SECTION 11.5
Volume II

PRE-APPROVED REPAIR PROCEDURES FOR STRUCTURAL STEEL

11.5.1 PURPOSE

This section provides pre-approved repair procedures for structural steel produced by fabricators.

11.5.2 AUTHORITY

Sections 20.23(3)(a) and 334.048(3), Florida Statutes (F.S.)

11.5.3 REFERENCES

American Welding Society (AWS), American National Standards Institute, Inc. American Association of State Highway Transportation Officials (AASHTO)/AWS D1.5, Bridge Welding Code

American Welding Society (AWS) D1.1/D1.1M, Structural Welding Code – Steel

11.5.4 SCOPE

This procedure affects fabrication facilities, the State Materials Office, and those consultants who are involved in the verification and quality assurance inspection/testing of steel and other miscellaneous metal products.

11.5.5 GENERAL INFORMATION

These preapproved procedures are not mandatory, so fabricators may elect to use alternative procedures. If a fabricator chooses to use one of the pre-approved procedures for repairs, the procedure does not have to be submitted to the engineer for approval with the exception of Repair Procedure 1 which does require Engineer's approval. If a fabricator elects to use an alternative repair procedure, it must be submitted to the Engineer for approval before any repairs are started. In all cases the Quality Assurance Inspector (QAI) must be notified of the procedure that will be used prior to starting repairs.

The fabricator may incorporate these preapproved procedures into their ***Quality Control Plan***.

Florida Department of Transportation

Repair Procedure 1
STIFFENER or GUSSET REMOVAL PROCEDURE
(Non-Fracture Critical Members)

Approval from the Engineer **shall be received** before improperly fitted and welded members are cut apart.

The following procedure is to be used to remove and replace stiffeners that have been installed and welded:

1. Notify the Quality Assurance Inspector prior to starting the repair procedure.

2. Remove the stiffener by cutting to 1/8” above the fillet welds.

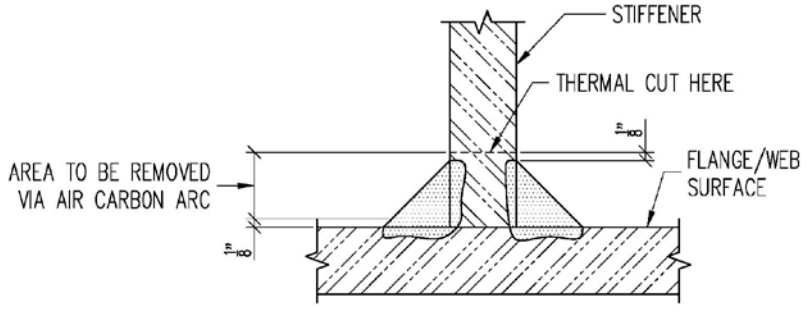
3. Using air carbon arc, being extremely careful not to damage the web/flange base metal, remove the weld and remaining stiffener to within 1/8” of the base metal.

4. Grind the remaining fillet weld/stiffener smooth and flush with the surrounding base metal. Grind parallel to the direction of applied stress.

5. Inspect all of the weld removal areas by Magnetic Particle Test Method.

6. If applicable, fit and weld the replacement stiffener at the specified location in accordance with the applicable approved welding procedure specification.

7. Complete a corrective action report and provide a copy to the FDOT inspection agency.



STIFFENER REMOVAL DETAIL

Florida Department of Transportation

Repair Procedure 2
REPAIR of GOUGES in FLAME CUT EDGES
(Non-Fracture Critical Members)

I. Gouges over 3/16” to a maximum of 7/16” deep (But not exceeding a length of 1-1/2” parallel to the member)

1. Notify the Quality Assurance Inspector prior to starting the repair procedure.

2. Grind the gouge to bright metal with a bottom radius of 1/4 inch minimum and a 20 degree minimum bevel on each side of the gouge.

