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Dimensions

All distance dimensions in this catalog are in MM (millimeter) only. Other units are denoted in metric system.

Drawings and illustrations

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General information about Bridge Expansion Joint

Introduction

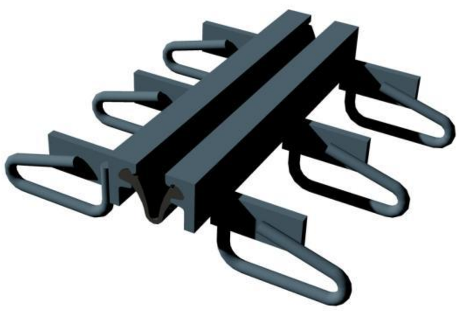
Bridge expansion joints are essential components that ensure uninterrupted traffic flow between structures while accommodating movement caused by shrinkage, temperature variations, and other forces in reinforced and pre-stressed concrete, composite, and steel structures. These joints play a critical role in distributing loads and ensuring safety over gaps between bridge decks or abutments.

In addition to their structural function, expansion joints must minimize noise, particularly in urban settings. Water tightness is also crucial to prevent water ingress into the substructure. Design considerations should aim for ease of replacement with minimal disruption to traffic.

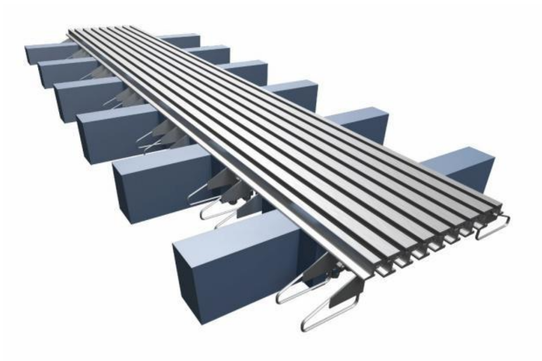
Types of Expansion Joints

Various types of bridge expansion joints accommodate movements ranging from 10 mm to 2,000 mm or above. The following six major types of expansion joints are part of IEC's supply scope:

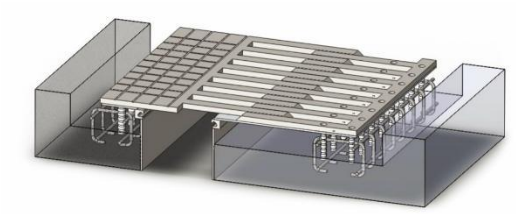
1. **Stripseal Joint (Single-Gap or Nosing Joint)**
2. **Modular Expansion Joint (MBJS as per AASHTO)**
3. **Finger Expansion Joint**
4. **Mat Expansion Joint (Reinforced Rubber)**
5. **Asphaltic Plug Expansion Joint**
6. **Railway Expansion Joint**



Stripseal expansion joint



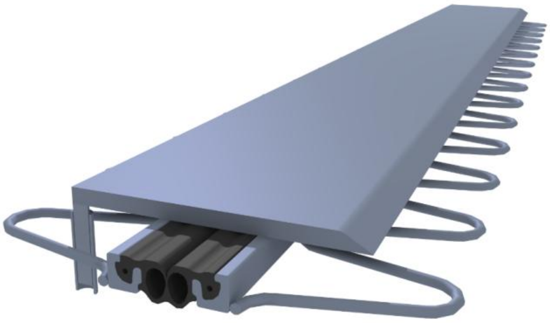
Modular expansion joint



Finger expansion joint

Mat expansion joint (Reinforced rubber)

