HC-Omega armour joint
Design guide

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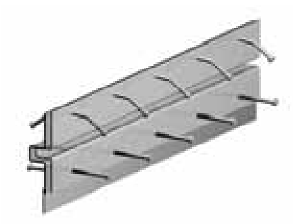
Description

The ***HC-Omega*** construction and expansion joint is made of two continuous cold-rolled profiles in 5 mm thick SJ235JRG2 steel. These profiles fit together tightly due to their clever, standardised form. For anchoring into concrete, these profiles are provided with ø10 mm, 125 mm long anchor bolts that are automatically welded on every 200 mm using resistance butt welding.

The top sides of the profiles are ***milled*** after being assembled to guarantee practically perfect flatness and straightness. The profiles are connected together using wing bolts with plastic nuts that do not need to be removed after being put in place. The profiles are assembled with an overlap of 15mm so that the next profile can easily be connected to the previous profile during installation.
The profile is made in standard lengths of 3 m and is available in heights from 120 to 300 mm. We provide custom solutions above 300 mm.
With their continuous form, these profiles prevent strain being concentrated during load transfer. ***This means that a higher load transfer is possible in comparison to discontinuous profiles***. The patented corrugated upper side in 5 mm thick steel ensures continuous support of passing wheels regardless of the direction, size and form of the wheel, from the placement of the joint to its maximum opening of 20 mm. By neutralising the striking impact of the wheels, forklift drivers experience unprecedented ***comfort.*** At the same time, maximum ***edge protection*** and ***load transfer*** are achieved, significantly reducing the chance of damage to the floor, the vehicle, or the goods being transported. This corrugated upper side is especially recommended in thoroughfares and/or other areas of the floor that experience high forklift traffic.



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Characteristics

- ***Free horizontal expansion and contraction*** of the industrial floor. As the poured concrete dries, the inevitable contraction is taken up by the horizontal spreading of the HC-Omega expansion joint. This prevents the formation of cracks as a result of the drying process. This crack formation also occurs if a hole is cut into the floor too late, which is unnecessary with the installation of a dilatation joint.
- ***Preventing vertical movement*** The minute tolerances between the profiles and the typical Omega form connection prevent the slightest vertical movement between the separate floor sections that are created. The steel profiles also ensure the elastic behaviour of the joint.
- ***Load transfer*** With forklift traffic, the HC-Omega expansion joint provides a transfer of loads from one floor section to another. This means that the floor is less subject to wear, the chance of damage is reduced, and the lifetime of the industrial floor is lengthened considerably. This load transfer is maximised with the corrugated design.
- ***Maximum load.*** The rigid steel structure ensures that maximum loads are handled with minimum deformation.
- ***Edge protection.*** The 5 mm thick steel profiles together with the corrugated design give maximum edge protection. In this way, the chance of the edges of floor sections crumbling is substantially reduced.
- ***Construction joint profile*** The HC-Omega profiles are placed according to a layout plan with limited dimensions to separate the different floor sections. The sections can then be poured and finished according to the daily schedule.
- ***Easy installation.*** The HC-Omega expansion joint is quite easy and quick to install according to the installation instructions given below in this technical documentation.
- ***Shock-free transfer.*** The corrugated design guarantees shock-free transfer between two floor sections up to a maximum opening of 20 mm, even with forklifts with very small wheels.

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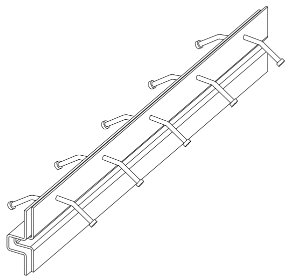
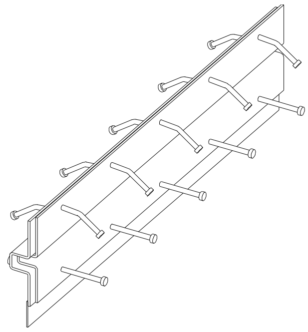
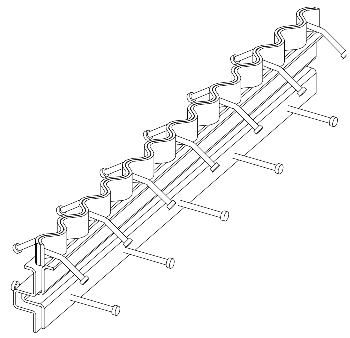
Product overview







