



Expansion Joints

Bridge Field Services





Expansion Joints

- Permit expansion, contraction, and/or rotational movement
- Located above piers, abutments, pin & hangers, or placed on a sleeper slab



:

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Expansion Joints

- Restricted movement leads to stresses that may cause irreversible damage



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Expansion Joints

- Damaged joints will leak resulting in deterioration of superstructure and substructure elements below.





Expansion Joints

- Joints typically placed transverse but may also be longitudinal
- Required on deck widths greater than 100'

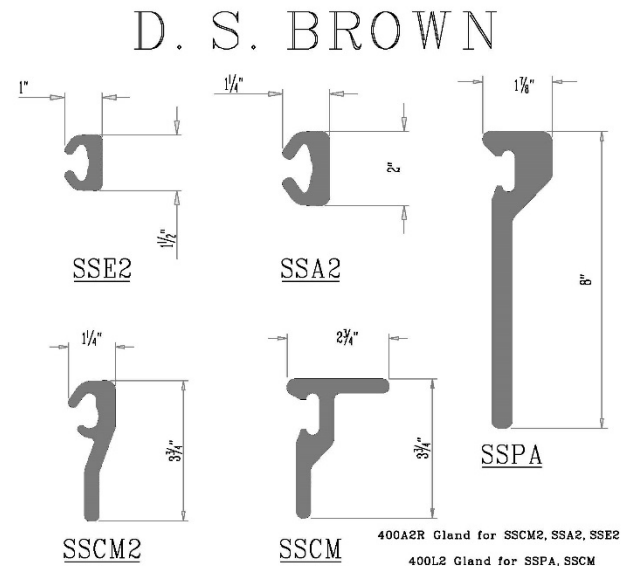
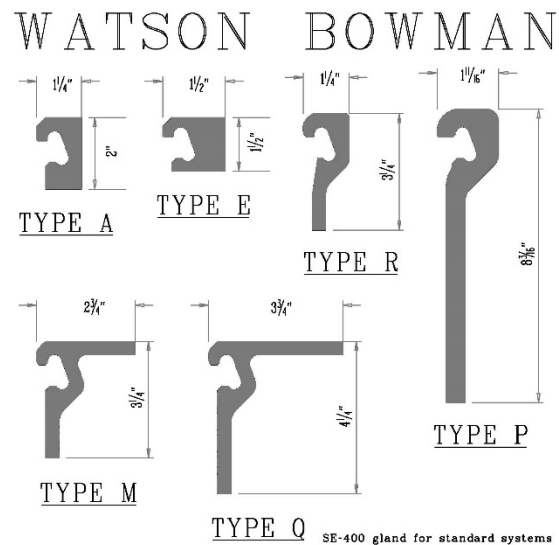


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Expansion Joints

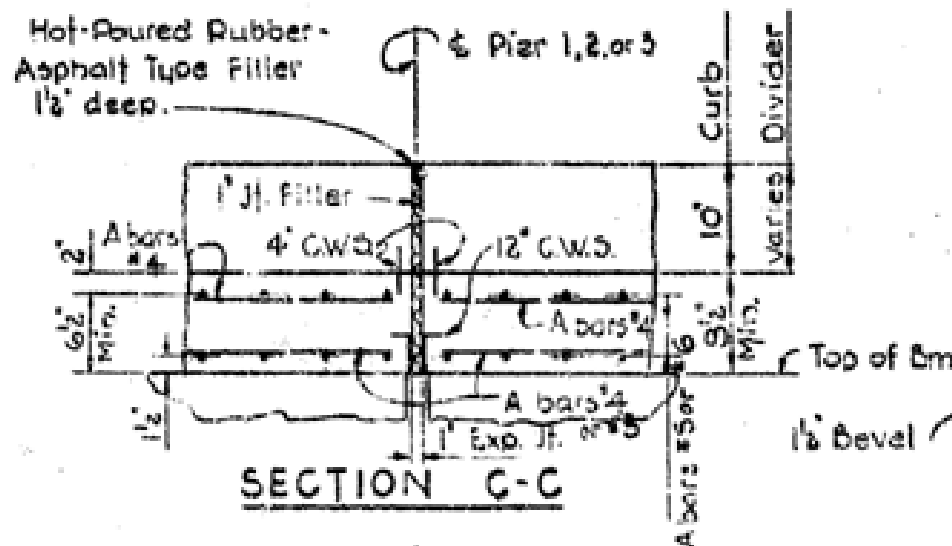
- Multiple styles with proprietary alterations



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Field Formed Joint

- Hot-poured rubber with copper waterstop
- Seal deterioration leads to “bathtub” and accelerated deck deterioration
- Utilized often during 1960’s

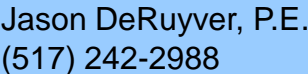




Field Formed Joint



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- Hot-poured rubber placed between plates prevents moisture intrusion
- Requires annual maintenance





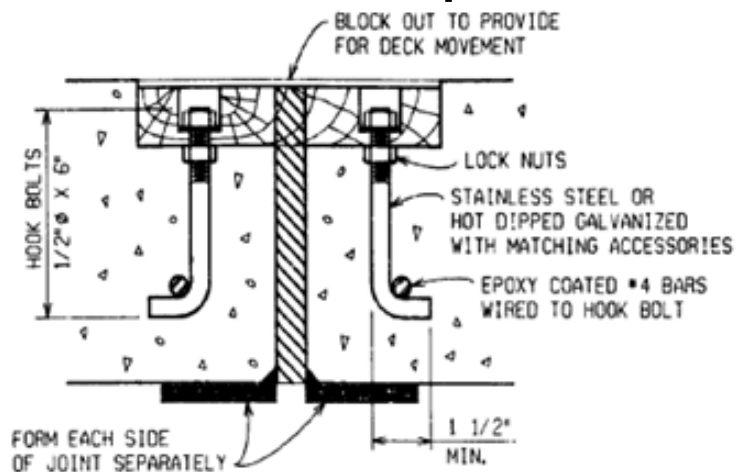
Sliding Plate Joint



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Block Out Joint

- Seal held in place by manufactured panels anchored to deck
- Difficult to seal vertical face of formed block out
- Susceptible to snow plow damage



DETAIL FOR ANCHORAGE CAST IN PLACE

MANUFACTURER IS TO FURNISH BOLTS,
NUTS, WASHERS, #4 BARS, AND TIES.



