

MAURER Expansion Joints - Railway



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Railway bridges are usually designed for speeds up to 350 km/h, characteristic wheel loads of 250 kN multiplied by a load class coefficient α (0.75 - 0.46) and a dynamic coefficient of set loads of 250 kN, multiplied by the load class coefficient α (0.75 - 1.46) and the dynamic coefficient ϕ (1,0 - 2,0). MAURER railway expansion joints fulfil these boundary conditions.

Weather phenomena



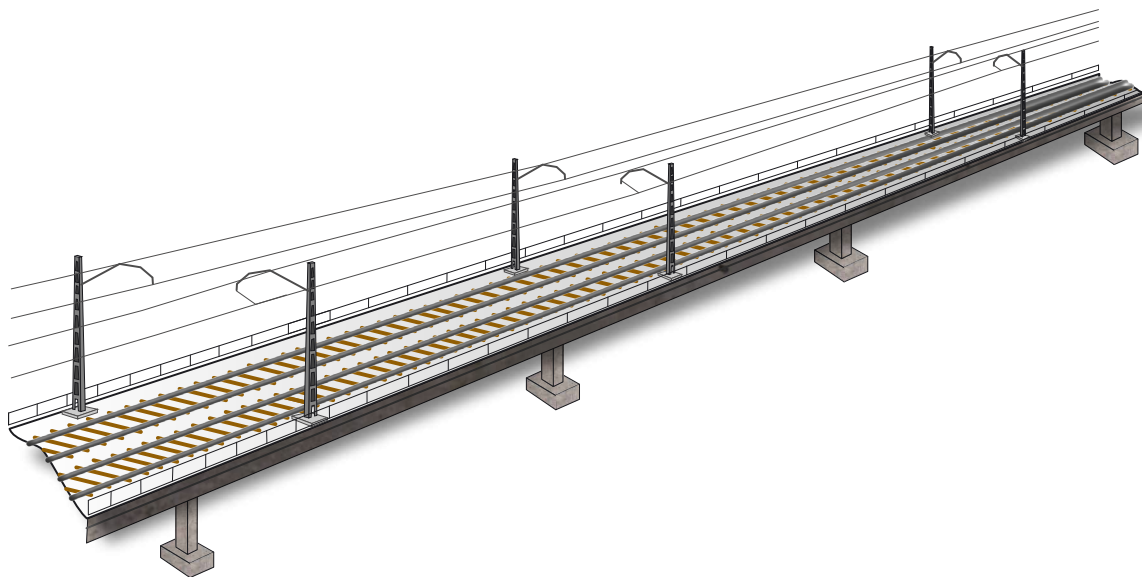
Traffic



Creep and shrinking



Seismic events



>> Characteristics

- Optimal adaption to structural geometry
- Fatigue-resistant connections
- Low life-cycle costs
- Service life > 50 years



Guided Cross Tie

A cross tie is always used when the rail support point forces or distances or the technical requirements (e.g. height offset or angle of inclination) cannot be achieved. The cross tie is a watertight bridging structure with six degrees of freedom. The movement of the structure is divided into smaller individual gaps by controlled sleepers.

MAUER Type CT

- Compliance with the permissible rail support point forces and distances
- Transfer of live loads
- Restraint-free absorption of superstructure displacements and twists independent of direction and axis
- Watertight and maintenance-free
- Service life > 60 years
- Supplied fully assembled
- Quick and easy installation



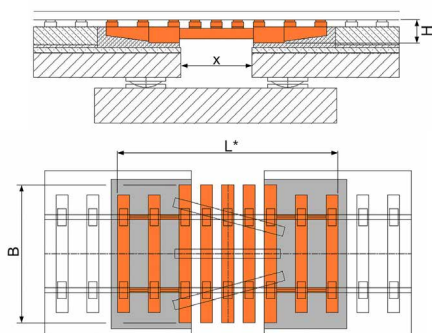
Cross tie



Cross tie

Dimensions of CT2 and CT4

	Number of gaps	$d_{x,b}$	$d_{x,E}$	L	B	H	x	d_y	δ_x	max d_z
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mrad]	[mm]
CT2	2	400	800	3700	2660	510	500	$\leq \pm 4,5$	$\leq \pm 1,8$	-1.4 bis +2.5
CT4	4	800	1600	4200	2960	510	1000	$\leq \pm 7$	$\leq \pm 3$	-3 bis +4