Type 1
HC-omega armour joint with 2 x 1 row anchor bolts

Type 2
HC-Omega armour joint with 2 x 2 rows anchor bolts

Type 3
HC-Omega armour joint corrugated with 2 x2 row anchor bolts

Technical specifications of the HC-Omega armour joint

	1	2	3
Thickness		2 x 5 mm	
Steel grade		SJ235JRG2	
Length	3 m	3 m	2.997 m
Type of anchor bolts	Ø10 lg 125 mm 2 x 5 pieces/m Automatically welded	Ø10 lg 125 mm 2 x 10 pieces/m Automatically welded	Ø10 lg 125 mm 2 x 10 pieces/m Automatically welded
Production		Cold rolled for optimal tolerances in construction	
Steel construction		Untreated natural steel electro-galvanized Stainless steel by request	
Profile height	120-200 mm Other dimensions by request	180-300 mm Other dimensions by request	180-300 mm Other dimensions by request
Finishing		Top side milled 15 mm overlap at the end for smooth connections	
Fastening		Attached with M6 x 20 wing bolts and polyamide plastic nuts. These attachments must not be removed after installation. The tensile force of the concrete breaks the connection with the polyamide nut.	
Concrete reinforcement		Both concrete with steel mesh and fibre reinforced concrete	
Fittings		T- and X-shaped intersections	
Auxiliary equipment		Tool for height adjustment and placement	
Straightness of horizontal surface		1 mm / 3 m	
Straightness of vertical surface		2 mm/3m	
Shock-free transfer	N	N	YES

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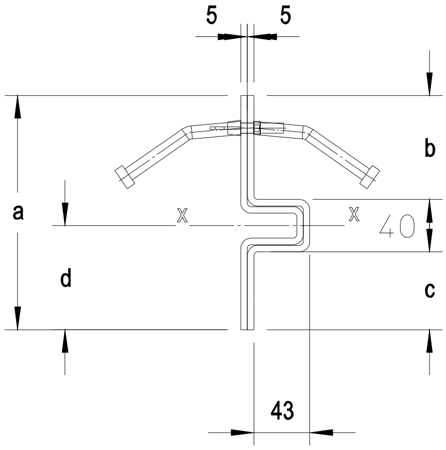
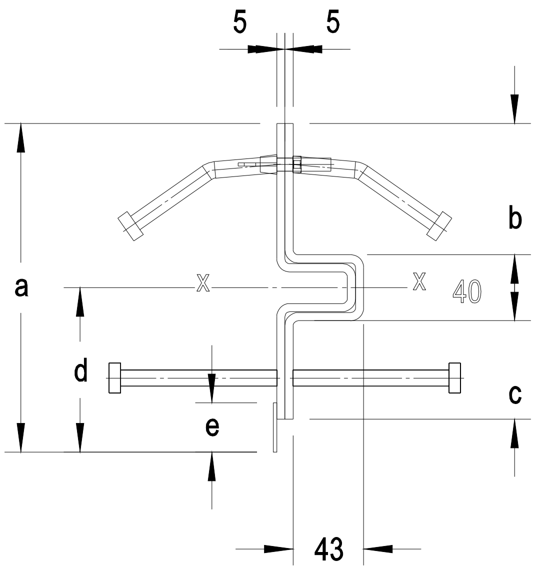


HC-Omega a x 5, 2 x 1 row of pins								
Profile height a (mm)	**Floor thickness (mm)**	**b (mm)**	**c (mm)**	**d (mm)**	**Ixx (cm^4)**	**Wxx (cm^3)**	**Weight kg/metre**	**Metres per pallet**
120	130-140	55	25	53.7	131	20	15.9	126
130	140-150	60	30	59.0	165	23	16.7	126
140	150-160	70	30	62.4	195	25	17.5	108
150	160-170	70	40	69.5	252	31	18.3	108
160	170-180	70	50	76.5	323	39	19.2	108
180	190-200	80	60	86.8	460	49	20.8	90
200	200-220	85	75	98.5	659	65	22.5	90



