IOWA DEPARTMENT OF TRANSPORTATION

To Office: Bridges and Structures Date: February 5, 2002

Attention: All Employees Ref. No.: 521.2

From: Gary Novey

Office: Bridges and Structures

Subject: MM No. 30 (Finger Joints)

Recently there has been the need to use finger joints on a number of projects (Design No. 2197-Polk/Warren, Des No. 1199-Woodbury, and Des. No. 500-Woodbury). Finger joints are required when thermal movements exceed those which can be accommodated by strip seals. Strip seals can accommodate movements up to about 5" (125 mm). Consult with your section leader before using finger joints to accommodate movements that exceed 10" (250 mm). Based on the 2000 AASHTO LRFD Bridge Design Specifications and reports from NCHRP (NCHRP 141, 1989) and FHWA (FHWA Technical Advisory, 1980), the following recommendations for the design of finger joints have been adopted.

1. Limit deck surface openings to permit safe operation of motorcycles. When the maximum longitudinal opening in the direction of traffic exceeds 8" (200 mm), the transverse opening shall not exceed 2" (50 mm). For longitudinal openings less than 8" (200 mm), the transverse opening may be increased to 3" (75 mm). [AASHTO LRFD 14.5.3.2]

2. Where narrow bicycle tires are anticipated, use special floor plates in the shoulder area. [AASHTO LRFD 14.5.3.2]

3. The minimum joint opening (maximum design temperature) in the longitudinal direction is 0.5" (12 mm).

4. The maximum joint opening (minimum design temperature) in the longitudinal direction shall maintain at least a 1.5" (38 mm) tooth overlap. [AASHTO LRFD 14.5.3.2]

5. Align teeth with respect to the bearing device. Typically, this will be in the longitudinal direction of the bridge unless the structure is on a curved alignment.

6. Give special attention to details of the joint anchorage system. On structural steel supported bridges, the joints should be rigidly connected to the stringers or girders.

7. Tooth thickness shall not exceed 3" (75 mm). If necessary the designer may either use stiffeners to support the fingers or let the fingers bear on a support beam. For examples, see plan details of the Saylorville Reservoir Bridge and the Iowa Illinois Memorial Bridge on I-74 over the Mississippi River, respectively.

8. As outlined in BDM 5.7.1 “Joints”, the teeth shall be designed as cantilevers. An impact factor of 1.75 shall be used per AASHTO LRFD 3.6.2.1. Let the weight of one wheel with impact equal, W = 1.75*16 kips = 28.0 kips (1.75*72.5 kN = 126.88 kN). Let N equal the number of teeth in the width of the wheel. Based on AASHTO LRFD 3.6.1.2.5 “Tire Contact Area” use 20” (510 mm) for the width of one wheel. The load per tooth, W/N shall be applied 3” (75 mm) from the end of the tooth, or WN/2 shall be applied 1.5” (38 mm) from the end of the tooth, whichever produces the largest stress. Only the teeth on one side of the joint shall be considered as resisting the load. [American Civil Engineering Practice, 1902 ed., Robert Abbett]
9. Finger plate armor should be pierced with ¾” (20 mm) diameter vertical vent holes spaced not more than 18” (450 mm) on center in order to expel entrapped air. Hand packing of concrete under the armor is required. [AASHTO LRFD 14.5.3.5]

10. The top of the expansion device is to be parallel to grade and the end of each tooth is to be beveled a ¼” in 3” (6 mm in 75 mm). Maintain at least an 1/8” (3 mm) gap between adjacent fingers.

11. Since finger joints are considered open joints, elastomeric drainage troughs are required to prevent deicing chemicals and debris from spilling onto the ends of the beams, bearings, and substructure elements below.

When considering the use of the elastomeric drainage troughs, three aspects are of primary concern: sheet type, elastomer, and trough details.

1. Sheet type

    a. Sheet types should be low durometer (50 to 60) and synthetic fabric reinforced.

    b. Thickness of the side curtains and the reinforced neoprene trough should be 1/4” (6 mm).

2. Elastomer

    Place the following standard note on the plans: “The elastomer compound for trough and curtains shall be in accordance with table B of article 4195.02 of the standard specifications, except the tensile strength shall be 1500psi (10.3 MPa) minimum or it shall be (EPDM) Ethylene Propylene Diene Monomer (ASTM D 2000, Line call-outs 3BA, 515, A14, B13, F17, C12, K21, Z1, Z2).”

Joint Details (See Figure)

a. To limit the possibility of debris accumulation, a minimum slope of 8% is required for the drainage trough.

