BUREAU OF STRUCTURES

Bridge Technical Committee Meeting Minutes

Date: Thursday, March 21, 2024 **Time:** 1:00pm-3:30pm **Location:** HF S149

Introductions 5 *min*

Online attendees: Gary Courneya, Greg Baer, Dominique Bechle, Brad Diener, Greg Brecka, Julie Brooks, Brent Freeman, Christine Hamil, Phil Ciha, Ruth Coisman, Josh Dietsche, Chris Fredrick, Habib Tabatabai, Hans Hallanger, Isaac Groshek, Joe Lombard, Steve Katzner, Najoua Ksontini, Leah Rhodes, Leslie Ashauer, Tirupan Mandal, Matt Grove, Michael Ryan, Dave Pantzlaff, Pat Cashin, Patrick Wiseley, Cami Peterson, Jason Roselle, Julie Slota, Dan Sydow, Tadd Owens, Tim Borowski, Tim MacLaughlin-Barck, Craig Webster

In-Person attendees: Laura Shadewald, Aaron Bonk, Mark Finnell, David Stanke, Erik Heitman, Scott Stroud, Joe Balice, Carla Principe, John Rublein, Ann Thielmann, Chad Halverson, Mark Mutziger, Brian Rowekamp, Luke Haun, Dan Kowalski, Craig Pringle, Kevin Weber, Bill Hardy, Ryan Janssen, Kyle Busch

Subcommittee Report(s) 5 *min*

5 min **Design & Construction Subcommittee Update** — Aaron Bonk

No specific requests came in from the contracting community since this last BTC meeting. Subcommittee will remain in place on an as-needed basis. No current plan in place for a meeting of this group.

Standing Topics 15 *min*

5 min **Wisconsin Highway Research Program Bridge Items** — Laura Shadewald

Laura discussed a completed project (Improving Bridge Concrete Overlay Performance), and current projects: Vertical and Overhead Patches, Bridge Thermography Policy, Underwater Concrete Pours, and State of Practice for Specifying and Repairing Mechanically Stabilized Earth Walls. Please see the link below for more information.
http://wisconsindot.gov/Pages/about-wisdot/research/whrp.aspx

Also, please send any ideas for future research topics to James Luebke (james.luebke@dot.wi.gov) by April 12th. The WHRP TOC plans to discuss and rank FFY26 Structures Research Project ideas May/June 2024.

5 min **Bridge Manual Updates** — Laura Shadewald

Laura discussed the BOS process for releasing updates to the Bridge Manual every 6 months, including webinars highlighting the updates that were recently made. Two items of note for this release include minor updates to the following areas:

- Preboring Piles – Consolidated existing guidance for clarity. Added "For problem soils, contact the Bureau of Technical Services,

Geotechnical Engineering Unit to discuss preboring considerations."

- Tension Zones – Added guidance to Ch. 24 for showing tension zones on contract plans and updated Standard 24.02 accordingly.

A link to the slides that were presented for the last WBM updates is here: https://wisconsindot.gov/dtsdManuals/strct/manuals/bridge/webinar-24-01.pdf

5 min	**Specification Changes/Updates** Mark Zander wasn't available to attend this meeting, so Laura presented the spec updates that are coming with the next publication. Laura shared the draft updates with the notification to attendees that these are draft at this point as not all of them have been approved by FHWA at the time of this meeting. Updates of note include (but are not limited to) aggregate changes for prestressed concrete girders, code updates within the steel section (506) of the spec, weld procedure references, bolting updates (discussed later in this meeting), temporary bridge driving surface limitations, etc.	Laura Shadewald

Previous Meeting Carryover Topics/Action Item(s) Review — 35 *min*

5 min	**Initiative to Reduce Overruns in Concrete Masonry Overlays** Aaron Bonk held multiple discussions with others within WisDOT since the last Bridge Tech Committee meeting. The consensus was that while there are some projects that overrun these quantities, there are no significant improvements that come without significant additional resources that may not end up improving the situation. Given these discussions, the decision has been made to leave the design, estimating, and quantity calculations; along with the bid item units as is and continued monitoring will be completed moving forward.	Aaron Bonk
5 min	**Seal Concrete Mix Design** This topic was discussed at the Fall 2023 Bridge Technical Committee meeting and has carryover action items. Language was added to 501.2.7.4 of the standard spec to allow 100% passing the 1-inch sieve.	Aaron Bonk
5 min	**In-Stream Barge Spud Pile Restrictions** A meeting was held at the end of October to discuss clarifying the intent of in-stream disturbances including for barge spud piles. On at least one project last construction season there were disputes over the spec, intent of the spec, implementation consistency from project to project, etc. Discussions during the meeting were brief as no significant progress had been made on this item since the previous meeting. Cami Peterson indicated that WDNR has held internal	Aaron Bonk

	discussions related to how their staff view this work, what their intentions are and the needs for the bid item inclusion in the plans, etc. Cami indicated WDNR is open to further discussions with WisDOT right now. Additional discussions need to be held related to in-stream disturbances and closure windows limiting work through the winters. Tim MacLaughlin-Barck and Kevin Weber indicated that they'd like to get involved in discussions at a higher level about how to address these. Issues related to the workload that is coming to be built and the contracting resourcing available will present themselves in the very near future. **Action Item(s):** BOS will schedule a meeting with WDNR to specifically discuss spud pile issues. Additionally, Matt Grove and Aaron Bonk will coordinate to schedule more discussions amongst WisDOT/WDNR/contractors related to the larger picture restriction windows. An update at the next Bridge Tech Committee meeting related to the outcome of the discussions will be held.	
5 min	**False Decking** This topic was brought forward at the Fall 2023 Bridge Tech Committee meeting. BOS staff have had some conversations with other WisDOT staff and would like to pull together a smaller working group to address all aspects of this prior to making a determination on how to move forward. Volunteers for the working group included the following: David Stanke, Scott Stroud, Kevin Weber, Dan Kowalski. Tim MacLaughlin-Barck indicated that if a special provision is put into the contract, there will need to be requirements put in place related to what it is that is required to "qualify" as false decking. **Action Item(s):** Aaron Bonk will coordinate and schedule a meeting with the working group prior to the next Bridge Tech Committee Meeting in order to determine how to clarify this issue for future projects.	Aaron Bonk
5 min	**Piling Overages with and without Preboring Measurement** This topic was discussed at the Fall 2023 Bridge Technical Committee meeting and has carryover action items. This topic remains under review and BOS will work with others to consider updates. **Action Item(s):** Laura Shadewald will follow-up on this item with Jake Gregerson and make considerations for shifts in how this type of issue is designed and how it should be handled in construction contract administration.	Laura Shadewald
5 min	**Removing Structure Over Waterway Bid Items** This topic was discussed at the Fall 2023 Bridge Technical	Aaron Bonk

	Committee meeting and has carryover action items. Aaron Bonk made a call to contractors to provide any information that they have to be shared to generate better widespread agreement/awareness of how each of the different bid items are handled. **Action Item(s):** Contractors to consider sending in example photos and/or videos of removal operations that align with the different bid items for use in compiling a clarification document. Contractors to consider adjustments to the bid items as they are configured right now to improve biddability and reduce the likelihood of disputes.	
5 min	**Erosion Control/Turbidity Barrier Issues** Hans discussed the fact that guidance and training has been provided to construction administration staff as a part of the spring construction conferences and other avenues. Hundreds of state and consultant staff were a part of these discussions and more widespread awareness of this environmental issue has been generated. Discussions related to the design process were also held related to length of installation, flashiness of waterways, etc. Bureau of Technical Services plans on developing additional FDM language to compliment Bridge Manual language regarding cofferdams and addressing concerns during the design process to ensure the issues are resolved.	Hans Hallanger

New Topics — 80 *min*

5 min	**Adhesive Anchor Cure Period** Kevin Weber discussed the issue with anchoring decorative railing to the concrete parapets. There is language in the specs that requires waiting 21 days after concrete placement. Kevin indicated that a lot of their contracts are 45 days in length total, which doesn't allow for this waiting period to be met. Laura Shadewald stated that the 21-day requirement comes from ACI and AASHTO guidance documents. **Action Item(s):** WisDOT needs to review the length of project schedules with this item included in it (similar situation with protective surface treatment as well, as well as numerous other items). This will require involvement from BPD and Region staff that set project schedules.	Kevin Weber
5 min	**Prestressed Girder Rebar Tails** David brought forward this issue on projects with the old AASHTO girders with the shear stirrups that extend away from the centerline of the girders. He indicated that the Department's desire to avoid damaging girder to flanges is inconsistent with their desire to sawcut above the girder	David Stanke

	flanges. David's contention is that there is a misunderstanding of what the intention of the design of those shear stirrups is. Tim MacLaughlin-Barck indicated that safety considerations for workers and the roadway/waterway below is critical.	
5 min	**Maturity Method for P/S Girders** Brian indicated that the maturity method information is found within 502 of the standard spec and is wondering why it can't apply to the prestressed concrete section of the spec. Brian indicated that he'd be willing to have an expert on the maturity method come in to discuss this process. His desire would be to use this for the release strength and not the 28-day strength. Tirupan Mandal indicated that the PCI Manual does not accept the maturity method and that has been the justification for not going down this path. Tirupan indicated that if PCI provides some guidance to County/Brian, he should pass this along to WisDOT and we'd reconsider its use and modify the specs as such.	Brian Rowekamp
30 min	**Field Welding/Fabrication Updates** Carla Principe, Bill Hardy, and Ryan Janssen from BOS presented this topic. See the attachments at the end of the meeting minutes for the slides that were presented. Discussion items of note included: - Reminders for annual field welding plan updates and submittals to BOS for acceptance - Weld procedure specifications and the recommendation to use approved weld procedures when possible - Preheat requirements for pipe and H-pile sections - Starting in 2025, WisDOT will ask for proof of continuity for the 2 years prior to the yearly submittal date - Clarification of vertical and overhead welds for pile splice weld details - Field welding inspection checklists and contractor vs. project leader/manager roles and responsibilities - Field bolting requirements with high strength bolts	Carla Principe/Bill Hardy
5 min	**Temporary Overhang Deck Support for Staged Construction** Dan indicated that they have had some projects where their design was done to meet the standard/spec that it was originally designed for as opposed to the current spec. Dan asked that loads be provided in the contract plans for the contractor to design to. Aaron indicated that it is the expectation that designers are assessing these situations for something that is constructable, and this has been conveyed to the design community. Brad Diener indicated that in the November 2023 letting, pre-	Dan Kowalski

	bid questions were posed (B-70-132) and the contracting community were told that they simply needed to bid the project as it is shown. David Stanke indicated that from the contractor community side of things, design guidance isn't enough and if asked, the designers should be able to provide the design concept that they had analyzed to the contractor for their review, use, and/or modification. Designers should be considering providing the loads to the contractor and notifying them whether the existing structure is able to sufficiently handle the applied loads or not.	
5 min	**Railroad Construction Plan Review Durations** Luke discussed recent projects where the railroad required the contractor to utilize guidelines from 1998 for bridge removal operations. There was a litany of issues that the railroad had with the contractor's removal plan, when other projects (both for the same and other railroad owners) had accepted those exact same removal plans. There is a lack of consistency of approvals for these plans. Matt Grove also mentioned that this issue isn't isolated to bridges, but this issue has been elevated up through the WisDOT Secretary's Office as well. Greg Baer stated that WisDOT Rails & Harbors is also trying to identify the right people on the railroad side of things to get into the room to have discussions on improving this process. Joe Balice indicated that FHWA has not had specific conversations related to these reviews. He also indicated that FHWA doesn't have any influence over how railroads handle the projects with railroad ownership, so the likelihood of them being able to significantly impact the railroad's processes is minimal.	Dan Kowalski/Luke Haun
5 min	**IRI Ride Roadway Spec Application to Bridges** This item will be deferred to the next meeting.	Dan Kowalski
5 min	**Bird Netting – WisDOT March Letting Proposal #17** This project was brought forward as a follow-up from past conversations amongst this committee. For this specific project, the work involved replacement of the structural approach slabs for the Lake Butte des Morts bridges on IH 41 in the NER. Pre-bid questions were posted to BidExpress about whether bird netting was actually necessary or not. Answers stated that netting was required between the abutments and first piers away from the abutments. Laura Shadewald reviewed this issue with the Region on this project and their response was that DNR was concerned with the anticipated vibration and required the use of this bid item. Additional follow-up on this item will be done with WDNR.	Dan Kowalski

