

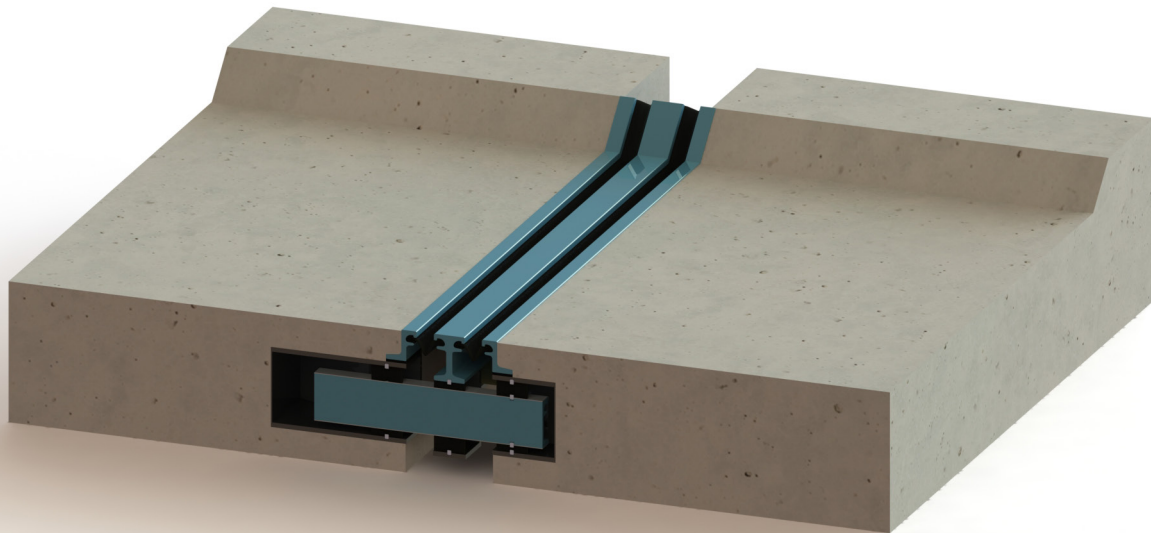


HIJOINT

ROAD EXPANSION JOINTS



Kaohsiung Port Expressway
Kaohsiung, Taiwan



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HIRUN
INTERNATIONAL

The engineering solution.



HIRUN INTERNATIONAL

We are a professional design, production, testing and installation company of structural devices with over 50 years' experience in the field. Hirun International has been involved in the design of bearings, anti-seismic devices, post tensioning and expansion joints for the most important infrastructure lines of the world and for strategic buildings like hospitals schools and administrative compounds.

HIRUN INTERNATIONAL is an engineering company having its roots in the deep heart of the most modern and advanced civil engineering technologies.

The core of the company is composed by pioneers that in the last 50 years had a leading position in developing worldwide very important technologies such as: structural bearings, expansion joints, post-tensioning system, anti-vibration and anti-seismic systems.

The Directors of the company in the past years were proudly involved in the definition of international standards or key specifications such as: EN1337 (European standard for structural bearings), EN15129 (European standard for antiseismic devices), special bearings for High speed railway lines (as examples in Italy, Taiwan and China) and Metro lines (as example the Bangkok metro system).

In the past years, the evidence of the strong innovation attitude is represented by several patents issued and this aim is still well alive in the company. Patents and customized unique solutions such as: special dampers, new materials for different applications, customized combinations and applications of different structural devices. This attitude is pushing the company to a never ending improvement.

We are now a specialized company for the application, the design, the production, the installation and the testing of all the following engineering technologies: Structural bearings, Seismic devices, Expansion joints, Post-tensioning systems, Anti-vibration devices.

A special attention is dedicated to the quality of the products.

We design and produce starting from the control of the internal process; we are qualified ISO:9001 and we got several international qualifications such as the CE marking certificate for our products.

To achieve the above mentioned targets we created a very successful cooperation with partners in many fields such as: industries producing innovative materials, factories, universities and seismic laboratories in many parts of the world. Our partners are diversified for location and capacity in order to create an active and efficient network which can cooperate to match the most challenging needs of all the clients.