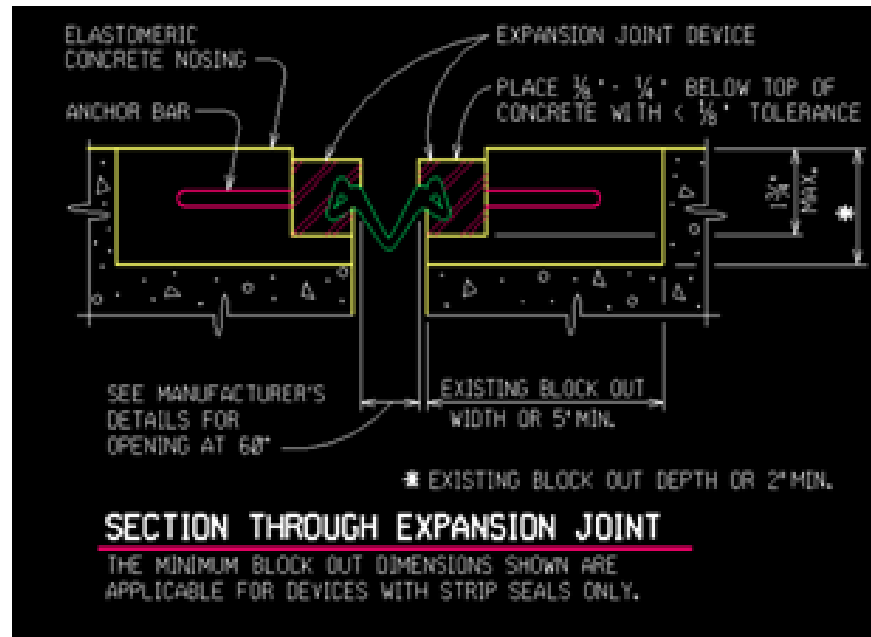
Block Out Joint



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Partial Depth Joint (EJ4)

- Strip seal with horizontal anchors
- Fast joint replacement
- Relies on chemical bond of elastomeric concrete to deck slab





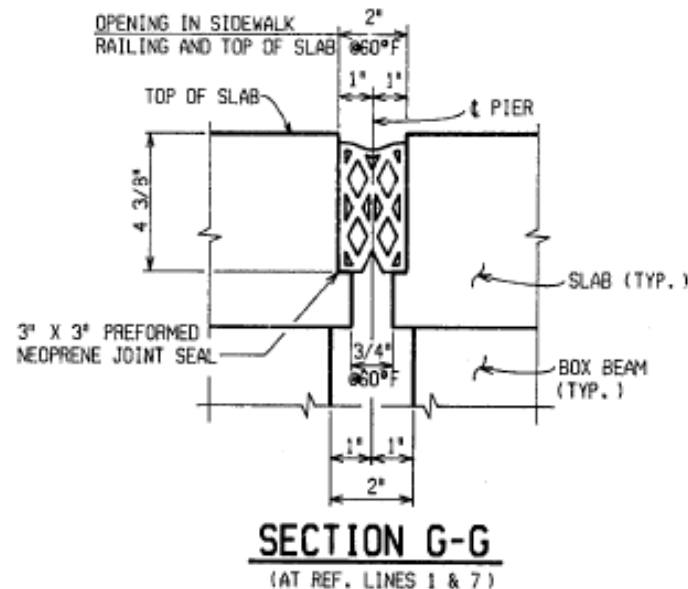
Partial Depth Joint (EJ4)



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Compression Joints

- Seal must always remain in compression
- Multiple temperature cycles leads to reduced effectiveness





Compression Joints



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Bridge Design Manual

- Joint Replacement
 - Leaking joints must be replaced or repaired
 - Joints in good condition must be replaced to match new deck grades for overlay projects

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Bridge Design Manual

- Joint Device Replacement
 - Remove concrete full depth at least 1'-6" on either side of the joint
 - The expansion joint device shall be replaced with an approved product
 - Anticipated openings greater than 4" require a modular joint (special provision)



