a. Description. This work consists of providing all designs, shop drawings, testing, labor, tools, equipment and materials necessary to fabricate and install a modular expansion joint system of the size and type shown on the plans at the location(s) shown on the plans. Ensure this work is in accordance with section 707 of the Standard Specifications for Construction and as described herein. Ensure shop welding is in accordance with AWS D1.1/D1.1M Structural Welding Code - Steel as modified by the 12SP-707A - Special Provision for Structural Steel and Aluminum Construction included in the contract.

Integrate the component elements into a complete modular expansion joint system. The component elements generally consist of but are not limited to steel edge beams, steel separation beam(s), low-stress mechanically locked neoprene sealing element(s), a supporting system, and a sliding steel plate system at the sidewalks, concrete median barriers and concrete parapet joints as shown on the plans. Provide a modular expansion joint system that is continuous across the full width of the roadway and continues beneath the median barriers and parapets.

Acceptable systems and suppliers of the modular expansion joint system are:

1. D. S. Brown Company, North Baltimore, OH.
2. Watson Bowman ACME, Amherst, N.Y.

b. Testing. Perform all tests necessary to assure that all materials to be incorporated into the work comply with this special provision and the standard specifications. Do not make use of nor incorporate into the work any materials until all tests have been performed and the materials are found to be acceptable. Ensure tests are performed only by a nationally accredited testing laboratory. Ensure the test results are notarized and submitted to the Engineer for review in accordance with the standard specifications.

c. Design Criteria. Design the modular expansion joint system to the following requirements:

1. General Requirements. The modular expansion joint system must seal the roadway deck surface, gutters, curbs and parapet walls as indicated on the plans, thereby preventing water from seeping or leaking through the joint area. Any seeping or leaking of water through the joint system will be cause for rejection. Design the modular expansion joint system as a continuous, full-length system without field splices, unless staged construction (part-width) or excessive lengths (greater than 72 feet) prohibits monolithic fabrication. A maximum of two sections per joint will be allowed for stage construction or modular expansion joints greater than 72 feet. Provide continuous elastomeric sealing element that are limited to a maximum of 3 inches of movement per seal.
2. System Requirements at Bridge Deck. Provide a system that consists of preformed elastomeric expansion joint seals mechanically held in place by machined or extruded steel edge and separation beams. Support each transverse separation beam individually by an independent support bar welded to the separation beam. Suspend these support bars over the joint opening by sliding elastomeric bearings. The system must provide equidistant control over the movements of the preformed sealers. Design this equidistant control system such that the maximum compressive force is developed when the joint is at its maximum opening.

3. Center and Edge Beams. Ensure the center beams and edge beams are monolithic, non-welded, machined or extruded solid steel sections received from the mill. Rolled sections with bent or welded seal retainer clips are prohibited. Ultrasonically test 100 percent of full penetration butt welded center beams. Ensure this testing is witnessed by the Engineer.

4. Loading. Design the expansion joint system for MS23 (HS25) loading with 30 percent impact. The expansion joint system must accommodate the joint movements indicated on the plans.

5. System Requirements at Sidewalks, Barriers, and Parapets. Ensure the expansion joint device at sidewalks, concrete median barriers, and concrete parapet joints has a sliding steel plate fabricated and installed according to the plans.

6. Manufacturing Requirements. Only suppliers who have successfully completed the fatigue testing as described in this special provision will be permitted to design, manufacture and supply bridge modular expansion joints.

d. Fatigue Testing. Ensure structural steel members are properly proportioned so that the maximum stresses in the members do not exceed the basic allowable stresses given in AASHTO subsection10.3.2. The actual stress range of the structural member connections and components must not exceed the allowable fatigue stress range of category C 10 ksi for over 2,000,000 cycles given in AASHTO Table 10.3.1A.

The expansion joint structural steel members, connections, and steel components must remain free of cracks. Fatigue testing is necessary to establish the proper AASHTO fatigue category for all structural members, connections, and components.

e. Limit State Fatigue Wheel Loads. Design the transverse center beams, edge beams, support bars, bearings and other structural elements for the simultaneous application of the vertical and horizontal limit state fatigue wheel loads shown below:

1. Vertical Wheel Load Range 26.0 kips/wheel
   (Live Load including 30 percent Impact, Normal to Roadway Surface)

2. Horizontal Wheel Load Range 8.0 kips/wheel
   (Live Load including 30 percent Impact, Parallel to Roadway Surface)

3. Ensure these limit state fatigue wheel loads include impact and are modified for the effect of roadway grades when the grade exceeds 4 percent. For roadway grades 4 percent or less, the loads shown can be used without modification.
f. Application of Limit State Fatigue Wheel Load Ranges. For the design of the center beams and edge beams, ensure the two vertical and horizontal load ranges described above are spaced 6 feet apart and applied at the roadway surface as a rectangular patch loading. The rectangular patch must have a 9 inch length in the direction of traffic and a 20 inch width perpendicular to the direction of traffic.