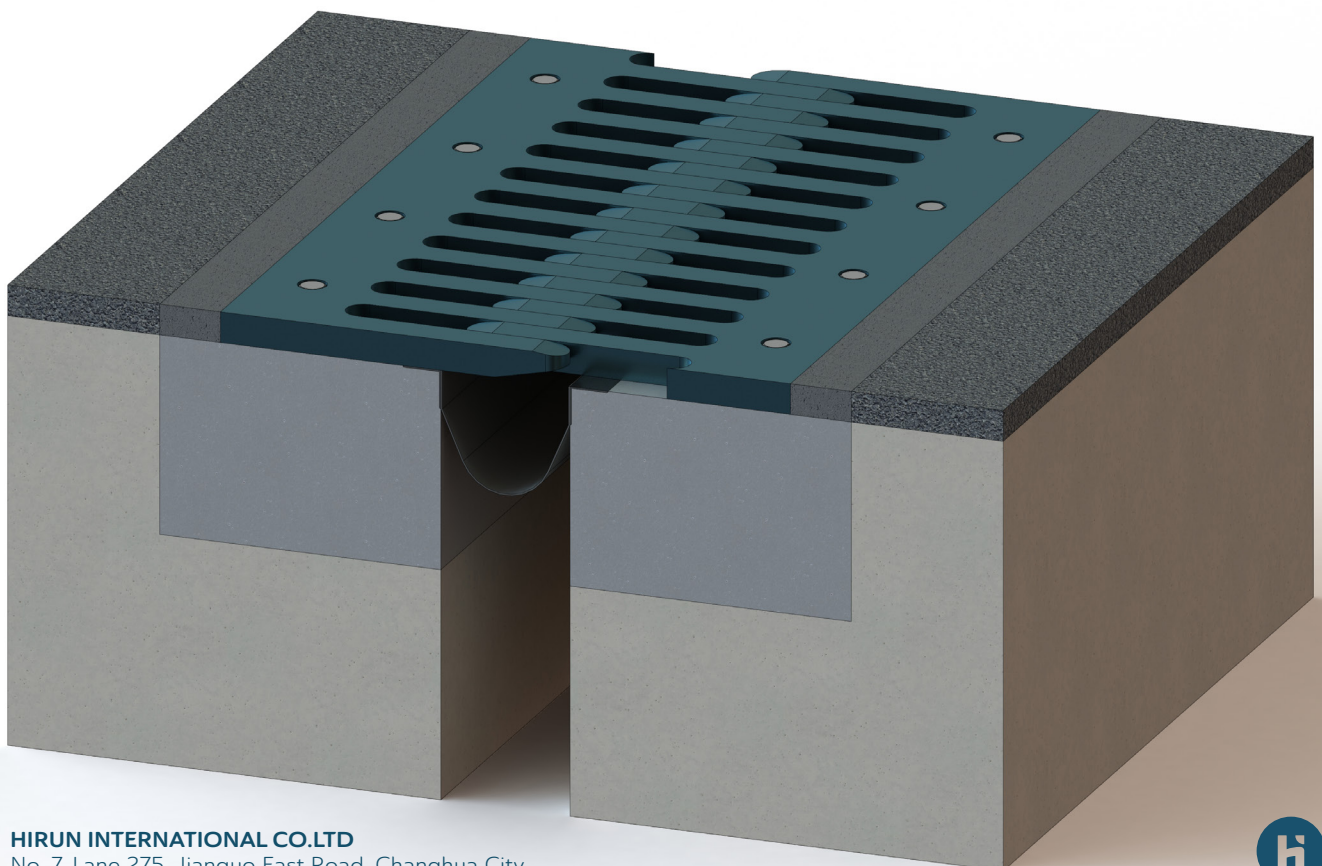
We aim to become the leading specialized company for the most peculiar and important civil engineer projects in the world: **THE ENGINEERING SOLUTION.**



Smoothly connecting bridges and people.

Bridges are always in movement due to traffic, wind, temperature, earthquake and other effects. The function of the expansion joints is essential to grant these movements and support in the same time the traffic in a smooth and safe way granting at the same time the waterproofing.

Expansion joints shall minimize the impact with the traffic: they shall be reliable and have a long service life without maintenance.



