FABRICATOR PERSPECTIVE

TRIPLE I-GIRDER BENT CAPS

Smarter. Stronger. Steel.

November 12, 2024

WHAT ARE WE GOING TO DISCUSS?

FOUR SIDED BOXES VERSUS TRIPLE I-GIRDER BENT CAPS

- WHAT WE LIKE AND WHAT WE DON'T LIKE.

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- WHAT WE LIKE AND WHAT WE ~~DON'T LIKE~~ WOULD RATHER NOT SEE.

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- EASIER TO FABRICATE

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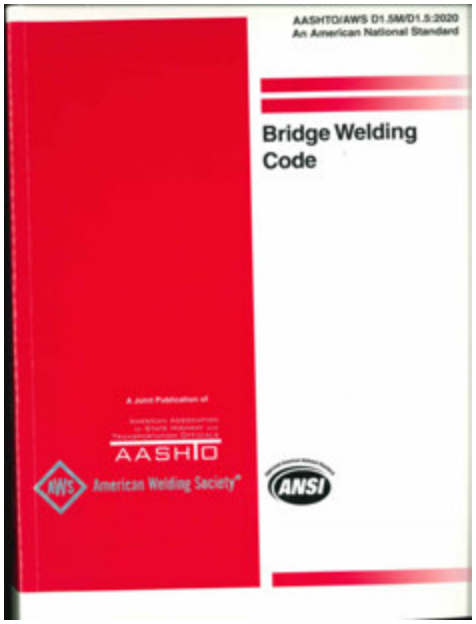
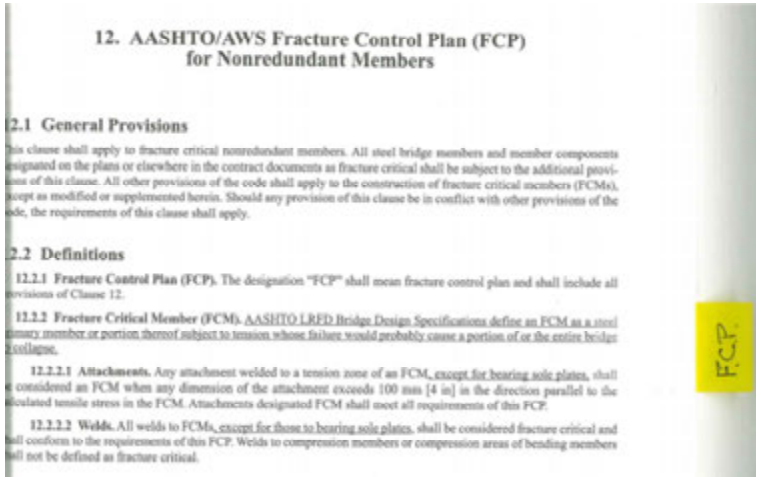
- EASIER TO FABRICATE
- UNEXPECTED DISCOVERIES

WHAT WE WOULD RATHER NOT SEE.

- 4 SIDED BOXES USED AS STRADDLE BENT CAPS - NONREDUNDANT MEMBERS.
- That means the FRACTURE CONTROL PLAN must be followed, with "*FRACTURE CRITICAL*" MATERIALS; WELDING, TESTING & REPAIR; and more frequent FIELD INSPECTION.





12. AASHTO/AWS Fracture Control Plan (FCP) for Nonredundant Members

2.1 General Provisions

his clause shall apply to fracture critical nonredundant members. All steel bridge members and member components signated on the plans or elsewhere in the contract documents as fracture critical shall be subject to the additional provi- ions of this clause. All other provisions of the code shall apply to the construction of fracture critical members (FCMs), xcept as modified or supplemented herein. Should any provision of this clause be in conflict with other provisions of the ode, the requirements of this clause shall apply.

2.2 Definitions

12.2.1 **Fracture Control Plan (FCP).** The designation "FCP" shall mean fracture control plan and shall include all rovisions of Clause 12.

12.2.2 **Fracture Critical Member (FCM).** AASHTO LRFD Bridge Design Specifications define an FCM as a steel imary member or portion thereof subject to tension whose failure would probably cause a portion of or the entire bridge collapse.

12.2.2.1 **Attachments.** Any attachment welded to a tension zone of an FCM, except for bearing sole plates, shall considered an FCM when any dimension of the attachment exceeds 100 mm [4 in] in the direction parallel to the lculated tensile stress in the FCM. Attachments designated FCM shall meet all requirements of this FCP.

12.2.2.2 **Welds.** All welds to FCMs, except for those to bearing sole plates, shall be considered fracture critical and all conform to the requirements of this FCP. Welds to compression members or compression areas of bending members all not be defined as fracture critical.

F.C.P.