HC-Omega a x 5, 2 x 2 row of pins									
Profile height a (mm)	**Floor thickness (mm)**	**B (mm)**	**C (mm)**	**D (mm)**	**E (mm)**	**Ixx (cm4)**	**Wxx (cm³)**	**Weight kg/metre**	**Metres per pallet**
160	130-140	70	50	76.5	0	323	39	20.39	108
180	140-150	80	60	86.8	0	460	49	22.03	90
200	150-160	85	75	98.5	0	659	65	23.66	90
220	160-170	85	75	111.2	30	785	72	24.27	81
240	170-180	85	75	124.5	50	947	82	24.75	81
260	190-200	85	75	137.7	70	1154	94	25.23	63
280	200-220	85	75	150.9	90	1406	109	25.71	63
300	200-220	85	75	163.9	110	1705	125	26.19	63

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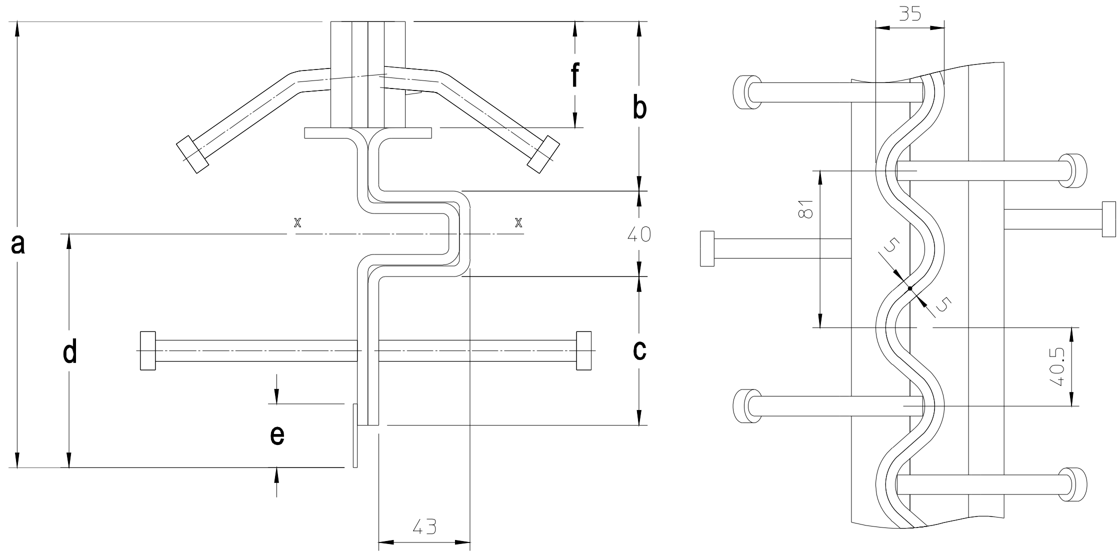

Top view

HC-Omega a x 5, corrugated construction 2 x 2 rows of anchors									
Profile height a (mm)	**Floor thickness (mm)**	**b (mm)**	**c (mm**	**D (mm)**	**E (mm)**	**F (mm)**	**Ixx (cm^4)**	**Wxx (cm^3)**	**Weight (kg/m)**
140	150-160	75	25	60	0	35	324	54	18.86
160	170-180	95	25	72	0	45	466	64	20.62
180	190-200	100	40	84	0	45	728	87	22.22
200	210-220	110	50	95	0	55	1097	115	24.02
220	230-240	120	60	105	0	55	1616	152	25.62
240	250-260	130	70	117	0	55	2314	197	27.22
260	270-280	130	70	135	30	55	3152	233	27.70
280	290-300	130	70	156	50	55	4243	270	28.02
300	310-320	130	70	174	70	55	4773	315	28.34

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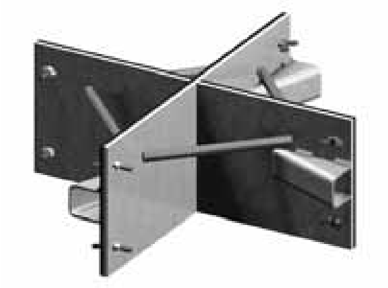
Accessories

Junctions

These are available in all dimensions in proportion to the profile used.