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How to select the right expansion joint

We can provide 3 types of joints

HIMOD MODULAR JOINT

The modular joints consist of a succession of watertight V-shaped rubber seals elements and center steel beams supported by a moveable steel cross beam bridging the structural gap.

The center beams is sliding on the crossbeams,

The gaps between the center beams are equalized by elastomeric springs

HIFLEX RUBBER MAT JOINT

This joint consists of elastomeric elements reinforced by suitable steel plates completely embedded in the rubber and vulcanized to it. The rubber mat includes a suitable anchorage system. The mat carries the traffic loads. The movements take place by deformation of the rubber mat by shear

HICOMB FINGER TYPE JOINTS

A Cantilever Expansion Joint consists of cantilever symmetrical and non-symmetrical elements (such as comb or saw-tooth or sinusoidal plates), which are anchored on one side of the deck joint gap and interpenetrate to bridge the deck joint gap. The elements are flush with the running surface.

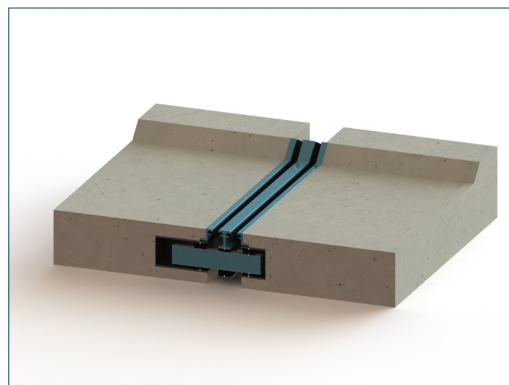
The main characteristics of these types of joints are summarized in the following table

TYPE	ADVANTAGES	DISADVANTAGES
HICOMB	Low cost High durability (>50 years)	Limited waterproofing Transversal movements not allowed
HIFLEX	Low cost Easy installation Transversal movements allowed Silent Limited space required	Medium durability (>30 years) Not recommended in cold climates
HIMOD	Perfect waterproofing High durability (>50 years)	Expensive Transversal movements limited High space required

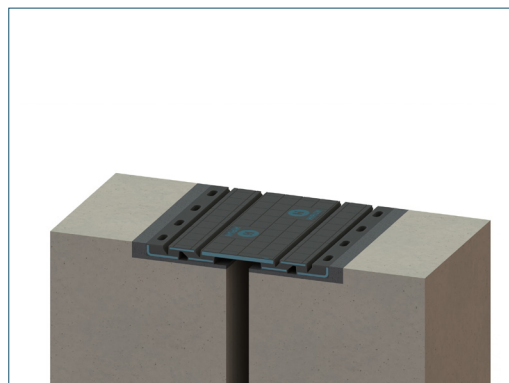
The required longitudinal movement of an expansion joint may be evaluated as follows.

The reference length "L" for the evaluation of the movement is the distance from the expansion joint to the nearest fixed bearings, from both sides.

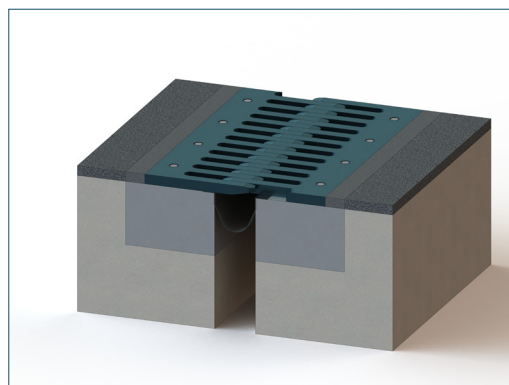
The longitudinal movement is composed by the following terms



Modular Joint



Rubber Mat Joint



Finger Type Joint



Irreversible movements (for concrete bridges only)

Shrinkage of the concrete

The precise value of the shrinkage may be evaluated in accordance with the relevant applicable standard in function of the technical properties of the concrete and the environmental conditions (humidity and temperature).