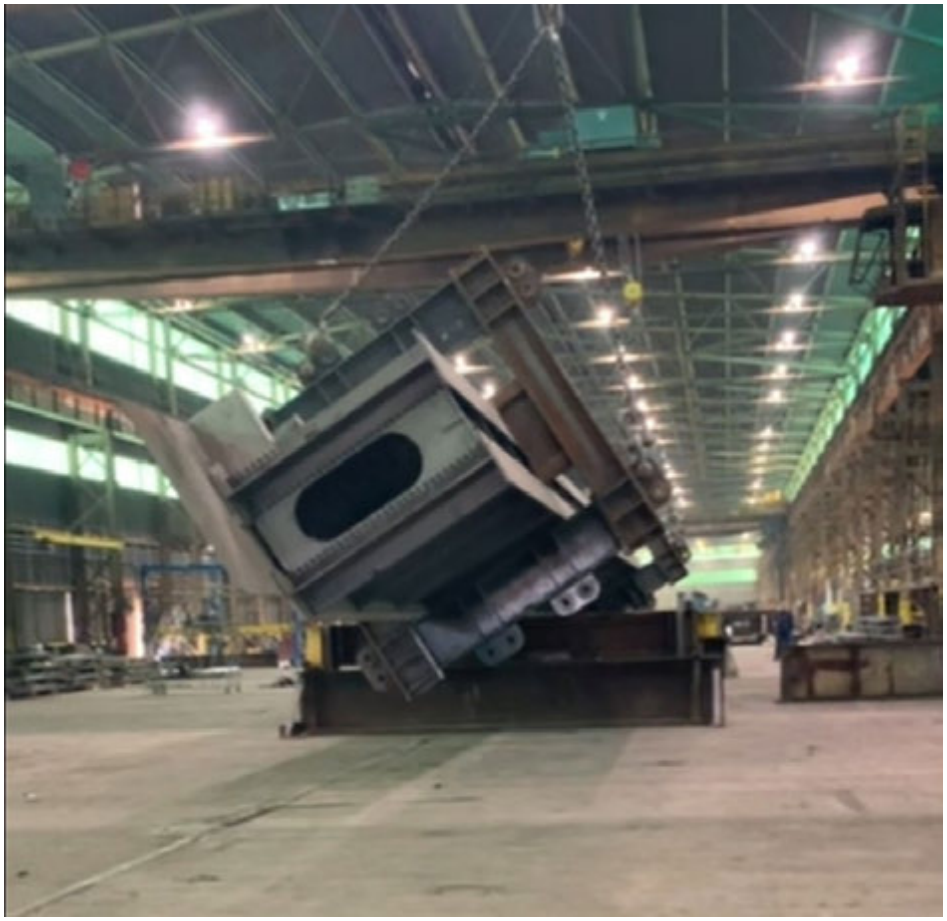
WHAT WE WOULD RATHER NOT SEE.

- COMPLETE JOINT PENETRATION Groove Welds. Boxes nearly always have some CJP welding at flange to web connections.
- PAINTING inside boxes.

Backing bar

PROBLEM AREAS.

- Rolling of Boxes and Triple I Girders to get them into position for assembly and welding.
- Overhead welding is to be avoided.



PROBLEM AREAS.

- Working inside of 4 sided boxes.
- OSHA Confined Space Standards addressing hazards and risk.
- Issues to contend with:
  - Extra employees required as attendants
  - Monitoring Air Quality
  - Heat from welding and material preheating for welding
  - Noise from installing drift pins, bolting, grinding, etc.

PROBLEM AREAS.

- Confined Spaces with 4 sided boxes.

Big Box

November 12, 2024

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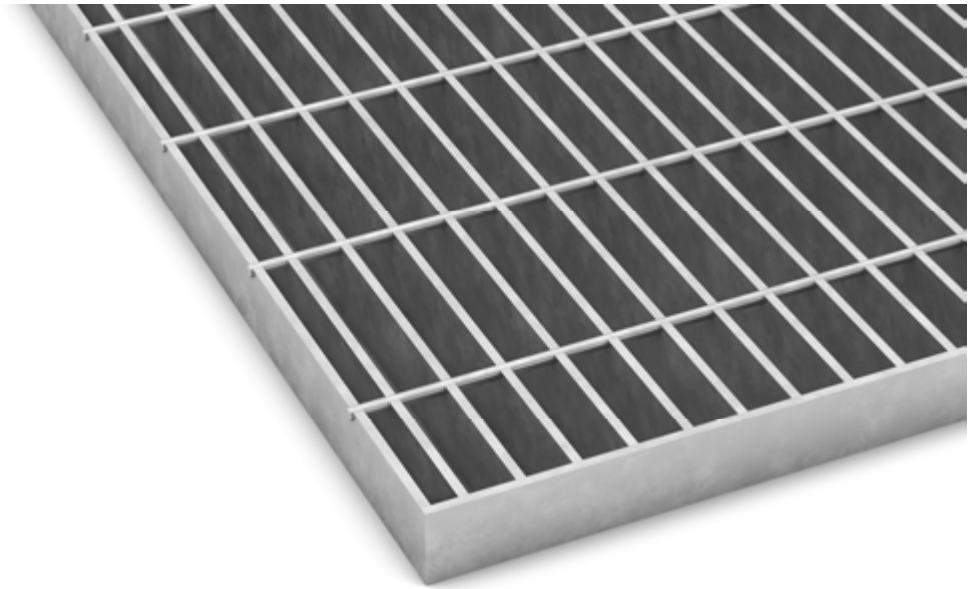
- Confined Spaces with 4 sided boxes.
- OSHA Confined Space Standards addressing hazards and risk.

