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.15 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	91.45 k **OK**		AASHTO 6.10.9.1-1

Project:	10x165 TB		Page:	
Client:	TrueNorth Steel		Design By:	BJS
Job #:	18161-0006		Review By:	MS
Description:	S/N 165TB10H10- PFS0198		Date:	03/05/18

Pedestrian Bridge Design AASHTO LRFD Bridge Design Specification — **ST 2/2**

HSS Member Compression Calculations

HSS Member Compression Length (ft)	11.150 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	6.43 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	17.600			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	17.600			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.300		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	52.13			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	75.30			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.990			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	0.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	191.73 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	0.00 k			
HSS Member Compression ϕ_cP_n (k)	191.73 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.03	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	6.43 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	125.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_{n}	305.43 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	6.43 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	125.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	360.08 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	125.00 k			
HSS Member Tension ϕP_n (k)	305.43 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	1.35 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	0.25 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	46.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.41			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.44	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.558 in	**OK**		

DCI ENGINEERS	Project:	10x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

VERTICAL DESIGN

HSS Member Design

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS8X8X3/8	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	5.72 k		
HSS Member Shear V_{uWeak} (k)	0.25 k		
HSS Member Compression P_u (k)	96.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	7.750 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	7.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	10.40 in^2		AASHTO 6.12.2.2.2
HSS Member S_x (in^3)	24.90 in^3		AASHTO 6.12.2.2.2
HSS Member I_y (in^4)	100.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	102.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	7.750 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	7.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^2)	10.40 in^2		AASHTO 6.12.2.2.2
HSS Member S_y (in^3)	24.90 in^3		AASHTO 6.12.2.2.2
HSS Member I_x (in^4)	100.00 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	102.58 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	7.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	147.81 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	20.92		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	147.81 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	5.72 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	147.81 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	7.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	147.81 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	20.92		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	147.81 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.25 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	147.81 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	7.750 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	10.40 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	19.900			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	19.900			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	1.000		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	27.00			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	30.00			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	0.157			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	96.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	438.40 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	96.00 k			
HSS Member Compression ϕ_cP_n (k)	438.40 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.22			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.43	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	10.40 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	494.00 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	10.40 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	582.40 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	494.00 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	23.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	102.58 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.23	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.388 in	**OK**		

DCI ENGINEERS	Project:	10x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

HSS Member Design — END WIND BRACE DESIGN

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS4X4X3/8	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		
HSS Member Shear V_{uWeak} (k)	0.00 k		
HSS Member Compression P_u (k)	92.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Strong} (ft)	12.600 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	3.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	4.78 in²		AASHTO 6.12.2.2.2
HSS Member S_x (in^)	5.13 in³		AASHTO 6.12.2.2.2
HSS Member I_y (in^)	10.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	21.01 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C

HSS Member Unbraced Length l_{Weak} (ft)	12.600 ft	May Be User Defined	
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	3.30 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	4.78 in²		AASHTO 6.12.2.2.2
HSS Member S_y (in^)	5.13 in³		AASHTO 6.12.2.2.2
HSS Member I_x (in^)	10.30 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	21.01 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	3.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	66.84 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	9.46		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	66.84 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	66.84 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	3.30 in		
HSS Member Thickness t (in)	0.349 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	66.84 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	9.46		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	66.84 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.00 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	66.84 k **OK**		AASHTO 6.10.9.1-1

HSS Member Compression Calculations

HSS Member Compression Length (ft)	12.600 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	4.78 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	8.460			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	8.460			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	0.650		May Be User Defined, Welded End K = 0.'	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	92.57			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	66.86			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	1.497			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	92.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	115.48 k	**OK**		AASHTO 6.9.4.1

HSS Member Combined Axial Compression And Flexure Calculations

HSS Member Compression P_u (k)	92.00 k			
HSS Member Compression ϕ_cP_n (k)	115.48 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.80			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	0.88	**OK**		AASHTO 6.9.2.2

HSS Member Tension Calculations

HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	4.78 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	227.05 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	4.78 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	267.68 k	**OK**		AASHTO 6.8.2.1-2

HSS Member Combined Tension And Flexure Calculations

HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	227.05 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	21.01 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.10	**OK**		AASHTO 6.8.2.3

HSS Member Strong Axis Deflection Calculations

HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.630 in	**OK**		

DCI ENGINEERS	Project:	10x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB10H10- PFS0198	Date:	03/05/18

HSS Member Design — TYP WIND BRACE DESIGN

HSS Member Miscellaneous Input

Factored Demands From Model Analysis

HSS Member Grade	A847		AASHTO 6.4.1
HSS Member Section	HSS4X4X1/4	Min Thickness Closed Member = 0.25 in	Specification 8.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k	May Be User Defined	
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		
HSS Member Shear V_{uWeak} (k)	0.00 k		
HSS Member Compression P_u (k)	75.00 k	May Be User Defined	
HSS Member Tension T_u (k)	0.00 k		

HSS Member Strong Axis Flexural Calculations

HSS Member Unbraced Length l_{Strong} (ft)	12.600 ft	May Be User Defined	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member b_{Strong} (in)	3.53 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	3.37 in²		AASHTO 6.12.2.2.2
HSS Member S_x (in^)	3.90 in³		AASHTO 6.12.2.2.2
HSS Member I_y (in^)	7.80 in4		AASHTO 6.12.2.2.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nStrong}$ (ft*k)	15.81 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Weak Axis Flexural Calculations

HSS Member Unbraced Length l_{Weak} (ft)	12.600 ft	May Be User Defined	C6.12.2.2.2, Ignore Lateral Torsional Resistance For Boxes, Although C
HSS Member Flange Yield Stress F_y (ksi)	50 ksi		AASHTO 6.4.1
HSS Member E (ksi)	29000 ksi		AASHTO 6.4.1
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member b_{Weak} (in)	3.53 in		AASHTO 6.12.2.2.2
HSS Member A_g (in^)	3.37 in²		AASHTO 6.12.2.2.2
HSS Member S_y (in^)	3.90 in³		AASHTO 6.12.2.2.2
HSS Member I_x (in^)	7.80 in4		AASHTO 6.12.2.2.2
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k		
ϕ_f	1.00		AASHTO 6.5.4.2
HSS Member Flexural $\phi_f M_{nWeak}$ (ft*k)	15.81 ft*k **OK**		AASHTO 6.12.2.2.2-1

HSS Member Strong Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Strong} (in)	3.53 in		
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force $V_{pStrong}$ (	47.76 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Strong}	15.17		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Strong}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling $V_{crStrong}$ (k)	47.76 k		AASHTO 6.10.9.2
HSS Member Shear $V_{uStrong}$ (k)	0.10 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nStrong}$ (k)	47.76 k **OK**		AASHTO 6.10.9.1-1

HSS Member Weak Axis Shear Calculations

HSS Member Web Yield Stress F_{yw} (ksi)	50 ksi		AASHTO 6.4.1
HSS Member Web Depth D_{Weak} (in)	3.53 in		
HSS Member Thickness t (in)	0.233 in		AASHTO 6.12.2.2.2
HSS Member Plastic Shear Force V_{pWeak} (	47.76 k		AASHTO 6.10.9.2-2
HSS Member Web Slenderness λ_w=D_{Weak}/	15.17		AASHTO 6.10.9.3.2
HSS Member Shear Buckling Coefficient k	5.00	Unstiffened Webs	AASHTO 6.10.9.2
HSS Member Shear Factor C_{Weak}	1.00		AASHTO 6.10.9.3.2
HSS Member Shear Buckling V_{crWeak} (k)	47.76 k		AASHTO 6.10.9.2
HSS Member Shear V_{uWeak} (k)	0.00 k		AISC Table 3-23 Case 1
ϕ_v	1.00		AASHTO 6.5.4.2
HSS Member Shear $\phi_v V_{nWeak}$ (k)	47.76 k **OK**		AASHTO 6.10.9.1-1

Project:	10x165 TB		Page:	
Client:	TrueNorth Steel		Design By:	BJS
Job #:	18161-0006		Review By:	MS
Description:	S/N 165TB10H10- PFS0198		Date:	03/05/18

Pedestrian Bridge Design AASHTO LRFD Bridge Design Specification — **ST 2/2**

HSS Member Compression Calculations				
HSS Member Compression Length (ft)	12.600 ft		May Be User Defined	
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	3.37 in²			AASHTO 6.12.2.2.2
HSS Member Flange Local Buckling $\lambda_f=b_f/$	14.200			AISC Tables
HSS Member Flange Local Buckling Limit	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Web Local Buckling $\lambda_w=h/t_w$	14.200			AISC Tables
HSS Member Web Local Buckling Limit λ_w	40.941	**OK**		AASHTO 6.9.4.2-6
HSS Member Effective L Factor Strong K_x	0.900		May Be User Defined, Welded End K = 0.7	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Effective L Factor Weak K_y	0.650		May Be User Defined, Welded End K = 0.7	AASHTO 4.6.2.5, DG3 2.3.1
HSS Member Strong Axis Slenderness K_xl	89.53			AASHTO 6.9.3
HSS Member Weak Axis Slenderness $K_yl/$	64.66			AASHTO 6.9.3
HSS Member Slenderness Limit Kl/r	120.00	**OK**	Primary Members Limit	AASHTO 6.9.3
HSS Member Slenderness λ_c	1.400			AASHTO 6.9.4.1-3
HSS Member Compression P_u (k)	75.00 k			
ϕ_c	0.90			AASHTO 6.5.4.2
HSS Member Compression ϕ_cP_n (k)	84.76 k	**OK**		AASHTO 6.9.4.1
HSS Member Combined Axial Compression And Flexure Calculations				
HSS Member Compression P_u (k)	75.00 k			
HSS Member Compression ϕ_cP_n (k)	84.76 k	**OK**		AASHTO 6.9.4.2
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.88			AASHTO 6.9.2.2
HSS Member Combined Compression Inte	1.00	**OK**		AASHTO 6.9.2.2
HSS Member Tension Calculations				
HSS Member Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
HSS Member A_g (in^)	3.37 in²			AASHTO 6.8.2.1
HSS Member Tension T_u (k)	0.00 k			
ϕ_y	0.95			AASHTO 6.5.4.2
HSS Member Gross Section Yielding ϕ_yP_n	160.08 k	**OK**		AASHTO 6.8.2.1-1
HSS Member Tensile Stress F_u (ksi)	70 ksi			AASHTO 6.4.1
HSS Member Net Area A_n (in^)	3.37 in²		Assume Full Gross Section	AASHTO 6.8.3
HSS Member Shear Lag Reduction Factor	1.00		Tension Load To Each Member Element	AASHTO 6.8.2.2-1
HSS Member Tension T_u (k)	0.00 k			
ϕ_u	0.80			AASHTO 6.5.4.2
HSS Member Net Section Fracture ϕ_uP_{nu} (	188.72 k	**OK**		AASHTO 6.8.2.1-2
HSS Member Combined Tension And Flexure Calculations				
HSS Member Tension T_u (k)	0.00 k			
HSS Member Tension ϕP_n (k)	160.08 k	**OK**		AASHTO 6.8.2.1
HSS Member Moment $M_{uStrong}$ (ft*k)	1.00 ft*k			
HSS Member Flexural $\phi_fM_{nStrong}$ (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member Moment M_{uWeak} (ft*k)	1.00 ft*k			
HSS Member Flexural ϕ_fM_{nWeak} (ft*k)	15.81 ft*k	**OK**		AASHTO 6.12.2.2.2-1
HSS Member P_u/P_r Ratio	0.00			AASHTO 6.8.2.3
HSS Member Combined Tension Interacti	0.13	**OK**		AASHTO 6.8.2.3
HSS Member Strong Axis Deflection Calculations				
HSS Member Deflection Limit	L/240			
HSS Member Deflection δ_x (in)	0.250 in			From Model Analysis
HSS Member Allowable Deflection δ_{xAll} (in)	0.630 in	**OK**		

Steel Beam Design - Per AASHTO LRFD Bridge Design Specification

Project: 0006 OAK GROVE

Girder description: Non-Composite Plate Girder

TRANSVERSE BEAM DESIGN

Bridge Span Length	9.5	ft
Unbraced Length L_b	9.5	ft
Moment Magnification Factor		
(6.9.2.2) & (4.5.3.2.2b) Moment Magnification Factor δ_b =	1.00	
C_m =	1.0	
Strong Axis k =	1.0	
Strong Axis Euler Buckling Load $P_{e,x}$ =	6868	
Factored Loads		
(Factored axial & lateral pipeline + wind + braking load) = P_u	0	kips
(Factored axial load on bottom flange from Anchor HSM) = P_u	0	kips
$V_{u,y}$	16	kips
$V_{u,x}$	0	kips
T	0	kip-ft
Factored Design Forces		
Design Moment Mu (+)	33	kip-ft
Magnified Noncomposite Dead Load $M_{u,x}$ (+)	33	kip-ft
Capacity Checks		
Non-Composite Flexural Capacity (ΦMnx)	166	kip-ft
Axial Capacity (ΦPn)	170	kip-ft
Shear Capacity (ΦVn)	108	kip
Combined Moment and Axial	-	

Compactness and Proportion Limits

148.003833

Interior Web Panel:	UNSTIFFENED
Flange:	COMPACT
Flange Proportions:	OK
Web:	COMPACT
Web Proportions:	OK

I Section Properties

	W16x26:	
D (Total Depth)	15.7	in
b_f (Flange width)	5.5	in
t_f	0.375	in
t_w	0.25	in
F_{yw}:	50,000	psi
F_{yf}	50,000	psi
Web depth D	15.0	in
D/t_w	59.8	
J	0.3	in^4
Girder only I_x	312	in^4
I_y	10	in^4
Top flange girder only S_x	40	in^3
Bottom flange girder only S_x	40	in^3
S_y	4	in^3
I_{yc}	5	in^4
I_{yt}	5	in^4
Area	7.86	in^2
Web A_w	3.74	in^2
One flange A_f	2.06	in^2
r_x	6.30	in
r_y	1.15	in
M_{yc}	166	kip-ft
M_{yt}	166	kip-ft
Plastic Section Properties		
Z_x	46	in^3
Z_y	29	in^3
M_p	190	kip-ft

Weights

I Girder	**27**	plf

Stiffeners

Longitudinal Web Stiffeners Present (yes/no)?:	no	
Transverse Web Stiffeners Present (yes/no)?	no	
Stiffener Spacing (d_0)	0	in
Longitudinal stiffener spacing ds	0	in
1.5D	22.425	in
3D	44.85	in
INTERIOR WEB PANEL	**UNSTIFFENED**	

6.10.1.9 Web Bend-Buckling Resistance

D_c	7.5	in
(w/out long.) k	36.0	
(with long.) k	46.6	
F_{crw}	262.7	ksi
F_{crw}	50.0	ksi
F_{crw}	71.4	ksi
Use F_{crw}	50.0	ksi

6.10.1.10 Flange-strength reduction factors

Hybrid Factor R_h	1.00	
a_{wc}	1.81	
R_b	1.00	
R_b	1.00	

6.10.2 Cross Section Proportion Limits

D/t_w	59.80	**OK**
		N/A
$b_f/2t_f$	7.33	**OK**
D/6	2.49	**OK**
$1.1t_w$	0.28	**OK**
I_{yc} / I_{yt}	1.00	**OK**

6.10.6.2.3 Composite section in Negative Flexure and Non-composite sections Provisions for Appendix A or 6.10.8

F_{yf}	50,000	**OK**
D_{cp}	7	in
$2*D_c/t_w$	59.80	
$5.7*\sqrt{(E/F_{yc})}$	137.27	**OK**
I_{yc} / I_{yt}	1.00	**OK**
	APPENDIX A MAY BE USED	

Appendix A Composite section in Negative Flexure and Non-composite sections
A6.2 Web Plastification Factors

Web Elastic Moment slenderness ratio λ_w	59.80	
$\lambda_{pw(Dcp)}$	85.89	
$\lambda_{pw(Dc)}$	85.89	
λ_{rw}	137.27	
WEB :	**COMPACT**	
Web plastication factor R_{pc}	1.15	
Web plastication factor R_{pt}	1.15	
Plastic Moment ϕM_n	190	k-f

6.10.8 Flexural Resistance - Noncomposite Sections

6.10.8.2.2 Local Buckling Resistance

Compression flange slenderness ratio λ_f	7.33		
λ_{pf}	9.15		
λ_{rf}	16.12		
FLANGE :	**COMPACT**		
F_{nc}	50	ksi	
F_{yr}	35	ksi	
F_{nc}	54	ksi	
Use F_{nc}	50	ksi	

6.10.8.2.3 Lateral Torsional Buckling Resistance

L_b	114	in	
r_t	1.39	in	
L_p	33.5	in	
L_r	126	in	
C_b	1.0		
F_{nc}	50	ksi	
F_{nc}	37	ksi	
$F_{nc} = F_{cr}$	43	ksi	
Use F_{nc}	37	ksi	
F_{nc}	37	ksi	
ΦM_{nc}	**122**	k-ft	
R_pM_y	**190**	k-ft	

6.10.8.3 Tension-Flange Flexural Resistance

F_{nt}	50	ksi
ΦM_{nt}	**166**	k-ft

Shear Resistance

6.10.9.3 Nominal Resistance of <u>Stiffened</u> Webs

<u>Interior Panels</u>		
D/t_w	59.80	
d_o/D	0.00	
k	5.00	
$1.12\sqrt{(Ek/F_{yw})}$	60.31	
$1.4\sqrt{(Ek/F_{yw})}$	75.39	
C	1.00	D/tw<=1.12 √(Ek/Fyw)
C	1.01	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)
C	1.27	D/tw>1.4 √(Ek/Fyw)
Use: C	1.000	
V_p	108	kips
Interior Web Proportion Coefficient	1.8 1.0	
ΦV_n	108	kips
ΦV_n	108	kips
Use: ΦV_n	108	kips
<u>End Panels</u>		
ΦV_n	108	kips

6.10.9.2 Nominal Resistance of <u>Unstiffened</u> Webs

<u>Interior and End Panels</u>		
k	5.00	
C	1.00	D/tw<=1.12 √(Ek/Fyw)
C	1.01	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)
C	1.27	D/tw>1.4 √(Ek/Fyw)
Use: C	1.000	
ΦV_n	108	kips

6.10.11 Transverse Web Stiffeners

6.10.11.1.2 Projecting Width

Thickness of projecting stiffener t_p	0.5	in
Width of projecting stiffener b_t	6	in
Stiffener F_y	50000	psi
2.0+D/30	2.50	**OK, bt > 2.0 +D/30**
16*t_p	8.00	**OK, bt < 16*tp**
b_f/4	1.5	**OK, bt > bf/4**
b_t/t_p	12.00	

6.10.11.1.3 Moment of Inertia

Stiffener bending rigidity parameter J	#DIV/0!	in^2
Stiffener Moment of Inertia I_t	36.0	in^4
Stiffener Moment of Inertia I_t	72.0	in^4
b	0.0	in^4
Minimum I_{t1}	#DIV/0!	in^4
ρ_t	1.0	
F_{crs}	50.0	ksi
Minimum I_{t2}	0.1	in^4
When longitudinal stiffener present, Minimum I_t	#DIV/0!	in^4

6.10.11.3 Longitudinal Stiffeners

Thickness of stiffener t_s	0.75	in
Width of projecting stiffener b_t	5	in
Stiffener F_{ys}	50000	psi
effective web width	4.5	in
stiffener area	3.75	in^2
web effective area	1.13	in^2
x(bar)	2.14	in
0.48*t_p*SQRT(E/F_{ys})	8.7	
Long. Stiffener I_l	13.78	in^4
	0.0	in^4
Long. Stiffener r_l	1.68	in
	0.00	in

Axial Resistance - Per AASHTO LRFD Bridge Design Specifications 4th Ed. 2007 - 2009 Interim

Unbraced length L	9.50	ft
Unbraced length L	114.00	in

Girder Noncomposite Properites

D(total)	15.7	in
Web depth D	15	in
tw	0.25	in
bf	5.5	in
tf	0.375	in
F_y	50	ksi
SQRT(E/Fy)	24.08	
As	7.86	in^2
rx	6.30	in
ry	1.15	in
K	1.0	

6.9.3 Limiting Slenderness Ratios

Slenderness ratio	99.04
Primary members K*L / r <= 120	**OK**
Secondary members K*L / r <= 140	**OK**

Steel Beam Design - Per AASHTO LRFD Bridge Design Specification

Project: 0006 OAK GROVE

Girder description: Non-Composite Plate Girder

STRINGER DESIGN

Bridge Span Length		9.5	ft
	Unbraced Length L_b	9.5	ft
Moment Magnification Factor			
(6.9.2.2) & (4.5.3.2.2b) Moment Magnification Factor δ_b =		1.00	
C_m =		1.0	
Strong Axis k =		1.0	
Strong Axis Euler Buckling Load $P_{e,x}$ =		636	
Factored Loads			
(Factored axial & lateral pipeline + wind + braking load) = P_u		0	kips
(Factored axial load on bottom flange from Anchor HSM) = P_u		0	kips
$V_{u,y}$		16	kips
$V_{u,x}$		0	kips
T		0	kip-ft
Factored Design Forces			
Design Moment Mu (+)		31	kip-ft
Magnified Noncomposite Dead Load $M_{u,x}$ (+)		31	kip-ft
Capacity Checks			
Non-Composite Flexural Capacity (ΦMnx)		40	kip-ft
Axial Capacity (ΦPn)		127	kip-ft
Shear Capacity (ΦVn)		37	kip
Combined Moment and Axial		-	

Compactness and Proportion Limits

49.03102126

Interior Web Panel: UNSTIFFENED

Flange: NON-COMPACT

Flange Proportions: OK

Web: COMPACT

Web Proportions: OK

I Section Properties

	W6x15:	
D (Total Depth)	6	in
b_f (Flange width)	6	in
t_f	0.26	in
t_w	0.23	in
F_{yw}:	50,000	psi
F_{yf}	50,000	psi
Web depth D	5.5	in
D/t_w	23.8	
J	0.1	in^4
Girder only I_x	29	in^4
I_y	9	in^4
Top flange girder only S_x	10	in^3
Bottom flange girder only S_x	10	in^3
S_y	3	in^3
I_{yc}	5	in^4
I_{yt}	5	in^4
Area	4.38	in^2
Web A_w	1.26	in^2
One flange A_f	1.56	in^2
r_x	2.57	in
r_y	1.46	in
M_{yc}	40	kip-ft
M_{yt}	40	kip-ft
Plastic Section Properties		
Z_x	11	in^3
Z_y	35	in^3
M_p	45	kip-ft

Weights

I Girder	**15**	plf

Stiffeners

Longitudinal Web Stiffeners Present (yes/no)?:	no	
Transverse Web Stiffeners Present (yes/no)?	no	
Stiffener Spacing (d_0)	0	in
Longitudinal stiffener spacing ds	0	in
1.5D	8.22	in
3D	16.44	in
INTERIOR WEB PANEL	**UNSTIFFENED**	

6.10.1.9 Web Bend-Buckling Resistance

D_c	2.7	in
(w/out long.) k	36.0	
(with long.) k	46.6	
F_{crw}	1655.2	ksi
F_{crw}	50.0	ksi
F_{crw}	71.4	ksi
Use F_{crw}	50.0	ksi

6.10.1.10 Flange-strength reduction factors

Hybrid Factor R_h	1.00	
a_{wc}	0.81	
R_b	1.00	
R_b	1.00	

6.10.2 Cross Section Proportion Limits

D/t_w	23.83	**OK**
		N/A
$b_f/2t_f$	11.54	**OK**
D/6	0.91	**OK**
$1.1t_w$	0.25	**OK**
I_{yc} / I_{yt}	1.00	**OK**

6.10.6.2.3 Composite section in Negative Flexure and Non-composite sections Provisions for Appendix A or 6.10.8

F_{yf}	50,000	**OK**
D_{cp}	3	in
$2*D_c/t_w$	23.83	
$5.7*\sqrt{(E/F_{yc})}$	137.27	**OK**
I_{yc} / I_{yt}	1.00	**OK**
	APPENDIX A MAY BE USED	

Appendix A Composite section in Negative Flexure and Non-composite sections
A6.2 Web Plastification Factors

Web Elastic Moment slenderness ratio λ_w	23.83	
$\lambda_{pw(Dcp)}$	92.83	
$\lambda_{pw(Dc)}$	92.83	
λ_{rw}	137.27	
WEB :	**COMPACT**	
Web plastication factor R_{pc}	1.11	
Web plastication factor R_{pt}	1.11	
Plastic Moment ϕM_n	45	k-f

6.10.8 Flexural Resistance - Noncomposite Sections

6.10.8.2.2 Local Buckling Resistance

Compression flange slenderness ratio λ_f	11.54		
λ_{pf}	9.15		
λ_{rf}	16.12		
FLANGE :	**NON-COMPACT**		
F_{nc}	50	ksi	
F_{yr}	35	ksi	
F_{nc}	45	ksi	
Use F_{nc}	45	ksi	

6.10.8.2.3 Lateral Torsional Buckling Resistance

L_b	114	in	
r_t	1.63	in	
L_p	39.2	in	
L_r	147	in	
C_b	1.0		
F_{nc}	50	ksi	
F_{nc}	40	ksi	
$F_{nc} = F_{cr}$	50	ksi	
Use F_{nc}	40	ksi	
F_{nc}	40	ksi	
ΦM_{nc}	**32**	k-ft	
R_pM_y	**45**	k-ft	

6.10.8.3 Tension-Flange Flexural Resistance

F_{nt}	50	ksi
ΦM_{nt}	**40**	k-ft

Shear Resistance

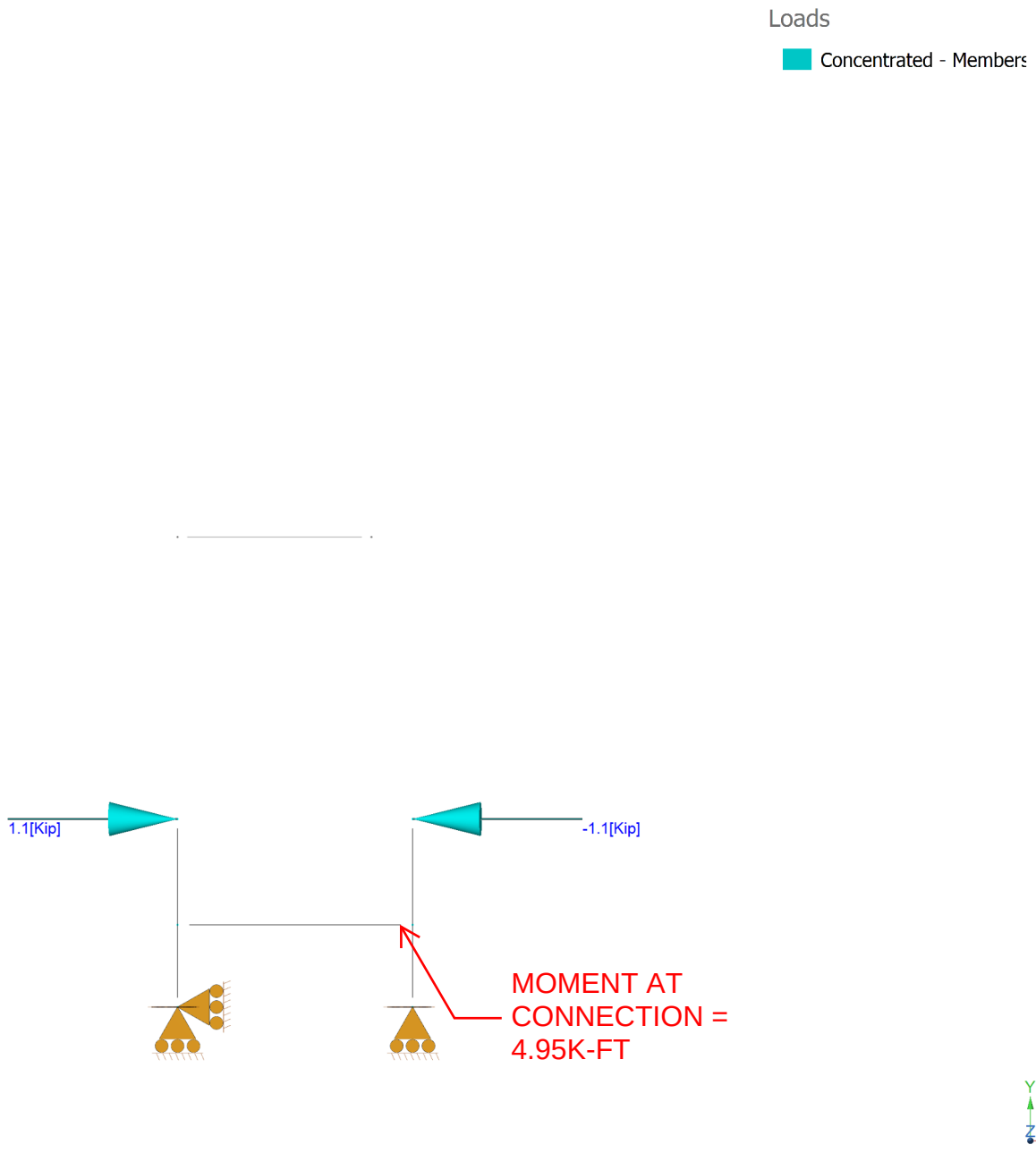
6.10.9.3 Nominal Resistance of <u>Stiffened</u> Webs

	<u>Interior Panels</u>		
D/t_w	23.83		
d_o/D	0.00		
k	5.00		
$1.12\sqrt{(Ek/F_{yw})}$	60.31		
$1.4\sqrt{(Ek/F_{yw})}$	75.39		
C	1.00	D/tw<=1.12 √(Ek/Fyw)	
C	2.53	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)	
C	8.02	D/tw>1.4 √(Ek/Fyw)	
Use: C	1.000		
V_p	37	kips	
Interior Web Proportion	0.8		
Coefficient	1.0		
ΦV_n	37	kips	
ΦV_n	37	kips	
Use: ΦV_n	37	kips	
	<u>End Panels</u>		
ΦV_n	37	kips	

6.10.9.2 Nominal Resistance of <u>Unstiffened</u> Webs

	<u>Interior and End Panels</u>		
k	5.00		
C	1.00	D/tw<=1.12 √(Ek/Fyw)	
C	2.53	1.12 √(Ek/Fyw)<D/tw<=1.4 √(Ek/Fyw)	
C	8.02	D/tw>1.4 √(Ek/Fyw)	
Use: C	1.000		
ΦV_n	37	kips	

Current Date: 2/19/2018 2:04 PM
Units system: English
File name: J:\1610-Kalispell\2018 Projects\18161-0006 TrueNorth Bridge 165TB10H10-PFS0198\4- Calculations\Bridge Calcs\FARGO PED TRUSS N20.etz\
Load condition: LL=Live Load



T →

C ←

CHECK WELD:

ASSUME TOP AND BOTTOM FLANGE WELDED ONLY,
T = C = 4.95K-FT/1.33FT = 3.72K

R = 0.6*F*0.707*D/16*L = 0.6*70*0.707*5/16*5.5 =51K (OK)

W16X26 FLANGE

DCI ENGINEERS	Project:	12x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB12H10-PFS0198	Date:	03/19/18

Transverse Wood Plank Deck Design

Transverse Wood Plank Miscellaneous Input

Wood Plank Size	4x12 Dim	Assume Weak Axis Bending Orientation	
Lumber Grade	Douglas Fir-Larch No. 2 Dimension		
Wood Plank Continuity	Continuous Over 3 Or More Spans		
Load Duration Type	2 Months (Vehicle Live Load)		AASHTO Table 13.5.5A
Repetitive Member Factor	Considered		
Wet Service Condition	Moisture Content Less Than 19%		
Incising Condition	Not Considered		
Spacing Of Beams S (ft)	2.00 ft		
Beam Flange Width (in)	6.00 in		
$F_{bo(y)}$ (psi)	900 psi		AASHTO 8.4.1.1.4-1
$F_{vo(y)}$ (psi)	180 psi		AASHTO 8.4.1.1.4-1
$F_{co(Parallel)}$ (psi)	1350 psi		AASHTO 8.4.1.1.4-1
$E_{co(y)}$ (psi)	1600000 psi		AASHTO 8.4.1.1.4-1
Design Wheel Load (lb)	8000 lb	Utilize 12000 lb For H15, HS15, H20, HS20	
Wheel Load Distribution Width b_t (in)	10.00 in		AASHTO 3.6.1.2.5
Wheel Load Distribution Length b_d (in)	20.00 in		AASHTO 3.6.1.2.5
Load Factor Case	Service Load I		AASHTO 3.4.1-1
γ	1.00		AASHTO 3.4.1-3
β_D	1.00		CALTRANS 3.22.1A
β_L	1.00		CALTRANS 3.22.1A

Transverse Wood Plank Design Loading Input

w_{Plank} (psf)	10.3 psf	3x Timber Deck = 7.3 psf, 4x Timber Deck = 10.3 psf
$w_{Ballast}$ (psf)	0.0 psf	8" Side Dam, Deck 12x4-1/4", Ballast = 80 psf (140 pcf)
$w_{Wearing}$ (psf)	0.0 psf	2" Wearing Surface = 23.3 psf, Municipality 3" Asphalt = 35.0 psf
w_{DL} (lb/in)	0.80 lb/in	