As an average value of the shrinkage deformation the following value may be considered:

$$\varepsilon_s = 30 \times 10^{-5}$$

And the movement due to the shrinkage to be applied to the joint:

$$D_s = \varepsilon_s \times L$$

This value may be reduced for prefabricated elements if the installation of the joints is delayed from the time of casting of the structural elements

Creep of the concrete

The precise value of the creep may be evaluated in accordance with the relevant applicable standard in function of the compressive stress of the concrete, the technical properties of the concrete and the environmental conditions (humidity and temperature).

As an average value of the creep deformation the following value may be considered:

$$\varepsilon_c = 60 \times 10^{-5}$$

And the movement due to the shrinkage to be applied to the joint:

$$D_c = \varepsilon_c \times L$$

This value may be reduced for prefabricated elements if the installation of the joints is delayed from the time of casting of the structural elements

Reversible movements (temperature)

The precise effect of the temperature may be evaluated in function of the local environmental conditions. Normally, for temperate zones a variation of temperature:

$$\Delta T = \pm 30^\circ C$$

Is considered

The deformation of the structure due to temperature variations is given by:

$$\varepsilon_{\Delta T} = \alpha \Delta T$$

Where α is the thermal coefficient of the structure

$\alpha = 10^{-5}$ for concrete

$\alpha = 1.2 \times 10^{-5}$ for steel

The movement due to the temperature variation to be applied to the joint results:

$$D_{\Delta T} = \pm \varepsilon_{\Delta T} \times L$$



Other effects

Flexural bending of the beams

Displacement of the piers due to wind, braking and centrifugal forces, earthquake

Displacement of anti-seismic devices

Seismic actions

For the evaluation of the movement of the joints the following combinations shall be considered

A. Serviceability Limit State Frequent (SLSF)

It includes the following effects

100% irreversible effects

100% temperature effects

Other actions at SLS

With this combination the joint movement shall remain within the nominal value.

The opening of the gaps of the joint at the road level with this combination is normally limited to 80 mm to grant a suitable comfort to the utilizers

B. Serviceability Limit State Rare (SLSR)

It includes the following effects

100% irreversible effects

50% temperature effects

Other actions at SLS

Frequent earthquake (50 years return period)

With this combination the joint movement may exceed the nominal value, however the joint shall remain in the elastic field and any damage shall be prevented

The opening of the gaps of the joint at the road level with this combination may reach 100 mm or more

C. Ultimate Limit State (ULS)

It includes the following effects

100% irreversible effects

50% temperature effects

Other actions at ULS

Design earthquake

With this combination the joint may fail but the failure shall be easily repaired to quickly restore the traffic after the earthquake.

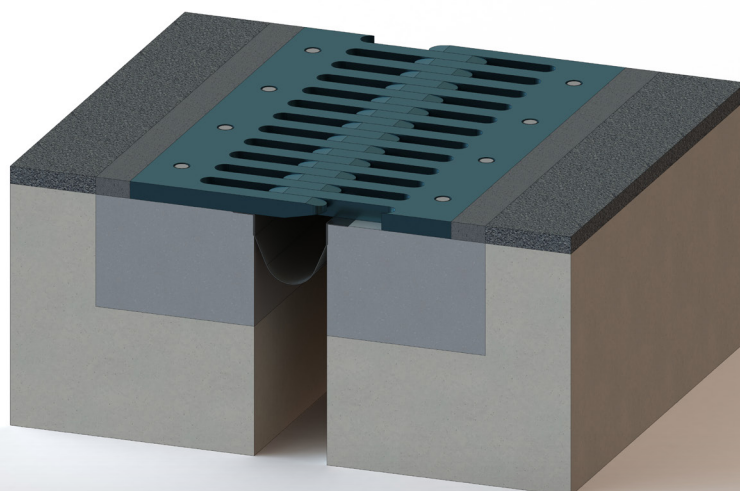
Major failures that may generate danger for the utilizers (as for instance falling down of the cross beam in the modular joints) shall be prevented.



The very robust and durable solution.

HICOMB finger joint represent a very strong and durable solution at a reasonable price. They are suitable for longitudinal movements up to 800 mm in SLSF conditions and assure a very smooth and silent riding. They are easy to install as they may be supplied in segments of 2 meters length and therefore are very suitable for repair works with limited interference with the traffic.