Flexible Plug Expansion Joint

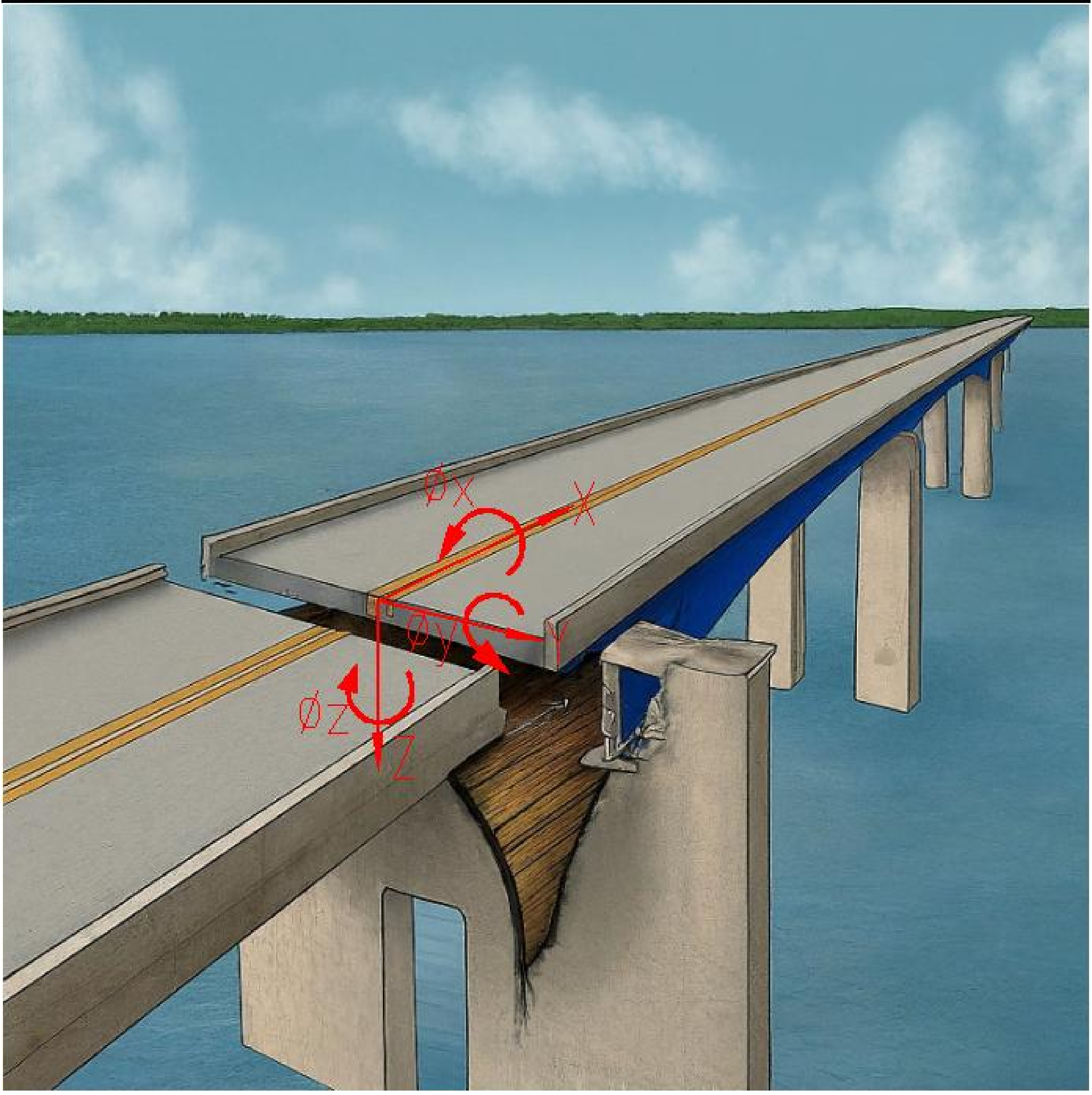


Railway expansion joint

Calculation of movements of expansion joint

The movement of expansion joints depends on bridge size and bearing arrangement. Typically, joint design focuses on horizontal translation orthogonal to the joint. However, all translations and rotations must be considered to ensure displacements remain within the joint's limits.

Movement can result from temperature variations, external loads, and the natural shrinkage or creep in concrete or composite structures. These movements should be calculated during the structural analysis phase and are generally the responsibility of the consultant or designer.



An illustration showing the location and function of bridge expansion joint
(permissible movement/rotation in 6 degrees)

Corrosion prevention

Corrosion prevention is vital for ensuring the longevity of expansion joints and protecting the entire bridge structure. At IEC, standard corrosion prevention procedures for stripseal, modular, or finger joints include:

- **Exposed Steel Surfaces**:
  - Blast cleaning to Swedish Standard SA2.5 for derusting
  - Hand cleaning to remove dirt, rust, mill scale, or oil stains
  - Coating applications:

    1.Primer: Zinc-rich epoxy paint (min. 60 µm)
    2.Final coat: Acrylic aliphatic polyurethane paint (min. 80 µm, applied 2-3 times)
    3.Total dry film thickness: 240-320 microns (finish coat: 60 microns)

- Coating color per RAL 7042 unless otherwise specified
- **Hot-Dip Galvanizing**: Available upon request according to ISO 1461:2009 standards, or as part of a duplex system for added reliability.