3. Attach run-off tabs with no tack welds outside the repair area. Tack welds must be consumed by final weld.

4. Preheat per the applicable WPS and maintain the interpass temperature.

5. A qualified welder must weld the defect, using an applicable approved Welding Procedure Specification.

6. Remove run-off tabs and grind surfaces smooth and flush. Final grinding shall be parallel to the direction of stress.

7. Ultrasonic and Magnetic Particle Testing shall be performed in accordance with the applicable sections of ***AWS D1.5***.

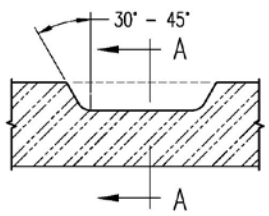
   Note: Material defects exposed by thermal cutting shall not be repaired per this procedure.

II. Gouges 3/16” or less in Depth (But not exceeding 2% loss of cross section area)

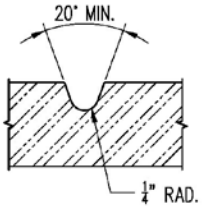
1. These gouges shall be repaired by grinding in the direction of applied stress in the member.
2. Such removals shall be faired to the metal edge with a slope not to exceed one in ten.
3. Material may be repaired by welding as described above.

Note: Material defects exposed by thermal cutting shall not be repaired per this procedure.

Approval of these procedures does not supersede any applicable provisions of ***AWS D1.5*****.**



EXCAVATION DETAIL



SECTION A–A

Florida Department of Transportation

Repair Procedure 3
REPAIR OF ARC STRIKES
(Non-Fracture Critical Members)

Repairs shall be in accordance with ***AWS D1.5***, ***Section 3.10***

1. Notify the Quality Assurance Inspector prior to starting the repair procedure.

2. Grind to bright metal to remove the defective area. The excavation shall be smooth and free of irregularities.

3. On tension and reversal of stress members, Magnetic Particle (preferably by the yoke method) Test the area to assure removal of all discontinuities.

4. On tension and reversal of stress members, verify that the heat affected zone remaining in the member is not unacceptably hard. Hardness values shall not exceed ***Rockwell C30*** in the heat affected zone or the hardness value measured in the unaffected base metal, whichever is higher. Heat affected zone hardening generally extends less than 3 mm (1/8 inch) into the base metal; unacceptable hardening can be removed by shallow grinding.

5. If the grinding resulted in excavation greater than that allowed by ***ASTM A6/6M***, weld the defect by a qualified welder, using an approved ***Welding Procedure Specification***.

6. Magnetic Particle Testing shall be performed for the welded repair area.

Florida Department of Transportation

Repair Procedure 4
CORRECTING FLANGE TILT OR BEARING CONTACT
For material with specified minimum yield strength not greater than 50,000 psi only

1. Notify the Quality Assurance Inspector prior to starting the repair procedure.

2. Heat shall be applied to the girder to adjust flange tilt or to square the bearing to meet contractual requirements. Heating shall not be applied to one location more than three times until all other locations have been utilized.

3. All work shall be performed in accordance with ***AWS D1.5*** and ***FDOT Specification Section 460***.

4. Heating patterns shall be indicated on the girder as required to correct the flange tilt or bearing square condition.

5. Heating shall be performed using a rosebud tip. Rosebud tip selection shall be made to promote heating efficiency while minimizing distortion and excessive heating to the flange.

6. Heating shall be confined to the planned patterns. The steel shall be brought to a temperature between 600 and 1150 degrees Fahrenheit as rapidly as possible. Temperature indicating crayons or other devices for measuring temperature between 600 and 1200 degrees Fahrenheit shall be utilized. All heat measurements shall be taken after the torch has been removed from the steel. Any heating that results in a steel temperature in excess of 1200 degrees Fahrenheit shall be brought to the attention of the engineer for review.

7. Quenching with water or a combination of air and water is not permitted. Cooling with dry compressed air is permitted after the steel has been allowed to cool naturally to 600 degrees Fahrenheit.

8. Further conditioning, such as grinding, may be required to reduce high spots on the outside surface of the bearing area to achieve a flat and smooth condition after heating.

