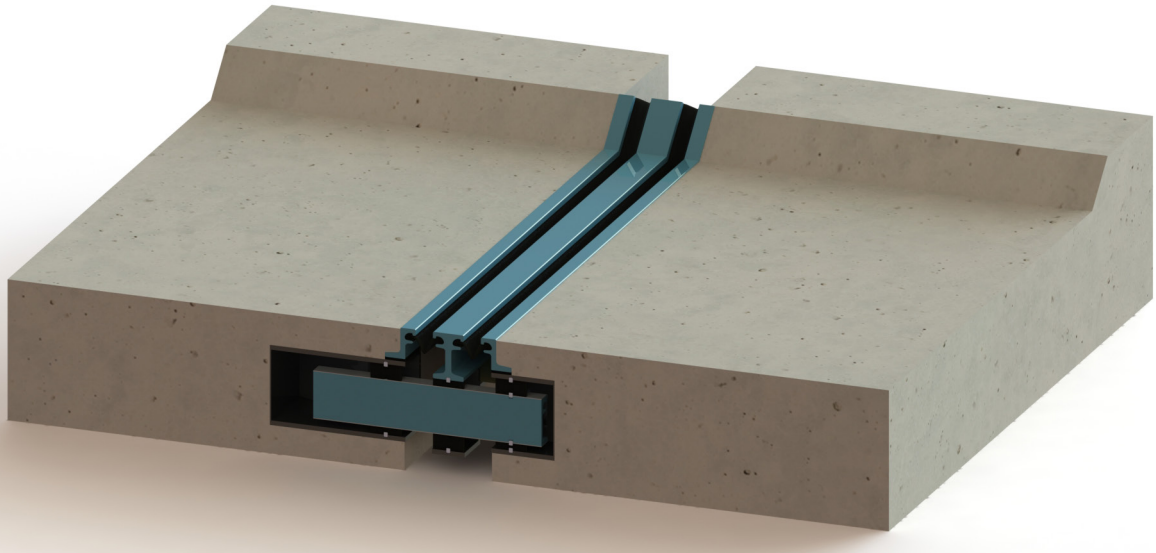
# HIJOINT

## ROAD EXPANSION JOINTS

**Kaohsiung Port Expressway**
*Kaohsiung, Taiwan*



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**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.**