Transverse Wood Plank Flexural Calculations

Wood Plank Design Thickness t_{Deck} (in)	3.50 in		
Design Wood Plank Span s (ft)	1.50 ft		CALTRANS 3.25.1.2
Wood Plank Continuity Factor	0.80		CALTRANS 3.25.1.2
M_{DL} (in*lb)	26 in*lb		FS Timber Bridge DM 7-53
M_{LL} (in*lb)	22414 in*lb		FS Timber Bridge DM 7-53
M_{TOT} (in*lb)	22440 in*lb		
C_F	1.10		
C_M	1.00		
C_D	1.15		
C_r	1.15		
C_{fu}	1.10		
C_i	1.00		
f_b (psi)	977 psi		
F'_b (psi)	1440 psi	**OK**	

Transverse Wood Plank Shear Calculations

Design Wood Plank Span s (ft)	1.50 ft		
V_{DL} (lb)	4 lb		FS Timber Bridge DM 7-59
V_{LL} (lb)	4222 lb	AISC Table 3-23.5 & 3-23.4	FS Timber Bridge DM 7-141
V_{TOT} (lb)	4227 lb		
C_M	1.00		
C_D	1.15		
C_i	1.00		
f_v (psi)	161 psi		
F'_v (psi)	207 psi	**OK**	

Transverse Wood Plank Deflection Calculations

Design Wood Plank Span (ft)	1.50 ft		CALTRANS 3.25.1.2
Wood Plank Continuity Factor	0.80		CALTRANS 3.25.1.2
Wood Plank Deflection Criteria	L/425		
C_M	1.00		
C_i	1.00		
E'_o (psi)	1600000 psi		
Wood Plank Deflection δ_{LMax} (in)	0.012 in		FS Timber Bridge DM 7-56
Wood Plank LL Deflection Span Ratio	L / 1530	**OK**	

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:45AM

Wood Beam

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ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING

ADDITIONAL WOOD DECK CHECK:

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-10

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

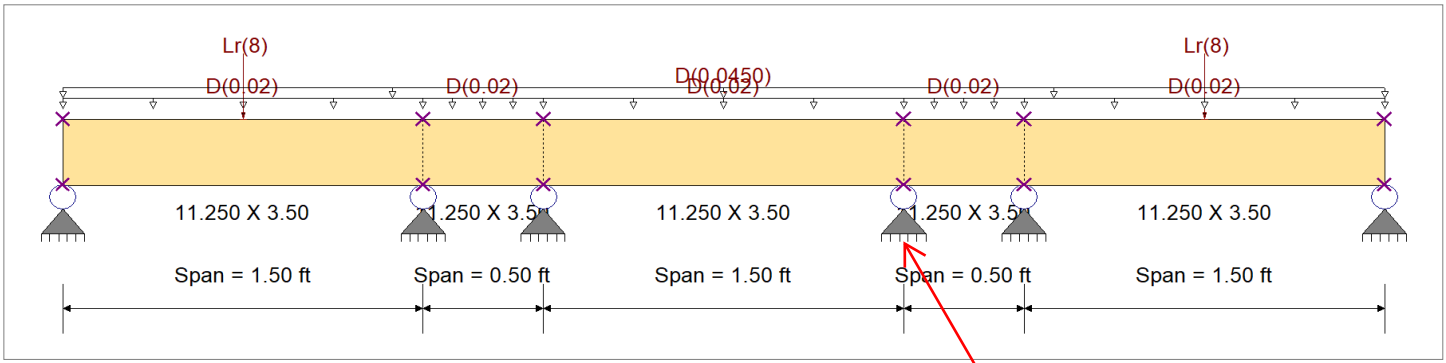
Beam Bracing : Completely Unbraced

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.20 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Loads on all spans...
Uniform Load on ALL spans : D = 0.0450 k/ft

REPRESENT FLANGE LOCATIONS

Load for Span Number 1
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Point Load : Lr = 8.0 k @ 0.750 ft

Load for Span Number 2
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Load for Span Number 4
Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Load for Span Number 5
Point Load : Lr = 8.0 k @ 0.750 ft

Uniform Load : D = 0.020 , Tributary Width = 1.0 ft

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:45AM

Wood Beam

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ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 — **Licensee : DCI ENGINEERS**

Description : WOOD DECKING

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.783 : 1	Maximum Shear Stress Ratio	=	0.877 : 1
Section used for this span		11.250 X 3.50	Section used for this span		11.250 X 3.50
fb : Actual	=	1,114.26 psi	fv : Actual	=	197.41 psi
FB : Allowable	=	1,423.13 psi	Fv : Allowable	=	225.00 psi
Load Combination		+D+Lr+H	Load Combination		+D+Lr+H
Location of maximum on span	=	0.741 ft	Location of maximum on span	=	1.215 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.009 in	Ratio =	2018	>=360
Max Upward Transient Deflection	0.000 in	Ratio =	0	<360
Max Downward Total Deflection	0.009 in	Ratio =	2001	>=180
Max Upward Total Deflection	0.000 in	Ratio =	0	<180

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
+D+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.04	1.68	162.00
Length = 0.50 ft	2	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.03	1.68	162.00
Length = 1.50 ft	3	0.005	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1024.65	0.03	1.68	162.00
Length = 0.50 ft	4	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.04	1.68	162.00
Length = 1.50 ft	5	0.008	0.010	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1024.65	0.04	1.68	162.00
+D+L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.04	1.68	180.00
Length = 0.50 ft	2	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.03	1.68	180.00
Length = 1.50 ft	3	0.005	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1138.50	0.03	1.68	180.00
Length = 0.50 ft	4	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.04	1.68	180.00
Length = 1.50 ft	5	0.007	0.009	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1138.50	0.04	1.68	180.00
+D+Lr+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.783	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	2.13	1,114.26	1423.13	5.18	197.41	225.00
Length = 0.50 ft	2	0.632	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.72	899.49	1423.13	3.73	197.41	225.00
Length = 1.50 ft	3	0.061	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.17	86.46	1423.13	3.71	197.41	225.00
Length = 0.50 ft	4	0.632	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.72	899.49	1423.13	5.18	197.41	225.00
Length = 1.50 ft	5	0.783	0.877	1.25	1.100	1.00	1.15	1.00	1.00	1.00	2.13	1,114.26	1423.13	5.18	197.41	225.00
+D+S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 0.50 ft	2	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.03	1.68	207.00
Length = 1.50 ft	3	0.004	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1309.28	0.03	1.68	207.00
Length = 0.50 ft	4	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 1.50 ft	5	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
+D+0.750Lr+0.750L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.588	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1423.13	3.90	148.48	225.00
Length = 0.50 ft	2	0.475	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1423.13	2.80	148.48	225.00
Length = 1.50 ft	3	0.047	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.13	66.20	1423.13	2.78	148.48	225.00
Length = 0.50 ft	4	0.475	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1423.13	3.90	148.48	225.00
Length = 1.50 ft	5	0.588	0.660	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1423.13	3.90	148.48	225.00
+D+0.750L+0.750S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 0.50 ft	2	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.03	1.68	207.00
Length = 1.50 ft	3	0.004	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1309.28	0.03	1.68	207.00
Length = 0.50 ft	4	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
Length = 1.50 ft	5	0.006	0.008	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1309.28	0.04	1.68	207.00
+D+0.60W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666
Licensee : DCI ENGINEERS

Description : WOOD DECKING

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
+D+0.70E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
+D+0.750Lr+0.750L+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.460	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1821.60	3.90	148.48	288.00
Length = 0.50 ft	2	0.371	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1821.60	2.80	148.48	288.00
Length = 1.50 ft	3	0.036	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.13	66.20	1821.60	2.78	148.48	288.00
Length = 0.50 ft	4	0.371	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.29	676.55	1821.60	3.90	148.48	288.00
Length = 1.50 ft	5	0.460	0.516	1.60	1.100	1.00	1.15	1.00	1.00	1.00	1.60	837.44	1821.60	3.90	148.48	288.00
+D+0.750L+0.750S+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 0.50 ft	2	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.03	1.68	288.00
Length = 1.50 ft	3	0.003	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	5.41	1821.60	0.03	1.68	288.00
Length = 0.50 ft	4	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
Length = 1.50 ft	5	0.004	0.006	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.73	1821.60	0.04	1.68	288.00
+0.60D+0.60W+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 0.50 ft	2	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.02	1.01	288.00
Length = 1.50 ft	3	0.002	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	3.25	1821.60	0.02	1.01	288.00
Length = 0.50 ft	4	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 1.50 ft	5	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
+0.60D+0.70E+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.50 ft	1	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 0.50 ft	2	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.02	1.01	288.00
Length = 1.50 ft	3	0.002	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	3.25	1821.60	0.02	1.01	288.00
Length = 0.50 ft	4	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00
Length = 1.50 ft	5	0.003	0.003	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.64	1821.60	0.03	1.01	288.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+Lr+H	1	0.0090	0.703		0.0000	0.000
	2	0.0000	0.703	+D+Lr+H	-0.0007	0.209
+D+Lr+H	3	0.0013	0.759		0.0000	0.209
	4	0.0000	0.759	+D+Lr+H	-0.0007	0.297
+D+Lr+H	5	0.0089	0.816		0.0000	0.297

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5	Support 6
Overall MAXimum	2.907	8.954	-3.724	-3.724	8.954	2.907
Overall MINimum	2.862	8.862	0.065	0.065	8.862	2.862
+D+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+L+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+Lr+H	2.907	8.954	-3.659	-3.659	8.954	2.907
+D+S+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.750Lr+0.750L+H	2.192	6.739	-2.728	-2.728	6.739	2.192
+D+0.750L+0.750S+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.60W+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.70E+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.750Lr+0.750L+0.450W+H	2.192	6.739	-2.728	-2.728	6.739	2.192
+D+0.750L+0.750S+0.450W+H	0.045	0.092	0.065	0.065	0.092	0.045
+D+0.750L+0.750S+0.5250E+H	0.045	0.092	0.065	0.065	0.092	0.045
+0.60D+0.60W+0.60H	0.027	0.055	0.039	0.039	0.055	0.027

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

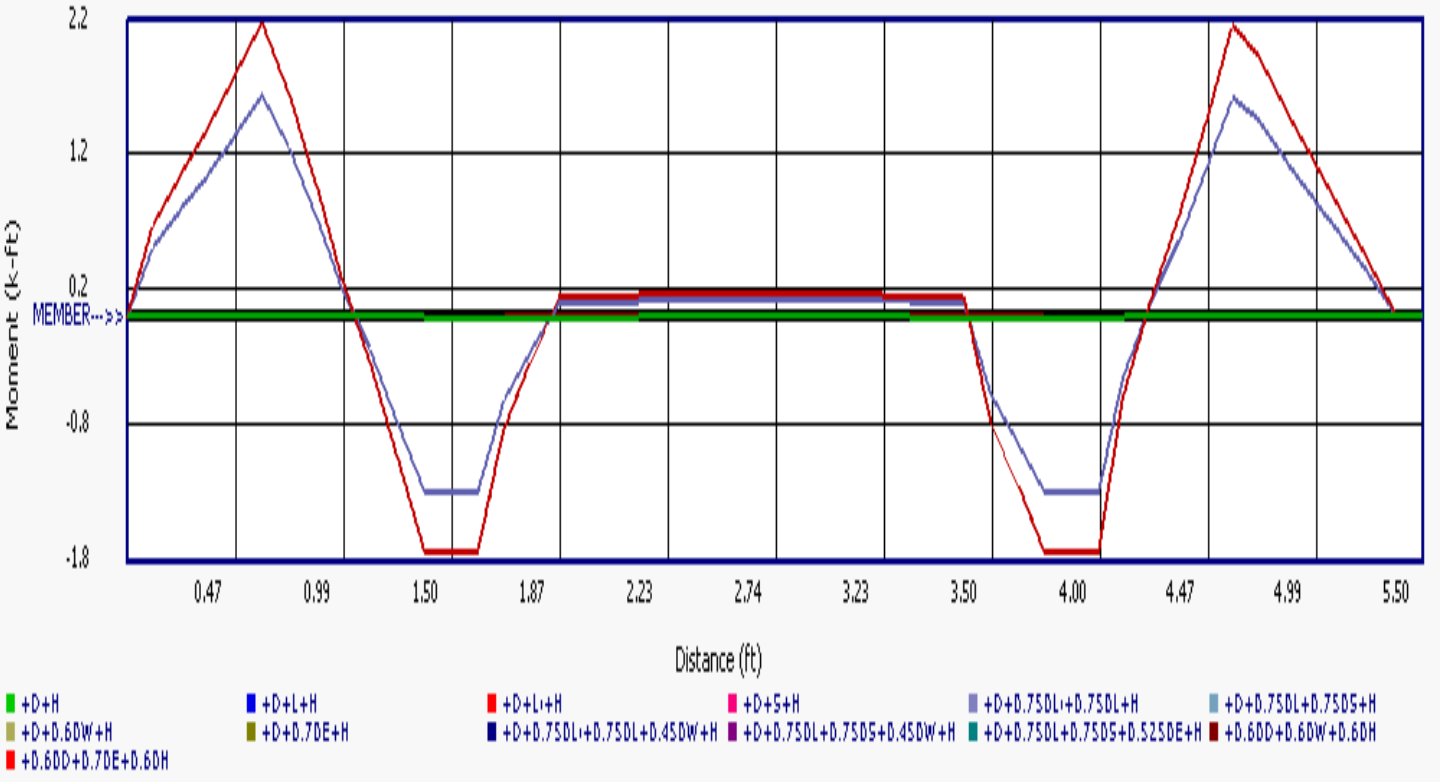
Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5	Support 6
+0.60D+0.70E+0.60H	0.027	0.055	0.039	0.039	0.055	0.027
D Only	0.045	0.092	0.065	0.065	0.092	0.045
Lr Only	2.862	8.862	-3.724	-3.724	8.862	2.862
L Only						
S Only						
W Only						
E Only						
H Only						



Wood Beam

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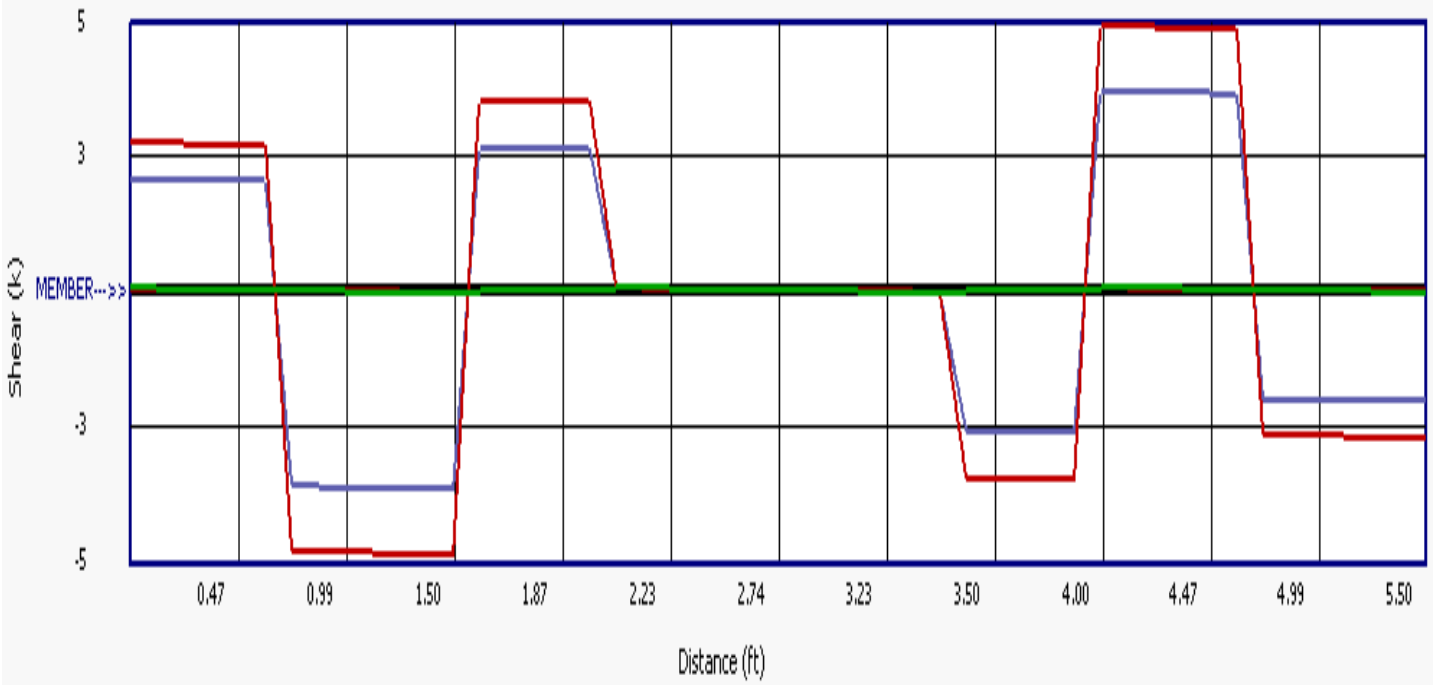
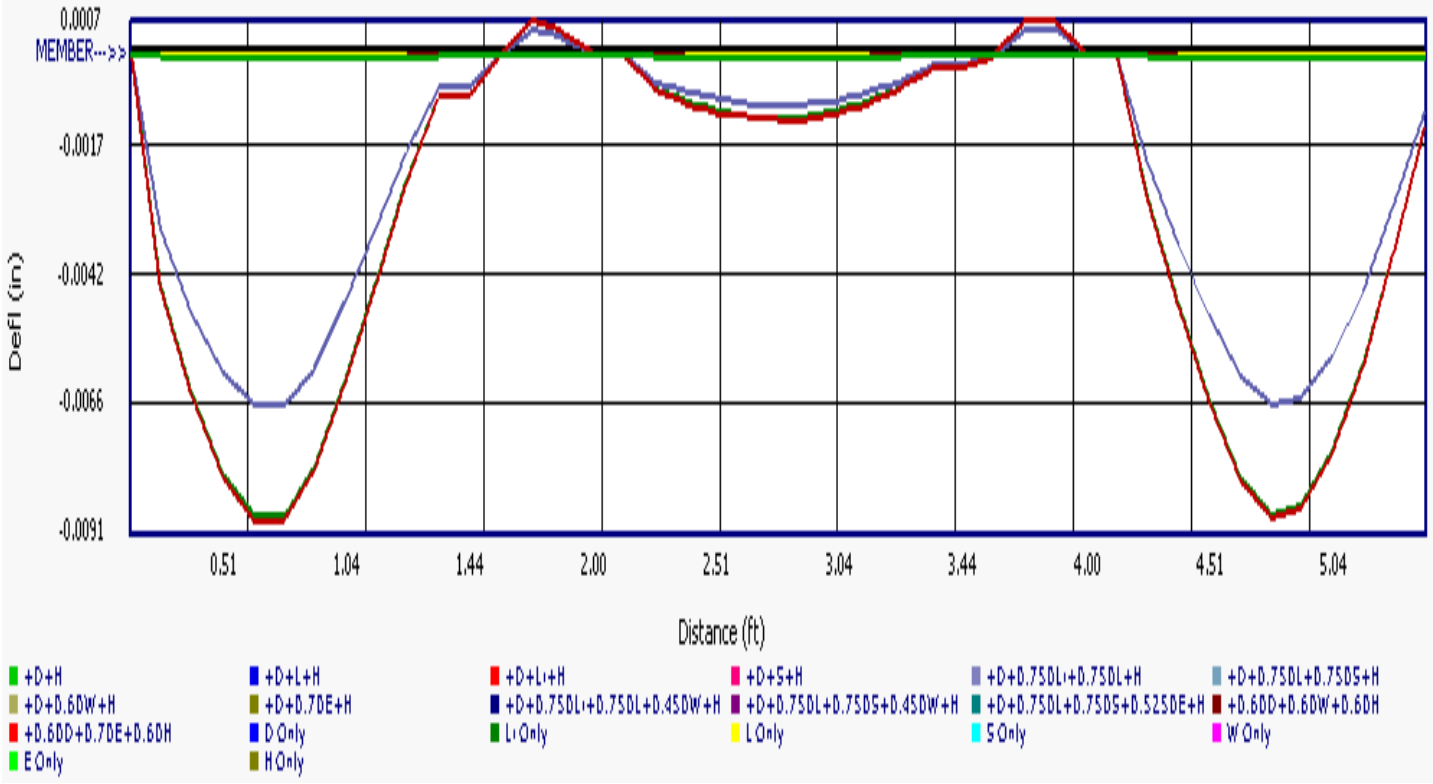
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666
Licensee : DCI ENGINEERS

Description : WOOD DECKING





Title Block Line 1
You can change this area
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and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:50AM

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER

TIRE LOAD CANNOT EXTEND INTO CANTILVER, THEREFORE WE ARE USING 90PSF

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : ASCE 7-10

Wood Species : Douglas Fir - Larch
Wood Grade : No.2

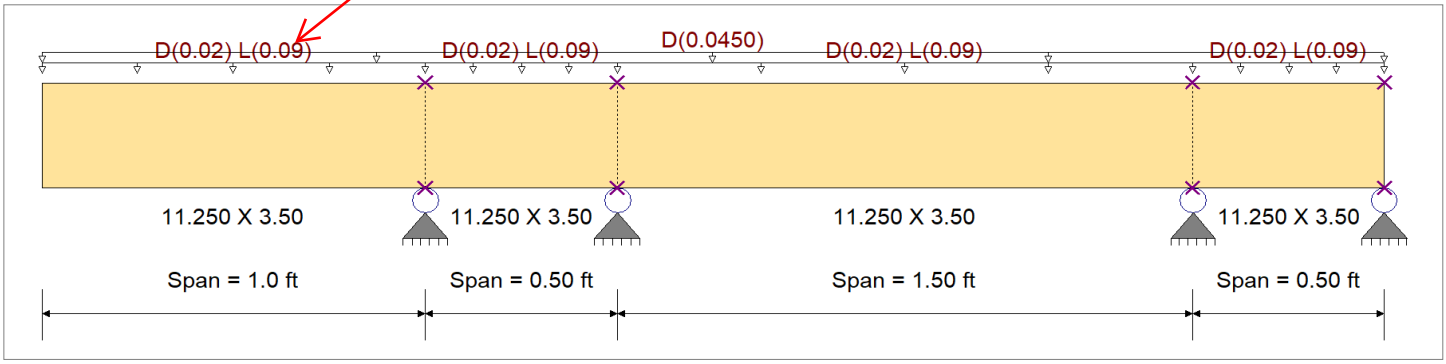
Beam Bracing : Completely Unbraced

Fb +	900.0 psi
Fb -	900.0 psi
Fc - Prll	1,350.0 psi
Fc - Perp	625.0 psi
Fv	180.0 psi
Ft	575.0 psi

E : Modulus of Elasticity

Ebend- xx	1,600.0 ksi
Eminbend - xx	580.0 ksi
Density	31.20 pcf

Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Loads on all spans...
Uniform Load on ALL spans : D = 0.0450 k/ft

Load for Span Number 1
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Load for Span Number 2
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Load for Span Number 3
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Load for Span Number 4
Uniform Load : D = 0.020, L = 0.090 , Tributary Width = 1.0 ft

Title Block Line 1
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and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:50AM

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 — **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.038 : 1	Maximum Shear Stress Ratio	=	0.027 : 1
Section used for this span		11.250 X 3.50	Section used for this span		11.250 X 3.50
fb : Actual	=	42.72 psi	fv : Actual	=	4.90 psi
FB : Allowable	=	1,138.50 psi	Fv : Allowable	=	180.00 psi
Load Combination		+D+L+H	Load Combination		+D+L+H
Location of maximum on span	=	1.000 ft	Location of maximum on span	=	1.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.000 in	Ratio =	0 <360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.001 in	Ratio =	25842 >=180
Max Upward Total Deflection	0.000 in	Ratio =	0 <180

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
+D+H													0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.019	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1024.65	0.06	2.20	162.00
Length = 0.50 ft	2	0.019	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1024.65	0.06	2.20	162.00
Length = 1.50 ft	3	0.007	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1024.65	0.04	2.20	162.00
Length = 0.50 ft	4	0.007	0.014	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1024.65	0.02	2.20	162.00
+D+L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.038	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.08	42.72	1138.50	0.13	4.90	180.00
Length = 0.50 ft	2	0.038	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.08	42.72	1138.50	0.13	4.90	180.00
Length = 1.50 ft	3	0.014	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.03	15.92	1138.50	0.09	4.90	180.00
Length = 0.50 ft	4	0.014	0.027	1.00	1.100	1.00	1.15	1.00	1.00	1.00	0.03	15.92	1138.50	0.05	4.90	180.00
+D+Lr+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.013	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1423.13	0.06	2.20	225.00
Length = 0.50 ft	2	0.013	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1423.13	0.06	2.20	225.00
Length = 1.50 ft	3	0.005	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1423.13	0.04	2.20	225.00
Length = 0.50 ft	4	0.005	0.010	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1423.13	0.02	2.20	225.00
+D+S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.015	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1309.28	0.06	2.20	207.00
Length = 0.50 ft	2	0.015	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1309.28	0.06	2.20	207.00
Length = 1.50 ft	3	0.005	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1309.28	0.04	2.20	207.00
Length = 0.50 ft	4	0.005	0.011	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1309.28	0.02	2.20	207.00
+D+0.750Lr+0.750L+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.026	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1423.13	0.11	4.22	225.00
Length = 0.50 ft	2	0.026	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1423.13	0.11	4.22	225.00
Length = 1.50 ft	3	0.010	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1423.13	0.08	4.22	225.00
Length = 0.50 ft	4	0.010	0.019	1.25	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1423.13	0.05	4.22	225.00
+D+0.750L+0.750S+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.028	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1309.28	0.11	4.22	207.00
Length = 0.50 ft	2	0.028	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1309.28	0.11	4.22	207.00
Length = 1.50 ft	3	0.010	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1309.28	0.08	4.22	207.00
Length = 0.50 ft	4	0.010	0.020	1.15	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1309.28	0.05	4.22	207.00
+D+0.60W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 0.50 ft	2	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 1.50 ft	3	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.04	2.20	288.00
Length = 0.50 ft	4	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.02	2.20	288.00
+D+0.70E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 0.50 ft	2	0.011	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.04	19.21	1821.60	0.06	2.20	288.00
Length = 1.50 ft	3	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.04	2.20	288.00
Length = 0.50 ft	4	0.004	0.008	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	7.16	1821.60	0.02	2.20	288.00
+D+0.750Lr+0.750L+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00

Title Block Line 1
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Title Block Line 6

Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 5 MAR 2018, 9:50AM

Wood Beam

File = J:\1X9KPI~9\2SLM8Y~2\1IZIJA~H\4J3R7R~2\BFK1SN~G\WEH8MS~1.EC6
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER

Load Combination / Segment Length	Span #	Max Stress Ratios M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	fb	F'b	Shear Values V	fv	F'v
Length = 0.50 ft	2	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 1.50 ft	3	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.08	4.22	288.00
Length = 0.50 ft	4	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.05	4.22	288.00
+D+0.750L+0.750S+0.450W+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 0.50 ft	2	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 1.50 ft	3	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.08	4.22	288.00
Length = 0.50 ft	4	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.05	4.22	288.00
+D+0.750L+0.750S+0.5250E+H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 0.50 ft	2	0.020	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.07	36.84	1821.60	0.11	4.22	288.00
Length = 1.50 ft	3	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.08	4.22	288.00
Length = 0.50 ft	4	0.008	0.015	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.03	13.73	1821.60	0.05	4.22	288.00
+0.60D+0.60W+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 0.50 ft	2	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 1.50 ft	3	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.02	1.32	288.00
Length = 0.50 ft	4	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.01	1.32	288.00
+0.60D+0.70E+0.60H					1.100	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 1.0 ft	1	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 0.50 ft	2	0.006	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.02	11.52	1821.60	0.03	1.32	288.00
Length = 1.50 ft	3	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.02	1.32	288.00
Length = 0.50 ft	4	0.002	0.005	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.01	4.30	1821.60	0.01	1.32	288.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L+H	1	0.0009	0.000		0.0000	0.000
	2	0.0000	0.000	+D+L+H	-0.0000	0.222
+D+L+H	3	0.0001	0.722		0.0000	0.222
	4	0.0000	0.722	+D+L+H	-0.0000	0.203

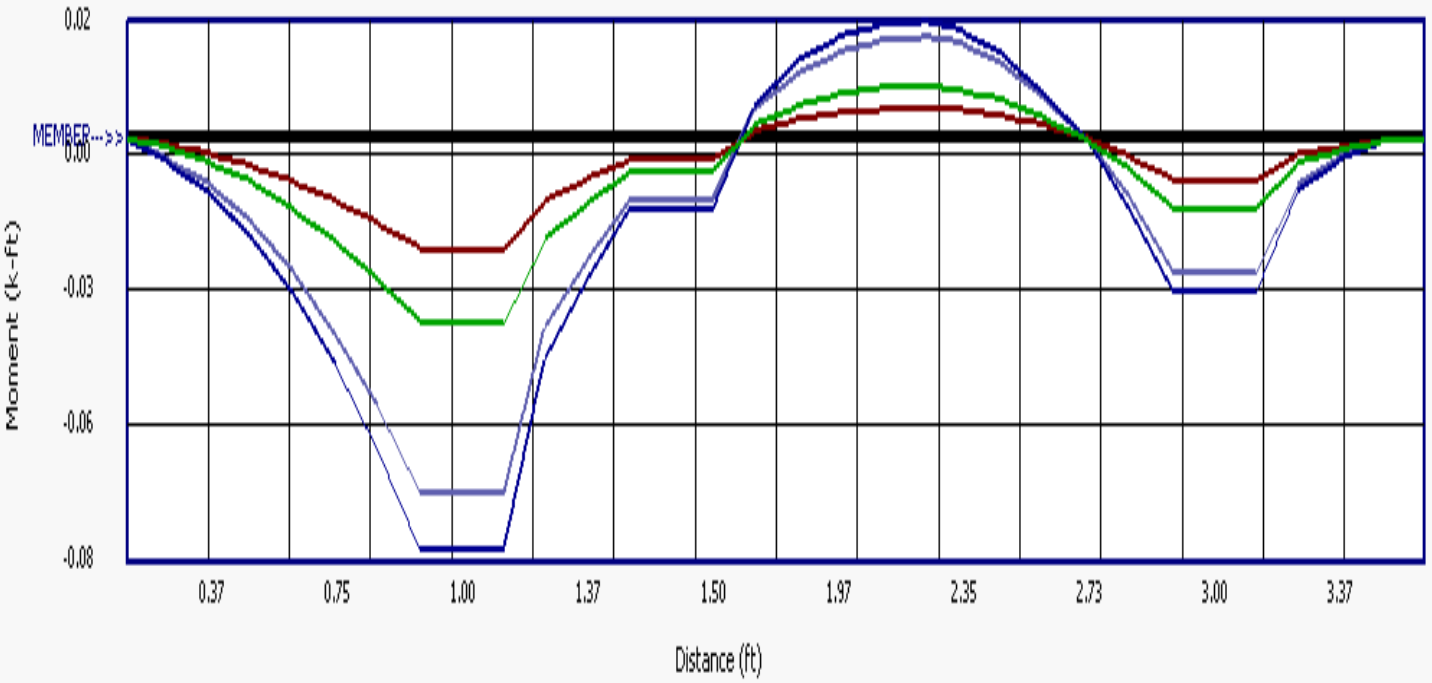
Vertical Reactions

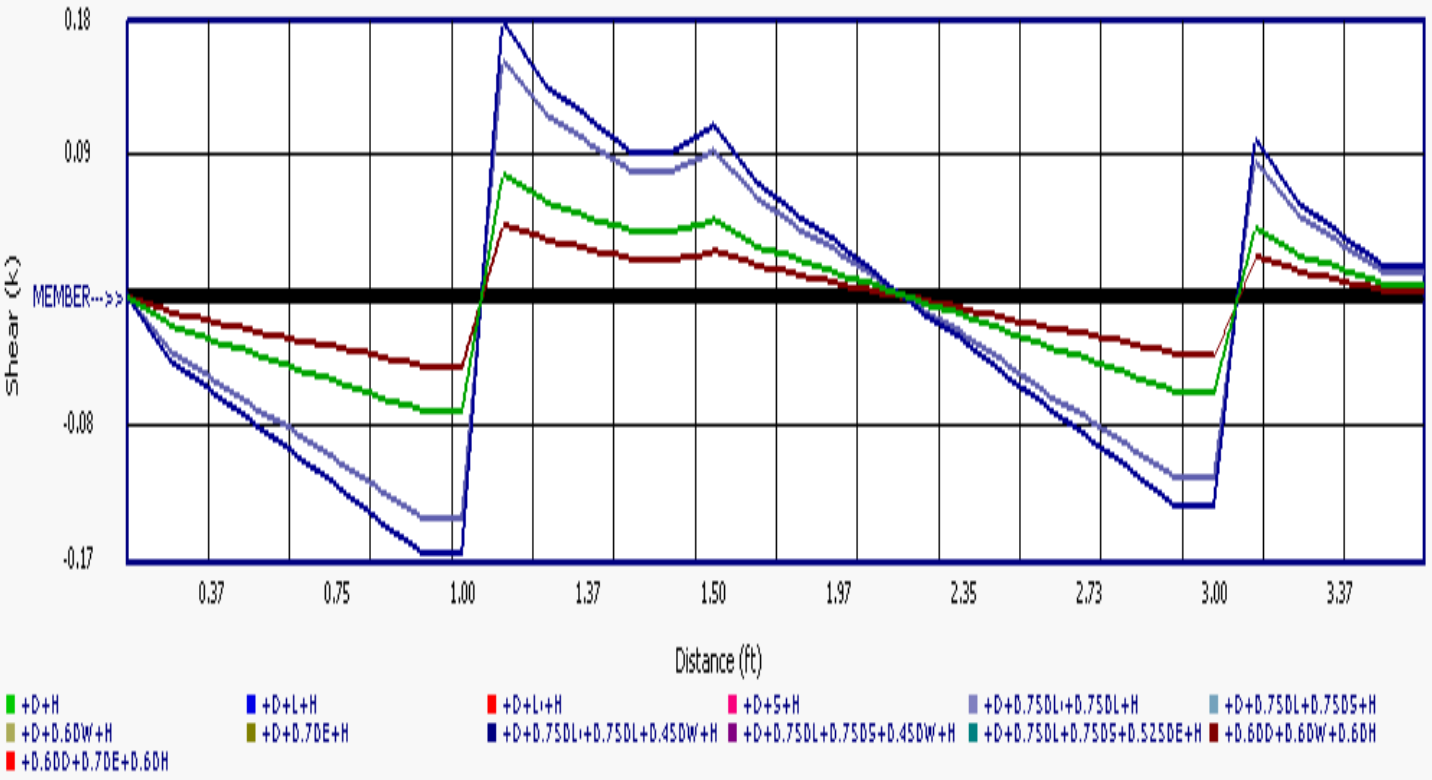
Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3	Support 4	Support 5
Overall MAXimum		0.340	0.017	0.235	-0.020
Overall MINimum		0.187	0.010	0.130	-0.009
+D+H		0.153	0.008	0.106	-0.009
+D+L+H		0.340	0.017	0.235	-0.020
+D+Lr+H		0.153	0.008	0.106	-0.009
+D+S+H		0.153	0.008	0.106	-0.009
+D+0.750Lr+0.750L+H		0.293	0.015	0.203	-0.017
+D+0.750L+0.750S+H		0.293	0.015	0.203	-0.017
+D+0.60W+H		0.153	0.008	0.106	-0.009
+D+0.70E+H		0.153	0.008	0.106	-0.009
+D+0.750Lr+0.750L+0.450W+H		0.293	0.015	0.203	-0.017
+D+0.750L+0.750S+0.450W+H		0.293	0.015	0.203	-0.017
+D+0.750L+0.750S+0.5250E+H		0.293	0.015	0.203	-0.017
+0.60D+0.60W+0.60H		0.092	0.005	0.064	-0.005
+0.60D+0.70E+0.60H		0.092	0.005	0.064	-0.005
D Only		0.153	0.008	0.106	-0.009
Lr Only					
L Only		0.187	0.010	0.130	-0.011
S Only					
W Only					
E Only					
H Only					

