CONSULTING ENGINEERS
GENERAL MEMORANDUM 12-03

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING AND
CONSTRUCTION
OFFICE OF ENGINEERING

New Bridge Design Standard Practices
Revised Asphaltic Plug Expansion Joint
Revised Approach Slab Limits

June 18, 2012

To: CONSULTING ENGINEERS

The Bridge Design Standard Practices are hereby revised to include new standard practices regarding selection and use of the "Asphaltic Plug Expansion Joint System," an update to the special provision for the "Asphaltic Plug Expansion Joint System," and revised limits for the design of bridge approach slabs on bridges with sidewalks (enclosed). The revised special provision for the "Asphaltic Plug Expansion Joint System" is posted electronically on the Department of Transportation's (Department) website in the "Owned Special Provisions" folder located under "Contract Development and Cost Estimating." The Bridge Design Manual located on the Department's website will be revised accordingly to incorporate the subject revisions in the near future. These new design practices should be immediately incorporated in all on-going design projects including contract addendum phases where possible.

Very truly yours,

Timothy M. Wilson, P.E.
Manager of Highway Design
Bureau of Engineering and Construction

Enclosure

New Bridge Design Standard Practices

Asphaltic Plug Expansion Joint System

The revisions to the special provision for the Asphaltic Plug Expansion Joint System and related Bridge Design Manual sections noted below are to clarify and refine the construction installation requirements and to assure the joint applications will comply with manufacturer's expansion joint limitation criteria. Described below is a new standard practice that updates Sections 10.2.1 through 10.2.3 of the Bridge Design Manual in regard to the design selection of bridge deck expansion joints and includes revisions to the special provision for the "Asphaltic Joint Expansion Joint System".

New design practice:

The attached revised special provision for the Asphaltic Plug Expansion Joint system shall be incorporated in all projects that require this construction item. The special provision has been updated to refine installation requirements to assure the joint is installed in a manner that will not exceed its movement capacity. Designers shall include on the contract plans a table of expansion joint thermal movement ranges for each proposed asphaltic plug expansion joint installation location. The maximum design thermal movement range at each bridge deck expansion joint location to receive an asphaltic plug expansion joint shall be indicated in the table. The revised special provision provides ambient temperature installation limitations that are referenced to the maximum thermal movement range of the expansion joint. These new requirements will assure that an asphaltic plug expansion joint will not be installed outside an allowable ambient temperature range that would exceed its movement capacity. The asphaltic plug joint must not be installed in any applications where the bridge joint skew angle exceeds 45^0. In addition, the asphaltic plug expansion joint shall not be installed in a bridge joint location where both highway grade exceeds 4% and joint is located within 150 feet of a traffic intersection, unless otherwise approved by the Department.

Bridge Design Manual Revisions

Section 10.2.1 through 10.2.3 shall be replaced with the following:

10.2.1 Fixed Joints

10.2.1 Abutment Joints

For joints at abutments, the first preference for joint type should be the asphaltic plug expansion joint system except where the joint skew angle is greater than 45^0, or where both the bridge grade exceeds 4% and joint location is within 150 feet of an intersection. For these exceptions the Silicone Expansion joint system should be used unless otherwise approved by the Department.

10.2.1.2 Pier Joints

For joints at piers, the first preference for joint type should be the asphaltic plug expansion joint system except where the joint skew angle is greater than 45^0, or where both the bridge grade exceeds 4% and joint location within 150 feet of an intersection. For these exceptions the Silicone Expansion joint system should be used unless otherwise approved by the Department.

10.2.1.3 Box Culverts

Joints in the roadway surface above the edge (horizontal limit) of a reinforced concrete box culvert shall be considered only where the depth of pavement above the top of box culvert is 4 inches or less. In such cases where the depth of bituminous cover above the top of box culvert is less than 4", the designer shall consult with the Department for optimal joint selection on a case-by case basis.

Section 10.2.2 Expansion joint with Movement up to 5/8" shall be replaced with the Following:

10.2.2 Expansion joints with movements up to 1-1/2"

10.2.2.1 Abutment Joints

For joints at abutments, the first preference for joint type should be the asphaltic plug expansion joint system except where the joint skew angle is greater than 45^0, or where both the bridge grade exceeds 4% and joint location is within 150 feet of an intersection. For these exceptions the Silicone Expansion joint system should be used unless otherwise approved by the Department.

