097.13 DPWH
09-19-2013

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila

SEP 18 2013

DEPARTMENT ORDER)
No. 85)
Series of 2013) 09.19.13

SUBJECT : **Prescribing Guidelines on the Use of Expansion Joints in Bridges**

In order to ensure proper selection, installation, repair and maintenance of expansion joints in bridges, the attached **Guidelines On The Use of Expansion Joints in Bridges** is hereby prescribed for the guidance and compliance of all concerned.

This Order shall take effect immediately.

ROGELIO L. SINGSON
Secretary

Department of Public Works and Highways
Office of the Secretary
WIN3R00821

DPWH GUIDELINES ON THE USE OF EXPANSION JOINTS IN BRIDGES

1. Introduction

Generally, expansion joints for bridges are designed to provide for continuity between two parts of the structure which are in relative movements because of thermal deformations, creep, shrinkage and displacement/ deflection of the structure under traffic load.

The function of expansion joints is that joint should be capable of accommodating all movement of the deck mainly due to translation and rotation. In the process, it must not cause unacceptable stresses either in the joint itself or to the structure by way of restraint. Further requirements are on water tightness drainage, low noise level (especially in an urban environment) and good riding quality. Therefore bridge expansion joints should:

- permit the expansion/contraction of the span/spans to which it is fixed without causing any distress or vibration to the structure;
- cause no inconvenience/hazard to the road user and offer good riding comfort;
- be capable of withstanding the traffic loads including dynamic effects;
- be skid free and resistant to polishing of surface exposed to traffic; and
- ensure accessibility for inspections and easy maintenance with all parts vulnerable to wear being easily replaceable

2. Selection of Expansion Joints

Table 2.1 shall be used for selection of expansion joint types based on required direction/degree of movement and structural gap. It should be noted that the range and amount of movement, cross-sectional shapes, material components and applicability for the different types of bridge expansion joints may vary per manufacturer's specification subject to checking/ approval of the Engineer to conform to the approved plans.

Other factors such as cost, durability, difficulty/cost of repair/ maintenance and environmental aspects should be considered in selection of bridge expansion joints.

Table 2.1 Expansion Joints Selection Matrix

GAP (mm)	MAXIMUM MOVEMENT (mm)	TRANSVERSAL MOVEMENT (mm)	EXPANSION JOINT TYPE	GENERAL DESCRIPTION
Not exceeding 45mm	± 15	10	**Strip seal**	An elastomeric strip seal system consists of a preformed elastomeric gland mechanically locked into metallic (steel or aluminum) edge rails generally embedded into the concrete deck on each side of an expansion joint gap.
15 – 45	± 15	10	**Compression seal**	Continuous elastomeric sections (Generally the basic material is polychloroprene or otherwise known as Neoprene), typically with extruded internal web systems, installed within an expansion joint gap with metallic (steel or aluminum) mounts to seal the joint effectively against water and debris infiltration.
25 – 75	± 25			
30 – 90	± 30			
40 – 120	± 40			
50 – 150	± 50			
30 to 45	± 15	6	**Asphaltic Plug Joint**	Asphaltic plug joints combines an elastomer modified bitumen binder and selected single sized aggregates for the strength and flexibility of the joints. (Refer also to D.O. no. 23 series of 2006)
45 – 100	± 25	10		
50 – 100	± 25	10	**Rubber (Multiplex) Expansion Joint**	Molded elastomer elements, vulcanized and bonded to metal inserts designed to take up the running loads and distribute forces. They are subsequently connected to one another by a high quality adhesive to form a continuous, sealed and lasting sealing joint. The expansion joint permits movement of the structure by shear deformation of the rubber elements.
100 - 150	± 50	10		
50 – 100	± 50	10	**Steel Finger Type**	Galvanized steel or aluminum elements with 'tooth comb' shaped slender fingers in plan, which interlock with the opposing element, thereby providing a smooth transition over the large underside structure gap.
100 – 150	± 100			
150 – 200	± 150			
200 – 250	± 200			
More than 200mm	Varies	Varies	**Modular Expansion Devices**	Refer to Section 3.1 of this Guidelines