9. The required Magnetic Particle Testing stipulated by ***AWS D1.5*** shall be performed after all heating is completed.

Florida Department of Transportation

Repair Procedure 5
HEAT SWEEP PROCEDURE

The following heat sweep procedure shall be used for material with specified minimum yield strength not greater than 50,000 psi. The heating temperature shall not exceed 1200 degrees Fahrenheit as controlled by temperature indicating devices. Camber members before heat curving when required.

Heat Source:	Oxy-fuel heating, single or multiple torches
Fuel Gas:	Optional
Technique:	Vee or Edge Heating
Heating Temperature:	600 - 1150 Degrees Fahrenheit

1. Notify the Quality Assurance Inspector prior to starting the repair procedure.

2. Brace or support the member in such a manner that the tendency of the girder to deflect laterally during the heat-curving process will not cause the member to overturn. Appropriate blocking, as required, shall be used to attain the required sweep and to prevent excessive movement. Sweep tolerances shall be specified by the applicable code and contract specifications.

3. Members should be heat-curved prior to the attachment of end bearing stiffeners, lateral gusset plates, longitudinal stiffeners, welding of intermediate stiffeners and connection plates to the flanges. Longitudinal stiffeners are required to be heat curved or cut to the required radius prior to being welded to the curved member.

4. Heating shall be performed using a rosebud tip. Rosebud tip selection shall be made to promote heating efficiency while minimizing distortion and excessive heating in the member. Heating shall not be applied to one location more than three times until all other locations have been utilized**.** If multiple locations are to be heated, do not reheat the same location until after at least three heats at other locations

5. Curve members by either continuous edge or vee heating. For the continuous edge method, heat a strip or intermittent strips along the edge of the top and bottom flange in an essentially simultaneous manner depending on flange widths and thickness; use a strip of sufficient width and temperature to obtain the required curvature. For the vee heating, heat the top and bottom flanges in truncated

triangular or wedge shaped areas having their base along the flange edge and spaced at regular intervals along each flange; using spacing and temperature as required to obtain the required curvature, and to allow heating to progress along the top and bottom flanges at approximately the same rate.

6. For the Vee heating, terminate the apex of the truncated triangular area applied to the inside flange surface just before the junction of web and the flange is reached. To avoid unnecessary web distortion, take special care when heating the inside flange surface (the surface that intersects the web) so that heat is not applied directly to the web. When the radius of curvature is 1000 feet or more, extend the apex of the truncated triangular heating pattern applied to the outside flange surface to the juncture of the flange and web. When the radius of curvature is less than 1000 feet, extend the apex of the truncated triangular heating pattern applied to the outside flange surface past the web for a distance equal to 1/8 of the flange width or three inches, whichever is less. For the truncated triangular pattern, provide an included angle of approximately 15 to 30 degrees, but do not exceed 10 inches for the base of the triangle. The flange edges to be heated are those that will be on the inside of the horizontal curve after heating. The heating torch shall not be returned to the apex of the heating triangle after heating has progressed toward the base.

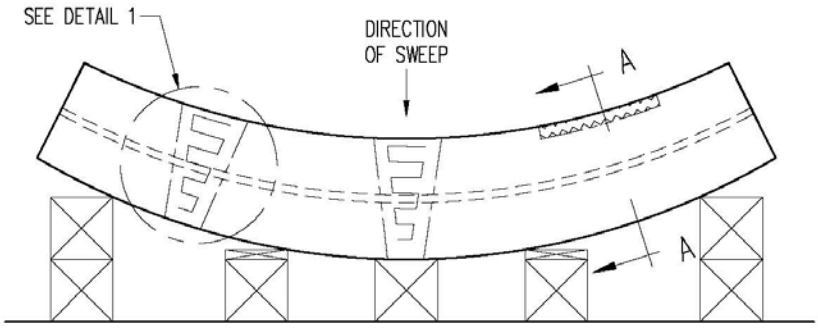
7. Heating shall be confined to the planned patterns. The steel shall be brought to a temperature of between 600 and 1150 degrees Fahrenheit as rapidly as possible. Temperature indicating crayons or other devices for measuring the temperature between 600 and 1200 degrees Fahrenheit shall be utilized. All heat measurements shall be taken after the torch has been removed from the steel. Any heating that results in a steel temperature in excess of 1200 degrees Fahrenheit shall be brought to the attention of the engineer.