1. As shown below, the percentage of the loads applied to the center beams and edge beams is based on the mid-range position of the seals and the width of the center beams.

<table>
<thead>
<tr>
<th>Width of Seal</th>
<th>Percent of Load Acting on One Center Beam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Beam or Edge Beams</td>
<td>40%</td>
</tr>
<tr>
<td>2 1/4 inch or less</td>
<td>40%</td>
</tr>
<tr>
<td>3 1/4 inch</td>
<td>50%</td>
</tr>
<tr>
<td>4 inch</td>
<td>60%</td>
</tr>
</tbody>
</table>

2. Ensure when the roadway grade exceeds 4 percent, the additional horizontal component due to the grade is added to the horizontal limit states fatigue wheel load described previously.

g. Fatigue Limit State Design. Satisfy the fatigue limit state equation shown below for all expansion joint steel structural members, connections, and steel components.

1. Fatigue Limit State Equation P: $f_{sr,calc} \leq F_{sr,test}$

where:

- $f_{sr,calc}$ = calculated stress based on the simultaneous application of the vertical and horizontal limit state fatigue wheel loads.
- $F_{sr,test}$ = constant amplitude fatigue limit.

2. Perform constant amplitude fatigue testing to determine $F_{sr}$ the constant amplitude fatigue limit for all structural members, connections, and components.

3. Apply the test loading so that a vertical and horizontal loading are applied simultaneously. Perform testing so that the horizontal load is 20 percent of the vertical load.

h. Materials. Ensure the modular joint system and all its component parts, including stiffening plates and anchorages, are supplied by a single supplier. Ensure the supplier is certified by the American Institute of Steel Construction (AISC) for Category Simple Steel Bridges (Sbr).

1. Metals.

   A. Structural Steel. Provide structural steel in accordance with AASHTO M 270 Grade 50W with a silicon content of less than 0.06 percent or between 0.15 through 0.25 percent suitable for galvanizing. Charpy V-Notch for the center beam and support bar must meet 20 foot-pounds at 40 degrees Fahrenheit (F). The minimum thickness of any steel element must not be less than 3/8 inch. Hot-dip galvanize all steel after fabrication according to ASTM A 123 (AASHTO M 111), except stainless steel surfaces. Repair galvanizing according to ASTM A 780 using the Zinc-Based Soldering Method (hot-stick).
B. Stainless Steel. Provide stainless steel in accordance with *ASTM A 240*, Type 302 or 304 with 2B finish.

C. Other Materials. Aluminum and aluminum alloys are prohibited.

2. Neoprene (Polychloroprene) Seal. Supply and install the neoprene (polychloroprene) seal in one continuous length. No splices are permitted. Ensure the seal is a strip seal and must promote self-removal of foreign material during normal joint operation. Each neoprene seal must allow a maximum opening per cell of 3¼ inches. The physical properties must meet the requirements of Table 1 below.

3. Lubricant Adhesive. Provide material that is one part moisture curing polyurethane and aromatic hydrocarbon solvent mixture and must not contain less than 65 percent solids content, to be used in bonding the polychloroprene box seal to the steel shapes, as recommended by the manufacturer.

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Test Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength, min., ksi</td>
<td>D 412</td>
<td>2 ksi (min.)</td>
</tr>
<tr>
<td>Elongation @ break, min., %</td>
<td>D 412</td>
<td>250% (min.)</td>
</tr>
<tr>
<td>Hardness, Type A durometer, points</td>
<td>D 2240 (modified)</td>
<td>50 - 65</td>
</tr>
<tr>
<td>Oven aging, 70hr. @ 212°F</td>
<td>D 573</td>
<td>20% (max.)</td>
</tr>
<tr>
<td>Tensile strength, max., % loss</td>
<td></td>
<td>20% (max.)</td>
</tr>
<tr>
<td>Elongation, max., % loss</td>
<td></td>
<td>0 to +10 pts.</td>
</tr>
<tr>
<td>Hardness, Type A durometer, points change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Swell, ASTM Oil No. 3, 70hr. @ 212°F</td>
<td>D 471</td>
<td>45%</td>
</tr>
<tr>
<td>Weight change, max., %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ozone resistance</td>
<td>D 1149 (modified)</td>
<td>no cracks</td>
</tr>
<tr>
<td>20% strain, 300 pphm in air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70hr. @ 104°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low temperature stiffening, 7 days @ 14°F</td>
<td>D 2240</td>
<td>0 to +15 pts.</td>
</tr>
<tr>
<td>Hardness, Type A durometer, points change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compression Set, 70hr. @ 212°F max.</td>
<td>D 395</td>
<td>40% (max.)</td>
</tr>
<tr>
<td>Method B (modified)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Hardware and Fasteners.

