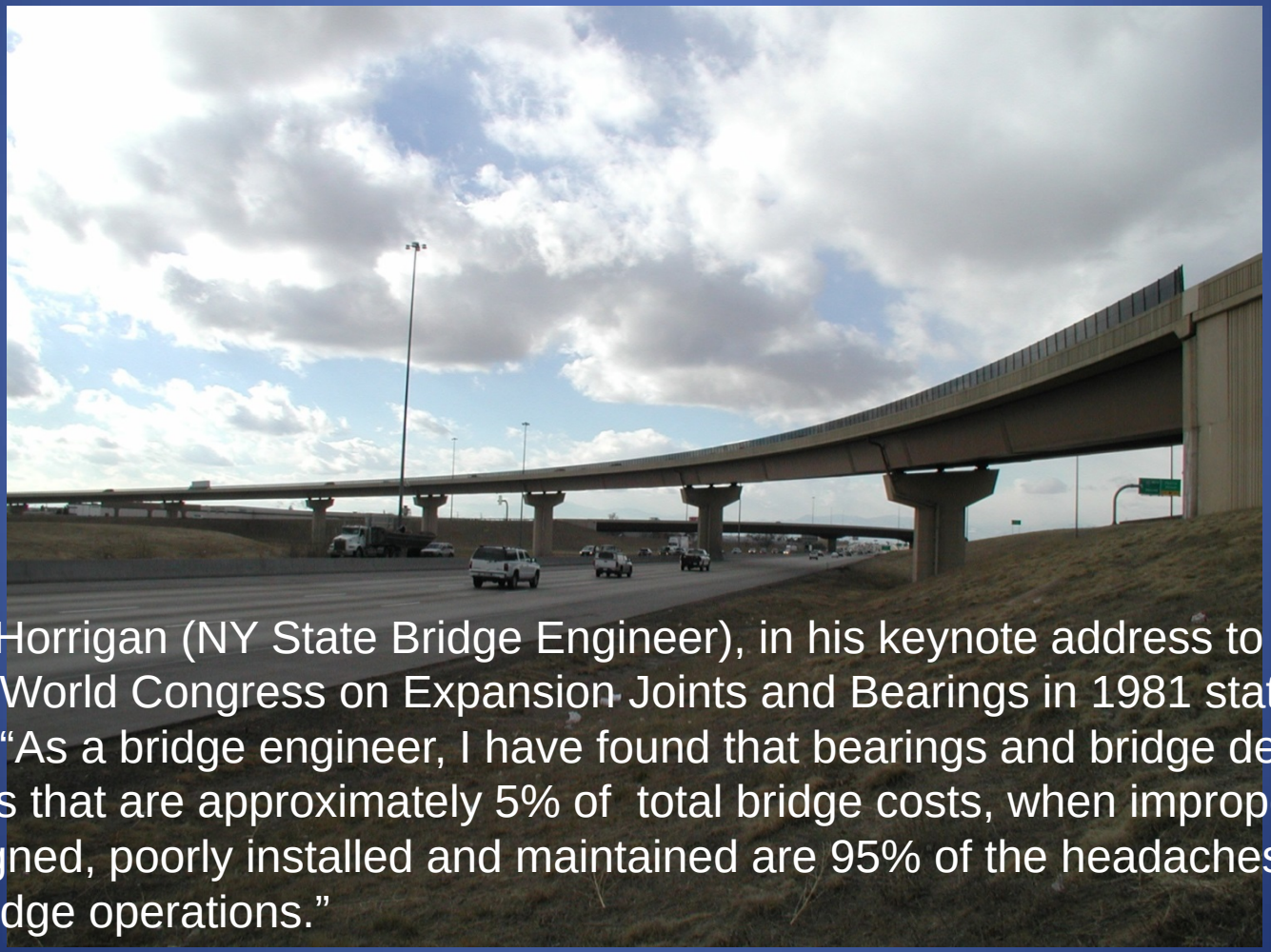
CDOT EXPANSION JOINTS

LEARNING OBJECTIVES:

CDOT EXPANSION JOINTS



E.V. Horrigan (NY State Bridge Engineer), in his keynote address to the First World Congress on Expansion Joints and Bearings in 1981 stated that, “As a bridge engineer, I have found that bearings and bridge deck joints that are approximately 5% of total bridge costs, when improperly designed, poorly installed and maintained are 95% of the headaches of bridge operations.”

CDOT EXPANSION JOINTS

GLENWOOD CANYON

ROADWAY

BEARING BELOW

CDOT EXPANSION JOINTS

VAIL PASS

ROADWAY

BEARING BELOW

CDOT EXPANSION JOINTS

C-470

ROADWAY

BEARING BELOW

CDOT EXPANSION JOINTS

ELEVATED I-70

ROADWAY

STRUCTURE BELOW

CDOT EXPANSION JOINTS

DENVER STREETS

ROADWAY

STRUCTURE BELOW

CDOT EXPANSION JOINTS

BRIDGE EXPANSION DEVICE FUNCTION

1. ACCOMMODATE BRIDGE MOVEMENT DUE TO THERMAL LOADS, LIVE LOADS, SHRINKAGE, SHORTENING, CREEP, ETC.
2. PROTECT BRIDGE COMPONENTS BELOW WEARING SURFACE FROM CORROSION.

Note that the expansion device is part of the ***wearing*** surface!

COMPROMISE OF EITHER FUNCTION SHOULD TRIGGER IMMEDIATE JOINT REPLACMENT!

CDOT EXPANSION JOINTS

BRIDGE EXPANSION DEVICE WEAR

CDOT EXPANSION JOINTS

BRIDGE EXPANSION DEVICE WEAR

EXPANSION JOINT THEORY

THERMAL EXPANSION:

Steel coefficient of expansion: 0.0000065

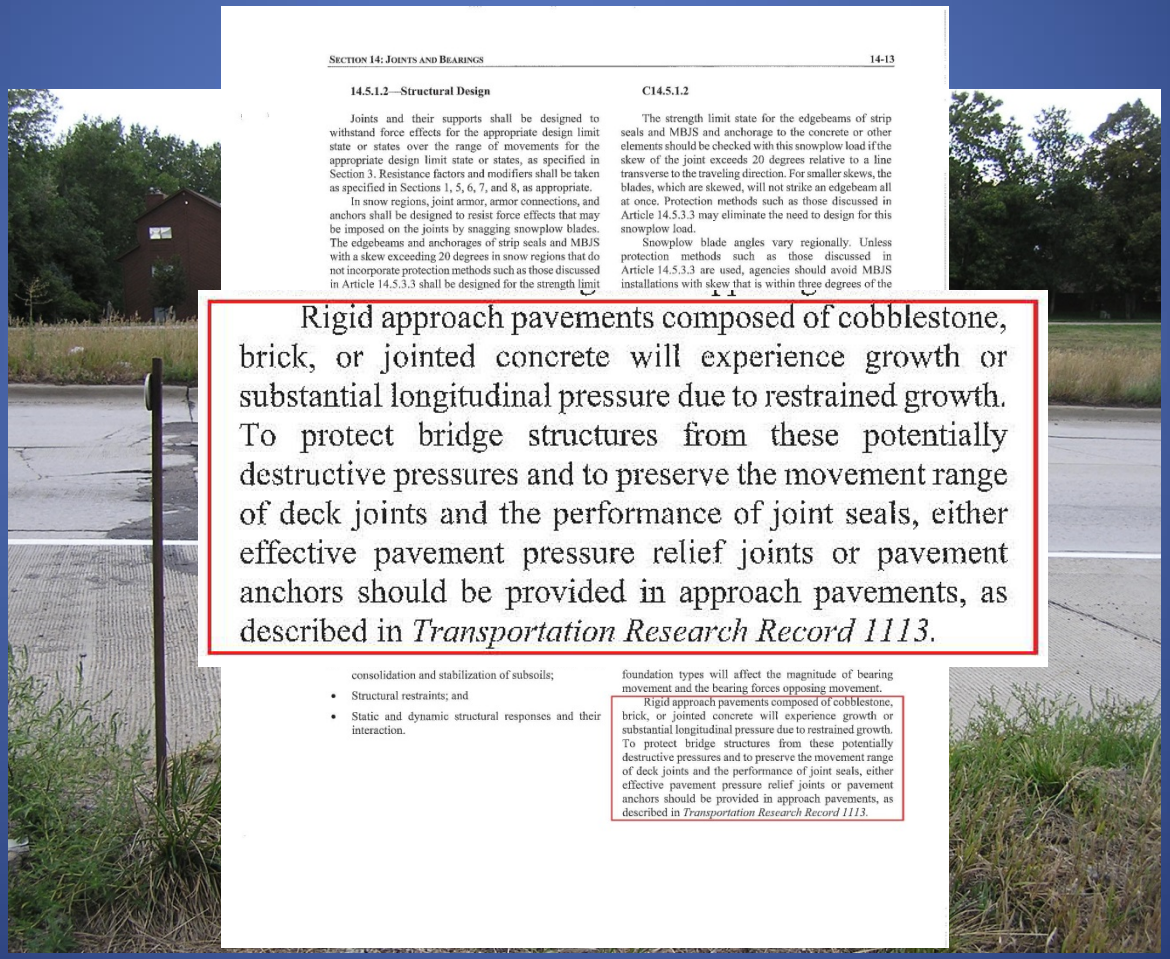
Concrete coefficient of expansion: 0.0000059

100 ft steel bridge (100°F) = 0.78”

100 ft concrete bridge (100°F) = 0.708”

EXPANSION JOINT THEORY

PAVEMENT GROWTH:



SECTION 14: JOINTS AND BEARINGS 14-13

14.5.1.2—Structural Design

Joints and their supports shall be designed to withstand force effects for the appropriate design limit state or states over the range of movements for the appropriate design limit state or states, as specified in Section 3. Resistance factors and modifiers shall be taken as specified in Sections 1, 5, 6, 7, and 8, as appropriate.

In snow regions, joint armor, armor connections, and anchors shall be designed to resist force effects that may be imposed on the joints by snagging snowplow blades. The edgebeams and anchorages of strip seals and MBJS with a skew exceeding 20 degrees in snow regions that do not incorporate protection methods such as those discussed in Article 14.5.3.3 shall be designed for the strength limit

C14.5.1.2

The strength limit state for the edgebeams of strip seals and MBJS and anchorage to the concrete or other elements should be checked with this snowplow load if the skew of the joint exceeds 20 degrees relative to a line transverse to the traveling direction. For smaller skews, the blades, which are skewed, will not strike an edgebeam all at once. Protection methods such as those discussed in Article 14.5.3.3 may eliminate the need to design for this snowplow load.