8. Quenching with water or a combination of air and water is not permitted. Cooling with dry compressed air is permitted after the steel has been allowed to cool naturally to 600 degrees Fahrenheit.

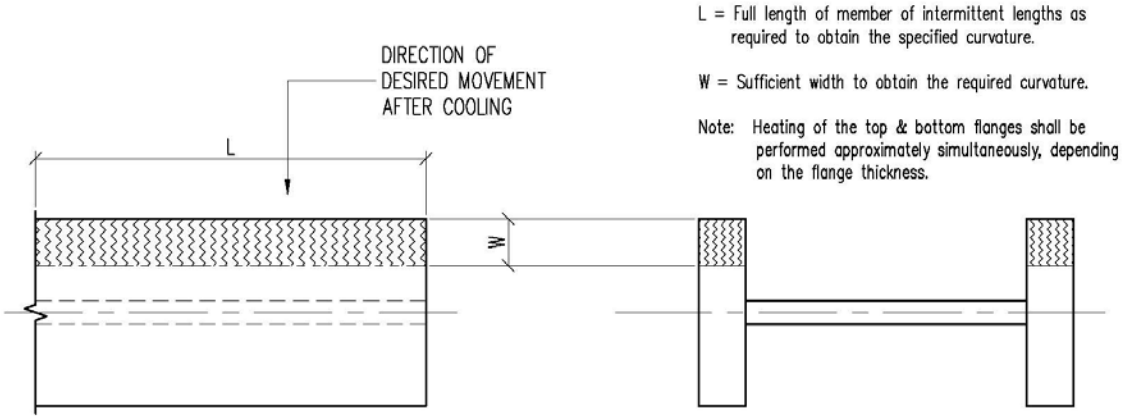
9. The required Magnetic Particle Testing stipulated by ***AWS D1.5*** shall be performed after all heating is completed.

10. All work described above shall be performed in accordance with ***AWS D1.5*** and ***FDOT Specification Section 460***.

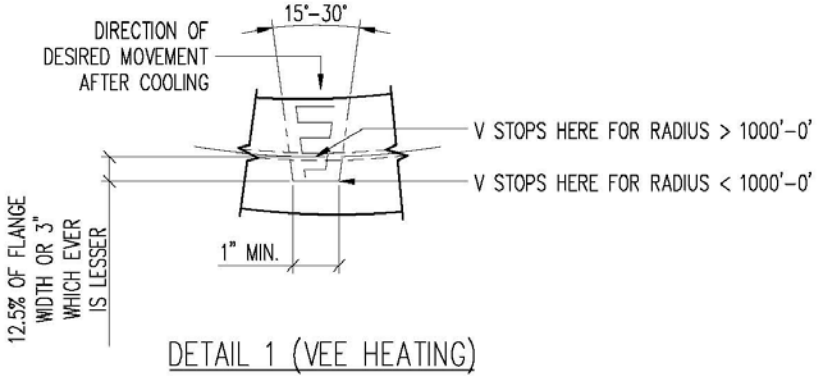
SWEEP SKETCH #1



SUGGESTED HORIZONTAL BLOCKING DETAIL



SECTION A–A (EDGE HEATING)



DETAIL 1 (VEE HEATING)

Florida Department of Transportation

Repair Procedure 6
REPAIR OF BASE METAL DEFECTS
(Non-Fracture Critical Members)

The following procedure shall be utilized to repair base metal defects on rolled surfaces within the limitations of the applicable ***AWS D1.5 (D1.1)*** and ***ASTM A6 Specifications***.