X-junctions



T-junctions

Assembly assistance

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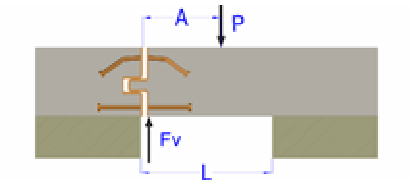
Load transfer

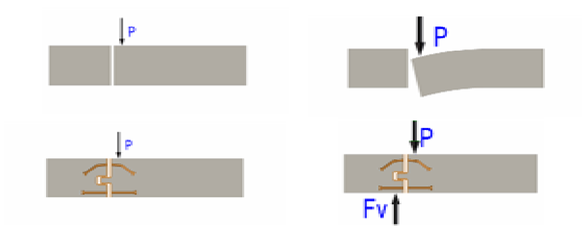
The load transfer by the profile depends on a number of factors

- A primary factor is a position variable. This indicates the position of the load relative to the joint and support.



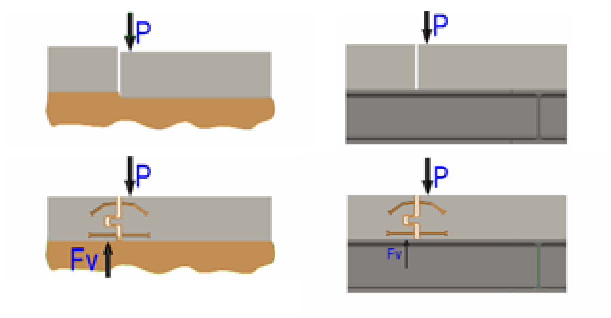
$$F_v = \frac{P \times (L-A)}{L}$$

- A second factor is the size of the load in proportion to the thickness of the floor. Load transfer is only provided from the moment that the load is large enough to move or deform the floor section until any play between the sections has been taken up.



Small load　　Large load

- A third factor that affects load transfer is the foundation. With a massive foundation, the loads will be supported by the foundation. In the case of a floor on piles, the load will have to be fully supported by the profile.



Unstable foundation　　Massive foundation

If a load is placed on the edge of a slab, the strain in the concrete is about 50% higher than a load in the middle of the slab. The expansion joint compensates this increase and will transfer up to 100% of this load to the adjoining slab, depending on the foundation, the position and size of the load.

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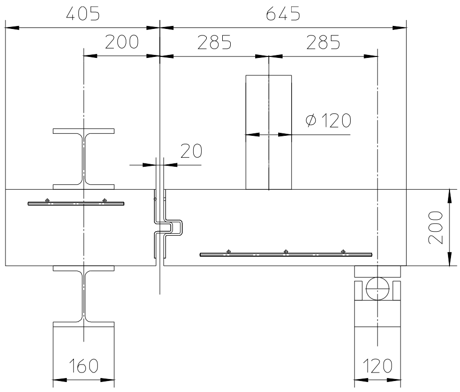
Testing

The joints have been tested to their maximum capacity by the Magnel lab associated with the University of Ghent.

Test setup

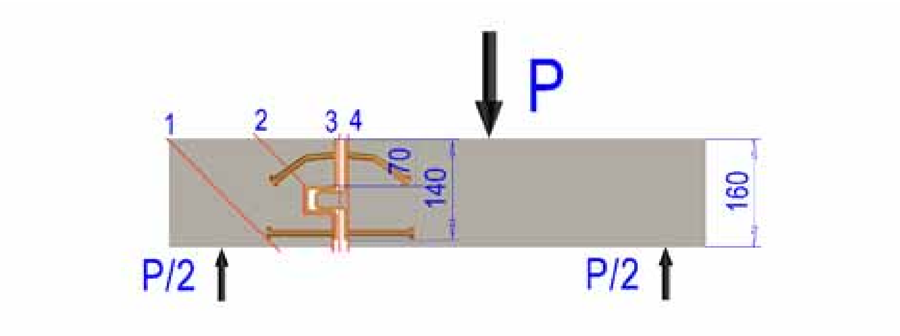
It was decided to test the joint without support such that the load transfer through the joint was maximized.
The joint was placed in a test specimen with dimensions 1 m x 1.05 m.
The joint openings of 10 mm and 20 mm were tested.
For the concrete, a test was done with non-reinforced concrete (c30/37) and with fibre reinforced concrete (45 kg fibres/m^3).