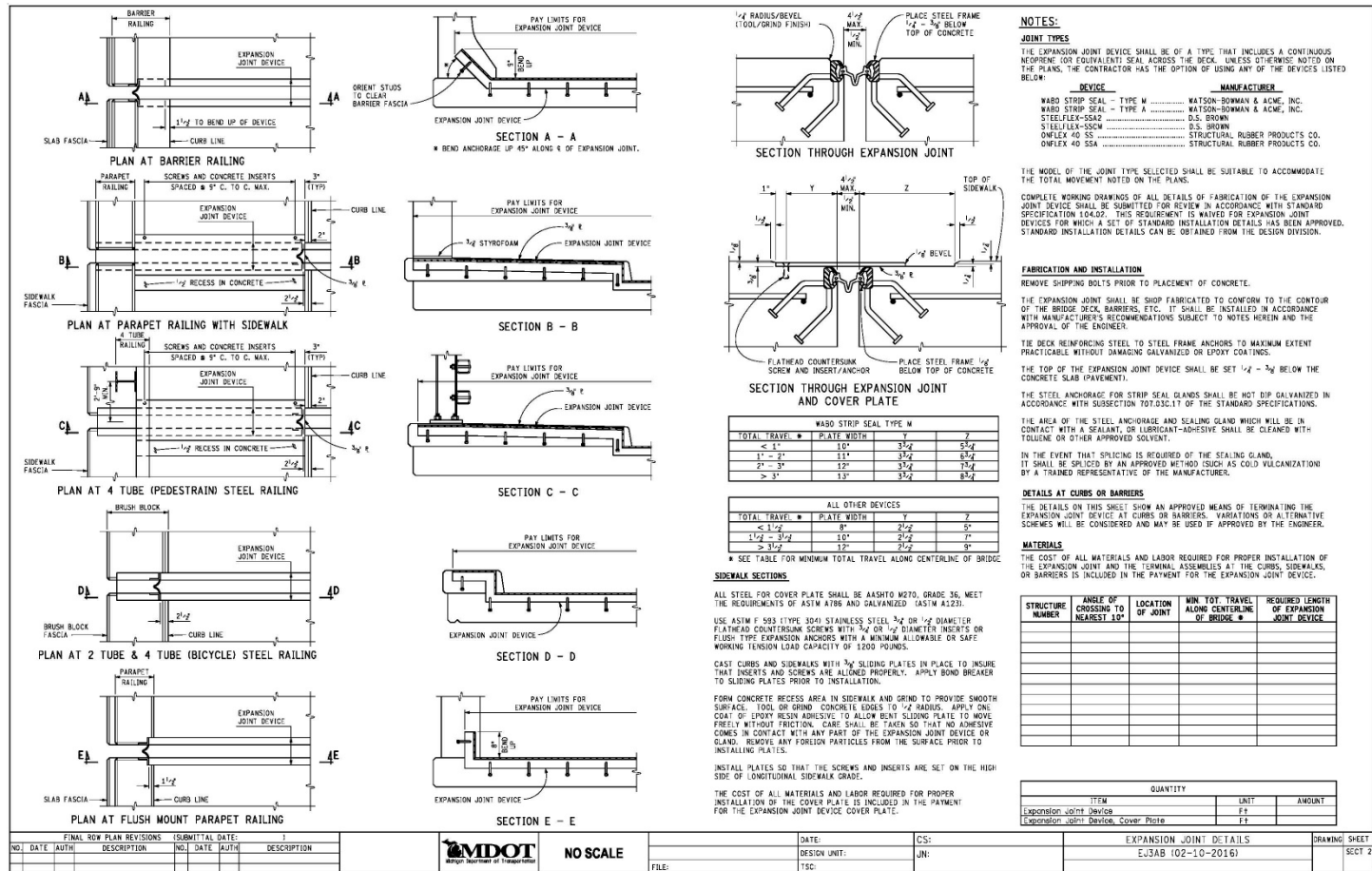
EJ3 Detail

- Multiple plan and section views for end treatments
 - Barrier
 - Sidewalk
 - Brush Block
 - Parapet
- Typical cross sections detailed.

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EJ3 Detail

- Angle of crossing $\geq 70^\circ$



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Joint Removal

- 1" saw cut required a minimum of 1'-6" on either side of joint if the deck will receive an
 - Epoxy overlay
 - Healer sealer
 - No surface modification
- No saw cutting required for rigid overlay

