RECOSTAL
BY DYWIDAG

RECOSTAL® Keyboard

Isolation joint for concrete floor slabs

RECOSTAL® Keyboard

Introduction

RECOSTAL® Keyboard units are designed as formwork for the installation of contraction joints in industrial ground floor slabs. Rather than subsequently saw cuttings joints, a controlled crack appears along the unit.

The trapezoidal profile provides a keyed profile between the slabs. Deflection of the individual floor slabs can thus be avoided. In order to increase the capacity to withstand shear forces, the RECOSTAL® Keyboard units can be equipped with additional dowel bars.

The height can be adjusted with set-screws incorporated in the formbraces. There is a wide variety of systems available for the top of the RECOSTAL® Keyboard units to allow for various applications.

Design of joints in industrial ground floor slabs

Occuring erratic shrinkage during the installation of industrial ground floor slabs leads to the formation of cracks, a process that has to be taken into account. A common method is to saw cut joints.

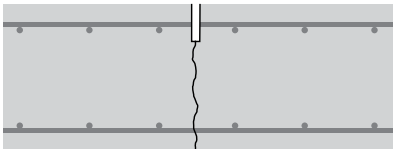
The 5 to 7 cm deep sawn joints weaken the surface of the plane and induce a planned crack. Typically the concrete should crack along this joint during shrinkage.

Refurbished saw cut joint with supplementary dowel bars

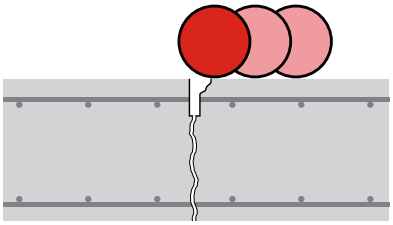
Risks of saw cut joints

Subsequent saw cutting causes uncontrolled crack patterns which make the planned transfer of shear forces impossible. The undefined shear force, when exposed to loads generated by shrinking slabs and forklift trucks, leads to spalling.

Industrial ground floor slabs with constant forklift loading are especially subsceptible to damage. Subsequent remedial action is costly and entails extensive technical refurbishing operations.



Saw cut joint with early stages of crack formation



Initial spalling and crack formation

Keyboard units provide the safe solution

Rather than saw cutting joints, keyboard units are installed in order forklift trucks are transferred effectively even if the joint opens. The load bearing capacity of the keyboard units was verified by tests carried out by the MFPA Leipzig.

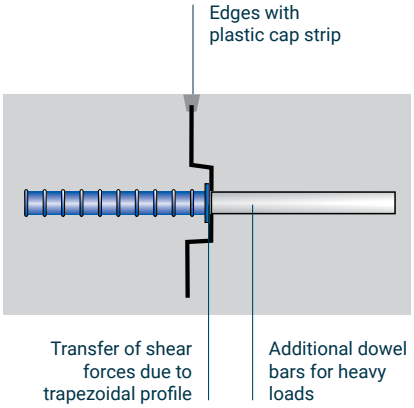
Depending on the distance of the joint and the joint opening, spalling of edges is prevented by angled plastic cap strips or edge protection profiles made from sharp-edged flat steel.

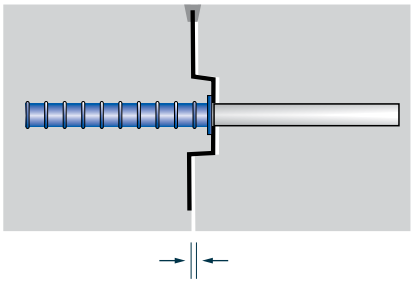
According to the DBV- Bulletin “Industrial floor slabs“

In the case of constructions with contraction joints, the planner has to point out to the contractor that damage to the joint is likely to occur when subjected to dynamic loads and that the appearance of cracks outside the joint can not be ruled out.