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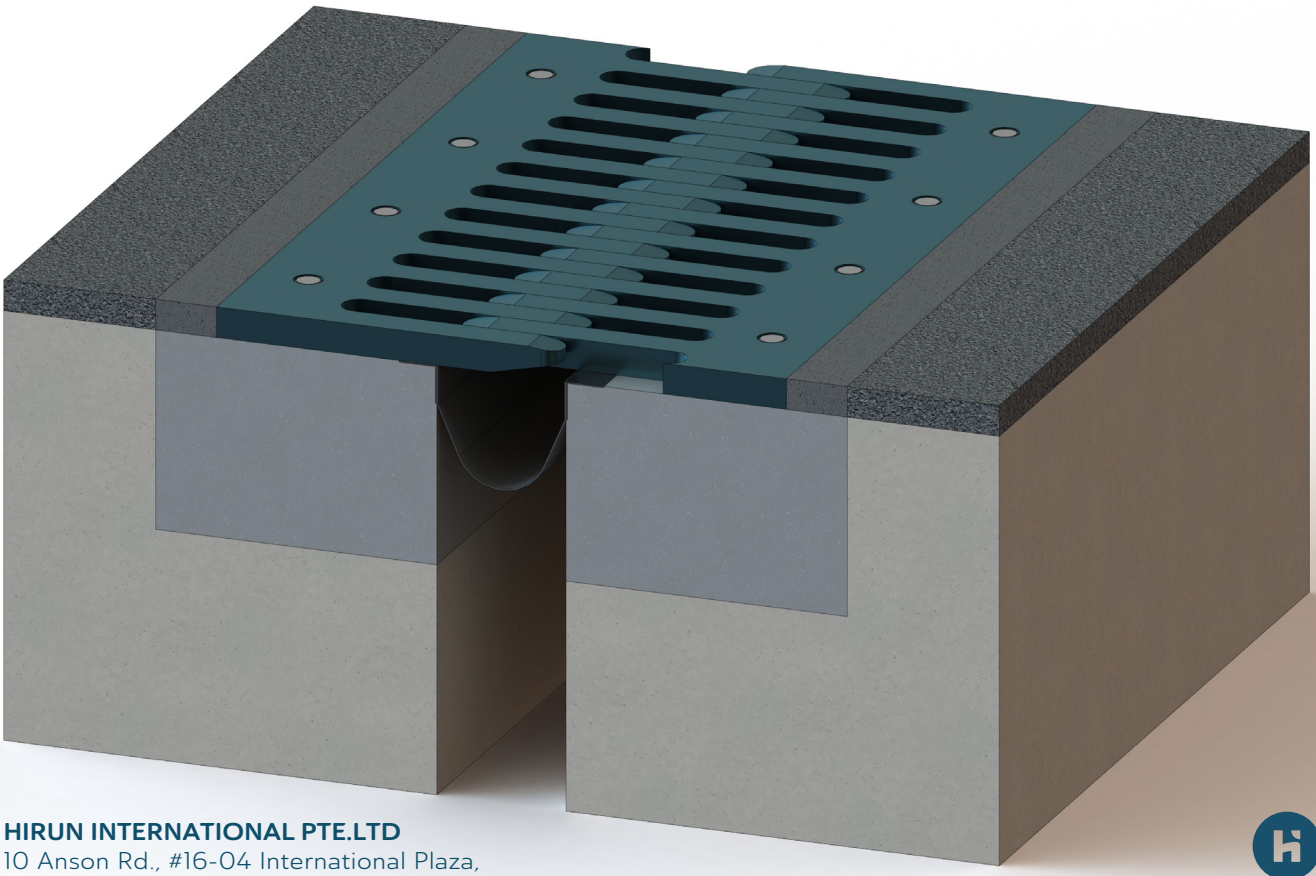
**HIJOINT** ROAD EXPANSION JOINTS

# 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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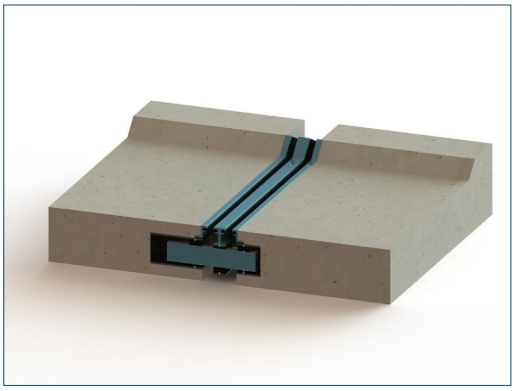
# How to select the right expansion joint