Small Box

3'-3 Tall
3'-5 Wide

PROBLEM AREAS.

- Grating in Triple I-Girder Caps
- Procurement Issues to contend with:
  - Type of grating specified – Galvanized steel, fiberglass, aluminum, or other each have their own peculiar requirements.
  - Whatever type of grating is chosen, Designers must investigate available options and make those clear in the plans.
  - Fasteners must be investigated and specifics provided in the plans.



(9) 3/4" x 3/4" mesh molded (grey or brown colored) FRP Grating cut to fit between girder webs. Grating shall support a design live load of 100 psf, be non-corrosive and have an ASTM-E-84 Class 1 fire rating. Clips to secure grating shall be made of Grade 316 stainless steel and require no drilling to the girder flanges. Material cost of grating,

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  - Even closed at top with bearing pedestals bolted to the top flange, it is easier to fab than 4-sided box.

UNEXPECTED DISCOVERIES.

- Lessons learned from first two Triple I-Girder Caps during estimating, detailing and fabrication.
- HEAVY - Weight of complete assembly, over 100 tons, can make movement at shop difficult requiring multiple cranes or Mi-Jacks.

Picture courtesy MI-Jack on-line pictures

UNEXPECTED DISCOVERIES.

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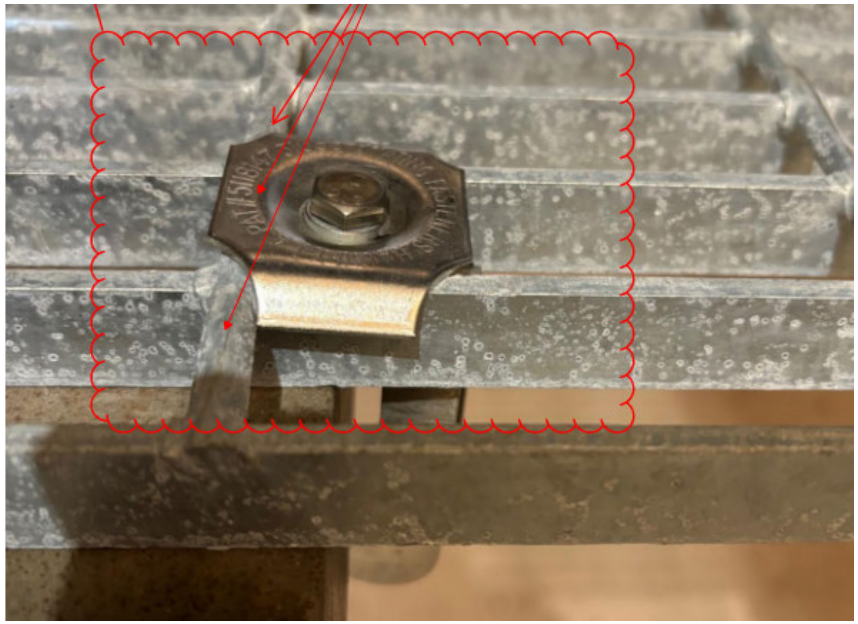
- Weight of complete assembly can make movement at shop difficult requiring multiple cranes or Mi-jacks
- Grating became the biggest hurdle.
  - Notes on design plans were not specific enough, not even stating the direction of the bearing bars.
  - The standard available clips were insufficient length to clamp thick flanges and field splice plates.
  - (cont)

Grating fabricated over a bearing sole plate where it is not needed.

UNEXPECTED DISCOVERIES.

- Lessons learned from first two Triple I-Girder Caps during estimating, detailing and fabrication
- Grating became the biggest hurdle. (cont.)
  - Clips may not work:
    - Not long enough for thick flanges and field splice plates.
    - Interference with cross-rods
    - What is the best fastener? Mulitple options: saddle clips, G-clips, threaded studs, etc.



COMMENTARY ON THE HEAVY TRIPLE I-GIRDER BENT CAPS .

Steel bent caps sometimes have to be long to clear obstacles. This leads to heavy weights of the triple girder caps with assemblies in excess of 100 tons.

- Normally this results in the addition of field bolted splices to reduce the weight for the fabricators and shipment.
- There can be another option, and that is to ship the girders separately, leaving the girders long and eliminating the field splices. Field assembly would be needed. This can be done with all three girders or with two girders shop assembled and one shipped for field assembly.

Basically, it comes down to whether the erector prefers blocking the shipped assemblies with bolting field splices or installing individual girders and diaphragms.

Ex: 120'-0 long Triple I-Girder Bent Cap weighing 155 tons would require field splices

versus

Three full length girders weighing 50 tons each shipped separately with no field splices.

OBSERVATION.

As a fabricator, WWAS LIKES TRIPLE I-GIRDER BENT CAPS.

Why?

1. No Fracture Control Plan.

2. Rolling of assemblies for welding eliminated.

3. Reduction of CJP welds.

4. No Confined Space hazards and requirements for activities such as welding, bolting and painting.

QUESTIONS?

Thank you