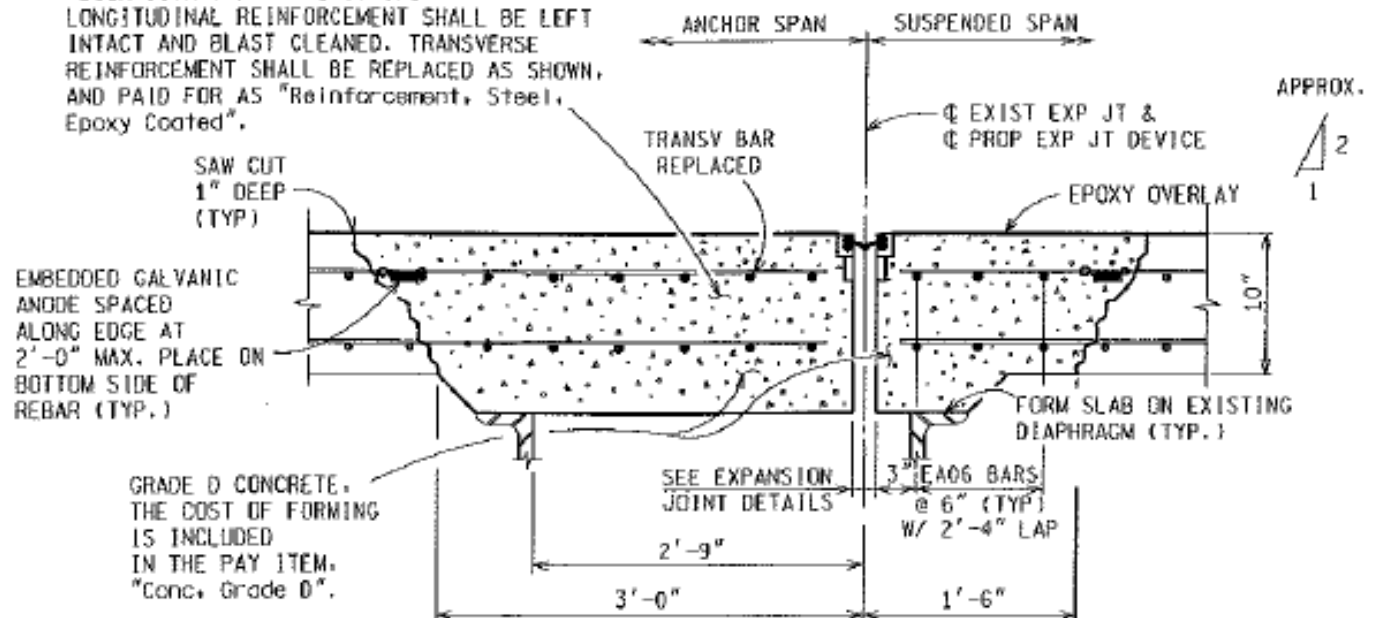




Saw Cut Deck

DECK SECTION

REMOVE EXISTING JOINT. CONCRETE REMOVAL IS INCLUDED IN PAY ITEM "Deck Joint, Rem". EXISTING LONGITUDINAL REINFORCEMENT SHALL BE LEFT INTACT AND BLAST CLEANED. TRANSVERSE REINFORCEMENT SHALL BE REPLACED AS SHOWN, AND PAID FOR AS "Reinforcement, Steel, Epoxy Coated".



SECTION AT PROPOSED EXPANSION JOINT DEVICE

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No Saw Cutting

REMOVE EXISTING EXPANSION JOINT. CONCRETE REMOVAL IS INCLUDED IN THE BID ITEM "DECK JOINT, REM". EXISTING LONGITUDINAL REINFORCEMENT SHALL BE LEFT INTACT AND BLAST CLEANED. TRANSVERSE REINFORCEMENT SHALL BE REPLACED AS SHOWN, AND PAID FOR AS "REINFORCEMENT, STEEL, EPOXY COATED".

EXISTING EXPANSION JOINT & PROPOSED EXPANSION JOINT DEVICE

TRANS. REINF. REPLACED

APPROX. $\frac{2}{1}$

TOP OF EXISTING SLAB AFTER SCARIFYING

CONCRETE BRIDGE DECK OVERLAY

CONC. GRADE D. (CONC. BRIDGE DECK OVERLAY, MAY BE SUBSTITUTED BUT WILL BE PAID FOR AS "CONC. GRADE D") COST OF FORMING IS INCLUDED IN THE BID ITEM "CONC. GRADE D".

SEE EXPANSION JOINT DETAILS

75

EA19

Ø 150

450 MIN.

450 MIN.

SECTION AT PROPOSED EXPANSION JOINT DEVICE

BEFORE FORMING, SOUND CONCRETE TO SEE IF ADDITIONAL REMOVAL WILL BE REQUIRED.

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Concrete Removal

- Section 712.03 Removing Superstructure Concrete at Expansion and Construction Joints on Concrete Beam Bridges
 - Do not use machine-mounted hydraulic or pneumatic equipment
 - Contractor may use manual pneumatic hammers with 60 pound maximum rating

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Concrete Removal

- Section 712.03 Removing Superstructure Concrete at Expansion and Construction Joints on Steel Beam Bridges
 - May use machine-mounted hydraulic or pneumatic equipment with 300 foot-pounds maximum rating
 - Do not allow machine mounted equipment within 12" of beam ends or within 6" of transverse saw cuts



Concrete Removal



- Use pneumatic 60 pound hammers near beams ends and transverse saw cuts

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Concrete Removal



Impact Energy Class	KF 1 150 ft. lbs.	KF 2 250 ft. lbs.	KF 3 350 ft. lbs.
Weight in Lbs. (kg)			
Standard Version	154 (70)	203 (92)	300 (136)
SS Version	n/a	n/a	552 (250)
FSP Version**	n/a	n/a	470 (213)**
Qt Version**	n/a	n/a	480 (218)**
Length in Inches (mm)			
Standard Version	35.5 (900)	40 (1015)	44 (1,115)
SS Version	n/a	n/a	56 (1,422)
FSP Version**	n/a	n/a	58 (1,473)**
Qt Version**	n/a	n/a	57 (1,448)**
Adjustable BPM	900 ~ 1,250	900 ~ 1,200	700 ~ 900
Acceptable GPM Range (LPM)	3 ~ 5 (12 ~ 20)	4 ~ 8 (16 ~ 30)	6.5 ~ 10.5 (25 ~ 40)
Acceptable PSI Range (Bar)	1,450 ~ 2,030 (100 ~ 140)	1,450 ~ 2,030 (100 ~ 140)	1,450 ~ 2,030 (100 ~ 140)
85 dB(A) Qt version @:	n/a	n/a	8 - meters
Working Steel Diameter in Inches (mm)	1.42 (36)	1.77 (45)	2.00 (52)
Working Steel:			
new length measured from fronthed (in)	10.25	11.5	12.75
replaceable length measured from fronthed (in)	7.25	8.5	9.00
Recommended Carrier in U.S. Tons	1.1 ~ 1.6	1.6 ~ 2.75	2.75 ~ 3.85

- Verify the impact energy if a machine-mounted hammer is used



Exposed Reinforcement

- Blast clean to remove scale or accumulated rust from exposed longitudinal reinforcement



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Exposed Reinforcement

- Replace exposed transverse bars
- Supplement broken or missing reinforcement and bars that have lost $\frac{1}{4}$ or more of original diameter



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Exposed Reinforcement



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Exposed Reinforcement

- Lap bar length must be at least 35 bar diameters
- Tie bar laps in at least two locations
- Tie bar intersections at every third intersection



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Forming

- Block forms from the beam flanges
- Form slabs as shown on the plans
 - Level with end diaphragms
 - Flush with bottom of deck surface
- Remove forms upon completion of the work