3. Installation Procedures

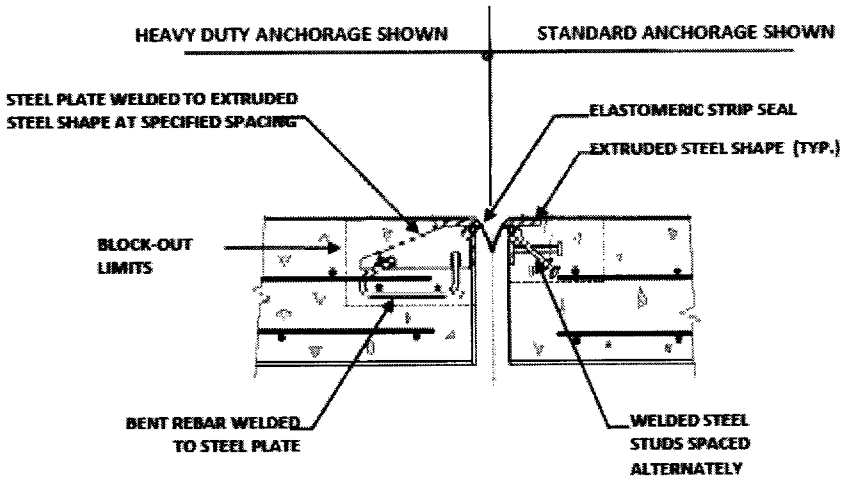
3.1. General

- Care shall be taken to ensure that all members are straight, flat and free from twists, bends, and distortions due to welding. The units shall be shop assembled and checked for matching of sliding surfaces, correct cross-fall and skew angle, as well as accurate positioning and alignment of supporting brackets.

- All metal surfaces to be galvanized shall be cleaned thoroughly of rust, rust scale, mill scale, dirt, paint, and other foreign material by commercial sand, grit or shop blasting, and pickling prior to galvanizing. Heavy deposits of oil and grease shall be removed with solvents prior to blasting and pickling.
- Matching expansion joints shall be assembled and bolted together for shipping. Expansion joint assemblies shall be match marked.
- The Contractor shall exercise care in the handling of all units to prevent twists, bends, and warping.
- The Contractor shall install expansion joints as shown on the Drawings and shall be responsible for the correct matching and seating of parts. The expansion joints shall be checked for accurate matching of sliding plates with the expansion joints installed at the specified skew angle and cross-fall.
- The preformed neoprene joint seal at each expansion joint unit shall be installed in accordance with the manufacturer's instructions and as one continuous piece after completion of all concreting operations. Joint seals shall not be installed prior to casting of the expansion joints into the concrete.

❖ *Important*: To ensure that expansion joints will not be affected with instantaneous dead load deflection which consequently cause tilting/ difference in level, it should be installed after curing of deck slab and removal of superstructure falsework (if any). Joints shall be anchored to slab rebars and poured with non-shrink concrete on blocked-out portion of slab as shown in the drawings.

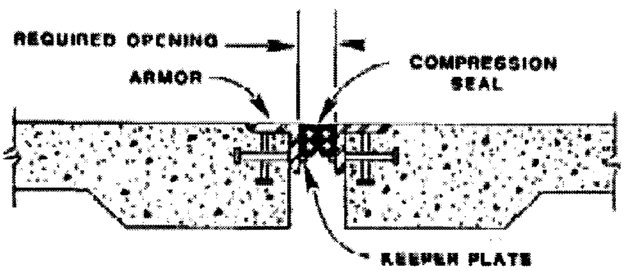
3.2. Strip Seal Joints



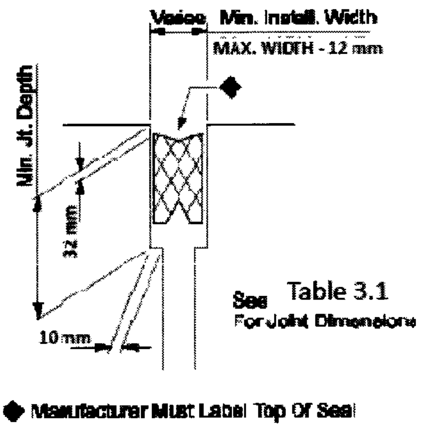
1) If the system is to be installed in sections, special care should be taken to the field weld details on shop drawings.
2) The Strip Seal joint system is lifted and lowered into final position. The steel edge members are suspended into the block out utilizing adjustable leveling devices.

