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A COMPLETE RANGE OF EXPANSION JOINTS FOR BRIDGES AND OTHER STRUCTURE

Goodco Z-Tech expansion joints were developed to enable structures to move freely while ensuring the deck’s watertightness. The joints are designed to accommodate movements caused by thermal expansion, concrete creep and shrinkage, as well as movements caused by passing vehicles, such as rotation and breaking. The technical solutions offered by Goodco Z-Tech will help maintain the flexibility of the structure at all times.

MODULAR JOINTS – SERIES 2000

Series 2000 modular joints have proven their effectiveness in hundreds of installations over the years. This joint system, which ensures the continuity of the road surface while maintaining a watertight seal during large structural movement (more than 100 mm), has been in use in Canada for more than 30 years. Goodco Z-Tech has created modular joints that meet the most recent internationally recognized standards and can adapt to extreme operating conditions and complex geometries. Series 2000 modular joints can be used on any type of bridge deck under construction or rehabilitation and are easily adaptable to large skew. Additionally, Goodco Z-Tech modular joints can be designed to withstand movement caused by an earthquake without permanent damage.

When anticipated movement are smaller than 100 mm, the use of Series 1000 or 1100 expansion joints is recommended.

FEATURES

- Locked-in strip seal
- Simple installation and replacement of strip seals
- Total watertightness
- Custom-designed anchoring system
- Resistance to snow removal equipment
- Protection against corrosion
- Easily replaceable components

One of the six, 23-m long modular joints installed on the Burlington Bay Skyway Bridge, located between Burlington and Hamilton, Ontario.

Figure 1: Isometric view of an LG-3 joint
CHARACTERISTICS AND COMPONENTS

Series 2000 modular joints use a set of strip seals locked into centre beams and edge beams to allow for greater deck movement than traditional joints.

The centre beams are fitted with welded stirrups, in which the support bars slide with the help of low-friction sliding interfaces. Each support bar rests on sliding bearings inside support boxes, these boxes are supported in the structure’s headers.

An equidistance system enables the openings between each module to remain equal during use. This system ensures proper functioning and better durability of the joint, as the entire system undergoes movement in a similar way.

WATERTIGHT STRIP SEAL

The extruded LS-5 strip seal, made of high-strength neoprene, locks into the centre beams and edge beams to ensure that the system is completely watertight, even under harsh conditions with extensive use of de-icing agents. Their shape allows for full closure between each centre beam. The strip seal is installed using a water soluble lubricant and requires no adhesive to ensure watertightness.

When their length permits it, strip seals are typically shop-installed on modular joints but they may also be installed or replaced on site. Although these strip seals are highly durable, they may need to be replaced in the event of an accident. This can easily be done at any time on site, with no need for concrete demolition or complete replacement of the joint.

ANCHORING SYSTEM

As Series 2000 modular joints are custom designed for each project, design engineers have the option of selecting or designing the anchoring system that best serves their needs for the desired application. You will find in this brochure various types of anchoring systems designed to offer proper resistance and good protection against damage caused by snow-plow blades.
**CHARACTERISTICS AND COMPONENTS**

**MOVEMENT**

Series 2000 modular joints can accommodate movements and rotations along the three major axes.

![Figure 3: Movement and rotation permitted by a modular joint](image)

**SEISMIC MOVEMENT**

Modular joints can be designed to accommodate transverse seismic movement and can even exceed the maximum allowable service displacement in the event of an earthquake. By using easily replaceable components, the joints can be designed to be resistant to significant seismic movement without suffering permanent damage. This way, the bridge can be opened to traffic immediately following an earthquake. After the adjustment or replacement of certain components, the joint will return to its original watertightness and performance.

![Final assembly of a six-module joint after galvanizing](image)

**COMPONENTS**

- **Figure 4: Centre beam**
- **Figure 5: Edge beam**
- **Figure 6: Alternative edge beam**
- **Figure 7: Support bar**
- **Figure 8: Alternative support bar**
- **Figure 9: LS-5 strip seal**
A modular joint’s maximum movement is dictated by the number of strip seals it has and the maximum movement of each of those strip seals. The LS-5 strip seal permits a maximum allowable opening of 80 mm at serviceability limit states and full closure between the centre beams. Table 1 shows the minimum and maximum openings and important dimensions for a Type LG modular joint, in accordance with the CAN/CSA-S6 code. These dimensions may be larger depending on a project’s particular conditions, such as a special anchoring system offering protection against snow-plow blades or an earthquake-resistant modular joint. While the table of openings is limited to 10 strip seals, modular joints with a greater number of strip seals are available. Please contact us for more information.