5 min	**Box Culvert Joints** This item will be deferred to the next meeting.	Dan Kowalski
5 min	**Girder Deflection/Rebound on Redecks** This item will be deferred to the next meeting.	Dan Kowalski
5 min	**Deck Slab Joint Locations Relative to Girder Flanges on Deck Widenings** This item will be deferred to the next meeting.	Dan Kowalski

BUREAU OF STRUCTURES

Bridge Technical Committee Meeting Sign-In Sheet

Date: Thursday, March 21, 2024 **Time:** 1:00pm-3:30pm **Location:** HF S149

Name	Company	Email
Kyle Busch	WisDOT BOS	kyle.busch@dot.wi.gov
Ryan Janssen	WisDOT BOS SPU	Ryan.Janssen@dot.wi.gov
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Laura Shadewald	WisDOT BOS	Laura.Shadewald@dot.wi.gov

(4) Ensure the lubricant-adhesive consistency works well at the temperatures the seals are installed, is compatible with the seals and the concrete, and is relatively unaffected by the normal moisture in the concrete.

(5) Deliver the lubricant-adhesive in containers plainly marked with the manufacturer's name or trademark, lot number, and manufacture date.

(6) Use joint seals compatible with concrete, or steel and resistant to abrasion, oxidation, oils, gasoline, salt, and other materials spilled on or applied to the surface.

(7) Shape the seal so that in its compressed condition the top center of the exposed surface is depressed below the edges of the installed seal. At the joints maximum opening, the minimum unit pressure on the sides of the joint seal must be 3 psi.

(8) Mark the top surface of the seal at one-foot intervals clearly, in a manner durable enough to make length determinations of the seal after installing in the pavement joints.

(9) Mark shipping containers for seals clearly, with the manufacturer's name, the size of the seal, the lot number, and the manufacture date.

502.2.7.3 Expansion Devices

Revise 502.2.7.3 to change from polychloroprene to elastomeric strip seals.

(1) Ensure that expansion devices are fabricated by an approved fabricator selected from the APL for fabricated bridge components. Furnish ASTM A 709 grade 36 steel extrusions and retainers galvanized according to ASTM A123 after fabrication.

(2) The minimum thickness of the elastomeric strip seal must be 1/4 inch for non-reinforced elastomeric glands and 1/8 inch for reinforced glands. Furnish the strip seal gland in lengths suitable for a continuous one-piece installation at each individual expansion joint location. Conform to ASTM D5973 and as follows.

ELASTOMERIC STRIP SEALS[1]

PROPERTY	VALUE	TEST METHOD
Tensile strength, min	2000 psi	ASTM D412
Elongation @ break, min	250 %	ASTM D412
Hardness, type A, durometer	60 +/- 5 points	ASTM D2240
Compression set, 70 hours @ 212 F, max	35 %	ASTM D395 Method B Modified
Ozone resistance, after 70 hours at 100 F under 20 percent strain with 100 pphm ozone	no cracks	ASTM D1149 Method A
Mass change, in oil #3 after 70 hours at 212 F, max	45 %	ASTM D471

[1] Submit a manufacturer's certified report of test or analysis for production of elastomeric represented showing test results for the cured material supplied and certifying that it meets the specifications.

502.2.8 (Vacant)

502.2.9 Non-Bituminous Joint Sealer

(1) Furnish gray sealant complying with ASTM C920 for non-sagging grade NS, class 25, traffic area use T, and either single-component type S, or multi-component type M.

502.2.10 Hot-Poured Elastic Joint Sealer

(1) Furnish material conforming to ASTM D6690.

502.2.11 Crack and Surface Sealers

(1) Furnish crack and surface sealers from the APL as follows:

- Crack sealer: Low viscosity bridge deck sealers list.
- Protective surface treatment: Concrete protective surface treatment list.
- Pigmented surface sealer: Cure and seal compound - non-traffic structural masonry list.

502.2.12 Adhesive Anchors

(1) Unless the plans show stainless steel, furnish either stainless steel or galvanized anchors, bolts, studs, nuts, and washers. Ensure that galvanized materials are either hot dipped according to ASTM F2329 or mechanically galvanized according to ASTM B695 Class 55; ensure that the same galvanization process is used for all parts of the assembly. If the plans show using reinforcing bars, use grade 60 bars conforming to AASHTO M31 and to 505.2.

503 Prestressed Concrete Members

503.1 Description

(1) This section describes fabricating, furnishing, transporting, and erecting prestressed concrete girders, or other prestressed concrete members.

(2) These specifications provide for prestressing concrete members by the pretensioning method. In this method, stress the reinforcing tendons initially, then place and cure the concrete and release the stress from the anchorages to the concrete after developing specified concrete strength.

503.2 Materials

503.2.1 General

(1) Furnish materials conforming to the following:

Bar steel reinforcement.....505

(2) Use galvanized or epoxy-coated steel, stainless steel, or non-metallic materials for hardware incorporated into the finished structure.

503.2.2 Concrete

503.2.2 Add via ASP-6 with November 2023 LET. Update reference for coarse aggregate material gradation.

(1) Furnish concrete as specified in 501. If the design ultimate stress, f'_c, the plans show is 8000 psi or higher for a prestressed concrete I-type girder, extend 28-day strength requirements within 503 for that girder to 56 days.

(2) Ensure concrete attains a minimum 28-day compressive strength of 6000 psi for prestressed I-type girders. Base tests on 6-inch by 12-inch cylinders, or 4-inch by 8-inch cylinders, provided the engineer develops and approves a correlation factor. Mold concrete cylinders in steel or plastic molds. Cure concrete cylinders according to WTM R100, except cure the cylinders with the member until release strength is obtained, then cure the cylinders according to WTM R100. Maintain laboratory facilities and equipment according to AASHTO M201. Make 3 cylinders for each line of prestressed members poured and test each cylinder according to WTM T22. Calibrate cylinder-testing equipment at least annually according to AASHTO T67. Average the strengths of the 2 cylinders with the highest test results for each line and use the average to determine compliance with the 28-day strength requirement. Ensure that neither of the 2 cylinders with the highest test results has a strength less than 10 percent below the required strength.

(3) Instead of the above acceptance procedure, the engineer will allow early acceptance of the prestressed units, before the 28-day test, if 2 successive laboratory tests on standard test specimens, cured continuously with and in the same manner as the units, indicate compressive strength in excess of the required 28-day strength. Test the 28-day strength cylinders and record the results to maintain continuity of the contractor's quality control records.

(4) Have an HTCP-certified PCC Technician I sample concrete, perform fresh concrete testing, and fabricate and cure cylinders. Have an HTCP-certified Concrete Strength Tester, working in a department-qualified laboratory, perform cylinder and core compression tests. Determine the compressive strength in psi for each cylinder according to WTM T22. Test each cylinder to failure. Use a compression machine that automatically records the date, time, rate of loading on a load vs. time plot, and maximum load for each cylinder. Include a printout of this information with the strength documentation for each cylinder tested. Notify the engineer immediately if concrete cylinder compressive strengths are less than the required 28-day strength. Keep neatly documented records of cylinder testing on the day of the test and make them available to the engineer.

(5) Furnish prestressed concrete members cast from air-entrained concrete, except I-type girders may use non-air-entrained concrete. Use type I, IL, IS, IP, IT, II, or III cement. The contractor may replace up to 30 percent of type I, IL, II, or III cement with an equal weight of fly ash, slag, or a combination of fly ash and slag. Ensure that fly ash conforms to 501.2.4.2.2 and slag conforms to 501.2.4.2.3. Use only one source and replacement rate for work under a single bid item. Use a department-approved air-entraining admixture conforming to 501.2.5.2 for air-entrained concrete. Use only coarse aggregate conforming to 310.2(2).

(6) Determine proportions for the mix within the following limitations:

Water cementitious material ratio, w/cm.....0.45 or less[1]

Cementitious material content.....610-800 pounds per cubic yard

Air content:

Prestressed I-type girders..... 6.0 percent maximum

Other components.....4.5 - 7.5 percent

- Conform to the following physical properties:

	POLYISOPRENE (NATURAL RUBBER)	POLYCHLOROPRENE (NEOPRENE)
Grade (durometer)	60±5	60±5
Physical properties		
Hardness (ASTM D2240)	60+/-5	60+/-5
Tensile strength (ASTM D412), psi	2500	2500
Ultimate elongation, minimum percent	400	400
Low temperature brittleness (ASTM D746, procedure B)		
Brittleness at -54.4°F	No Failure	No Failure
Laminated pad adhesion test (ASTM D429, method B)		
Bond strength, psi	40	40

506.2.6.2 Non-Laminated Elastomeric

(1) Form non-laminated elastomeric bearings by casting or extruding rubber or neoprene in a single, integral layer to the required plan thickness. Avoid heating or damaging the material if cutting.

506.2.6.3 Laminated Elastomeric

(1) Furnish alternate layers of elastomer and steel reinforcement integrally bonded together, with reinforcement spaced as the plans show and parallel to the pad top and bottom surfaces. Cover reinforcement edges with a minimum of 1/4 inch of elastomer. Seal edge cavities using heat bonded vulcanized patching or an engineer-approved elastomeric sealant.

(2) Conform to AASHTO M251 tolerances, dimensions, and configurations; except cover the top and bottom steel plates with 1/4 inch of elastomer with a +1/8 to -1/16-inch thickness tolerance. Use rolled steel conforming to ASTM A36 or ASTM A1011 grade 36 or higher, for internal steel reinforcement.

(3) Ensure that the manufacturer molds their name or trademark into the edge of each pad on a face visible after structure erection.

(4) Submit shop drawings to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2.

506.2.6.4 Testing

(1) Conform to the bearing testing and acceptance criteria specified in AASHTO M251, section 8 as follows:

- Determine compressive strain according to section 8.8.1. Ensure that compressive strain in any layer of an elastomeric bearing does not exceed 7 percent at 800 psi average unit pressure for the full size bearing.
- Proof load each bearing according to section 8.8.2. Use a compressive load of 1200 psi for non-laminated bearings and 1800 psi for laminated bearings.

(2) Provide a manufacturer's certified report of test or analysis to the engineer for each production lot of bearings at least 30 days before shipment to the contractor. The department may require additional test samples from the bearings to confirm manufacturer test results before shipment.