- L : Length of the Guided Cross-Tie in centre position
- B : Width of the Guided Cross-Tie
- H : Height of the Guided Cross-Tie
- $d_{x,b}^{1)}$: Maximum capacity for longitudinal service movements
- $d_{x,E}^{1)}$: Maximum longitudinal movement due to an earthquake
- $d_y^{2)}$: Maximum lateral movement
- $\delta_x^{2)}$: Maximum torsional movement
- $d_z^{2)}$: Maximum vertical movement
- x : Recommended minimum structural gap

* in centre position

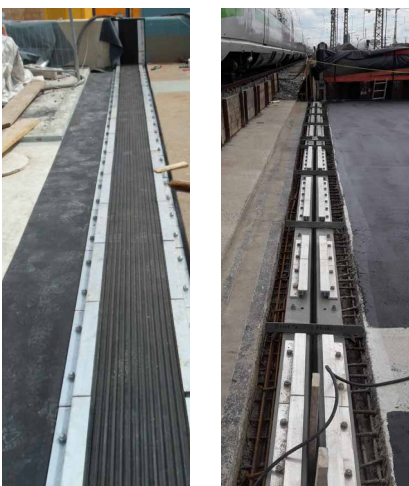
¹⁾ Maximum longitudinal movements due to earthquakes while complying with a maximum distance of the rail fastening system of 650 mm. Greater distances can be considered on a project basis, but may result in a change to the geometry.
²⁾ The indicated movements refer to the capacity of the rails, since the expansion joints can accommodate significantly larger movements. Additional information see TI_033 "Guided Cross Tie".

Mat expansion joints

These are not driven over directly and serve to seal the structure gap while simultaneously absorbing the occurring displacements and twists of the superstructure. The traffic loads are transferred via the ballast bed. MAURER Mat Expansion Joints are approved by the DB AG by means of a manufacturer-related product qualification (HPQ). In contrast, the cross tie corresponds to a bridging construction across the structure gap, which directly absorbs and transfers the traffic loads in addition to the superstructure movements.

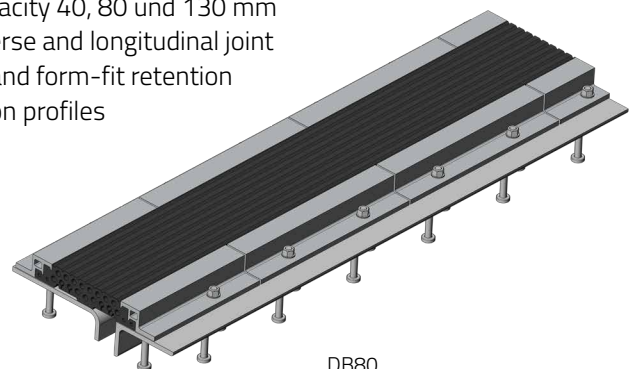
Mat expansion joint (single seal) < 130 mm

MAURER sub ballast mat joints consist of a steel substructure onto which the elastomer expansion profiles are screwed using aluminum clamping profiles.



MAURER TYPE DB40, DB80 and DB130

- Approved according to RIL 804 and HPQ
- Maximum expansion joint gap 130 mm
- Movement capacity 40, 80 und 130 mm
- Variant transverse and longitudinal joint
- Force-locking and form-fit retention of the expansion profiles



Type	a	h	f	t _f
DB40	250	200	40	250

① Mat profile ③ Sub structure
 ② Klaw profile ④ Ballast protection grip

All dimensions in mm.