**TABLE OF OPENINGS**

**Figure 10: Typical dimensions for a Type LG modular joint**

**TABLE 1**

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of strip seals</th>
<th>Total movement</th>
<th>Minimum opening at SLS Jmin</th>
<th>Maximum opening at SLS Jmax**</th>
<th>Support box (mobile side) B1</th>
<th>Support box (fixed side) B2</th>
<th>H Total height</th>
</tr>
</thead>
<tbody>
<tr>
<td>LG-2</td>
<td>2</td>
<td>160 mm</td>
<td>81 mm</td>
<td>241 mm</td>
<td>330 mm</td>
<td>145 mm</td>
<td>323 mm</td>
</tr>
<tr>
<td>LG-3</td>
<td>3</td>
<td>240 mm</td>
<td>162 mm</td>
<td>402 mm</td>
<td>415 mm</td>
<td>145 mm</td>
<td>323 mm</td>
</tr>
<tr>
<td>LG-4</td>
<td>4</td>
<td>320 mm</td>
<td>243 mm</td>
<td>563 mm</td>
<td>495 mm</td>
<td>145 mm</td>
<td>323 mm</td>
</tr>
<tr>
<td>LG-5</td>
<td>5</td>
<td>400 mm</td>
<td>324 mm</td>
<td>724 mm</td>
<td>570 mm</td>
<td>145 mm</td>
<td>323 mm</td>
</tr>
<tr>
<td>LG-6</td>
<td>6</td>
<td>480 mm</td>
<td>405 mm</td>
<td>885 mm</td>
<td>650 mm</td>
<td>145 mm</td>
<td>346 mm</td>
</tr>
<tr>
<td>LG-7</td>
<td>7</td>
<td>560 mm</td>
<td>486 mm</td>
<td>1046 mm</td>
<td>730 mm</td>
<td>145 mm</td>
<td>346 mm</td>
</tr>
<tr>
<td>LG-8</td>
<td>8</td>
<td>640 mm</td>
<td>567 mm</td>
<td>1207 mm</td>
<td>815 mm</td>
<td>145 mm</td>
<td>346 mm</td>
</tr>
<tr>
<td>LG-9</td>
<td>9</td>
<td>720 mm</td>
<td>648 mm</td>
<td>1368 mm</td>
<td>895 mm</td>
<td>145 mm</td>
<td>346 mm</td>
</tr>
<tr>
<td>LG-10</td>
<td>10</td>
<td>800 mm</td>
<td>729 mm</td>
<td>1529 mm</td>
<td>970 mm</td>
<td>145 mm</td>
<td>346 mm</td>
</tr>
</tbody>
</table>

* See the following page for openings allowed by the Ministry of Transportation of Ontario.
** The maximum opening may be larger at the ultimate limit states (ULS).

These dimensions are based on standard details and are provided solely for information purposes. Bridge skew and seismic considerations may change these values. Please contact our experts to determine the modular joint’s dimensions according to your project specifications.
Joints are manufactured to match perfectly the structure’s profile, enabling surface water to remain on the deck so that it can be directed toward the drainage systems designed for this purpose.

**TYPE LG JOINT (MTQ)**

The modular joints developed to meet the MTQ’s requirements use plates to protect against damage caused by snow-plow blades.

**TYPE LG JOINT (MTO)**

The modular joints approved by the Ministry of Transportation of Ontario (MTO) are equipped with an epoxy injection system. The injection is performed after the joint’s headers have been concreted. It fills the voids under the angles and seals cracks that may have developed during concrete curing. This system may be implemented for other types of Goodco Z-Tech modular joints.