A. Shear Connector Studs. Provide shear developers in accordance with subsection 906.08 of the Standard Specifications for Construction.

B. Bolts, Nuts, and Washers. Provided material must be in accordance with *ASTM A 325* and be galvanized according to *ASTM A 153*.

5. Support Bar Bearings. Provide support bar bearings fabricated from elastomeric pads according to subsection 914.12 of the Standard Specifications for Construction with polytetrafluorethylene (PTFE) surfacing, or from polyurethane compound with PTFE sliding surfaces. The PTFE material must be 100 percent virgin Teflon, woven PTFE fabric or
dimpled PTFE meeting the requirements of ASTM D 1457 and conforming to the requirements of section 18.4.3, Division II Construction, AASHTO Standard Specifications for Highway Bridges, 16th Edition, with Interim Specifications.

6. Control Springs. Provide suitable elastomeric type springs which work longitudinally to maintain equidistant spacing between transverse edge and separation beams.

7. Support Bars. Provide support bars that as a minimum:

   A. Are solid steel sections.

   B. Incorporate stainless steel sliding surfaces to minimize resistance to joint movement.

   C. Are supported above, below, and laterally as required to prevent uplift, transmit bearing loads, and maintain positioning of the bar.

   D. Has each transverse rail (separation beam) resting on a separate support bar at each support assembly.

   E. Are spaced not more than 4 feet 6 inches apart.

   F. Has connections of the support bars to the center beam(s) that are full penetration welded connections. Ultrasonically test 100 percent of these welded connections which will be witnessed by the Engineer. Repair defects in accordance with subsection 707.03.C.9.d of the Standard Specifications for Construction.

8. Separation Beams/Transverse Dividers. Design for MS23 (HS25) loading with 30 percent impact.

   i. Movement Capacity. The total horizontal movement of each individual sealing element must not exceed 3 inches. The movement capacity of each modular joint assembly must satisfy the horizontal and transverse movement requirements as detailed on the plans and in this special provision.

   j. Drawings. Submit shop drawings to the Engineer for approval according to subsection 104.02 of the Standard Specifications for Construction for each expansion joint device required on the bridges. Include tables showing the total anticipated movements for each joint and the required setting width of the joint assemblies at various temperatures. In addition, two copies of all approved fabrication shop drawings, which can be used to reproduce additional copies, must be provided to the bridge erection contractor and other interested parties for use during field installation.

   k. Construction Requirements. Provide factory prefabricated assemblies of the modular expansion joint devices that have a provision for field adjustment to the ambient temperature at the time of installation. Preset the joint opening as indicated on the plans.

   1. Manufacturer Representation. The manufacturer of the expansion devices must have a qualified technical service representative on the project to supervise installation. The cost and expenses related to this technical assistance will be considered included in the unit price bid for this item.
2. Materials. Inspect all materials and allow the Engineer to inspect all materials at the shop and as they arrive at the project site. Follow all of the manufacturer's recommendations with regard to protecting the materials from mechanical damage and damage due to excessive temperatures, sunlight, moisture, dirt, and debris. Promptly replace any materials damaged during storage or installation at no additional cost to the project.

3. Shipping. The modular joint system manufacturer must ship the modular joint system in one piece held firmly together with shipping clamp assemblies, leveling assemblies and lifting device assemblies (as required based on joint size).

4. Installation. The modular joint system manufacturer's instructions for the proper installation of the joint system must be included on the shop drawings. Shop drawings which lack supplier's installation instructions will be returned without approval.

5. Connection. Anchor the expansion joint system as shown on the plans. Anchor slider plates to the concrete with cast-in-place inserts. Accurately set and securely support the expansion joint system at the correct grade and elevation and the correct joint opening as shown on the plans and on the shop drawings.