10.2.2.2 Pier Joints
For joints at piers, the first preference for joint type should be the asphaltic plug expansion joint system except where the joint skew angle is greater than 45^0, or where both the bridge grade exceeds 4% and joint location is within 150 feet of an intersection. For these exceptions the Silicone Expansion joint system should be used unless otherwise approved by the Department.

10.2.2.4 Pin and Hanger Joints
For existing joints that have pin and hanger devices connecting the beams, the first preference for joints shall be the "Silicone Expansion Joint System".

Section 10.2.3 shall be deleted and remain blank.

Approach Slabs at Structures

Described below is a new Bridge Design Standard Practice that revises Section 5.8 of the Bridge Design manual in regard to installation limits of approach slabs at structures carrying sidewalks.

New practice:

The current design practice does not address the limits of approach slab placement where the carrying structure includes a sidewalk. As a result, approach slabs on bridge designs carrying sidewalks have often been terminated at the gutter line, resulting in sidewalk settlement where the approach sidewalk meets the bridge deck sidewalk. The new practice described in the revised Bridge Design Manual article below requires that approach slabs extend the full width of the roadway, including shoulders and sidewalks, where present to eliminate the potential of sidewalk settlement at the transition to the bridge deck sidewalk.

Section 5.8 shall be replaced with the following:

5.8 APPROACH SLABS
Approach slabs shall be provided on all bridges carrying State highways. Approach slabs shall be strongly considered on all bridges undergoing superstructure replacement and local road bridges.

Approach slabs should extend the full width of the roadway including shoulders and sidewalks where proposed. Approach slabs shall have a standard length of 16 feet and thickness of 1'-3". Generally, approach slabs

should follow the skew of the bridge for skew angles up to 35°. For skew angles greater than 35°, the ends of the approach slabs should be square to the roadway with a minimum length of 15 feet. For bridge designs without sidewalks, acute corners of approach slabs and approach pavement should be squared off for a distance of five feet from the gutter line. For bridge designs with sidewalks, the acute corners shall be squared off within the horizontal limits of the sidewalk and outside the expansion joint upturn transitions between gutter line and sidewalk elevations. Approach slabs shall be anchored to the bridge abutment.

Approach slabs shall be constructed with Class "F" Concrete and two mats of epoxy-coated reinforcement. Approach slabs shall be covered with a waterproofing membrane and a bituminous concrete overlay. All the material items used in the construction of the approach slabs, including the overlay, shall be included in the structure items and quantities.

All elevations necessary for construction of the approach slabs shall be shown on the plans. These elevations shall include the elevations at the point of application of grade line, the gutter lines and at shoulder break lines at both ends of the approach slabs.

ITEM #0520036A - ASPHALTIC PLUG EXPANSION JOINT SYSTEM

Description: Work under this item shall consist of furnishing and installing an asphaltic plug expansion joint system (APJ) in conformance with ASTM D6297, as shown on the plans, directed by the Engineer and as specified herein.

Work under this item shall also consist of removal and disposal of bituminous concrete, membrane waterproofing, and existing joint components and sealing elements, excluding the removal of Portland cement concrete headers.

Work under this item shall also consist of cleaning and sealing median barrier joints, parapet joints, and sidewalk joints in accordance with the plans and this specification.

Materials: The following APJ's are qualified for use under this item:

Product	Supplier
Expandex	BASF/Watson Bowman Acme Inc. 95 Pineview Drive Amherst, NY 14228
Matrix 502[1]	Crafco, Inc. 420 N.Roosevelt Ave. Chandler, AZ 85226
Thorma-Joint	Dynamic Surface Application, Ltd. 373 Village Road Pennsdale, PA 17756

1. Matrix 502 is sold exclusively by D. S. Brown Company, 300 East Cherry Street,
North Baltimore, Ohio 45872

The APJ component materials including asphaltic binder, aggregate, bridging plates, and the backer rods shall comply with ASTM D6297.

The material composition of the binder and aggregate and their relative mix proportions shall be as specified in Table 1 of ASTM D6297. The aggregate shall meet the requirements of Article M.04.01-1 for wear and soundness and shall meet a gradation as specified by the Supplier.

All backer rods shall satisfy the requirements of ASTM D5249, Type 1.

The bridging plates shall be steel conforming to the requirements of ASTM A36 and be a minimum ¼" thick and 8" wide. For joint openings in excess of 3" the minimum plate dimensions shall be ⅜" thick by 12" wide. Individual sections of plate shall not exceed 4' in length. Steel locating pins for securing the plates shall be size 16d minimum, hot-dip galvanized, and spaced no more than 12" apart.