Snowplow blade angles vary regionally. Unless protection methods such as those discussed in Article 14.5.3.3 are used, agencies should avoid MBJS installations with skew that is within three degrees of the

Rigid approach pavements composed of cobblestone, brick, or jointed concrete will experience growth or substantial longitudinal pressure due to restrained growth. To protect bridge structures from these potentially destructive pressures and to preserve the movement range of deck joints and the performance of joint seals, either effective pavement pressure relief joints or pavement anchors should be provided in approach pavements, as described in *Transportation Research Record 1113*.

consolidation and stabilization of subsoils;

- Structural restraints; and
- Static and dynamic structural responses and their interaction.

foundation types will affect the magnitude of bearing movement and the bearing forces opposing movement.

Rigid approach pavements composed of cobblestone, brick, or jointed concrete will experience growth or substantial longitudinal pressure due to restrained growth. To protect bridge structures from these potentially destructive pressures and to preserve the movement range of deck joints and the performance of joint seals, either effective pavement pressure relief joints or pavement anchors should be provided in approach pavements, as described in *Transportation Research Record 1113*.

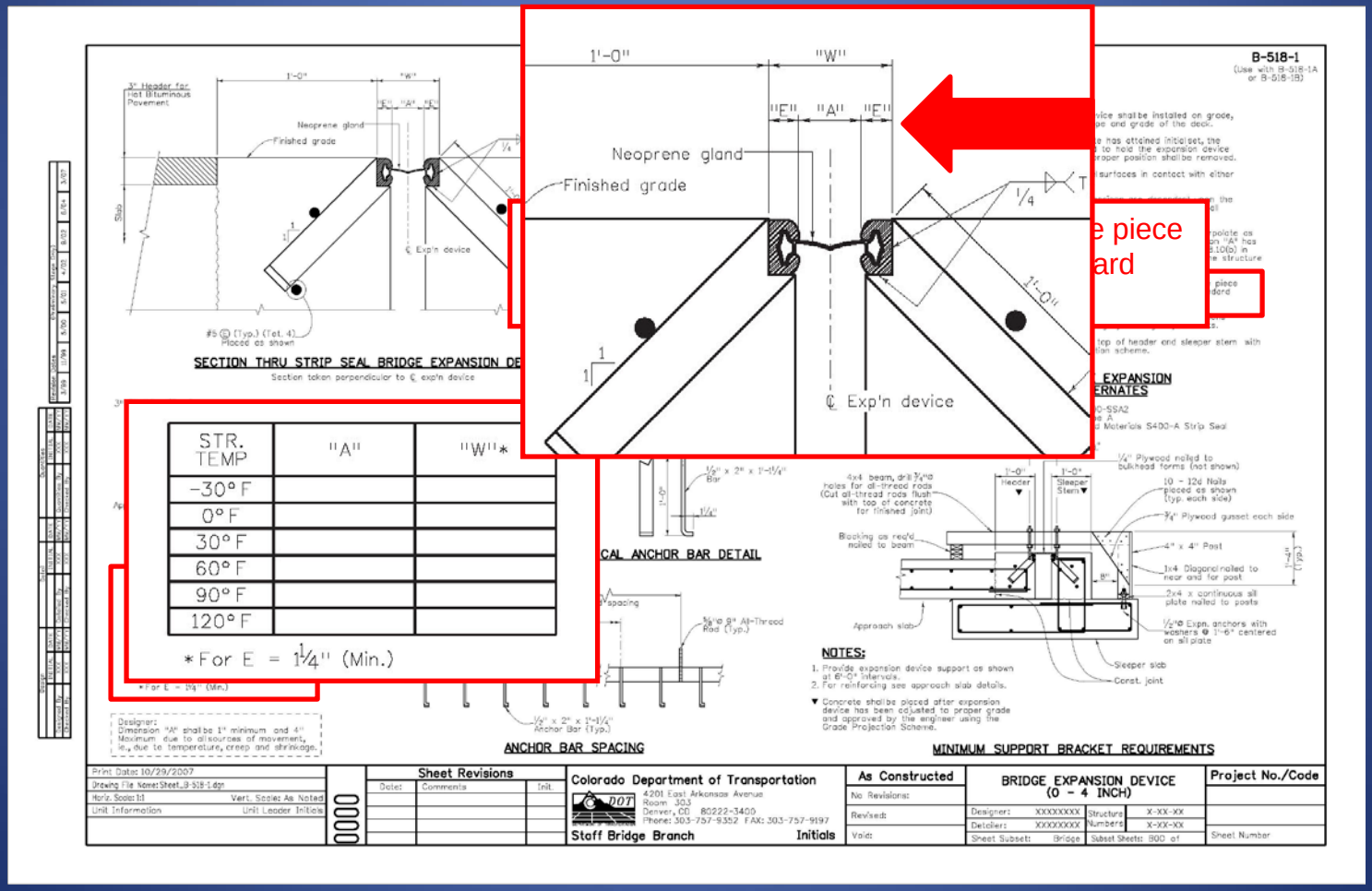
EXPANSION JOINT THEORY

PAVEMENT GROWTH:

3 ½” OFFSET DUE TO PAVEMENT GROWTH IN 10 YEARS!

CDOT EXPANSION JOINTS

CDOT STANDARD B-518-1



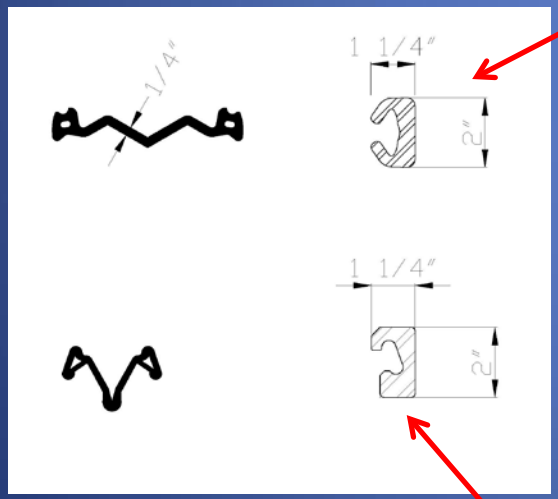
CDOT EXPANSION JOINTS

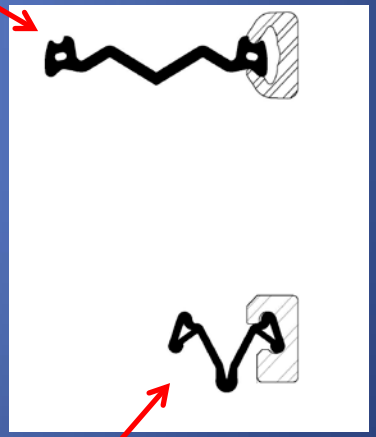
STEEL RAIL SHAPES:

DIMENSIONS

INSTALLED

D.S. BROWN

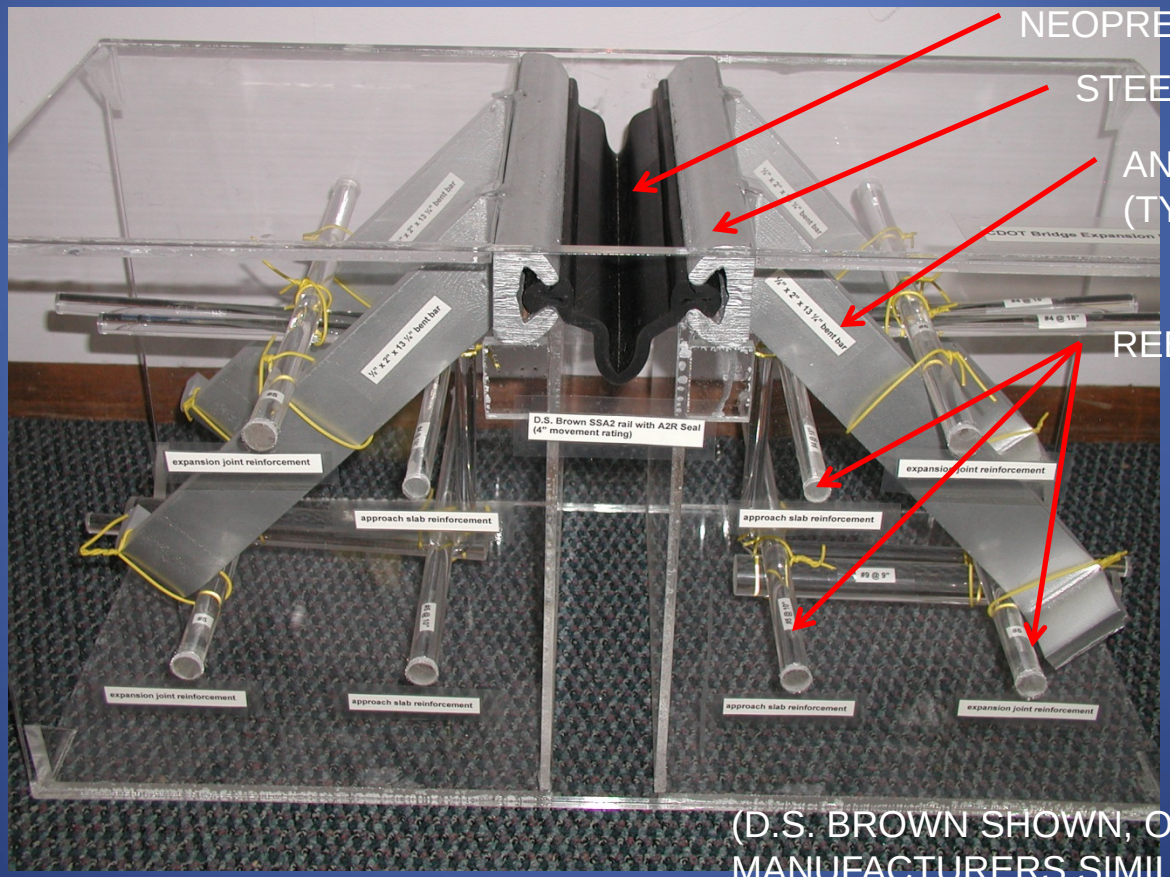




WATSON-BOWMAN-ACME

CDOT EXPANSION JOINTS

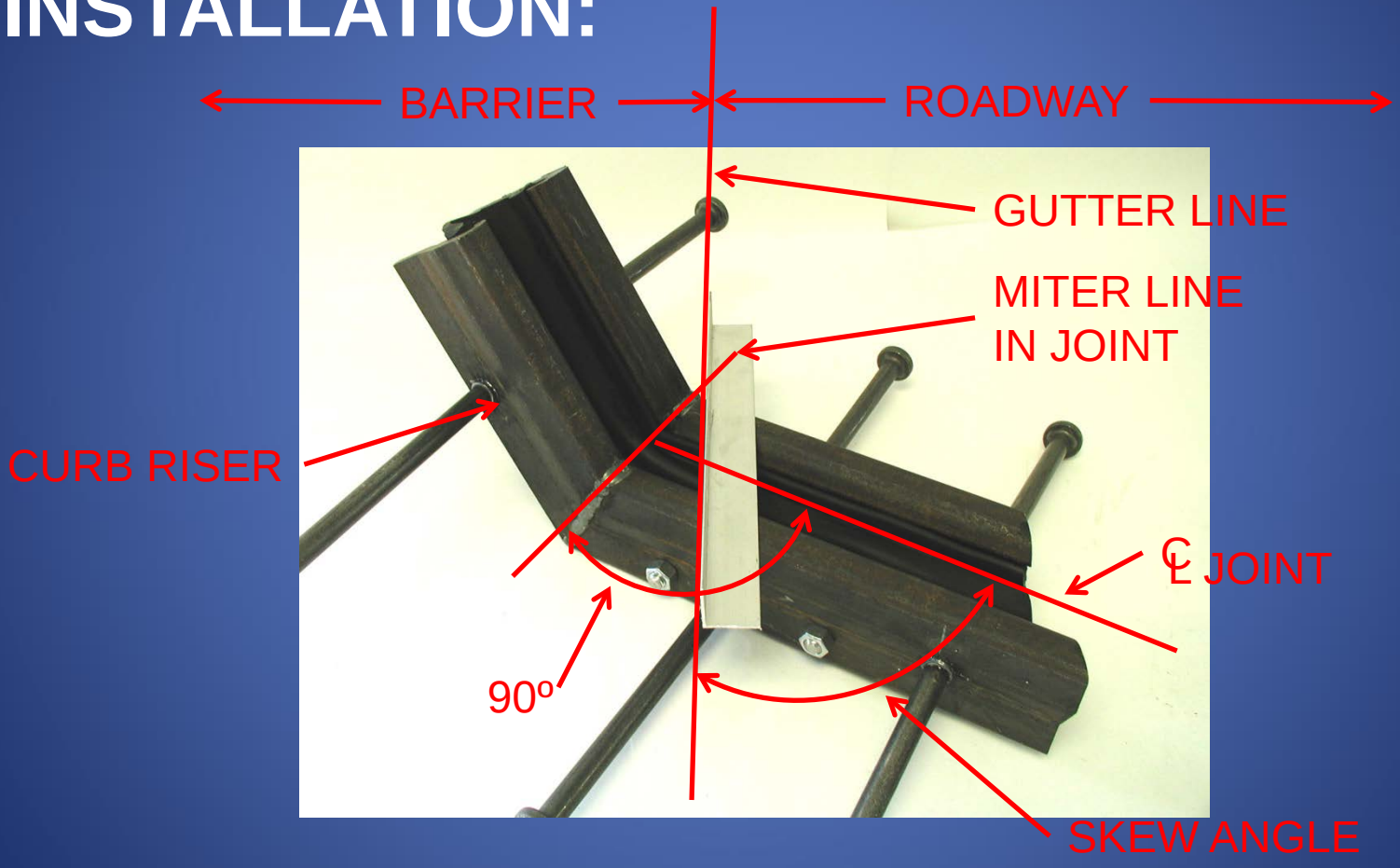
BRIDGE EXPANSION DEVICE (0-4”)



(D.S. BROWN SHOWN, OTHER MANUFACTURERS SIMILAR)

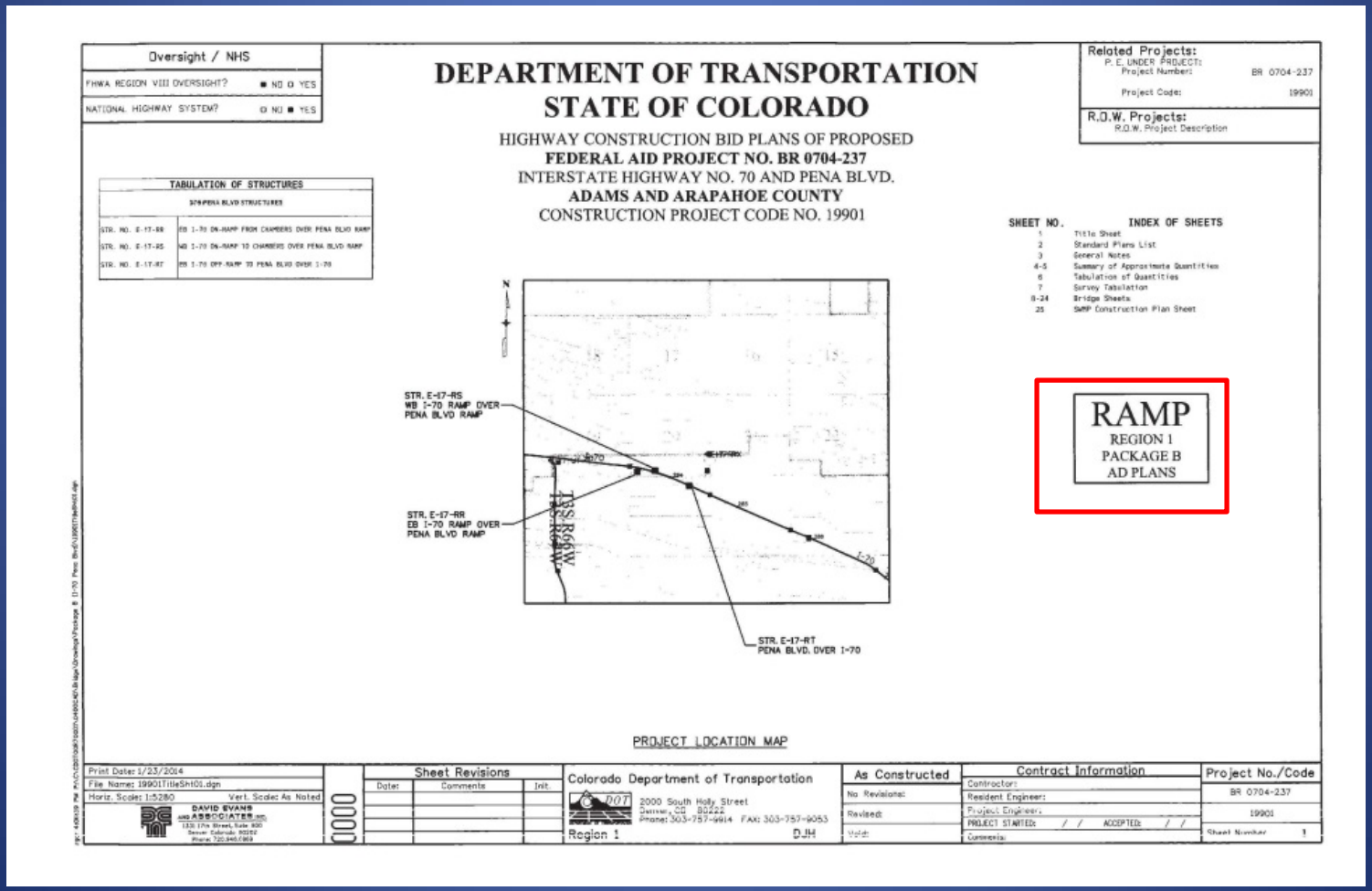
CDOT EXPANSION JOINTS

INSTALLATION:



CDOT EXPANSION JOINTS

RAMP PROJECTS



Oversight / NHS

FHWA REGION VIII OVERSIGHT? ● NO ○ YES

NATIONAL HIGHWAY SYSTEM? ○ NO ● YES

DEPARTMENT OF TRANSPORTATION
STATE OF COLORADO

HIGHWAY CONSTRUCTION BID PLANS OF PROPOSED
FEDERAL AID PROJECT NO. BR 0704-237
INTERSTATE HIGHWAY NO. 70 AND PENA BLVD.
ADAMS AND ARAPAHOE COUNTY
CONSTRUCTION PROJECT CODE NO. 19901

Related Projects:
P. E. UNDER PROJECT:
Project Number: BR 0704-237
Project Code: 19901

R.O.W. Projects:
R.O.W. Project Description

TABULATION OF STRUCTURES

STR. NO. E-17-RR	EB I-70 ON-RAMP FROM CHAMBERS OVER PENA BLVD RAMP
STR. NO. E-17-RS	WB I-70 ON-RAMP TO CHAMBERS OVER PENA BLVD RAMP
STR. NO. E-17-RT	EB I-70 OFF-RAMP TO PENA BLVD OVER I-70

INDEX OF SHEETS

SHEET NO.	
1	Title Sheet
2	Standard Plans List
3	General Notes
4-5	Summary of Approximate Quantities
6	Tabulation of Quantities
7	Survey Tabulation
8-24	Bridge Sheets
25	SWMP Construction Plan Sheet

RAMP
REGION 1
PACKAGE B
AD PLANS

STR. E-17-RS
WB I-70 RAMP OVER
PENA BLVD RAMP

STR. E-17-RR
EB I-70 RAMP OVER
PENA BLVD RAMP

STR. E-17-RT
PENA BLVD. OVER I-70

T3S R66W

PROJECT LOCATION MAP

Print Date: 1/23/2014
File Name: 19901TitleSht01.dgn
Horiz. Scale: 1:5280 Vert. Scale: As Noted

DAVID EVANS AND ASSOCIATES, INC.

Sheet Revisions

Date	Comments	Init.

Colorado Department of Transportation
2000 South Holly Street
Denver, CO 80222
Phone: 303-757-9914 FAX: 303-757-9053
Region 1 DJH

As Constructed
No Revisions:
Revised:
Void:

Contract Information
Contractor:
Resident Engineer:
Project Engineer:
PROJECT STARTED: / / ACCEPTED: / /
Comments:

Project No./Code
BR 0704-237
19901
Sheet Number 1

CDOT EXPANSION JOINTS

RAMP STANDARD DRAWING

COLORADO PROJECT NO. BR 0704-237 **January 30, 2014**
SUBACCOUNT NO. 19901

REVISION OF SECTION 518
BRIDGE EXPANSION DEVICE

Section 518 of the Standard Specifications is hereby revised for this project as follows:

In subsection 518.04, delete the second paragraph and replace with the following:

The device shall consist of a continuous premolded elastomeric expansion joint seal (also called neoprene gland) and steel extrusions as shown on the plans, required by the manufacturer, or specified herein for attaching the elastomeric expansion joint to the steel armor or anchors. The expansion device shall have a rated range of movement of 4 inches including rotations.

In subsection 518.04, delete the fourth paragraph and replace with the following:

Steel extrusions and cover plates shall conform to the specifications of ASTM A588, whereas other structural steel shall conform to the specifications of ASTM A709 Grade 36 or ASTM A588. Fabrication and welding of structural steel shall conform to the requirements of Section 509. The material designations for all steel components shall be shown in the Contractor's shop drawings.