Expansion Joint Device

- Shall be of a type that includes a continuous neoprene seal across the deck
- Approved devices
 - Watson-Bowman Wabo Strip Seal Type M
 - Watson-Bowman Wabo Strip Seal Type A
 - D.S. Brown Steelflex SSA2
 - D.S. Brown Steelflex SSCM
 - Structural Rubber Products Onflex 40 SS
- The model of the joint type selected shall be suitable to accommodate the total movement noted on the plans

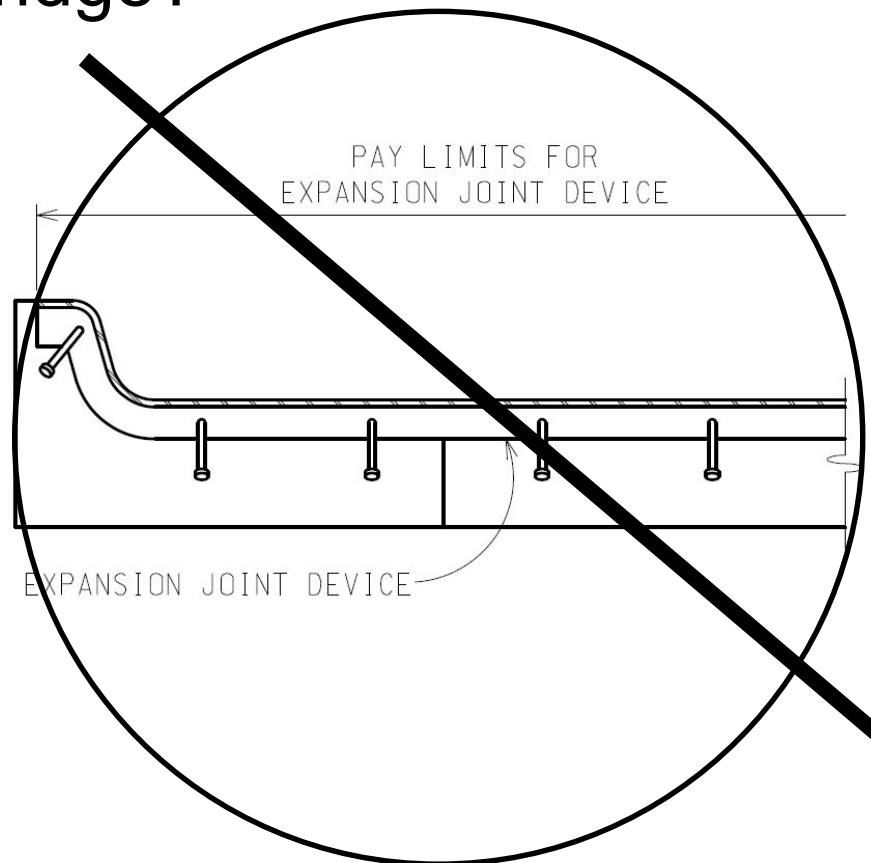
Fabrication

- The expansion joint shall be shop fabricated to conform to the contour of the bridge
- The steel anchorage for strip seal glands shall be hot dip galvanized in accordance with 707.03C.17



Fabrication

- The expansion joint shall be shop fabricated to conform to the contour of the bridge?





Setting Device

- The top of the expansion joint shall be set $\frac{3}{8}$ " to $\frac{1}{4}$ " below the concrete slab.



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Setting Device

- If device is not properly recessed it will be damaged by snowplows



- Damaged joint
- Properly Recessed



Secure Device

- Secure device anchors to deck reinforcement to maintain proper grade
- Remove shipping devices between rails (bolts).



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Field Welding Device Ends

- Review section 707.03.D.8.b
- Blast clean or grind contact surfaces



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Field Welding Device Ends

- Bring parts into close contact
 - If separation between parts exceed $1/16$ " increase the legs of the fillet weld by the distance
 - Do not weld if separation exceeds $3/16$ "



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Anodes

- Install approved galvanic anodes to uncoated reinforcement along the perimeter of the repair
- Space anodes as shown on the plans but do not exceed 24"



Maintain Opening

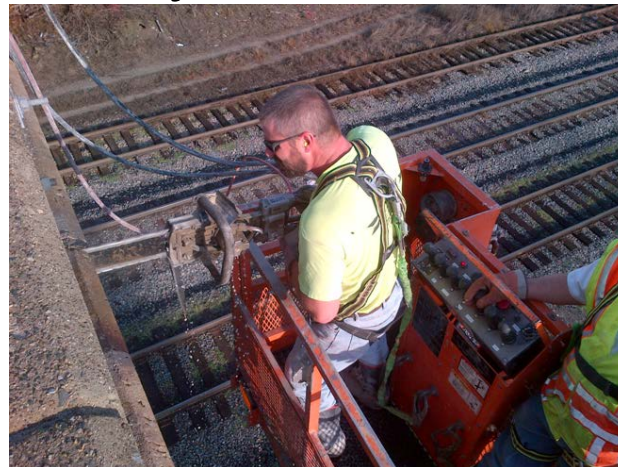
- Place extruded polystyrene foam or other material to maintain 2" opening
- Keeps concrete from entering joint.