Other materials which shall be used in conjunction with the qualified APJ's are as follows:

Parapet Sealant:

The sealant used in parapet joint openings shall be a single component non-sag silicone sealant that conforms to the requirements of ASTM D5893.

Sidewalk Sealant:

The sealant used in sidewalk joint openings shall be a rapid cure, self-leveling, cold applied, two-component silicone sealant. The silicone sealant shall conform to the following requirements:

Properties - As Supplied	**Test Method**	**Requirement**
Extrusion Rate	ASTM C1183	200-600 grams/min
Leveling	ASTM C639	Self-Leveling
Specific Gravity	ASTM D792	1.20 to 1.40

Properties - Mixed	**Test Method**	**Requirement**
Tack Free Time	ASTM C679	60 min. max.
Joint Elongation – Adhesion to concrete	ASTM D5329 [1,2,3]	600% min
Joint Modulus @ 100% elongation	ASTM D5329 [1,2,3]	15 psi max
Cure Evaluation	ASTM D5893	Pass @ 5 hours

1. Specimens cured at 77±3°F. and 50±5% relative humidity for 7 days
2. Specimens size: ½"wide by ½"thick by 2" long
3. Tensile Adhesion test only

The date of manufacture shall be provided with each lot. No sealant shall be used beyond its maximum shelf-life date.

The following two–part silicone sealants are known to have met the specified requirements:

Product	Supplier
Dow Corning 902RCS	Dow Corning Corporation 2200 W Salzburg Road Auburn, Michigan 48611
Wabo SiliconeSeal	BASF/Watson Bowman Acme Corporation 95 Pineview Drive Amherst, New York 14228

Other two-component silicone joint sealants expressly manufactured for use with concrete that conform to the aforementioned ASTM requirements will be considered for use provided they are submitted in advance for approval to the Engineer. Other joint sealants will be considered for use only if a complete product description is submitted, as well as documentation describing at least five installations of the product. These documented installations must demonstrate that the product has performed successfully for at least three years on similar bridge expansion joint applications.

A Materials Certificate and Certified Test Report for the asphaltic binder shall be submitted by the Contractor in accordance with the requirements of Article 1.06.07 certifying that the asphaltic binder satisfies the requirements of the most current version of ASTM D6297.

A Materials Certificate for all other components of the APJ, backer rod and sealant used in sealing parapet and sidewalk joint openings, shall be submitted by the Contractor in accordance with the requirements of Article 1.06.07

Construction Methods: The APJ shall be installed at the locations shown on the plans and in stages in accordance with the traffic requirements in the special provisions "Maintenance and Protection of Traffic" and "Prosecution and Progress".

At least 30 days prior to start of installation of the APJ, the Contractor shall submit to the Engineer for approval a detailed Work Quality Control Plan for the installation of the APJ. The submittal shall include all aspects of the installation of the expansion joint system including name of the qualified product selected by the Contractor, a detailed step by step installation procedure and a list of the specific equipment to be used for the installation. The detailed Work Quality Control Plan must fully comply with the supplier's written recommendations and address all anticipated field conditions.

An experienced technical representative employed by the APJ supplier, acceptable to the Engineer, shall be present during the first installation of the APJ to provide the Contractor aid and independent instruction as required to obtain an installation in accordance with ASTM D6297 and satisfactory to the Engineer. Should the Engineer determine that additional

technical aid is required after the first installation of the APJ, the technical representative shall be present at additional installations as ordered by the Engineer at no additional cost to the State.

The APJ shall not be installed when bituminous concrete overlay is wet. The APJ shall only be installed when the bridge superstructure surface temperature is within the allowable limits specified in the table below and when the ambient air temperature is within the range of 40^0F and rising to 95^0F with no rain in the work-shift forecast. The allowable bridge superstructure surface temperature range is determined using the thermal movement range provided on the contract plans for the proposed APJ deck installation location and the selected APJ product.