1. Notify the Quality Assurance Inspector prior to starting the repair procedure.

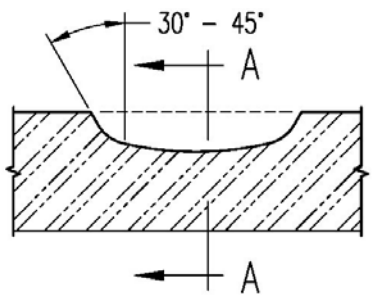
2. Grind to bright metal to remove the defective area. The excavation shall be smooth and free of irregularities.

3. Excavations shall be made with a minimum ¼ inch bottom radius. The sides shall slope at a minimum 20-degree included angle and the ends shall slope back at a 30-degree minimum. Attach run-off tabs when necessary. Tack welds are not permitted outside the weld area.

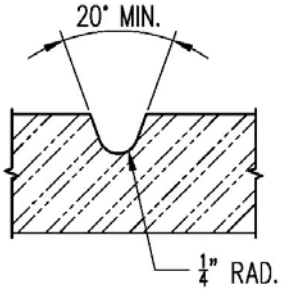
4. Magnetic Particle Test the area to assure removal of all discontinuities. Inspect both parallel and perpendicular to the length of area to be repaired.

5. Weld the excavation using a qualified welder, using an approved ***Weld Procedure Specification***. Grind weld flush with surrounding base metal. Grind parallel to the direction of applied stress.

6. 6. Magnetic Particle or Ultrasound, depending on depth of repair per ***AWS D1.5***, ***Section 3.2.2.3***.



EXCAVATION DETAIL



SECTION A–A

Florida Department of Transportation

Repair Procedure 7
HEAT CAMBER PROCEDURE
(Rolled Beams and I-Beam Welded Girders*)

The following heat cambering procedure shall be used for material with specified minimum yield strength not greater than 50,000 psi. The heating temperature shall not exceed 1200 degrees Fahrenheit as controlled by temperature indicating devices.

*NOTE: For welded girders, cut the web to the prescribed camber with suitable allowance for shrinkage due to cutting, welding and heat curving. Camber correction by heating shall be limited to twice the allowable tolerance from the as-planned camber.

Heat Source:	Single or Multiple Torches
Fuel Gas:	Optional
Technique:	Vee, Strip or Rectangular Heating
Heating Temperature:	600 - 1150 Degrees Fahrenheit

1. Notify the Quality Assurance Inspector prior to starting the repair procedure.

2. The member shall also be supported or braced in such a manner as to prevent the member from overturning. Appropriate blocking, as required, shall be used to attain the required camber and to prevent excessive movement. (See ***Sketch 1*** for suggested vertical and ***Sketch 2*** for suggested horizontal blocking details). Camber tolerances shall be specified by the applicable code and contract specifications.

3. Heat cambering shall be performed using triangular vee, strip, block, edge, and rectangular heating patterns. The heating patterns shall be spaced and marked throughout the length of the member as required to provide the specified camber (see sketches for details of the heating pattern). Heating shall be performed using rosebud tip. Rosebud tip selection shall be made to promote heating efficiency while minimizing distortion and excessive heating to the member.

4. Vee heating shall begin at the apex of the heating pattern. As heating progresses toward the top of the vee, the heating torch shall not be returned to the apex of the heating pattern or to a previously heated area. Heating may be performed either from one side of the web using one torch, or from both sides of the web using two torches. Heating shall not be applied to one location more than three times until all other locations have been utilized. If multiple locations are to be heated, do not reheat the same location until after at least three heats at other locations.