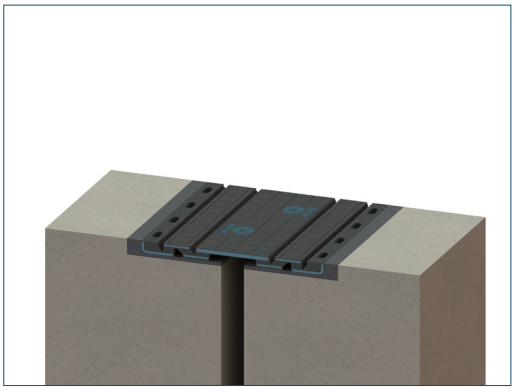
We can provide 3 types of joints

**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



*Modular Joint*

**HIFLEX** RUBBER MAT JOINT
This jont consist 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



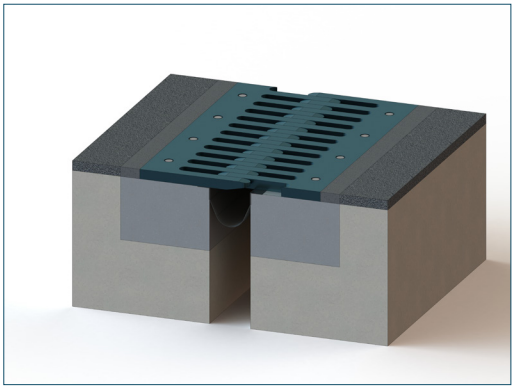
*Rubber Mat Joint*

**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<br>High durability (>50 years) | Limited waterproofing<br>Transveral movements not allowed |
| **HIFLEX** | Low cost<br>Easy installation<br>Transversal movements allowed<br>Silent<br>Limited space required | Medium durability (>30 years)<br>Not recommended in cold climates |
| **HIMOD** | Perfect waterproofing<br>High durability (>50 years) | Expensive<br>Transveral movements limited<br>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



*Finger Type Joint*

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# 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:

$$\Delta T = \pm 30°C$$

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

α = 10-5 for concrete
α = 1.2 x 10-5 for steel

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

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

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# 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

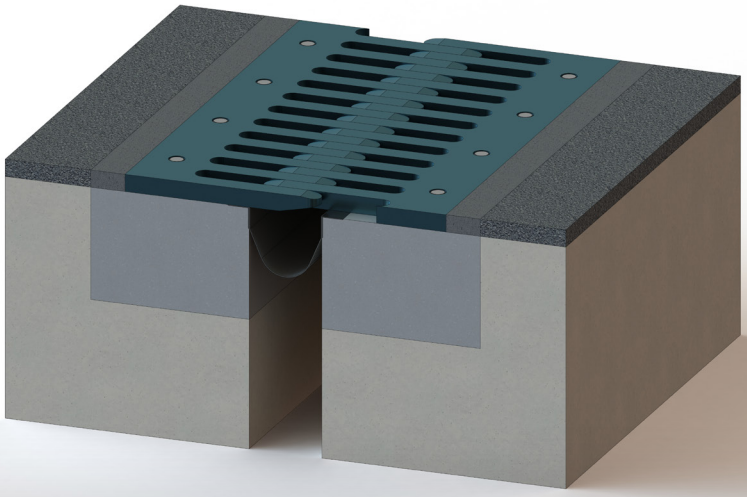
**B. Serviceability Limit State Rare (SLSR)**
It includes the following effects
100% irreversible effects
50% temperature effects
Other actions at SLS
Frequent earthquake (50 years return period)
With this combination the joint movement may exceed the nominal value, however the joint shall remain in 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.
Mayor failures that may generate danger for the utilizers (as for instance falling down of the cross beam in the modular joints) shall be prevented.

# HICOMB FINGER JOINTS

# 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

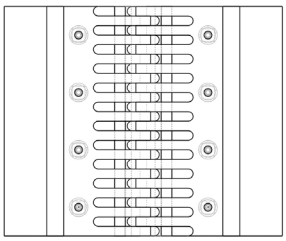
**LONGITUDINAL DISPLACEMENT**

Medium

**TRASVERSAL DISPLACEMENT**

Zero

# HICOMB FINGER JOINTS



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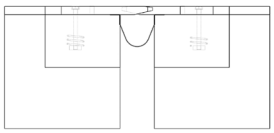