Wood Beam

Description : WOOD DECKING - CANTILEVER





Wood Beam

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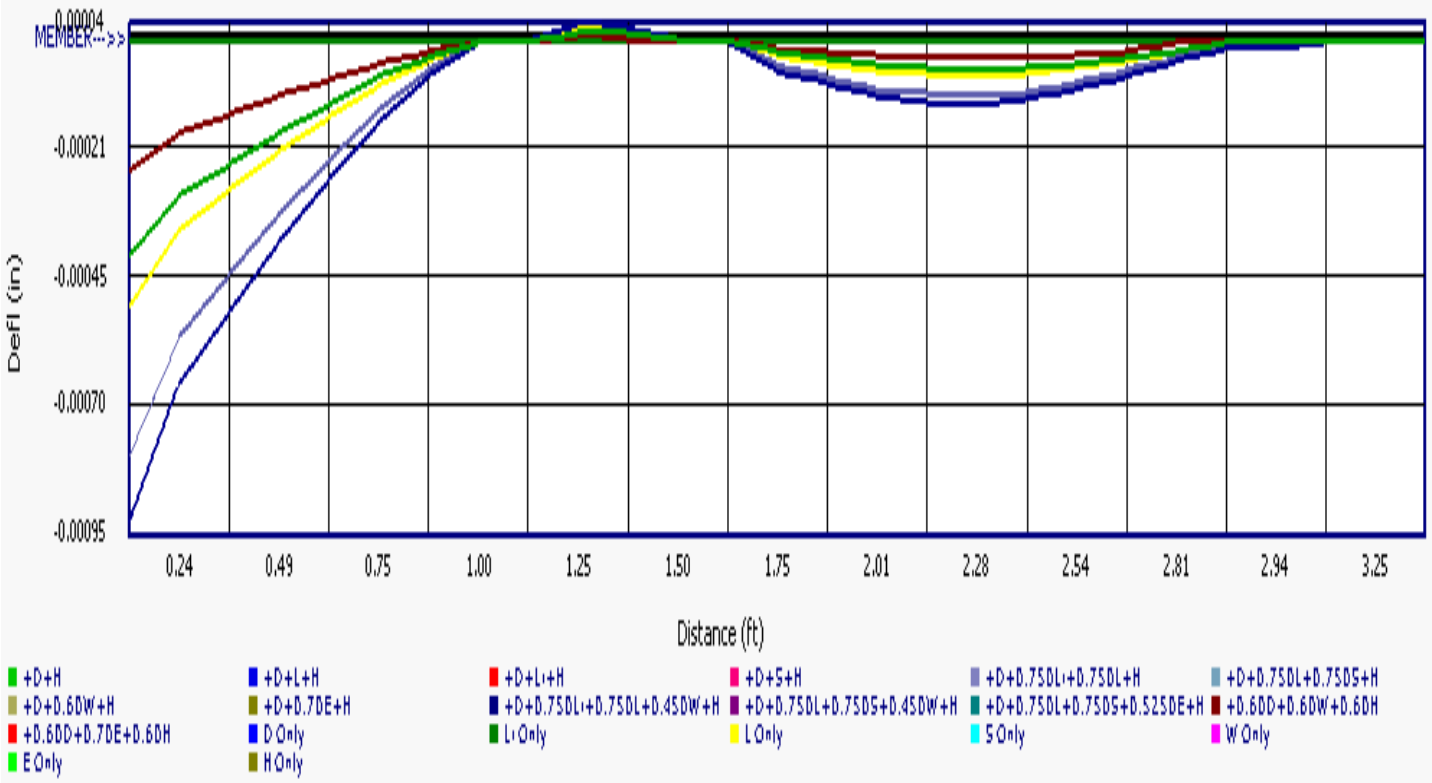
ENERCALC, INC. 1983-2017, Build:10.17.12.10, Ver:10.17.12.10

Lic. # : KW-06001666 **Licensee : DCI ENGINEERS**

Description : WOOD DECKING - CANTILEVER



Summary of Values per Beam Span

Beam Span Moments & Shears at Incremental Locations

Load Type/ Combination	Span Location (ft)	Span ID	Shear (k)	Moment (ft-k)
+D+H	0.00	Span 1	0.000	0.000
+D+H	0.11	Span 1	-0.008	-0.000
+D+H	0.23	Span 1	-0.017	-0.002
+D+H	0.34	Span 1	-0.025	-0.004
+D+H	0.46	Span 1	-0.034	-0.008
+D+H	0.57	Span 1	-0.042	-0.012
+D+H	0.68	Span 1	-0.050	-0.017
+D+H	0.80	Span 1	-0.059	-0.023
+D+H	0.91	Span 1	-0.067	-0.031
+D+H	1.01	Span 2	0.079	-0.036
+D+H	1.06	Span 2	0.075	-0.032
+D+H	1.12	Span 2	0.070	-0.028
+D+H	1.18	Span 2	0.066	-0.024
+D+H	1.23	Span 2	0.062	-0.020
+D+H	1.29	Span 2	0.058	-0.017
+D+H	1.35	Span 2	0.054	-0.014
+D+H	1.41	Span 2	0.049	-0.011
+D+H	1.46	Span 2	0.045	-0.008
+D+H	1.54	Span 3	0.047	-0.004
+D+H	1.71	Span 3	0.035	0.003

ADDITIONAL CALCS

DCI ENGINEERS	Project:	12x165 TB	Page:	
	Client:	TrueNorth Steel	Design By:	BJS
	Job #:	18161-0006	Review By:	MS
	Description:	S/N 165TB12H10-PFS0198	Date:	07/18/18

Padeye Design

Padeye Miscellaneous Input

Padeye Plate Grade	A709 Grade 50			AASHTO Table 6.4.1-1
Padeye Plate Thickness t_p (in)	1.50 in			
Padeye Plate Length L_p (in)	7.00 in			
Padeye Plate Height H_p (in)	6.50 in			
Padeye Hole Diameter d_{hole} (in)	2.25 in			
Padeye Horizontal Edge Distance a (in)	2.375 in	**OK**		
Padeye Vertical Edge Distance e (in)	2.250 in	**OK**		
Padeye Demand P (k)	60.00 k			Vertical Service Level Load
Padeye Demand P Load Angle θ (°)	45.00 °		From Horizontal, 90° Is Vertical Load, Acts Through Centerline Hole	

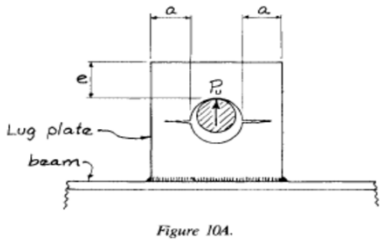


Figure 10A.

Padeye Tension Failure Calculations

Padeye Ultimate Stress F_u (ksi)	65 ksi			AASHTO 6.4.1
Tension Failure Safety Factor $FS_{Tension}$	5.00			Ricker Page 157
Tension Failure P_n (k)	92.63 k			Ricker Page 157

Padeye Snug Fit Calculations

Padeye Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
Padeye Allowable Stress F_b (ksi)	33 ksi			
Snug Fit Crushing Failure P_n (k)	151.88 k			Ricker Page 152
Less Than Snug Fit Tearout P_n (k)	186.00 k			Ricker Page 152

Padeye Shear Failure Calculations

Padeye Yield Stress F_y (ksi)	50 ksi			AASHTO 6.4.1
Shear Failure Safety Factor FS_{Shear}	1.50			AISC 360-05 G2.1.a
Shear Failure V_n (k)	135.00 k			AISC 360-05 G2.1

Padeye Dishing Calculations

Minimum Padeye Plate Thickness t_{pmin} (in)	0.56 in			Ricker Page 157, AISC 360-05
Padeye Plate Thickness t_p (in)	1.50 in	**OK**		

Padeye Weld Calculations

Treat Weld Group As Line

Deck To Beam Min Fillet Weld Size (in)	5/16 in			AASHTO 6.13.3.4
Deck To Beam Max Fillet Weld Size (in)	23/16 in			AASHTO 6.13.3.4
Padeye Fillet Weld Size (in)	3/8 in	**OK**		
Ω	1.88			AISC 360-05 Table J2.5
Padeye Fillet Weld Shear Cap R_n (k/in)	11.85 k/in		Fillet Weld Each Side Of Padeye	AASHTO 6.13.3.2.4b-1
Padeye Fillet Weld Group S_w (in²/in)	8.17 in³/in			
Padeye Fillet Weld Group M_u (in*k)	132.58 in*k			
Padeye Fillet Weld Group P_{uV} (k)	42.43 k			
Padeye Fillet Weld Group P_{uH} (k)	42.43 k			
Padeye Fillet Weld Group f_{1M} (k/in)	16.23 k/in			
Padeye Fillet Weld Group f_{2V} (k/in)	6.06 k/in			
Padeye Fillet Weld Group f_{3H} (k/in)	6.06 k/in			
Padeye Fillet Weld Group f_{peak} (k/in)	23.10 k/in			
Padeye Fillet Weld Group f_{avg} (k/in)	17.47 k/in			
Padeye Fillet Weld Group $R_{nWeldReq}$ (k/in)	11.55 k/in	**OK**	Minimum Weld Length Shall Be 1.5 in	AASHTO 6.13.3.5
$t_{MinPadeye}$ Match Weld Rupture (in)	0.571 in	**OK**		AISC 13th Ed. Page 9-5

Padeye Design Summary

Padeye Demand P (k)	60.00 k	
Padeye Controlling Capacity P_n (k)	92.63 k	**OK**

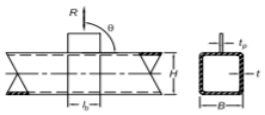
HSS Plastificaiton Check

Width of HSS member, B	8.00 in	
Thickness of HSS Member, t	0.47 in	
Width of Plate, Bp	7.00 in	
Thickness of Plate, tp	1.50 in	
Qf	1	TENSION

Longitudinal Plate:

HSS Wall Plastification, Rn/Ω=	67.20 k	**OK**

Connection Type	Connection Available Strength
Longitudinal Plate T-, Y- and Cross-Connections, Under Plate Axial Load	Limit State: HSS Plastification



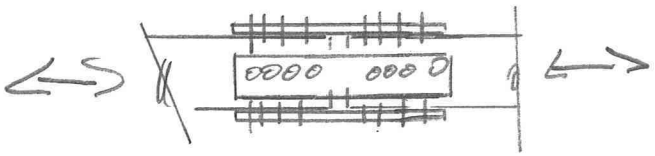
$$R_n \sin\theta = \frac{F_y t^2}{1-\frac{t_p}{B}}\left(\frac{2l_b}{B}+4\sqrt{1-\frac{t_p}{B}Q_f}\right) \quad \text{(K1-12)}$$

$\phi = 1.00$ (LRFD) $\quad \Omega = 1.50$ (ASD)

EDCI ENGINEERS	Project No.	Sheet No.
Project 165x10 TB, Fargo		Date
Subject Calcs		By

Chord Splice Design:

Loads:



STR I

C = 526 k (Top chord)

T = 190 k (Bot chord)

Serv II

C = 400k

T = 145k

↳ 6.13.2.1.1 - Slip critical joints shall prevent slip under Serv II

Bolt Spacing: Ref 6.13.2.6 → Try 7/8" ϕ Bolt A325

Min Spacing = 3D = 3x 7/8 = 2.63 in

Min Clear = 2D = 1.75 in

Min End = 1.125"

~~Min Clear End~~ =

Min Edge = 1.125"

Spacing = 3*D = 2.63in

DCI ENGINEERS	Project No.	Sheet No.
Project 165 x 10 TB		Date
Subject Calcs		By

Shear Resistance of Bolts:

* Threads excluded

$$\phi R_n = \phi_s \times 0.48 \times A_b \times F_{ub} \times N$$

↳ $\phi_s = 0.8$ (0.6)

$A_b = 0.442\ in^2$

$F_{ub} = 125\ ksi$

$N = 1$ shear plane

$$= 0.8 \times 0.48 \times 0.442 \times 125 \times 1 = 21.2\ k/bolt$$

$$\#\ of\ Bolts = \frac{526\ k}{21.2\ k} = 24\ Bolts$$

VERIFY 100% BENDING CAPACITY:
HSS BENDING CAPACITY = 160 K-FT
RESULTS IN T=C = 192K PER SIDE.
PER SPEC 1.00*192K = 192K
10*21.2 = 212K > 192K OK

Bearing Resistance:

3/4" shear PL

$\phi R_n = \phi_b \cdot 2.4 \times d \times t \times F_u$ clear Dist > 2d

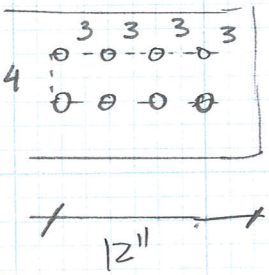
$= 0.8 \times 2.4 \times 0.75 \times \frac{3}{8} \times 70\ ksi$ (0.75 (OK BY INSPECTION))

$= 37.8\ k \Rightarrow 24\ Bolts\ ok$

DCI ENGINEERS

Project	165x10 TB	Project No.	Sheet No.
Subject		Date	
		By	

Block Shear:



$A_t = \frac{1}{2} \times 12" = 6 in^2$

(Neglegable shear)

=

$\phi R_r = \phi \times F_u A_t = 0.8 \times 70 \times 6 = 336 k$

Four sides => $336k \times 4 = 1344 k$ ✓ ok

Slip Resistance:

$\phi R_n = \phi K_n \times K_s \times N_s \times P_t$

$K_n = 1$

$K_s = 0.5$ Class B

$N_s = 1$

$P_t = 39 k$

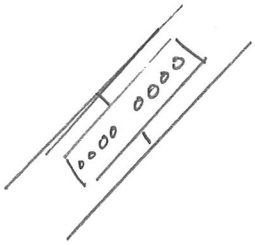
$\phi R_n = 1.0 \times 1 \times 0.5 \times 1 \times 39 = 19.5 k/bolt$

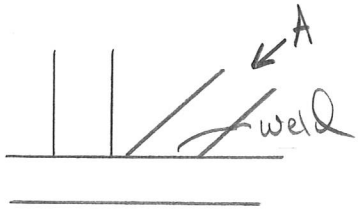
$\frac{400}{19.5} = 20$ bolts ✓ ok

DCI ENGINEERS	Project No. 0006	Sheet No.
Project 165x10 TB Fargo		Date
Subject Calcs		By

Diagonal Design

Axial Load from RAM = 127 k factored





* see RAM steel code check. HSS 6x6x1/4 ok in axial compression
* 7/8" ϕ Bolts

↳ Shear Resistance of Bolts:

$$\phi R_n = \phi_s \times 0.48 \times A_b \times F_{ub} \times N$$

$\phi_s = 0.8$ (0.6 OK BY INSP)
$A_b = 0.442$
$F_{ub} = 125$ ksi A325
$N = 1$

3/4"HOLLO-BOLT = 8992#
127/8.992=14
16 BOLTS PROVIDED

VERIFY 75% BENDING CAPACITY:
HSS BENDING CAPACITY = 50K-FT
RESULTS IN T=C = 100K PER SIDE.
PER SPEC 0.75*100K = 75K
4*21.2 = 84.8K > 75K OK

$= 0.8 \times 0.48 \times 0.442 \times 125 \times 1 = 21.2$ k/bolt

$$\#\text{ of bolts Req} = \frac{127\text{k}}{21.2\text{k/bolt}} = 6 \text{ bolts ok}$$

(16 bolts provided)

↳ Weld Resistance

- weld All around w/ 5/16 Fillet

$$\phi R_n = 0.6 F_{Exx} \times \sqrt{2}/2 \times D/16 \times \ell$$

$= 0.6 \times 70\text{ksi} \times \sqrt{2}/2 \times 5/16 \times (6 \times 4) = 223$ k ok

STEEL LAMINATED ELASTOMERIC BEARINGS by LRFD
An Excel spreadsheet for the design of rectangular expansion bearing pads (or fixed bearings with laminated pads)

Spreadsheet meets AASHTO LRFD Specifications
The spreadsheet is applicable only for typical rectangular bearings with up to one translation and up to one rotation about weak axis.

Adjust shaded items 1k through 1u to design the bearing. See Documentation for item by item documentation.

Today's date: 7-Mar-18

Item	Description	Input/Computed	Units	Allowable	Min/Max	Check	Comment, [AASHTO LRFD Article]
1	**Design data**						**Enter values for shaded cells. Resolve any NGs.**
1a	Project name	Fargo Lift Bridge					
1b	Project number	18161-0006					
1c	Designer	BJS					
1d	P_D	26.00	kips				Use DC1+DC2+DW.
1e	$P_{Live,\ maximum}$	40.00	kips				Use LL without IM. [14.4.1]
1f	P_{TL}, Service I vertical	66.00	kips	450.00	max	OK	Check with supervising section leader if NG.
1g	P_{sd}	26.00	kips				Minimum vertical force due to permanent loads.
1h	V_l, Service I lateral	5.00	kips				
1i	Theta required	0.00500	radians	0.00500	min	OK	Minimum is for construction inaccuracies. [C14.4.2]
1j	Delta required	0.950	inches	2.500	max	OK	Check with supervising Section Leader if NG.
1k	Elastomer hardness	50	durometer	50 or 60		OK	50 durometer is preferred; 60 is an option. ***Correct if NG!***
1l	Exterior layer thickness	0.250	inches	0.438	max	OK	0.250 inches is preferred. Exterior layer <= 0.7h_{ri}. [14.7.6.1]
1m	Exterior layer credit	0					Credit will apply for typical Iowa bearings. [14.7.6.3.5d]
1n	Interior layer, h_{ri}	0.625	inches				0.500 inches is preferred. Usual range is 0.375 to 0.75 inches.
1o	Number of interior layers	5					n is the total of number of interior layers plus exterior layer credit.
1p	Elastomer thickness, h_{rt}	3.625	inches				
1q	Steel grade	50	ksi				Usually ASTM A570 Grade 36 is sufficient.
1r	Steel laminate, h_s	0.1250	inches				0.125 inches is preferred.
1s	Coefficient of friction	0.300					Coefficient is for clean concrete. [C14.8.3.1]
1t	Bearing length, L	14.000	inches				For rotation capacity L typically will be less than W.
1u	Bearing width, W	16.000	inches				
1v	Shape factor, S_i	5.973					[14.7.5.1]
1w	Compressive stress	0.295	ksi				Use S_i and this stress to determine compressive strain.
1x	Compr. Strain: automatic	1.753	per cent				Strain automatically computed. **See Aashto Lrfd Fig. C14.7.5.3.3-1**
1y	Compr. Strain: user entry	4.6	per cent				User value for compr strain. **for "Stress Strain Curves".**
1z	Total thickness	4.375	inches	5.00	max	OK	This dimension establishes elevations. Check if NG.
2	**Design checks**						**Ensure that checks are OK or otherwise approved.**
2a	S_i^2/n (See comment.)	7.14		16	max	OK	Check for excessive shear strain at large rotations [14.7.6.1, C14.7.6.1]. Limits: 16 for square or nearly square pad, 20 for rectangular pad with n ≥ 3, 22 for rectangular pad with n = 2
2b	Compression	0.295	ksi	1.250	max	OK	Increase W and/or L if NG. [14.7.6.3.2]
2c	Compression, shape	0.295	ksi	0.709	max	OK	Adjust W, L, or h_{ri} if NG. [14.7.6.3.2]
2d	Deflection, interior layer	0.0285	inches	0.0563	max	OK	Increase W and/or L and/or durometer if NG. [14.7.6.3.3]
2e	Rotation	0.00500	radians	0.02000	max	OK	Check for Method A assumption. Add curved sole plate if NG.
2f	Stability height for L	4.375	inches	4.667	max	OK	Increase L and/or decrease thickness if NG. [14.7.6.3.6]
2g	Stability height for W	4.375	inches	5.333	max	OK	Increase W and/or decrease thickness if NG. [14.7.6.3.6]
2h	Shear deformation	0.950	inches	1.813	max	OK	Increase h_{rt} if NG. [14.7.6.3.4]
2i	Reinforcement, yield	0.1250	inches	0.0110	min	OK	Increase h_s if NG. [14.7.6.3.7, 14.7.5.3.5]
2j	Reinforcement, fatigue	0.1250	inches	0.0093	min	OK	Increase h_s if NG. [14.7.6.3.7, 14.7.5.3.5, 6.6.1.2.3]
2k	Longitudinal anchorage	7.63	kips	7.80	max	OK	Lower durometer and/or increase h_{rt} if NG. [C14.8.3.1]
2l	Transverse anchorage	5.00	kips	7.80	max	OK	Add steel guide or restrainer if NG. [C14.8.3.1]
3	**Additional information**						**Usually this information will not be needed.**
3a	Shear at required delta	7.63	kips				
3b	Shear at max delta	14.56	kips				
3c	Steel volume	0.0940	cubic feet				
3d	Neoprene volume	0.4731	cubic feet				
3e	Bearing weight	81.54	pounds				Densities are 490 pcf for steel and 75 pcf for neoprene.
3f	Compression strain	4.6	per cent				
3g	Initial LL deflection	0.100	inches				Live load deflections are based on strain for total load.
3h	Initial TL load deflection	0.166	inches				
3i	Long-term LL deflection	0.125	inches	0.125	max	OK	This check is only advisory and is not office policy.
3j	Long-term TL deflection	0.207	inches				

USE 14X16X4.375" DURO 50 ELASTOMERIC BEARING PAD
WITH 6 LAYERS OF STEEL REINF

Loads

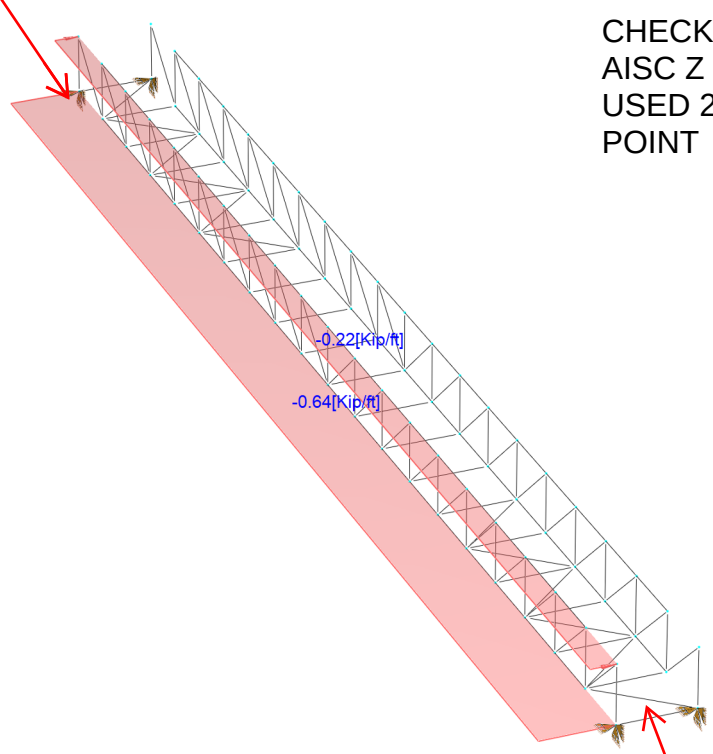
Global distributed - Members
Local distributed - Members

BASE WIND VELOCITY = 100MPH (AASHTO 3.8)
BASE WIND PRESSURE P = 0.05KSF (3.8.1.2.1)

AREA OF PANEL = 15SF
WIND LOAD = 0.05KSF*15SF*1.15 = 0.86K/FT
(APPLIED AS 0.64K/FT BOTTOM AND 0.22K/FT TOP)

REACTION =
086klf*165ft/2 = 71k

CHECK ANCHOR BOLT SHEAR:
AISC Z = 44K PER 1-1/4" BOLT
USED 2 BOLTS AT EACH BEARING POINT



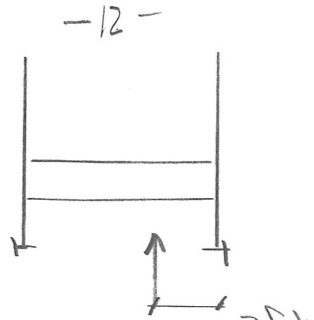
AXIAL LOAD IN
FLOOR BEAM = 92k

DCI ENGINEERS	Project No. 18161-0006	Sheet No.
Project: Fargo Lift Bridge		Date
Subject: wind uplift		By

Vertical Wind

Per AASHTO 3.8.2:

Total uplift $0.02\,ksf \times 12\,ft \times 165\,ft = 39.6\,k$



$OM = 20k \times 9ft = 180\,k\text{-}ft$

$RM = \frac{105k}{2} \times 6ft = 315\,k\text{-}ft$ (DL)

$uplift = (180 - 315)^{k\text{-}ft} \times \frac{1}{12ft} = -11.3$

No Net uplift

Additional overturning from wind Load at top chord:

$22plf \times 165/2 = 1.82k$

$R = 1.82k \times (8.5/11.17) = 1.4k$ up/down

$R_{min} = -11.3k - 1.4k = -9.9k$ ∴ No net uplift

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Railing System Load/Deflection Testing

Test Type:	Horizontal Load to 365 lbs per ASTM 985 per section 7.1.5	Submitted By:	JM	Date	07/31/12
Test Focus (Part #s):	1929				
Railing Type:	Handrail Brackets, Slip-fit Components, 1.66 Schedule 40 pipe				
Railing Specifications:	42" TOR 48" C2C of Brackets				
Test Method:	Pull to Ultimate test load, record deflections.				

Test Specifications per ASTM E985:		**Results:**				
Safety Factor of 2.0	**System Calculations:**	**Load (lbf)**	**Displacement (in.)**			**Test AVG**
			Trial #1	**Trial #2**	**Trial #3**	
Pre Load	**180 (lbf)**	Preload	0.137	0.134	0.103	0.125
Released Test Load	**90 (lbf)**	RTL	0.000	0.000	0.000	0.000
		150	0.027	0.039	0.035	0.034
Ultimate Test Load	**365 (lbf)**	200	0.077	0.088	0.065	0.077
		250	0.123	0.134	0.099	0.119
Deflection Specifications Per ASTM E985		300	0.198	0.203	0.162	0.188
Max Deflection	**(h/24)+(l/96) @ mid = 2.25 in (h/12) @ post = 3.50 in**	ULT	0.340	0.362	0.245	0.316
		RD	0.066	0.076	0.054	0.065
		500	0.736	0.750	0.450	0.645
Residual Deflection (At RTL)	**20% of MD or 0.5 in if less @ mid = 0.45 in @ post = 0.70 in**					

NOTES:

Trial #1 at 0 lbf = 3.787 in

Trial #2 at 0 lbf = 3.881 in

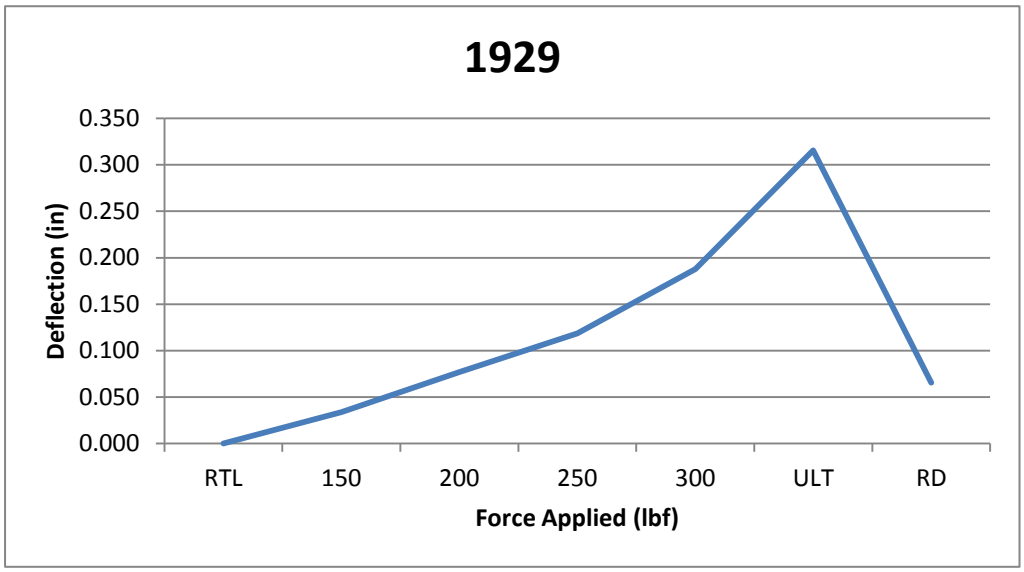
Trial #3 at 0 lbf = 3.952 in

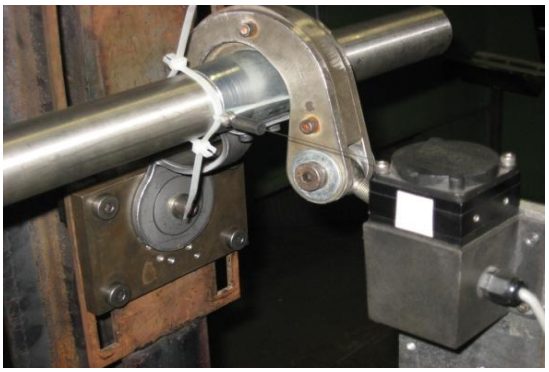
Potentiometer cannot be zeroed, so calculations are done manually

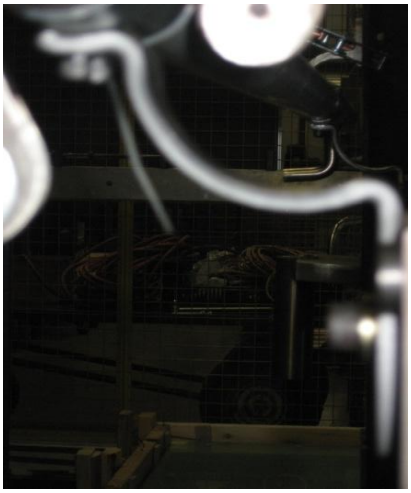
CONCLUSIONS:

1929 bracket passed ASTM deflection standards for horizontal testing.