Type	a	h	f	t _f
DB80	375	200	50	450

① Mat profile ③ Sub structure
 ② Klaw profile ④ Ballast protection grip

All dimensions in mm.

Type	a	h	f	t _f
DB130	475	200	70	450

① Mat profile ③ Sub structure
 ② Klaw profile ④ Ballast protection grip

All dimensions in mm.

Mat expansion joint (multiple seal) < 260 mm

By connecting 2 expansion mats in series, the expansion distances can be doubled.

MAURER Type DB160 and DB260

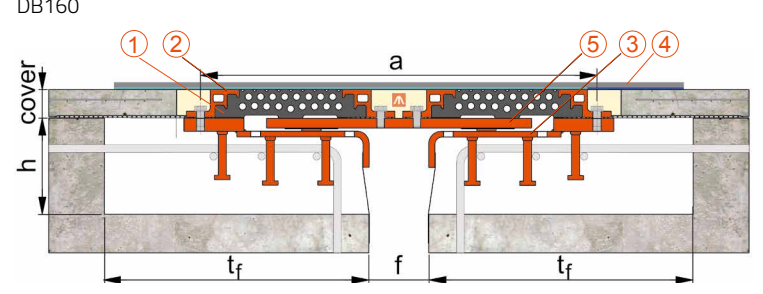
- Movement capacity of ± 80 mm resp. ± 130 mm by coupling of two single seal DB-Mat expansion joints Type DB80 or DB130



DB130



DB160

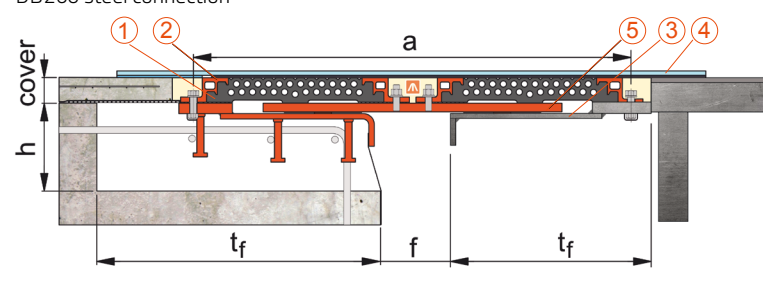


Type	a	h	f	t _f
DB160	825	200	125	550

- ① Mat profile ④ Ballast protection grip
- ② Klaw profile ⑤ Cover plate
- ③ Sub structure

All dimensions in mm.

DB260 steel connection



Type	a	h	f	t _f
DB260	1025	205	150	665

- ① Mat profile ④ Ballast protection grip
- ② Klaw profile ⑤ Cover plate
- ③ Sub structure

All dimensions in mm.

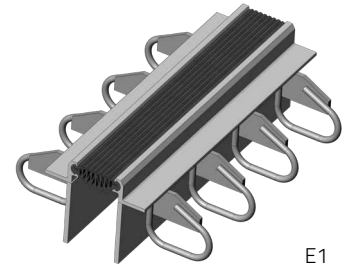
Elastoblock

These consist of a substructure similar to the strip joint type D1 and a mat-shaped sealing profile with the same surface. This makes the system suitable for pedestrian and cycle bridges or areas with mixed traffic (e.g. car parks).



MAURER Type E1 / E2

- Vulcanized molded parts
- Several profiles can be connected in series
- Watertight, de-icing salt, oil and petrol resistant constructions



E1

E1

Type	a	h	f	t _f
E1-80	100	240	100	300
E1-100	130	240	150	300

① Edge profile ③ Reinforcement
 ② Elastomeric profile

All dimensions in mm.
 Movement capacity E1: 80 – 100 mm
 Movement capacity E3: 240 – 300 mm