Isolation joint units for industrial floor slabs

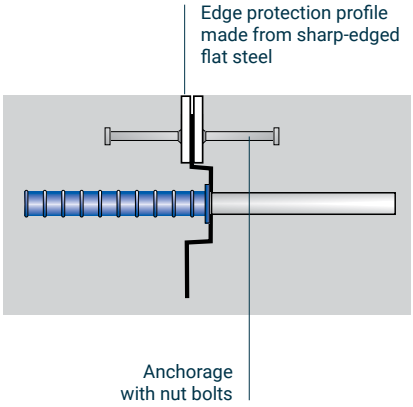
RECOSTAL® Keyboard XL for small joint expansions

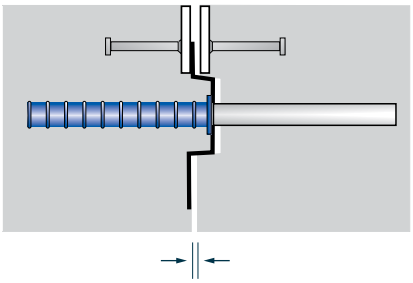




Joint expansion less than 3 mm

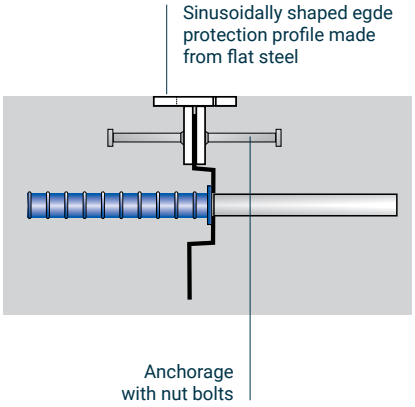
RECOSTAL® Keyboard XLV/XLW for larger joint expansions