Upturns

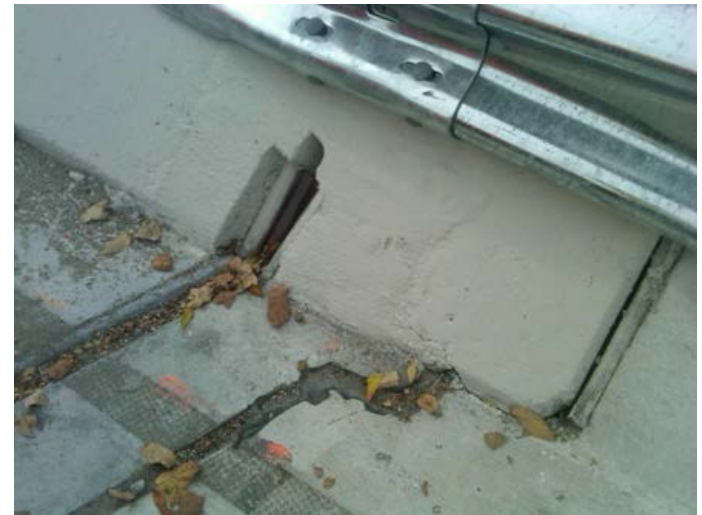
- Prior to pouring concrete inspect expansion joint device terminations
 - **Ensure opening is maintained throughout entire joint length and railing**
 - Verify expansion/contraction may occur freely



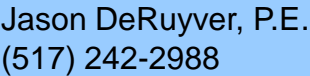


Upturns

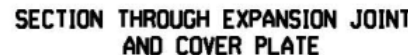
- Verify each rail is separate of one another



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- All steel for expansion joint and cover plate shall be AASHTO M270, Grade 36, and galvanized with a static coefficient of friction of 0.6 or greater
- Use ASTM F 593 (Type 304) stainless steel $\frac{3}{4}$ " diameter flathead countersunk screws with $\frac{3}{4}$ " diameter inserts





Sidewalk Plates

- Form concrete recess area in sidewalk
- Cast curbs and sidewalks with 3/8" sliding plates in place to insure alignment
- Apply bond breaker to sliding plates prior to installing



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Concrete

- Moisten surface without leaving free water
- Place Grade D concrete or substitute overlay concrete





Concrete

- Vibrate to consolidate concrete around anchors
- Apply a layer of wet burlap and cover with 4-mil thick layer of polyethylene



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Installing Sidewalk Plates

- Grind concrete to provide a smooth surface for the plate to slide on
- Apply one coat of epoxy resin adhesive to allow the bent sliding plate to move without friction
- Install plates so that the screws and inserts are set on the high side of longitudinal sidewalk grade







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Gland Installation

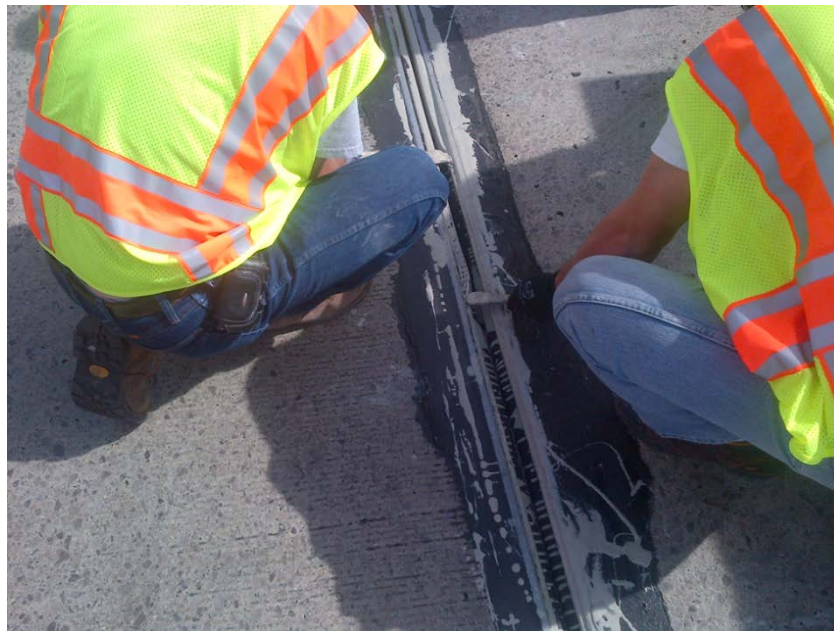
- Clean gland and rail cavity with toluene to remove oils
- Apply an approved lubricant-adhesive liberally to the gland before inserting into rail

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Sealing Element Cross-Section	Sealing Element	Movement Range		Joint Opening	Corresponding Steelflex® Rail
		MR _L	MR _T		
 A2R	A2R – 400	4.0 (102)	±2.0 (51)	0.5 – 4.5 (13) (114)	SSCM2 SSA2 SSE2M
 A2R-XTRA	A2R – XTRA	7.0 (178)	±2.0 (51)	0.5 – 7.5 (13) (191)	
 A2R-O	A2R – O	4.0 (102)	±0.5 (13)	1.0 – 5.0 (25) (127)	
 L2	L2 – 400	4.0 (102)	±2.0 (51)	0 – 4.0 (0) (102)	SSPA SSCM
 L2-500	L2-500	5.0 (127)	±2.0 (51)	0 – 5.0 (0) (127)	
 L2-O	L2-O	4.0 (102)	±0.5 (13)	1.0 – 5.0 (25) (127)	
Bold numbers represent inches; metric (mm) in parentheses					

Gland Installation

- Install the gland in one continuous piece
- If the gland is not continuous and requires splicing use cold vulcanization or other approved means





Gland Installation



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Gland Replacement

- A joint may not require replacement if adjacent concrete is sound, rail is intact, and deck grades remain unchanged



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Gland Replacement

- A torn or broken gland may be the cause of leakage



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Gland Replacement SP

12DS706(L760)

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
EXPANSION JOINT GLAND REPLACEMENT

BRG:AM

1 of 1

APPR:CER:TES:10-26-16

a. Description. This work consists of replacing strip seal glands as shown on the plans in accordance with the repair procedure described herein. Perform this work in accordance with sections 706 and 712 of the Standard Specifications for Construction.