- **Non-Exposed Steel Surfaces**:
  Similar procedures as for exposed surfaces, but with two coatings and a minimum thickness of 120 microns.
- **Temporary Devices**:
  Epoxy paint (min. 50 µm) applied post-shot blasting, with colors such as blue or red.
- **Bolts**: Treated with Dacromet.

Painting of modular expansion joint at IEC workshop for NOH2 project in Doha Qatar, 2018

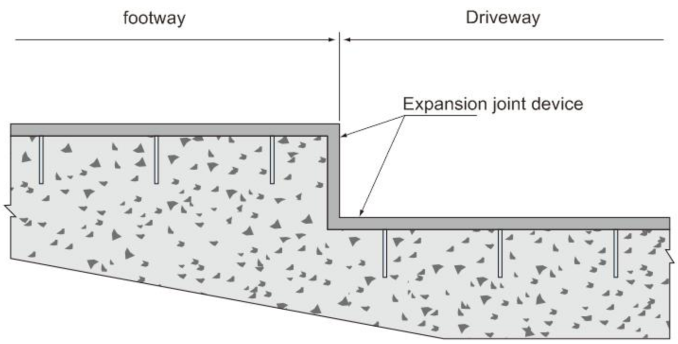
Painting of finger expansion joint at IEC for Tama Bridge over Nile, Egypt, 2019

paint film thickness 243 microns (C5-MI) for E-ring road project in Doha Qatar, 2018

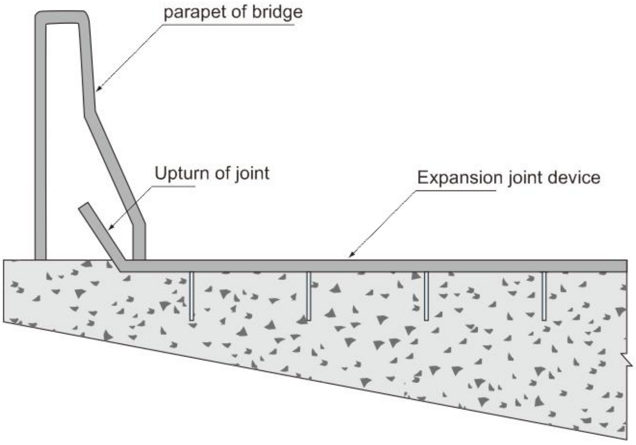
Hot-dip-galvanized treatment for NOH2 project in Doha Qatar, 2019

Sidewalk and parapet design

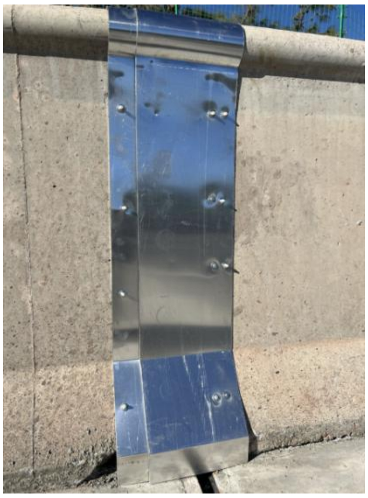
Many joints must be designed to integrate with sidewalks or parapets. For modular joints, an upturn design allows them to extend into parapets or sidewalks.



Upturn design of modular joint so they can extend upward into parapet or sidewalk



how the upturn extends into the reserved void in the parapet



Cover plate over the modular expansion joint in the parapet area

To ensure a safe passage for pedestrians or cyclists, a thin galvanized steel cover plate is installed over the expansion joint on sidewalks. This plate is bolted on one side, allowing the other side to move freely and accommodate expansion.


A typical design of a cover plate for the sidewalk area over the expansion joint upturn

For detail designs, consult IEC specialist engineer.

Handling, packaging and storage

Bridge expansion joints are protected during transit and storage. Proper lifting methods, including the use of cranes for strip and modular joints and forklifts for finger joints, ensure safety and prevent damage. Joints should be stored in clean, dry environments free from contaminants.