The waterproofing is granted by a drainage system underneath the joint



++ Main Field

Any kind of bridges and building



INSTALLATION

Requires trained team



DURABILITY

> 50 years



MAINTENANCE

Corrosion protection after 15 years



COST

Best cost/performance ratio



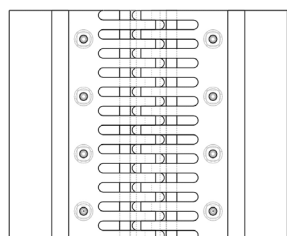
LONGITUDINAL DISPLACEMENT

Medium



TRASVERSAL DISPLACEMENT

Zero



Plan



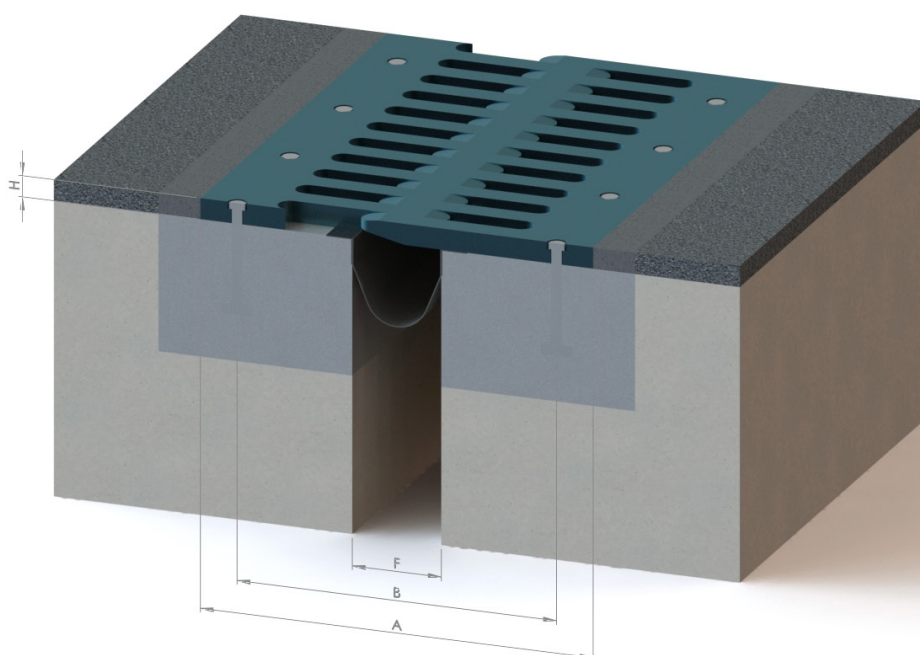
Section

Dimensions and performances are given for guidance only.

For a more detailed design please contact our technical office

Dimensions Table **HICOMB**

JOINT TYPE	Movement	A	H	B	F	Anchor bolts
	±mm	(mm)				
HICOMB 100	±50	470±250	30	385±50	70±50	M 16
HICOMB 200	±100	780±250	45	640±0	120±100	M 16
HICOMB 300	±150	1090±250	60	900±150	170±150	M 24
HICOMB 400	±200	1420±250	80	1165±200	220±200	M 24
HICOMB 500	±250	1720±250	95	1420±250	270±250	M 24





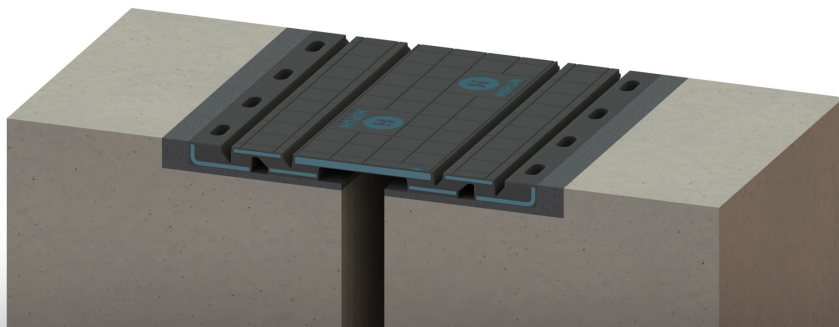
The very easy solution.