The 1929 bracket was able to withstand 500lbf horizontal pull; therefore it has a safety factor of at least two.







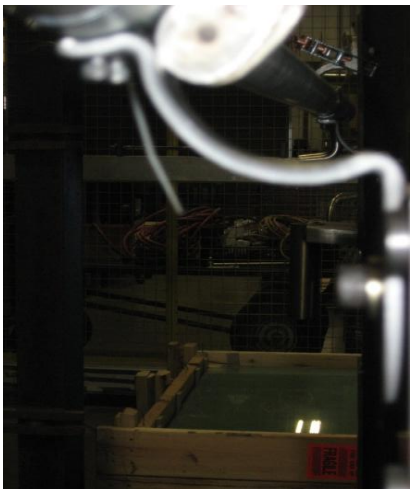
Initial Setup, Trial #1

Preload of 180 lbf
(Actual Deflection of 0.137 in)

Release Test Load of 90 lbf

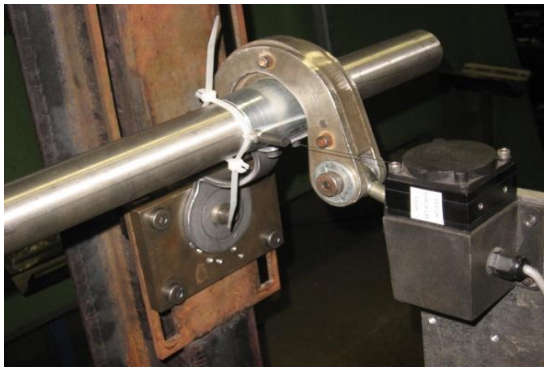
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.34 in)

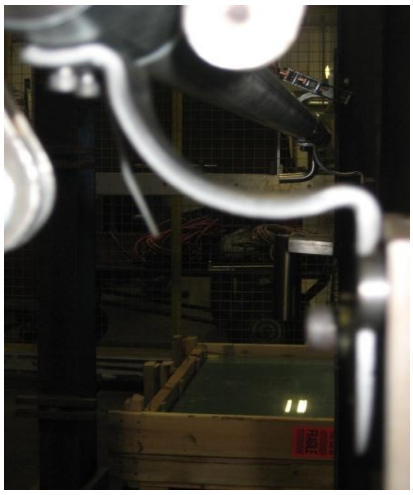
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.066 in)

Achieved 500 lbf





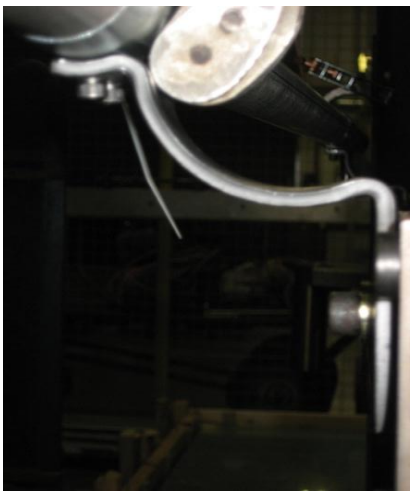
Initial Setup, Trial #2

Preload of 180 lbf
(Actual Deflection of 0.134 in)

Release Test Load of 90 lbf

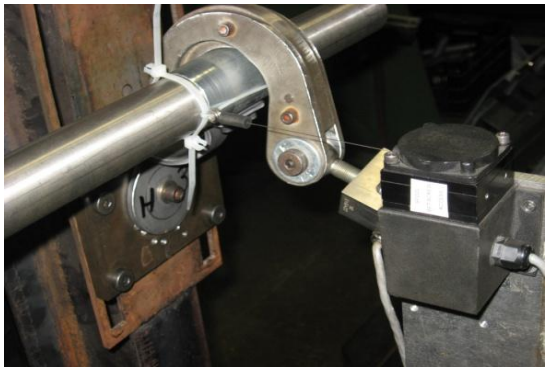
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.362 in)

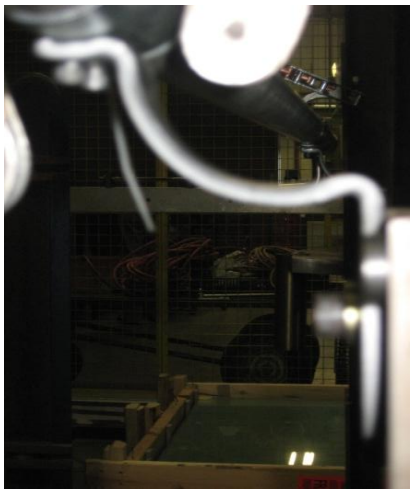
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.076 in)

Achieved 500 lbf





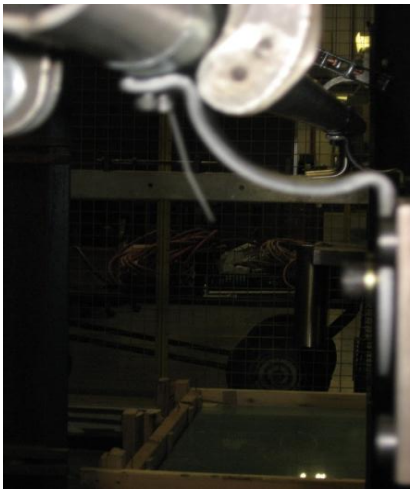
Initial Setup, Trial #3

Preload of 180 lbf
(Actual Deflection of 0.103 in)

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.245 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.054 in)

Achieved 500 lbf

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Railing System Load/Deflection Testing

Test Type:	Vertical Load to 356 lbf per ASTM E985 per section 7.1.5	Submitted By:	JM	Date	07/10/12
Test Focus (Part #s):	1970R				
Railing Type:	Handrail Brackets, Slip-fit Components, 1.66 Schedule 40 pipe				
Railing Specifications:	42" TOR 48" C2C of Brackets				
Test Method:	Pull to Ultimate test load, record deflections.				

Test Specifications per ASTM E935:	
Safety Factor of 2.0	**System Calculations:**
Pre Load	**180 (lbf)**
Released Test Load	**90 (lbf)**
Ultimate Test Load	**365 (lbf)**
Deflection Specifications Per ASTM E985	
Max Deflection	**(1/96) @ mid= 0.5 in**
Residual Deflection (At RTL)	**20% of MD @ mid = N/A**

Results:

Load (lbf)	Displacement (in.)			Test AVG
	1	2	3	
Preload	0.031	0.031	0.038	0.0333
RTL	0	0	0	0.0000
150	0.004	0.004	0.006	0.0047
200	0.014	0.013	0.018	0.0150
250	0.025	0.028	0.037	0.0300
300	0.038	0.041	0.044	0.0410
UTL	0.059	0.063	0.066	0.0627
RD	0.002	0.007	0.008	0.0057

NOTES:

Trial 1 at 0 lbf = 3.781 in

Trial 2 at 0 lbf = 3.787 in

Trial 3 at 0 lbf = 3.759 in

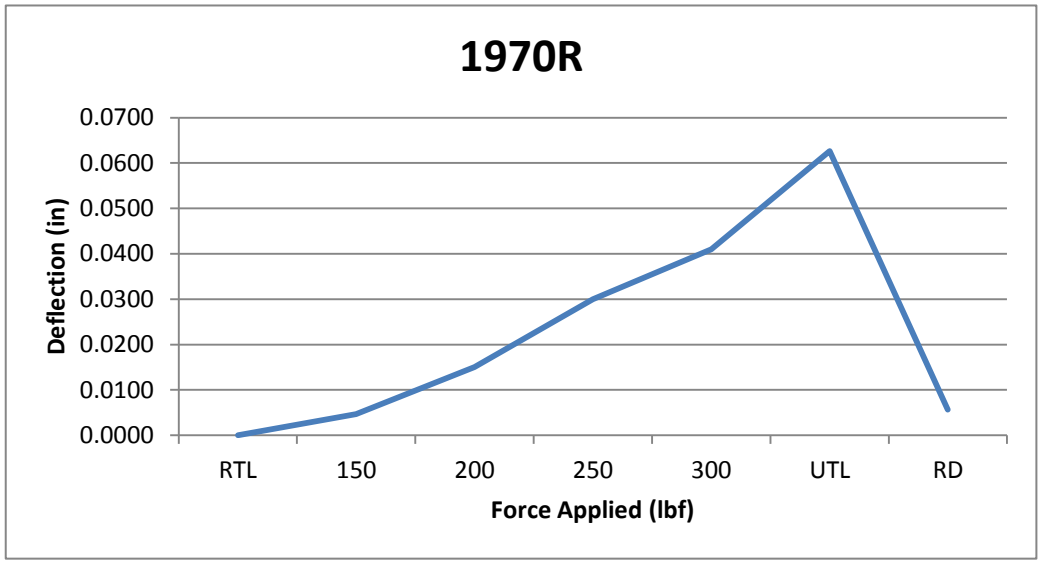
Potentiometer cannot be zeroed, so calculations are done manually

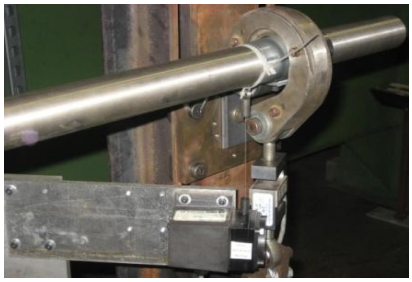
CONCLUSIONS:

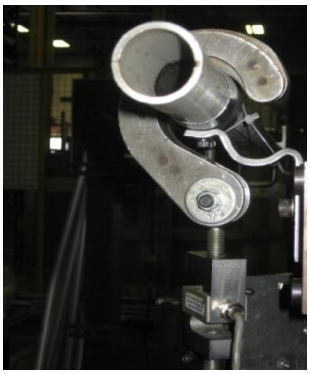
1970R bracket passed ASTM deflection standards for vertical testing.

The 1970R bracket was able to withstand 500lbf vertical pull; therefore it has a safety factor of at least two.

50PLF*8.25FT = 412#
500/412 = 1.2 SAFETY FACTOR







Initial Setup, Trial 1

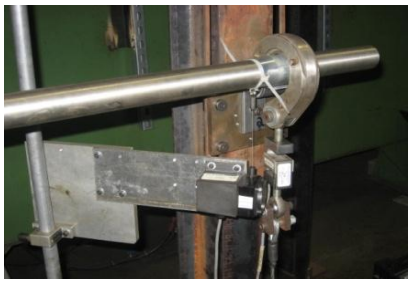
Preload of 180 lbf
(Actual Deflection of 0.031 in)

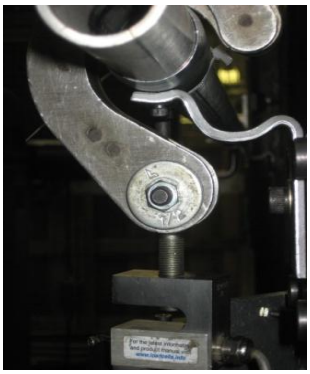
Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.059 in)

Deflection at UTL

Residual Deflection at 90 lbf
(Actual Deflection of 0.002 in)





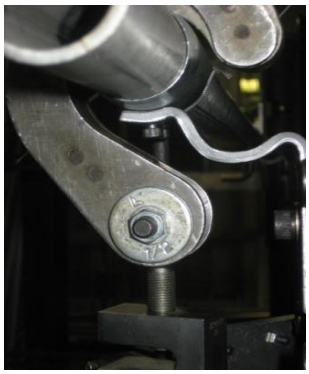
Initial Setup, Trial 2

Preload of 180 lbf
(Actual Deflection of 0.031 in)

Release Test Load of 90 lbf

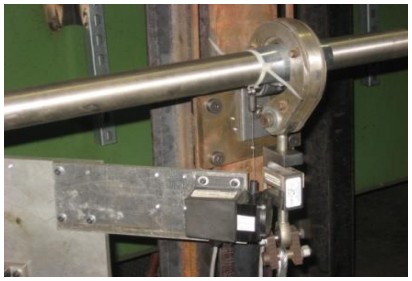
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.063 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.007 in)

500 lbf Achieved



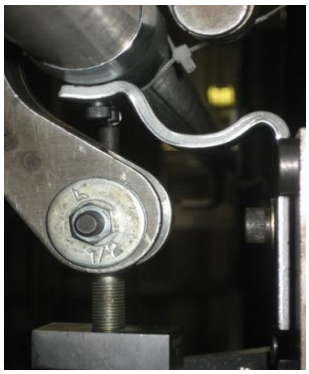
Initial Setup, Trial 3

Preload of 180 lbf
(Actual Deflection of 0.038 in)

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.066 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.008 in)

500 lbf Achieved

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Railing System Load/Deflection Testing

Test Type:	Horizontal Load to 365 lbs per ASTM 985 per section 7.1.5	Submitted By:	JM	Date	07/31/12
Test Focus (Part #s):	1970R				
Railing Type:	Handrail Brackets, Slip-fit Components, 1.66 Schedule 40 pipe				
Railing Specifications:	42" TOR 48" C2C of Brackets				
Test Method:	Pull to Ultimate test load, record deflections.				

Test Specifications per ASTM E985:		**Results:**				
Safety Factor of 2.0	**System Calculations:**	**Load (lbf)**	**Displacement (in.)**			**Test AVG**
			Trial #1	**Trial #2**	**Trial #3**	
Pre Load	**180 (lbf)**	Preload	0.097	0.088	0.075	0.087
Released Test Load	**90 (lbf)**	RTL	0.000	0.000	0.000	0.000
		150	0.034	0.028	0.025	0.029
Ultimate Test Load	**365 (lbf)**	200	0.077	0.070	0.059	0.069
		250	0.111	0.112	0.096	0.106
Deflection Specifications Per ASTM E985		300	0.163	0.154	0.143	0.153
Max Deflection	**(h/24)+(l/96) @ mid = 2.25 in (h/12) @ post = 3.50 in**	ULT	0.258	0.263	0.252	0.258
		RD	0.015	0.021	0.011	0.016
		500	0.464	0.469	0.490	0.474
Residual Deflection (At RTL)	**20% of MD or 0.5 in if less @ mid = 0.45 in @ post = 0.70 in**					

NOTES:

Trial #1 at 0 lbf = 4.519 in

Trial #2 at 0 lbf = 4.532 in

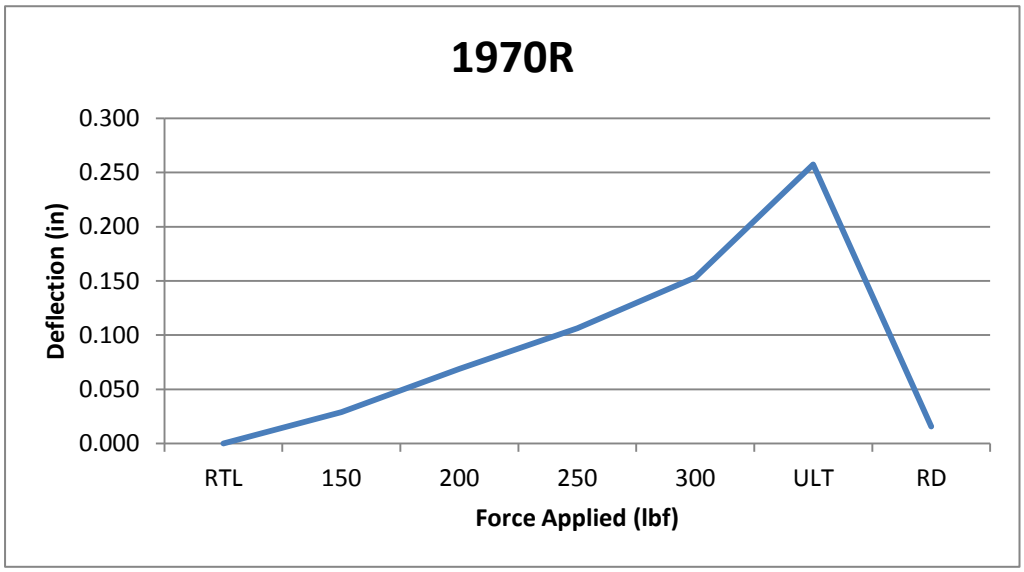
Trial #3 at 0 lbf = 4.515 in

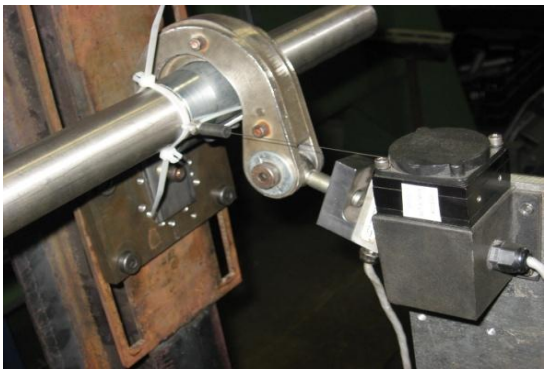
Potentiometer cannot be zeroed, so calculations are done manually

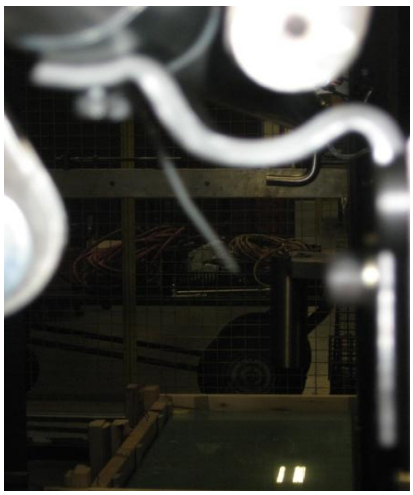
CONCLUSIONS:

1970R bracket passed ASTM deflection standards for horizontal testing.

The 1970R bracket was able to withstand 500lbf horizontal pull; therefore it has a safety factor of at least two.







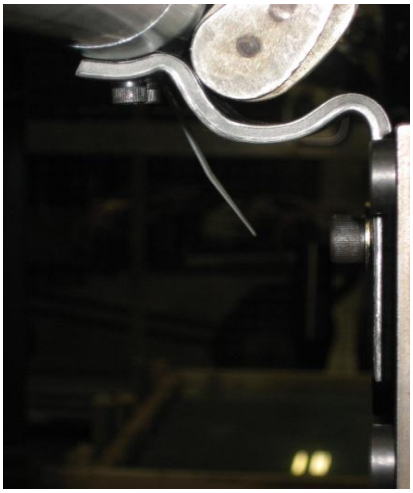
Initial Setup, Trial #1

Preload of 180 lbf
(Actual Deflection of 0.097 in)

Release Test Load of 90 lbf

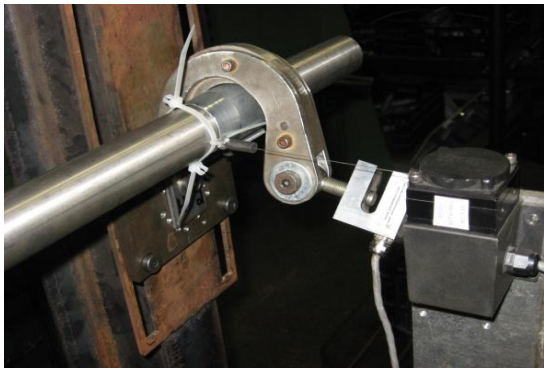
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.258 in)

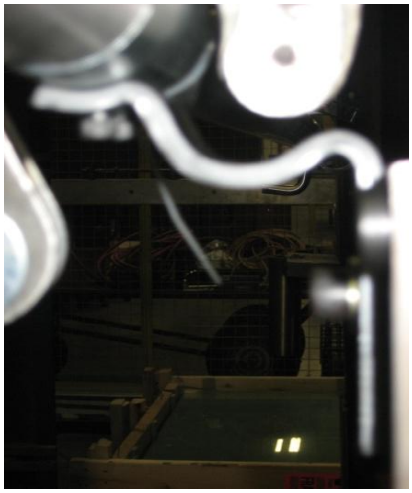
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.015 in)

Achieved 500 lbf





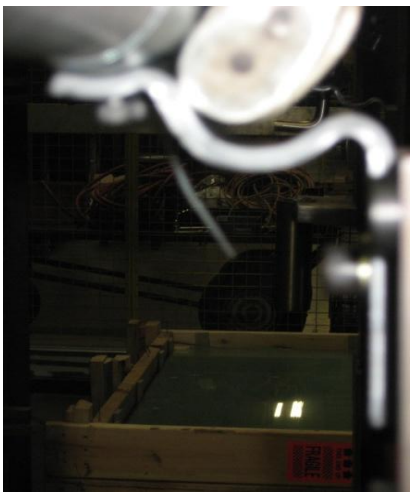
Initial Setup, Trial #2

Preload of 180 lbf
(Actual Deflection of 0.088 in)

Release Test Load of 90 lbf

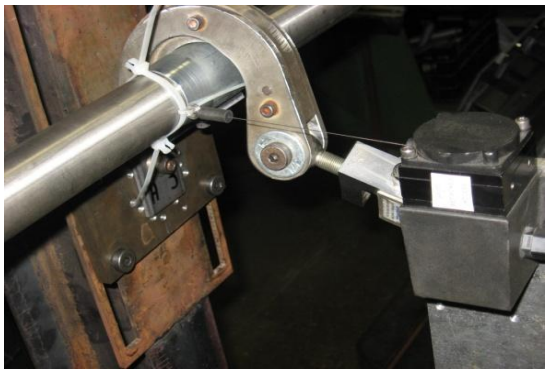
Ultimate Test Load of 365 lbf
(Actual Deflection of 0.263 in)

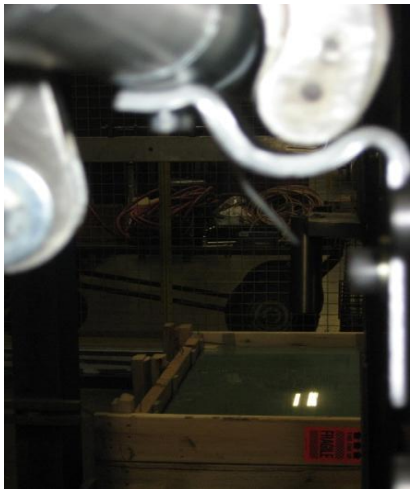
Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.021 in)

Achieved 500 lbf





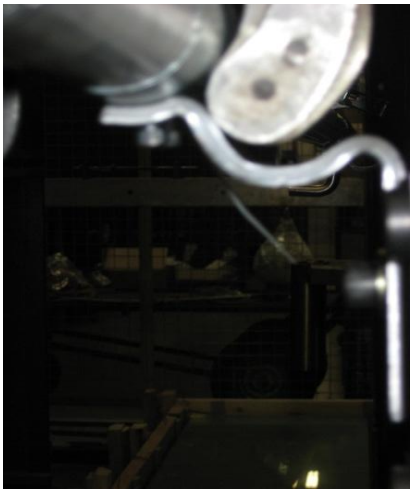
Initial Setup, Trial #3

Preload of 180 lbf
(Actual Deflection of 0.075 in)

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
(Actual Deflection of 0.252 in)

Deflection at UTL



Residual Deflection at 90 lbf
(Actual Deflection of 0.011 in)

Achieved 500 lbf

TrueNorth Steel®

info@TrueNorthSteel.com
TrueNorthSteel.com

702 13th Ave East
West Fargo, ND 58078
Phone: 701.373.7781
Fax: 701.373.8014

Steel Vehicular and Pedestrian Bridge Warranty

LIMITED WARRANTY. In order for there to be any coverage under the warranty herein, the following terms and conditions must be satisfied: (1) The bridge must be (i) installed within the United States and Canada; (ii) the bridge must be installed and maintained in accordance with all applicable manufacturer , owner and industry instructions, specifications and standards that were in effect as of the date of the shipment; (iii) the bridge must be installed and maintained in accordance with all applicable government laws, regulations, rules, ordinances, codes and other requirements that were in effect as of the date of shipment; (iv) the bridge's installation and maintenance must be upgraded in accordance with all manufacturer, industry and/or government instructions, specifications, standards, laws, regulations, rules, ordinances, codes and other requirements that may become effective after date of shipment. (2) Upon discovery of issues related to materials or workmanship or any other matter for which the warranty or other claim may be brought and in accordance with Section 11, the Seller, together with its representatives and anyone else acting on its behalf, must be given written notice of the event and must be given the opportunity to inspect and test the bridge and the site where the bridge was installed before, during and after any change in any condition that might affect the ability of the Seller to determine what happened and/or the cause of what happened. The owner will take all caution and responsibility to determine the safety of the bridge until due process is completed. The owner of the bridge bears the responsibility of establishing that any alleged issues related to materials or workmanship is covered by the warranty herein. (3) If it is established that the event is covered by the warranty herein, the Manufacturer will at its sole option: (i) repair the bridge; or (ii) replace the bridge with a bridge of approximately the same size, design, quality of material and workmanship specified for the original bridge. Manufacturer will repair or replace the bridge within a reasonable time period agreed upon by the manufacturer and owner. If the Manufacturer, at its sole discretion, is unable to repair or replace the bridge, it will refund the original purchase price of the bridge.

What is covered by warranty: Provided that the terms and conditions set forth herein are fully satisfied, "TrueNorth Steel", a registered tradename and its Affiliates (hereinafter refer to as "Seller") warrants the bridge against defective steel materials or workmanship for up to ten (10) year following the delivery of the bridge to the customer. Steel decks and wood carry no warranty, with the exception of naturally durable Ipe hardwood decking and Ipe hardwood attachments shall carry a one (1) year warranty against rot, termite damage, or fungal decay. The warranty coverage provided herein extends only to the initial end user. Extended warranty from the original purchase date must be granted upon written request by a dealer/distributer to the Manufacturer for the initial end user.

What is not covered: (1) The Seller does not warrant any additional accessories and/or other attachments connected to the bridge. Under no circumstances will the Seller be liable for (i) the cost of repair or replacement of any accessories or other attachments to the bridge placed by others including pavement or other materials placed as a driving surface; or (ii) labor costs or other installation costs either for the bridge's original installation or for its repair or replacement or (iii) damage to the bridge or other property resulting from wind, rain, earthquake, building or earth collapse, explosions, and other acts of nature or man; or (iv) damage caused by installation, outside attachments not included in original bridge design, operating, service, maintenance (including de-icing agents) and/or repair practices; (v) failure due to defective materials and/or workmanship occurring later than one (1) year following delivery of the bridge, (vi) delivery to and from Seller's facility for repair or replacement; (vii) any exterior coatings unless specified in writing at time of purchase by the Seller and touch up to exterior coating as a result of delivery or installation, or (viii) any other damages as the result of delivery or installation. (2) This warranty shall not cover defects in the bridge caused by abuse, misuse, overloading, accident, improper installation, maintenance, alteration or any other cause not expressly warranted. This warranty does not cover damage resulting from or relating to the use of any kind of de-icing material. This warranty shall be void unless owner's records are supplied which show that the bridge has been properly maintained. (3) Warranty does not cover any issues related to the design, installation, failure or settlement of the bridge abutment, piling, retaining walls or other structures supporting the bridge. Seller is not responsible for scour, erosion or other design aspects related to soils, foundations or other hydraulic degradation of streams. (3) Warranty does not cover any issues related to the design, installation, failure or settlement of the bridge abutment, piling, retaining walls or other structures supporting the bridge.

Quality Assurance / Control Plan for Bridge Projects

TrueNorth Steel's Quality Assurance and Control Plan for Bridges includes QC hold points throughout the fabrication process to ensure conformance with customer requirements, project specifications, AISC requirements, and the applicable AWS Welding Code.

Various forms are utilized and may be submitted to the customer to confirm the quality process during fabrication: MTRs to support material heat numbers; QC Reports documenting welder IDs associated with each fabricated member, main material heat numbers, and QC inspection points; third party NDT inspection reports; and Daily Paint Logs, documenting paint application data and inspection.

Quality Assurance and Quality Control Functions

1. Pre-Production
    a. The Project Manager reviews the project scope and determines what document submittals are required and when they are to be submitted.
    b. The Project Manager sends a 'New Project' group email to inform all key personnel of the upcoming project and schedules a Kick-Off Meeting, if applicable.
    c. QA Manager and QC Inspectors attend Project Kick-Off Meeting to understand scope of work and identify special requirements,
        i. Discuss when verified MTRs are to be submitted to the Owner, per the contract requirements,
    d. QA Manager and/or QC Inspector assist Project Manager with selection of appropriate Weld Procedure Specifications.
    e. QA Manager confirms all welder qualifications (welder continuity) are current prior to welding.
    f. QA Manager and Shop Supervisor conduct a Kick-Off meeting with the applicable fabrication crew to review requirements and scope of work:
        i. Overall Project review, including special requirements
        ii. Material specifications (quantity, size, grade, weight and length descriptions)
        iii. Review of drawing details
        iv. Weld process, WPS review, posting of WPSs on shop floor

2. In-process Production
    a. QC Inspection points (**Hold points requiring QC inspection prior to proceeding**)
        i. Confirm, and maintain record of, heat number and matching MTRs prior to cutting material.
        ii. Flange and/or Web shop splice fit-up (if applicable) prior to welding.
        iii. Verification of layout/fit up prior to tack welding.
        iv. Verification of camber and/or sweep prior to layout.
        v. Final critical to quality dimension verification.
        vi. Final visual inspection.
            1. 100% visual inspection of all welds.