E2

Type	a	h	f	t _f
E2-160	265	240	180	300
E2-200	325	240	270	300

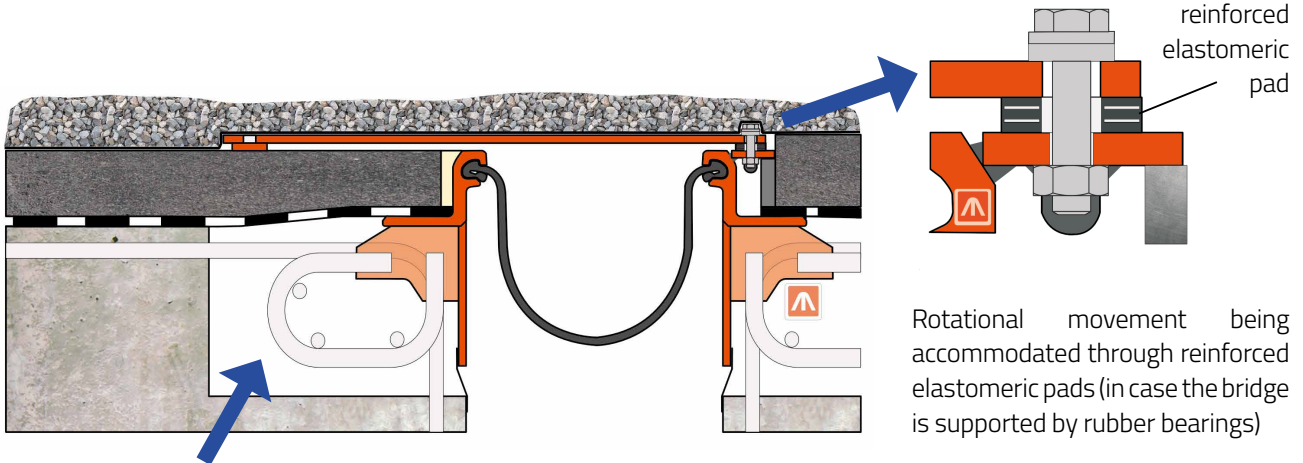
① Edge profile ③ Support bar
 ② Elastomeric profile

All dimensions in mm.
 Movement capacity E2: 160 – 200 mm
 Movement capacity E4: 400 mm

Special designs and accessories

MAURER plate supported

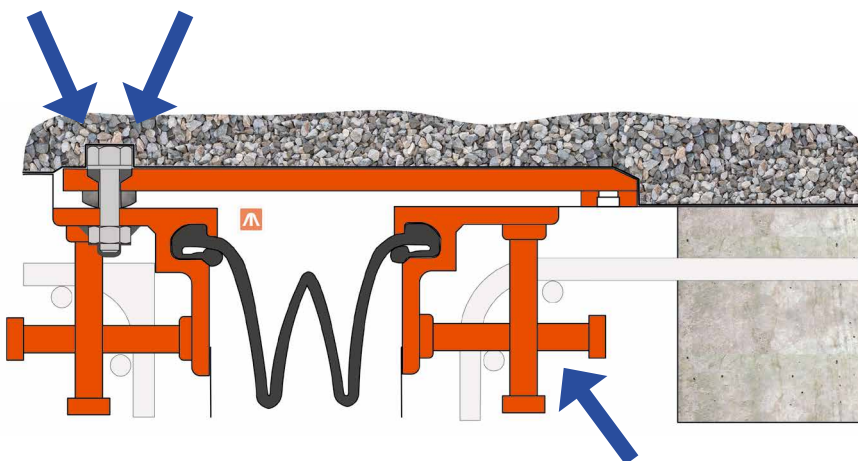
MAURER solution for small longitudinal movements and vertical rotations.



Joint edge profile with a horizontal flange to connect water stop of bridge, anchored into concrete with an anchor plate with welded anchor loops.

MAURER solution for medium to large longitudinal movements and vertical rotations.