They are made of rubber-steel vulcanized elements. The rubber is deformed by shear to allow longitudinal and transversal movement.

They are suitable to accommodate movements up to 400 mm in service conditions and 1000 mm in earthquake conditions.

Since they can accommodate longitudinal and transversal movements of the same value they are very suitable for base isolated bridges with movements in the 2 directions.

Their installation is very simple and, since they are made in segments of length not exceeding 2 meters, they can be used for repair jobs with minimum interference with the traffic



Main Field

Any kind of bridges
Base isolated bridges



INSTALLATION

Requires trained team



DURABILITY

> 30 years



MAINTENANCE

Not required



COST

Medium



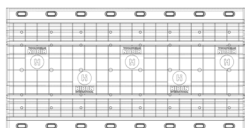
LONGITUDINAL DISPLACEMENT

Medium



TRASVERSAL DISPLACEMENT

High



Plan



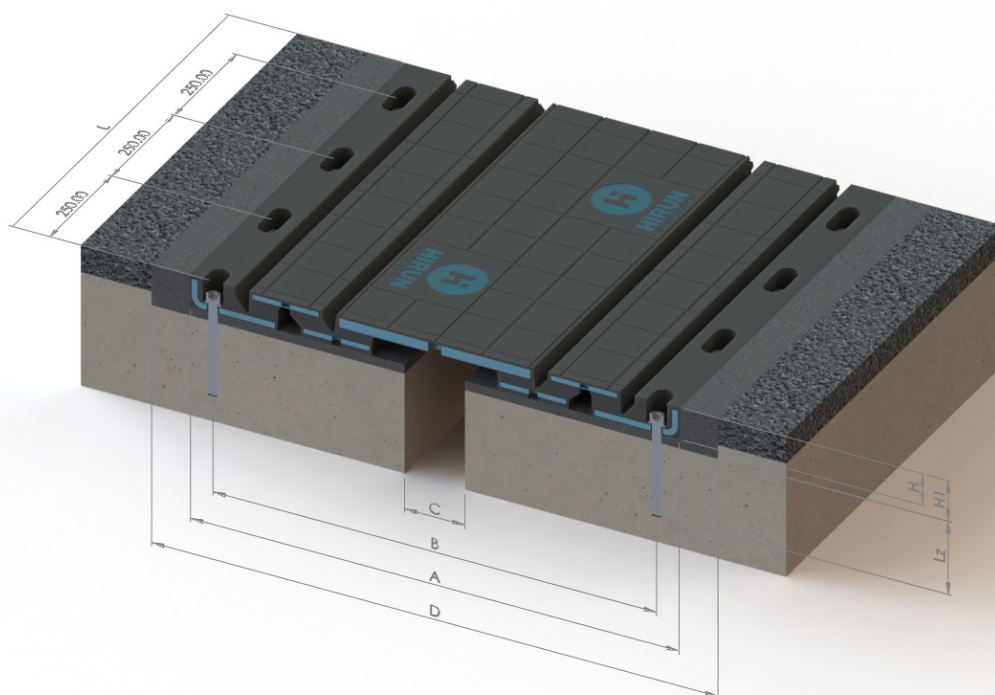
Section

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Dimensions Table HIFLEX

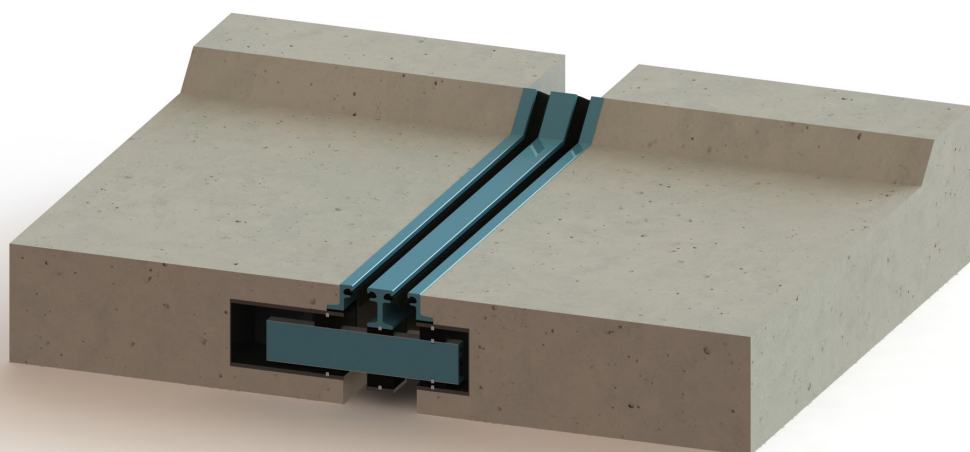
JOINT TYPE	Longitudinal/ Transversal Movement	A	B	C	D	D	Lz	H	H1	BOLTS