2. Inspect all holes for burr removal and/or chamfered edges
3. 100% visual inspection of material (gouge and/or spatter removal as required)
4. Inspect and document blast profile (if applicable)
5. Inspect and document D.F.T. of painted girders (if applicable)

vii. Document Non-Conformances and coordinate customer approval of Corrective Action
1. Oversee implementation and inspection of any approved repairs

3. Third party NDT Inspection (if applicable)
   a. Confirm inspector qualification certifications are valid and current.
   b. Review inspection reports of NDT inspection (UT, MT, RT)

4. QA/QC Personnel

Josh Benson
Quality Manager
AWS CWI (#21061081)

Alex Plocker
Quality Supervisor

Taylor Burns
Quality Control Inspector
Fabrication and Coatings

Trace Waterworth
Quality Control Inspector
Fabrication and Coatings

Bridge Name	Width	Length	Year Built	Location City	Location State	Installing Contractor Name	Contact Number
Business 50 West Trail Bridge	8	100	2021	Jefferson City	MO	Don Rhea	573-619-8363
Clifford Township Pedestrian Bridge	8	70	2021	Clifford	PA	MaryAnn Tayoun	570-222-9364
Fall Creek Falls Trail Bridge	5	64	2021	Glide	OR	Dave Molitor	509-361-3400
Canyon Creek Trail Bridge	6	100	2021	Kettle Falls	WA	Dave Molitor	509-361-3400
Wyeth Trail Bridge	3	51	2021	Wyeth	OR	Dave Molitor	509-361-3400
Ravensdale Creek Trail Bridge	12	110	2021	Black Diamond	WA	Matthew Scarsella	206-817-2765
Barnaby Slough Trail Bridge	8	80	2021	La Conner	WA	Devin Smith	360-303-5768
Gravette Trail Bridge	6	32	2021	Augusta	GA	Kurt Eyring	709-736-6588
N. Hico Street Pedestrian Bridge	10	55	2021	Siloam Springs	AR	Rome Wesson	479-935-0381
Blain Road Pedestrian Bridge	5	85	2021	North Grosvendale	CT	Thomas Catucci	111-111-1111
Gateway Park Trail Bridge	10	94	2021	Sheridan	WY	Shane Nelson	406-551-0263
Kootenai Creek Road Safety Bridge	11	122	2022	Stevensville	MT	Kris Anderson	406-594-2285
Philip Rotella Golf Course Bridge	10	40	2022	Theillis	NY	Bruce Smith	845-494-6715
Bermuda Run Blue Heron Trail Bridge	10	100	2022	Bermuda Run	NC	Kenny Blackwelder	980-521-5624
Liberty University Pedestrian Bridge 10.83x145	10.83	145	2022	Lynchburg	VA	Julie Glover	434-582-2855
O&O Ski Lodge | Moonlight Basin Trail Bridge	6	114	2022	Big Sky	MT	Tom McMollom	406-407-5224
9th Street Sidewalk & Pedestrian Bridge	6	40	2022	Challis	ID	Bret Getty	208-833-2237
Pelican Rapids Dam Removal Bridge	10	120	2022	Pelican Rapids	MN	Tim Nelson	320-491-2350
Crawford State Park Southern Trail Bridge	10	175	2022	Crawford	TX	Kyle Hardie	704-604-3829
Bixby East Fry Trail Bridge	10	100	2022	Bixby	OK	Derek Bremseth	918-381-2004
Bridgeway Station Ped Bridge	6	49	2022	Mauldin	SC	Theresa Rowe	964-270-9245
24 Road Multi-Modal Path Bridge	10	50	2023	Grand Junction	CO	Dan Williams	970-812-6097
Crooked Creek Trail Bridge	7	110	2023	Troy	OR	Dave Molitor	509-341-3400
Sander's Park Pedestrian Bridge	8	57	2023	Crestwood	MO	Alex Leslie	636-222-1626
Lake Francis Trail Bridge	12	75	2023	Watts	OK	Wade Evans	620-202-2568
Southside Diversion Dam Bridge	10	155	2023	Pueblo	CO	Scot Burbidge	719-224-0103
Walk Me To School Pedestrian Bridge	8	100	2023	Mont Belvieu	TX	Steven Hamilton	832-918-2674
23114 Wheatland N. Laramie River Ped Bridge	3.25	80	2023	Wheatland	WY	Kurt Reiman	307-631-4561
Flint Hills Trail Bridge	13	237	2023	Ottawa	KS	Aaron Carter	316-452-0954
City of La Junta Arroyo Trail North Bridge	10	75	2023	La Junta	CO	Kyle Casper	970-804-0379
Barkman Library Pedestrian Bridge	6	50	2023	Pueblo	CO	Mark Miller	719-493-8153
Virgin River North/Rimrock Washout	10	60	2024	St. George	UT	Joseph Nielson	801-691-8304
Waterworks Park Island Pedestran Bridge	10	155	2024	Pueblo	CO	Scot Burbidge	719-225-0103
Delta Gateway Park Pedestrian Bridge	12	100	2024	Provo	UT	Ross Barrell	801-664-8263
Zion Park KOA Pedestrian Bridge #1	10	100	2024	Virgin	UT	Kyson Spendlove	435-705-9794
Captain Williams Road Pedestrian Bridge	8	80	2024	Carlsbad	NM	Mike Martinez	575-361-7745
Bronco Butte Pedestrian Bridge	8	60	2024	Phoenix	AZ	John Bacigalupi	602-377-5347
Covelo SR 162 Corridor Trail Ped	10	240	2024	Covelo	CA	Mel Goodwin	707-489-6966
Mitchell Spillway Ped Bridge	12	162	2024	Mitchell	SD	Dave Nolz	605-310-6574
Nevada & Tejon Skewed Pedestrian Bridge	10	41	2024	Colorado Springs	CO	Joe Haberl	303-627-2600
Halfway Wash Trail Bridge	10	60	2024	St George	UT	Paul Stead	801-835-2938
Apache Trails Bridge	8	68.5	2024	Apache Junction	AZ	John Bacigalupi	602-377-5347
Poudre River Trail Bridge	10	85	2024	Fort Collins	CO	Greg Oakes	970-481-7332
TDA Downtown Revitalization Pedestrian Bridge	8	120	2024	Newton	TX	Mark Bean	409-384-0936
Carpenters Bayou Pedestrian Bridge	14	150	2024	Houston	TX	Robert Meador	832-492-8228
River Legacy Park Trail Bridge	14	70	2024	Arlington	TX	Maddox Humphrey	817-266-5124
BackboneTrail Bridge	10	180	2024	Marble Falls	TX	Chase Botkin	512-633-5229
Pecan Grove Trail Bridge	10	120	2024	Anna	TX	Johnny Gann	214-793-8288
St. Vrain Trail Bridge	10	80	2024	Lyons	CO	Marcin Gliszewski	970-305-0535

Garlic Creek Trail Bridge	10	160	2024	Buda	TX	Jordan Estrada	361-771-6122
South Trail NLT 3-04 Pedestrian Bridge	10	80	2024	Columbia City	IN	John Deathe	260-609-6537
Pearson Park South & North Bridge	6	100	2024	West Des Moines	IA	Ryan Cheeseman	515-490-4440
Lake Isabella Blvd Ped Bridge	10	80	2025	Lake Isabella	CA	Ben Walnum	562-477-0836
Dimmit DS Pedestrian Bridge	16	100	2025	Carrizo Springs	TX	David Slaugtter III	956-237-8627
Governors Drive Shared Use Path	10	100	2025	Casselton	ND	Jason Odegard	701-741-3397
Mandan Boat Ramp Pedestrian Bridge	6	90	2025	Mandan	ND	Cole Higlin	701-220-1494
Lake Medina Greenway Trail Bridge	12	120	2025	Medina	OH	Matt Schlosser	419-631-8697
Baechtel Trail Bridge	12	135	2025	Willits	CA	Kevin Bouthllier	707-272-0098
Trail to Crane Creek Regional Park Trail Bridge	8	90	2025	Rohnert Park	CA	Joel Gonnella	707-890-0515
Arroyo Hondo Trail Bridge	10	95	2025	Santa Fe	NM	Joe Cuilty	505-872-2841
White River Pedestrian Bridge	10	95	2025	Cumrod	AR	Lance Griffin	870-500-1061

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RECOMMENDATIONS FOR INSPECTION AND MAINTENANCE OF TRUENORTH STEEL BRIDGES

INSPECTION

I. USER SAFETY (INSPECTION BY OTHERS)

A. Each bridge should be inspected at regular intervals (at least once per year) to ensure that all items of user safety are accounted for and performing properly. Those areas of special concern should be as follows:

1. All safety rails, handrails, rubrails, fencing or other types of safety features should be in place with complete structural integrity and capacity. There shall be no sharp edges or protrusions on any feature that could produce bodily harm or be a hazard to the user.

2. All deck surfaces should be without gaps, cracks or projections that could create a trip hazard or interfere with the user in any way. Special consideration should be given to any smooth deck surface that could also create a possible slip hazard.

II. STRUCTURAL INTEGRITY (INSPECTION BY OTHERS)

A. Each bridge should be inspected at regular intervals not to exceed one year. Pages 5-13 of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Maintenance Inspection of Bridges provides an excellent guide for this inspection. We recommend its use, particularly in the case of bridges for vehicular use. This visual inspection should include, but not be limited to the following:

1. Check the decking to insure it is in satisfactory condition. Pay special attention to timber decks at their contact surfaces where they bear on stringers.

2. All steel surfaces should be inspected to insure that they are performing satisfactorily. Check for any excessive corrosion on weathering steel bridges or paint and caulk integrity on painted bridges, paying special attention to the following areas:

   a. All steel below the deck, particularly the tops of stringers supporting wood decks.

   b. Truss or floor system joints where debris or water may accumulate.

   c. Anywhere vegetation or other material may have come in contact with the steel.

NOTE: Any weathering steel surface not exposed to the atmosphere should be checked to insure it has formed its protected oxide layer.

3. Check all steel surfaces and welded and bolted connections for cracks. Pay special attention to the welded truss and floor beam joints in vehicular or material handling bridges subject to fatigue stresses.

4. Check the ends of the bridge for any damage which may have been caused by vehicular impact.

5. Check the integrity of concrete abutments and/or piers for scour due to water flow if applicable, etc., per AASHTO's Manual for Maintenance Inspection or the foundation engineer's recommendations.

6. Check anchor bolts for damage and see that they are secure. Examine all bearings to ascertain that they are functioning properly. Expansion bearings and the expansion joints at the ends of the bridge must be checked to see that they can move freely and are clear of all foreign material.

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7. SPLICED BRIDGES:

a. Check the bolted splices for any excessive corrosion or cracking of the steel or fasteners,

b. Make sure all weep holes are open and clear of debris to allow for complete drainage of any moisture which may collect on the interior tube surfaces.

B. If problems are seen during the inspection procedure, cleaning and repair or replacement of weathering steel bridge components may be necessary; painted bridges may require cleaning and repainting or replacement of some or all members.

MAINTENANCE FOR PAINTED BRIDGES

Painted bridges, like any painted structure, require periodic inspections and painting. The following steps will help increase the life span of your bridge:

A. After inspections, or any time loss or damage of the paint coat is noticeable, problem areas should be repaired as follows:

1. Select a maintenance coating system based on the following:

a. Inspection report findings

b. Environment (identify any corrosives)

c. Degree of surface preparation attainable

d. Current paint compatibility

NOTES:

*** Generic type compatibility is a major factor in the selection of a system (some coating systems are not recommended over a particular type of existing material).**

*** Depending upon the surface performance, an upgrade in the coating system may be necessary at this time.**

2. Clean all applicable surfaces as dictated by the repair system chosen (i.e., pressure wash, brush off, blast clean, etc.)

3. Apply repair coats per the coating manufacturer's recommendations.

4. Caulk all unwelded seams which are in need of repair with a good quality clear silicone caulk suitable for exterior use.

B. The entire bridge structure may require periodic repainting dependent upon varying factors such as the existing paint system, bridge usage, atmospheric environment, etc. Repainting may be required every 5-10 years, depending on environment and usage. The frequency of re-painting (if applicable) will need to be determined by the inspector. In many instances, keeping up with regular touch up painting is adequate in lieu of re-painting. The following steps should be followed when repainting the bridge structures:

1. Remove wood decking or grating, fencing, wood rubrails and any other non-painted items which will not be receiving new paint. Obviously, concrete and asphalt decked bridges will be painted with the deck in place, unless these decks have deteriorated to the point of replacement. If this is the case, remove the deck prior to painting, if not, special care should be exercised to insure problem areas below deck are cleaned and painted properly.

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2. Select a coating system based on parameters similar to those outlined in the repair painting section, paying attention to the following items:

    - Protecting the surrounding environment, specifically against any hazardous materials
    - Substrate condition
    - Surface preparation limitations

3. After selecting a system compatible with all existing surface conditions and site limitations, clean all surfaces and apply according to the manufacturer's recommendations.

4. After the coating system has properly cured, caulk all unwelded seams with a good quality clear silicon caulk suitable for exterior use and replace the decking, fencing, etc., which were removed prior to cleaning and repainting the structure. This is also an excellent time to replace the wood rub rail which may have shown excessive deterioration.

MAINTENANCE FOR WEATHERING STEEL BRIDGES

Weathering steel is not a maintenance free material. The following steps will help increase the life span of your bridge. TrueNorth Steel recommends rinsing the steel truss and beneath the bridge every 3 months if the bridge is within a two-mile radius of coastal waters or other corrosive environments. For areas where salting may occur to speed up snow and ice melt, the bridge should be sprayed thoroughly as soon as warmer weather allows.

A. Avoid using de-icing salts for snow removal. De-icing salts can severely damage the weathering steel.

B. Avoid retention of debris on the steel surfaces. Flush bridges at areas which accumulate debris (including salt) on a regular basis.

C. Prevent weathering steel from any long-term contact with vegetation, masonry or other materials so that the weathering process can proceed on a natural basis.

D. If excessive corrosion is encountered due to salts from adjacent roadways or roadways beneath an overpass structure, or for any other reason, it may be wise to blast clean and paint the truss joints, the steel beneath the deck or any area which exhibits excessive corrosion.

MAINTENANCE FOR DECKING

I. WOOD DECKS

Wood is a natural material which exhibits large volume changes with variations in moisture content and time, particularly in the width direction, which can cause gaps to form between the planks. Cupping and splits may also occur which need to be repaired. Please note: It is the owner's responsibility to keep the wood deck free from cupping, splits, gaps and smooth surfaces.

A. Replace all planks that have deteriorated past a useful and safe life.

B. Eliminate gaps between the planks which might be large enough for a high-heeled shoe to become lodged. Eliminating the gaps should be done as follows:

    1. Remove all deck bolts.

    2. Remove plank hold-down angles. Be sure to mark their locations for ease of reinstallation.

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3. Slide wood planks together.

4. Add new plank or planks to fill up the excess space.

5. Reinstall plank hold down angles.

6. Drill new holes in wood planks.

7. Install new deck bolts (see shop drawings for size and material).

C. Replacement planks may be purchased through TrueNorth Steel.

D. Over time with exposure to the environment, wood may become smooth, particularly when wet with rain, dew, snow, sleet, ice, etc. Periodically it may be necessary to "roughen" the surface of the decking with large grit sandpaper.

II. GRATING DECKS

A. Repair or replace any grating which shows damage or deterioration to the main bearing bars.

B. If galvanized or painted, inspect to see if corrosion has occurred. Wire brush any spots exhibiting corrosion and repair. We recommend the use of either sprayed zinc metalizing or the use of organic zinc rich paint for repairing galvanized surfaces.

C. For weathering steel grating, if excessive corrosion is encountered due to salts from adjacent roadways or roadways beneath an overpass structure, or for any other reason, it may be wise to blast clean and paint the grating.

III. CONCRETE & ASPHALT

For all concrete and asphalt decks, TrueNorth Steel Bridge supplies a steel corrugated form decking to aid in the placement of the concrete or asphalt. For asphalt decks, this steel form is the main load carry member. For concrete decks, this steel form may or may not be integral to the deck design (as in a composite deck). The contractor places the reinforcing and concrete, or the asphalt, after installation of the bridge. During inspection, the asphalt or concrete covering should be checked for excessive cracking and deterioration. At the same time, the seal form decks should be checked for excessive rusting and/or damage. If the coverings are deemed to require replacement, the steel forms may be reused if they are not damaged or do not show excessive corrosion.

Structural form decks (for asphalt decks and composite concrete decks) may require replacement even when the deck surface itself is sound.

TrueNorth Steel concrete and asphalt decks are usually not designed to accept the added dead weight of an overlay. Therefore, please check with TrueNorth Steel before adding any overlay on the deck to be sure the additional weight won't be of concern.

See the shop drawing for recommended concrete strength, reinforcing size, slab and asphalt thickness, control joint location and surface finish.

Please note: Maintenance of the bridge decking, including keeping it free from slip or trip hazards, is the owner's responsibility.

TrueNorth Steel celebrated its 75th year anniversary in 2020, and we currently manufacture steel bridges at three of our locations; Billings, MT, West Fargo, ND, and Lubbock, TX. Our bridge manufacturing facilities have fabricated literally hundreds of steel bridges. In addition and since 1985, our Billings and West Fargo facilities have manufactured steel welded plate girder bridges (for interstate highway applications) with girders measuring up to 172" in depth. TrueNorth Steel is one of the most experienced and respected names in steel bridge fabrication. We pride ourselves in leading the industry with the most extensive quality management system, and we stand behind every bridge with our reputation. We trust that you will find TrueNorth Steel more than fully qualified to bid and supply this bridge project. Following are examples of various bridges fabricated by TrueNorth Steel.

Pedestrian Modular Bridge Project List

Bridge Name & Size	Location	Owner	Contact Info
• Santiam River Park Pedestrian Bridge 8’ x 130’	Stayton, Oregon	City of Stayton, OR	Mike Brash, 503-769-2919
• 93rd Street Over Bergholtz Creek Pedestrian Bridge 6’ x 84’	Niagara Falls, New York	City of Niagara Falls, NY	Nick Soroka, 716-828-1218
• Chico Creek Phase II Trail Bridge 8’ x 100’	Bremerton, Washington	Kitsap Golf Club	Richard Geiger, 360-427-9436
• Leo Adler Memorial Parkway North Pedestrian Bridge 10’ x 95’	Baker City, Washington	Baker City, WA	Dennis Dice, 541-382-9187
• Midwest City Trail Bridge 5’ x 100’	Midwest City, Oklahoma	Midwest City, OK	Patrick Menefee, 405-739-1399
• Cache La Poudre Regional Trail Bridge 10’ x 130’	Larimer County, Colorado	City of Fort Collins, CO	Dan Giesler, 970-223-3151
• Tarrytown Riverwalk Metro North Footbridge 6’ x 80’	Westchester County, NY	City of Tarrytown , NY	Wayne Howard, 914-636-0000
• Woodbine Pedestrian Bridge 8’ x 106’	Danville, California	City of Danville, CA	Jim Freethy, 925-855-1440
• Lykins Gulch Trail Bridge 10’ x 93’	Longmont, Colorado	City of Longmont, CO	Amy Powell, 303-532-0004
• 36th Street Pedestrian Bridge 12’ x 201’	Boise, Idaho	Ada County, ID	Anthony Guho, 208-939-8850

Additional Bridge Examples
Lower Dry Fork Dam – 4x58-8 – Lonepine, MT - 2013
Hyalite West Shore – 10x70 Bozeman, MT – 2013
College Street 12x55 – Moscow, ID – 2012
Beaver Creek St Park – (2) 5x38, 1 5x25, 1 5x60 Havre, MT - 2012
Ruby Dam – 6x121 - Madison County., MT – 2011
Champion Trail Truss 12x105 – Irving, TX – 2011
Silver Bow Creek 10x80 – Butte, MT – 2011
Meador-Kansas Ellis 8x81 – Bellingham, WA – 2011
Freemont Park (3) 8x50, Freemont, UT – 2010
Spanish Forks 12x74, Spanish Forks, UT – 2010
River Bluffs Open space Cache La Poudre Regional Trail 10x130, Larimer Co, CO - 2010
Sedona School 5x75 – Sedona, AZ – 2009
Lake Jackson 8x70, Lake Jackson, TX - 2010
Horse Barn Trail 8x38, Rodgers, AK, - 2010

AMERICAN INSTITUTE OF STEEL CONSTRUCTION

CERTIFICATION PROGRAMS

PROUDLY RECOGNIZE THAT

TrueNorth Steel - West Fargo

2021-04-28-001912F

MAINTAINS OPERATIONS LOCATED AT

420 East Main Avenue
West Fargo, ND 58078 United States

THAT SUCCESSFULLY MEET THE QUALITY CERTIFICATION REQUIREMENTS FOR

Building Fabricator

Bridge Fabricator - Advanced

Fracture Control Endorsement - Bridge

Complex Coating Endorsement 1 - Enclosed

CERTIFICATION NUMBER	C-00027953
ISSUED	October 3, 2025
VALID THROUGH	December 31, 2026

PRESIDENT

AMERICAN INSTITUTE OF STEEL CONSTRUCTION

CERTIFICATION PROGRAMS

PROUDLY RECOGNIZE THAT

TrueNorth Steel - Fargo

2018-08-31-003634F

MAINTAINS OPERATIONS LOCATED AT

4401 Main Ave E.
Fargo, ND 58103 United States

THAT SUCCESSFULLY MEET THE QUALITY CERTIFICATION REQUIREMENTS FOR

Building Fabricator
Bridge Fabricator - Advanced
Fracture Control Endorsement - Bridge
Complex Coating Endorsement 1 - Enclosed

CERTIFICATION NUMBER	C-00028012
ISSUED	October 14, 2025
VALID THROUGH	December 31, 2026

PRESIDENT

AMERICAN INSTITUTE OF STEEL CONSTRUCTION

CERTIFICATION PROGRAMS

PROUDLY RECOGNIZE THAT

TrueNorth Steel - Lubbock

2021-07-13-002194F

MAINTAINS OPERATIONS LOCATED AT

401 North Loop 289
Lubbock, TX 79403 United States

THAT SUCCESSFULLY MEET THE QUALITY CERTIFICATION REQUIREMENTS FOR

Building Fabricator

Bridge Fabricator - Intermediate

Fracture Control Endorsement - Bridge

Complex Coating Endorsement P1 - Enclosed

CERTIFICATION NUMBER	C-00028170
ISSUED	November 19, 2025
VALID THROUGH	January 31, 2027

PRESIDENT

TrueNorthSteel

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Andy Boyer	**Stamp #:**	5	**Test Date:**	5/4/2020
Employee ID #:				**Rev Date:**	N/A
TNS Division:	Fargo			**Code:**	AWS D1.5

Test WPS No:	FCAW 71E .0625		
Type of Joint:	Plate Groove Weld	Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug slot (except CJP T, Y & K conn's)		
Base Metal Welded:	ASTM A572 to ASTM A572		

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process	**FCAW**	**FCAW**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Backing	3/8" x 1"	Backing or Backgouging
Filler metal classification	E71T-1	All Approved
Filler metal specification	5.20	5.xx
Filler metal F-No.	N/A	N/A
Welding position - groove	Horizontal	Horizontal & Flat
Welding position - fillet	N/A	Horizontal & Flat
Weld progression	N/A	N/A
Shielding gas	100% CO_2	A5.xx Approved
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	Single	Single
VISUAL EXAMINATION RESULTS (6.10.1)	**Acceptable**	
FILLET TEST RESULTS (6.23.4.1 & 6.23.2.2)	N/A	N/A
Fracture Test Root Penetration:	N/A	N/A
Macroetch	N/A	N/A

GUIDED BEND TESTS (6.17.12)	**Specimen 1**	**Specimen 2**
Side Bend	Acceptable	Acceptable

RADIOGRAPHIC TEST RESULTS (6.23.3) **N/A**

Film Identification No N/A Lab Test Number: N/A

Date of Test: 5/4/2020 Test Conducted by: Jason Hewson

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of:

Clause 5 of AWS D1.5 - Structural Welding Code - Bridge

TrueNorth Steel

AWS® Jason Hewson
CW[illegible]581
QC1 EXP. 10/1/2022

Authorized by: Jason Hewson

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Andy Boyer**	Stamp:	5	Date:	8/13/2020
Test WPS No.:	SMAW Limited 3G			Rev/Date:	
Type of Joint:	Plate Groove Weld			Type:	Manual
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**SMAW / Manual**	**SMAW / Manual**
Base metal thickness - groove (in.)	3/8" Plate	1/8" to 3/4"
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	Backing or Backgouging
Filler metal classification	E7018	
Filler metal specification	5.1	
Filler metal F-No.	4	F1-F4
Welding position - groove	3G - Vertical	Flat, Horizontal and Vertical
Welding position - fillet	N/A	Flat, Horizontal and Vertical
Weld progression	Vertical Up	Vertical Up
Shielding gas	N/A	N/A
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Root/Face Bend	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By	Jason Hewson
Date of Test	8/13/2020

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company TrueNorth Steel

Authorized By

Jason Hewson
CWI 13101581
QC1 EXP. 10/1/2022

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

Welder or welding operator's name Brent Williams Identification no. 12
Welding process FCAW Manual ____ Semiautomatic X Mechanized ____
Position 3G
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)
In conformance with WPS no. FCAW 71E.0625 FL UNL (3G Weld Test)
Material specification ASTM A709-50
Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.20 Classification E71T-1C H8 F no. ____
Describe filler metal (if not covered by AWS specification) Flux Core
Is backing used? Yes
Filler metal diameter and trade name Lincoln Outershield 71 Elite
Flux for SAW or gas for GMAW or FCAW-G 100% CO2

VISUAL INSPECTION (6.26.1)

Appearance Acceptable Undercut None Piping porosity N/A

Guided Bend Test Results

Type	Result	Type	Result
Side Bend	Acceptable		
Side Bend	Acceptable		

Test conducted by Kyle Keller Laboratory test no. N/A
per AWS D1.5 Chapter 4 Test date 5/2/18

Fillet Test Results

Appearance ____ Fillet size ____
Fracture test root penetration ____ Macroetch ____
(Describe the location, nature, and size or any crack or tearing of the specimen.)
Test conducted by ____ Laboratory test no. ____
per ____ Test date ____

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks

Test witnessed by ____ Test no. ____
per ____

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code.*
(year)

Manufacturer or Contractor TrueNorth Steel
Authorized By Jason Hewson
Date 5/2/18

Form N-5

Form N-5—Welder and Welding Operator Qualification Record

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

Welder or welding operator's name Brent Williams Identification no. 12
Welding process SMAW Manual X Semiautomatic ____ Mechanized ____
Position 3G
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)
In conformance with WPS no. SMAW 3G UL
Material specification ASTM A572 Gr 50
Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.1 Classification E7018-HR4 F no. ____
Describe filler metal (if not covered by AWS specification) ____
Is backing used? Yes
Filler metal diameter and trade name 1/8" Lincoln Excalibur 7018-MR
Flux for SAW or gas for GMAW or FCAW-G ____

VISUAL INSPECTION (6.26.1)

Appearance Acceptable Undercut Acceptable Piping porosity Acceptable

Guided Bend Test Results

Type	Result	Type	Result
Side	Acceptable		
Side	Acceptable		

Test conducted by Kyle Keller Laboratory test no. N/A
per AWS D1.5 Test date 5/2/18

Fillet Test Results

Appearance ____ Fillet size ____
Fracture test root penetration ____ Macroetch ____
(Describe the location, nature, and size or any crack or tearing of the specimen.)
Test conducted by ____ Laboratory test no. ____
per ____ Test date ____

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks

Test witnessed by ____ Test no. ____
per ____

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code.*
(year)

Manufacturer or Contractor TrueNorth Steel
Authorized By Jason Hewson CWI# 13101581
Date 5/2/18

Form N-5

Form N-5—Welder and Welding Operator Qualification Record

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

Welder or welding operator's name Brent Williams Identification no. 12
Welding process SMAW Manual X Semiautomatic ____ Mechanized ____
Position 4G
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)
In conformance with WPS no. SMAW 4G UL
Material specification ASTM A572 Gr 50
Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.1 Classification E7018-HR4 F no. ____
Describe filler metal (if not covered by AWS specification) ____
Is backing used? Yes
Filler metal diameter and trade name 1/8" Lincoln Excalibur 7018-MR
Flux for SAW or gas for GMAW or FCAW-G ____

VISUAL INSPECTION (6.26.1)

Appearance Acceptable Undercut Acceptable Piping porosity Acceptable

Guided Bend Test Results

Type	Result	Type	Result
Side	Acceptable		
Side	Acceptable		

Test conducted by Kyle Keller Laboratory test no. N/A
per AWS D1.5 Test date 5/2/18

Fillet Test Results

Appearance ____ Fillet size ____
Fracture test root penetration ____ Macroetch ____
(Describe the location, nature, and size or any crack or tearing of the specimen.)
Test conducted by ____ Laboratory test no. ____
per ____ Test date ____

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks

Test witnessed by ____ Test no. ____
per ____

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code.*
(year)

Manufacturer or Contractor TrueNorth Steel
Authorized By Jason Hewson CWI# 13101581
Date 5/2/18

Form N-5

Form N-5—Welder and Welding Operator Qualification Record

TrueNorth Steel

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Deb Proffit	**Stamp #:**	8	**Test Date:**	10/12/2020
Employee ID #:				**Rev Date:**	N/A
TNS Division:	Fargo			**Code:**	AWS D1.5

Test WPS No:	FC71.062.100 B-U4a-GF		
Type of Joint:	Plate Groove Weld	Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug slot (except CJP T, Y & K conn's)		
Base Metal Welded:	ASTM A572 to ASTM A572		

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process	**FCAW**	**FCAW**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Backing	3/8" x 1"	Backing or Backgouging
Filler metal classification	E71T-1	All Approved
Filler metal specification	5.20	5.xx
Filler metal F-No.	N/A	N/A
Welding position - groove	Horizontal	Horizontal & Flat
Welding position - fillet	N/A	Horizontal & Flat
Weld progression	N/A	N/A
Shielding gas	100% CO2	A5.xx Approved
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	Single	Single

VISUAL EXAMINATION RESULTS (6.10.1)	**Acceptable**	
FILLET TEST RESULTS (6.23.4.1 & 6.23.2.2)	N/A	N/A
Fracture Test Root Penetration:	N/A	N/A
Macroetch	N/A	N/A

GUIDED BEND TESTS (6.17.12)	**Specimen 1**	**Specimen 2**
Side Bend	Acceptable	Acceptable

RADIOGRAPHIC TEST RESULTS (6.23.3)	**N/A**		
Film Identification No	N/A	Lab Test Number:	N/A

Date of Test: 10/12/2020 Test Conducted by: Jason Hewson

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of:

Clause 5 of AWS D1.5 - Structural Welding Code - Bridge

TrueNorth Steel

AWS® Jason Hewson CWI STAMP 01581 QC1 EXP. 10/1/2022

Authorized by: Jason Hewson

TrueNorth Steel

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Garrett Anderson	**Stamp #:**	22	**Test Date:**	10/18/2020
Employee ID #:				**Rev Date:**	N/A
TNS Division:	Fargo			**Code:**	AWS D1.5

Test WPS No:	FC71.062.100 B-U4a-GF		
Type of Joint:	Plate Groove Weld	Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug slot (except CJP T, Y & K conn's)		
Base Metal Welded:	ASTM A572 to ASTM A572		

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process	**FCAW**	**FCAW**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Backing	3/8" x 1"	Backing or Backgouging
Filler metal classification	E71T-1	All Approved
Filler metal specification	5.20	5.xx
Filler metal F-No.	N/A	N/A
Welding position - groove	Horizontal	Horizontal & Flat
Welding position - fillet	N/A	Horizontal & Flat
Weld progression	N/A	N/A
Shielding gas	100% CO2	A5.xx Approved
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	Single	Single

VISUAL EXAMINATION RESULTS (6.10.1)	**Acceptable**	
FILLET TEST RESULTS (6.23.4.1 & 6.23.2.2)	N/A	N/A
Fracture Test Root Penetration:	N/A	N/A
Macroetch	N/A	N/A

GUIDED BEND TESTS (6.17.12)	**Specimen 1**	**Specimen 2**
Side Bend	Acceptable	Acceptable

RADIOGRAPHIC TEST RESULTS (6.23.3)	**N/A**		
Film Identification No	N/A	Lab Test Number:	N/A

Date of Test: 10/18/2020 Test Conducted by: Jason Hewson

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of:

Clause 5 of AWS D1.5 - Structural Welding Code - Bridge

TrueNorth Steel

AWS® Jason Hewson CWI 15101581 QC1 EXP. 10/1/2022 STAMP

Authorized by: Jason Hewson

TrueNorth Steel

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Jakob Bjorland	**Stamp #:**	54	**Test Date:**	10/13/2020
Employee ID #:				**Rev Date:**	N/A
TNS Division:	Fargo			**Code:**	AWS D1.5

Test WPS No:	FC71.062.100 B-U4a-GF		
Type of Joint:	Plate Groove Weld	Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug slot (except CJP T, Y & K conn's)		
Base Metal Welded:	ASTM A572 to ASTM A572		

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process	**FCAW**	**FCAW**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Backing	3/8" x 1"	Backing or Backgouging
Filler metal classification	E71T-1	All Approved
Filler metal specification	5.20	5.xx
Filler metal F-No.	N/A	N/A
Welding position - groove	Horizontal	Horizontal & Flat
Welding position - fillet	N/A	Horizontal & Flat
Weld progression	N/A	N/A
Shielding gas	100% CO2	A5.xx Approved
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	Single	Single

VISUAL EXAMINATION RESULTS (6.10.1)	**Acceptable**	
FILLET TEST RESULTS (6.23.4.1 & 6.23.2.2)	N/A	N/A
Fracture Test Root Penetration:	N/A	N/A
Macroetch	N/A	N/A

GUIDED BEND TESTS (6.17.12)	**Specimen 1**	**Specimen 2**
Side Bend	Acceptable	Acceptable

RADIOGRAPHIC TEST RESULTS (6.23.3)	**N/A**		
Film Identification No	N/A	Lab Test Number:	N/A

Date of Test: 10/13/2020 Test Conducted by: Jason Hewson

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of:

Clause 5 of AWS D1.5 - Structural Welding Code - Bridge

TrueNorth Steel

AWS® Jason Hewson
STAMP 3101581
QC1 EXP. 10/1/2022

Authorized by: Jason Hewson

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Jory Vernetti**	Stamp:	**9**	Date:	2/15/2017
Test WPS No.:	FCAW 71E .0625			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**FCAW /SemiAutomatic**	**FCAW Semi-Auto, Auto & Machine**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With backing only
Filler metal classification	E71T-1	
Filler metal specification	5.20	
Filler metal F-No.	N/A	N/A
Welding position - groove	1G - Flat	Flat
Welding position - fillet	N/A	Flat and Horizontal
Weld progression	N/A	N/A
Shielding gas	100% CO^2	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Side Bend 1G	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By: Alan Sherbo - AWS CWI #14060851

Date of Test: 2/15/2017

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company: TrueNorth Steel

Authorized By:

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

TrueNorth Steel

Welder or welding operator's name Joe Vernetti Identification no. #9

Welding process FCAW Manual Semiautomatic X Mechanized

Position FLAT & HORIZONTAL
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)

In conformance with WPS no. FCAW 71E #6

Material specification ASTM A709-50

Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.20 Classification E71T-1C H8 F no. 6

Describe filler metal (if not covered by AWS specification)

Is backing used? YES

Filler metal diameter and trade name 1/16"; Lincoln Outershield 71 Elite

Flux for SAW or gas for GMAW or FCAW-G N/A

VISUAL INSPECTION (6.26.1)

Appearance ACCEPTABLE Undercut NONE Piping porosity NONE

Guided Bend Test Results

Type	Result	Type	Result
NONE		NONE	
NONE		NONE	

Test conducted by N/A Laboratory test no. N/A

per N/A Test date N/A

FILLET TEST RESULTS

Appearance N/A Fillet size N/A

Fracture test root penetration N/A Macroetch N/A

(Describe the location, nature, and size or any crack or tearing of the specimen.)