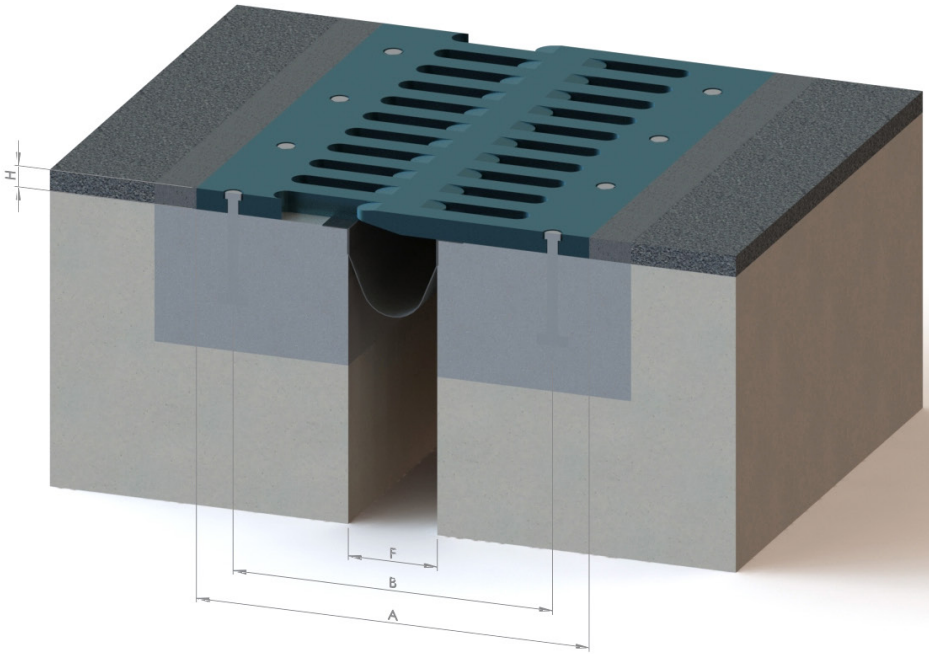
*Section*

## 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 |

Dimensions and performances are given for guidance only.

For a more detailed design please contact our technical office

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# **HIFLEX** RUBBER MAT EXPANSION JOINTS

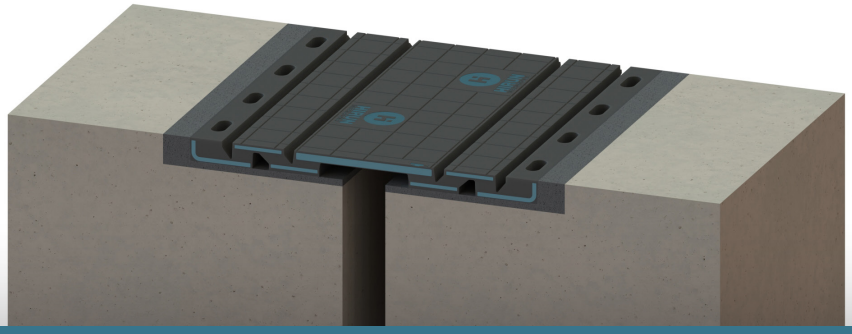
# The very easy solution.

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 isolted bridges

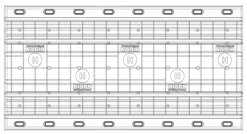
| | |
|---|---|
| **INSTALLATION** | Requires trained team |
| **DURABILITY** | > 30 years |
| **MAINTENANCE** | Not required |
| **COST** | Medium |

**LONGITUDINAL DISPLACEMENT**

Medium

**TRASVERSAL DISPLACEMENT**

High



*Plan*



*Section*

Dimensions and performances are given for guidance only.