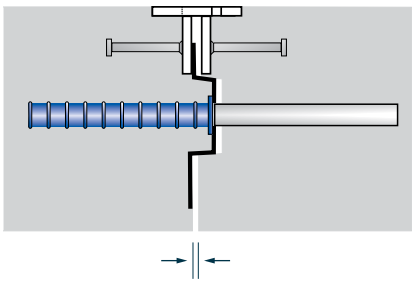




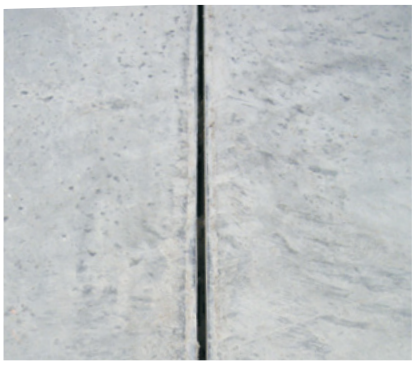
Joint expansion up to 12 mm

RECOSTAL® Keyboard XLS to reduce vibration

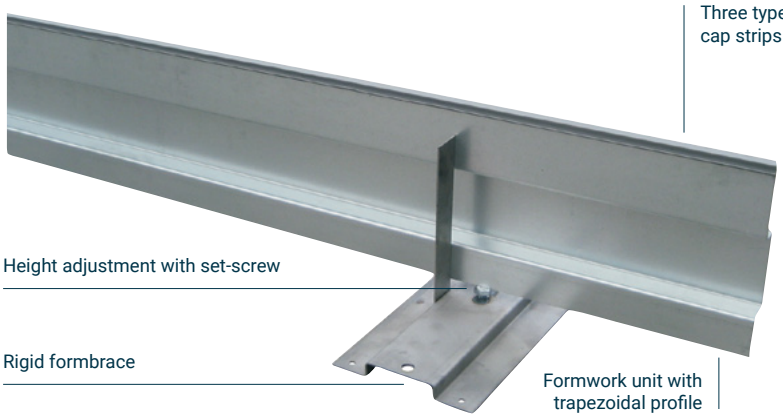


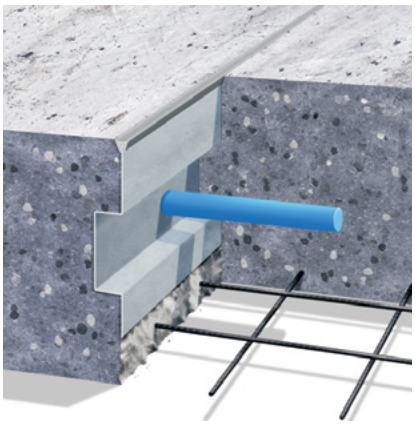


Joint expansion up to 12 mm

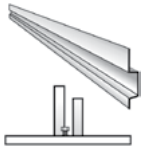


RECOSTAL® Keyboard XL



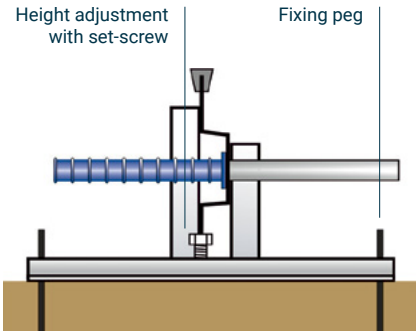


List of parts RECOSTAL® Keyboard XL



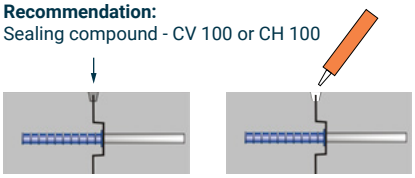
Keyboard type	Formbrace type	Unit height	Slab height[1)]
XL 150	KBS 150	120	150
XL 180	KBS 180	145	180
XL 200	KBS 200	165	200
XL 250	KBS 250	215	250
XL 300	KBS 300	265	300

1) Other heights available on request

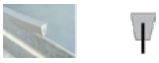
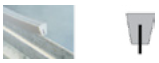
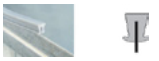


RECOSTAL® Keyboard XL units induce the appearance of planned cracks along the joint. The top of the unit consists of a plastic cap strip which can be installed either as a permanent or a removable strip. If the cap strip is removed, the joint can be sealed with an elastic sealing compound.

Recommendation:
Sealing compound - CV 100 or CH 100



Accessories RECOSTAL® Keyboard XL

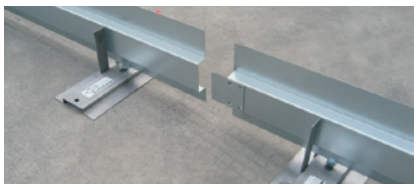
	Item
	PVC cap strip type 75E, removable, width 7.5 mm, colour: grey, 24 m/roll
	PVC cap strip type 120E, removable, width 12 mm, colour: grey, 6 m/roll
	PVC cap strip type 95P, permanent, width 9.5 mm, colour: grey, 24 m/roll, UV-stabilised
	Contaseal Joint Sealing Compound CH 100 highly elastic with strong bond, 600 ml tube
	Contaseal Joint Sealing Compound CV 100 highly elastic with strong bond, 4 kg can

Dowel bars for RECOSTAL® Keyboard XL, XLV and XLS

	Item
	Dowel sleeve, PVC, for dowel bars Ø 16 mm, L = 300 mm for dowel bars up to L = 600 mm, can be shortened to any length
	Dowel sleeve, PVC, for dowel bars Ø 20 mm, L = 300 mm for dowel bars up to L = 600 mm, can be shortened to any length
	Dowel bar Ø 16, L = 300/400/500/600 mm, galvanized Dowel bar Ø 20, L = 300/400/500/600 mm, galvanized Other dowel diameter on request