**TABLE 2**

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of strip seals</th>
<th>Total movement</th>
<th>Minimum opening at SLS (J_{\text{min}}^*)</th>
<th>Maximum opening at SLS (J_{\text{max}}**)</th>
<th>Support box (mobile side) B1</th>
<th>Support box (fixed side) B2</th>
<th>(H) Total height</th>
</tr>
</thead>
<tbody>
<tr>
<td>LG-3</td>
<td>3</td>
<td>135</td>
<td>267</td>
<td>402</td>
<td>675</td>
<td>350</td>
<td>355</td>
</tr>
<tr>
<td>LG-4</td>
<td>4</td>
<td>180</td>
<td>383</td>
<td>563</td>
<td>760</td>
<td>350</td>
<td>355</td>
</tr>
<tr>
<td>LG-5</td>
<td>5</td>
<td>225</td>
<td>499</td>
<td>724</td>
<td>835</td>
<td>350</td>
<td>355</td>
</tr>
<tr>
<td>LG-6</td>
<td>6</td>
<td>270</td>
<td>615</td>
<td>885</td>
<td>915</td>
<td>350</td>
<td>380</td>
</tr>
<tr>
<td>LG-7</td>
<td>7</td>
<td>315</td>
<td>731</td>
<td>1046</td>
<td>995</td>
<td>350</td>
<td>380</td>
</tr>
<tr>
<td>LG-8</td>
<td>8</td>
<td>360</td>
<td>847</td>
<td>1207</td>
<td>1075</td>
<td>350</td>
<td>380</td>
</tr>
</tbody>
</table>

* The minimum opening may be smaller at the ultimate limit states (ULS).
** The maximum opening may be larger at the ultimate limit states (ULS).

These dimensions are based on standard details and are provided solely for information purposes. Bridge skew and seismic considerations may change these values. Please contact our experts to determine the modular joint’s dimensions according to your project specifications.
TROUGHS

The modular joints can be equipped with a trough, providing a second watertightness barrier. The trough can also help reduce ambient noise from the passage of vehicles.

ALTERNATIVE ANCHORING SYSTEM

Fusion-welded studs can also be used as a concrete anchoring system.

JOINT COVER PLATES

It may be important to cover the joint using a plate in some applications, for example at pedestrian crossings or to preserve the continuity of sidewalks, curbs or concrete barrier walls. In those situations, joint cover plate systems can be added to the expansion joints. These plates are bolted down to allow for the installation and replacement of strip seals. Plates with non-skid patterns are available.
CONNECTIONS

If the bridge’s geometry does not allow for a modular joint to be delivered in a single section, or if the joint must be coordinated with phase work, modular joints can be provided in several sections that will be spliced on site. In these cases, we recommend installing temporary strip seals at the shop to protect the joint’s sliding and equidistance components, unless effective protection is ensured on the job site at all times. When the work is finished and all sections of the joint are installed, the full-length permanent strip seals are installed.

The splice between two joint sections has been specifically designed to be resistant to repetitive loading cycles that may cause fatigue failure. The connection is made using a combination of bolting and welding. Splice plates with A325 bolts and welding along the full thickness of the top flanges help make a strong connection across the centre beams.

Figure 19: Splice of a Series 2000 joint

Figure 20: Detail of welds (end view)
TYPE LX JOINT FOR REDUCED HORIZONTAL SPACE

The symmetric Type LX joint is used when horizontal space is limited on both sides of the joint. Movement is spread equally on each header by using a centre beam that is welded by a complete penetration weld to the support bar.

LATERAL SEISMIC MOVEMENT

When the structure may be subjected to lateral movements, as in the case of significant seismic movement, the joint is designed with special features, including trapezoidal support boxes that allow for lateral movement on both sides. Furthermore, the support bars can be extended to ensure continuity of the deck when the seismic movement exceeds the 80 mm limit per strip seal (at ultimate limit state).

TYPE LR JOINT FOR REDUCED VERTICAL SPACE

The Type LR joint is used when vertical space is limited. It is ideal in cases of rehabilitation, where the bridge deck is relatively thin.

The geometric characteristics of a structure may make adjustments necessary. A skew, an orthotropic deck or ducts can all be taken into consideration in the design and fabrication of Goodco Z-Tech modular joints. Please contact us.
Since modular joints withstand repeated wheel loads during the passage of vehicles, they are particularly prone to fatigue. The durability of the components that are most susceptible to fatigue failure has thus been studied based on our experts’ experience and in accordance with current international standards with several tests.