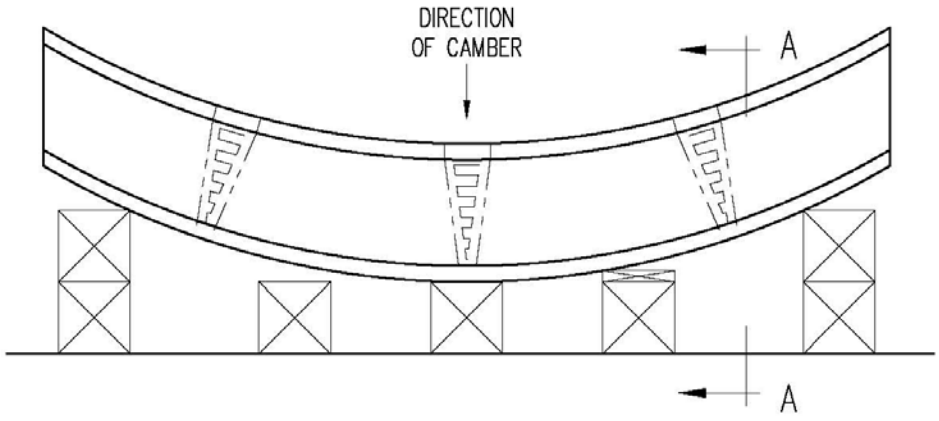
5. Heating shall be confined to the planned patterns. The steel shall be brought to a temperature between 600 and 1150 degrees Fahrenheit as rapidly as possible. Temperature indicating crayons or other devices for measuring temperature between 600 and 1200 degrees Fahrenheit shall be utilized. All heat measurements shall be taken after the torch has been removed from the steel. Any heating that results in a steel temperature in excess of 1200 degrees Fahrenheit shall be brought to the attention of the engineer.

6. Quenching with water or a combination of air and water is not permitted. Cooling with dry compressed air is permitted after the steel has been allowed to cool naturally to 600 degrees Fahrenheit.

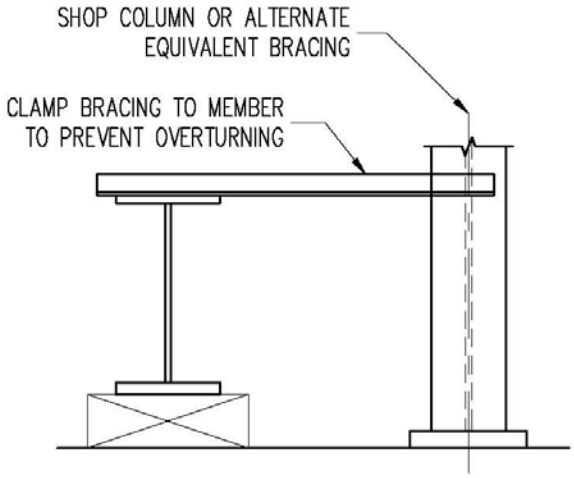
7. Required Magnetic Particle Testing for the girder shall be performed after all heating is completed.

8. All work described above shall be performed in accordance with ***AWS D1.5*** and ***FDOT Specification Section 460***.

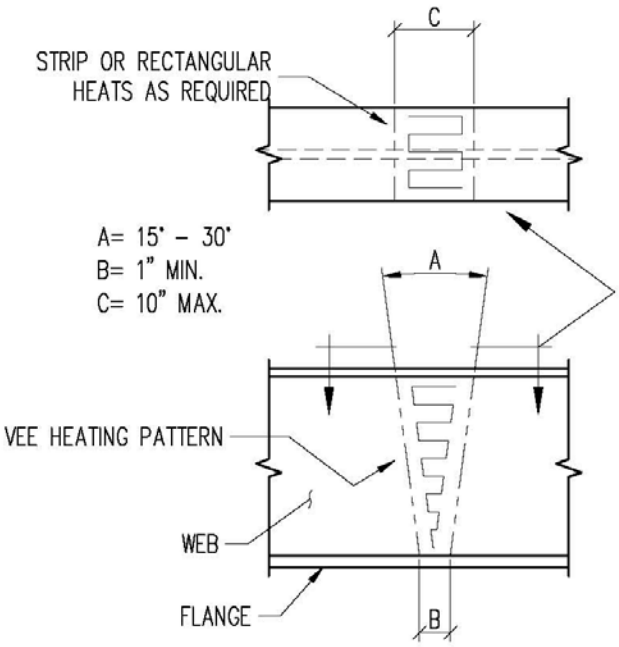
CAMBER SKETCH #1 (VERTICAL)