Packed for Irbid Ring, Amman, Jordan, 2016

Packed inside container for Rayyan Road, Qatar, 2021

Packed in closed wooden/steel case or frame for container loading

Applied codes/standards

IEC's expansion joints are designed to meet load requirements as specified by various international standards, including:

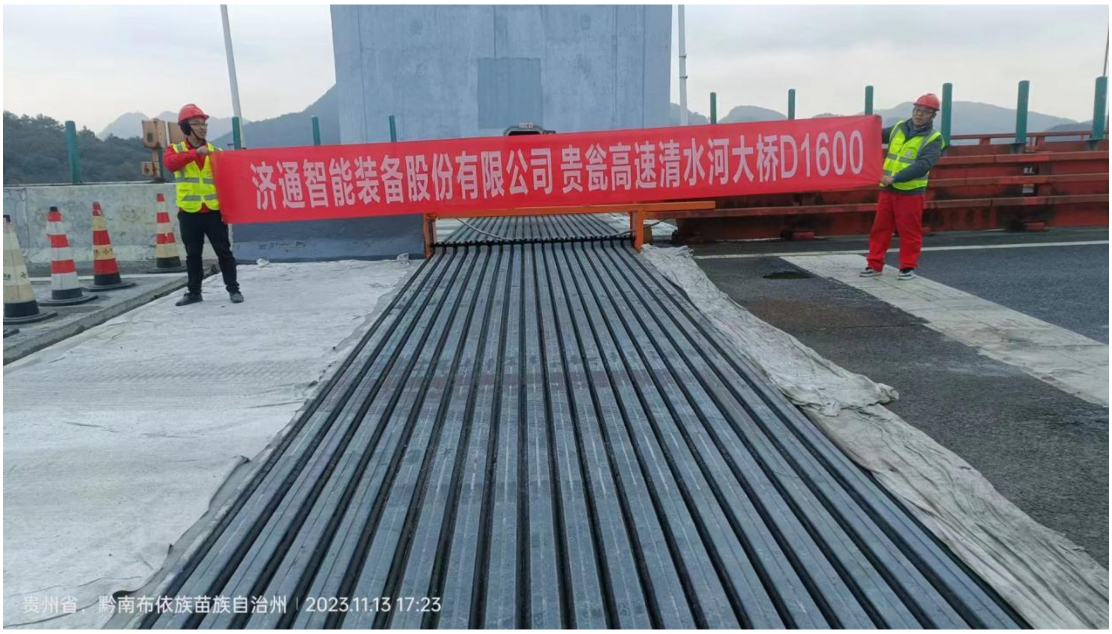
- Chinese Specifications JT 723-2018
- AASHTO LRFD
- European Standards (ETAG 032 or superseded versions)
- Indian Standards (IRC:SP:69-2011)
- BD 33/94 Specifications

IEC's expert engineers are capable of customizing designs to meet unique project specifications.

Installtion&Maintenance

The installation and maintenance processes for various types of expansion joints share some commonalities but also exhibit significant differences. For detailed guidance tailored to your specific needs, consult IEC engineers.

Modular Bridge Joint System (MBJS)