	±mm	(mm)								
HIFLEX 50	25	292	220	45	450	2000	140	35	60	M12×190
HIFLEX 80	40	276	220	50	450	2000	140	45	70	M12×190
HIFLEX 120	60	393	300	70	560	2000	140	56	80	M16×200
HIFLEX 160	80	472	370	90	640	2000	130	81	100	M16×200
HIFLEX 200	100	897	795	110	1070	2000	160	63	80	M20×230
HIFLEX 250	125	901	801	135	1220	2000	150	78	90	M20×230
HIFLEX 320-400	160-200	1277	1165	220	1450	1250	210	85	110	M24×300
HIFLEX 320-700	160-350	1490	1380	360	1670	1250	210	85	110	M24×300
HIFLEX 320-1000	160-500	1620	1510	510	1800	1250	210	85	110	M24×300





The very big movements solution.

This joints are made of special steel profiles with interlocked rubber seals providing the waterproofing of the system.



++ Main Field

Up to 2000 mm movement or more



INSTALLATION

Requires trained team



DURABILITY

> 50 years



MAINTENANCE

Limited



COST

High



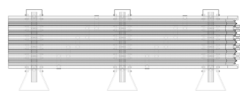
LONGITUDINAL DISPLACEMENT

High



TRASVERSAL DISPLACEMENT

Small



Plan



Section

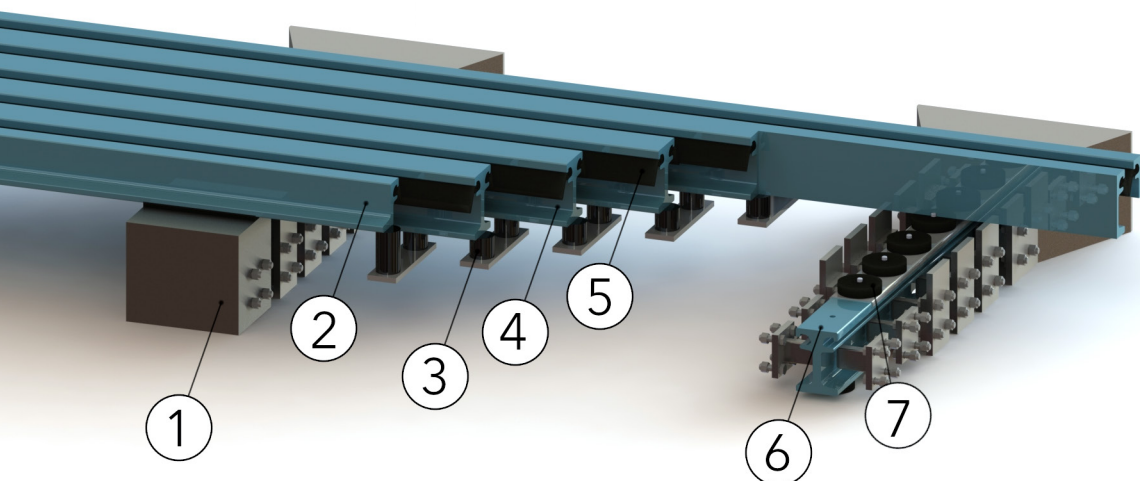
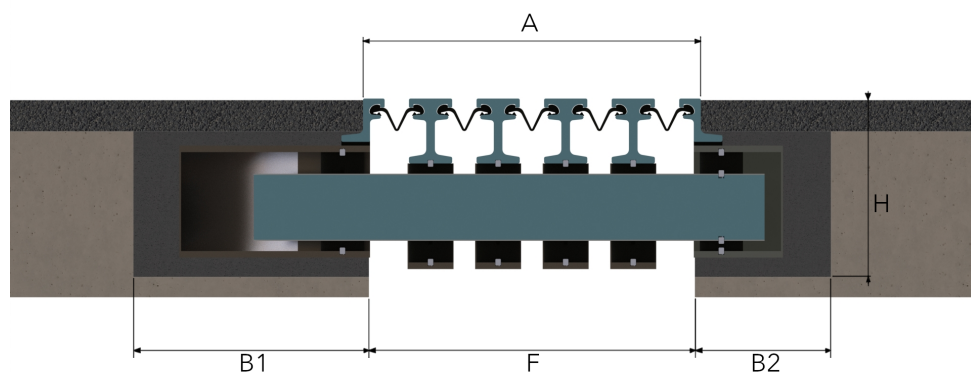
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Dimensions Table