In subs

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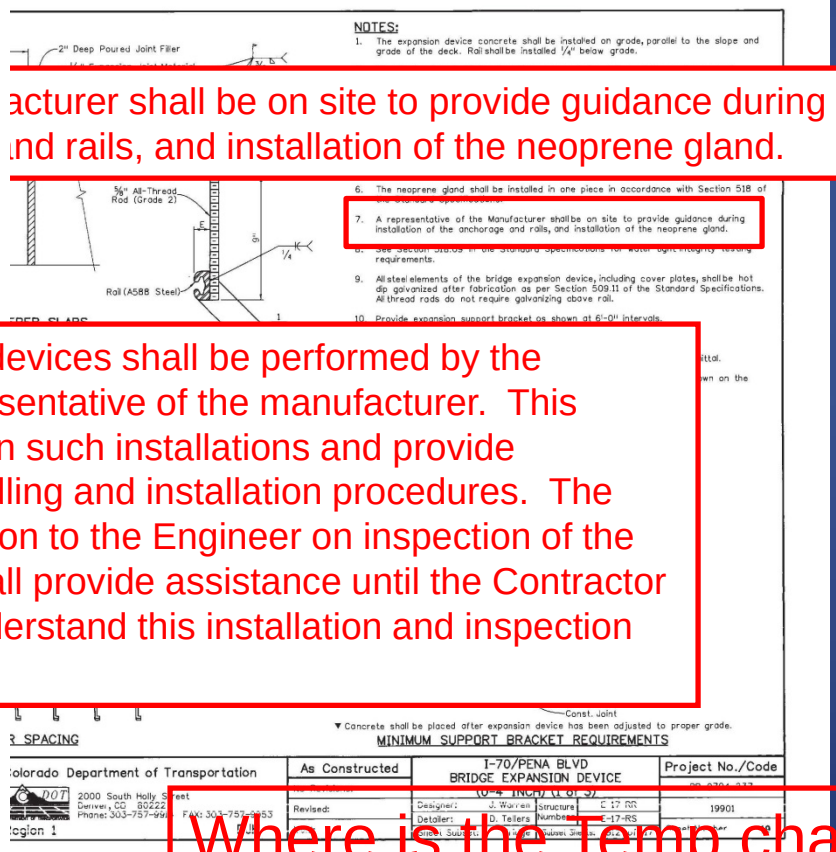
procedures.

END OF SECTION REVISION

27



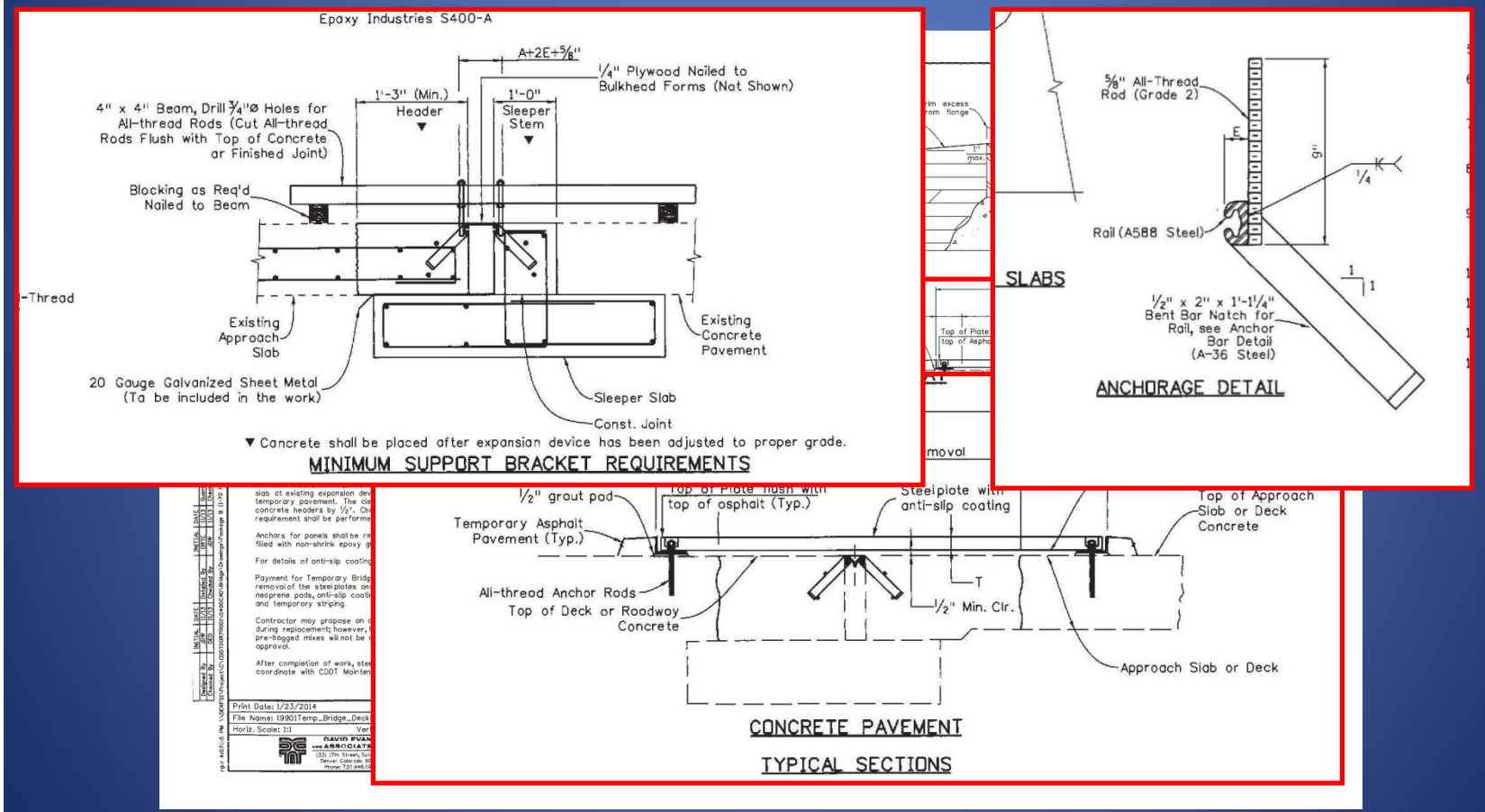
acturer shall be on site to provide guidance during
nd rails, and installation of the neoprene gland.

The initial installations of expansion devices shall be performed by the Contractor in the presence of a representative of the manufacturer. This representative shall be experienced in such installations and provide information to the Contractor on handling and installation procedures. The representative shall provide information to the Engineer on inspection of the expansion device installation and shall provide assistance until the Contractor and the Engineer agree that they understand this installation and inspection procedures.

Where is the Temp chart?

CDOT EXPANSION JOINTS

TEMPORARY BRIDGE DECK



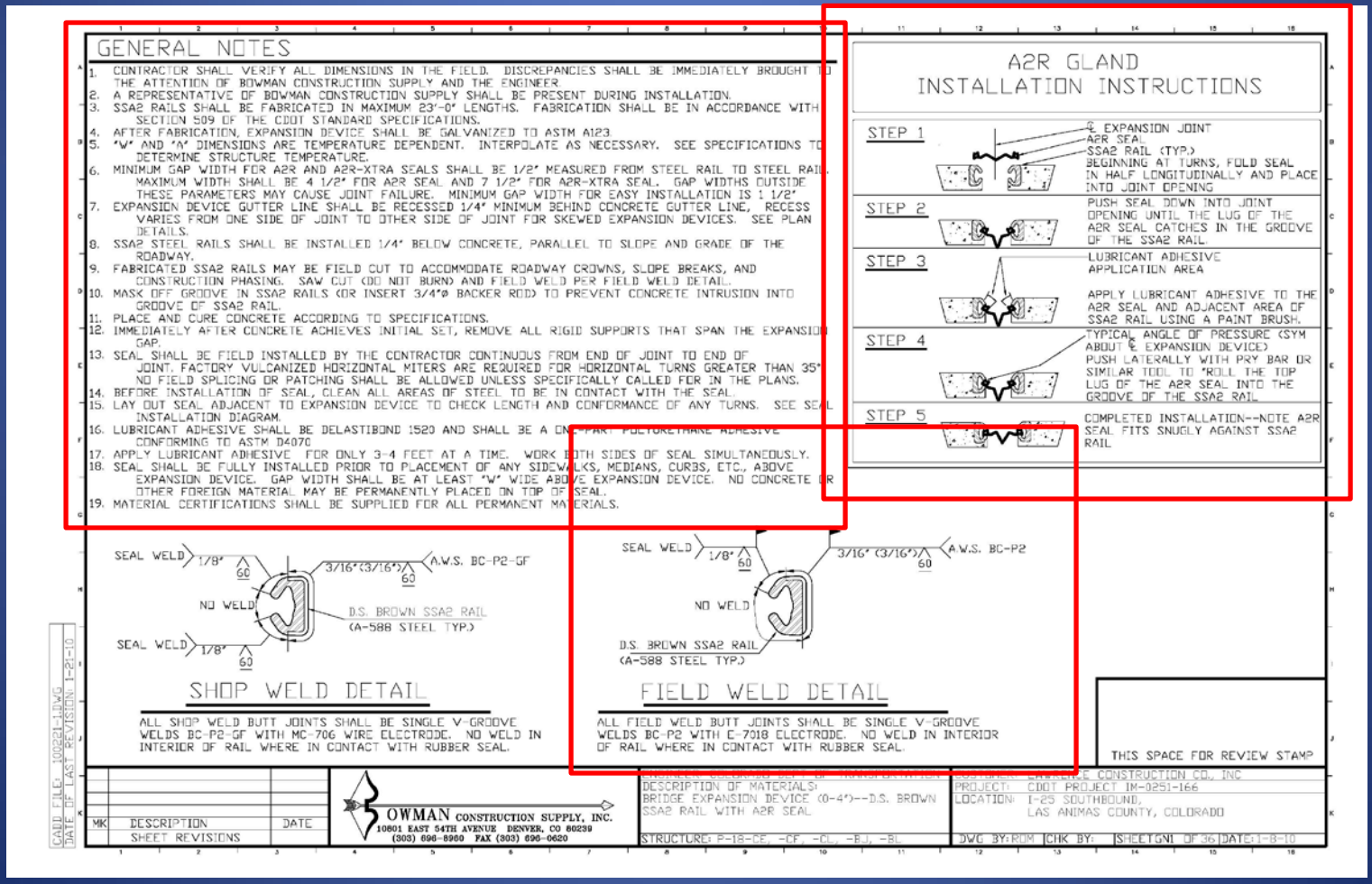
CDOT EXPANSION JOINTS

REASON FOR TEMPORARY BRIDGE DECK:

ALLOW TIME TO PERFORM WORK

CDOT EXPANSION JOINTS

SHOP DRAWINGS REQUIRED



GENERAL NOTES

1. CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD. DISCREPANCIES SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF BOWMAN CONSTRUCTION SUPPLY AND THE ENGINEER.
2. A REPRESENTATIVE OF BOWMAN CONSTRUCTION SUPPLY SHALL BE PRESENT DURING INSTALLATION.
3. SSA2 RAILS SHALL BE FABRICATED IN MAXIMUM 23'-0" LENGTHS. FABRICATION SHALL BE IN ACCORDANCE WITH SECTION 509 OF THE CDOT STANDARD SPECIFICATIONS.
4. AFTER FABRICATION, EXPANSION DEVICE SHALL BE GALVANIZED TO ASTM A123.
5. "W" AND "A" DIMENSIONS ARE TEMPERATURE DEPENDENT. INTERPOLATE AS NECESSARY. SEE SPECIFICATIONS TO DETERMINE STRUCTURE TEMPERATURE.
6. MINIMUM GAP WIDTH FOR A2R AND A2R-XTRA SEALS SHALL BE 1/2" MEASURED FROM STEEL RAIL TO STEEL RAIL. MAXIMUM WIDTH SHALL BE 4 1/2" FOR A2R SEAL AND 7 1/2" FOR A2R-XTRA SEAL. GAP WIDTHS OUTSIDE THESE PARAMETERS MAY CAUSE JOINT FAILURE. MINIMUM GAP WIDTH FOR EASY INSTALLATION IS 1 1/2"
7. EXPANSION DEVICE GUTTER LINE SHALL BE RECESSED 1/4" MINIMUM BEHIND CONCRETE GUTTER LINE, RECESS VARIES FROM ONE SIDE OF JOINT TO OTHER SIDE OF JOINT FOR SKEWED EXPANSION DEVICES. SEE PLAN DETAILS.
8. SSA2 STEEL RAILS SHALL BE INSTALLED 1/4" BELOW CONCRETE, PARALLEL TO SLOPE AND GRADE OF THE ROADWAY.
9. FABRICATED SSA2 RAILS MAY BE FIELD CUT TO ACCOMMODATE ROADWAY CROWNS, SLOPE BREAKS, AND CONSTRUCTION PHASING. SAW CUT (DO NOT BURN) AND FIELD WELD PER FIELD WELD DETAIL.
10. MASK OFF GROOVE IN SSA2 RAILS (OR INSERT 3/4"ø BACKER ROD) TO PREVENT CONCRETE INTRUSION INTO GROOVE OF SSA2 RAIL.
11. PLACE AND CURE CONCRETE ACCORDING TO SPECIFICATIONS.
12. IMMEDIATELY AFTER CONCRETE ACHIEVES INITIAL SET, REMOVE ALL RIGID SUPPORTS THAT SPAN THE EXPANSION GAP.
13. SEAL SHALL BE FIELD INSTALLED BY THE CONTRACTOR CONTINUOUS FROM END OF JOINT TO END OF JOINT. FACTORY VULCANIZED HORIZONTAL MITERS ARE REQUIRED FOR HORIZONTAL TURNS GREATER THAN 35° NO FIELD SPLICING OR PATCHING SHALL BE ALLOWED UNLESS SPECIFICALLY CALLED FOR IN THE PLANS.
14. BEFORE INSTALLATION OF SEAL, CLEAN ALL AREAS OF STEEL TO BE IN CONTACT WITH THE SEAL.
15. LAY OUT SEAL ADJACENT TO EXPANSION DEVICE TO CHECK LENGTH AND CONFORMANCE OF ANY TURNS. SEE SEAL INSTALLATION DIAGRAM.
16. LUBRICANT ADHESIVE SHALL BE DELASTIBOND 1520 AND SHALL BE A ONE-PART POLYURETHANE ADHESIVE CONFORMING TO ASTM D4070.
17. APPLY LUBRICANT ADHESIVE FOR ONLY 3-4 FEET AT A TIME. WORK BOTH SIDES OF SEAL SIMULTANEOUSLY.
18. SEAL SHALL BE FULLY INSTALLED PRIOR TO PLACEMENT OF ANY SIDEWALKS, MEDIANS, CURBS, ETC, ABOVE EXPANSION DEVICE. GAP WIDTH SHALL BE AT LEAST "W" WIDE ABOVE EXPANSION DEVICE. NO CONCRETE OR OTHER FOREIGN MATERIAL MAY BE PERMANENTLY PLACED ON TOP OF SEAL.
19. MATERIAL CERTIFICATIONS SHALL BE SUPPLIED FOR ALL PERMANENT MATERIALS.

A2R GLAND INSTALLATION INSTRUCTIONS

STEP 1 — EXPANSION JOINT; A2R SEAL; SSA2 RAIL (TYP.); BEGINNING AT TURNS, FOLD SEAL IN HALF LONGITUDINALLY AND PLACE INTO JOINT OPENING

STEP 2 — PUSH SEAL DOWN INTO JOINT OPENING UNTIL THE LUG OF THE A2R SEAL CATCHES IN THE GROOVE OF THE SSA2 RAIL

STEP 3 — LUBRICANT ADHESIVE APPLICATION AREA; APPLY LUBRICANT ADHESIVE TO THE A2R SEAL AND ADJACENT AREA OF SSA2 RAIL USING A PAINT BRUSH.

STEP 4 — TYPICAL ANGLE OF PRESSURE (SYM ABOUT ℄ EXPANSION DEVICE) PUSH LATERALLY WITH PRY BAR OR SIMILAR TOOL TO "ROLL" THE TOP LUG OF THE A2R SEAL INTO THE GROOVE OF THE SSA2 RAIL

STEP 5 — COMPLETED INSTALLATION--NOTE A2R SEAL FITS SNUGLY AGAINST SSA2 RAIL

SHOP WELD DETAIL

ALL SHOP WELD BUTT JOINTS SHALL BE SINGLE V-GROOVE WELDS BC-P2-GF WITH MC-706 WIRE ELECTRODE. NO WELD IN INTERIOR OF RAIL WHERE IN CONTACT WITH RUBBER SEAL.

FIELD WELD DETAIL

ALL FIELD WELD BUTT JOINTS SHALL BE SINGLE V-GROOVE WELDS BC-P2 WITH E-7018 ELECTRODE. NO WELD IN INTERIOR OF RAIL WHERE IN CONTACT WITH RUBBER SEAL.

THIS SPACE FOR REVIEW STAMP

CADD FILE: 100221-1.DWG
DATE OF LAST REVISION: 1-21-10

MK	DESCRIPTION	DATE
	SHEET REVISIONS	

OWMAN CONSTRUCTION SUPPLY, INC.
10801 EAST 54TH AVENUE DENVER, CO 80239
(303) 696-8900 FAX (303) 696-0620

DESCRIPTION OF MATERIALS:
BRIDGE EXPANSION DEVICE (0-4")--D.S. BROWN SSA2 RAIL WITH A2R SEAL

STRUCTURE: P-18-CE, -CF, -CL, -BJ, -BL

CONTRACTOR: LAWRENCE CONSTRUCTION CO., INC.
PROJECT: CDOT PROJECT IM-0251-166
LOCATION: I-25 SOUTHBOUND, LAS ANIMAS COUNTY, COLORADO

DWG BY: ROM | CHK BY: | SHEET: GN1 OF 36 | DATE: 1-8-10

CDOT EXPANSION JOINTS

SHOP DRAWING DETAILS:

1. CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD. DISCREPANCIES SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF BOWMAN CONSTRUCTION SUPPLY AND THE ENGINEER.
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11. PLACE AND CURE CONCRETE ACCORDING TO SPECIFICATIONS.
12. IMMEDIATELY AFTER CONCRETE ACHIEVES INITIAL SET, REMOVE ALL RIGID SUPPORTS THAT SPAN THE EXPANSION GAP.
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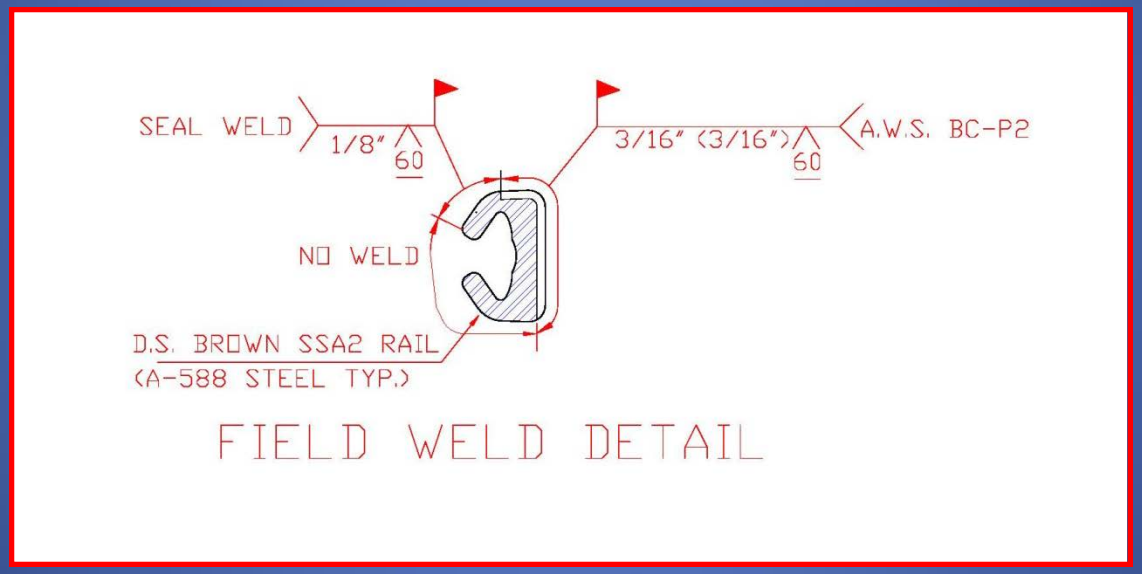
19. MATERIAL CERTIFICATIONS SHALL BE SUPPLIED FOR ALL PERMANENT MATERIALS.