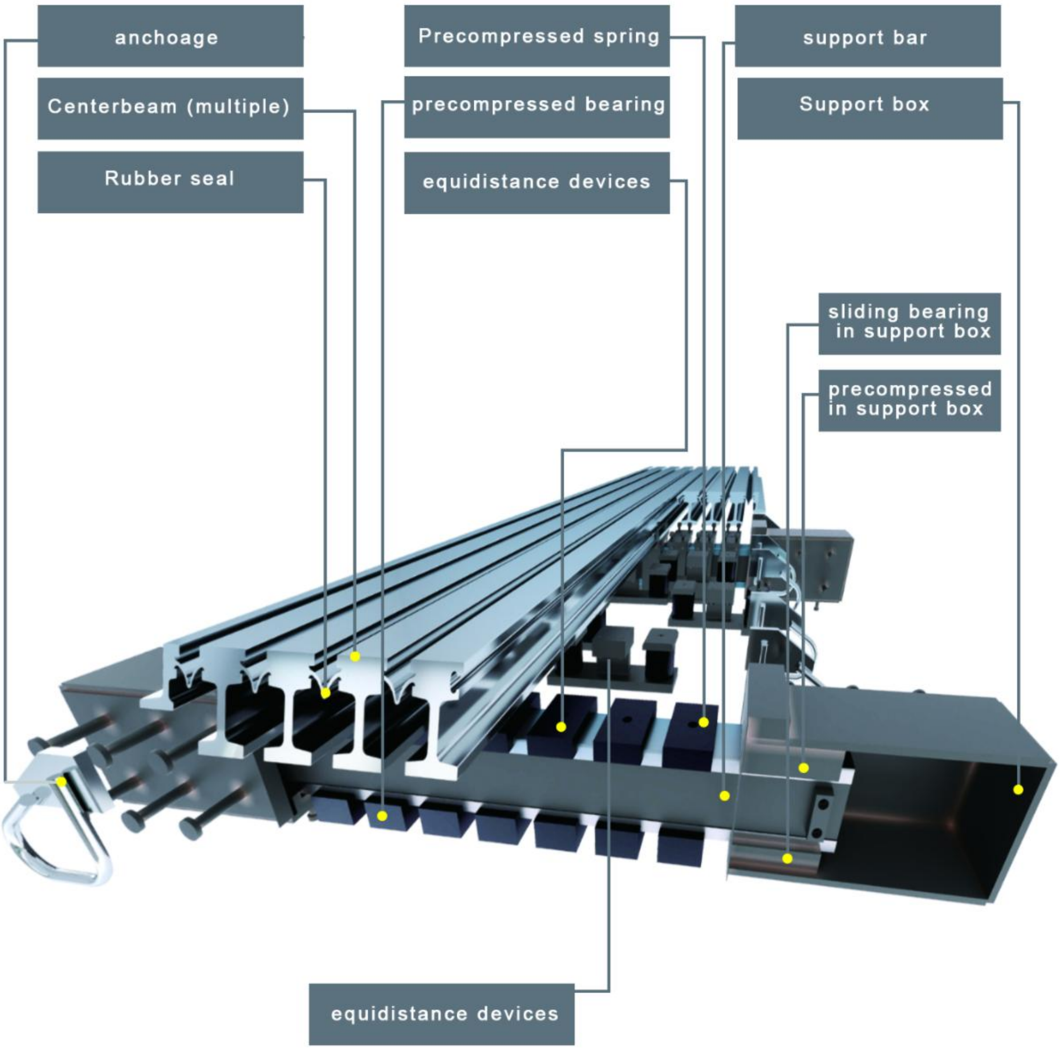
20-cell modular expansion joint fabricated and installed by IEC in Qingshuihe bridge, Guizhou Province, Southwest China in 2024

1. design principle

The Modular Bridge Joint System **(MBJS)** is designed to accommodate both movement and rotation between adjacent bridge elements when the movement exceeds the capacity of a strip seal or finger joint. The system divides the total movement into several individual gaps using horizontal surface beams called centerbeams. In addition to supporting wheel loads, a well-designed modular joint also prevents water and debris from draining onto the substructure.

According to AASHTO LRFD Bridge Design Specifications, modular joints are classified into Multiple-Support-Bar (MSB), Single-Support-Bar (SSB), and Swivel types. MBJS can be customized to meet different load and movement requirements. For typical applications, where excessive transverse or vertical movement is not required, IEC uses the MSB system for movement ranges up to 320 mm (4-cell modular joint). For larger movements, the SSB system is used.

As per EOTA EAD 120113-00-0107 and AASHTO LRFD standard , the maximum movement per cell is regulated to 80 mm. Therefore, the total movement capacity of a MBJS is determined by multiplying the number of cells by 80 mm.