HIMOD

JOINT TYPE	Movement	Rubber seals	A	Weight	H	B1	B2	B3	F
	±mm		(mm)	Kg	(mm)				
HIMOD 80	40	1	120	50	280	300	300	-	40
HIMOD 160	80	2	240	180	290	300	300	210	170
HIMOD 240	120	3	360	280	290	400	400	350	290
HIMOD 320	160	4	480	390	320	450	450	480	410
HIMOD 400	200	5	600	400	350	710	350	340	530
HIMOD 480	240	6	720	500	350	790	350	340	650
HIMOD 560	280	7	840	610	370	870	350	340	770
HIMOD 640	320	8	960	730	370	950	350	370	890
HIMOD 720	360	9	1080	860	390	1030	350	370	1010
HIMOD 800	400	10	1200	980	390	1110	350	370	1130
HIMOD 880	440	11	1320	1120	420	1190	350	390	1250
HIMOD 960	480	12	1440	1280	420	1270	350	390	1370



1. Casing box
2. Lateral profile
3. Centering device
4. Central profile
5. Rubber seal
6. Support beam
7. Sliding bearing

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References

OWNER	CONTRACTOR	PROJECT	QUANTITY	YEAR
Taiwan National Expressway Bureau	BES	C-303Z, North 2nd-Highway Keelung - Xi Zhi	165M	2013
Taiwan National Expressway Bureau	Evergreen	C-343B, Douliu Interchange Lu Nei - Douliu section	628M	2013
Taiwan National Expressway Bureau	Evergreen	C-313, 2nd Highway, Da An Bridge ShiHu - Da An section	195M	2013
Taiwan Housing&Urban Developement Bureau	Evergreen	EW-9/10, East-West-Expressway Wan Li - Rui Bin	88M	2013
Taiwan Housing&Urban Developement Bureau	Evergreen	EW-16/17, East-West-Expressway Wan Li - Rui Bin	69M	2013
Taiwan Housing&Urban Developement Bureau	Evergreen	EW-19/20, East-West-Expressway Wan Li - Rui Bin	111M	2013
Taiwan National Expressway Bureau	BES	C-355, 2nd Highway extension PaiHo - SinHua section	60M	2013
Taiwan National Expressway Bureau	BES	C-306, 2nd Highway extension Houlong section	347.77M	2013
Taiwan National Expressway Bureau	BES		722M	2013
Taiwan National Expressway Bureau	BES	C-344Z, 2nd Highway extension Douliu - DaLin section	182M	2013
Taiwan Highway Bureau	Evergreen	E-201, East-West-Expresswy NanLiao - ChuTung	441M	2013
Taiwan Highway Bureau	Evergreen	E-506, East-West-Expresswy TaiSi - KuKheng section	1191M	2013
Taiwan National Expressway Bureau	ZhaoYi	C-322B, 2nd Highway ShenGang section	1191M	2015
China High Speed Rail		Goungzhou to Wuhan project (AW type)	18740M	2013
China High Speed Rail		Tainjin to Beijing project (AW Type)	2400M	2012
China High Speed Rail		Goungzhou to Zhouhai project (AW type)	8100M	2014
China High Speed Rail		Goungzhou to Shenzhen project (AW type)	2600M	2016