3) Before securing or casting the system to the structure, the joint opening of the system should be adjusted to the proper ambient temperature.
4) Complete all bolted or welded connections to the superstructure. When casting the joint into the structure, proper compaction of concrete around the system is required.
5) The neoprene elastomeric gland should be field installed in continuous lengths spanning the entire roadway width. The lubricant- adhesive is brushed into the full perimeter of the gland cavity on the steel edge member prior to actual gland installation.
6) Clean all excess adhesive from the edges of the joint opening and from the top of the seal as soon as the installation is completed.

3.3. Compression Seal Joints



DETAIL SHOWN WITH ARMOR



DETAIL SHOWN WITHOUT ARMOR

Ease of installation is achieved using a lubricant-adhesive which as the name implies acts initially as lubricant then cures out to form an adhesive membrane between the contact faces of the angle and seal. This membrane together with the compressive action of the seal is designed to provide a waterproof joint interface.

1) Thorough cleaning of joint faces is essential. The joint opening must be abrasive blasted to remove all latencies and contaminants which may cause bonding problems; use a solvent on oily areas.
2) Measure and cut to exact length needed for continuous joint, being careful not to pull or stretch the seal. Stretching in excess of 5% is not permitted.
3) Require application of the manufacturer's lubricant-adhesive to the sides of the neoprene seal as well as the joint faces immediately prior to the installation of the compression seal. An adequate coating of the lubricant-adhesive is helpful in the installation. Wear appropriate safety gloves when handling lubricant-adhesive.

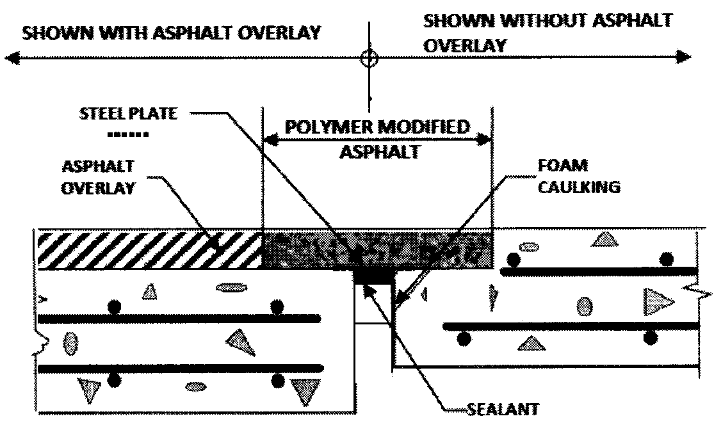
4) Compress seal and insert into joint opening. Proper installation tools consist of hand or machine tools that compress and eject the seal or weighed rollers that squeeze it in place. Screwdrivers, pry bars or other sharp ended tools which may puncture the seal are not allowed. Clean the excess lubricant from the top surfaces.
5) The seal should be installed below the finished surface and should never protrude above the joint edge. The minimum depth recess to top of seal is 6 mm. See the movement chart (Table 3.1) for proper groove depth.
6) Prior to shipping, all compression seals are to be labeled TOP SIDE by the manufacturer. Field installation reports indicate difficulty in determining top side for some types of seals. Also, the seal cross-section is not shown on a shop drawing unless the joint is armored.

Table 3.1 Approximate Compression Seal Dimensions (mm)

Seal Width	Seal Height	Minimum Joint Width	Maximum Joint Width	Minimum Installation Width*	Minimum Joint Depth
50	50 ±	25 ±	45 ±	32 ±	73 ±
55	65 ±	25 ±	50 ±	35 ±	80 ±
65	70 ±	32 ±	55 ±	40 ±	90 ±
75	85 ±	35 ±	65±	45 ±	110 ±
90	90 ±	38 ±	75±	55 ±	120 ±
100	115 ±	45 ±	90 ±	65 ±	140 ±

**This is the minimum practical limit as suggested by seal manufacturers.*

3.4. Asphaltic Plug Joints



1) Layout – In case the trenches are not preformed, joints are laid out on the site by locating the exact gap opening and measuring 250 mm on both sides from the center of the gap. The center of the layout shall be the center of the gap. Chalk marks both sides of the joint width. Cut the full depth using a concrete cutter. A strict minimum of 50 mm depth is observed. In case where there is wearing course and the thickness is less than 50 mm, the deck shall be chipped upon the approval of the engineer to attain the required depth. After cutting the full depth of the joint, break the joint location by using a jack hammer. Remove all broken slabs to open a trench. The side wall shall also be free from loose debris and shall at least be at right angle with the exposed deck.