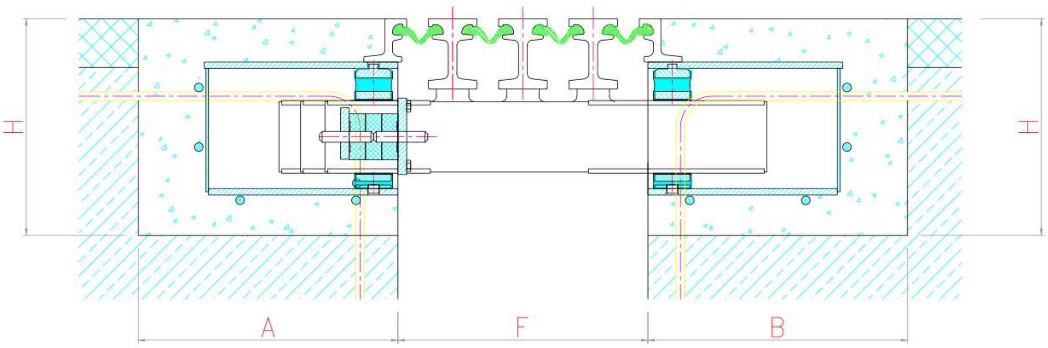


A typical schematic illustration of MSB structure

2. Movement capacity

IEC adopts the MSB structure for modular joints which are 2-cell, 3-cell and 4-cell with the convention design to meet the longitudinal movement while limited transversal and vertical movement or rotation is allowed. For larger transversal and vertical movement, Consult IEC expert on project basis.

Below images are tables reflect the structure and key dimensions. Special designs according to actual project situation are also available. Thus such dimension are subject to change. Consult IEC expert for details.



A section view showing the denotations for the key dimensions for MSB structure

Type	Design longitudinal movement(mm)	A(mm)	B(mm)	F_{min}(mm)	F_{max}(mm)	H(mm)
DSB-M-160	0~160	350	350	110	270	350
DSB-M-240	0~240	420	420	190	430	400
DSB-M-320	0~320	480	480	280	600	400

Key dimensions for MSB structure DSB-M series

2.2 SSB structure

For 5-cell and above joints, SSB structure is used, allowing movements and rotation in every direction if necessary. The elastic control system can accommodate large transverse and vertical movement without developing constrain forces.

The maximum movement capacities and the main required dimensions of the block-out (recess) in the bridge structure for the installation of various sizes of expansion joint are provided in the table below.

A section view showing the denotations for the key dimensions for SSB structure

Type	Design longitudinal movement(mm)	B(mm)	A(mm)	F_{min}(mm)	F_{max}(mm)	H(mm)
DSB-400	0~400	640	300	380	780	360
DSB-480	0~480	720	300	422	902	400
DSB-560	0~560	800	300	510	1070	450
DSB-640	0~640	880	300	590	1230	500
DSB-720	0~720	960	300	670	1390	500
DSB-800	0~800	1040	300	750	1550	500
DSB-880	0~880	1120	300	830	1710	500

DSB-960	0~960	1200	300	910	1870	550
DSB-1040	0~1040	1330	350	910	2030	550
DSB-1120	0~1120	1410	350	1070	2180	550
DSB-1200	0~1200	1490	350	1150	2350	550

Key dimensions for SSB structure DSB series (or equals to SB as denotation)

2.3 for larger transversal movement--Swivel MBJS

While the previously mentioned types of MBJS accommodate longitudinal movements, special consideration must be given when significant transverse movement is required. According to AASHTO Bridge Design Specifications, the Swivel MBJS (referred to as XLF by IEC) is introduced to handle both longitudinal and transverse movements. The XLF joint allows for large transverse displacements.