(3) Ensure that each bearing delivered to the project is labelled to clearly indicate its production lot and can be tied to its associated test results.

506.2.7 Welded Stud Shear Connectors

Revise 506.2.7 to update references to current edition of AWS D1.5 Bridge Code.

(1) For shear connector studs conform to ASTM A108, cold-finished bars, grades 1015, 1018, or 1020, either semi- or fully killed. If using flux-retaining caps, use low carbon grade steel for the caps suitable for welding that comply with ASTM A109.

(2) Tensile properties, determined testing bar stock after drawing, or of finished studs, must conform to the following:

Minimum tensile strength	60 ksi
Minimum yield strength[1]	50 ksi
Minimum elongation	20 percent in 2 inches
Minimum reduction of area	50 percent

[1] As determined by the 0.2 percent offset method.

(3) Determine tensile properties according to ASTM A370. Perform tensile tests of finished studs on studs welded to test plates using a test fixture similar to figure 9.2 of clause 9 of AWS D 1.5 (2020). If fracture occurs outside the middle half of the gauge length, repeat the test.

(4) Ensure that finished studs are of uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other injurious defects. Produce the finish by cold drawing, cold rolling, or machining.

(5) Furnish arc shield (ferrule) of heat-resistant ceramic or other material with each stud that does not damage the welds, or does not cause excessive slag, and will not crumble or break due to thermal or structural shock before completing the weld.

(6) Submit the following information on the studs to the engineer for approval before installation:

- The name of the manufacturer.
- A detailed description of the stud and arc shield.
- Documentation that the studs qualify as specified in the current edition of AWS D 1.5.

506.2.8 Bearing Assemblies

506.2.8.1 General

(1) Use bearing assemblies conforming to the material requirements, sizes, and details the plans show.

(2) Blast clean fabricated structural steel bearing components as specified in 506.3.31.3 before galvanizing. After galvanizing, apply a wash primer to the components and the coating system in the color selected for the structural steel under the concrete. If using weathering steel, paint the bearing assemblies with one coat of organic zinc-rich primer and one shop coat of high-build brown epoxy paint. Do not blast clean, galvanize, or paint stainless steel and teflon surfaces.

506.2.8.2 Fixed Bearing Assemblies

(1) Galvanize the complete bearing assembly, including anchor bolts, nuts and washers, but excluding elements welded to the girder. Galvanize anchor bolts, nuts, and washers, according to ASTM F2329 or mechanically galvanize according to ASTM B695 Class 55; ensure that the same galvanization process is used for all parts of the assembly. Galvanize the remainder of the assembly according to ASTM A123.

506.2.8.3 Expansion Bearing Assemblies

(1) An expansion bearing assembly unit consists of a top sole plate, a bottom masonry plate, a rocker plate, a slide plate, side retainers, anchor bolts with nuts and washers, and a lead plate, as described below and as the plans show.

(2) Galvanize all structural steel surfaces, including anchor bolts, nuts and washers, that do not come in contact with other structural steel surfaces, or stainless steel, or polytetrafluoroethylene (PTFE) surfaces, as specified in 506.2.8.2 for fixed bearing assemblies.

(3) For the stainless steel sheet for the top element of sliding bearings use type 304 conforming to ASTM A240 and ensure it is not less than 1/16 inch thick after finishing. Make the finished stainless surface a plane within a tolerance of 1/32 inch and with a 2B finish as specified in ASTM A480.

(4) During welding, protect the surface of the stainless steel plate from weld splatter.

(5) After fabrication, provide a near mirror finish on the surface of the stainless steel plate.

(6) Use PTFE materials that are virgin polytetrafluoroethylene fluorocarbon resin, unfilled conforming to ASTM D4894. The finished materials must exhibit the following physical properties:

REQUIREMENT	TEST METHOD	UNFILLED VALUE
Hardness at 78 F	ASTM D2240 Shore "D"	50-65
Tensile strength, psi	ASTM D638	2800 min
Elongation, percent	ASTM D638	200 min
Specific gravity	ASTM D792	2.16 +/- 0.03
Melting point	ASTM D4591	621 +/- 18 F

(7) Ensure the finished PTFE sheet is not less than 1/16 inch or more than 3/32 inch thick.

(8) Bond the PTFE sheet to the 1/2-inch steel sheet with extreme care using a proven high-temperature-resistant epoxy bonding material. Use a 2-component, medium viscosity epoxy resin conforming to ASTM D1763 for this purpose.

(9) The engineer may allow welding to steel plate that has a bonded PTFE surface provided welding procedures are established that restrict the maximum temperature reached by the bond area to less than 300 F. Monitor temperature using temperature-indicating crayons, liquids, or bimetal thermometers.

(10) If epoxy bonding PTFE sheets, ensure that one side of the PTFE sheet is factory treated by the sodium naphthalene or sodium ammonia process by a department-approved manufacturer.

for fabricated bridge components with each set of shop drawings. Department review does not relieve the contractor from responsibility for errors or omissions on shop drawings.

(3) Shop drawings are part of the contract. The department must approve differences between shop drawings and contract plans. The contractor bears the costs of department-approved substitutions. Do not deviate from or revise drawings without notifying the department and resubmitting revised drawings and an updated department form DT2333.

(4) Ensure that the fabricator submits a PDF file of shop drawings for railroad structures to the railroad company's chief engineering officer upon contract completion.

506.3.3 Structural Steel Identification

Revise 506.3.3 language that is no longer required by ASTM A6.

(1) Identify structural steel as specified in ASTM A6. Before working any piece in the shop, move the identifying marks a sufficient distance away from the end to ensure the identity of the piece during fabrication. Mark angles on the inside of a leg. Mark beams and channels on the inside of a flange. Mark the ends of pieces if assembly will destroy or make identification by the above methods impossible. If the contractor fails to exercise the above precautions, the engineer will reject the piece.

506.3.4 Rolled Material

506.3.4.1 Straightening

(1) Ensure rolled material is straight before being laid off or worked. If straightening is necessary, perform it without injuring the metal. The engineer may reject material with sharp kinks and bends.

506.3.4.2 Camber

(1) If the plans show, camber rolled beams conforming to a uniform, approximately circular curve for the entire length of the beam or between designated points. Ensure the camber is within the tolerance specified in the American Institute of Steel Construction Manual and AWS D1.5 Bridge Welding Code.

(2) Use engineer-approved cambering methods, either cold or with heat. Select heat areas so that no distortion other than the required camber occurs. Use a procedure that prevents beam flange warpage.

(3) Support the beam near its ends facing the side made concave upward. Apply propane, natural gas, or other engineer-approved gas flame to areas selected. Play the flame over the section until the metal attains a maximum temperature of 1100 F for A709 HPS 70W and 100W steel or a maximum of 1200 F for other A709 steels. Monitor the temperature using temperature-indicating crayons, liquids, or bimetal thermometers. Notify the engineer before applying any heat.

(4) Heat the areas in generally wedge- or triangular-shaped areas with an included angle between 10 and 20 degrees. Locate the vertex of the angle on the web midway between flanges. Slowly play the flame over the area heated, starting at the vertex of the angle and finishing at the widest part of the heated wedge, extending across the flange width. Manipulate the torch, or torches, to rapidly bring the total area heated to the proper temperature at the same time.

(5) Space the heated sections to produce uniform curvature. Heat no less than 3 sections. It may require heating additional sections if the beam is unusually long or heavily cambered. Do not use water to cool the metal, or heat any area more than once. Air cool the heated metal slowly away from wind or drafts. The engineer may reject the beam if improper heating or cooling occurs that might affect the strength or ductility of the metal.

506.3.5 Bolt Holes

(1) The standard hole size for bolts smaller than 1-inch diameter is the nominal bolt diameter plus 1/16 inch. For 1-inch and larger diameter bolts, the standard hole size is the nominal bolt diameter plus 1/8 inch. Punch or drill bolt holes.

(2) The contractor may punch bolt holes full-size in material forming a member made of no more than 5 metal thicknesses and if the metal is not thicker than 3/4 inch for structural carbon steel, 5/8 inch for high-strength structural steel, or 1/2 inch for quenched and tempered alloy steel. For more than 5 metal thicknesses, or if the main material is thicker than 3/4 inch for structural carbon steel, 5/8 inch for high-strength structural steel, 1/2 inch for quenched and tempered alloy steel, or if required otherwise, subpunch, or subdrill holes 3/16 inch smaller. After assembling, ream or drill from the solid to full-size. The contractor may use oversized holes in secondary members if the engineer allows.

(3) Obtain written approval from BOS before using computer-numerically-controlled (CNC) equipment to drill full-size holes in components otherwise requiring reamed, sub-sized holes. Perform periodic check assemblies of components to verify CNC system accuracy. Notify BOS immediately and stop

(2) Flame cut plates in a direction that allows the stress in the plate, when assembled, to be parallel to the direction the plate was rolled.

(3) Ensure that flame cutting is adjusted and manipulated to cut within the prescribed lines. Flame cut surfaces must conform to the ANSI surface roughness value of 1000 for material up to 4 inches thick and 1600 for material 4 to 8 inches thick, except that the ends of members not subject to calculated stress at the ends must have a surface roughness value of 2000. Round the corners of flame cut surfaces of members that carry calculated stress to approximately a 1/16-inch radius by grinding after flame cutting.

(4) Cut re-entrant cuts to a radius of not less than one inch.

(5) Remove surface roughness exceeding the above values and occasional gouges not more than 3/16 inch deep on otherwise satisfactory flame cut surfaces by machining or grinding. Correct defects by flairing into the cut surface on a slope of at least 1 to 10. Repair gouges of flame cut edges more than 3/16 inch deep by welding, if the engineer approves, with low-hydrogen electrodes not exceeding 5/32 inch in diameter and with a preheat as noted in the engineer approved welding procedure specification (WPS). Grind the completed weld smooth and flush with the adjacent surface.

506.3.9 Edge Planing

(1) Plane the sheared edge of plates more than 5/8-inch thick and carrying calculated stress to a depth of 1/4 inch.

506.3.10 Connections

(1) Unless specified otherwise, make connections with 3/4-inch ASTM F3125 A325 high-strength bolts.

506.3.11 (Vacant)

506.3.12 Bolts and Bolted Connections

506.3.12.1 General

(1) Furnish sufficient bolts of each type, size, and length required with an ample surplus to replace those lost or rejected.

(2) Perform shop assembly and matchmarking as specified in 506.3.7.

(3) If assembled, ensure joint surfaces, including those adjacent to washers, are free of scale, dirt, oil, burrs, pits, and other defects that prevent solid seating of the parts.

506.3.12.2 Unfinished Bolts

(1) If using unfinished bolts for temporary connections and other specifically allowed uses, use standard bolts with hexagon heads and nuts. Ensure the bolt hole diameters are 1/16 inch greater than that of the bolt.

(2) Thread bolts transmitting shear so that not more than one thread is within the grip of the metal. Use lock washers under the nuts for unfinished bolts used in permanent connections.

506.3.12.3 High-Strength Bolts

Revise 506.3.12.3 connection information, update bolt tension information on Table 506-1 to match RCSC table, change Rotational Capacity Testing to manufacturer only, unless the fastener condition change prior to installation. Add time limit for pre-installation verification testing, require repeat RoCAP and PIV if fastener condition changes, and that engineer may require additional testing under certain conditions.