Test conducted by N/A Laboratory test no. N/A

per N/A Test date N/A

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks
XRWQ-JV	Acceptable to Code				

Test witnessed by Brent Thorsness (NDT Level II)

per Pro Inspection Services

Test no. XRWQ-JV

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code.*

Manufacturer or Contractor TrueNorth Steel Date: 3/26/18

Authorized By: Jason Hewson AWS CWI

AWS Jason Hewson CWI 13101581 QC1 EXP. 10/1/2019

AWS son 1581 10/1/2019

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Jory Vernetti**	Stamp:	**9**	Date:	8/13/2020
Test WPS No.:	Weld Test			Rev/Date:	
Type of Joint:	Plate Groove Weld			Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**FCAW /SemiAutomatic**	**FCAW Semi-Auto, Auto & Machine**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	Backing or Backgouging
Filler metal classification	E71T-1	
Filler metal specification	5.20	
Filler metal F-No.	N/A	N/A
Welding position - groove	3G - Vertical	Flat, Horizontal and Vertical
Welding position - fillet	N/A	Flat, Horizontal and Vertical
Weld progression	Vertical Up	Vertical Up
Shielding gas	100% CO^2	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Side Bend 3G	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By	Jason Hewson
Date of Test	8/13/2020

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company TrueNorth Steel

Authorized By

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Jory Vernetti**	Stamp:	**9**	Date:	2/15/2017
Test WPS No.:	SAW F7A4-EM12K-H8/860			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**SAW / Machine**	**SAW / Machine**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With Backing Only
Filler metal classification	F7A4-EM12K-H8	
Filler metal specification	5.17	
Filler metal F-No.	N/A	N/A
Welding position - groove	1G - Flat	Flat Only
Welding position - fillet	N/A	Flat and Horizontal
Weld progression	N/A	N/A
Flux	F7A4-EM12K-H8/860 Flux	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	Single Electrode	Single Electrode

VISUAL EXAMINATION RESULTS	**Specimen 1**	**Specimen 2**
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	**Specimen 1**	**Specimen 2**
Side Bend 1G	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By	Alan Sherbo
Date of Test	2/15/2017

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company TrueNorth Steel

Authorized By

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Logan Brown**	Stamp:	**B**	Date:	3/22/2011
Test WPS No.:	Weld Test HH			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**FCAW /SemiAutomatic**	**FCAW Semi-Auto, Auto & Machine**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With backing only
Filler metal classification	E71T-1	
Filler metal specification	5.20	
Filler metal F-No.	N/A	N/A
Welding position - groove	2G - Horizontal	Flat and Horizontal
Welding position - fillet	N/A	Flat and Horizontal
Weld progression	N/A	N/A
Shielding gas	100% CO^2	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Side Bend 2G	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By	Rick Steiner
Date of Test	3/22/2011

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company TrueNorth Steel

Authorized By

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Logan Brown**	Stamp:	**B**	Date:	6/28/2016
Test WPS No.:	Weld Test HH			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**FCAW /SemiAutomatic**	**FCAW Semi-Auto, Auto & Machine**
Base metal thickness - groove (in.)	3/8"	CJP:1/8" to 3/4" PJP:1/8" to Unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With backing only
Filler metal classification	E71T-1	
Filler metal specification	5.20	
Filler metal F-No.	N/A	N/A
Welding position - groove	3G - Vertical	Flat, Horizontal and Vertical
Welding position - fillet	N/A	Flat, Horizontal and Vertical
Weld progression	Vertical Up	Vertical Up
Shielding gas	100% CO^2	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	**Specimen 1**	**Specimen 2**
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	**Specimen 1**	**Specimen 2**
Side Bend 3G	Acceptable	Acceptable

Test Conducted By	Rick Steiner
Date of Test	6/23/2016

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 4 of AWS D1.1, Structural Welding Code - Steel.

Company TrueNorth Steel

Authorized By

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Logan Brown**	Stamp:	**B**	Date:	9/25/2017
Test WPS No.:	SMAW Limited 3G			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Manual
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**SMAW / Manual**	**SMAW / Manual**
Base metal thickness - groove (in.)	3/8" Plate	1/8" to 3/4"
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With backing only
Filler metal classification	E7018	
Filler metal specification	5.1	
Filler metal F-No.	4	F1-F4
Welding position - groove	3G - Vertical	Flat, Horizontal and Vertical
Welding position - fillet	N/A	Flat, Horizontal and Vertical
Weld progression	Vertical Up	Vertical Up
Shielding gas	N/A	N/A
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Side Bend 3G	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By	Alan Sherbo
Date of Test	9/25/2017

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company TrueNorth Steel

Authorized By

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

Welder or welding operator's name Matt Aalgaard Identification no. 28
Welding process FCAW Manual ____ Semiautomatic X Mechanized ____
Position 2G
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)
In conformance with WPS no. FCAW 71E.0625 FL UNL (2G Weld Test)
Material specification ASTM A709-50
Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.20 Classification E71T-1C H8 F no. ____
Describe filler metal (if not covered by AWS specification) Flux Core
Is backing used? Yes
Filler metal diameter and trade name Lincoln Outershield 71 Elite
Flux for SAW or gas for GMAW or FCAW-G 100% CO2

VISUAL INSPECTION (6.26.1)

Appearance Acceptable Undercut None Piping porosity N/A

Guided Bend Test Results

Type	Result	Type	Result
Side Bend	Acceptable		
Side Bend	Acceptable		

Test conducted by Jason Hewson Laboratory test no. N/A
per AWS D1.5 Chapter 4 Test date 8/15/18

Fillet Test Results

Appearance ____ Fillet size ____
Fracture test root penetration ____ Macroetch ____
(Describe the location, nature, and size or any crack or tearing of the specimen.)
Test conducted by ____ Laboratory test no. ____
per ____ Test date ____

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks

Test witnessed by ____ Test no. ____
per ____

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code.*
(year)

Manufacturer or Contractor TrueNorth Steel
Authorized By Jason Hewson
Date 8/15/18

Form N-5

Form N-5—Welder and Welding Operator Qualification Record

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

TrueNorth Steel

Welder or welding operator's name Trace Waterworth Identification no. #25

Welding process FCAW Manual Semiautomatic X Mechanized

Position FLAT & HORIZONTAL
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)
In conformance with WPS no. FCAW 71E #6
Material specification ASTM A709-50
Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.20 Classification E71T-1C H8 F no. 6

Describe filler metal (if not covered by AWS specification)

Is backing used? YES

Filler metal diameter and trade name 1/16"; Lincoln Outershield 71 Elite

Flux for SAW or gas for GMAW or FCAW-G N/A

VISUAL INSPECTION (6.26.1)

Appearance ACCEPTABLE Undercut NONE Piping porosity NONE

Guided Bend Test Results

Type	Result	Type	Result
NONE		NONE	
NONE		NONE	

Test conducted by N/A Laboratory test no. N/A
per N/A Test date N/A

FILLET TEST RESULTS

Appearance N/A Fillet size N/A
Fracture test root penetration N/A Macroetch N/A

(Describe the location, nature, and size or any crack or tearing of the specimen.)
Test conducted by N/A Laboratory test no. N/A
per N/A Test date N/A

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks
XRWQ-TT	Acceptable to Code				

Test witnessed by Brent Thorsness (NDT Level II)
per Pro Inspection Services
Test no. XRWQ-TT

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code*.

Manufacturer or Contractor TrueNorth Steel Date: 3/26/18

Authorized By: Jason Hewson AWS CWI

AWS® Jason Hewson
CWI 13101581
QC1 EXP. 10/1/2019

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

TrueNorth Steel

Welder or welding operator's name Trace Waterworth Identification no. #25

Welding process FCAW Manual Semiautomatic X Mechanized

Position FLAT & HORIZONTAL
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)
In conformance with WPS no. FCAW 71E #6
Material specification ASTM A709-50
Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.20 Classification E71T-1C H8 F no. 6

Describe filler metal (if not covered by AWS specification)

Is backing used? YES

Filler metal diameter and trade name 1/16"; Lincoln Outershield 71 Elite

Flux for SAW or gas for GMAW or FCAW-G N/A

VISUAL INSPECTION (6.26.1)

Appearance ACCEPTABLE Undercut NONE Piping porosity NONE

Guided Bend Test Results

Type	Result	Type	Result
NONE		NONE	
NONE		NONE	

Test conducted by N/A Laboratory test no. N/A
per N/A Test date N/A

FILLET TEST RESULTS

Appearance N/A Fillet size N/A
Fracture test root penetration N/A Macroetch N/A

(Describe the location, nature, and size or any crack or tearing of the specimen.)
Test conducted by N/A Laboratory test no. N/A
per N/A Test date N/A

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks
XRWQ-TT	Acceptable to Code				

Test witnessed by Brent Thorsness (NDT Level II)
per Pro Inspection Services
Test no. XRWQ-TT

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code*.

Manufacturer or Contractor TrueNorth Steel Date: 3/26/18

Authorized By: Jason Hewson AWS CWI

AWS® Jason Hewson
CWI 13101581
QC1 EXP. 10/1/2019

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Trace Waterworth	Stamp:	25	Date:	2/14/2017
Test WPS No.:	SAW F7A4-EM12K-H8/860			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	SAW / Machine	SAW / Machine
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With Backing Only
Filler metal classification	F7A4-EM12K-H8	
Filler metal specification	5.17	
Filler metal F-No.	N/A	N/A
Welding position - groove	1G - Flat	Flat Only
Welding position - fillet	N/A	Flat and Horizontal
Weld progression	N/A	N/A
Flux	F7A4-EM12K-H8/860 Flux	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	Single Electrode	Single Electrode

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Side Bend 1G	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By	Alan Sherbo
Date of Test	2/14/2017

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company TrueNorth Steel

Authorized By Alan W. Sherbo

TrueNorthSteel

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Tyler Mehrer	**Stamp #:**	83	**Test Date:**	5/4/2020
Employee ID #:				**Rev Date:**	N/A
TNS Division:	Fargo			**Code:**	AWS D1.5

Test WPS No:	FCAW 71E .0625		
Type of Joint:	Plate Groove Weld	Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug slot (except CJP T, Y & K conn's)		
Base Metal Welded:	ASTM A572 to ASTM A572		

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process	**FCAW**	**FCAW**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Backing	3/8" x 1"	Backing or Backgouging
Filler metal classification	E71T-1	All Approved
Filler metal specification	5.20	5.xx
Filler metal F-No.	N/A	N/A
Welding position - groove	Vertical	Vert/Horz/Flat
Welding position - fillet	N/A	Vert/Horz/Flat
Weld progression	Vertical Up	Vertical Up
Shielding gas	100% CO_2	A5.xx Approved
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	Single	Single
VISUAL EXAMINATION RESULTS (6.10.1)	**Acceptable**	
FILLET TEST RESULTS (6.23.4.1 & 6.23.2.2)	N/A	N/A
Fracture Test Root Penetration:	N/A	N/A
Macroetch	N/A	N/A

GUIDED BEND TESTS (6.17.12)	**Specimen 1**	**Specimen 2**
Side Bend	Acceptable	Acceptable

RADIOGRAPHIC TEST RESULTS (6.23.3) **N/A**

Film Identification No N/A Lab Test Number: N/A

Date of Test: 5/4/2020 Test Conducted by: Jason Hewson

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of:

Clause 5 of AWS D1.5 - Structural Welding Code - Bridge

TrueNorth Steel

AWS® Jason Hewson
CWI STAMP 581
QC1 EXP. 10/1/2022

Authorized by: Jason Hewson

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Tyler Mehrer	Stamp:	83	Date:	8/13/2020
Test WPS No.:	SMAW Limited 3G			Rev/Date:	
Type of Joint:	Plate Groove Weld			Type:	Manual
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	SMAW / Manual	SMAW / Manual
Base metal thickness - groove (in.)	3/8" Plate	1/8" to 3/4"
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	Backing or Backgouging
Filler metal classification	E7018	
Filler metal specification	5.1	
Filler metal F-No.	4	F1-F4
Welding position - groove	3G - Vertical	Flat, Horizontal and Vertical
Welding position - fillet	N/A	Flat, Horizontal and Vertical
Weld progression	Vertical Up	Vertical Up
Shielding gas	N/A	N/A
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Root/Face Bend	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By	Jason Hewson
Date of Test	8/13/2020

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company TrueNorth Steel

Authorized By

TrueNorthSteel

WELDER QUALIFICATION TEST RECORD

Welder's Name:	Wyatt Ledoux	**Stamp #:**	75	**Test Date:**	9/11/2020
Employee ID #:	75			**Rev Date:**	
TNS Division:	Fargo			**Code:**	AWS D1.5

Test WPS No: FC71.062.100 B-U4a-GF
Type of Joint: Plate Groove Weld — Type: Semi-Automatic
Joint Qualified: Groove, fillet, Plug & Slot (except CJP,T,Y, & K conn's)
Base Metal Welded: ASTM A572-50 to ASTM A572-50

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process	**FCAW**	**FCAW**
Base metal thickness - groove (in.)	1' Plate	1/8" to Unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to Unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Backing	3/8" x 1"	Backing or Backgouging
Filler metal classification	E71T-1	
Filler metal specification	AWS 5.20	AWS 5.XX
Filler metal F-No.	N/A	N/A
Welding position - groove	Horizontal	Horizontal & Flat
Welding position - fillet	N/A	Horizontal & Flat
Weld progression	N/A	N/A
Shielding gas	100% CO2	100% CO2
Welding current/polarity	DCEP (reverse)	DCEP (reverse)
Transfer mode (GMAW)	Globular	Globular
Single/multiple electrode	Single	Single

VISUAL EXAMINATION RESULTS (6.10.1)	**Acceptable**	
	Acceptable	
FILLET TEST RESULTS (6.23.4.1 & 6.23.2.2)	None	
Fracture Test Root Penetration:	None	
Macroetch	None	

GUIDED BEND TESTS (6.17.12)	**Specimen 1**	**Specimen 2**
Side Bend	Acceptable	Acceptable

RADIOGRAPHIC TEST RESULTS (6.23.3)

Film Identification No: N/A — Lab Test Number: N/A

Date of Test: 9/11/2020 — Test Conducted by: Jason Hewson

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of:

9/11/2020

TrueNorth Steel

Jason Hewson
CWI 13101581
QC1 EXP. 10/1/2022

Authorized by:

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Yevgeniy Patselov**	Stamp:	**15**	Date:	2/14/2017
Test WPS No.:	FCAW 71E .0625			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**FCAW /SemiAutomatic**	**FCAW Semi-Auto, Auto & Machine**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With backing only
Filler metal classification	E71T-1	
Filler metal specification	5.20	
Filler metal F-No.	N/A	N/A
Welding position - groove	1G - Flat	Flat
Welding position - fillet	N/A	Flat and Horizontal
Weld progression	N/A	N/A
Shielding gas	100% CO^2	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	Specimen 1	Specimen 2
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	Specimen 1	Specimen 2
Side Bend 1G	Acceptable	Acceptable

Tested Under D1.5 Criteria

Test Conducted By: Alan Sherbo - AWS CWI #14060851

Date of Test: 2/14/2017

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 5 of AWS D1.5, Bridge Welding Code.

Company: TrueNorth Steel

Authorized By: Alan W. Sherbo

WELDER AND WELDING OPERATOR QUALIFICATION RECORD

Welder or welding operator's name Yevgeniy Patselov Identification no. 15
Welding process SMAW Manual X Semiautomatic ____ Mechanized ____
Position 4G
(Flat, horizontal, overhead or vertical—if vertical, state whether upward or downward)
In conformance with WPS no. SMAW 3G UL
Material specification ASTM A572 Gr 50
Thickness range this qualifies Unlimited

FILLER METAL

Specification no. AWS 5.1 Classification E7018-HR4 F no. ____
Describe filler metal (if not covered by AWS specification) ____
Is backing used? Yes
Filler metal diameter and trade name 1/8" Lincoln Excalibur 7018-MR
Flux for SAW or gas for GMAW or FCAW-G ____

VISUAL INSPECTION (6.26.1)

Appearance Acceptable Undercut Acceptable Piping porosity Acceptable

Guided Bend Test Results

Type	Result	Type	Result
Side	Acceptable		
Side	Acceptable		

Test conducted by Kyle Keller Laboratory test no. N/A
per AWS D1.5 Test date 6/18/18

Fillet Test Results

Appearance ____ Fillet size ____
Fracture test root penetration ____ Macroetch ____
(Describe the location, nature, and size or any crack or tearing of the specimen.)
Test conducted by ____ Laboratory test no. ____
per ____ Test date ____

RADIOGRAPHIC TEST RESULTS

Film Identification	Results	Remarks	Film Identification	Results	Remarks

Test witnessed by ____ Test no. ____
per ____

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in conformance with the requirements of AASHTO/AWS D1.5M/D1.5, (2015) *Bridge Welding Code*.
(year)

Jason Hewson
CWI 13101581
QC1 EXP. 10/1/2019

Manufacturer or Contractor TrueNorth Steel
Authorized By Jason Hewson CWI# 13101581
Date 6/18/18

Form N-5

Form N-5—Welder and Welding Operator Qualification Record

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Andy Boyer	OPTIONAL PHOTO ID	Test Date	9/27/2018	Rev.
ID Number	5		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiautomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 9/27/2018

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	August Rahlf	OPTIONAL PHOTO ID	Test Date	10/2/2018	Rev.
ID Number	74		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 10/2/2018

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Austin Stanton	OPTIONAL PHOTO ID	Test Date	10/8/2018	Rev.
ID Number	78		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 10/8/2018

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Ben Spaeth	OPTIONAL PHOTO ID	Test Date	4/2/19	Rev.
ID Number	88		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 4/2/19

Form M-4 (See http://go.aws.org/D1forms)

WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICAITON TEST RECORD

TrueNorth Steel

Welder's Name: Brent Williams Stamp: #12 Date: 3/28/18 Page: 1
Test WPS No.: GM.D1.8.045.90-10.2G.SB.CJP Rev.: 0 WPQ No.: N/A
Type of Joint Welded: Plate Groove Weld (max root opening = 3/16")
Joint Type(s) Qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base Metal(s) Welded: ASTM A572 Gr50 to A572 Gr50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding Process / Type:	GMAW-C/ Semiautomatic	GMAW-C/ Semiautomatic
Base Metal Thickness – Groove:	.375" (max root opening = 3/16")	CJP: 1/8" to ¾" PJP: 1/8" to Unlimited
Base Metal Thickness – Fillet:	N/A	1/8" to Unlimited
Pipe Diameter – Groove:	N/A	24" and over with backing, back gouging or both
Pipe Diameter – Fillet:	N/A	All Diameters
Box Tube Size:	N/A	All Sizes with backing, back gouging or both
Dihedral Angle – Fillet:	N/A	30° to Unlimited
Backing:	Backing Used (Steel)	With Steel backing only
Filler metal classification:	E70C-6M H4 (.045")	
Filler metal specification:	5.18	
Filler metal F-No.:	6	N/A
Welding Position – Groove:	2G – Horizontal	Flat & Horizontal
Welding Position – Fillet:	N/A	Flat & Horizontal
Weld Progression:	N/A	N/A
Shielding Gas:	90% Argon, 10% CO2	
Welding Current / Polarity:	DCEP (reverse)	
Transfer Mode (GMAW):	N/A	N/A
Single / multiple electrode:	N/A	N/A

Notes:
Visual Inspection Acceptable: Yes Other Test Results:

GUIDED BEND TEST (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: N/A Test No.: N/A
Inspected by: N/A Title: N/A Date: N/A

RADIOGRAPHIC TEST RESULTS (4.31.3.2)

Film ID No.	Results	Remarks	Film ID No.	Results	Remarks
XRWQ-BW	Acceptable				

Organization: Pro Inspection Services Test No.: XRWQ-BW
Inspected by: Brent Thorsness Title: ANST Level II Date: 4/11/18

We, the undersigned, certify that the statements in this record are correct and that test welds were prepared, welded and tested in conformance with the requirements of Clause 5 of AWS D1.8/D1.8M Structural Welding Code – Seismic Supplement.

Manufacturer or Contractor:
Certified By: Jason Hewson Date: 4/11/18 Quality Control-TNS

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Cooper Thurston	OPTIONAL PHOTO ID	Test Date	10/3/2018	Rev.
ID Number	76		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor True North Steel

Authorized by Jason Hewson

Date 10/3/2018

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

#8

True North Steel

Welder's Name: Proffit, Deb Stamp: DP 1G Stamp Number: DP 1G

Test WPS No.: N/A Rev.: 0 WPQ No.: DP092012 Date: 9/20/2012 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Manual	GMAW / Manual, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	Over 24"
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: DP 1G

Inspected by: Troy Fink 9/20/2012 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
DP 1G	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: DP 1G

Interpreted by: Troy Fink 9/20/2012 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson (Jason Hewson) 12/17/13 (Date) Quality Control-TNS

WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder GMAW

Name Garrett Anderson Identification No. 22

Welding Procedure Specification No. GM.045.95-5.2G.SBB Rev 0 Date 8/10/18

Variables	Record Actual Values Used in Qualification	Qualification Range
Process/Type [Table 4.12, Item (1)]	GMAW	
Electrode (single or multiple) [Table 4.12, Item (7)]	Single	
Current/Polarity	DCEP	
Position [Table 4.12, Item (4)]	2G	Unlimited
Weld Progression [Table 4.12, Item (5)]	Horizontal	
Backing (YES or NO) [Table 4.12, Item (6)]	YES	
Material/Spec.	to	
Base Metal		
Thickness: (Plate)	1"	
Groove		
Fillet	Groove	
Thickness: (Pipe/tube)		
Groove		
Fillet		
Diameter: (Pipe)		
Groove		
Fillet		
Filler Metal (Table 4.12)		
Spec. No.	A 5.18	
Class	ER70S-6	
F-No. [Table 4.12, Item (2)]		
Gas/Flux Type (Table 4.12)	90% Argon/10% CO2	
Other		

VISUAL INSPECTION (4.9.1)

Acceptable YES or NO YES

Guided Bend Test Results (4.31.5)

Type	Result	Type	Result
Side Bend 1/Acceptable		Side Bend 2/Acceptable	

Fillet Test Results (4.31.2.3 and 4.31.4.1)

Appearance _____ Fillet Size _____

Fracture Test Root Penetration _____ Macroetch _____

(Describe the location, nature, and size of any crack or tearing of the specimen.)

Inspected by _____ Test Number _____

Organization _____ Date _____

RADIOGRAPHIC TEST RESULTS (4.31.3.2)

Film Identification Number	Results	Remarks	Film Identification Number	Results	Remarks

Interpreted by _____ Test Number _____

Organization _____ Date _____

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (2015 (year)) *Structural Welding Code—Steel.*

Manufacturer or Contractor TrueNorth Steel Authorized By Jason Hewson

Form N-4 Date 8/10/18

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Hue Lam	OPTIONAL PHOTO ID	Test Date	4/2/19	Rev.
ID Number	87		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 4/2/19

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Jacob Hodenfield	OPTIONAL PHOTO ID	Test Date	5/24/19	Rev.
ID Number	90		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 5/24/19

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Jaden Hodenfield	OPTIONAL PHOTO ID	Test Date	5/24/19	Rev.
ID Number	91		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 5/24/19

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Jakob Bjorland	OPTIONAL PHOTO ID	Test Date	11/25/2019	Rev.
ID Number	54		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiautomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 11/25/2019

Form M-4 (See http://go.aws.org/D1forms)

WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder GMAW

Name Janelle Cave Identification No. 27

Welding Procedure Specification No. GM.045.95-5.2G.SBB Rev 0 Date 8/10/18

Variables	Record Actual Values Used in Qualification	Qualification Range
Process/Type [Table 4.12, Item (1)]	GMAW	
Electrode (single or multiple) [Table 4.12, Item (7)]	Single	
Current/Polarity	DCEP	
Position [Table 4.12, Item (4)]	2G	Unlimited
Weld Progression [Table 4.12, Item (5)]	Horizontal	
Backing (YES or NO) [Table 4.12, Item (6)]	YES	
Material/Spec.	to	
Base Metal		
Thickness: (Plate)	1"	
Groove		
Fillet	Groove	
Thickness: (Pipe/tube)		
Groove		
Fillet		
Diameter: (Pipe)		
Groove		
Fillet		
Filler Metal (Table 4.12)		
Spec. No.	A 5.18	
Class	ER70S-6	
F-No. [Table 4.12, Item (2)]		
Gas/Flux Type (Table 4.12)	90% Argon/10% CO2	
Other		

VISUAL INSPECTION (4.9.1)

Acceptable YES or NO YES

Guided Bend Test Results (4.31.5)

Type	Result	Type	Result
Side Bend 1/Acceptable		Side Bend 2/Acceptable	

Fillet Test Results (4.31.2.3 and 4.31.4.1)

Appearance _____ Fillet Size _____

Fracture Test Root Penetration _____ Macroetch _____

(Describe the location, nature, and size of any crack or tearing of the specimen.)

Inspected by _____ Test Number _____

Organization _____ Date _____

RADIOGRAPHIC TEST RESULTS (4.31.3.2)

Film Identification Number	Results	Remarks	Film Identification Number	Results	Remarks

Interpreted by _____ Test Number _____

Organization _____ Date _____

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (2015 (year)) *Structural Welding Code—Steel.*

Manufacturer or Contractor TrueNorth Steel Authorized By Jason Hewson

Form N-4 Date 8/10/18

ID "R"

WELDER, WELDING OPERATOR OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder: Semi-automatic

Name: Jason Hewson (O) Identification No.:

Welding Procedure Specification No.: Rev: Date:

	Record Actual Values Used in Qualification	Qualification Range
Variables		
Process/Type (5.16.2)	GMAW	
Electrode (Single or Multiple)	Single	Single
Current/Polarity	DC-EP	
Position (5.16.5)	1G	1G, 1F
Weld Progression (5.16.7)	N/A	N/A
Backing (YES or NO) (5.16.18)	With	With
Material/Spec. (5.16.1)	A36 to A36	
Base Metal		
Thickness: (Plate)		
Groove	.375"	.125" to .750"
Fillet		Unlimited
Thickness: (Pipe/tube)		
Groove		.125" to .750"
Fillet		Unlimited
Diameter: (Pipe)		
Groove		24" & Over
Fillet		24" & Over
Filler Metal (5.16.3)		
Spec. No.	5.18	
Class	ER70S-6	
F-No.	6	
Gas/Flux Type (5.16.4)	95% Argon/5% CO2	
Other	N/A	

VISUAL INSPECTION (5.12.6 or 5.12.7)

Acceptable YES or NO yes

Guided Bend Test Results (5.28.1/5.29.1)

Type	Result	Type	Result

Fillet Test Results (5.28.2/5.28.3; 5.39.3/5.39.4)

Appearance: Fillet Size:

Fracture Test Root Penetration: Macroetch:

(Describe the location, nature, and size of any crack or tearing of the specimen)

Inspected by: Test Number:

Organization: Date:

RADIOGRAPHIC TEST RESULTS (5.28.4/5.39.2)

Film ID No.	Results	Remarks	Film ID No.	Results	Remarks
1G JH	Satisfactory-Porosity-Slag				

Interpreted by: Todd Schultz/ASNT-TC-1A Level II Test Number:

Organization: Midwest Industrial X-Ray, Inc. Date: 10/29/99

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 5, Part C or D of ANSI/AWS D1.1, (1998) Structural Welding Code--Steel

Manufacturer or Contractor: Fargo Tank year

Authorized By: James Rudiang

WELDER, WELDING OPERATOR OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder: Metal Core Semi-automatic | SS#: N/A

Name: Jason Hewson (O) | Identification No.: JH

Welding Procedure Specification No.: N/A | Rev: | Date:

	Record Actual Values Used in Qualification	Qualification Range
Variables		
Process/Type (5.16.2)	GMAW	
Electrode (Single or Multiple)	single	single
Current/Polarity	DC-EP	
Position (5.16.5)	1G	1G,1F,2F
Weld Progression (5.16.7)	n/a	n/a
Backing (YES or NO) (5.16.18)	with backing	with backing
Material/Spec. (5.16.1)	A36	
Base Metal		
Thickness: (Plate)		
Groove	1.0"	.125" to unlimited
Fillet		.125" to unlimited
Thickness: (Pipe/tube)		
Groove		.125" to unlimited
Fillet		.125" to unlimited
Diameter: (Pipe)		
Groove		over 24"
Fillet		over 24"
Filler Metal (5.16.3)		
Spec. No	5.18	
Class	E70C-GM-H4	
F-No.	6	6
Gas/Flux Type (5.16.4)	75%Argon/25%Co2	
Other	N/A	

VISUAL INSPECTION (5.12.6 or 5.12.7)

Acceptable YES or NO: yes

Guided Band Test Results (5.28.1/5.29.1)

Type	Result	Type	Result

Fillet Test Results (5.28.2/5.28.3; 5.39.3/5.39.4)

Appearance: | Fillet Size:

Fracture Test Root Penetration: | Macroetch:

(Describe the location, nature, and size of any crack or tearing of the specimen)

Inspected by: | Test Number:

Organization: | Date:

RADIOGRAPHIC TEST RESULTS (5.28.4/5.39.2)

Film ID No.	Results	Remarks	Film ID No.	Results	Remarks
1G JH	Satisfactory- no apparent defects				

Interpreted by: Troy Fink / ASNT-TC-1A Level II | Test Number:

Organization: Midwest Industrial X-Ray Inc. | Date: 5/14/2008

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 5, Part C or D of ANSI/AWS D1.1, (2006) Structural Welding Code--Steel

Manufacturer or Contractor: Fargo Tank | year

Authorized By: Jim Rudiang

Date: 5/13/2008 | MIX Invoice: 18705 | Form E-4

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Javier Lopez	OPTIONAL PHOTO ID	Test Date	2/6/2020	Rev.
ID Number	34		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	TrueNorth Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiautomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 2/6/2020

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: **Johnston, Jeff** Stamp: **#30** Stamp Number: **#30**

Test WPS No.: **GM.045.95-51G.VBUTT** Rev.: **0** WPQ No.: **JJ032614** Date: **3/26/2014** Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 30

Inspected by: Ken Kolb 3/26/2014 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
JJ30	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 30

Interpreted by: Ken Kolb 3/26/2014 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 3/26/2014 (Date) Quality Control-TNS

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Jeremy Truhlicka	OPTIONAL PHOTO ID	Test Date	2/6/2020	Rev.
ID Number	71		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	TrueNorth Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor True North Steel

Authorized by Jason Hewson

Date 2/6/2020

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Lundon, Jesse Stamp: #31

Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: JL122115 Date: 12/21/2015 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 572, Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: JL31

Inspected by: Mike Arlt 12/21/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
JL31	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: JL31

Interpreted by: Mike Arlt 12/21/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lynnes 12/21/15 (Date) Quality Control-TNS

WELDER AND WELDING OPERATOR QUALIFICATION TEST RECORD

Welder or welding operator's name Jesse Lundon 31 Identification no. —
Welding process SMAW Manual X Semiautomatic — Machine —
Position 1G Flat
(Flat, horizontal, overhead or vertical — if vertical, state whether upward or downward)
In accordance with procedure specification no Prequalified
Material specification ASTM A36 to A36
Diameter and wall thickness (if pipe) — otherwise, joint thickness .375" Plate T
Thickess range this qualifies .125 to .750 Groove & Unlimited Fillet

FILLER METAL

Specification no. SFA 5.10 Classification E7018 F no. 4
Describe filler metal (if not covered by AWS specification)

Is backing strip used? Yes .250"
Filler metal diameter and trade name 1/8"
Flux for submerged arc or gas for gas metal arc or flux cored arc welding N/A

VISUAL INSPECTION (9.25.1)

Appearance Good Undercut None Piping porosity None

Guided Bend Test Results

Type	Result	Type	Result

Test conducted by Chuck Schaan Laboratory test no. #2
per Midwest Industrial X-Ray, Test date 3-19-1992

Fillet Test Results

Appearance — Fillet size —
Fracture test root penetration — Macroetch —
(Describe the location, nature, and size of any crack or tearing of the specimen.)
Test conducted by Chuck Schaan Laboratory test no. #2
per Midwest Industrial X-Ray, Inc. Test date 3-19-1992

RADIOGRAPHIC TEST RESULTS

Film identification	Results	Remarks	Film identification	Results	Remarks
JL 1G	Satisfactory	Porosity			

Test witnessed by Mike Manger Test no. 2443
per Midwest Industrial X-Ray, Inc.

We, the undersigned, certify that the statements in this record are correct and that the welds were prepared and tested in accordance with the requirements of AASHTO/AWS D1.5, (88 (year)) Bridge Welding Code.