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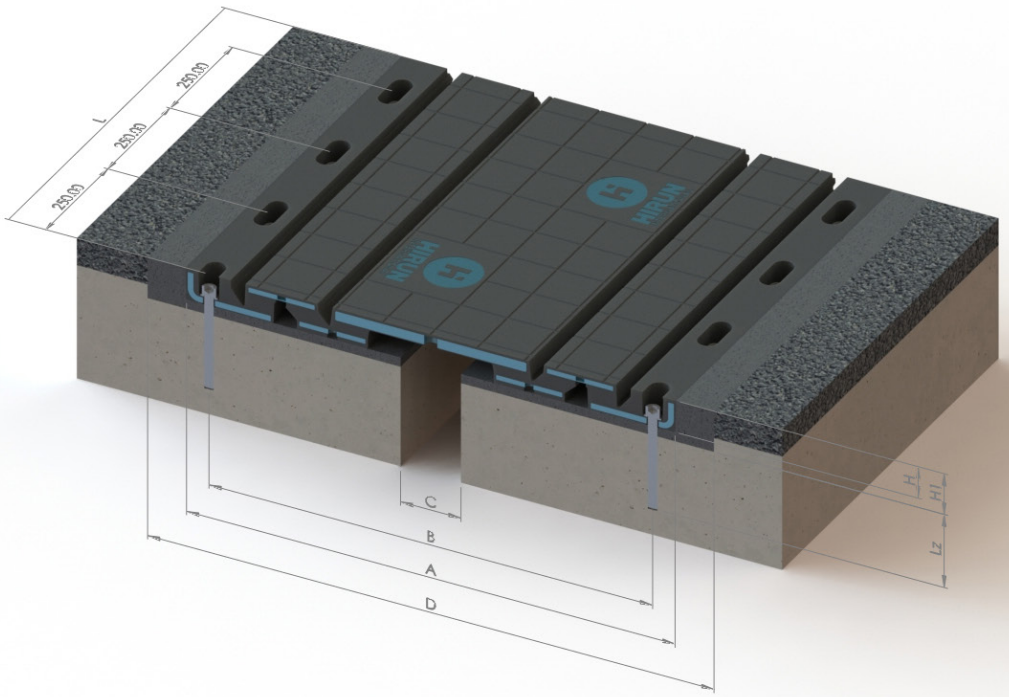
## Dimensions Table

# 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 |

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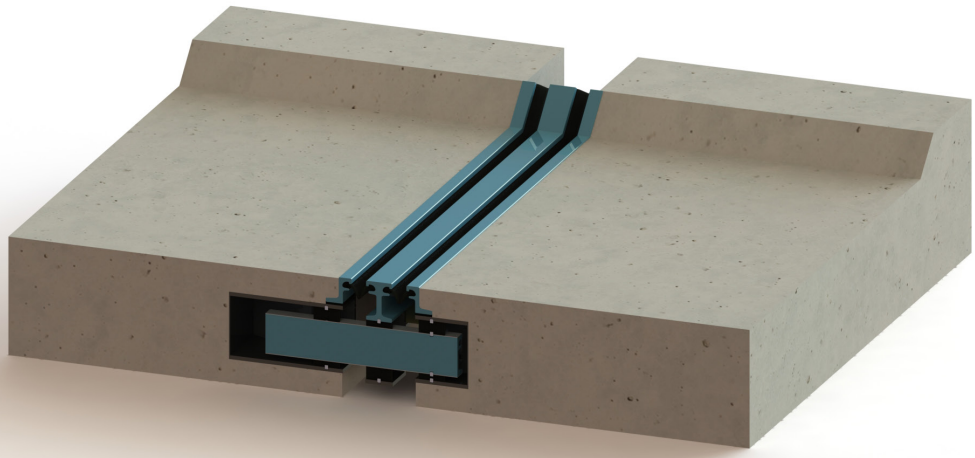
**HIMOD** MODULAR EXPANSION JOINTS

# 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

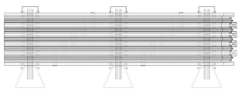
| | |
|---|---|
| **INSTALLATION** | Requires trained team |
| **DURABILITY** | >50 years |
| **MAINTENANCE** | Limited |
| **COST** | High |