6. Temperature Adjustments. Measure the structure temperature by recording the temperature of the underside of the concrete slab at each end of the superstructure element adjacent to the expansion joint. Take the average of the readings to use with the temperature correction factor shown on the plans.

7. Inspection. Immediately prior to installation, the joint system must be inspected by the Engineer for proper alignment and complete mechanical anchorage between the neoprene seal and the steel edge beams and separation beams. No bends or kinks in the joint system are allowed (except as necessary to follow the roadway grades). Polychloroprene seal not fully bonded to the steel must be fully anchored, or otherwise corrected to the satisfaction of the Engineer at the expense of the Contractor. The Engineer will visually inspect the anchors, and give them a light blow with a 5 pound hammer. Any anchor which does not have a complete end weld, or does not emit a ringing sound when struck a light blow with a hammer, must be replaced. All anchor replacements are at the expense of the Contractor.

8. Tools and Templates for Installation. Provide any mechanical systems or templates needed to set the joint system to the proper width.

9. Installation Requirements. Install the modular expansion joint system according to the manufacturer's shop drawings and instructions, this special provision, and as approved by the Engineer. The permanently installed joint system must match the finished roadway profile and grades. Ensure after the joint system has been permanently installed, a watertight test, as described herein, is performed.

10. Field Welding. Field welding of modular expansion joints is not permitted except as shown on contract plans. Field welding where permitted must be according to subsection 707.03.D.8 of the Standard Specifications for Construction and witnessed by the Engineer. If field welding is allowed to join together joints longer than 72 feet, ensure all field welding, non-destructive testing and galvanizing repair is completed before installing the joint in the bridge deck. Exceptions to this are part-width deck construction. Ensure non-destructive testing according to subsection 707.03.D.8 of the Standard Specifications for Construction is
witnessed by the Engineer a minimum of 24 hours after field welding has been completed. Ensure damaged areas and the field welded splice locations are cleaned and coated according to ASTM A 780 Zinc-Based Soldering Method (hot-stick). No additional compensation will be allowed for cleaning and coating but will be considered included in the contract unit price for this item.

11. Definition. The words "permanently installed" as used above is interpreted to mean that any work necessary to be done to any other part of the structure in order to achieve a truly complete permanent installation has been done. This will apply even if the other work is to be paid for under other items of the contract.

12. Concrete Placement. Place and finish the surrounding concrete, after the modular joint system has been set to its final line and grade, according to section 706 of the Standard Specifications for Construction. Prime all existing concrete surfaces, prior to concrete placement, with an approved concrete bonding agent. Finish the uppermost surface of the concrete placement as directed by the Engineer.

l. Watertight Integrity Test. Test the entire (full length) joint system for watertight integrity at least 48 hours after the joint system has been fully installed.

1. Test Method. Employ a method satisfactory to the Engineer. Cover the entire joint system with water, either ponded or flowing, for a minimum of 1 hour. Inspect the concrete surfaces under the joint during this 1 hour period and also for 1 hour after the supply of water has been stopped, for any evidence of dripping water or moisture. Water tightness is interpreted to be no free dripping water from any surface on the underside of the joint. Patches of moisture will not be cause for non-acceptance.

2. Leakage. Should the joint system exhibit any evidence of water leakage, the Contractor must locate the point(s) of leakage and take any and all measures necessary to stop the leakage as approved by the Engineer. This work will be done at the Contractor's expense.

3. Additional Tests. In the event that measures to eliminate leakage have to be taken, a subsequent water integrity test must be performed, subject to the same conditions as the original test.

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

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion Joint System, Modular, __ inch</td>
<td>.................................................................Foot</td>
</tr>
</tbody>
</table>

Expansion Joint System, Modular, __ inch will be measured in place by the foot along the centerline of the joint from edge to edge (face of parapet to face of parapet) of the joint system approved by the Engineer. All sliding plate assemblies at the sidewalks, parapets, and median barriers will not be measured for payment.

Modular Expansion Joint System, __ inch includes furnishing, delivering and installing the modular expansion joint system; furnishing and installing hardware and other accessories; development of shop drawings, working drawings and design calculations; testing; sampling; on
site supervision by and expenses for the manufacturer's technical representative; and providing all equipment, non-destructive testing, tools, material, labor and all other appurtenant and collateral work necessary to construct the modular expansion joint system as shown on the plans and as specified herein.

The contract unit price will also include field welding, field touch-up and coating, furnishing and installing all sliding plate assemblies at the parapets and median barriers, steel brackets at steel stringers and grouting as indicated on the plans and in this special provision.