506.3.12.3.1 General

(1) Install bolts according to AASHTO LRFD Bridge Construction Specifications, article 11.5.5, with the following exceptions:

1. If connections are assembled, install bolts with a hardened washer under the nut or bolt head, whichever is the element turned in tightening.
2. If using oversized holes, 2 hardened washers are required, one under the bolt head and one under the nut.
3. Bring the bolted parts into solid contact bearing before final tightening. Use not less than 25 percent of the total number of bolts in a joint to serve as fitting up bolts.
4. For steel diaphragms on prestressed concrete bridges do the following:
   4.1. For steel-to-steel connections within diaphragms:
      - Tension by the turn-of-nut method.
   4.2. For steel-to-concrete girder connections:
      - No PIV or field rotational capacity (RoCAP) testing is required.
      - Tighten as the plan details specify.

(2) The contractor may use a flat washer if the surface adjacent to and abutting the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. For slopes greater than 1:20, use smooth, beveled washers to produce parallelism.

(3) Tighten each fastener to provide, if all fasteners in the joint are tight, at least the minimum bolt tension as follows:

TABLE 506-1 BOLT TENSION

BOLT SIZE	REQUIRED MINIMUM BOLT TENSION[1]
1/2-inch	12 kips
5/8-inch	19 kips
3/4-inch	28 kips
7/8-inch	51 kips
1-inch	51 kips
1 1/8-inch	64 kips
1 1/4-inch	81 kips
1 3/8-inch	97 kips
1 1/2-inch	118 kips

[1] Equal to the proof load by the length measurement method as specified in ASTM F3125 for grade A35 bolts.

(4) Tighten threaded bolts by the turn-of-nut method while holding the bolt head. Where clearance is an issue, the contractor may tighten the bolt head while holding the nut.

(5) The contractor may use alternate tightening methods if the engineer approves before use.

(6) Snug all bolts during installation according to AASHTO LRFD Bridge Construction Specifications, article 11.5.5.4.1.

(7) Do not reuse galvanized F3125 A325 bolts. The contractor may reuse uncoated F3125 A325 bolts, if the engineer approves, but not more than once. The department will not consider re-tightening previously tightened bolts that become loosened by the tightening of adjacent bolts as reuse.

(8) Before fasteners are delivered to the site, provide documentation of rotational capacity testing in accordance with ASTM F3125, Annex A2, Rotational Capacity (RoCap)Test. The fasteners must be received in packages that match the fastener assembly combination as tested. If documentation of RoCap testing is not received; then perform this testing in the field prior to installation.

(9) Provide and use a Skidmore-Wilhelm Calibrator or an acceptable equivalent tension measuring device at each job site during erection. Perform pre-installation verification (PIV) testing in the field conforming to the procedures enumerated in department form DT2114 no earlier than 14 calendar days prior to permanent bolting. Submit 2 copies of form DT2114 to the engineer.

(10) Check galvanized nuts to verify that a visible dyed lubricant is on the threads and at least one bolt face.

(11) Ensure that uncoated bolts are oily to the touch over their entire surface when delivered and installed.

(12) Prior to installation, ensure that the fastener condition has not changed due to accumulation of rust or dirt, weathering, mixture of tested assembly lots, or other reasons. If changes have occurred, including cleaning and re-lubricating of weathered bolts, the engineer will require re-qualification using RoCap testing in the field, for a minimum of two fastener assemblies of each combination to be used in permanent bolting, and PIV re-testing.

(13) Additional RoCap or PIV tests are required whenever the condition of the fasteners or understanding of the bolting crew is in question by the Engineer. Do not allow permanent bolting until PIV testing is completed.

(15) Install bolt, nut, and washer combinations from the same rotational-capacity lot.

506.3.12.3.2 Turn-of-Nut Method

Revise 506.3.12.3.2 to remove under-rotation tolerance per RCSC.

(1) Snug bolts to ensure connection faying surfaces are in firm contact. Snug-tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a person using an ordinary spud wrench. Snug systematically from the most rigid part of the connection to free edges repeating until all bolts in the connection are snug-tight. Then tighten all bolts in the connection by the nut rotation specified in table 506-2. Ensure the part not turned by the wrench does not rotate.

TABLE 506-2 NUT ROTATION FROM SNUG-TIGHT CONDITION[1]

DISPOSITION OF OUTER FACES OF BOLTED PARTS			
Bolt length measured from underside of head to extreme end of point	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (bevel washer not used)	Both faces sloped not more than 1:20 from normal to bolt axis (bevel washers not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters[2]	2/3 turn	5/6 turn	1 turn

[1] 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 - 0 degrees, + 30 degrees; for bolts installed by 2/3 turn and more, the tolerance should be - 0 degrees, + 45 degrees.

[2] No research work has been performed by the Research Council on Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters, therefore, determine the required rotation by actual tests in a suitable tension device simulating the actual conditions.

506.3.12.3.3 Contractor QC Testing

506.3.12.3.3.1 General

(1) Notify the engineer before performing the required field rotational-capacity and pre-installation testing. Do not begin bolt installation without the engineer's approval. The engineer may verify bolt installation by periodically testing with a calibrated torque wrench for bolts tensioned by turn-of-the-nut.

506.3.12.3.3.2 Turn-of-Nut Method QC

(1) In the presence of the engineer, use a torque wrench to perform QC testing for each completed bolted connection.

(2) Calibrate the torque wrench using 3 bolt/nut/washer assemblies of the same rotational-capacity lot and condition as those undergoing QC testing. Place a washer under the part turned and tighten each bolt in a contractor-furnished bolt tension calibration device to the minimum inspection tension required on department form DT2114 using a torque wrench. Average the 3 tests to determine the inspection torque for that rotational-capacity lot.

(3) Perform QC testing on a minimum of 10 percent of the bolts, but not less than 2 bolts, selected randomly in each connection. Test bolts by applying the inspection torque determined in the pre-installation test in the tightening direction. If any nut or bolt turns, check all bolts in that connection, or alternatively, the fabricator or erector may re-tighten all bolts in the connection and retest the retightened connection at the prescribed QC testing frequency.

506.3.13 Abutting Joints

(1) Mill or saw cut abutting joints in compression members of trusses and in columns to give a true and square cut.

(2) Openings at abutting joints in tension members in continuous I-beams and plate girders must not exceed 3/8 inch.

506.3.14 Facing of Bearing Surfaces

(1) Make the top and bottom surfaces of steel slabs and the base plate and cap plates of columns and pedestals straight, smooth, and free from warp and must bear evenly throughout.

(2) If necessary, plane the bases of welded steel bearings after welding to secure an even bearing.

(3) Plane the bases of cast steel bearings after annealing to secure an even bearing.

(4) Ensure that the sole plates of beams and girders have full contact with the flanges, and that the bearing surface is smooth, true, and perpendicular to the web of the member. Ensure that curved sole plates make full line bearing with masonry or bearing plates, and that the line is at right angles to the axis of the member and perpendicular to the web of the member unless the plans show otherwise.

(5) If planing the curved surfaces of expansion bearings, operate the tool so that the cut is in the expansion direction. If the cut of the tool is at right angles, make the finished surface the true arc of a circle, smooth and free from ridges.

(6) Finish contact steel surfaces subject to sliding motion in the direction of motion as specified in ANSI No. 125.

(7) Machine finish surfaces that the plans show to receive a surface finish.

(8) Polish finish the surfaces of bronze bearing plates intended for sliding contact.

(9) If using lubricated bronze plates, cover the finished surface of the expansion plate assembly in contact with the lubricated bronze plate with a plastic or other engineer-approved coating after machining. Before erecting the girder, remove this coating and coat the surface with graphite.

506.3.15 Web and Flange Plates

(1) At bolted splices, the clearance between the ends of the web and flange plates must not exceed 3/8 inch.

(2) If the plans show camber for welded girders, produce the camber by machine flame cutting the web plate. Cut cambers on a continuous smooth curve. If the engineer approves, correct moderate deviations from specified camber by a carefully supervised application of heat.

(3) For welded girders, if detailed to a horizontal curve greater than 3 degrees, cut the flange plates to a continuous smooth curve by machine flame cutting. If the curve is 3 degrees or less, curve the girder by either heat curving methods that the engineer approves, unless the plans specify otherwise. The contractor may curve the girder by machine flame cutting.

(4) Assemble the web and flange plates in the work so that the direction of stress in the plate, as assembled, is parallel with the direction that the plate was rolled.

506.3.16 Fit of Stiffeners

(1) Ensure that the end stiffeners of girders and stiffeners intended as supports for concentrated loads bear fully on the flanges that they transmit load to or from which they receive load. Obtain full bearing by milling, or grinding, or in the case of weldable steel in compression areas, by welding as the plans show or as specified.

(2) If the clearance between the end of the stiffener and the flange for stiffeners is not intended to support concentrated loads, then the gap must not exceed 1/16 inch unless the plans show or the contract specifies otherwise.

506.3.17 Pin and Roller Details

506.3.17.1 Pins and Rollers

(1) Turn pins and rollers to the dimensions the plans show and make them straight, smooth, and free from flaws.

(2) Forge and anneal pins and rollers more than 9 inches in diameter. For pins and rollers 9 inches or less in diameter use either forged and annealed or cold-finished, carbon-steel shafting.

(3) In pins larger than 9 inches in diameter, bore a hole, not less than 2 inches in diameter and full length along the axis after the forging cools below the critical range under conditions suitable to prevent injury by too rapid cooling and before annealing.

(4) Use standard recessed pin nuts for nuts in connection with pins.

506.3.17.2 Pinholes

(1) Bore pinholes true to the specified diameter, smooth, straight, at right angles with the axis of the member, and parallel with each other unless required otherwise. Produce the final surface by using a finishing cut.

(2) The pinhole diameter for pins without bushings must not exceed the pin diameter by more than 1/50 inch for pins 5 inches or less in diameter, or 1/32 inch for larger pins. For pins with bushings, follow the manufacturer’s recommendations for tolerances of pins and bushings.

506.3.17.3 Threads for Bolts and Pins

(1) Threads for bolts and pins for structural steel construction must conform to the Unified Standard Series UNC-ANSI B1.1, Class 2A for external threads and Class 2B for internal threads, except that pin ends with a diameter of 1 3/8 inch or more must have 6 threads per one inch.

506.3.18 Finished Members

(1) Make finished members true to line and ensure they are free from twists, bends, and open joints.

506.3.19 Welding

506.3.19.1 General

(1) Weld steel structures as the plans show and conforming to the current edition of AWS D 1.5, Bridge Welding Code. Furnish welders or welding operators certified to the requirements of AWS D 1.5. If the engineer questions a welder or welding operator's ability, requalification tests are required under AWS D-1.5. Have a department-approved independent testing agency perform requalification testing.

(2) Submit an annual field welding plan conforming to CMM 520.6.5.4 on department form DT2337. Do not begin field welding without a department-approved welding plan that includes the specific welding procedures required to perform the work under the contract.

(3) Notify the engineer before field welding on primary members and do not begin welding without department approval, except notification and approval is not required for the following:

- Welding shear studs when with a stud gun.
- Field welding bearing sole plates to steel girder flanges.
- Welding threaded rods to the top flange of girders to install new expansion joints.