The fatigue resistance of the centre beam/support bar assembly has been tested in accordance with the recommendations of the National Cooperative Highway Research Program’s *Fatigue Design of Modular Bridge Expansion Joints* (NCHRP 402, 1997) and Section 14.5.6.9 of the 2007 *AASHTO LRFD Bridge Design Specifications* by the École de technologie supérieure (ÉTS) at the Université du Québec à Montréal. This study concluded that the fatigue resistance of the stirrups and other welded components matches AASHTO’s Category C details. Additional studies at fatigue and ultimate limit states on the stirrups, equidistance system and sliding interfaces have also been conducted to verify long-term performance and optimize the design of Goodco Z-Tech modular joints.

![Test set-up at the ÉTS during fatigue testing in accordance with NCHRP-402](image1)

![Instrumentation of the tested specimen](image2)

**S-N curves for stirrup details**

![S-N curves for stirrup details](image3)
INSTALLATION

As the modular joint is comprised of several mobile pieces that must work together to ensure the bridge’s continuity, its installation must be performed meticulously and in accordance with good industry practices. We strongly recommend that installation be performed by our team of specialized technicians. They conduct a full inspection of the joints before and after concreting in order to ensure the joint’s proper functioning and watertightness.

The joint must be positioned in its block-out and aligned according to the bridge deck’s geometry. If the joint is delivered in several sections, splice plates and seal welds ensure the joint’s structural continuity.

After the joint has been adjusted, the concrete can then be poured and construction on the bridge can continue. After the concrete is poured, the full-length strip seals are installed, and water tests are performed if required.

We recommend that a surveyor be on site when adjustments are made to the joint.
To view the detailed procedure for installing a modular joint, visit our website at www.canambridges.com/jointsinstallation
The epoxy injection process, as required by the Ministry of Transportation of Ontario, helps fill voids under the angles and seal cracks that may have developed during concrete curing. The injection is done before the water test. The injection process is described in more detail in our brochure on Series 1100 (Goodflex) expansion joints. For more information on the epoxy injection system, please also refer to page 7 of this brochure.

To view the detailed procedure for installing a joint with the epoxy injection system, visit our website at www.canambridges.com/jointsinstallation
Installation of an LX-14 modular joint in the orthotropic deck of a suspension bridge.

Goodco Z-Tech provided eight pot bearings, eight self-lubricating bronze spherical bearings (installed under the inclined legs) and two LG-3 modular joints for this bridge.

Goodco Z-Tech provided four LG-6 modular joints and two LG-4 modular joints for this bridge.

Goodco Z-Tech provided 60 laminated elastomeric bearings, 4 laminated elastomeric seismic isolators and 2 LG-5 modular joints during the rehabilitation of this bridge.

18 LG-3 joints were provided during the construction of this bridge.

Goodco Z-Tech provided single cell joints, an LG-4 joint, an LG-6 joint and an LG-7 joint for this bridge.

Serge-Marcil Bridge, Highway 30 – Les Cèdres/Salaberry-de-Valleyfield, QC

Laviolette Bridge – Trois-Rivières, QC
QUALITY COMMITMENT

QUALIFICATIONS

Our team of engineering and technical drafting professionals has in-depth knowledge of 3D software tools, such as SolidWorks and Tekla Xsteel.

W59: Welded Steel Construction (Metal Arc Welding)

W47.1, Division 1: Certification of Companies for Fusion Welding of Steel Structures

W186: Welding of Reinforcing Bars in Reinforced Concrete Construction

Our products are designed and manufactured using state-of-the-art equipment, handled by a skilled and experienced team.

Our teams of specialized technicians install strip seals on the job site. We also offer a comprehensive joints installation service.

Our stringent quality control process results in products that meet our clients’ highest expectations.

Engineering, Drafting CAD

Manufacturing

Quality Control

Installation
With more than 60 years of experience, Goodco Z-Tech is the leading Canadian manufacturer of structural bearings and expansion joints. Supported by a highly skilled and competent team who work with state-of-the-art equipment, Goodco Z-Tech designs and fabricates a broad range of products for highway and railway bridges, and other structures. Goodco Z-Tech works closely with Canam-Bridges, a North American leader in the design, fabrication and construction of steel bridges.