2) Cleaning – Clean the trench thoroughly by using compressed air to remove all visible dusts. It is best to wire brush the sides of the trench as well as the deck to remove all loose particles.

3) Installation of Premoulded Joint Filler – Install compressible premoulded tuber type joint filler on the trench gap. Make sure that the premoulded expansion joint filler was installed approximately 25 mm below the deck level at 25% minimum compression to allow the binder to fill the top portion and prevent from falling.

4) Hot Air/ Flame Cleaning/ Pre-heating – The trench is then cleaned and pre-heated by using hot compressed air. This shall remove all remaining debris and will completely clean and heat the trench to prepare it for priming.

5) Priming – Heat the binder to its working temperature of 190 to 210°C. When the binder is ready for use, prime the trench with the binder. Ensure that all surfaces are evenly covered with binder. Ensure that the top of the premoulded expansion joint filler is also filled with binder up to the deck level.

6) Plating – Cover the top gap. Position the plate cover on the center of the gap and fix it with the locating pin. In small joint gaps, the primary purpose of the plate is to prevent the binder from continuously flowing to the gap during priming. However, in case where the joint gap exceeds 30 mm in width, the plate shall be of importance to distribute vehicular loading.

7) Plate Priming – Pour binder on top of the plate and ensure that all the surface of the steel plate including its sides is covered with binder.

8) Stone Laying – Prepare the pre-washed aggregates (normally gabbros of granite family), by putting it inside a mixing tub. Heat the aggregates while the tub is rotating until it reaches the working temperature of 150 to 180°C.

   - A premix of one layer of aggregates can be put in the trench. Rake the aggregates to spread it evenly on the trench. Make sure not to lay the stone more than 25 mm thick per layer.

- Aggregate size are normally 14 mm or 20 mm in diameter, depending on the size of the joint, pre-washed; clean and packed in 20 to 23 kg.

9) Binder Pouring – pour the binder on top of the stone layer. Rake the stones to spread it evenly on the trench. Ensure that each stone is covered with binder and the aggregates are in contact with each other. Pour binder to the trench and repeat stone laying ánd the binder pouring [process until the stone and binder layer are approximately 20 mm to 25 mm below the wearing surface.

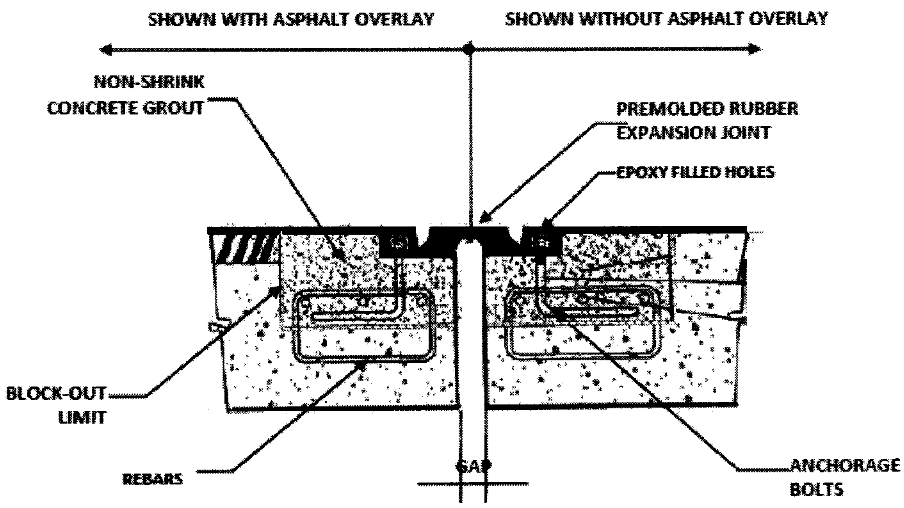
10) Topping – Prepare a premix of binder and stone in the tub on a 6:1 approximately proportion. Keep the mixing tub rotating while pouring the premix inside the tub. Make sure all aggregates are suitably covered with binder. Pour the premix on top of the joint to a level of approximately 20 mm above the wearing surface.

11) Compaction – Wait for the temperature to drop at about 80°C, then using a vibratory plate compactor, compact the finished expansion joint to level the joint with the wearing surface. Make multiple passes to ensure that the joint is properly compacted. This will prevent the joint from setting on the later stage after opening to traffic.