b. Materials. For the strip seals provide a continuous neoprene gland to replace the existing gland. Determine the correct seal manufacturer from field inspection. Shop fabricate the gland to conform to the contour of the bridge deck, all upturns and the field measured dimensions of the joints as shown on the plans. Use lubricant/adhesive to install and seal the joint as recommended by the manufacturer.

c. Equipment. Provide equipment in accordance with subsection 712.03.A of the Standard Specifications for Construction.

d. Construction. Remove the existing gland. Clean exposed structural steel expansion joint device in accordance with the Society for Protective Coatings (SSPC)-SP2, Hand Tool Cleaning. Protect the work and environment in accordance with section 715 the Standard Specifications for Construction. Install the gland in accordance with the manufacturer's recommendations.

e. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item

Pay Unit

Strip Seal Gland ReplacementFoot

Strip Seal Gland Replacement will be measured to the limits shown on the plans. The unit price for **Strip Seal Gland Replacement** includes the cost of removing the existing gland, any associated appurtenances, cleaning the expansion joint device, protecting the work and environment during cleaning, providing and installing the replacement glands, lubricants and any associated appurtenances.

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Gland Repair

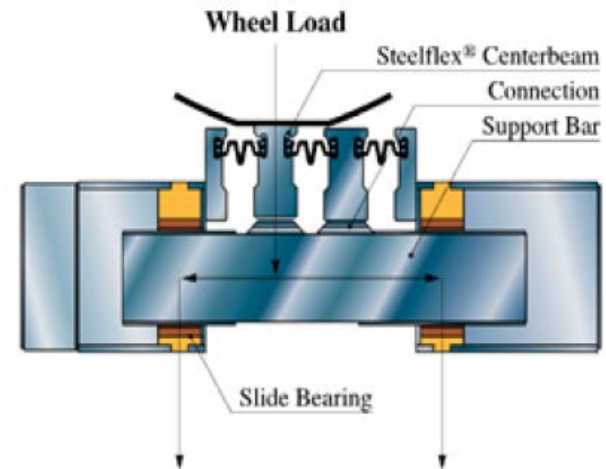
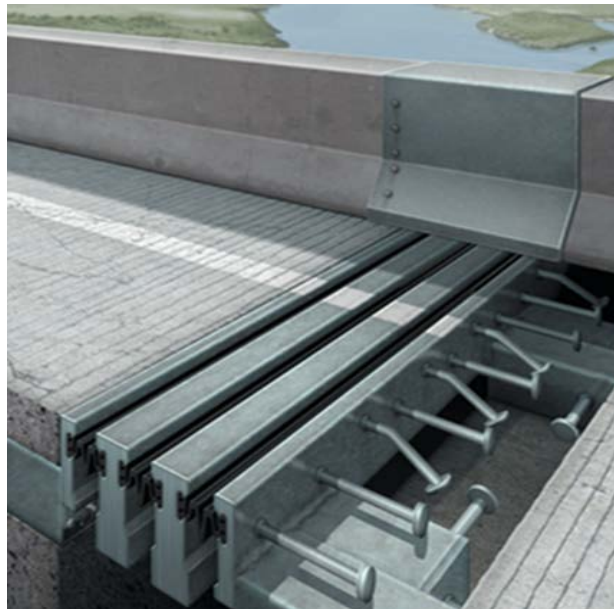


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Modular Expansion Joint Systems

- Installed where expansion/contraction exceeds 4"
- 8 page special provision details design, testing, material, and construction requirements

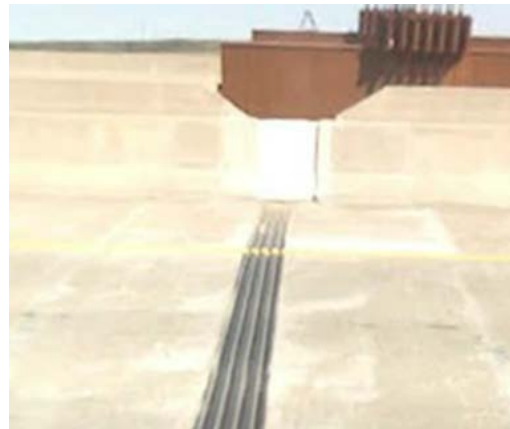


Wheel Load Transfer



Modular Expansion Joint Systems

- Acceptable suppliers limited to D.S. Brown Co. and Watson Bowman ACME
- Manufacturer's representative to be on site during installation
- Temperature adjustment required
- Watertight integrity test must be performed





Modular Expansion Joint Systems

- Monolithic unless part-width or restricted by 72' length
- MDOT requires 3" limit per seal

Joint Device Symbol	Model Number	Total Movement	Cells	"A" Blockout Depth	"B" Blockout Width	"C" Min.	"C" Max.	"W" Mid Temp	"X"
	D-160	6.30 (160)	2	14 (356)	15 (391)	3.35 (85)	5.71 (145)	8.17 (208)	12.2 (310)
	D-240	9.45 (240)	3	14 (356)	18 (457)	4.92 (125)	9.65 (245)	12.24 (311)	12.2 (310)
	D-320	12.60 (320)	4	14 (356)	22 (559)	6.50 (165)	13.78 (350)	16.32 (415)	12.2 (310)
	D-400	15.75 (400)	5	14 (356)	25 (635)	8.07 (205)	17.91 (455)	20.39 (519)	12.2 (310)
	D-480	18.90 (480)	6	14 (356)	28 (711)	9.65 (245)	21.85 (555)	24.47 (622)	12.2 (310)
	D-560	22.05 (560)	7	14 (356)	31 (787)	11.22 (285)	25.98 (660)	28.54 (725)	12.2 (310)
	D-640	25.20 (640)	8	15.25 (387)	34 (864)	12.80 (325)	30.12 (765)	32.62 (829)	13.3 (338)
	D-720	28.35 (720)	9	15.5 (394)	37 (940)	14.37 (365)	34.06 (865)	36.69 (932)	13.6 (345)