Test results

Type	Anchors upper/lower	Opening (mm)	Concrete height (mm)	Fibre reinforced concrete (y/n)	Failure load kN
HC-Omega 140	Upper	10	150	N	90
HC-Omega 140	Upper	20	150	N	120
HC-Omega 180	Upper	10	200	Y	160
HC-Omega 180	Upper	20	200	Y	197
HC-Omega 180	Upper + lower	10	200	Y	272
HC-Omega 180	Upper + lower	20	200	Y	244

Analysis of the different ways the joint failed



Technical data

- Concrete thickness H: 160 mm
- Height of the profile: h= 140 mm.
- Anchor failure strength: σ_{ank} 450 N/mm^2
- Failure strength of steel σ_{st} = 350 N/mm^2
- Characteristic compression strength of the concrete f_{ck} = 25 N/mm^2
- Anchor diameter ø10 mm
- Load transfer 50%
- P = force per length unit
- n_{ank} = Number of anchors per length unit
- ζ= shear stress

Different ways of failure

Hc-Omega with one row of anchors

1. Failure of the concrete due to shear:

$$P = 1/\text{Load transfer} * H * \sqrt{2} * \zeta \quad \text{where } \zeta = 0.05 \text{ x}* f_{ck} / 1.5$$

$$P = 1/0.5 * 160 * \sqrt{2} * 0.05 \text{ x } 25 / 1.5$$
$$= 377 \text{ kN}$$

2. Failure of the anchors on the side of the nose

$$P = 1/\text{load transfer} * (a * \sqrt{2} * \zeta + A_{ank} * n_{ank} * \zeta_{ank})$$

$$\text{where } \zeta_{ank} = 0.8 \text{ x}* \sigma_{ank}$$

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$P = 1/0.5 * (70 * \sqrt{2} * 0.05 * 25 /1.5 + 10^2 * \pi/4 * 6 * 0.8 * 0.45)$

P = 504 kN

3. Failure of the profile

$P = 1/\text{load transfer} * A * \zeta_{st}$

where $\zeta_{st} = 0.8 x * \sigma_{st}$

$P = 1/0.5 * (5 * 4 * 0.8 * 350)$

P = 11,200 kN

4. Failure of the anchors on the flat side

$P = 1/\text{load transfer} * (a * \zeta + A_{ank} * n_{ank} * \zeta_{ank})$

where $\zeta_{ank} = 0.8 x * \sigma_{ank}$

$P = 1/0.5 * (20 * 0.05 * 25 /1.5 + 10^2 * \pi/4 * 6 * 0.8 * 0.45)$

P = 372 kN

For the given example, the load applied along the joint could reach 372 kN taking into account that 50% of this charge is transferred.

Hc-Omega with two rows of anchors

1. Failure of the concrete due to shear:

$P = 1/\text{Load transfer} * H * \sqrt{2} * \zeta$ where $\zeta = 0.05 x * f_{ck} / 1.5$

$P = 1/0.5 * 160 * \sqrt{2} * 0.05 x 25 / 1.5$

= 377 kN

2. Failure of the anchors on the side of the nose

$P = 1/\text{load transfer} * (a * \sqrt{2} * \zeta + A_{ank} * n_{ank} * \zeta_{ank})$

where $\zeta_{ank} = 0.8 x * \sigma_{ank}$

$P = 1/0.5 * (70 * \sqrt{2} * 0.05 * 25 /1.5 + 10^2 * \pi/4 * 10 * 0.8 * 0.45)$

P = 730 kN

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3. Failure of the profile

P = 1/load transfer * A * ζ_{st}
where ζ_{st}= 0.8 x* σ_{st}

P = 1/0.5 * (5 * 4 * 0.8* 350)
P = 11,200 kN

4. Failure of the anchors on the flat side

P = 1/load transfer * (a * ζ + A_{ank}* n_{ank} * ζ_{ank})
where ζ_{ank}= 0.8 x* σ_{ank}