12) Top Screed Surface – After compaction, prepare a binder topping and pour the heated binder on top of the compacted joint. Wearing a heavy duty heat resistant hand gloves, manually screed the topping. Avoid too thick binder topping (recommended thickness is about 2 to 3 mm) and ensure that there are visible signs of stones after finishing the top screed. The top screed binder shall also serve as the waterproof top surface.

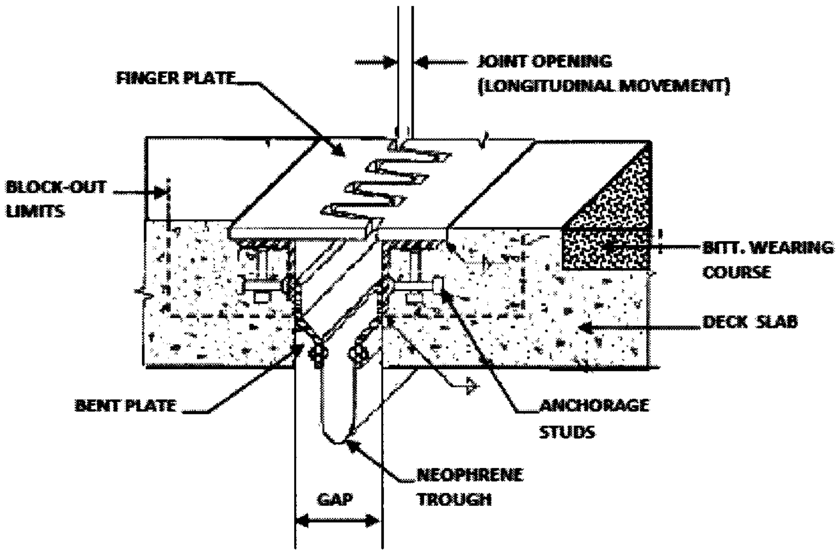
13) Cleaning – Clean the surrounding area and pour water on the finished expansion joint. Allow to cure for about 15 to 30 minutes depending on the ambient condition of the surrounding. The road could be immediately opened to traffic after cooling.

3.5. Rubber (Multiflex) Expansion Joints



1) Prepare the block-out area for the premoulded rubber joint assembly on both sides of the joint.
   - Pre-formed block-out area for new deck slab; or
   - Saw-cut and chip-off asphalt wearing course and concrete on existing deck slab.
2) Set the anchorage bolts.
   - Spot weld anchorage bolts on slab rebars to avoid movement during installation of rubber joint assembly and pouring of concrete grout, or
   - Drill holes to locate the anchor bolts. Expansion bolts or chemically grouted bolts can be used per manufacturer's specification.
3) Pouring of bottom non-shrink concrete layer.
4) Installation of rubber joint assembly making sure that it is in level with the roadway on both sides of the joint and follows the cross slope of the road section.
5) Pouring of side concrete.
6) Curing of concrete.
7) Application of epoxy resin to cover bolts

3.6. Steel Finger-Type Bridge Expansion Joints



1) Prepare and clean the block-out area for the steel finger-type joint assembly on both sides of the joint.
   - Pre-formed block-out area for new deck slab; or
   - Saw-cut and chip-off asphalt wearing course and concrete on existing deck slab.
2) Set the steel finger-type joint assembly, spot welding the anchor bolts or hoop type anchorage to the slab rebars to avoid movement during pouring of concrete grout. Make sure that both sides of the joint assembly are level with the roadway and follows the cross slope of the road section.

3) Pouring of non-shrink concrete on the block-out area up to the level of finger plates.

3.7. Modular Expansion Joints

3.7.1 Description

Modular expansion devices consist of molded elastomeric seals which are mechanically locked between steel separation beams. The name "Modular" is used due to the configuration which incorporates a series of standard units. Each unit can accommodate 75 mm of movement; up to 760 mm of movement normal to the joint can be provided. The separation beams are supported by individual support beams; welding provides a permanent contact. The support beam is held down by its extremities at the bearings and is seated within the support box. The support boxes are to be constructed with a minimum steel plate thickness of 13 mm.