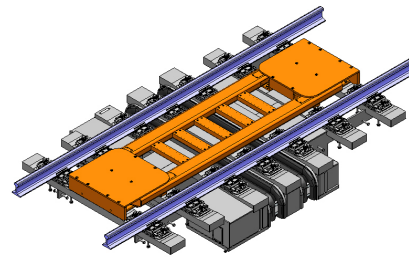
Medium to large vertical rotations accommodated through a double spherical hinge system (used in case pot- or spherical bearings are used as bridge bearings)



Joint with edge profile designed for pure concrete slab (no direct connection for water stop of bridges) anchored into concrete with a certain arrangement of anchor studs reinforced elastomeric pad

Derailment protection system

The derailment protection system ensures that the train is guided over the Guided Cross-Tie in the longitudinal direction in a controlled manner in the event of a derailment. The standard system is designed for a lateral load of 100 kN.

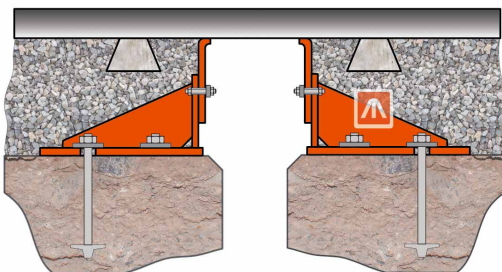


The system does not rest on the movable sleepers and can therefore swivel and move freely above the sleepers. This means that all necessary movement and rotation are still in the Guided Cross-Tie. The system is equipped with a maintenance-free MSM® sliding bearing system to ensure low wear and controlled sliding performance with minimum resistance.



Open Railway Joints

These types are considered for use in railway bridges where the maximum movement is greater than 260 mm. In the area of the expansion joint, there is no ballast bed or the generally modern design of a monolithic rigid rail with direct superstructure is used.



>> Characteristics

- The top surface can be open gap or closed gap (by means of a stainless-steel cover plate)
- Provide electrical isolation

Quality and Specifications

Abstracts from the test programs

- Load capacity and relaxation of bearings and springs
- Fatigue resistance and wear of bearings and springs
- Fatigue strength of metallic components
- Water tightness
- Movement capacities



Fatigue resistance test, cross tie



Sliding distance test, cross tie

Implemented management and third-party monitoring systems as well as welding and product certificates

- DIN EN ISO 9001 „Quality management systems“
- DIN EN ISO 14001 „Environment management systems“
- DIN ISO 45001 „Occupational health and safety management systems – Requirements with guidance for use“
- DIN EN 1090-1 „Execution of steel structures and aluminum structures – Requirements for conformity assessment of structure components“
- DIN EN 1090-2 „Execution of steel structures and aluminum structures – Technical requirements for steel structures“
- DBS 918005 „Manufacturer-specific product qualification HPQ Roadway transition joints for transversal and longitudinal joints on railway bridges according to RIL 804.5201“
- ISO 3834 „Quality requirements for fusion welding of metallic materials“ CWB „Canadian Welding Bureau“
- AREMA – American Railway Engineering and Maintenance-of-Way Association



References

>> Railway viaduct 2 and 4 of the local traffic project Toluca – Valle de Mexico, Mexico

For the two up to 3,865 m long bridges of the new intercity railway line Toluca-Mexico-City, the cross ties were needed due to the large service and earthquake movements.



>> Bridge Samuel-de Champlain in Montreal, Canada

In the middle of the bridge, the 2-lane bus line was converted into a 2-lane railway line. Here, the high requirement for vertical movement and seismic displacements at the structure joints could only be met with cross ties.



>> 2nd main line Munich, Germany

The main line in Munich, which opened in 1972, connects the Leuchtenbergring station in the east with Laim in the west of Munich. In addition to 28 spherical bearings, 25 elastomeric bearings and a horizontal force bearing, approx. 450 m of single seal and 18 m of double seal mat expansion joints as well as approx. 1,000 m of sealing ends were manufactured, supplied and installed for the construction of the Laim railway station, of a public transport tunnel, two overpasses structures and a tied arch bridge.