(4) Visually inspect and certify the quality of field welds as follows:

1. Designate an inspector listed in the contractor's current approved field welding plan. For primary members, if welding requires department notification and approval, ensure the inspector is an AWS certified welding inspector.
2. Have the designated inspector complete department form DT2320 for each day of field welding and submit to the engineer for inclusion in the permanent project record.

506.3.19.2 Procedures

Revise 506.3.19.2 to require automatic welding and update reference information.

(1) Do not fabricate structural steel until the department approves welding procedures required under AWS D-1.1 and AWS D-1.5. Submit procedures for approval to the department's fabrication library at:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/fab-sharepoint.aspx

(2) Use automated submerged arc welding for primary shop welds in the flat position unless the engineer approves another welding process. Primary shop welds are defined as flange and butt welded splices in I-beams, box members, and plate girders; plate girder or box flange to web groove and fillet welds; and cover plate to flange fillet welds.

(3) Do not use electroslag or electrogas welding.

(4) Grind flange butt welds flush. Grind web butt welds to 1/6 of the web depth beginning at the point of maximum tension,1/6 of the web depth beginning at the point of maximum compression, and grind the entire outside surface of exterior girders. Ground surfaces that require grinding before performing radiographic or ultrasonic inspection. Grind plates with a surface or surfaces in the same plane flush. Grind plates with surfaces not in the same plane smooth.

(5) Ensure that weld metal for fillet and groove welds for exposed, bare, unpainted applications of ASTM A709 grade 50W steel possess similar atmospheric corrosion resistance and the same coloring characteristics as that of the base metal.

506.3.19.3 Procedure Qualifications

(1) Ensure that procedure qualifications conform to Clause 7 of AWS D-1.5 (2020).

(2) Complete qualification tests of the welding procedures and obtain the engineer's acceptance of them before beginning steel fabrication or field welding. Submit revisions in the welding procedure specifications to the engineer for approval and qualify them in the presence of the department's inspector to qualify for acceptance.

(3) Before welding under a procedure, confer with the department's inspector to ensure agreement regarding the procedure details, the welding sequence, the handling of materials to be inspected, the status of welders and welding inspectors qualifications, and the approval of electrodes, wire, flux, and other welding materials and equipment.

(4) Assign each welder or welding operator an identification mark for them to paint on the pieces welded. The welder or welding operator must use these identification marks for the duration of the contract.

506.3.19.4 Shop Welding Inspection

(1) Inspect shop welding according to the current edition of AWS D-1.5. Unless specified otherwise, test butt welds in main members by either the radiographic or the ultrasonic method.

(2) Test fillet welds and groove welds not covered otherwise in main members in a non-destructive manner by the magnetic particle method according to ASTM E709, utilizing the yoke method. This includes, but is not limited to, a minimum of 12 inches in every 10 feet or portion thereof of each weld connecting web to flange, bearing stiffener to web or flange, framing connection bar to web or flange, and longitudinal stiffener to web or vertical bar.

506.3.20 Stud Shear Connectors

(1) Use studs for shear connectors if the plans show. Weld conforming to Clause 9 of AWS D-1.5 (2020) except as follows:

1. Fillet welds varying in size from 3/16 to 5/16 inch are satisfactory provided the studs pass other required tests. Make adequate provision in structural member fabrication to compensate for camber loss due to shear connector welding.
2. Ensure the studs are free from rust, scale, rust pits, and oil at the time of welding and immediately before placing the concrete.
3. Longitudinal and lateral spacing of studs with respect to each other and to edges of beam or girder flanges must not vary more than 1/2 inch from the dimensions the plans show, except that the engineer will allow a variation of one inch if required to avoid obstruction of other attachments on the beam, or if welding a new stud to replace a defective one. Ensure a minimum distance from the edge of a stud shank to the edge of a beam or plate of one inch exists, but preferably 1 1/2 inch or more.
4. Notify the engineer promptly of any changes in the welding procedure at any time during construction.
5. If welding the studs reduces their height to less than normal, immediately stop welding and do not resume until correcting the cause.
6. After welding the studs to the beams, perform a visual inspection and give each stud a light blow with a hammer. Bend test studs without a complete 360-degree end weld, studs that do not ring when given a light blow with a hammer, studs repaired by welding, or studs reduced to less than normal in height due to welding. The bend test consists of bending the stud 15 degrees from its correct installation axis by striking with a hammer. In cases of a defective or a repaired weld, bend the stud in the direction that places the weld's defective portion in the greatest tension. Replace studs that crack either in the weld or in the shank.
7. The engineer may select additional studs to subject to the bend test specified in item 6 above.

506.3.21 Mill Inspection and Tests

(1) Ensure that the structural steel fabricator submits a certified report of test or analysis showing both physical and chemical tests of the material for each heat to the fabrication library. Also provide a copy to the inspector for examination before requesting the fabrication shop inspection, or when requesting the material prepayment inspection. The engineer will not approve prepayment for material without mill test reports.

506.3.22 Shop Inspection

(1) The engineer or an independent inspection agency under department contract may inspect structural steel and miscellaneous metals furnished. The department will provide the contractor with monthly consultant inspection invoices and identify any quality deficiencies at the fabrication facility.

(2) Give the engineer advanced notice before beginning shop work.

(3) Before requesting inspection, the fabricator must submit a list of main stress-carrying members and associated material heat numbers. Preserve the heat number, as marked by the rolling mill, for inspector identification. If fabrication obscures the original heat number, the fabricator must paint the number on the material in a conspicuous location.

(4) Provide facilities in the fabrication shop for inspection and allow inspectors necessary access to the work. Include office space at the fabrication shop for inspector use during fabrication, assembly, cleaning, and painting. Provide lighting, heating, and ventilation and ensure cleanliness. Ensure that office space is partitioned off from the fabricator's activities, has a separate locking door; or is part of a larger facility set aside for the exclusive use of outside inspection personnel. Provide telephone service, internet access, and adequate sanitary facilities in the immediate area. The engineer may require additional facilities to accommodate the number of inspectors necessary to inspect the volume of work. At engineer-determined major fabrication shops, provide at least 100 square feet of floor space with at least 2 desks, or a desk and table, and a file cabinet.

(5) The inspector may reject any material or work that does not conform to the specification requirements. Inspector acceptance of material or finished members does not preclude their subsequent rejection if found defective.

(6) Shop inspections facilitate the work and help avoid errors; they not relieve the contractor of responsibility to replace defective work or materials.

506.3.23 Marking and Shipping

Revise 506.3.23 to reorganize information and add information that must be displayed on container lables.

(1) Paint or mark each member with erection marks for identification and furnish a diagram showing the erection marks. Mark members weighing more than 3 tons with their weight. Load, transport, and unload without excessively stressing, deforming, or otherwise damaging. Ship girders and rolled beams in a standing position, maintain this position in subsequent operations. Fabricators may ship haunched sections of built-up girders in an inverted position.

(2) Ship high-strength bolts, nuts, and washers from each rotational-capacity lot in the same sealed waterproof container. Clearly and permanently mark, on the outside of each shipping container and

container lid, the bolt, nut and washer component lot numbers, rotational-capacity lot number, and manufacturer identification, in addition to a list and description of the contained material.

(3) Shipping containers must not exceed 300 pounds.

(4) Pack separately non-high-strength bolts of one length and diameter, and the loose nuts and washers supplied for each size of bolt, except ship galvanized bolts, nuts, and washers of the same size in the same containers. Clearly and permanently, mark a list on the outside of each shipping container that describes the contained material.

506.3.24 Handling and Storing

(1) Place material to be stored on skids above the ground. Keep it clean and properly drained. Place girders and beams upright, shore, and tie or brace to preclude tipping or overturning if exposed to high winds. Support long members, such as columns and chords, on skids placed near enough together to prevent injury from deflection. Loss of any material, or any damage caused after receiving it is the contractor's responsibility.

(2) Store bolts, nuts, and washers in sealed waterproof containers in a protected shelter to protect them from dirt and moisture until used. Maintain fastener system components as nearly as possible in the as-manufactured condition until installed. Remove from storage only as needed and promptly return unused components to storage.

506.3.25 Field Inspection

(1) The department may inspect fabrication work at the construction site. Provide on-site facilities and access for department inspectors to inspect materials and work not previously inspected at the shop.

506.3.26 Falsework

(1) The contractor may furnish used materials for falsework. Ensure proper design, construction, and maintenance of falsework in order to handle the loads placed upon it. Falsework must provide the required construction camber.

(2) Submit detailed plans for falsework to the engineer if requested. The engineer's approval of these plans, or acceptance of work constructed according to them does not relieve the contractor of responsibility for successful erection or satisfactory results.

(3) If building falsework over a stream or lake subject to boating use, construct it to provide horizontal and vertical clearance adequate for passage of rowboats and small powerboats. If building falsework over a highway or street used by traffic provide a minimum clearance, unless the plans or special provisions require otherwise, of 22 feet horizontal and 13 1/2 feet vertical.

(4) After completing the work, remove falsework piles down to at least 2 feet below streambed or finished ground line. Remove entirely any temporary bents, mudsills, and footings.

(5) Do not attach overhang bracket form supports to the girder web.

506.3.27 Erection

(1) Do not apply any part of the steel superstructure load to any concrete substructure unit until the concrete in that unit cures for at least 48 hours. Do not apply loads to beams of open-type structure units until the end of the required period for falsework support of these beams.

(2) Unless specified otherwise the minimum number of pickup points are as follows:

GIRDER LENGTH	MINIMUM NUMBER OF PICKUPS
0-50 feet	1
50 feet and over	2 or more

(3) Use an appropriate balance beam or spreader bar for 2 or more pickup points with a single crane. Locate pickup points to avoid damage to the girder and to balance the load at each point.

(4) Do not place a bent or twisted member until correcting its defects. The engineer will reject members seriously damaged in handling or transporting.

506.3.28 Straightening Bent Material

(1) Notify the engineer before straightening structural steel plates, angles, or other shapes. Describe the process that will be used. Do not proceed with the repair unless the engineer allows that process.

(2) Do not heat beyond a dull red condition, 1100 F for A709 HPS 70W and 100W steel or 1200 F for other A709 steels. Monitor temperature using temperature-indicating crayons, liquids, or a bimetal thermometer. Ensure that parts to be heated are substantially free of stress and external forces, except for stresses resulting from mechanical means used in the application of heat. After heating, cool the metal as slowly as possible away from drafts. Do not use water for cooling.

(3) After straightening a bend or buckle, inspect the repair and notify the engineer if fracture is identified.

526 Temporary Structures

526.1 Description

(1) This section describes the design, construction, maintenance, and removal of a temporary structure of the necessary area and width as shown on the contract plans.

526.2 Materials

(1) Furnish materials conforming to 500. The contractor may incorporate used materials in the structure if they are sound and suitable for the purpose intended.

526.3 Construction

526.3.1 Permits and Coordination

(1) Obtain necessary permits as specified in 107.3 and coordinate with the issuing agency in securing the permits and complying with permit terms.

526.3.2 Design

Revise 526.3.2 to clarify that loose materials including base aggregate are not allowed as the finished driving surface on the structure.

(1) Design the temporary structure conforming to the current edition of the AASHTO LRFD Bridge Design Specifications and AASHTO LRFD Bridge Construction Specifications. Design the temporary structure for permanent loads, using the requirements for a permanent bridge, with the following exceptions:

- no future wearing surface dead load included
- bar steel reinforcement does not need to be epoxy coated
- steel girders, if used, do not need to be painted
- fatigue does not need to be checked for steel superstructures
- design rail and posts according to the WisDOT Bridge Manual, chapter 30.