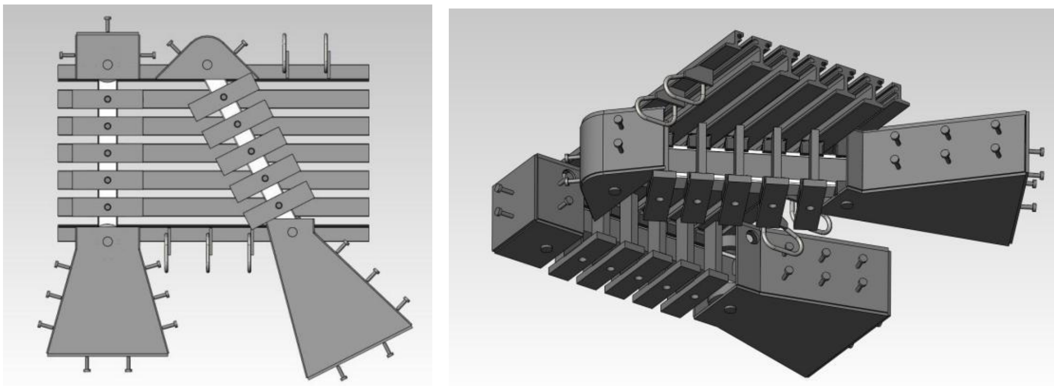
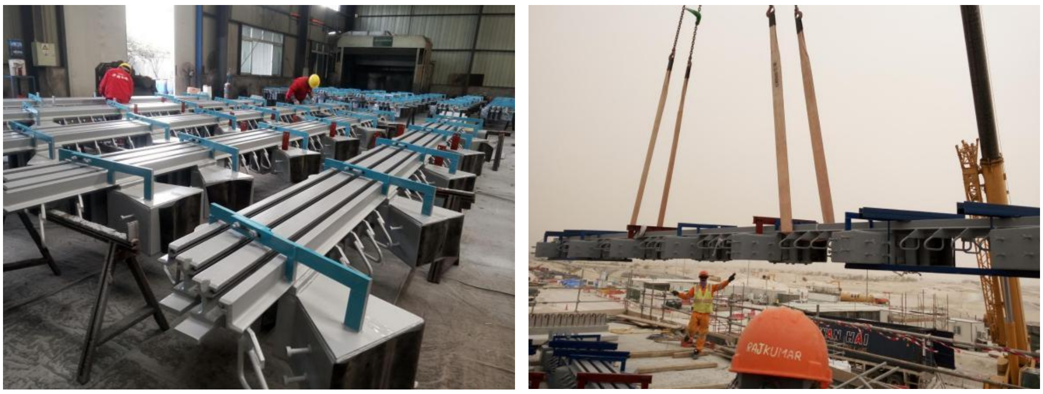


Illustration of swivel MBJS (XLF series) to cater for large long. & trans. Movement

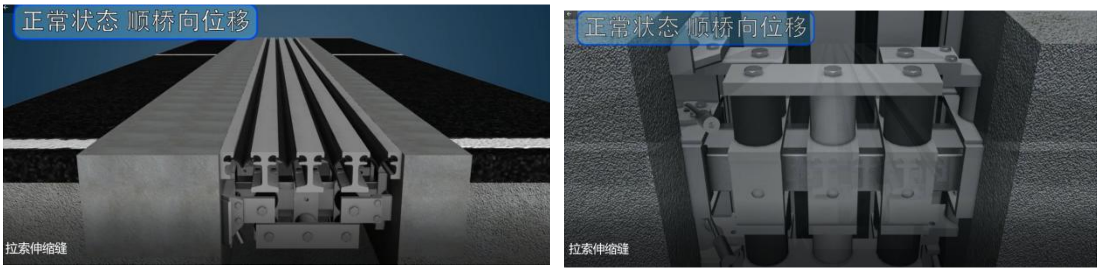


Over 550 meters of Swivel MBJS was supplied by IEC for NOH2 project, Qatar, 2017-2019

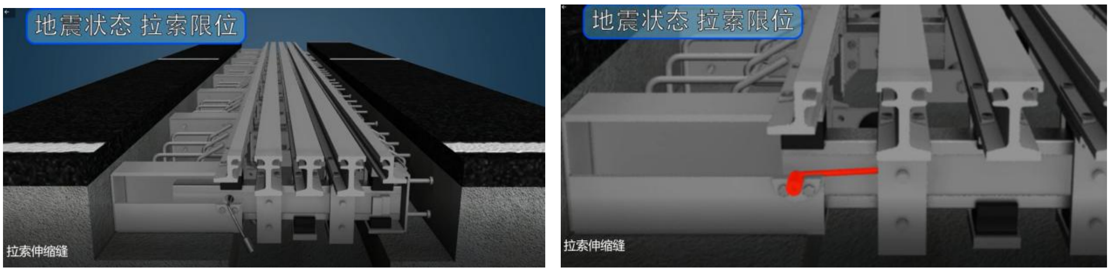
2.4 seismic considerations

For bridges located in seismic zones, IEC offers a cable-restrained MBJS system. This system is designed in collaboration with Tongji University Shanghai and other bridge engineering experts. The system functions similarly to a regular modular joint but includes cables that restrict excessive movement during seismic events.

During an earthquake, the tensioned cables prevent adjacent beams from colliding or separating excessively. Once the earthquake subsides, the cables allow the joint to return to its normal operation, ensuring stability and durability.