**LONGITUDINAL DISPLACEMENT**

High

**TRASVERSAL DISPLACEMENT**

Small



*Plan*



*Section*

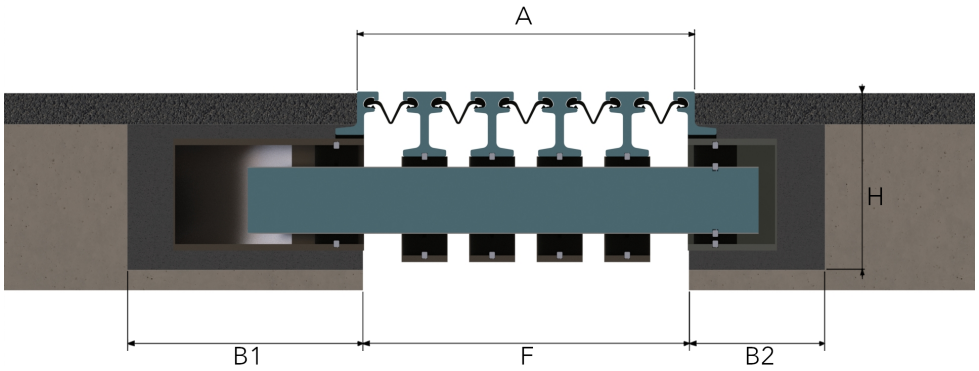
Dimensions and performances are given for guidance only.

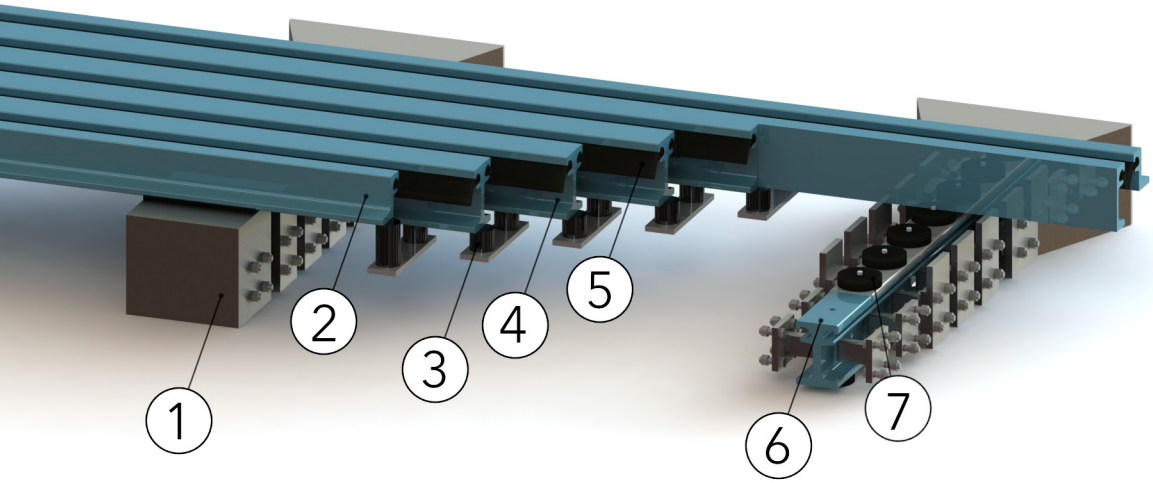
For a more detailed design please contact our technical office

## Dimensions Table

# HIMOD

| JOINT TYPE | Movement ±mm | Rubber seals | A (mm) | Weight Kg | H (mm) | B1 (mm) | B2 (mm) | B3 (mm) | F (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-Highwa Keelung - Xi Zhi | 165M | 2013 |
| Taiwan National Expressway Bureau | Evergreen | C-343B,Douliu Interchenge 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 Developèment Bureau | Evergreen | EW-9/10,East-West-Expressway Wan Li ~ Rui Bin | 88M | 2013 |
| Taiwan Housing&Urban Developèment Bureau | Evergreen | EW-16/17,East-West-Expressway Wan Li ~ Rui Bin | 69M | 2013 |
| Taiwan Housing&Urban Developèment 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-Espresswy NanLiao~ChuTung | 441M | 2013 |
| Taiwan Highway Bureau | Evergreen | E-506, East-West-Espresswy 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 |

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