(2) For temporary structures over water, ensure that the temporary structure spans the stream and has dimensions sufficient to not constrict stream flow. Ensure that the structure has a low superstructure elevation and an open waterway area no less than the contract plans specify. Provide vertical abutments designed to prevent spilling fill material into the stream. If building a temporary crossing over a stream or lake subject to boating use, construct it to provide horizontal and vertical clearance, as the jurisdictional agency may require, adequate for row boats and small power boats.

(3) For grade crossing temporary structures, ensure that the temporary structure spans the underpass roadway, underpass railroad, and/or underpass pedestrian facility as shown on the contract plans; and has sufficient lateral clear width meeting clear zone requirements per FDM 11-15-1.13. If clear zone requirements cannot be maintained, structure protection shall be required. Ensure that the structure has a low superstructure elevation no less than the existing, adjacent bridges or as shown on the plans.

(4) Ensure the temporary structure has a minimum roadway clear width as measured between the inside faces of the concrete barriers and at right angles to the centerline, and a minimum overall width, as shown on the plans. Show the minimum bridge length between faces of abutment support on the temporary structure plans.

(5) Open metal grate, wood or any loose materials including, but not limited to base aggregate, will not be allowed as the finished driving surface on the structure.

(6) If contractor owned structural steel beams are utilized for the temporary widening, they are to be sound continuous material, free from large holes and defects. Use of these members is subject to acceptance by the engineer. Welded splices of existing steel beams are not permitted.

(7) Design foundation support to current LRFD criteria based on site subsurface and geotechnical data; contractor to request these files from the engineer.

(8) Design and construct temporary structures to avoid conflicts with underground and overhead utilities within the project area. Refer to the plans and the utilities article of the special provisions for information on utility locations within the project area.

526.3.3 Plan Requirements and Submittals

(1) Provide plans, shop drawings, and design calculations, signed and sealed by a professional engineer registered in the state of Wisconsin, for temporary structures.

(2) Electronically submit one copy of plans and design calculations to place on file to the engineer, for review and acceptance by the Bureau of Structures. If the engineer requests, submit 2 extra copies of plans for review before ordering materials or starting construction. Make the submittal no later than 45 days after date of notice of contract approval.

Table 531-1 Ancillary Structure Foundation Bid Item Type Encoding

Type (structure)(span)-(design) *Example: A monotube cantiliver type III is coded as a Type MC-III.*					
STRUCTURE		SPAN		DESIGN	
M	Monotube	C	Cantilever	I	Standard WisDOT designs
T	Two-chord truss	F	Full-span	II	
F	Four-chord truss	B	Butterfly	III	
				IV	
				V	
___		___		NS	Non-standard

531.3.2 Drilling Shafts

(1) Before drilling, locate existing underground cable, utility, or drainage structures. Drill shafts for foundations to the depth and diameter the plans show with minimal disturbance to adjacent soil. Make shafts vertical within less than 1/8 inch per foot.

(2) Case holes as necessary to prevent introduction of unconsolidated material or water. Install engineer-approved casing during drilling operations with casing in intimate contact with shaft sidewalls. Ensure casing can withstand insertion and removal stresses as well as concrete and soil pressure.

(3) The engineer will coordinate with BOS to determine if casing will be left in place or removed. If removing, withdraw while placing concrete or immediately after concrete placement. If removing casing while placing concrete, place at least 3 feet of concrete before pulling the casing and maintain 2 feet of concrete head while pulling. Do not dislocate stub posts, the anchor rod assembly, or steel reinforcement. Prevent soil from mixing with the concrete.

(4) The engineer will coordinate with BOS if shallow obstructions, including bedrock, are encountered.

531.3.3 Placing Concrete

(1) Construct drilled shaft foundations as specified for foundations in 502.3. Cure exposed portions of foundations as specified in 502.3.8.1. Wait until concrete has attained 3500 psi compressive strength or has cured for 7 equivalent days, as specified in 502.3.10, before erecting any portion of the structure on the foundation.

(2) If the contract requires, install a 5/8-inch by 10-foot copper clad ground rod next to the support or as the engineer directs.

(3) Secure steel reinforcement and anchor rod assemblies in place before placing concrete. Maintain the clear distance between soil and the reinforcing steel cage the plans show. Ensure that anchor rod assemblies and post stubs remain secured in their specified location until the concrete hardens. Do not weld anchor rods. Protect anchor rod threads above the top of the foundation level from concrete splash. If required, place electrical conduit in the foundation as the plans show.

(4) Remove and replace the foundation under one or more of the following:

- Twisting, racking, or other movement of the anchor rods.
- Anchor rods are out of plumb, projection, or pattern.
- Anchor rod threads are damaged.

(5) Unless specified otherwise, the contractor may place concrete against the soil without forming. Form the portion that extends above the grade. Place concrete conforming to 502.3.5 in one continuous pour without construction joints. Provide a level plane finish on the upper surface.

(6) Construct single shaft foundations to extend above the finished grade as the plans show. Line the upper 18 inches with disposable casing and remove the casing before backfilling.

531.3.4 Clean up

(1) Dispose of drilling spoils and other surplus material and restore the site.

531.4 Measurement

(1) The department will measure Concrete Masonry Ancillary Structures Type NS by the cubic yard acceptably completed. The department will base measurement on the dimensions the plans show or that the engineer orders in writing. The department will not measure concrete placed outside the designated dimensions.

(2) The department will measure the Steel Reinforcement bid items by the pound acceptably completed. The department will compute the weight as specified for bar steel reinforcement under 505.4.

(3) The department will measure the Drilling Shaft bid items by the linear foot acceptably completed.

(4) The department will measure the Foundation bid items as each individual foundation acceptably completed.

(5) The department will measure Anchor Assemblies Poles on Structures as each individual assembly acceptably completed.

531.5 Payment

Revise 531.5 (Payment) to add bid item set for foundation two-shaft butterfly (type) (structure) and revise number set for foundation single-shaft (type) (structure).

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
531.1100	Concrete Masonry Ancillary Structures Type NS	CY
531.1140	Steel Reinforcement HS Ancillary Structures Type NS	LB
531.1160	Steel Reinforcement HS Coated Ancillary Structures Type NS	LB
531.2000 - 2999	Drilling Shaft (diameter)	LF
531.4000-4099	Foundation Camera Pole (height)	EACH
531.4500-4599	Foundation High Mast (height) (structure)	EACH
531.5000-5099	Foundation Two-Shaft Butterfly (type) (structure)	EACH
531.5100-5999	Foundation Single-Shaft (type) (structure)	EACH
531.6000-6999	Foundation Two-Shaft (type) (structure)	EACH
531.8990	Anchor Assemblies Poles on Structures	EACH

(2) Payment for Concrete Masonry Ancillary Structures Type NS is full compensation for providing concrete for non-standard sign structure foundations; and for anchor rod assemblies. The department will pay separately for excavating and backfilling drilled shafts under the Drilling Shafts bid items.

(3) Payment for the Steel Reinforcement bid items is full compensation for providing reinforcement used for non-standard sign structures foundations.

(4) Payment for the Drilling Shaft bid items is full compensation for excavating and backfilling; and for providing and removing casing.

(5) Payment for the Foundation bid items is full compensation for providing concrete foundations; for anchor rod assemblies; for reinforcing steel; and for embedded conduit and electrical components. The department will pay separately for excavating and backfilling drilled shafts under the Drilling Shafts bid items.

(6) Payment for Anchor Assemblies Poles on Structures is full compensation for providing anchor assemblies.

(7) The department will pay for removing ancillary structures foundations and their associated superstructures under the Removing Ancillary Structures bid items as specified in 204.5.

532.5 Payment

Revise 532.5 to add bid item ranges. Move specific bid items for Butterfly 2-Chord and Butterfly 4-Chord to bid item list.

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
532.4500-4599	High Mast (height) (structure)	EACH
532.5000	Sign Structure Mounted (structure)	EACH
532.5010-5039	Butterfly 2-Chord (type) (structure)	EACH
532.5040-5099	Butterfly 4-Chord (type) (structure)	EACH
532.5100-5199	Monotube Cantilever (type) (structure)	EACH
532.5200-5299	Monotube Full Span (type) (structure)	EACH
532.5300-5399	Truss Cantilever 2-Chord (type) (structure)	EACH
532.5400-5499	Truss Full Span 2-Chord (type) (structure)	EACH
532.6000-6099	Truss Cantilever 4-Chord (type) (structure)	EACH
532.6100-6199	Truss Full Span 4-Chord (type) (structure)	EACH

(2) Payment for the High Mast bid items is full compensation for providing high mast light towers; and for sequence and circuit identification plaques.

(3) Payment for the Sign Structure Mounted items is full compensation for providing sign mounts on structures.

(4) Payment for the Butterfly, Monotube, and Truss bid items is full compensation for providing the sign structures; for high-strength bolt/nut/washer assemblies and DTIs, including those required for testing; and for sign blanks.

(5) The department will pay for removing ancillary structures and their associated concrete foundations under the Removing Ancillary Structures bid items as specified in 204.5.

550 Driven Piles

550.1 Description

(1) This section describes providing steel piles, cast in place concrete piles, and precast concrete piles; providing test piles; driving piles; and determining required driving resistance. This section also describes preboring or redriving.

550.2 Materials

550.2.1 Steel Piles and Pile Shells

Revise 550.2.1 to add requirement to provide copy of mill certification and edit formula to match ss-506.2 and AWS D1.5 Annex: Alternate Methods for Determining Preheats.

(1) Submit a certified report of test or analysis as specified in 506.3.21 at or before pile delivery unless the engineer directs or allows otherwise. Ensure that piles have marks tying them to a specific test report, or absent marks, certify that all material furnished is represented by a submitted test report. Provide marks or certifications for each piece of a pile fabricated from multiple pieces.

(2) For HP sections, use ASTM A572 grade 50 steel unless the plans show otherwise. If the engineer allows, the contractor may substitute steel pipe or steel oil field pipe for HP piles. Use pipe with an outside diameter of 7 3/4 inches or greater, a wall thickness of 3/8 inch or greater, and a cross-sectional area that equals or exceeds 97 percent of the area of the HP section replaced.

(3) For steel pipe sections and steel pile shells for cast-in-place concrete piles, use ASTM A252 grade 3 steel. Provide a copy of the mill certification for the ASTM A252 lot to be used in the work to the engineer.

(4) For steel oil field pipe sections, use ASTM A252, Grade 3 steel with a maximum tensile strength of 85,000 psi. At or before delivery, certify the pipe's chemical composition and ensure that its carbon equivalency (CE) does not exceed 0.50 calculated as follows:

$$CE = C+(Mn+Si)/6+(Cr+Mo+V)/5+(Ni+Cu)/15$$

(5) Ensure that each individual oil field pipe delivered to the project conforms to the bill of lading and is marked to uniquely identify the load with a marking that is durable and legible. Use oil field pipe delivered in a magnetized condition for non-welded applications only.

550.2.2 Cast in Place Concrete Piles

(1) Furnish materials conforming to the following:

Concrete grade A	501
Steel reinforcement	505
Steel pile shells	550.2.1
Steel shell end plates	506.2.2.2

(2) The department will accept concrete by certification as specified for class III ancillary concrete in 716.