P = 1/0.5 * (20 * 0.05 * 25 /1.5 + 10^2 * Л/4 * 10 * 0.8* 0.45)
P = 598 kN

For the given example, the load applied along the joint could reach 598 kN taking into account that 50% of this charge is transferred. However the failure of the concrete will be at 377 kN

The values given in this example are only indicative values and must always be verified by a structural engineer.

The safety factors must be chosen in function of the application and rulings.
Higher safety factors must be used for dynamic loads than for static loads.
For floors on piles, we always recommend expansion joints with two rows of anchors.

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Installation instruction

The floor slab should be divided into square sections as much as possible. If this is not possible, the proportion of 3/2 for the width/length of the floor slab should be respected as much as possible.

The distance between the joints is determined in function of the expected shrinkage of the concrete. The shrinkage of a floor slab is strongly dependent on a number of thermal variables as well as the quality of the concrete. In any case, an attempt must be made to limit the opening of the joints to a maximum of 20 mm.
An indication in normal conditions would be floor sections of 30 to 40 metres. However, the advice of the project leader or expert is always recommended because shrinkage can vary considerably from country to country due to local environmental factors and concrete quality.

For intensively loaded floor sections, such as floors at loading bays and thoroughfares, we advise the use of the patented corrugated profile. The added cost is minimal relative to the total project investment, and is quickly recovered in view of the many advantages.

Fixed structures in the building such as columns and walls must be isolated with compressible material.

Ensure that no fixed connections are placed between 2 different floor slabs that could hinder the movement of these floor slabs, e.g. racks, conveyor belts, crash barriers, etc.

For some floors that are placed on a watertight membrane or insulation for example, the use of anchoring in the ground is not permitted. As an alternative we have adjustable placement feet available in our product range that do not require drilling through the foundation.

For floors on supporting piles, we always advise dilatation joints with a double row of anchors.

Check the presence of utilities and underground lines when using anchoring with pins in the ground.

A demonstration video of these installation instructions is available on our website at www.hcjoints.eu. This can be found on the page PROFILES / HC-O joint.

1. String a line in the location where the profiles are to be installed.
2. Lay the joints out along this line.
3. Place the first joint parallel to this line.
4. Bring them to the correct height using wedges or the height adjustment tool. (See accessories)
5. Hammer or drill pins into the ground vertically along the ends of the anchors with 2 on each side of the end of the profile. If desired, an additional pin can be placed in the middle of the profile.
6. Check the height level of the profile with a laser and check the alignment relative to the taut line.
7. Use a spirit level to check the levelness of the profile across the length.
8. Weld the pins to the profile. If welding work is not permitted on site, special adjustment feet are available.
9. Place the next profile with its overlap in the first profile. With the overlapping, the start of this profile is immediately at the correct height.
10. Bring the end of the second profile to the correct height with wedges or the height adjustment tool.
11. Repeat these steps from point 5 until an intersection, wall or column is reached.

For intersections:

1. Place the intersection in the location specified on the layout plan.
2. Measure the distance between the last placed joint and the intersection. Cut the joint to be placed to the correct length using a cutting disc.
3. Place the joint that has been cut to length according to the procedure described above.
4. Bring the intersection to the correct level and weld it to the joint. Remember to weld the supplied noses on to prevent the penetration of poured concrete into the joint.

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Maintenance and finishing

The HC-Omega dilatation joint is designed to protect the edges of concrete slabs that are automatically formed when the joint opens due to the shrinkage that occurs in the drying process.
We advise filling the openings that are created with a joint or sealing product to prevent the accumulation of dirt and dust in the joint. Sealing the joint with hard material also reduces the impact of forklift traffic on the edges of the profile.
The final sealing may only be done once the expansion of the joint is stabilised.