Manufacturer or contractor Fargo Tank Co. & Division
Authorized by Jim Rudlang
Date 3-19-1992 Test Plate ID# 11

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Jesus Anguiano	OPTIONAL PHOTO ID	Test Date	11/8/18	Rev.
ID Number	7		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.045.90-10.2G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	1 in	-
Welded To	ASTM A36	UNS K02600	1	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		Unlimited	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G,2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor True North Steel

Authorized by Jason Hewson

Date 10/2/2018

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Nelson, Joe Stamp: #33
Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: JN122115 Date: 12/21/2015 Page 1
Type of joint welded: Plate Groove weld
Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base metal(s) welded: ASTM A 36 to ASTM A 572, Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: JN33

Inspected by: Mike Arlt 12/21/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
JN33	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: JN33

Interpreted by: Mike Arlt 12/21/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lynnes 12/21/15 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Nelson, Joe Stamp: 33

Test WPS No.: GM.045.95-51G.VBUTT Rev.: 0 WPQ No.: GM.045.95-51G.VBUTT Date: 9/30/2016 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 572 Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: 33

Inspected by: Roberto Meza 9/30/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
1G 33 045	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: 33

Interpreted by: Roberto Meza 9/30/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lynnes 9/30/16 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Vernetti, Jory Stamp: WQ JV #9
Test WPS No.: GM.045.95-51G.VBUTT Rev.: 0 WPQ No.: JV110215 Date: 11/2/2015 Page 1
Type of joint welded: Plate Groove weld
Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: JV 1G

Inspected by: Kevin Clark 11/2/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
JV 1G	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: JV 1G

Interpreted by: Kevin Clark 11/2/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 11-2-15 (Date) Quality Control-TNS

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Joseph Stupnik	OPTIONAL PHOTO ID	Test Date	10/3/2018	Rev.
ID Number	77		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 10/3/2018

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Perkins, Justin Stamp: #26 Stamp Number: #26
Test WPS No.: GM.045.95-5.2G.SBB Rev.: 0 WPQ No.: JP052915 Date: 5/29/2015 Page 1
Type of joint welded: Plate Groove weld
Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base metal(s) welded: ASTM A 36 to ASTM A 572

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	2G - Horizontal	Flat & Horizontal
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: #26

Inspected by: Mario Lozoya 5/29/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
JP	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: #26

Interpreted by: Mario Lozoya 5/29/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson (Jason Hewson) 5-29-2015 (Date) Quality Control-TNS

WELDER, WELDING OPERATOR OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder: Semi-auto

Name: Justin Perkins 26 Identification No:

Welding Procedure Specification No: Rev: Date:

	Record Actual Values Used in Qualification	Qualification Range
Variables		
Process/Type (Table 4.10, Item (2))	GMAW	
Electrode (Single or Multiple) (Table 4.10, Item (9))	Single	Single
Current/Polarity	DC-EP	
Position (Table 4.10, Item (5))	1G	1G,1F,2F
Weld Progression (Table 4.10, Item (7))	N/A	N/A
Backing (YES or NO) (Table 4.10, Item (8))	yes	With Backing
Material/Spec. (Table 4.10, Item (1))	A36 to A36	
Base Metal		
Thickness: (Plate)		
Groove	.375"	.125" to .750"
Fillet		Unlimited
Thickness: (Pipe/tube)		
Groove		.125" to .750"
Fillet		Unlimited
Diameter: (Pipe)		
Groove		24" & Over
Fillet		24" & Over
Filler Metal (Table 4.10, Item (3))		
Spec. No	A 5.18	
Class	ER70S-6	
F-No.	6	6
Gas/Flux Type (Table 4.10, Item (4))	95%Argon/5% Co2	
Other		

VISUAL INSPECTION (4.8.1)

Acceptable YES or NO yes

Guided Bend Test Results (4.30.5)

Type	Result	Type	Result

Fillet Test Results (4.30.2.3 and 4.30.4.1)

Appearance: Fillet Size:

Fracture Test Root Penetration: Macroetch:

(Describe the location, nature, and size of any crack or tearing of the specimen)

Inspected by: Test Number:

Organization: Date: 4/21/2003

RADIOGRAPHIC TEST RESULTS (4.30.3.1)

Film ID No	Results	Remarks	Film ID No	Results	Remarks
1G JP	Satisfactory/ no apparent defects				

Interpreted by: Missy Manger/ ASNT-TC-IA Level II Test Number: MIX Invoice: 12729

Organization: Midwest Industrial X-Ray, Inc. Date: 7/7/2004

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 4 of ANSI/AWS D1.1 (2002) Structural Welding Code—Steel

Manufacturer or Contractor: Fargo Tank year

Authorized By: Jim Reiling

Date: 7/7/2004

Form E-4

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Kelly Koble	OPTIONAL PHOTO ID	Test Date	5/28/2019	Rev.
ID Number	53		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiautomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 5/28/2019

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: **Flemming, Kevin** Stamp: **#41** Stamp Number: **#41**

Test WPS No.: **GM.045.95-51G.VBUTT** Rev.: **0** WPQ No.: **KF032714** Date: **3/27/2014** Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 41

Inspected by: Ken Kolb 3/27/2014 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
KF41	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 41

Interpreted by: Ken Kolb 3/27/2014 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 3/27/2014 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Flemming, Kevin Stamp: 41

Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: GM.035.95-51G.VBUTT Date: 9/30/2016 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: 41

Inspected by: Roberto Meza 9/30/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
1G 41 035	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: 41

Interpreted by: Roberto Meza 9/30/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lyness 9/30/16 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Prashek, Lawrence Stamp: # 55 Stamp Number: # 55

Test WPS No.: GM.045.95-51G.VBUTT Rev.: 0 WPQ No.: LP082015 Date: 8/20/2015 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: LP 1G

Inspected by: Troy Fink 8/20/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
LP55 1G	Acceptable	Porosity			

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: LP 1G

Interpreted by: Troy Fink 8/20/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 8/20/2015 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Prashek, Lawrence Stamp: 55
Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: GM.035.95-51G.VBUTT Date: 9/30/2016 Page 1
Type of joint welded: Plate Groove weld
Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base metal(s) welded: ASTM A 36 to ASTM A 572 Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: 55

Inspected by: Roberto Meza 9/30/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
1G 55 035	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: 55

Interpreted by: Roberto Meza 9/30/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lyons 9/30/16 (Date) Quality Control-TNS

WELDER QUALIFICATION TEST RECORD

Welder's Name:	**Logan Brown**	Stamp:	**B**	Date:	3/9/2015
Test WPS No.:	MCAW2G.045 Unlimited			Rev:	0
Type of Joint:	Plate Groove Weld			Type:	Semi-Automatic
Joint Qualified:	Groove, fillet, plug and slot (except CJP T, Y & K conn's)				(Automatic, manual, etc.)
Base Metal Welded:	ASTM A572-50 to ASTM A572-50				

VARIABLE	VALUE used in QUALIFICATION	QUALIFICATION RANGE
Welding process/type	**GMAW /SemiAutomatic**	**GMAW Semi-Auto, Auto & Machine**
Base metal thickness - groove (in.)	1" Plate	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	N/A
Pipe diameter - fillet (in.)	N/A	N/A
Box tube size (in.)	N/A	N/A
Dihedral angle - fillet	N/A	N/A
Backing	Backing Used	With backing only
Filler metal classification	E70C-6M	
Filler metal specification	5.18	
Filler metal F-No.	N/A	N/A
Welding position - groove	2G - Horizontal	Flat and Horizontal
Welding position - fillet	N/A	Flat and Horizontal
Weld progression	N/A	N/A
Shielding gas	90% Argon / 10% CO^2	
Welding current/polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray Arc	Spray Arc or Globular
Single/multiple electrode	N/A	N/A

VISUAL EXAMINATION RESULTS	**Specimen 1**	**Specimen 2**
Appearance	Acceptable	Acceptable
Cracks	None	None
Undercut	None	None
Reinforcement	Acceptable	Acceptable

GUIDED BEND TESTS	**Specimen 1**	**Specimen 2**
Side Bend 2G	Acceptable	Acceptable

Test Conducted By	Rick Steiner
Date of Test	3/9/2015

The undersigned certify that the statements in this record are correct and that the test welds were prepared and tested in accordance with the requirements of Clause 4 of AWS D1.1 Structural Welding Code - Steel.

Company TrueNorth Steel

Authorized By

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Quang, Mai Stamp: #42 Stamp Number: #42

Test WPS No.: GM.045.95-51G.VBUTT Rev.: 0 WPQ No.: MQ032614 Date: 3/26/2014 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 42

Inspected by: Ken Kolb 3/26/2014 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
MQ 42	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 42

Interpreted by: Ken Kolb 3/26/2014 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson (Jason Hewson) 3/26/2014 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Quang, Mai Stamp: 42

Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: GM.035.95-51G.VBUTT Date: 10/13/2016 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 572 Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: 42

Inspected by: Sidrac Flores 10/13/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
GM 42 1G	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: 42

Interpreted by: Sidrac Flores 10/13/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lynnes 10/13/16 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: **Aalgard, Matt** Stamp: **#28** Stamp Number: **#28**

Test WPS No.: **GM.045.95-51G.VBUTT** Rev.: **0** WPQ No.: **MA032614** Date: **3/26/2014** Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 28

Inspected by: Ken Kolb 3/26/2014 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
MA 28	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 28

Interpreted by: Ken Kolb 3/26/2014 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 3/26/2014 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Aalgaard, Matt Stamp: #28

Test WPS No.: SAW.094.LIN761.1G.VBUTT Rev.: 0 WPQ No.: MA122115 Date: 12/21/2015 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 572, Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	SAW / Semiautomatic	SAW / Semiautomatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	F7A2-EM12K	
Filler metal specification	5.17	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Flux	761	
Welding current / polarity	Alternating current	
Transfer mode (GMAW)	N/A	N/A
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: MA28

Inspected by: Mike Arlt 12/21/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
MA28	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: MA28

Interpreted by: Mike Arlt 12/21/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lymes 12/21/15 (Date) Quality Control-TNS

WELDER, WELDING OPERATOR OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder	Submerged Arc	SS#	N/A
Name	Matt Aalgard 28	Identification No	MA
Welding Procedure Specification No.	SAW -7-8	Rev	Date 8-Jul

	Record Actual Values Used in Qualification	Qualification Range
Variables		
Process/Type [Table 4.10, Item (2)]	SAW	
Electrode (Single or Multiple) [Table 4.10, Item (9)]	single	single
Current/Polarity	DC-EP	
Position [Table 4.10, Item (5)]	1G	1G,1F,2F
Weld Progression [Table 4.10, Item (7)]	N/A	N/A
Backing (YES or NO)[Table 4.10, Item (8)]	with backing	with backing
Material/Spec [Table 4.10, Item (1)]	A36-650 to A36-650	
Base Metal		
Thickness (Plate)		
Groove	1.00"	.125" to unlimited
Fillet		.125" to unlimited
Thickness (Pipe/tube)		
Groove		.125" to unlimited
Fillet		.125" to unlimited
Diameter: (Pipe)		
Groove		24" & over
Fillet		24" & over
Filler Metal [Table 4.10, Item (3)]		
Spec. No.	A5.17	
Class	EM12K	
F-No.	6	6
Gas/Flux Type [Table 4.10, Item (4)]	Lincoln 860 neutral	
Other		

VISUAL INSPECTION (4.8.1)

Acceptable YES or NO yes

Guided Bend Test Results (4.30.5)

Type	Result	Type	Result

Fillet Test Results (4.30.2.3 and 4.30.4.1)

Appearance _____ Fillet Size _____

Fracture Test Root Penetration _____ Macroetch _____

(Describe the location, nature, and size of any crack or tearing of the specimen)

Inspected by _____ Test Number _____

Organization _____ Date _____

RADIOGRAPHIC TEST RESULTS (4.30.3.1)

Film ID No	Results	Remarks	Film ID No	Results	Remarks
1G MA	Satisfactory- no apparent defects				

Interpreted by Nick Furman / ASNT-TC-1A Level II Test Number _____

Organization Midwest Industrial X-Ray Inc Date 8/8/2008

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 4 ANSI/AWS D1.1, (2006) Structural Welding Code--Steel

Manufacturer or Contractor Fargo Tank year

Authorized By Jim Rudlang

Date 8/8/2008 MIX Invoice 19301 Form E-4

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Monte Scott	OPTIONAL PHOTO ID	Test Date	6/19/2017	Rev.
ID Number	52		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 6/19/2017

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Lynnes, Nathan Stamp: 04 Stamp Number: 04

Test WPS No.: GM.045.90-10.1G.SVB Rev.: 0 WPQ No.: NL022013 Date: 2/20/2013 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	Over 24"
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	90% Argon, 10%Co2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: WQ 04 U 1G

Inspected by: Troy Fink 2/20/2013 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
WQ 04 U 1G	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: WQ 04 U 1G

Interpreted by: Troy Fink 2/20/2013 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 2/17/13 (Date) Quality Control-TNS

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Nathan Edge	OPTIONAL PHOTO ID	Test Date	1/16/2018	Rev.
ID Number	85		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 1/16/2018

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Stalvik, Orville Stamp: 63

Test WPS No.: GM.045.95-51G.VBUTT Rev.: 0 WPQ No.: GM.045.95-51G.VBUTT Date: 9/30/2016 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 572 Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: 63

Inspected by: Roberto Meza 9/30/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
1G 63 045	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: 63

Interpreted by: Roberto Meza 9/30/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lyness 9/30/16 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Stalvik, Orville Stamp: #63
Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: OS122115 Date: 12/21/2015 Page 1
Type of joint welded: Plate Groove weld
Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base metal(s) welded: ASTM A 36 to ASTM A 572, Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: OS63

Inspected by: Mike Arlt 12/21/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
OS63	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: OS63

Interpreted by: Mike Arlt 12/21/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lynnes 12/21/15 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Myhra, Ross Stamp: RM 57 Stamp Number: RM 57

Test WPS No.: GM.045.95-51G.VBUTT Rev.: 0 WPQ No.: RM102513 Date: 10/25/2013 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% CO2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 57

Inspected by: Ken Kolb 10/25/2013 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
57	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 57

Interpreted by: Ken Kolb 10/25/2013 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 10/25/13 (Date) Quality Control-TNS

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Myhra, Ross Stamp: 57

Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: GM.035.95-51G.VBUTT Date: 9/30/2016 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 572 Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: 57

Inspected by: Roberto Meza 9/30/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
1G 57 035	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: 57

Interpreted by: Roberto Meza 9/30/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lynnes 9/30/16 (Date) Quality Control-TNS

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	San Magar	OPTIONAL PHOTO ID	Test Date	11/25/2019	Rev.
ID Number	89		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiautomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 11/25/2019

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Sanjay Majhi	OPTIONAL PHOTO ID	Test Date	11/25/2019	Rev.
ID Number	64		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 11/25/2019

Form M-4 (See http://go.aws.org/D1forms)

WELDER, WELDING OPERATOR OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder: Semi Automatic — SS#:

Name: Shane Lundon 32 — Identification No.:

Welding Procedure Specification No.: — Rev: — Date:

	Record Actual Values Used in Qualification	Qualification Range
Variables		
Process/Type (5.16.2)	GMAW	
Electrode (Single or Multiple)	Single	Single
Current/Polarity	DC-EP	
Position (5.16.5)	1G	1G, 1F, 2F
Weld Progression (5.16.7)	N/A	N/A
Backing (YES or NO) (5.16.18)	with backing	with backing
Material/Spec. (5.16.1)	A36 to A36	
Base Metal		
Thickness. (Plate)		
Groove	.375"	.125" to .750" max
Fillet		Unlimited
Thickness. (Pipe/tube)		
Groove		.125" To .750" max
Fillet		Unlimited
Diameter. (Pipe)		
Groove		24" & Over
Fillet		24" & Over
Filler Metal (5.16.3)		
Spec No.	5.18	
Class	ER70S-6	
F-No	6	6
Gas/Flux Type (5.16.4)	95% Ar / 5% Co2	
Other	N/A	

VISUAL INSPECTION (5.12.6 or 5.12.7)

Acceptable YES or NO: yes

Guided Bend Test Results (5.28.1/5.29.1)

Type	Result	Type	Result

Fillet Test Results (5.28.2/5.28.3/5.39.3/5.39.4)

Appearance — Fillet Size

Fracture Test Root Penetration — Macroetch

(Describe the location, nature, and size of any crack or tearing of the specimen)

Inspected by — Test Number

Organization — Date

RADIOGRAPHIC TEST RESULTS (5.28.4/5.39.2)

Film ID No	Results	Remarks	Film ID No	Results	Remarks
1G SL	Satisfactory / N.A.D				

Interpreted by: Brent Thorsness ASNT-TC-1A Level II — Test Number:

Organization: Midwest Industrial X-Ray, Inc. — Date: 1/23/03

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 5, Part C or D of ANSI/AWS D1.1 (2002) Structural Welding Code--Steel

Manufacturer or Contractor: Fargo Tank — year

Authorized By: James Ruslang

Date: 1/23/03 — MIX Invoice: 10917G — Form E-4

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Lundon, Shane Stamp: 32

Test WPS No.: GM.035.95-51G.VBUTT Rev.: 0 WPQ No.: GM.035.95-51G.VBUTT Date: 9/30/2016 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 572 Grade 50

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	.375	CJP: 1/8" to 3/4" PJP: 1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: 32

Inspected by: Roberto Meza 9/30/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
1G 32 035	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: 32

Interpreted by: Roberto Meza 9/30/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Nathan Lynnes 9/30/16 (Date) Quality Control-TNS

Nathan Lynnes

2013 Form 015 - Format C

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: **Reber, Todd** Stamp: **14** Stamp Number: **14**

Test WPS No.: **GM.045.95-51G.VBUTT** Rev.: **0** WPQ No.: **TR102513** Date: **10/25/2013** Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	N/A	N/A
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 14

Inspected by: Ken Kolb 10/25/2013 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
14	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: 14

Interpreted by: Ken Kolb 10/25/2013 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

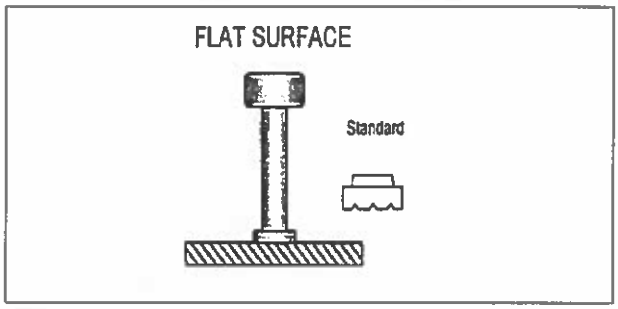
Manufacturer or Contractor: Midwest Industrial X-Ray

Certified By: Jason Hewson (Jason Hewson) 10/25/13 (Date) Quality Control-TNS

STUD WELDING PROCEDURE SPECIFICATION (WPS) Yes ☐
OR PROCEDURE QUALIFICATION RECORD (PQR) Yes ☐
OR WELDER QUALIFICATION RECORD (WQR) Yes ■

Company name TRUE NORTH STEEL
Supporting PQR no.(s) PREQUALIFIED AWS D1.1
Operator name 14 Todd Feber
Stud material C-1015
Material specifications ASTM A108-07/A29
Weld base diameter 3/4"

Stud Base Sketch/Application Detail



Machine data

Power supply
Make PRO WELD Model 1850
Stud gun model AG 900
Weld time Secs. .89 Cycles
Current 1500 ±5% OCV
Polarity DCEN Lift 3/32
Plunge (protrusion) 1/8-3/16
Weld cable size 4/0 Length
Number of grounds (workpiece leads) 1

Test no. 1
Revision no. Date
By
Authorized by Jason H Date 5/15/14

Base material

Specification A36/A572
Alloy and temper mild
Group no. 1&2 Surface condition HR ■ CR ☐
Coating
Cleaning method Grinding/Chipping
Decking gage N/A

Shape

Flat ■ Round ☐ Tube ☐ Angle ☐
Thickness 1/8-U

Ferrule

Part no. F152
Ferrule description Flat

Position

Overhead Downhand X Sidehand
Angular degrees from normal
Angle iron Inside radius Heel of angle

Shielding gas

Shielding gas(es) N/A
Composition N/A
Flow rate N/A

WELD TEST RESULTS

Stud No.	Visual Acceptance	Option #1 Bend Test	Option #2 Tension Test	Option #3 Torque Test*
1	ACCEPTABLE	ACCEPTABLE		
2	ACCEPTABLE	ACCEPTABLE		
3	ACCEPTABLE	ACCEPTABLE		
4	ACCEPTABLE	ACCEPTABLE		
5	ACCEPTABLE	ACCEPTABLE		
6	ACCEPTABLE	ACCEPTABLE		
7	ACCEPTABLE	ACCEPTABLE		
8	ACCEPTABLE	ACCEPTABLE		
9	ACCEPTABLE	ACCEPTABLE		
10	ACCEPTABLE	ACCEPTABLE		

*Note: Torque test optional for threaded fasteners only.

Mechanical tests conducted by TRUE NORTH STEEL Date ~~5/15/2014~~
(Company)

We, the undersigned, certify that the statements in this record are correct and the test welds were prepared, welded, and tested in accordance with the requirements of AWS B2.1/B2.1M, (2010 (year)), *Specification for Welding Procedure and Performance Qualification.*

Signed by Joan Hamm Title QC Date 5/15/14
(Contractor/Applicator)

Source: Adapted from AWS D1.1/D1.1M:2008, *Structural Welding Code—Steel*, Annex N Form N-9, American Welding Society.

Figure F.4—Example of a Welding Procedure Specification and Procedure Qualification Record for Stud Welding

STUD WELDING APPLICATION QUALIFICATION TEST DATA FORM PER SUBCLAUSE 7.6 Yes ☐
PRE-PRODUCTION TEST PER SUBCLAUSE 7.7.1 (WPS) Yes ☐
OR PROCEDURE QUALIFICATION RECORD (PQR) Yes ☐
OR WELDER QUALIFICATION RECORD (WQR) Yes ■

Company name True North Steel
Operator name 14
Test number 1
Weld stud material c-1015 Nelson
Weld stud size and PN#/Manufacturer S3L 3/4 101-098-015

Base Material
Specification ASTM A36, ASTM A572 GR 50
Alloy and temper
Surface condition HR ■ CR ☐
Coating n/a
Cleaning method grinding, chipping
Decking gage n/a

Shape of Base Material
Flat ■ Round ☐ Tube ☐
Angle ☐ Inside ☐ Outside ☐ Inside radius ☐
Thickness 1/4"-U

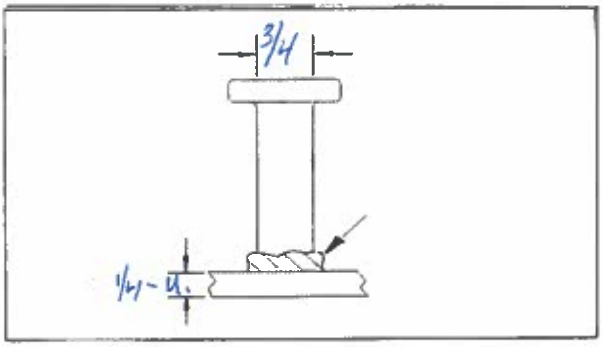
Ferrule
Part No./Manufacturer Nelson
Ferrule description F152

Equipment Data
Application Settings, Current, and Time Settings
Make Pro weld Model 1850
Stud gun: Make Pro weld Model AG 900
Weld time (seconds) .89
Current (amperage) 1500
Polarity: DCEN X DCEP
Lift 3/32
Plunge (protrusion) 1/8-3/16
Weld cable size 4/0 Length
Number of grounds (workpiece leads) 1

Welding Position
Flat (Down hand) ■ Horizontal (Side hand) ☐ Angular—degrees from normal ☐ Overhead ☐

Shielding Gas
Shielding gas(es)/Composition n/a
Flow rate n/a

Stud Base Sketch/Application Detail



WELD TEST RESULTS

Stud No.	Visual Acceptance	Option #1 Bend Test	Option #2 Tension Test	Option #3 Torque Test*
1	Acceptable	Acceptable		
2	Acceptable	Acceptable		
3	Acceptable	Acceptable		
4	Acceptable	Acceptable		
5	Acceptable	Acceptable		
6	Acceptable	Acceptable		
7	Acceptable	Acceptable		
8	Acceptable	Acceptable		
9	Acceptable	Acceptable		
10	Acceptable	Acceptable		

*Note: Torque test optional for threaded fasteners only.

Mechanical tests conducted by True North Steel (Company) Date 5/15/2014

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 7 of AWS D1.1/D1.1M, (2010 (year)) *Structural Welding Code—Steel.*

Signed by [signature] (Contractor/Applicator/Other) Title QC Date 5/15/2014

Form N-9 Company True North Steel

WELDER, WELDING OPERATOR OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder: Metal core semi-automatic | SS#: N/A

Name: Todd Reber (L | Identification No.: TR

Welding Procedure Specification No.: N/A | Rev: | Date:

	Record Actual Values Used in Qualification	Qualification Range
Variables		
Process/Type (5.16.2)	GMAW	
Electrode (Single or Multiple)	single	single
Current/Polarity	DC-EP	
Position (5.16.5)	1G	1G,1F,2F
Weld Progression (5.16.7)	n/a	n/a
Backing (YES or NO) (5.16.18)	with backing	with backing
Material/Spec. (5.16.1)	A36	
Base Metal		
Thickness: (Plate)		
Groove	1"	.125 to unlimited
Fillet		.125 to unlimited
Thickness: (Pipe/tube)		
Groove		.125 to unlimited
Fillet		.125 to unlimited
Diameter: (Pipe)		
Groove		24" & over
Fillet		24" & over
Filler Metal (5.16.3)		
Spec. No.	5.18	
Class	E70C-6M-H4	
F-No.	6	6
Gas/Flux Type (5.16.4)	75%Argon/25%Co2	
Other	N/A	

VISUAL INSPECTION (5.12.6 or 5.12.7)

Acceptable YES or NO: yes

Guided Bend Test Results (5.28.1/5.29.1)

Type	Result	Type	Result

Fillet Test Results (5.28.2/5.28.3; 5.39.3/5.39.4)

Appearance: | Fillet Size:

Fracture Test Root Penetration: | Macroetch:

(Describe the location, nature, and size of any crack or tearing of the specimen)

Inspected by: | Test Number:

Organization: | Date:

RADIOGRAPHIC TEST RESULTS (5.28.4/5.39.2)

Film ID No.	Results	Remarks	Film ID No.	Results	Remarks
1G TR	satisfactory- no apparent defects				

Interpreted by: Troy Fink / ASNT-TC-1A Level II | Test Number:

Organization: Midwest Industrial X-Ray Inc. | Date: 4/16/2009

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 5, Part C or D of ANSI/AWS D1.1, (2008) Structural Welding Code--Steel

Manufacturer or Contractor: Fargo Tank | year

Authorized By: Jim Rudlang

Date: 4/16/2009 | MIX Invoice: 20598 | Form E-4

WELDER, WELDING OPERATOR OR TACK WELDER QUALIFICATION TEST RECORD

Type of Welder: Semi Automatic — SS#: —

Name: Tom Grieve 39 — Identification No.: —

Welding Procedure Specification No.: — Rev: — Date: —

	Record Actual Values Used in Qualification	Qualification Range
Variables		
Process/Type (5.16.2)	GMAW	
Electrode (Single or Multiple)	Single	Single
Current/Polarity	DC-EP	
Position (5.16.5)	1G	1G 1F, 2F
Weld Progression (5.16.7)	N/A	N/A
Backing (YES or NO) (5.16.18)	with backing	with backing
Material/Spec. (5.16.1)	A36 to A36	
Base Metal		
Thickness: (Plate)		
Groove	.375"	.125" to .750" max
Fillet		Unlimited
Thickness: (Pipe/tube)		
Groove		.125" To .750" max
Fillet		Unlimited
Diameter: (Pipe)		
Groove		24" & Over
Fillet		24" & Over
Filler Metal (5.16.3)		
Spec. No.	5.18	
Class	ER70S-6	
F-No.	6	6
Gas/Flux Type (5.16.4)	95% Ar / 5% Co2	
Other	N/A	

VISUAL INSPECTION (5.12.6 or 5.12.7)

Acceptable YES or NO: yes

Guided Bend Test Results (5.28.1/5.29.1)

Type	Result	Type	Result

Fillet Test Results (5.28.2/5.28.3; 5.39.3/5.39.4)

Appearance: — Fillet Size: —

Fracture Test Root Penetration: — Macroetch: —

(Describe the location, nature, and size of any crack or tearing of the specimen)

Inspected by: — Test Number: —

Organization: — Date: —

RADIOGRAPHIC TEST RESULTS (5.28.4/5.39.2)

Film ID No	Results	Remarks	Film ID No.	Results	Remarks
1-G TG	Satisfactory / N.A.D.				

Interpreted by: Brent Thornsess ASNT-TC-1A Level II — Test Number: —

Organization: Midwest Industrial X-Ray, Inc. — Date: 1/23/03

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section 5, Part C or D of ANSI/AWS D1.1, (2002) Structural Welding Code--Steel

Manufacturer or Contractor: Fargo Tank — year

Authorized By: James Rudeng

Date: 1/23/03 — MIX Invoice: 109170 — Form E-4

Northern Technologies LLC
4032 7th Ave N
Fargo, ND 58102

TrueNorth Steel

Welder's Name: Grieve, Tom Stamp: #39
Test WPS No.: GMAW-STT.035.75-25.1G P-P Rev.: 0 WPQ No.: N/A Date: 8/25/2017 Page 1
Type of joint welded: Pipe Groove weld
Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base metal(s) welded: ASTM A 106, Grade B to ASTM A 106, Grade B

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type:	GMAW / Semiautomatic	GMAW / Semiautomatic
Base metal thickness - groove (in.):	0.226	1/8" to 3/4" PJP to unlimited
Base metal thickness - fillet (in.):	N/A	1/8" to unlimited
Pipe diameter - groove (in.):	4	3/4" to 4"
Pipe diameter - fillet (in.):	N/A	3/4" to 4"
Box tube size (in.):	N/A	All sizes
Dihedral angle - fillet:	N/A	30° to unlimited
Backing:	Backing used	With backing only
Filler metal classification:	ER70S-6	
Filler metal specification:	5.18	
Filler metal F-No.:	6	N/A
Welding position - groove:	1GR - Rotated	Flat only
Welding position - fillet:	N/A	Flat & Horizontal
Weld progression:	N/A	N/A
Shielding gas:	75% Argon, 25% CO2	
Welding current / polarity:	DCEP (reverse)	
Transfer mode (GMAW):	N/A	N/A
Single / multiple electrode:	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Northern Technologies Test No.: TG 39

Inspected by: Dan Marsolek 8/9/2017 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
TG 39	Acceptable				

Organization: Northern Technologies Test No.: TG 39

Interpreted by: Dan Marsolek 8/9/2017 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: TrueNorth Steel

Certified By: Josh Benson 8-10-17 (Date) Quality Control

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: Waterworth, Trace Stamp: 25

Test WPS No.: GM.045.95-51G.VBUTT Rev.: 0 WPQ No.: GM.045.95-51G.VBUTT Date: 6/14/2016 Page 1

Type of joint welded: Plate Groove weld

Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)

Base metal(s) welded: ASTM A 36 to ASTM A 36

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	1G - Flat	Flat only
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray Test No.: TW 25

Inspected by: Brent Thorsness 6/14/2016 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
TW 25	Acceptable				

Organization: Midwest Industrial X-Ray Test No.: TW 25

Interpreted by: Brent Thorsness 6/14/2016 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson (Jason Hewson) 6-16-2016 (Date) Quality Control-TNS

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Tucker Skoblik	OPTIONAL PHOTO ID	Test Date	10/1/2018	Rev.
ID Number	70		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.035.90-10.1G.SBB	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A36	UNS K02600	1	-	-	3/8	-
Welded To	ASTM A36	UNS K02600	1	-	-	3/8	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	3/8	-		1/8 in -3/4 in	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	ER70S-6		All
F-Number	-		-
Position	1G		
Groove – Plate & Pipe ≥ 24 in			1G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F,2F
Fillet – Pipe < 24 in			1F,2F
Progression	N/A		N/A
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Root Bend	4.9.3.3	Acceptable	-
Face Bend	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015) *Structural Welding Code—Steel*.
(year)

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 10/1/2018

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Tyler Mehrer	OPTIONAL PHOTO ID	Test Date	10/10/19	Rev.
ID Number	83		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	True North Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor TrueNorth Steel

Authorized by Jason Hewson

Date 10/10/19

Form M-4 (See http://go.aws.org/D1forms)

Welder Qualification Form (Single-Process)
WELDER, WELDING OPERATOR, OR TACK WELDER
PERFORMANCE QUALIFICATION TEST RECORD

Name	Wyatt Ledoux	OPTIONAL PHOTO ID	Test Date	2/6/2020	Rev.
ID Number	75		Record No.	-	0
Stamp No.	-		Std. Test No.	-	0
Company	TrueNorth Steel		WPS No.	GM.D1.8.1/16.90-10.2G.B-U4a-GF	0
Division	Fargo		Qualified To	AWS D1.1	

BASE METALS	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material	ASTM A572	Gr 50	2	-	-	1 in	-
Welded To	ASTM A572	Gr 50	2	-	-	1 in	-

VARIABLES	Actual Values		RANGE QUALIFIED
Type of Weld Joint	Plate-Groove with Backing		Groove, Fillet, Plug, and Slot Welds
Base Metal	Group 1 to Group 1		Any AWS D1.1 Qualified Base Metal

	Groove	Fillet		Groove	Fillet
Plate Thickness	1 in	-		1/8 in- Unlimited	1/8 in min.
Pipe/Tube Thickness	-	-		1/8 in -3/4 in	Unlimited
Pipe Diameter	-	-		24 in min.	Unlimited

Welding Process	GMAW		GMAW
Type *(Manual, Semiautomatic, Mechanized, Automatic)*	Semiautomatic		Semiatomatic, Mechanized, Automatic
Backing	With		With (incl. Backgouging and Backwelding)
Filler Metal (AWS Spec.)	A5.18		A5.xx
AWS Classification	E70C-6M H4		All
F-Number	-		-
Position	2G		
Groove – Plate & Pipe ≥ 24 in			1G, 2G
Groove – Pipe < 24 in			-
Fillet – Plate & Pipe ≥ 24 in			1F, 2F
Fillet – Pipe < 24 in			1F, 2F
Progression	-		-
GMAW Transfer Mode	Spray		Spray, Globular, Pulsed
Single or Multiple Electrodes	Single		Single
Gas/Flux Type	Argon 90% / CO2 10%		A5.xx Approved

TEST RESULTS

Type of Test	Acceptance Criteria	Results	Remarks
Visual	4.9.1	Acceptable	-
Side Bend 1	4.9.3.3	Acceptable	-
Side Bend 2	4.9.3.3	Acceptable	-

CERTIFICATION

Test Conducted by	
Laboratory	Internal
Test Number	
File Number	

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Clause 4 of AWS D1.1/D1.1M (2015 (year)) *Structural Welding Code—Steel*.