(3) Ensure that steel pile shells have a minimum nominal wall thickness of 0.219 inches unless the plans or special provisions specify otherwise. Use seamless cylindrical tubes or cylindrical tubes with a straight or spiral welded seam.

(4) Ensure that shell end plates are 3/4 or more inches thick, and have an outside diameter that does not exceed the pile outside diameter by more than 3/4 inch unless the plans show otherwise. Also ensure that shell end plate welds are watertight.

550.2.3 Precast Concrete Piles

(1) Furnish materials for precast concrete piles as specified for I-type girders in 503.2 modified as follows:

1. Use air-entrained concrete for piles unless the contract specifies otherwise.
2. Provide 28-day compressive strength of 6000 psi unless the contract specifies greater strength.

(2) Construct precast concrete piles conforming to 503.3.2 and 503.3.3 to plan dimensions within the following tolerances:

Cross-sectional dimensions	+/- 1/8 inch
Chamfers, miters, bevels, and radii	+/- 1/8 inch
Pre-stressing steel location	+/- 1/8 inch
Length	+/- 1/8 inch per 10 feet of length, not to exceed +/- 1/2 inch
Variation from true plane along the long axis	+/- 1/8 inch per 10 feet of length, not to exceed +/- 1/2 inch

(3) Transport, handle, and store to prevent damage. Do not deliver to the job site until the piles have developed their full design strength. Support during transport at designated lifting or supporting points or provide additional support as the fabricator recommends. Lift at points the plans show using fabric

shell strength in compression, tension, and bending. Ensure that pile shell splices are watertight. Except as allowed for oil field pipe, do not use mechanical splices.

(2) Weld splices conforming to the current edition of AWS D1.1 Structural Welding Code-Steel. Use shielded metal arc welding (SMAW) for welds on portions of piles that will be above grade in service.

(3) Submit an annual field welding plan conforming to CMM 520.6.5.4 on department form DT2337. Do not begin field welding without a department-approved welding plan that includes the specific welding procedures required to perform the work under the contract.

(4) Visually inspect and certify the quality of field welds as follows:

1. Designate an inspector listed in the contractor's current approved field welding plan.
2. Have the designated inspector complete department form DT2320 for each day of field welding and submit to the engineer for inclusion in the permanent project record.

550.3.4.1.2 Steel Oil Field Pipe Piling

(1) Position backup rings flush with the joint and place according to the current edition AWS D1.1 Structural Welding Code-Steel. Ensure that the rings allow the joint to contract freely as the weld cools. Make tack welds the smallest size necessary to hold the pipe ends in alignment for welding.

(2) For materials not listed in table 5.3 of AWS D1.1 (2020), preheat for a distance of 5 inches on both sides of the weld as follows:

- CE less than 0.35: heat to 100 F.
- CE greater than or equal to 0.35 and less than or equal to 0.45: heat to 175 F.
- CE greater than 0.45 and less than or equal to 0.50: heat to 300 F.

(3) Protect the pipe ends from high winds and precipitation during welding.

(4) If the engineer approves, the contractor may use threaded or mechanical splices.

550.3.4.2 Precast Concrete Piling

(1) Conform to splice details the plans show.

550.3.5 Driving Equipment

550.3.5.1 General

(1) Furnish a pile driving system capable of driving piles to the required driving resistance with a minimum blow count of 30 blows/foot and with a minimum rated hammer energy of 12,500 ft-lbs.

(2) The engineer will determine if the contractor's equipment is capable of driving piles to the required driving resistance and tip elevation. Do not drive piles until the engineer approves the driving equipment.

(3) Use an engineer-approved pile driving system. Submit department form DT3550 to the engineer at least 30 days before driving piles. Resubmit DT3550 if proposing changes to a previously approved pile driving system.

(4) The engineer may order the contractor to remove pile driving system components from service it they cause insufficient energy transfer or damage the pile. Do not return a component to service until the engineer determines that it has been satisfactorily repaired or adjusted.

550.3.5.2 Hammers

(1) Drive piles with diesel, air, steam, gravity, or hydraulic hammers. Do not use vibratory hammers unless the engineer approves. Re-strike piles driven with vibratory hammers with an impact hammer to determine the required driving resistance.

(2) Ensure that single acting diesel hammers are configured to accurately determine hammer stroke visually during driving. Provide a hammer manufacturer's chart equating stroke to equivalent energy.

(3) Ensure that double acting diesel hammers have a bounce chamber pressure gauge easily read from ground level. Provide a chart, calibrated to actual hammer performance, certifying the bounce chamber pressure that equates to either equivalent energy or stroke. At the beginning of pile driving, provide a hammer calibration chart that is less than 90 days old and recalibrate and provide a new certified chart at least every 90 calendar days during driving operations.

(4) Ensure that air, steam, or hydraulic hammers and associated equipment can maintain the manufacturer’s specified volume and pressure under working conditions and have easily accessible pressure gauges. Also ensure that the hammer striking parts of air or steam hammers weigh at least 2750 pounds and exceed the weight of the helmet plus pile being driven.

Field Welding & Fabrication Updates

Bridge Tech Meeting

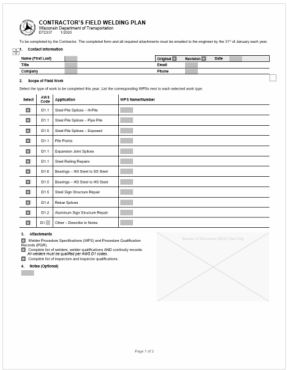
3/21/2024

Bill Hardy, CWI
Ryan Janssen, CWI
Carla Principe, PE

BUREAU OF STRUCTURES

1

Forms, Forms, Forms



DT2337

Contractor's Field Welding Plan

DT2320

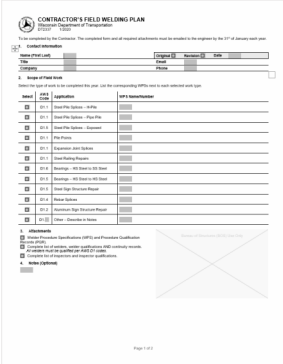
Field Welding Inspection Checklist

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/fab-cnstr.aspx

BUREAU OF STRUCTURES

2

DT2337 - Field Welding Plan

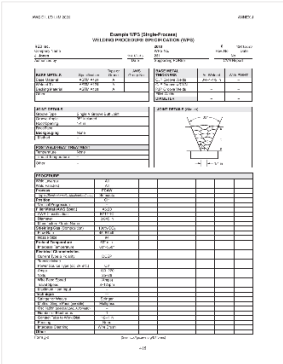

CONTRACTOR'S FIELD WELDING PLAN

- Must be submitted yearly before January 31st
- Must include the following:
  - Welding Procedure Specifications
  - Welder Qualifications
    - Welder Qualification Test Records (WQTR)
    - Continuity Records
  - Inspectors
    - Previously certified welder: provide copy of certification
    - Current certified welder: provide copy of certification
    - Individual who has been instructed on the visual acceptance criteria of AWSD1.1: provide proof of training

BUREAU OF STRUCTURES

3

Welding Procedure Specifications


Example WPS (Single-Process)
WELDING PROCEDURE SPECIFICATION (WPS)

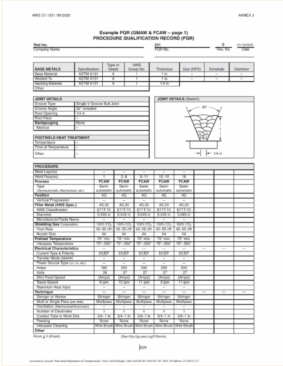
Requirements - Highlights

- Use prequalified WPSs when possible
- "Cast a wide net" – include several prequalified joints that can be used with the same welding process and parameters.
- Include fit-up tolerances and guidance for welders in the event tolerances cannot be met.
- List preheats by material thickness.
- List preheats by carbon equivalency for A252 Grade 3 (oil field pipe).

BUREAU OF STRUCTURES

4

Welding Procedure Specifications



A252 Material

What does AWS say?

- **5.3 Base Metal** Only base metals listed in Table 5.3 may be used in prequalified WPSs.
- **6.8.3 Base Metal Qualification** WPSs for base metals not listed in Table 5.3 or Table 6.9 shall be qualified in conformance with Clause 6.

BUREAU OF STRUCTURES

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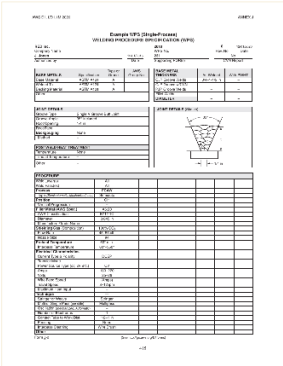
Welding Procedure Specifications



A252 Material

What does WisDOT Standard Specifications say?

- **550.3.4.1.2** For materials not listed in table 3.1 of the AWS D1.1 code, preheat for a distance of 5 inches on both sides of the weld as follows:
  - CE less than 0.35: heat to 100 F.
  - CE greater than or equal to 0.35 and less than or equal to 0.45: heat to 175 F.
  - CE greater than 0.45 and less than or equal to 0.50: heat to 300 F.

BUREAU OF STRUCTURES

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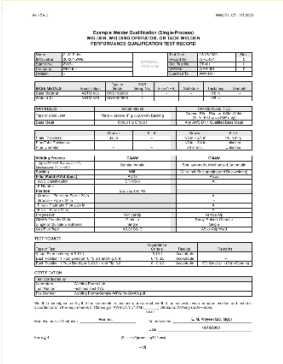
Welder Qualifications



Welders must be qualified for the required:

- Welding Process: SMAW, FCAW-S
- Welding Position : 1 - Flat 2 - Horizontal
  3 - Vertical 4 - Overhead
- Joint Geometry: Groove, Fillet
- Welded Section Shape: Plate, Tubular
  - Thickness Range
  - Diameter Range

BUREAU OF STRUCTURES

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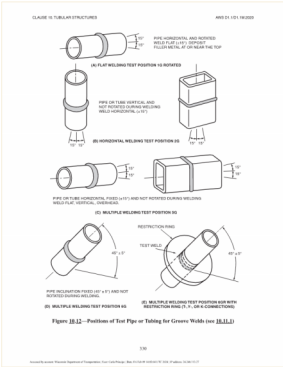
Welder Qualifications

Hints for requesting welder qualification tests



- When qualifying welders, check AWS D1.1 & D1.5 Qualification Clause requirements
- AWS D1 tables include the qualification tests needed to qualify a welder for production welding
- A welder qualification to 6G (pipe) will qualify a welder for plate, a wide range of pipe diameters and most welding positions

BUREAU OF STRUCTURES

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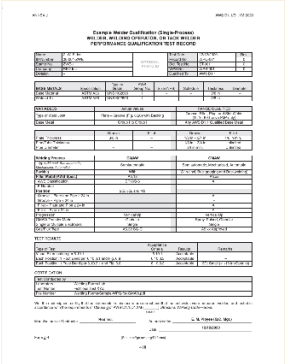
2020 AWS D1.1 reference cited

Welder Qualifications - Continuity



- Adhere to AWS D1.1 Period of Effectiveness Clause: (and equivalent section in AWS D1.5)
  - **6.2.3.1 Welders and Welding Operators.** The welder's or welding operator's qualification as specified in this code shall be considered as remaining in effect indefinitely unless:

    (1) the welder is not engaged in a given process of welding for which the welder or welding operator is qualified for a period exceeding six months, or

    (2) there is some specific reason to question a welder's or welding operator's ability (see 6.25.1).