The steel separation beams are spaced uniformly via a system of springs that counter the forces exerted on the seals. The springs are arranged such that they will be compressed when the joint is open and the seals are extended. They will relax as the elastomeric seals go into compression due to a rising temperature. Separation beams shall be designed for vertical load of AASHTO MS 18 (HS 20) Live Loading plus a minimum of 30 percent for impact and a horizontal load of 50% of vertical load. Specifications should include fatigue testing of weld details for separation beam to support beam connections.

The joint should be designed for 100,000,000 fatigue cycles. All joints should be tested and certified that they meet the loading requirements. Modular expansion devices are prefabricated as a single unit and transported to the site. Generally the anticipated joint opening is preset during fabrication and held in place with threaded rods. If the field temperature varies by more than 12^{o}C from the preset temperature; the joint opening is reset just prior to the closure pour. Refer to **Fig. 3.7-1** showing the strip-seal type neoprene gland element. The elastomeric neoprene box or strip seals are installed as one continuous length of any given joint application. In all cases, the modular expansion device is carried through the curb line without any change in direction and turned up at their extremities. Cover plates are detailed to cover and transition the gap on sidewalks rand other areas as needed.

Manufacturers recommend sizing the modular expansion device for the calculated movement perpendicular to the joint opening. Also, this recommendation is made for skewed structures. However, consideration should be given to selecting the next higher 75 mm capacity joint where skews are involved. This cost is nominal in comparison to the benefits gained from reducing the racking movement and stress in the seal parallel to the joint opening.

Research indicates that continuous modular expansion devices eliminate possible points of leakage by not having surfaces that have to be sealed. The higher installation costs of modular systems are offset by their greater capacity, improve performance, and reduced future maintenance costs.

Some construction details are recommended for long term performance of modular expansion devices. Minimum thickness of the separation beams, anchor beams and plates holding the equalizers is 19 mm. Full penetration welds should be used between the separation beams and individual support beams. All joined surfaces should be welded; this applies mainly to the support boxes. Use maximum spacing of 2.4 m to support the device during deck construction.

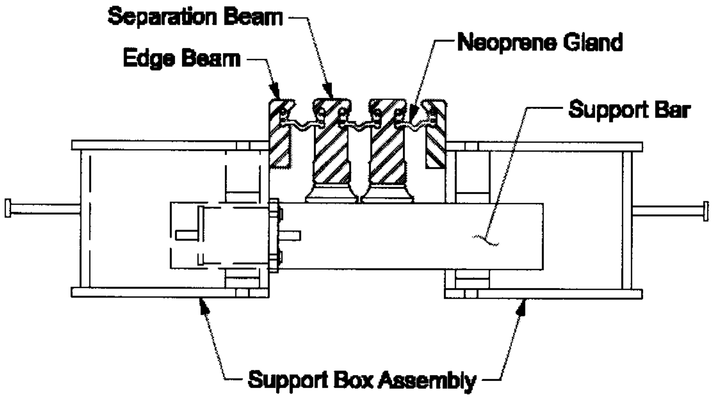


Fig. 3.7-1
Modular Expansion Device

3.7.2 Size Selection

The first consideration is the effective span length for computing total thermal movement at the given joint location. **Table 3.2** is established in accordance with AASHTO Specifications for a cold climate temperature range of -34° to 48°C, for steel girder structures. For local condition temperature rise and fall can be taken as +12.5°C. For preliminary design, maximum span lengths in Table 3.2 may be increased by 25 percent for multi-span pre-stressed girder structures taking into account the shortening due to creep and shrinkage of the concrete. The maximum expansion length, block out depths, and width requirements for a given joint size vary by manufacturer as the transverse separation beams vary in top flange width. Final construction details are to be as shown on approved shop drawings.

As an example, the size selection for steel girder structure having an expansion length of 220 m and a zero degree skew are the 3 cell models. However, the next size joint should be considered as it is desirable to allow 25 mm and preferably 50 mm extra movement for construction discrepancies. The strip-seal as an alternate sealing element has the advantage of being easier to install, allows a lower height of joint, and offers excellent tear resistance when reinforced.

After selecting the proper modular expansion device size, refer to Table 3.2 for the required clear opening between all flange tips at the mean temperature of 7.2°C. (Z = 1+2+3) Manufacturers of modular expansion joints recommend setting the joint opening just prior to completing the concrete pour.