ALLOWABLE BRIDGE SUPERSTRUCTURE SURFACE TEMPERATURE RANGE DURING ASPHALTIC PLUG EXPANSION JOINT INSTALLATION[1]

Deck Joint Thermal Movement Range Indicated on the Plans[2]	Expansion Joint Product		
	Expandex	Matrix 502	Thorma Joint
0" to ¾"	40° F to 95° F	40° F to 95° F	40° F to 95° F
7/8"	40° F to 93° F	40° F to 93 ° F	40°F to 95° F
1"	40° F to 80° F	40°F to 80°F	40° F to 95° F
1-1/8"	40° F to 70° F	40° F to 70° F	40° F to 95° F
1-1/4"	40° F to 62° F	40° F to 62° F	40° F to 86° F
1-3/8"	45° F to 55° F	45° F to 55° F	40° F to 77° F
1-1/2"	50° F limit	50° F limit	40° F to 70° F

1. The superstructure surface temperature shall be determined from the average of three or more surface temperature readings taken at different locations on the interior girder surfaces by the Contractor as directed by the Engineer. Temperature measurements of the superstructure shall be taken by the contractor with a calibrated hand held digital infrared laser-sighted thermometer on the surfaces of an interior steel girder, or interior concrete girder protected from direct sunlight. The infrared thermometer to be supplied by the Contractor for this purpose shall meet certification requirements of EN61326-1, EN61010-1, and EN60825-1 maintained by the European Committee for Electrotechnical

Standardization (CENELEC). The thermometer shall have a minimum distance-to-spot ratio of 50:1 and shall have adjustable emissivity control. The thermometer shall have a minimum accuracy value of ±1% of reading or ±2°F, whichever is greater. The thermometer shall be used in strict accordance with the manufacturer's written directions. An additional infrared thermometer satisfying the same standards to be used in this application shall also be provided to the Engineer for quality assurance purposes.

2. Linear interpolation may be used to determine an allowable surface temperature range for thermal movement ranges in between values shown in the table, as approved by the Engineer.

Prior to installing the APJ, the Contractor shall determine the exact location of the deck joint beneath the bituminous concrete overly.

The APJ shall be installed symmetrically about the deck joint opening to the dimensions shown on the plans and as directed by the Engineer. The proposed saw cut lines shall be marked on the bituminous concrete overlay by the Contractor and approved by the Engineer, prior to sawcutting. The maximum width of the APJ, measured perpendicular to the deck joint, shall not exceed 24" unless approved by both the Engineer and supplier. The sawcuts delineating the edges of the APJ shall extend full depth of the bituminous concrete overlay.

The existing bituminous concrete overlay, waterproofing membrane and/or existing expansion joint material, within the saw cut limits shall be removed and disposed of by the Contractor to create the joint cutout.

Concrete surfaces, that will support the bridging plates, shall be smooth and form a plane along and across the deck joint. Rough and damaged concrete surfaces shall be repaired with suitable cementitious leveling compound as recommended by the APJ supplier. The existing and repaired concrete surfaces shall provide continuous uniform support for the bridging plate and prevent the plate from rocking and deflecting.

Prior to the installation of the backer rod, all horizontal and vertical surfaces of the joint cutout shall be cleaned using a hot compressed air lance to remove any moisture and debris. The hot air lance shall be capable of producing an air stream at 3,000°F with a velocity of 3,000 feet per second. Primer, if required, shall be applied to the joint cutout surfaces as recommended by the joint supplier.

Backer rod, with a diameter at least 25% greater than the existing joint opening at the time of installation, shall be installed in the existing deck joint opening between the concrete edges.

Prior to application, the binder shall be heated, with equipment recommended by the supplier, to a temperature within the supplier's recommended application temperature range. During application, the temperature of the binder shall be maintained within this range. In no case shall the temperature of the binder go below 350° F nor exceed the supplier's recommended maximum heating temperature.

After installing the backer rod in the deck joint opening, asphaltic binder shall then be poured into the joint opening until it completely fills the gap above the backer rod. A thin layer of binder shall next be applied to the all horizontal and vertical surfaces of the joint cutout.

Bridging plates shall be placed over the deck joint opening in the joint cutout. The plates shall be centered over the joint opening and secured with locating pins along its centerline. The plates shall be placed end to end, without overlap, such that the gap between plates does not exceed ¼". The plates shall extend to the gutter line, where concrete support exists on both sides of the joint. Within APJ installation limits, where concrete support does not exist at both sides of the joint opening (such as where a bridge deck end abuts a bituminous concrete roadway shoulder), bridging plates shall not be installed. Installed bridging plates shall not rock or deflect in any way. After installation of bridging plates, asphaltic binder shall be applied to all exposed surfaces of the plates.