Continuity is process specific
Separate continuity records are needed for SMAW and FCAW

BUREAU OF STRUCTURES

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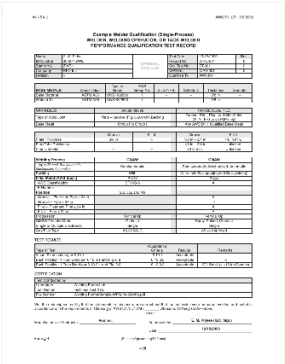
Welder Qualifications - Continuity



- If the Welding Qualification Test Record (WQTR) provided for the welder has a CWI stamp dated within the last six months, no further documentation is needed.
- If the WQTR is older than six consecutive months, a continuity record is needed. At least one entry on the continuity record is needed for every six consecutive months verifying the use of the welding process.

  Example: Test date 10 years ago = 19 continuity records (2 continuity records per year minus the original 6 months)

Starting 2025: WisDOT will ask for proof of continuity for the 2 years prior to the yearly submittal date of Jan-1

BUREAU OF STRUCTURES

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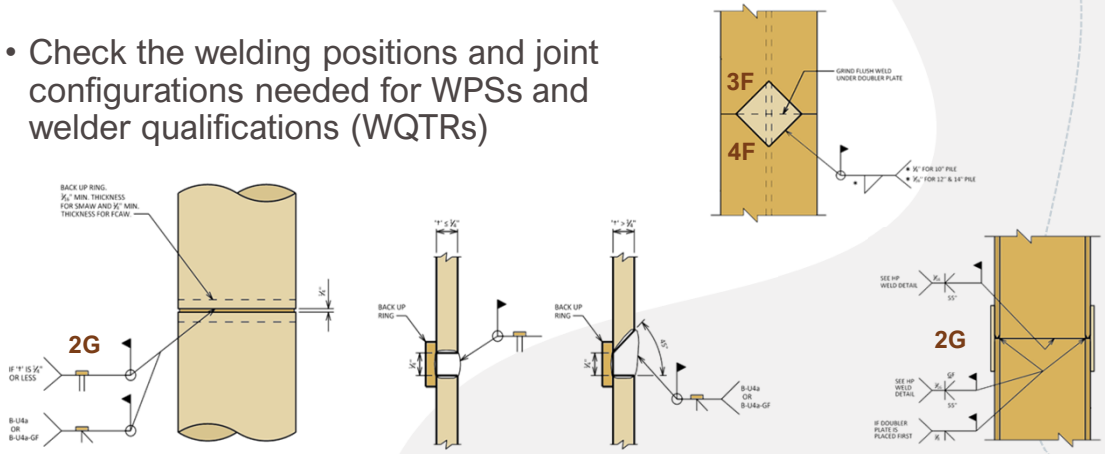
Field Welding Plan - Additional Notes

- Check the welding positions and joint configurations needed for WPSs and welder qualifications (WQTRs)



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Field Welding Plan - Additional Notes

- Use current AWS D1 references in all documentation.
- For new welder qualifications and welding procedure specifications use the current edition of AWS D1.1 or D1.5.
- WPSs should include all the information a welder needs to complete the weld per AWS and WisDOT specifications.

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Field Welding Inspection Checklist

- It is not just a contract requirement.
- DT2320 is an inspection record; a quality control and quality assurance check by the Contractor and the Department, respectively.
- To be filled out daily; one form per structure
- To be filled out by the contractor's designated inspector; not the individual welding.
- The inspection form must be filled out at the time of welding.

BUREAU OF STRUCTURES

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Field Welding Inspection Checklist

- Record the WPS ID
- The WPS must clearly list preheat temperatures
  - by base metal thickness
  - or carbon equivalency, when required
    - ✓ To determine preheat for A252 material, ensure the carbon equivalency (CE) of the lot is verified.
- Measure and record preheat temperatures

Please note that improper preheat can lead to delayed cracking

BUREAU OF STRUCTURES

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Field Welding Inspection Checklist

SMAW Electrodes

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*.

AWS D1.1 (2020)

Table 6.6
Allowable Atmospheric Exposure of Low-Hydrogen SMAW Electrodes

AWS Filler Metal Specification	Electrode	Hours[a]
A5.1	E70XX	4 max.
A5.5	E70XX-X	4 max.
	E80XX-X	2 max.
	E90XX-X	1 max.
	E100XX-X	1/2 max.
	E110XX-X	1/2 max.

AWS D1.5 (2020)

- Electrodes must be purchased in hermetically sealed containers
- Exposure time
  - E70XX = 4hrs
  - E70XXR = 9hrs (moisture resistant)
- Electrodes exposed for longer than allowed must be baked before use.
- For additional requirements and information please review: AWS D1.1 (2020) Clause 7.3
  AWS D1.5 (2020) Clause 6.5

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Field Welding Inspection Checklist


FIELD WELDING INSPECTION CHECKLIST
Wisconsin Department of Transportation
MS-1320 (08/2020)

- Record observations of weld quality.
- Contractor & Project Leader signatures at the bottom of the form certify that welds are visually acceptable, and welding was performed per all AWS & WisDOT requirements.
- Unacceptable welds must be corrected before piling driving can continue and before the DT2320 can be signed.

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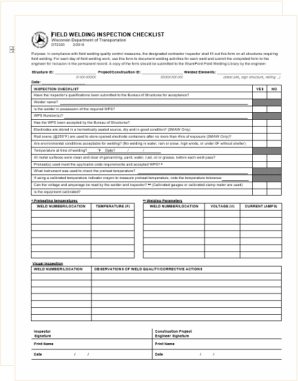
Field Welding Inspection Checklist

Role of Project Leaders/Managers



- Verify that a contractor has an accepted field welding plan that includes the WPS needed to complete the work
- Verify welder qualifications in the contractors accepted field welding plan
- Review and verify that the information recorded on form DT2320 Field Welding Inspection Checklist is complete and accurate
- Confirm assessment of final weld quality

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Field Welding Inspection Checklist

Role of Project Leaders/Managers & Contractors

- Contact the Structures Fabrication Unit (SFU) if…
  - The procedures (WPS) required to complete the work are not listed in the field welding plan
  - The personnel present at the site are not listed in the field welding plan
  - The contractor does not have an accepted field welding plan for the current construction year
  - Visually unacceptable welds are made and not corrected.
  - Unauthorized welding has occurred

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Field Welding Inspection Checklist

Role of Project Leaders/Managers & Contractors

- Unauthorized welds are prohibited. Do not allow unauthorized welding without review by the Bureau of Structures and approval of the Engineer
- Field welds, to the structure, not noted on the contract plans or standard drawings are considered unauthorized welds
- Some examples:
  - Safety rails welded to flanges
  - Form attachments to flange cover plates
  - Welded repairs without Engineer review and approval
  - Studs welded without a stud gun

Contacts for review and approval:
Aaron Bonk – BOS Design Chief
Carolyn Brugman – Construction Program Manager

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2025 WisDOT Standard Specification Changes – High Strength Bolts

- 506.3.12.3 High Strength Bolts
  - Rotational Capacity Testing (DT2113)
  - Pre-installation Verification Testing (DT2114)

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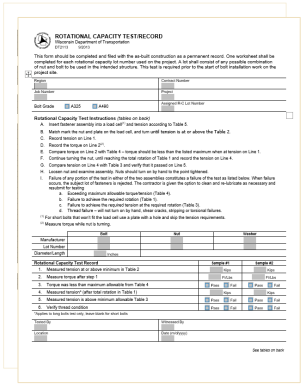
Field Bolting – High Strength Bolts


ROTATIONAL CAPACITY TEST/RECORD
Wisconsin Department of Transportation

Rotational Capacity Testing (RoCap)

2025 Standard Specification Changes

- Documentation of rotational capacity testing from the manufacturer must be provided before fasteners are delivered.
- The fasteners must be received in packages that match the fastener assembly combination as tested.

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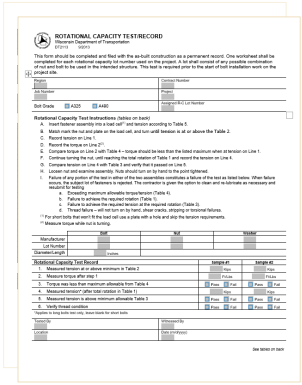
Field Bolting – High Strength Bolts


ROTATIONAL CAPACITY TEST/RECORD
Wisconsin Department of Transportation

Rotational Capacity Testing (RoCap)

2025 Standard Specification Changes

- Field RoCap tests are only required…
  - If documentation of manufacturer RoCap testing is not received (ASTM F3125 S4)
  - If prior to installation, the fastener condition has changed due to accumulation of rust or dirt, weathering, mixture of tested assembly lots, or other reasons.

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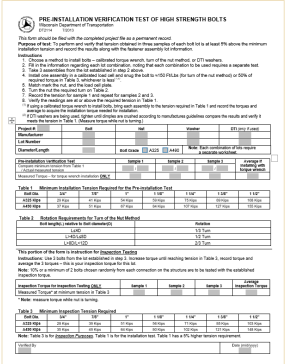
Field Bolting – High Strength Bolts


PRE-INSTALLATION VERIFICATION TEST OF HIGH STRENGTH BOLTS
Wisconsin Department of Transportation

Pre-Installation Verification (PIV)

2025 Standard Specification Changes

- Perform in the field no earlier than 14 calendar days prior to permanent bolting
- Fastener assemblies must be re-tested for PIV… if prior to installation, the fastener condition has changed due to accumulation of rust or dirt, weathering, mixture of tested assembly lots, lubricant has changed or other reasons.

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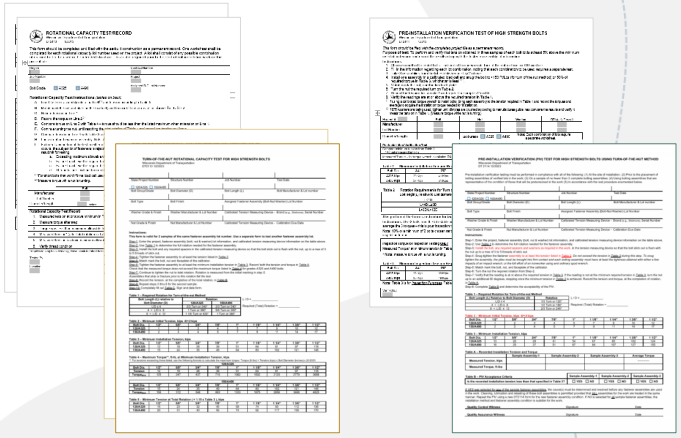
DT2113 & 2114 Updates

Coming Soon…

- Turn-of-the-nut only
- Updated minimum pretension values
- Updated language & instructions


ROTATIONAL CAPACITY TEST RECORD

PRE-INSTALLATION VERIFICATION TEST OF HIGH STRENGTH BOLTS

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Contacts

Structures Fabrication Unit

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Links

Fabrication & Field Welding Forms

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/fab-cnstr.aspx

SharePoint Fabrication & Field Welding Libraries

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/fab-sharepoint.aspx

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