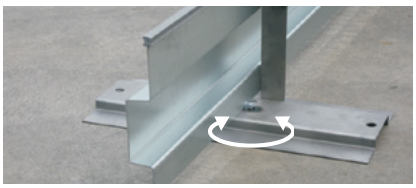
Dowel centres to specification

Cap strip



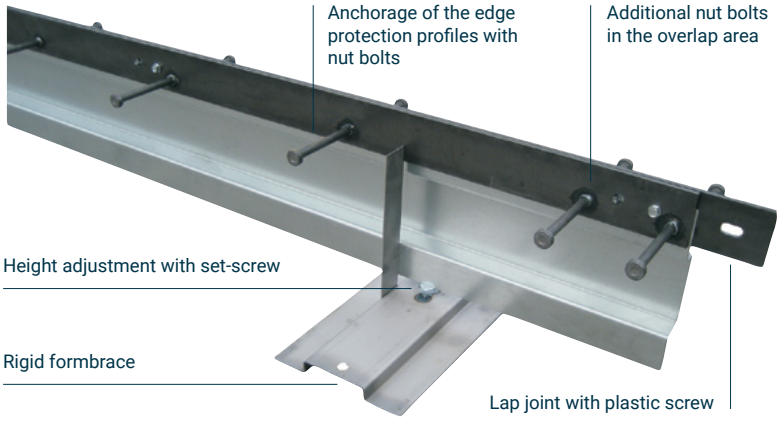
Lap joint

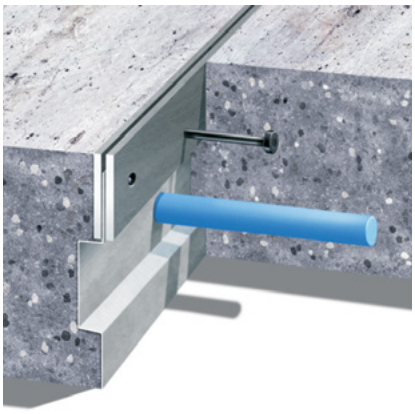
Stable installation with formbrace



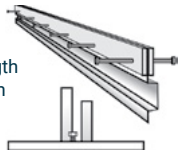
Height adjustment with set-screw

RECOSTAL® Keyboard XLV/XLW





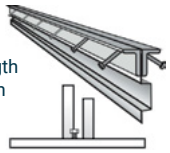
List of parts RECOSTAL® Keyboard XLV



Keyboard type	Formbrace type	Unit height	Slab height[1)]
XLV 150	KBS 150	120	150
XLV 180	KBS 180	145	180
XLV 200	KBS 200	165	200
XLV 250	KBS 250	215	250
XLV 300	KBS 300	265	300

1) Other heights available on request

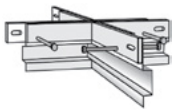
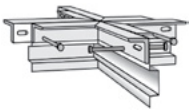
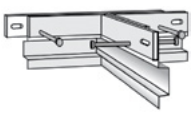
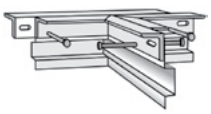
List of parts RECOSTAL® Keyboard XLW

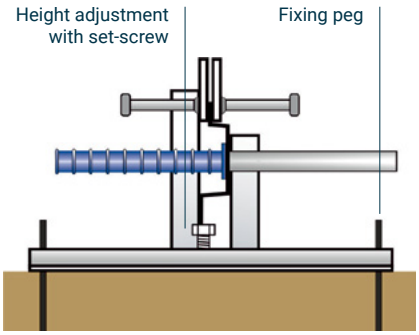


Keyboard type	Formbrace type	Unit height	Slab height[1)]
XLW 150	KBS 150	120	150
XLW 180	KBS 180	145	180
XLW 200	KBS 200	165	200
XLW 250	KBS 250	215	250
XLW 300	KBS 300	265	300

1) Other heights available on request

RECOSTAL® Keyboard preshaped parts

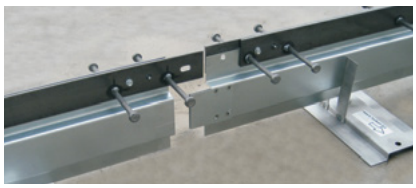
Cross unit XLV	Cross unit XLW
	
T-unit XLV	**T-unit XLW**
	



RECOSTAL® Keyboard XLV/XLW units induce the appearance of planned cracks along the joint. The top of the units consists of edge protection profiles which protect the concrete edges from spalling. There is a choice between type XLV and type XLW, depening on the respective requirement for edge protection.

Standard edge protection profiles are black steel. On request edge protection profiles are also available galvanized or made from non-corroding steel.

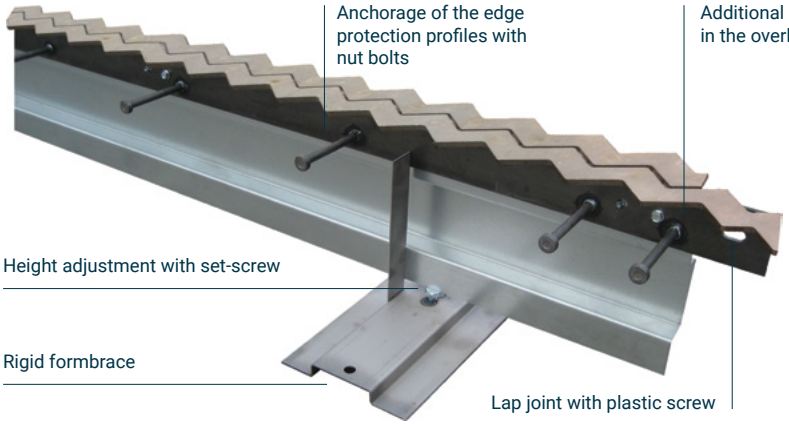
Intermediate sizes and fixed lengths are available on request.