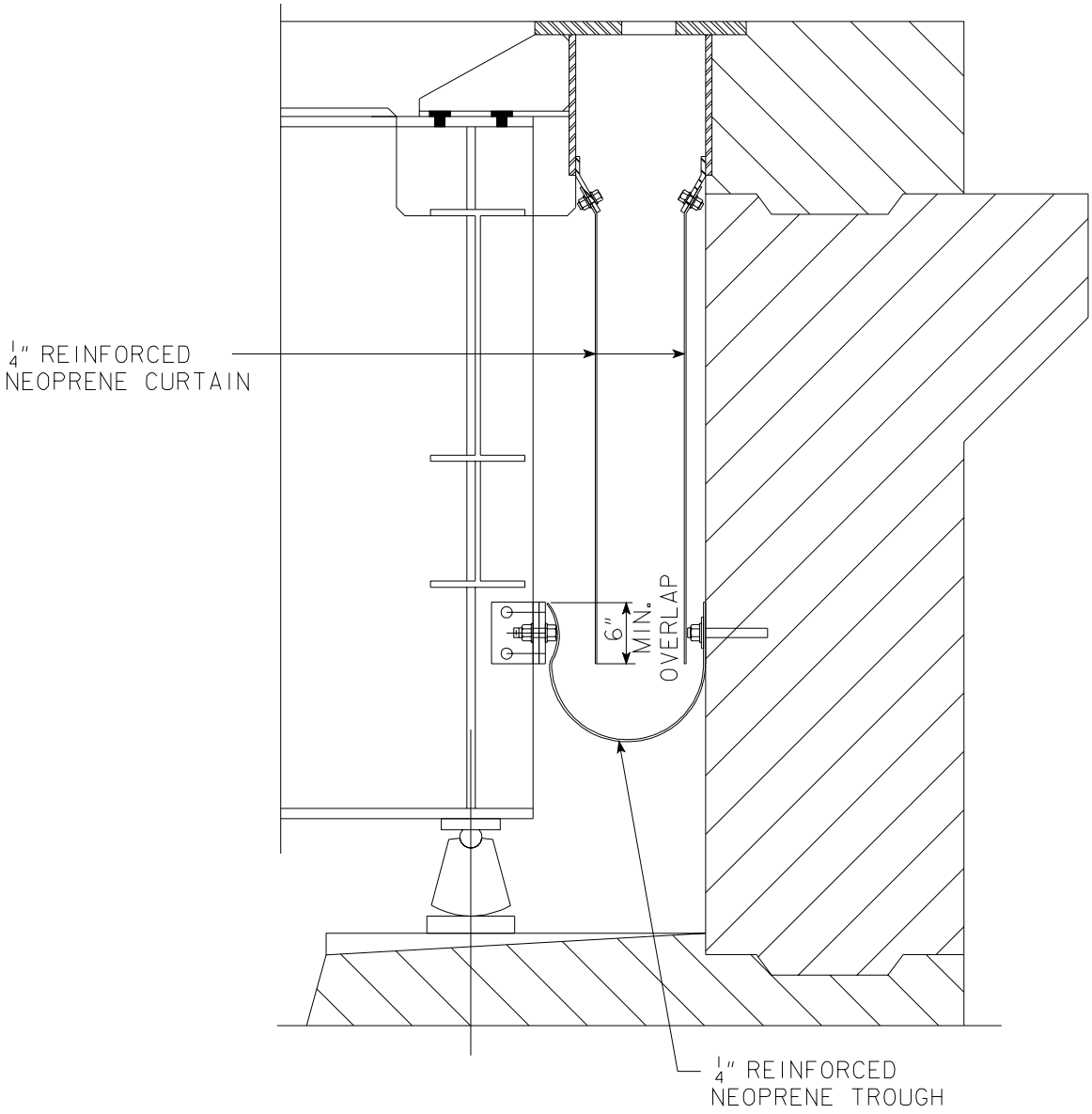
b. Drainage troughs should be continuous full width of the bridge including curb and parapet area when the joint is over a pier or at an abutment and elsewhere where a closed drainage system is required. Keep the drainage trough continuous the full width of the bridge, where possible. If not, check with the section leader.

c. If splicing of the elastomeric sheet side curtains is necessary, a minimum splice length (overlap) of 2' (610 mm) is recommended, overlap of the upstream sheet shall be on the inside relative to the downstream sheet.

d. The finished joint should be recessed 1/8" (3 mm) to avoid damage by traffic or snow removal equipment.

e. All hardware, including bolts, studs, washers and concrete anchors, used to attach the trough shall be stainless steel.

f. The troughs should be attached in a secure manner with a minimum of 5/8" (15.9 mm) diameter bolts at 18" (450 mm) centers.


1/4" REINFORCED
NEOPRENE CURTAIN
6" MIN. OVERLAP
1/4" REINFORCED
NEOPRENE TROUGH

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