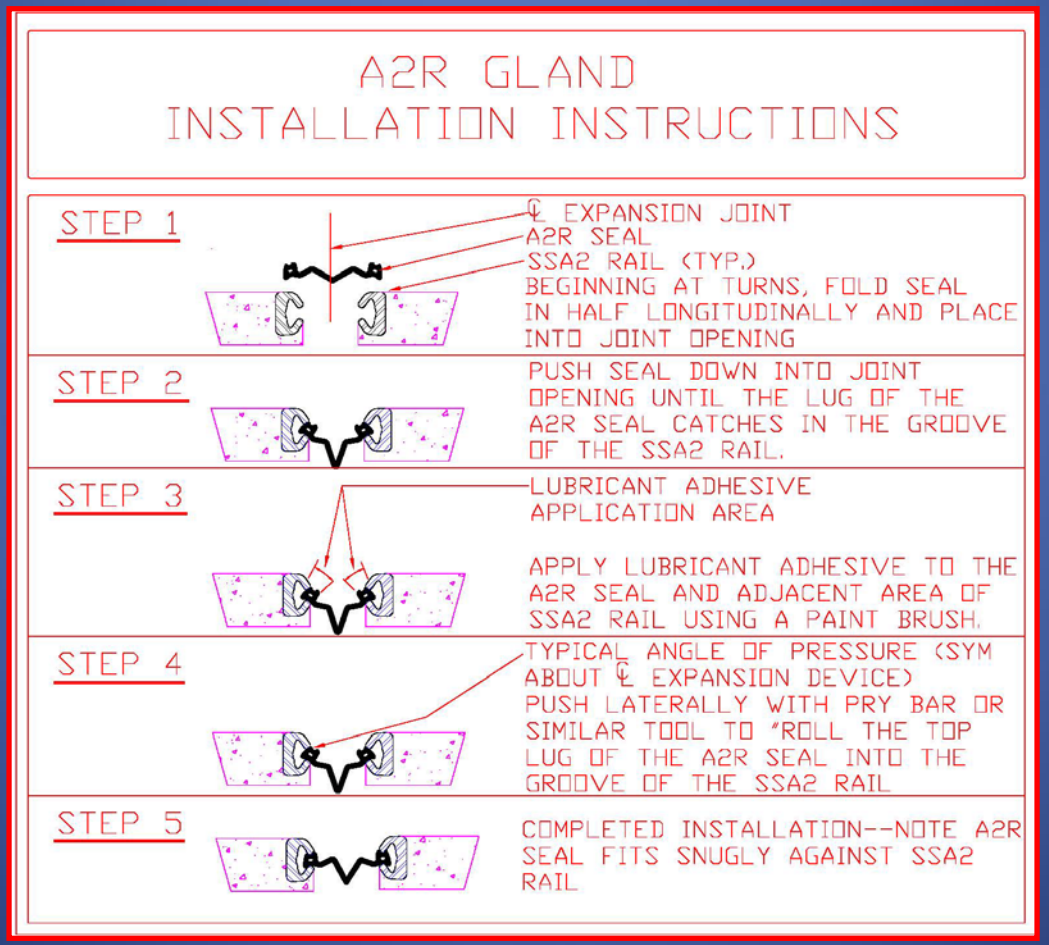
CDOT EXPANSION JOINTS

SHOP DRAWING DETAILS:



CDOT EXPANSION JOINTS

SHOP DRAWING DETAILS:



CDOT EXPANSION JOINTS

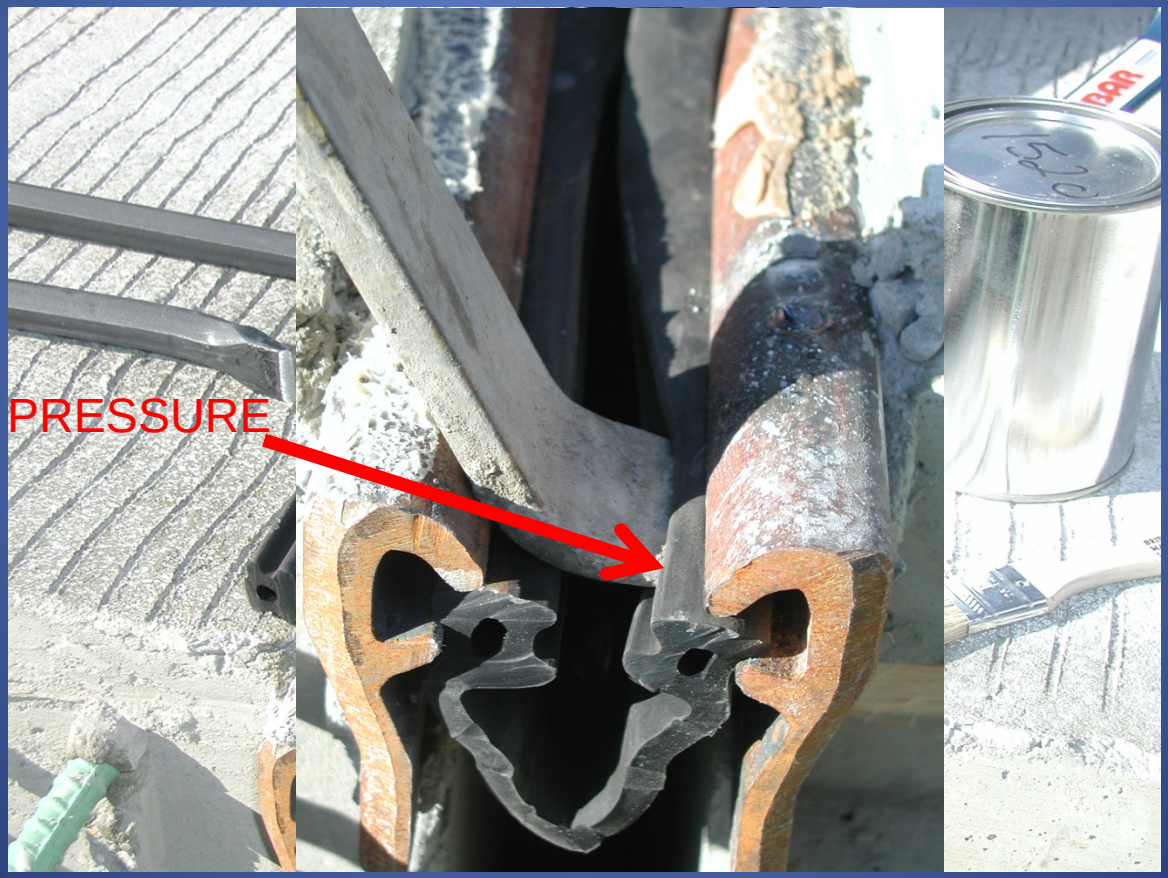
INSTALLATION:

NO SHARPS!

TYPICAL TOOLS

CDOT EXPANSION JOINTS

INSTALLATION:



CDOT EXPANSION JOINTS

INSTALLATION:

CDOT EXPANSION JOINTS

PHASED CONSTRUCTION

DO NOT CUT GLAND!

CDOT EXPANSION JOINTS

WHAT CAN GO WRONG-1: APPROACH

CDOT EXPANSION JOINTS

WHAT CAN GO WRONG-2:

POOR CONCRETE CONSOLIDATION

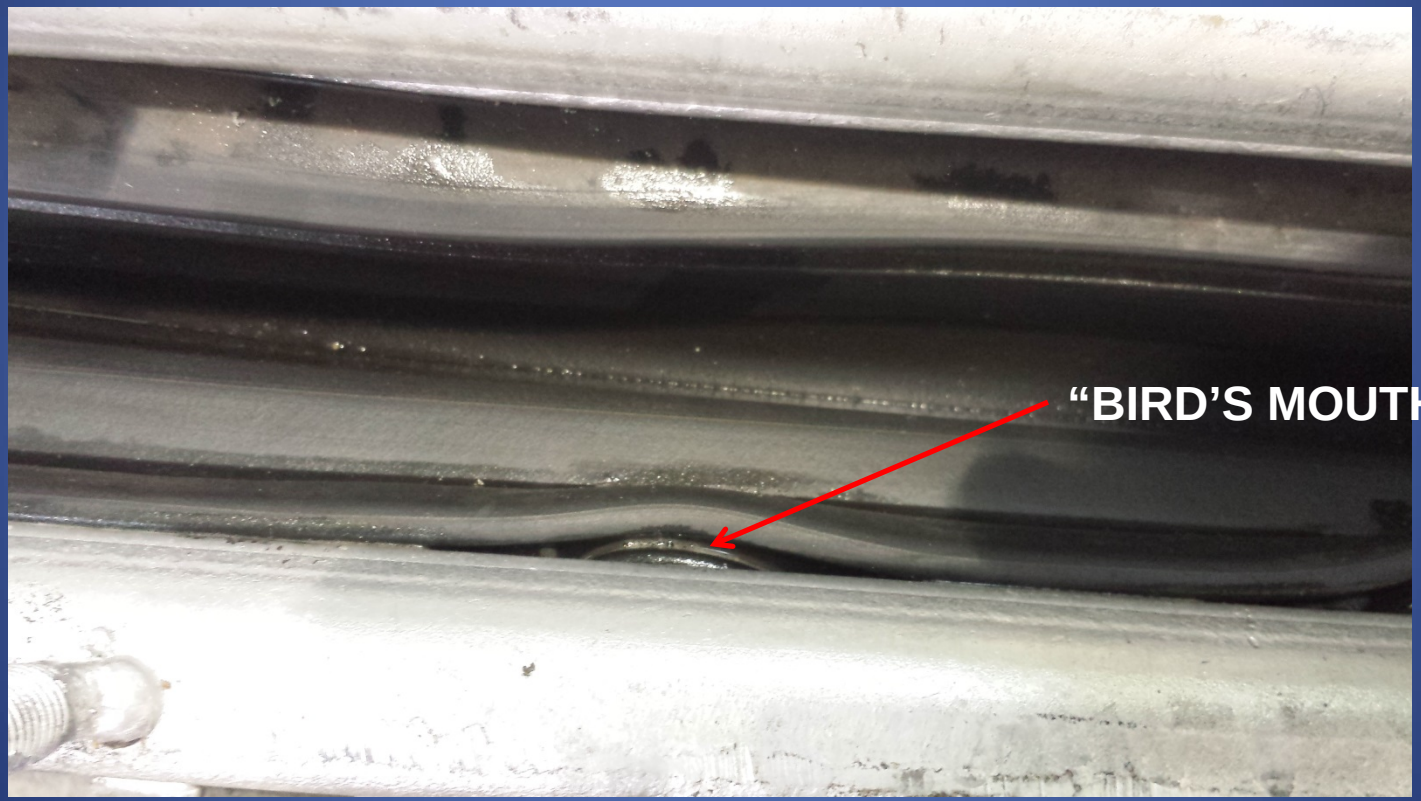
CDOT EXPANSION JOINTS

WHAT CAN GO WRONG-3:

INADEQUATE REBAR

CDOT EXPANSION JOINTS

WHAT CAN GO WRONG-4:

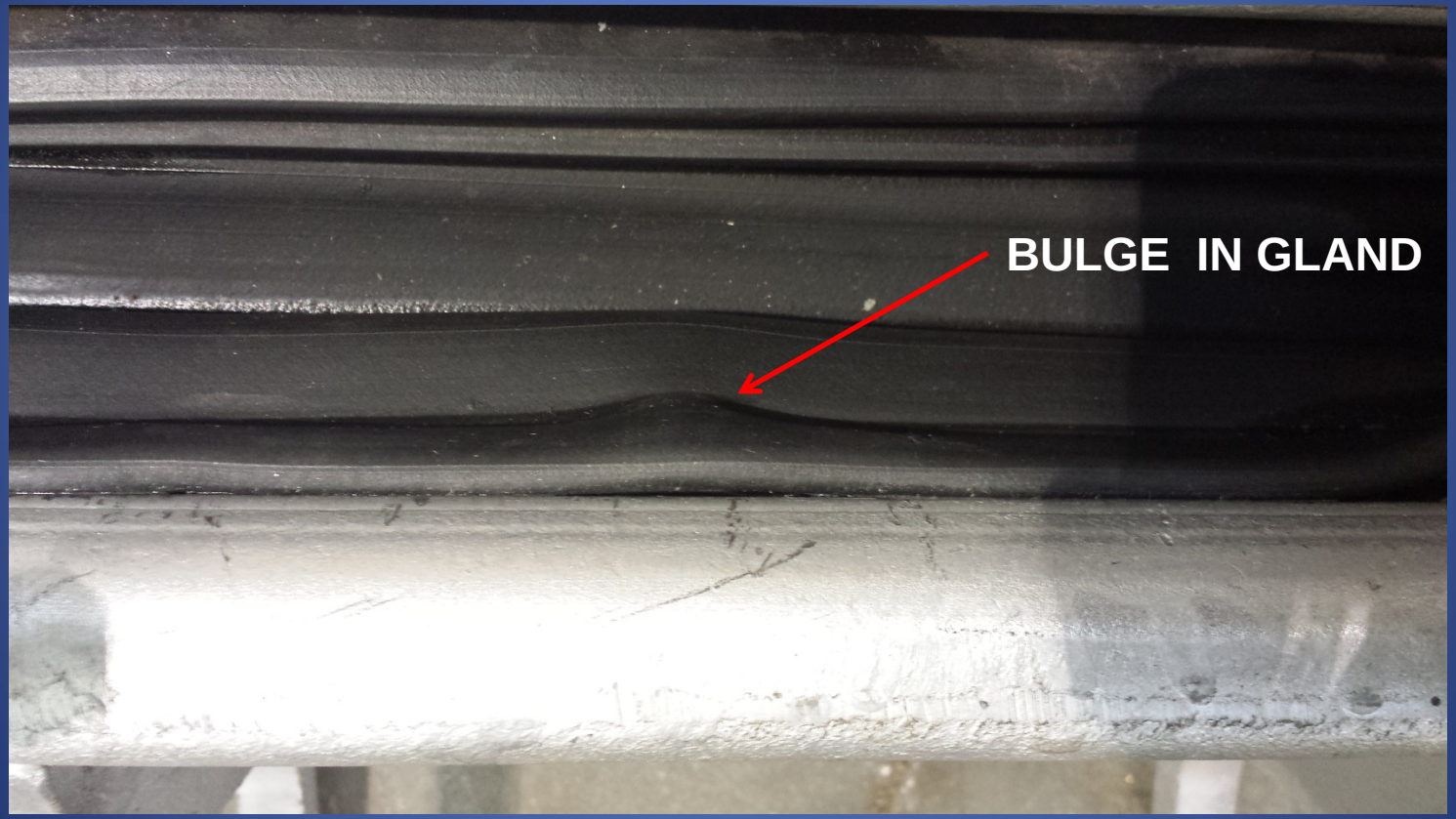


CAUSED BY:

- WORK TOO FAST
- OBSTRUCTION IN RAIL (WELD, STONE, ETC.)

CDOT EXPANSION JOINTS

WHAT CAN GO WRONG-5:

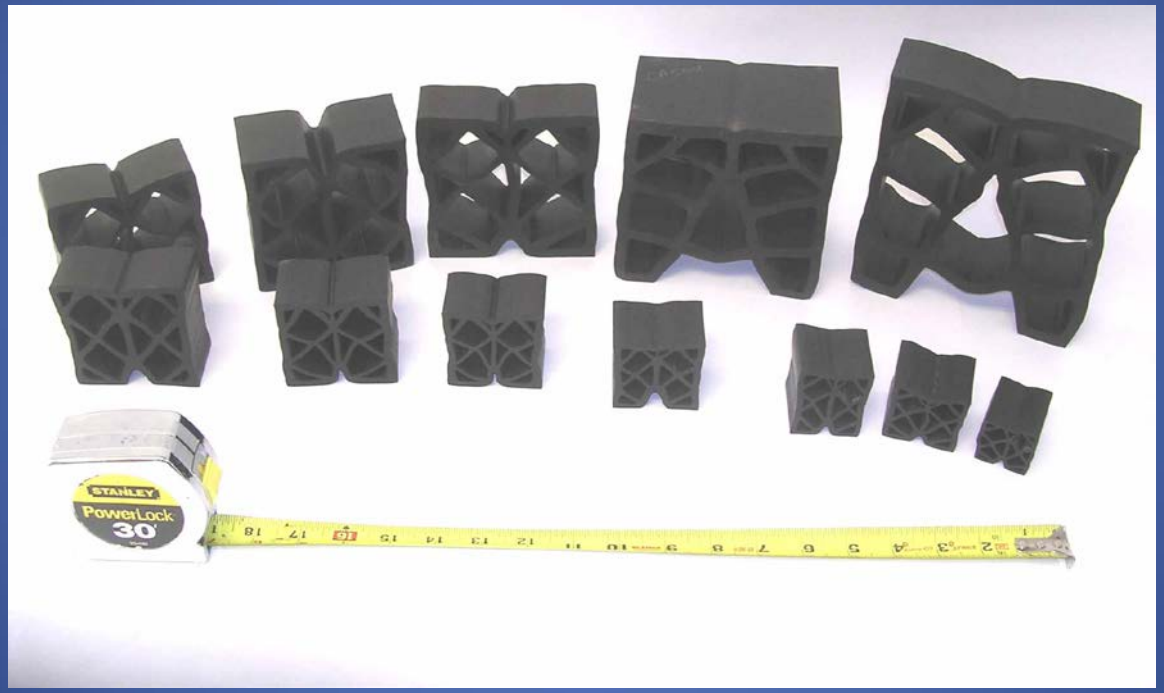


CAUSED BY:

- OBSTRUCTION IN GROOVE (STONE, ETC.)

CDOT EXPANSION JOINTS

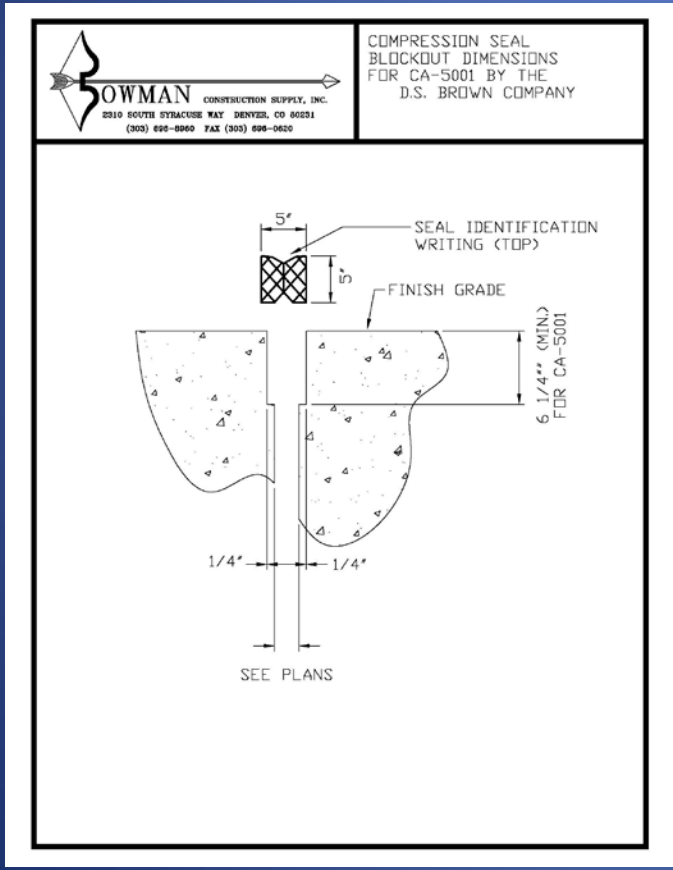
COMPRESSION SEALS



LARGER SIZED SEALS ARE USED FOR RELIEF JOINTS

CDOT EXPANSION JOINTS

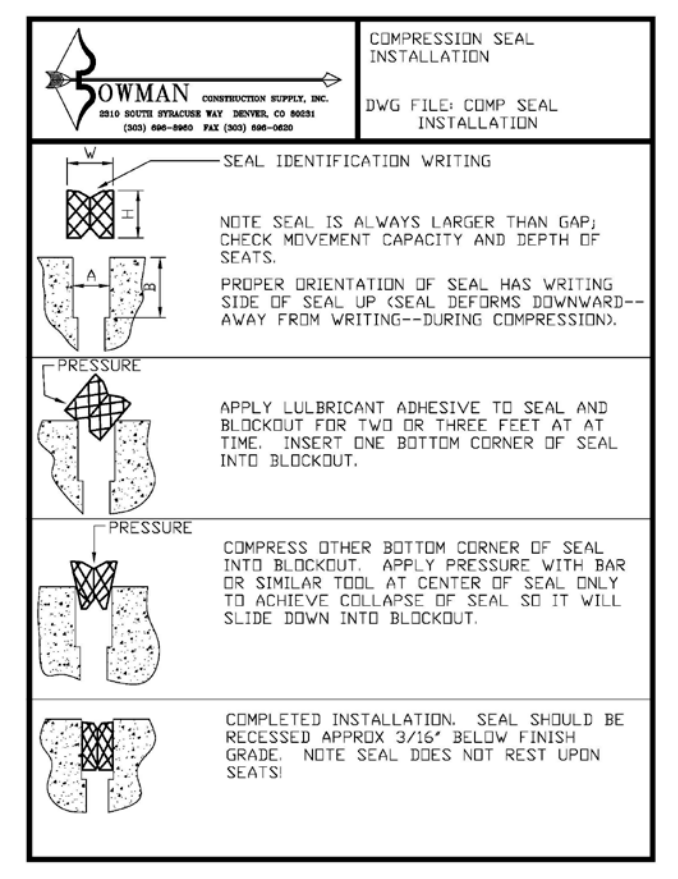
COMPRESSION SEALS



Delastic® Seal	Delastic® SEAL CHARACTERISTICS			JOINT DESIGN CRITERIA		
	Nominal Width (W)	Nominal Height (H)	Max. Movement	Narrowest Opening (A)	Widest Opening (A)	Minimum Depth (B)
CV-1250	**1.25** (32)	**1.25** (32)	**0.50** (13)	**0.56** (14)	**1.06** (27)	**1.63** (41)
CV-1625	**1.63** (41)	**1.88** (48)	**0.60** (15)	**0.73** (19)	**1.38** (35)	**2.25** (57)
CV-1752	**1.75** (44)	**1.75** (44)	**0.70** (18)	**0.79** (20)	**1.49** (38)	**2.40** (61)
CV-2000	**2.00** (51)	**2.00** (51)	**0.75** (19)	**0.95** (24)	**1.70** (43)	**2.75** (70)
CV-2250	**2.25** (57)	**2.33** (59)	**0.90** (23)	**1.01** (26)	**1.91** (49)	**3.00** (76)
CV-2502	**2.50** (64)	**2.50** (64)	**1.00** (25)	**1.13** (29)	**2.13** (54)	**3.20** (81)
CV-3000	**3.00** (76)	**3.25** (83)	**1.20** (31)	**1.34** (34)	**2.55** (65)	**4.25** (108)
CV-3500	**3.50** (89)	**3.50** (89)	**1.40** (36)	**1.58** (40)	**2.98** (76)	**4.45** (113)
CV-4000	**4.00** (102)	**4.00** (102)	**1.65** (42)	**1.75** (44)	**3.40** (86)	**5.63** (143)
CV-4500	**4.50** (114)	**4.50** (114)	**2.20** (56)	**2.03** (52)	**3.83** (97)	**6.13** (156)
CA-5001	**5.00** (127)	**5.00** (127)	**2.35** (60)	**1.90** (48)	**4.25** (108)	**6.25** (159)
CA-6000	**6.00** (152)	**6.00** (152)	**2.90** (74)	**2.20** (56)	**5.10** (129)	**7.75** (197)