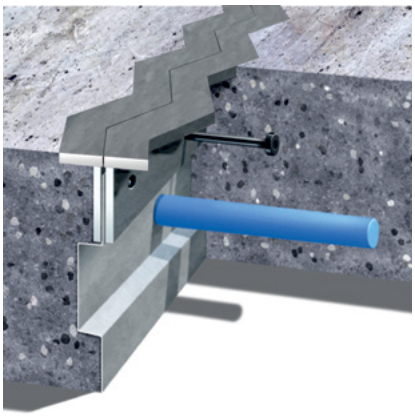

Lap joint


Lap joint with plastic screw

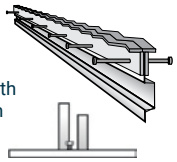

Height adjustment with set-screw

RECOSTAL® Keyboard XLS



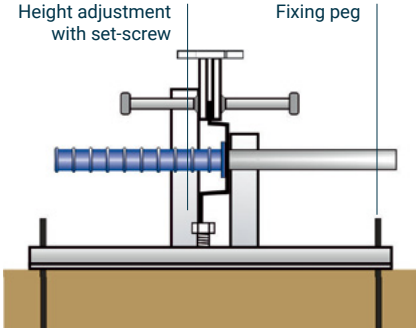


List of parts RECOSTAL® Keyboard XLS



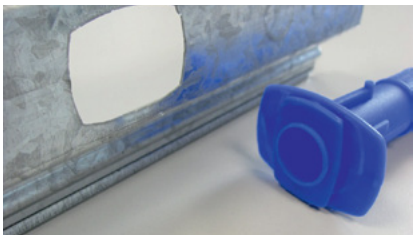
Keyboard type	Formbrace type	Unit height	Slab height[1)]
XLS 180	KBS 180	145	180
XLS 200	KBS 200	165	200
XLS 250	KBS 250	215	250
XLS 300	KBS 300	265	300

1) Other heights available on request



RECOSTAL® Keyboard XLS units induce the controlled formation of cracks along the joint. In addition to providing edge protection, vibration and shock-free passage over the joint is guaranteed. The sinusoidally shaped edge protection overlaps far enough to allow constant contact between the wheel and the track. Thus noise emissions, whole-body vibration and tyre wear are considerably reduced. Joint expansions of up to 12 mm are possible without having to take further measures.

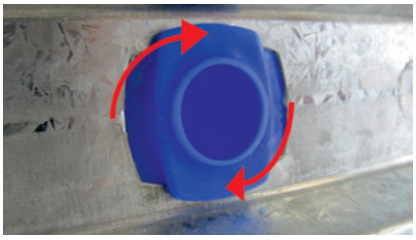
In the case of heavier shear force loads, RECOSTAL® Keyboard XLS can be fitted with additional dowel bars. The load capacities have been tested by the MFPA Leipzig. The edge protection profiles are typically made of black steel. On request, however, galvanized or non-corrosive edge protection profiles are also available. Preshaped parts like diversion or cross units are designed to fit perfectly. Positioning for the whole project can be included. Intermediate sizes and fixed lengths are also available on request.



Opening to accommodate dowel sleeve

Joint after concreting

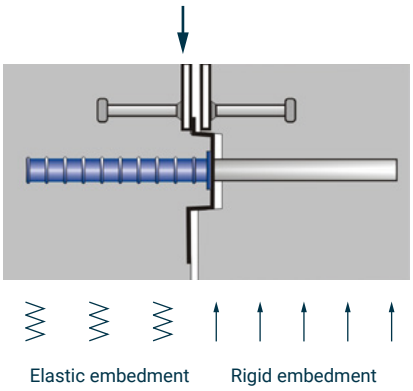
Joint expansion after shrinkage



Attachment of the dowel sleeve

Load bearing behaviour

Test set-up



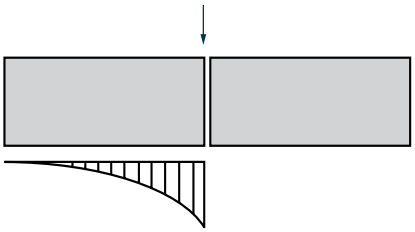
Testing of the load bearing capacity by the MFPA-Leipzig

Industrial ground floor slabs in standard applications are not regarded as structural elements in terms of the DIN EN 1992-1-1 and the DIN 1055-100. There is no Standard covering the design of concrete floor slabs for production halls and warehousing but the guidelines of the DIN EN 1992-1-1 and the DIN 1055-100 are highly recommendable for the construction of these industrial floor slabs.