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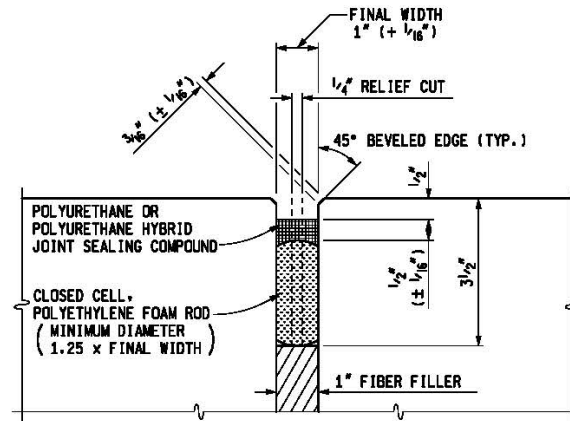
End Jts (E3) R-39-J

SYMBOL (E3)

NOTE:

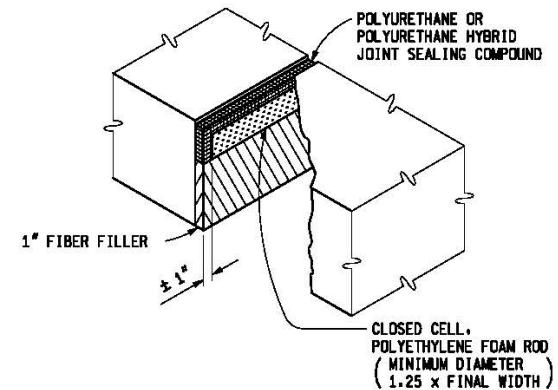
THE FINAL WIDTH OF THE GROOVE SHALL BE $1" + \frac{1}{16}"$ PLUS ANY INCREASE OR MINUS ANY DECREASE IN THE WIDTH OF THE RELIEF CUT. THE FINAL SAW CUT SHALL BE TO THE TOP OF THE FIBER FILLER WITH A MINIMUM DEPTH AS SHOWN AND SHALL BE CENTERED OVER THE FIBER FILLER WITH A HORIZONTAL TOLERANCE OF $\frac{1}{4}"$. FIBER FILLER FOR EXPANSION JOINTS IN CONCRETE SHOULDERS SHALL BE FREE OF HOLES OR OTHER DEFECTS AND TRIMMED TO FIT SHOULDER CONFIGURATIONS.

SYMBOL	LOAD TRANSFER ASSEMBLY	JOINT USE
(E3)	NO	PAVEMENT & SHOULDER



SAWED JOINT DETAIL

SAWED JOINT SEALED WITH POLYURETHANE OR POLYURETHANE HYBRID JOINT SEALING COMPOUND.



OUTSIDE EDGE TREATMENT

TRANSVERSE EXPANSION JOINT



End Jts (E3) R-39-J

SPECIAL PROVISION FOR E3 JOINT SEALANT

OFS:JD

1 of 2

APPR:ARB:JFS:03-07-17
FHWA:APPR:03-08-17

a. Description. This work consists of constructing and sealing new, or resealing existing, E3 expansion joints. Work includes removing any existing joint sealants and backer rods, cleaning the joints, and sealing the joints with a polyurethane or polyurethane hybrid joint sealant at the locations shown on the plans, or as directed by the Engineer. Perform all work in accordance with the standard specifications and standard plans, except as modified in this special provision.

b. Materials. Provide all materials in accordance with subsection 602.02 of the Standard Specifications for Construction, except as modified in this special provision.

Provide a solid, round, closed-cell, polyethylene foam backer rod meeting the requirements of *ASTM D 5249, for Type 1*. Non-sag polyurethane and polyurethane hybrids must meet *ASTM C 920, Type S, Grade NS, Class 35*. Self-leveling polyurethane and polyurethane hybrids must meet *ASTM C 920, Type S, Grade P, Class 35*. Select a polyurethane or polyurethane hybrid based on the performance requirements in Table 1, or as approved by the Engineer.

Table 1: Polyurethane or Polyurethane Hybrid Sealant Requirements

Property	Test Method	Minimum Result
Movement capability, %	<i>ASTM C 719</i>	+35/-35
Tensile strength, psi	<i>ASTM D 412</i>	175
Tear strength, pli	<i>ASTM D 624</i>	35
Ultimate elongation at break, %	<i>ASTM D 412</i>	500
Hardness, Shore A	<i>ASTM C 661</i>	25
Tack-free time, hrs	<i>ASTM C 679</i>	6
Adhesion in peel, lbf	<i>ASTM C 794</i>	20

c. Construction. Construct and seal E3 expansion joints in accordance with subsection 602.03 of the Standard Specifications for Construction and Standard Plan R-39 Series, except as modified in this special provision.

1. **Joint Preparation.** Immediately prior to application of the polyurethane or polyurethane hybrid sealant, clean joint faces by abrasive blasting to remove all materials that may interfere with the bonding or curing of the sealant. If resealing joint, remove all existing sealant prior to abrasive blasting. Ensure the prepared joint faces meet the *International Concrete Repair Institute Guideline No. 03732*, concrete surface profile 3 (CSP 3). Use a vacuum or oil-free moisture-free air blast to remove all dust and other loose material. Remove any oil or other contamination after initial cleaning. Ensure there is no visible moisture present on the surface of the concrete at the time of application. The Engineer will not allow the use of artificial heat to dry joints before sealing. Ensure that the fiber joint filler is secure and installed at the proper

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End Jts (E3) and Construction Jts



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End Jts (E3) and Construction Jts



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Questions?



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