Manufacturer or Contractor True North Steel

Authorized by Jason Hewson

Date 2/6/2020

Form M-4 (See http://go.aws.org/D1forms)

Midwest Industrial X-Ray
4032 7th Ave N
Fargo, ND 58102

True North Steel

Welder's Name: **Patselor, Yevgeniy** Stamp: **#15** Stamp Number: **#15**
Test WPS No.: **GM.045.95-5.2G.SBB** Rev.: **0** WPQ No.: **YP052215** Date: **5/22/2015** Page 1
Type of joint welded: Plate Groove weld
Joint type(s) qualified: All applicable groove, fillet, plug, and slot welds (except CJP T-, Y-, & K-connections)
Base metal(s) welded: ASTM A 36 to ASTM A 572

Variables (Table 4.12)	Actual Values Used	Range Qualified
Welding process / type	GMAW / Semiautomatic	GMAW / Semiautomatic, Machine, and Automatic
Base metal thickness - groove (in.)	1.00	1/8" to unlimited
Base metal thickness - fillet (in.)	N/A	1/8" to unlimited
Pipe diameter - groove (in.)	N/A	24" and over with backing, back gouging or both
Pipe diameter - fillet (in.)	N/A	All diameters.
Box tube size (in.)	N/A	All sizes with backing, back gouging or both
Dihedral angle - fillet	N/A	30° to unlimited
Backing	Backing used	With backing only
Filler metal classification	ER70S-6	
Filler metal specification	5.18	
Filler metal F-No.	6	N/A
Welding position - groove	2G - Horizontal	Flat & Horizontal
Welding position - fillet	N/A	Flat & Horizontal
Weld progression	N/A	N/A
Shielding gas	95% Argon, 5% O2	
Welding current / polarity	DCEP (reverse)	
Transfer mode (GMAW)	Spray arc	Spray or Globular arc
Single / multiple electrode	N/A	N/A

Notes:

Visual inspection acceptable: Yes Other test results:

Guided Bend Test (4.31.5)

Figure Number and Type	Result	Figure Number and Type	Result
None		None	
None		None	
None		None	

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: #15

Inspected by: Mario Lazoya 5/22/2015 (Date) ASNT Level II

Radiographic Test Results (4.31.3.2)

Film ID No.	Result	Remarks	Film ID No.	Result	Remarks
YP WI 15	Acceptable				

Organization: Midwest Industrial X-Ray - Fargo, ND Test No.: #15

Interpreted by: Mario Lozoya 5/22/2015 (Date) ASNT Level II

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M Structural Welding Code - Steel.

Manufacturer or Contractor: True North Steel

Certified By: Jason Hewson 5-25-15 (Date) Quality Control-TNS

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American Welding Society®

Certifies that Welding Inspector

Graham P. Gulsvig

has complied with the requirements of AWS QC1,
Standard for AWS Certification of Welding Inspectors

25053121
CERTIFICATE NUMBER

May/01/2028
EXPIRATION DATE

Richard L. Holdren
AWS PRESIDENT

Robert Dinos
AWS QUALIFICATION & CERTIFICATION
COMMITTEE CHAIR

American Welding Society®

Certifies that Welding Inspector

Matthew P. Aalgaard

has complied with the requirements of AWS QC1,
Standard for AWS Certification of Welding Inspectors

25011281
CERTIFICATE NUMBER

Jan/01/2028
EXPIRATION DATE

AWS PRESIDENT

AWS QUALIFICATION & CERTIFICATION
COMMITTEE CHAIR

American Welding Society®

Certifies that Welding Inspector

Taylor M. Burns

has complied with the requirements of AWS QC1,
Standard for AWS Certification of Welding Inspectors

23091861
CERTIFICATE NUMBER

Sep/01/2026
EXPIRATION DATE

AMERICAN WELDING SOCIETY INCORPORATED 1932 NEW YORK

AWS PRESIDENT

AWS QUALIFICATION & CERTIFICATION COMMITTEE CHAIR

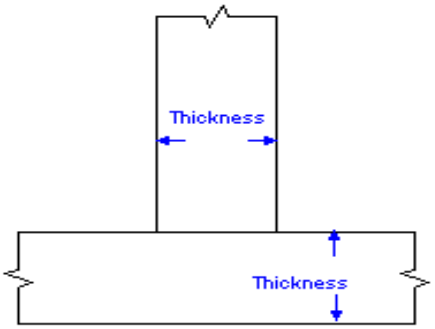
WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED No | **QUALIFIED BY PQR** Yes
or PROCEDURE QUALIFICATION RECORDS (PQR) N/A

Identification No.	**FC81.0625.100.Fillet 1-4 to 5-16**	Authorized By	Josh Benson	Date	10/11/2022
Welding Process(es)	FCAW	Revision No.	0	Rev. Date	N/A
Supporting PQR No(s).	See Note Below	Revision By	N/A		

AWS Code: AWS D1.5 2020 Bridge
TYPE: Semi-Auto

Joint Detail Fillet



JOINT DESIGN USED

Type:	T-Joint		
Single Weld:	Yes	Double Weld:	No
Backing:	N/A		
Backing Material:	N/A		
Root Opening:	0 - 1/16"		
Root Face Dimension:	N/A		
Groove Angle:	N/A	Radius (J-U):	
Back Gouging:	N/A		
Method:	N/A		

BASE METALS

AWS Material Group:	N/A
Material Specification:	ASTM A588
Diameter (Pipe):	N/A

WPS covers ASTM A36, A572 Gr.50, A588 (A709 Gr. 36,50,50W)

FILLER METALS

AWS Specification:	AWS 5.29
AWS Classification:	E81T1-Ni1C-JH4
Trade Name:	Lincoln Ultracore 81Ni1C-H
Electrode Diameter	1/16"

SHIELDING

Flux	N/A	Gas	CO2
		Composition	100%
		Flow Rate	40-45 CFH
		Nozzle Size	5/8"
Electrode/Flux Class:	N/A		

PREHEAT/INTERPASS **MAX 450°F**

Minimum Preheat/Interpass - Base Metal Thickness of Thickest Part

1/8" - 3/4" = 50°F.
3/4" -1-1/2" = 70°F.
1-1/2" - 2-1/2" = 150°F.
Over 2-1/2" 225°F.

POSITION

Position of Groove:	N/A	Fillet:	Flat/Horz.
Vertical Progression:	N/A		

ELECTRICAL CHARACTERICS

Transfer Mode (GMAW):	N/A		
Current/Polarity:	DCEP		
Tungsten Electrode (GTAW):			
Size:	N/A	Type:	

TECHNIQUE

Stringer and/or Weave Bead:	Stringer		
Multi-Pass and/or Single Pass:	Single		
Number of Electrodes:	One		
Electrode Spacing:	Longitudinal:	N/A	
	Lateral:	N/A	
	Angle:	N/A	
Contact Tube to Work Distance:	1/2" to 1"		
Peening Required:	N/A		
Interpass Cleaning:	N/A		

POSTWELD HEAT TREATMENT:

Temperature:	N/A
Time (Hr.):	N/A

WELDING PROCEDURE

Pass Or Weld Layers	Process	Weld Size	Filler Metals		Current			Travel Speed (in/min.)
			Dia.	Class	Type & Polarity	Amps or WFS	Volts	
Single	FCAW	1/4"	1/16"	E81T1-Ni1C-JH4	DCEP	280-335 Amps	25.8-29.5	13.5-16.5
Single	FCAW	5/16"	1/16"	E81T1-Ni1C-JH4	DCEP	280-335 Amps	25.8-29.5	8.6-10.5
	FCAW							
	FCAW							
	FCAW							
	FCAW							
	FCAW							

Written by: Joshua Benson CWI #21061081

Note: When the base metal temperature is below 32^0 F, preheat to a minimum of 70^0 F; the minimum interpass temperature shall be maintained during welding.

Note: Supporting PQR No(s). FWS81.0625.100.1F 3-16 1-4, FWS81.0625.100.2F 3-16 1-4, FWS81.0625.100.1F 5-16 3-8, FWS81.0625.100.2F 5-16 3-8

TrueNorth Steel

WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED No **QUALIFIED BY PQR** Yes

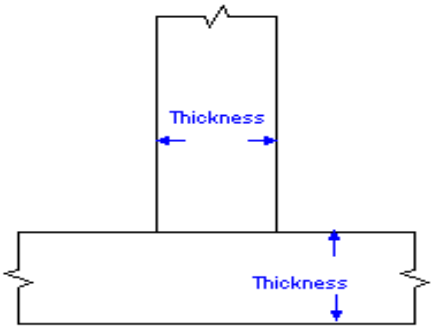
or PROCEDURE QUALIFICATION RECORDS (PQR) N/A

Identification No.	**FC81.0625.100.Fillet 3-16 to 5-16**	Authorized By	Josh Benson	Date	10/11/2022
Welding Process(es)	FCAW	Revision No.	0	Rev. Date	N/A
Supporting PQR No(s).	See Note Below	Revision By	N/A		

AWS Code: AWS D1.5 2020 Bridge

TYPE: Semi-Auto

Joint Detail Fillet



JOINT DESIGN USED

Type:	T-Joint		
Single Weld:	Yes	Double Weld:	No
Backing:	N/A		
Backing Material:	N/A		
Root Opening:	0 - 1/16"		
Root Face Dimension:	N/A		
Groove Angle:	N/A	Radius (J-U):	
Back Gouging:	N/A		
Method:	N/A		

BASE METALS

AWS Material Group:	N/A
Material Specification:	ASTM A588
Diameter (Pipe):	N/A

WPS covers ASTM A36, A572 Gr.50, A588 (A709 Gr. 36,50,50W)

FILLER METALS

AWS Specification:	AWS 5.29
AWS Classification:	E81T1-Ni1C-JH4
Trade Name:	Lincoln Ultracore 81Ni1C-H
Electrode Diameter	1/16"

SHIELDING

Flux	N/A	Gas	CO2
		Composition	100%
		Flow Rate	40-45 CFH
		Nozzle Size	5/8"
Electrode/Flux Class:	N/A		

PREHEAT/INTERPASS MAX 450°F

Minimum Preheat/Interpass - Base Metal Thickness of Thickest Part

1/8" - 3/4" = 50°F.

3/4" -1-1/2" = 70°F.

1-1/2" - 2-1/2" = 150°F.

Over 2-1/2" 225°F.

POSITION

Position of Groove:	N/A	Fillet:	Flat/Horz.
Vertical Progression:	N/A		

ELECTRICAL CHARACTERICS

Transfer Mode (GMAW):	N/A		
Current/Polarity:	DCEP		
Tungsten Electrode (GTAW):			
Size:	N/A	Type:	

TECHNIQUE

Stringer and/or Weave Bead:	Stringer	
Multi-Pass and/or Single Pass:	Single	
Number of Electrodes:	One	
Electrode Spacing:	Longitudinal:	N/A
	Lateral:	N/A
	Angle:	N/A
Contact Tube to Work Distance:	1/2" to 1"	
Peening Required:	N/A	
Interpass Cleaning:	N/A	

POSTWELD HEAT TREATMENT:

Temperature:	N/A
Time (Hr.):	N/A

WELDING PROCEDURE

Pass Or Weld Layers	Process	Weld Size	Filler Metals		Current			Travel Speed (in/min.)
			Dia.	Class	Type & Polarity	Amps or WFS	Volts	
Single	FCAW	3/16"	1/16"	E81T1-Ni1C-JH4	DCEP	280-335 Amps	25.8-29.5	18-22
Single	FCAW	1/4"	1/16"	E81T1-Ni1C-JH4	DCEP	280-335 Amps	25.8-29.5	13.5-16.5
Single	FCAW	5/16"	1/16"	E81T1-Ni1C-JH4	DCEP	280-335 Amps	25.8-29.5	8.6-10.5
	FCAW							
	FCAW							
	FCAW							
	FCAW							

Written by: Joshua Benson CWI #21061081

Note: When the base metal temperature is below 32^0 F, preheat to a minimum of 70^0 F; the minimum interpass temperature shall be maintained during welding.

Note: Supporting PQR No(s). FWS81.0625.100.1F 3-16 1-4, FWS81.0625.100.2F 3-16 1-4, FWS81.0625.100.1F 5-16 3-8, FWS81.0625.100.2F 5-16 3-8

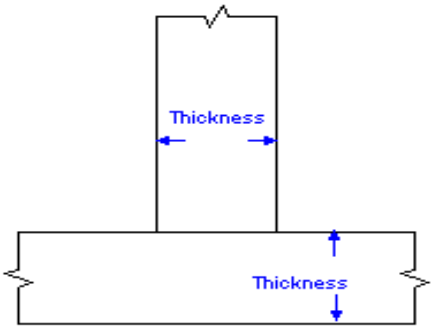
WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED No | **QUALIFIED BY PQR** Yes
or PROCEDURE QUALIFICATION RECORDS (PQR) N/A

Identification No.	**FC81.0625.100.Fillet 5-16 to 1**	Authorized By	Josh Benson	Date	10/11/2022
Welding Process(es)	FCAW	Revision No.	0	Rev. Date	N/A
Supporting PQR No(s).	See Note Below	Revision By	N/A		

AWS Code: AWS D1.5 2020 Bridge
TYPE: Semi-Auto

Joint Detail Fillet



JOINT DESIGN USED

Type:	T-Joint		
Single Weld:	Yes	Double Weld:	No
Backing:	N/A		
Backing Material:	N/A		
Root Opening:	0 - 1/16"		
Root Face Dimension:	N/A		
Groove Angle:	N/A	Radius (J-U):	
Back Gouging:	N/A		
Method:	N/A		

BASE METALS

AWS Material Group:	N/A
Material Specification:	ASTM A588
Diameter (Pipe):	N/A

WPS covers ASTM A36, A572 Gr.50, A588 (A709 Gr. 36,50,50W)

FILLER METALS

AWS Specification:	AWS 5.29
AWS Classification:	E81T1-Ni1C-JH4
Trade Name:	Lincoln Ultracore 81Ni1C-H
Electrode Diameter	1/16"

SHIELDING

Flux	N/A	Gas	CO2
		Composition	100%
		Flow Rate	40-45 CFH
		Nozzle Size	5/8"
Electrode/Flux Class:	N/A		

PREHEAT/INTERPASS **MAX 450°F**

Minimum Preheat/Interpass - Base Metal Thickness of Thickest Part

1/8" - 3/4" = 50°F.
3/4" -1-1/2" = 70°F.
1-1/2" - 2-1/2" = 150°F.
Over 2-1/2" 225°F.

POSITION

Position of Groove:	N/A	Fillet:	Flat/Horz.
Vertical Progression:	N/A		

ELECTRICAL CHARACTERICS

Transfer Mode (GMAW):	N/A
Current/Polarity:	DCEP
Tungsten Electrode (GTAW):	
Size: N/A	Type:

TECHNIQUE

Stringer and/or Weave Bead:		Stringer
Multi-Pass and/or Single Pass:		Both
Number of Electrodes:		One
Electrode Spacing:	Longitudinal:	N/A
	Lateral:	N/A
	Angle:	N/A
Contact Tube to Work Distance:		1/2" to 1"
Peening Required:		N/A
Interpass Cleaning:		N/A

POSTWELD HEAT TREATMENT:

Temperature:	N/A
Time (Hr.):	N/A

WELDING PROCEDURE

Pass Or Weld Layers	Process	Weld Size	Filler Metals		Current			Travel Speed (in/min.)
			Dia.	Class	Type & Polarity	Amps or WFS	Volts	
Single	FCAW	5/16"	1/16"	E81T1-Ni1C-JH4	DCEP	280-335 Amps	25.8-29.5	8.6-10.5
Multi-pass	FCAW	3/8"	1/16"	E81T1-Ni1C-JH4	DCEP	280-335 Amps	25.8-29.5	13.5-16.5
	FCAW							
	FCAW							
	FCAW							
	FCAW							
	FCAW							

Written by: Joshua Benson CWI #21061081

Note: When the base metal temperature is below 32^0 F, preheat to a minimum of 70^0 F; the minimum interpass temperature shall be maintained during welding.

Note: Supporting PQR No(s). FWS81.0625.100.1F 5-16 3-8, FWS81.0625.100.2F 5-16 3-8, 2021FC81.

TrueNorth Steel

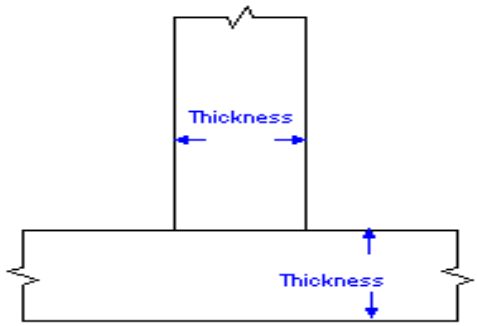
WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED No | **QUALIFIED BY PQR** Yes
or PROCEDURE QUALIFICATION RECORDS (PQR) N/A

Identification No.	**SAW61.0625.860.2F 1-4 5-16**	Authorized By	Josh Benson	Date	10/5/2022
Welding Process(es)	SAW	Revision No.	0	Rev. Date	N/A
Supporting PQR No(s).	FWS61.0625.860.2F 1-4 5-16	Revision By	N/A		

AWS Code D1.5 2020 Bridge
TYPE: Automatic

Joint Detail Fillet



JOINT DESIGN USED

Type:	Fillet		
Single Weld:	Yes	Double Weld:	N/A
Backing:	N/A		
Backing Material:	N/A		
Root Opening:	N/A		
Root Face Dimension:	N/A		
Groove Angle:	N/A	Radius (J-U):	
Back Gouging:	N/A		
Method:	N/A		

BASE METALS

AWS Material Group:	N/A
Material Specification:	ASTM A588
Diameter (Pipe):	N/A

WPS covers ASTM A36, A572 Gr.50, A588 (A709 Gr. 36,50,50W)

FILLER METALS

AWS Specification:	AWS 5.17
AWS Classification:	F7A4-EM12K-H8
Trade Name:	Lincolnweld L-61
Electrode Diameter	1/16"

SHIELDING

Flux	860	Gas	N/A
		Composition	N/A
		Flow Rate	N/A
		Nozzle Size	N/A
Electrode/Flux Class:	F7A4-EM12K-H8		

PREHEAT/INTERPASS **MAX 450°F**

Minimum Preheat/Interpass - Base Metal Thickness of Thickest Part

1/8" - 3/4" = 50°F. 1-1/2" - 2-1/2" = 150°F.
3/4" -1-1/2" = 70°F. Over 2-1/2" 225°F.

POSITION

Position of Groove:	N/A	Fillet:	Horizontal
Vertical Progression:	N/A		

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW):	N/A		
Current/Polarity:	DCEP		
Tungsten Electrode (GTAW):			
Size:	N/A	Type:	

TECHNIQUE

Stringer and/or Weave Bead:	Stringer		
Multi-Pass and/or Single Pass:	Single		
Number of Electrodes:	One		
Electrode Spacing:	Longitudinal:	N/A	
	Lateral:	N/A	
	Angle:	N/A	
Contact Tube to Work Distance:	1" to 1- 1/2"		
Peening Required:	N/A		
Interpass Cleaning:	Remove Slag and Brush as Needed		

POSTWELD HEAT TREATMENT:

Temperature:	N/A
Time (Hr.):	N/A

WELDING PROCEDURE

Pass Or Weld Layers	Process	Weld Size	Filler Metals		Current			Travel Speed (in/min.)
			Dia.	Class	Type & Polarity	Amps	Volts	
Single	SAW	1/4"	1/16"	F7A4-EM12K-H8	DCEP	306-374	26-30	11.1-15
Single	SAW	5/16"	1/16"	F7A4-EM12K-H8	DCEP	306-374	26-30	7.7-10.4

Written by: Rick Steiner CWI #10092621

Optimal Welder Settings: Volts (28) Amps (340)

WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED No | **QUALIFIED BY PQR** Yes

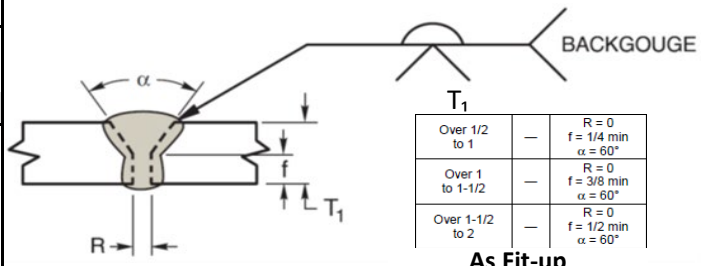
or PROCEDURE QUALIFICATION RECORDS (PQR) N/A

Identification No.	**SAW61.1-32.860.B-L2c-S**	Authorized By	Josh Benson	Date	4/6/2023
Welding Process(es)	SAW	Revision No.	0	Rev. Date	N/A
Supporting PQR No(s).	PQR-SAW-FC1	Revision By	N/A		

AWS Code: AWS D1.5 2020 Bridge

TYPE: Machine

Joint Detail B-L2c-S



As Fit-up

R = +1/16, -0

f = Not Limited

JOINT DESIGN USED

Type:	Single V Groove		
Single Weld:	No	Double Weld:	Yes
Backing:	No		
Backing Material:	N/A		
Root Opening:	0"		
Root Face Dimension:	See T_1 Chart		
Groove Angle:	60°	Radius (J-U):	
Back Gouging:	Yes		
Method:	Carbon Arc/Plasma		

BASE METALS

AWS Material Group:	N/A
Material Specification:	ASTM A709-50
Diameter (Pipe):	N/A

WPS covers ASTM A36, A572 Gr.50, A709 Gr. 36,50

FILLER METALS

AWS Specification:	AWS 5.17
AWS Classification:	EM12K
Trade Name:	Lincolnweld L-61
Electrode Diameter	3/32"

SHIELDING

Flux	Lincolnweld 860	Gas	N/A
		Composition	N/A
		Flow Rate	N/A
		Nozzle Size	3/4"
Electrode/Flux Class:	F7A4-EM12K-H8		

POSITION

Position of Groove:	Flat	Fillet:	N/A
Vertical Progression:	N/A		

ELECTRICAL CHARACTERICS

Transfer Mode (GMAW):	N/A		
Current/Polarity:	DCEP		
Tungsten Electrode (GTAW):			
Size:	N/A	Type:	

TECHNIQUE

Stringer and/or Weave Bead:	Stringer		
Multi-Pass and/or Single Pass:	Multi-pass		
Number of Electrodes:	One		
Electrode Spacing:	Longitudinal:	N/A	
	Lateral:	N/A	
	Angle:	N/A	
Contact Tube to Work Distance:	1" to 1- 1/2"		
Peening Required:	N/A		
Interpass Cleaning:	Remove Slag and Brush as Needed		

PREHEAT/INTERPASS

MAX 428°F

Minimum Preheat/Interpass - Base Metal Thickness of Thickest Part

1/8" - 3/4" = 50°F.

3/4" -1-1/2" = 70°F.

1-1/2" - 2-1/2" = 150°F.

Over 2-1/2" 225°F.

POSTWELD HEAT TREATMENT:

Temperature:	N/A
Time (Hr.):	N/A

WELDING PROCEDURE

Pass Or Weld Layers	Process	Weld Size	Filler Metals		Current			Travel Speed (in/min.)
			Dia.	Class	Type & Polarity	Amps or WFS	Volts	
All	SAW	N/A	3/32"	EM12K	DCEP	336-420 Amps	24.1-28.0	9.4-22.7

Written by: Joshua Benson CWI #21061081

Note: When the base metal temperature is below 32^0 F, preheat to a minimum of 70^0 F; the minimum interpass temperature shall be maintained during welding.

WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED No | **QUALIFIED BY PQR** Yes

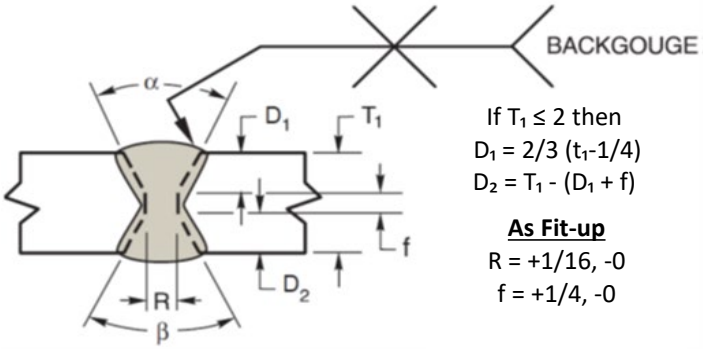
or PROCEDURE QUALIFICATION RECORDS (PQR) N/A

Identification No.	**SAW61.1-32.860.B-U3c-S**	Authorized By	Josh Benson	Date	4/6/2023
Welding Process(es)	SAW	Revision No.	0	Rev. Date	N/A
Supporting PQR No(s).	PQR-SAW-FC1	Revision By	N/A		

AWS Code: AWS D1.5 2020 Bridge

TYPE: Machine

Joint Detail B-U3c-S



If $T_1 \le 2$ then
$D_1 = 2/3\ (t_1 - 1/4)$
$D_2 = T_1 - (D_1 + f)$

As Fit-up
R = +1/16, -0
f = +1/4, -0

JOINT DESIGN USED

Type:	Double V Groove		
Single Weld:	No	Double Weld:	Yes
Backing:	No		
Backing Material:	N/A		
Root Opening:	0"		
Root Face Dimension:	1/4" min.		
Groove Angle:	60°	Radius (J-U):	
Back Gouging:	Yes		
Method:	Carbon Arc/Plasma		

BASE METALS

AWS Material Group:	N/A
Material Specification:	ASTM A709-50
Diameter (Pipe):	N/A

WPS covers ASTM A36, A572 Gr.50, A709 Gr. 36,50

FILLER METALS

AWS Specification:	AWS 5.17
AWS Classification:	EM12K
Trade Name:	Lincolnweld L-61
Electrode Diameter	3/32"

SHIELDING

Flux	Lincolnweld 860	Gas	N/A
		Composition	N/A
		Flow Rate	N/A
		Nozzle Size	3/4"
Electrode/Flux Class:	F7A4-EM12K-H8		

POSITION

Position of Groove:	Flat	Fillet:	N/A
Vertical Progression:	N/A		

ELECTRICAL CHARACTERICS

Transfer Mode (GMAW):	N/A		
Current/Polarity:	DCEP		
Tungsten Electrode (GTAW):			
Size:	N/A	Type:	

TECHNIQUE

Stringer and/or Weave Bead:	Stringer		
Multi-Pass and/or Single Pass:	Multi-pass		
Number of Electrodes:	One		
Electrode Spacing:	Longitudinal:	N/A	
	Lateral:	N/A	
	Angle:	N/A	
Contact Tube to Work Distance:	1" to 1- 1/2"		
Peening Required:	N/A		
Interpass Cleaning:	Remove Slag and Brush as Needed		

PREHEAT/INTERPASS **MAX 428°F**

Minimum Preheat/Interpass - Base Metal Thickness of Thickest Part

1/8" - 3/4" = 50°F. 1-1/2" - 2-1/2" = 150°F.

3/4" -1-1/2" = 70°F. Over 2-1/2" 225°F.

POSTWELD HEAT TREATMENT:

Temperature:	N/A
Time (Hr.):	N/A

WELDING PROCEDURE

Pass Or Weld Layers	Process	Weld Size	Filler Metals		Current			Travel Speed (in/min.)
			Dia.	Class	Type & Polarity	Amps or WFS	Volts	
All	SAW	N/A	3/32"	EM12K	DCEP	336-420 Amps	24.1-28.0	9.4-22.7

Written by: Joshua Benson CWI #21061081

Note: When the base metal temperature is below 32^0 F, preheat to a minimum of 70^0 F; the minimum interpass temperature shall be maintained during welding.

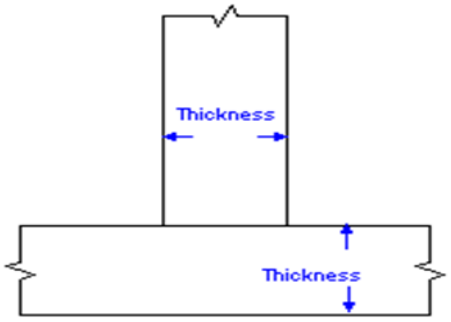
WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED No | **QUALIFIED BY PQR** Yes
or PROCEDURE QUALIFICATION RECORDS (PQR) N/A

Identification No.	**SAW61.3-32.860.2F 1-4 5-16**	Authorized By	Josh Benson	Date	4/26/2023
Welding Process(es)	SAW	Revision No.	0	Rev. Date	N/A
Supporting PQR No(s).	SAW61.0625.860.2F 1-4 5-16	Revision By	N/A		

AWS Code: AWS D1.5 2020 Bridge
TYPE: Machine

Joint Detail Fillet



JOINT DESIGN USED

Type:	T-Joint		
Single Weld:	Yes	Double Weld:	No
Backing:	N/A		
Backing Material:	N/A		
Root Opening:	0 - 1/16"		
Root Face Dimension:	N/A		
Groove Angle:	N/A	Radius (J-U):	
Back Gouging:	N/A		
Method:	N/A		

BASE METALS

AWS Material Group:	N/A
Material Specification:	ASTM A709-50
Diameter (Pipe):	N/A

WPS covers ASTM A36, A572 Gr.50, A588 (A709 Gr. 36,50,50W)

FILLER METALS

AWS Specification:	AWS 5.17
AWS Classification:	EM12K
Trade Name:	Lincolnweld L-61
Electrode Diameter	3/32"

SHIELDING

Flux	Lincolnweld 860	Gas	N/A
		Composition	N/A
		Flow Rate	N/A
		Nozzle Size	3/4"
Electrode/Flux Class:	F7A4-EM12K-H8		

POSITION

Position of Groove:	N/A	Fillet:	Horizontal
Vertical Progression:	N/A		

ELECTRICAL CHARACTERICS

Transfer Mode (GMAW):	N/A		
Current/Polarity:	DCEP		
Tungsten Electrode (GTAW):			
Size:	N/A	Type:	

TECHNIQUE

Stringer and/or Weave Bead:	Stringer		
Multi-Pass and/or Single Pass:	Single		
Number of Electrodes:	One		
Electrode Spacing:	Longitudinal:	N/A	
	Lateral:	N/A	
	Angle:	N/A	
Contact Tube to Work Distance:	1" to 1- 1/2"		
Peening Required:	N/A		
Interpass Cleaning:	N/A		

PREHEAT/INTERPASS **MAX 450°F**

Minimum Preheat/Interpass - Base Metal Thickness of Thickest Part

1/8" - 3/4" = 50°F. 1-1/2" - 2-1/2" = 150°F.
3/4" -1-1/2" = 70°F. Over 2-1/2" 225°F.

POSTWELD HEAT TREATMENT:

Temperature:	N/A
Time (Hr.):	N/A

WELDING PROCEDURE

Pass Or Weld Layers	Process	Weld Size	Filler Metals		Current			Travel Speed (in/min.)
			Dia.	Class	Type & Polarity	Amps or WFS	Volts	
Single	SAW	1/4"	3/32"	EM12K	DCEP	378-462 Amps	25.2-28.8	14-16
Single	SAW	5/16"	3/32"	EM12K	DCEP	378-462 Amps	25.2-28.8	11-13

Written by: Joshua Benson CWI #21061081

Note: When the base metal temperature is below 32^0 F, preheat to a minimum of 70^0 F; the minimum interpass temperature shall be maintained during welding.

American Welding Society®

Certifies that Welding Inspector

Trace D. Waterworth

has complied with the requirements of AWS QC1,
Standard for AWS Certification of Welding Inspectors

24092041
CERTIFICATE NUMBER

Sep/01/2027
EXPIRATION DATE

AMERICAN WELDING SOCIETY INCORPORATED 1932 NEW YORK

Michael Bryanski
AWS PRESIDENT

Robert Dinos
AWS QUALIFICATION & CERTIFICATION COMMITTEE CHAIR

American Welding Society®

Certifies that Welding Inspector

Travis J. Miller

has complied with the requirements of AWS QC1,
Standard for AWS Certification of Welding Inspectors

17050031
CERTIFICATE NUMBER

May/01/2026
EXPIRATION DATE

AMERICAN WELDING SOCIETY INCORPORATED 1932 NEW YORK

AWS PRESIDENT

AWS QUALIFICATION & CERTIFICATION COMMITTEE CHAIR