How cable-restrain MBJS works in normal condition



How cable-restrain MBJS works in seismic condition

Consult IEC engineers for detailed seismic solutions.

3. Materials

- **Centerbeams, Edgebeams, and Support Bars:** Typically made from Q345B steel (equivalent to S355JR steel or ASTM A709 Gr.50). Q345D steel (equivalent to S355J2) is also available upon request.
- **Support Boxes, Keeper Plates, and Anchorage:** Typically made from Q235B steel (equivalent to S235 or ASTM A709 Gr.36).
- **Sealing Element:** Usually made from EPDM rubber. Neoprene is also available upon request.
- **Control Springs, Compression Springs, and Sliding Bearings:** Made from steel-reinforced elastomeric bearings with virgin PTFE or polyurethane.

Different layouts of control springs alignment in differently-sized modular expansion joint
(right: control springs behaviour after Opening Movement with Vibration test
Left: control springs layout in a 14-cell MBJS for Hulukou Bridge over Jinsha River, Yunnan, China)

4. <u>Quality assurance</u>

IEC ensures strict quality control at every stage of the production process to meet international standards. IEC's quality management system is certified under:

- **ISO 9001:2015** for Quality Management.
- **EN ISO 9601** for Welding.
- **EN 1337-3** certification for elastomeric laminated bearings, applicable to elastomeric components of the MBJS.

IEC QC controller is working on a modular joint for dimension checking

5. Related certificate

- **ISO 9001:2015** Quality Management System
- **ISO 14001:2015** for Environmental Management System.
- **ISO 45001:2018** for Health and Safety Management System.
- **ISO 17025:2017** for Testing and Calibration Laboratories.
- **CRCC Certification** for bridge bearings and expansion joints, issued by the China Railway Test & Certification Center.

6. Test report (according to AASHTO LRFD Bridge Construction Specifications Section 19 Appendix A19)

IEC conducts a range of tests to ensure compliance with AASHTO LRFD Bridge Construction Specifications, including:

- **Opening Movement with Vibration (OMV) Test.**
- **Seal Push-Out (SPO) Test.**
- **Fatigue Testing** for long-term durability.

OMV and SPO test setup for IEC's modular expansion joint according to AASHTO LRFD Bridge Construction Specifications and NCHRP Report 467

20-seal modular joint was lifted up for installation for Qingshui River Bridge, Guizhou Province, China

7. Technical Submittals and Services

IEC offers comprehensive technical submittals and services, including:

- Detailed **Design Calculations** (primarily based on AASHTO standards; other specifications available upon request).
- **Design Shop Drawings** for accurate implementation.
- **Method Statements** for safe and effective installation.
- **Risk Assessments** of expansion joint installation.
- **Maintenance and Replacement Manuals.**
- **Storage, Lifting, and Handling Instructions** for modular joints.
- **Onsite Installation Assistance and Supervision** to ensure quality during construction.

8. Installation, maintenance and replacement

Consult IEC engineers for details

9. Suitable applications

Modular expansion joints are suitable for the following application areas:

- **Long-Span Bridges and Viaducts**

Designed to accommodate large longitudinal, transverse, and vertical movements, they are ideal for long-span bridges and viaducts.

- **High-Traffic Bridges**
  Suitable for highways, expressways, and urban bridges with heavy traffic, as they can handle significant dynamic loads.
- **Seismic Zones**
  Modular joints can accommodate the large displacements and rotations caused by seismic activity, making them a preferred choice in earthquake-prone areas.
- **Harsh Environmental Conditions**
  Their durability makes them effective in extreme weather conditions, including areas with wide temperature variations.
- **High-Load Applications**
  Designed to support heavy vehicular and dynamic loads, modular joints are often used in critical infrastructure projects.
- **Complex Movements**
  Suitable for bridges requiring multi-directional movement accommodation, such as thermal expansion, contraction, and structural rotation.

10. Notable projects

Qingshui River Bridge, Guizhou Province, China (1600mm movement)

New Orbital Highway 2, Doha, Qatar (SWIVEL 240/320 and MODULAR 160-240-320 MOVEMENT)

Hongkong-Zhuhai-Macau Bridge, Hongkong section (240/320mm)