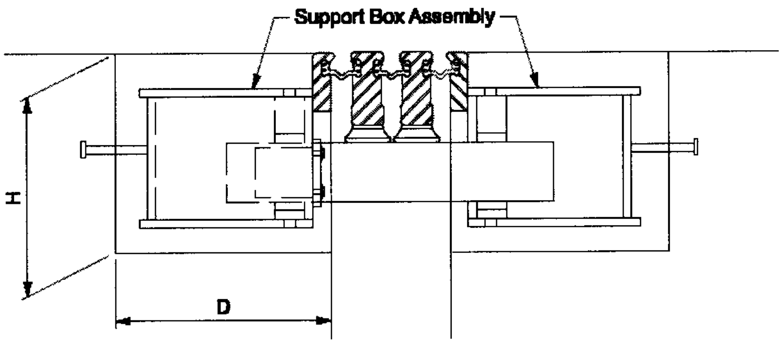


Fig. 3.7-2

Modular Expansion Device Dimensions

Table 3.2 Joint Clear Opening

Number of Cells	Max. Thermal Movement (mm)	Max. Expansion Length (m) Note 1.	Expansion Device Settings @ 7°C (mm) Z Note 2.	Standard Dimensions (mm) Note 2.	
				H	D
2	150	158	76	430 ±	457 ±
3	228	238	114	430 ±	533 ±
4	305	317	152	457 ±	635 ±

1. Maximum expansion range is based on steel girder structures in cold climate temperatures; -34 to 48°C.
2. The joint opening shown as Z for 7°C is taken at mean shaded underside of deck temperature normal to the joint for zero degree skew of structure. Separation beam flange widths vary between manufacturers and these values are given for total opening, actual dimensions shall be verified from manufacturer's standard details or shop drawings. See figure 28.5-2

Joint Performance

Currently the approved modular expansion devices with continuous neoprene seals and individual bearing support bars have performed well. From the maintenance standpoint, they are preferred over steel finger joints with troughs that require periodic cleaning. Galvanizing modular expansion joints is required due to the number of steel components subjected to chlorides and potential for corrosion. Strip seal joints require galvanizing too.

Joint cleaning and inspection/repair of the neoprene glands is imperative to insure long-term joint performance.

4. Repair and Maintenance

4.1. General

In conjunction with appropriate design procedures, the long-term performance and durability of expansion joint systems require the synergistic application of high-quality fabrication, competent construction practices, assiduous inspection, and routine maintenance. Expansion joint components and connections experience severe loading under harsh environmental conditions. An adequately designed system must be properly manufactured, installed, and maintained to assure adequate performance under these conditions. The importance of quality control must be emphasized.

Designers can provide valuable guidance to maintenance personnel with the goal of increasing service life. Manufacturers furnish designers and maintenance crews with guidelines and limitations for successfully designing and maintaining their products. In turn, designers and maintenance personnel provide feedback to manufacturers on the performance of their products and how they might be improved. Communication among disciplines is the key to improving long-term performance and durability

Defective/damaged expansion joints shall be repaired or replaced as the case maybe depending on the degree of damage. For joints which need to be replaced, the joint should be designed for movement of the bridge superstructure as called for in the original design.

When bridge overlaying or repair of existing wearing course is to be installed, the existing expansion joints should not be directly overlaid on top. In which case the joint shall be removed and replaced to be installed at the same level with the new wearing course.

Many existing bridges had unsealed joints. A simple gap in the deck accommodated small movements, while finger plate joints or similar systems such as sliding plate and saw tooth-plate joints accommodate larger movements. Water and debris simply fell through the joints which cause deterioration/corrosion of bearings and adjoining bridge members that lead to more serious structural problems. To catch water and debris that fall through them, open joints are provided with a neoprene trough (Fig. 4.1) and drainage system. But troughs tend to accumulate debris hence regular flushing and cleaning is necessary. Sealed type such as: asphaltic plug, compression seal and strip seal are practical alternatives for replacement or redesign of existing open joints.