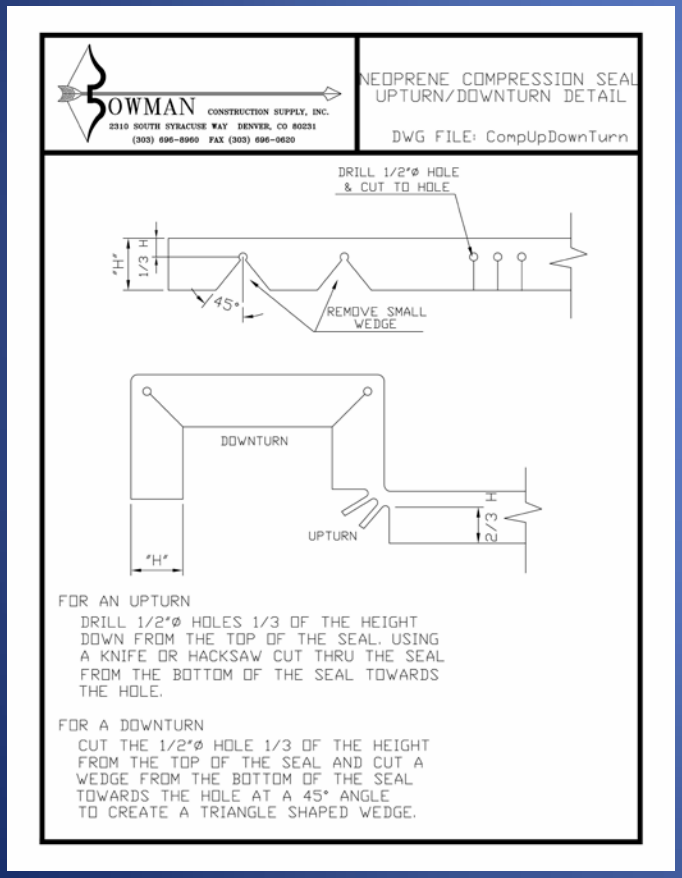
CDOT EXPANSION JOINTS

COMPRESSION SEALS



CDOT EXPANSION JOINTS

COMPRESSION SEALS



CDOT EXPANSION JOINTS

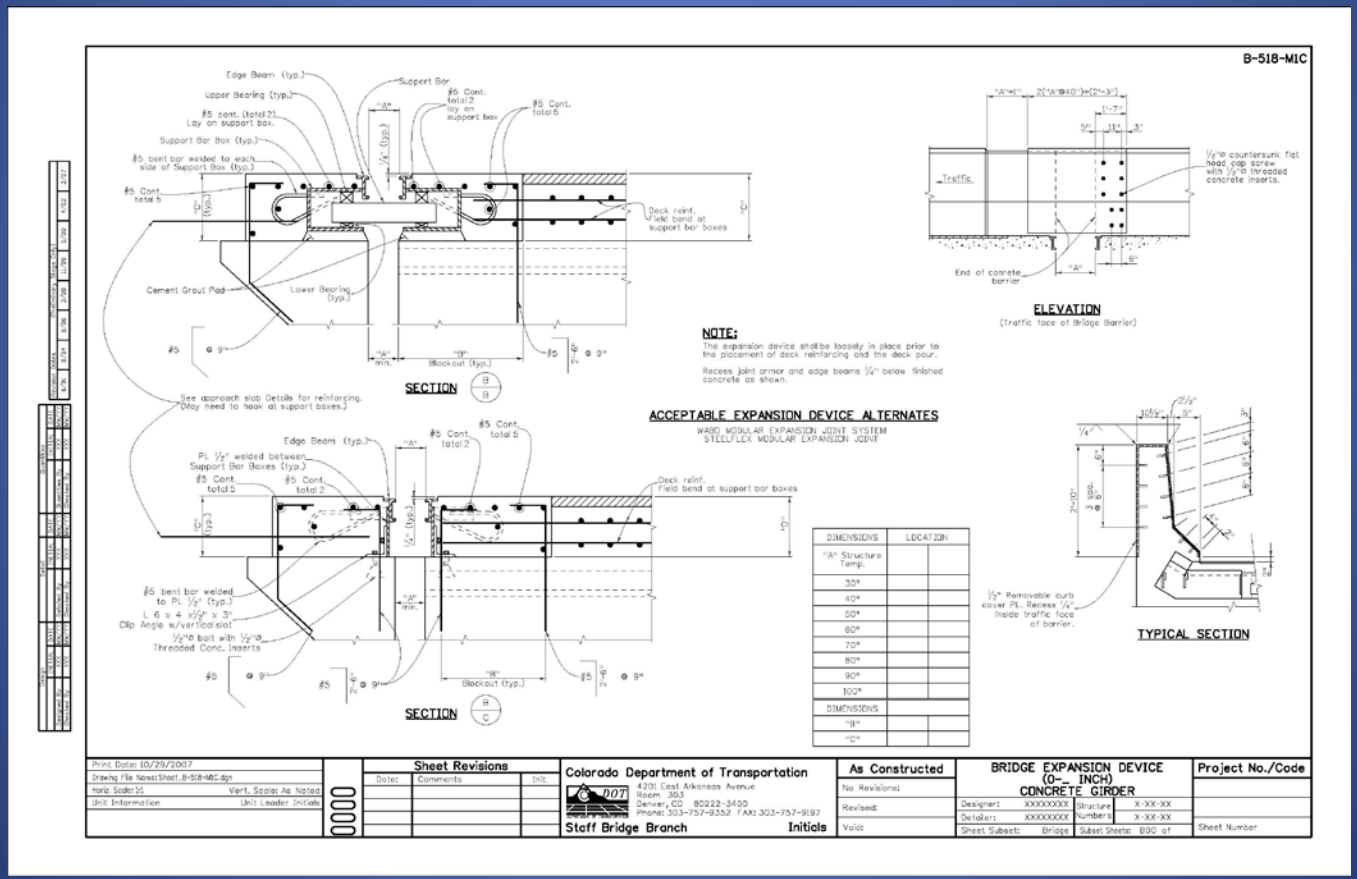
COMPRESSION SEALS

WHAT CAN GO WRONG-4:

- INCORRECT GAP WIDTH
- INCONSISTENT BLOCKOUT
- UPSIDE DOWN INSTALLATION
- SPALLED CONCRETE

CDOT EXPANSION JOINTS

MODULAR JOINTS



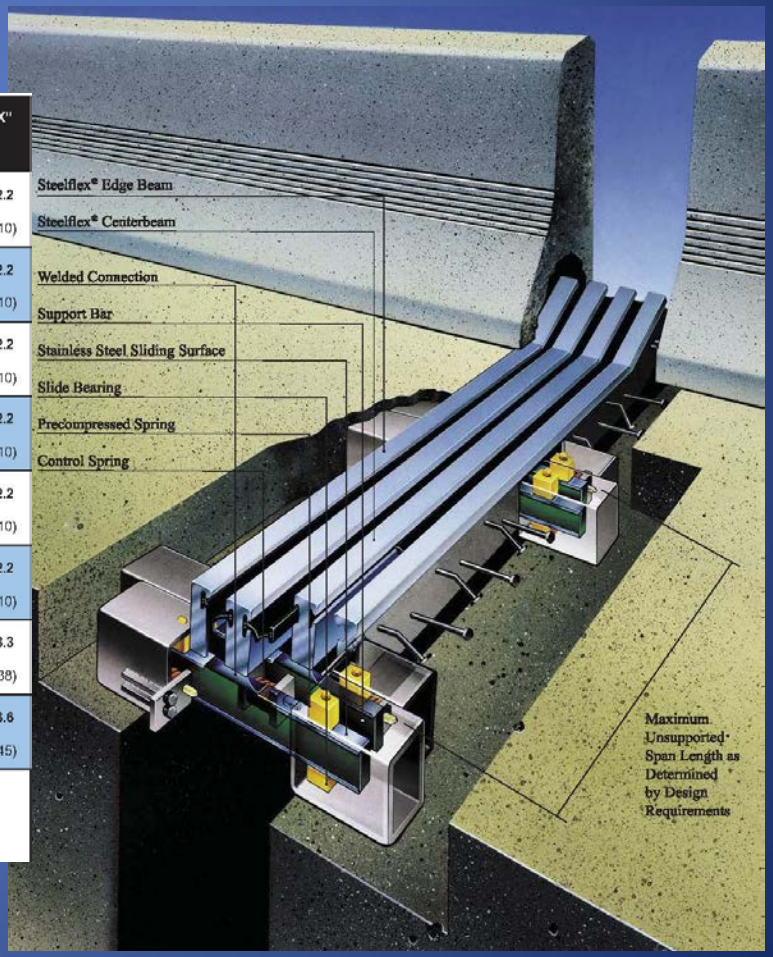
MANUFACTURER'S TECH REP REQUIRED!

CDOT EXPANSION JOINTS

MODULAR JOINTS

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)

Dimensions are based on design provisions in NCHRP Report 402.
Dimensions are based on 0 degree skew.
Bold numbers represent inches; metric (mm) shown in parentheses.
Shallower depths (X) may be possible upon special request.



CDOT EXPANSION JOINTS

MODULAR JOINTS

CDOT EXPANSION JOINTS

SUMMARY:

- **MANY ITEMS OUTSIDE OF BID ITEM HAVE A PROFOUND AFFECT UPON EXPANSION JOINT PERFORMANCE AND LONGEVITY!**
  - POOR EXISTING CONCRETE
    - REMOVAL TECHNIQUE MAY COMPROMISE EXISTING CONCRETE
  - POOR EXISTING REBAR
  - POOR APPROACH TO JOINT (SURVEY)
  - POOR CONCRETE CURE
  - IMPROPER GLAND INSTALLATION
    - CUTS, NICKS, BULGES
  - IMPROPER GAP (DIM “A”)

CDOT EXPANSION JOINTS

Questions?