The remainder of the joint cutout shall then be filled with a matrix of hot asphaltic binder and aggregate prepared in accordance with the joint supplier's instructions and the following requirements: The aggregate shall be heated in a rotating drum mixer to the supplier's recommended minimum temperature, but not less than 350° F. Asphaltic binder material, heated separately to a temperature within the range specified in the supplier's written instructions, shall be added to the mixer in a proportional amount recommended by the manufacturer to coat the aggregate. The temperature of the aggregate and binder shall be monitored with a calibrated digital thermometer. All aggregate shall be fully coated with hot asphaltic binder in the mixer before placement in the joint cutout. The combined matrix of hot binder and aggregate shall be installed in the joint cutout in lifts. The combined matrix lift thickness shall not exceed the supplier's written instructions but shall not exceed 2 inches in any case. Each intermediate lift shall be leveled and flooded with hot binder to the level of the matrix aggregate to fill voids in the surface. Following installation of the matrix in the joint cutout, the joint shall be compacted and top-dressed in accordance with the supplier's written instructions.

The Contractor shall be responsible for removing all binder material that leaks through the joint and is deposited on any bridge component, including underside of decks, headers, beams, diaphragms, bearings, abutments and piers.

Traffic shall not be permitted over the joint until it has cooled to 130° F when measured with a digital infrared thermometer. Use of water to cool the completed joint is permitted.

Before placement of any sealing materials in parapets, curbs, or sidewalks, the joints shall be thoroughly cleaned of all scale, loose concrete, dirt, dust, or other foreign matter by abrasive blast cleaning. Residual dust and moisture shall then be removed by blasting with oil free compressed air using a hot air lance providing an air temperature and directional air velocity capacity recommended by the joint manufacturer. Projections of concrete into the joint space shall also be removed. The backer rod shall be installed in the joint as shown on the plans. The joint shall be clean and dry before the joint sealant is applied. Under no circumstances is the binder material to be used as a substitute for the joint sealant.

Whenever blast cleaning is performed under this specification the Contractor shall take adequate measures to ensure that the blast cleaning will not cause damage to adjacent traffic or other facilities.

The joint sealant shall be prepared and placed in accordance with the manufacturer's instructions and with the equipment prescribed by the manufacturer. Extreme care shall be taken to ensure that the sealant is placed in accordance with the manufacturer's recommended thickness requirements.

The joint sealant shall be tooled, if required, in accordance with the manufacturer's instructions.

Primer, if required, shall be supplied by the sealant manufacturer and applied in accordance with the manufacturer's instructions.

When the sealing operations are completed, the joints shall be effectively sealed against infiltration of water. Any sealant which does not effectively seal against water shall be removed and replaced at the Contractor's expense.

The Contractor must certify that the plug joints were installed in accordance with the supplier's recommendations.

Any installed APJ that exhibits evidence of failure such as debonding, cracking, rutting, or shoving of the matrix shall be removed and replaced full-width and full–depth to a length determined by the Engineer. The reinstallation of joint shall be in accordance with the approved Work quality Control Plan, as directed by the Engineer, following a determination of the cause of failure, all at no additional cost to the State.

Method of Measurement: This work will be measured for payment by the number of cubic feet of Asphaltic Plug Expansion Joint System installed and accepted within approved horizontal limits. No additional measurement will be made for furnishing and installing backer rod and joint sealant in the parapets, concrete medians, curbs and/or sidewalks.

Basis of Payment: This work will be paid for at the contract unit price per cubic foot for "Asphaltic Plug Expansion Joint System", complete in place, which price shall include the, sawcutting, removal and disposal of bituminous concrete, membrane waterproofing, and existing joint components and sealing elements, the furnishing and placement of the cementitious leveling compound, cleaning of the joint surfaces, furnishing and installing bridging plates, furnishing and installing the asphaltic plug joint matrix, the cost of furnishing and installing joint sealant in parapets and sidewalks, the cost of all services associated with the technical representative, and all other materials, equipment including but not limited to portable lighting, tools, and labor incidental thereto. No additional payment shall be made for the 12" wide bridging plates that are required for deck joint openings with widths in excess of 3".

I N D E X

2012 CONSULTANT GENERAL MEMORANDA

No:		Subject:		Date:
12-01		New Bridge Design Standard Practice		03/16/12
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12-03		New Bridge Design Standard Practices Revised Asphaltic Plug Expansion Joint Revised Approach Slab Limits		06/18/12