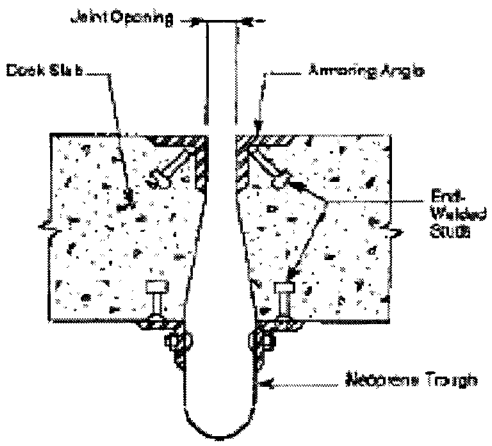


Fig. 4.1 TYPICAL NEOPRENE TROUGH FOR OPEN JOINTS

4.2. Deterioration Indicators

Although a deck joint system is often composed of a variety of materials (concrete, steel, aluminum, copper, plastics, neoprene, epoxy, etc.) with different physical and chemical properties, they all share a common fate: aging and deterioration. Starting with the day they are installed, the deck expansion joints are continually exposed to both natural elements and those introduced by humans. The combined effect of these elements on the joint components is a steady and unavoidable deterioration process. Therefore, deck expansion joint components should be carefully inspected to uncover the following common defects:

1) Loose, torn, split, cracked, damaged, or hardened seals.
2) Accumulation of debris and incompressible materials in the seals, drainage troughs, downspouts, and silting basins.
3) Loose, rusted, cracked, missing, or damaged steel plates, shapes, anchorage, bolts, nuts, and other metal components.
4) Cracked and spalled concrete, and rusted or exposed reinforcement, steel, or structural steel in the deck joint substrate.
5) Evidence of water leakage on the underside of the deck.
6) Evidence of noise during the passage of vehicles over the joints.
7) Restriction on freedom of joint movement.
8) Evidence of rotation, tilting, or settlement.
9) Incorrect joint opening or improper joint clearance and alignment.

The observed deterioration phenomena play a major role in establishing the deterioration curve of the expansion joint system. As a result, the cost-effectiveness of the various expansion joint systems on the market becomes the most important aspect in deciding which type to use. The difficulty arises from the fact that the service life of any system is affected to a noticeable degree by the level of service on the bridge, the environmental conditions in the area, and several other secondary parameters. The possible change in any of those parameters can affect the expected lifetime of the expansion joint system to varying degrees.

4.3. Strip Seal Joints

A sealed, waterproof joint system that uses steel plates and angles molded into neoprene covering to provide an anchorage and load transfer.

- Faulty section. Remove and replace.
- Manual removal of incompressible materials (dirt or debris) which tend to collect within the joint opening.
- Loose or broken bolts. Remove and replace broken bolts.

4.4. Compression Seal Joints

This is extruded neoprene with a cross-sectional design and elasticity to provide for retention of its original shape. Leakage is the most common failure associated with this joint sealant and requires replacement of the deficient seal over its entire length. If cold poured elastomeric sealants are approved for use, they make a desirable replacement for compression seals.

Maintenance

Manual removal of incompressible materials which tend to collect within the joint opening is desirable. However, in most cases this is not necessary since the tire forces the material against the elastic neoprene seal which rebounds causing the material to bounce up and out of the seal.

It is essential to the operation of the seal that no form of hot or cold joint filler be placed over the top of the seal. This includes resurfacing mats or overlays. The reasons are as follows:

- Hot fillers may either melt the seal or seriously affect the elastomeric properties for future performance.
- The filler acts as a constant media of transmitting undue vertical tire forces to the compression seal which may break the interface bond.

4.5. Asphaltic Plug Joints

The joint and transition strips should be approximately level with the adjacent deck surfaces to provide good ride quality. If the surface adjacent to a failed joint deteriorates, both the joint and the deteriorated surfacing should be replaced to improve ride quality and overall durability.

4.6. Steel Finger-Type Joints

Interlocking steel fingers attached to a steel plate allow longitudinal deck movements.

- Clogged joint and drain trough. Frequently flush and clean the joint and drainage system to remove debris accumulation in the system. This will also help prevent corrosion (expansion joint & adjacent steel members) and concrete deterioration.
- Loose joints. Remove loose or faulty bolts or rivets, reposition the expansion device, and rebolt. It may be necessary to countersink the bolts or rivets to avoid future problems.
- Broken finger joints. Weld replacement fingers onto the joint.
- Fingers closed. Trim the expansion fingers or remove the system, reposition, and reinstall.

All sealer materials are required for testing prior to installation and shall be witnessed by representatives from the DPWH Implementing Office.

Shop Drawings for all expansion joints (except poured rubber seals and open joints) should be submitted to the implementing Office concerned for approval prior to the construction.

Warranty clauses in the contract should be required for the Contractor/Manufacturer to enhance the quality of expansion joint installed.

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