SUGGESTED VERTICAL BLOCKING DETAIL

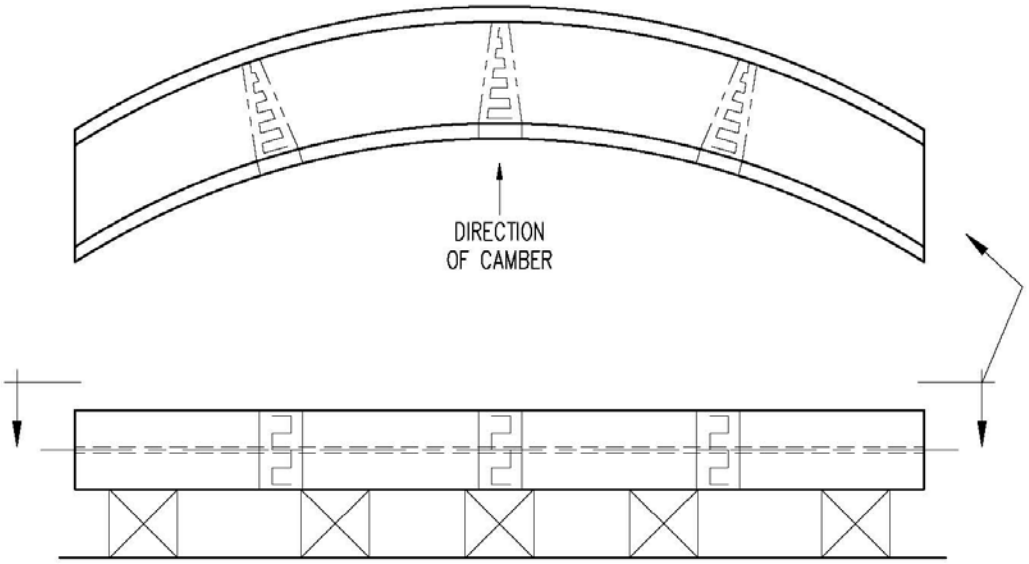


SECTION A–A



VEE, STRIP AND RECTANGULAR HEATING PATTERN DETAIL

CAMBER SKETCH #2 (HORIZONTAL)



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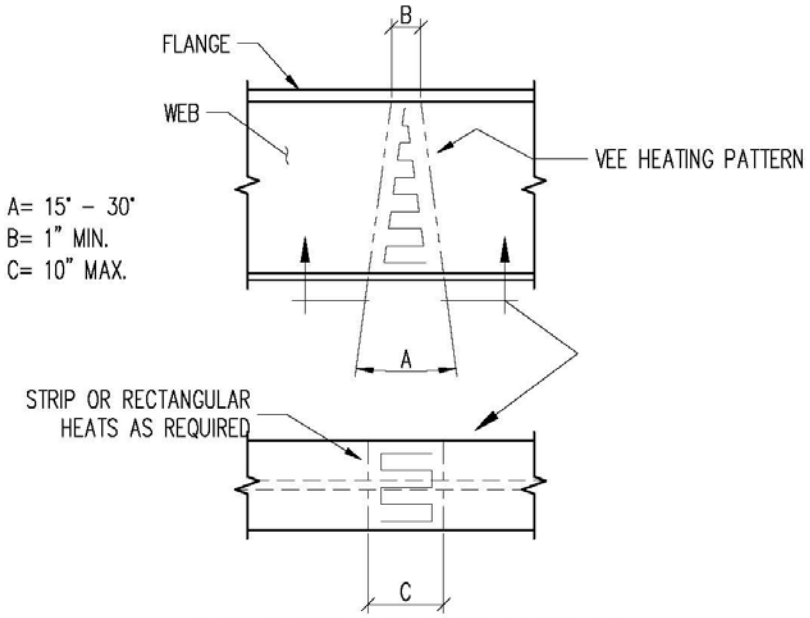

VEE, STRIP AND RECTANGULAR
HEATING PATTERN DETAIL