For additional guidance regarding the design of the joints, a series of laboratory tests was carried out by the MFPA-Leipzig to determine the bearing capactiy of the Keyboard units. 15 - 25 cm high slabs with varying joint openings of up to 12 mm were tested. The effect of applied loads in the case of Keyboard units with additional dowel bars was also examined. Table 1 shows the results from the load tests taking into account added safety factors.

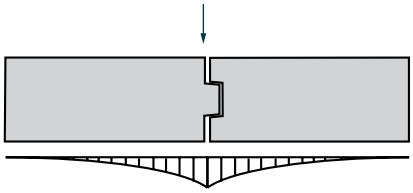
Differences in the load bearing behaviour

Load bearing behaviour of an open joint without trapezoidal profile

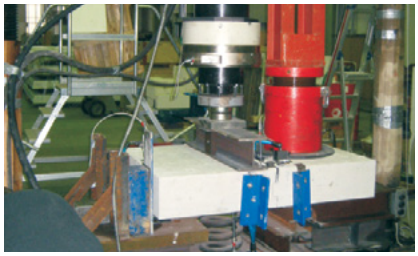


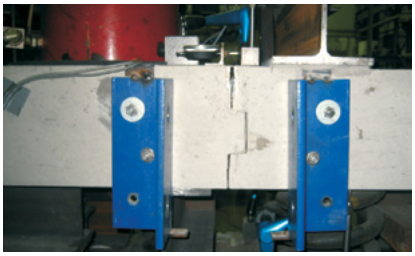
Extensive deflection, heavy load

Load bearing behaviour of an open joint with trapezoidal profile



Little deflection, light load





Load bearing behaviour of the Keyboard units

The specific trapezoidal profile of the Keyboard units and the option of including additional dowel bars allow for the transfer of shear forces across the adjacent slab. This results in a reduction of slab deformation and deflection and therefore reduces the bending stress applied to the concrete slab. Thus a much more economic design and construction of the floor slab in the particularly critical area around the slab edges is ensured. Due to the trapezoidal profile or dowel bars, the shear force to be transferred across the joint may, according to Lohmeyer/Ebeling*, be reduced by multiplying by the load factor = 0.60 (0.55). This validated by example FEM-calculations.

* Lohmeyer/Ebeling, Concrete Floors for Production Halls and Warehouses, issue 2008.

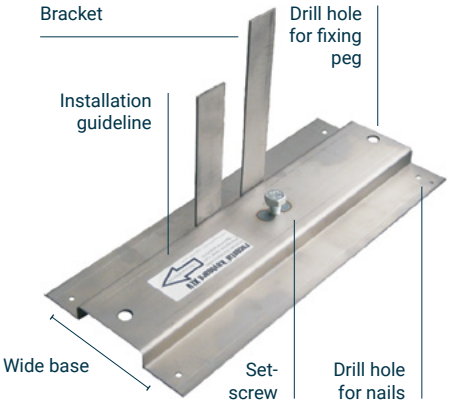
Bearing capacity of Keyboard units

Rated bearing capacity	10 kN	15 kN	25 kN	40 kN	60 kN
Wheel load	**Q_k = 13 kN**	**Q_k = 20 kN**	**Q_k = 32 kN**	**Q_k = 45 kN**	**Q_k = 70 kN**
Slab height 15 cm	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard with dowel bars Ø 20 mm, s = 40 cm		
Slab height 20 cm	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard with dowel bars Ø 20 mm, s = 40 cm	
Slab height 25 cm	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard with dowel bars Ø 20 mm, s = 40 cm
Slab height 30 cm	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard without dowel bars	Keyboard with dowel bars Ø 20 mm, s = 40 cm

Based on: forklift truck loading according to DIN 1055-3, concrete C25/30 (structurally reinforced), material g = 1.5, load gq = 1.6
Joint expansion v = 12 mm (in the case of smaller joint expansions heavier loads might be possible).

Installation

Fast installation with Keyboard formbraces



The installation with Keyboard formbraces has many advantages.

Wide base

- When inserting the Keyboard units, the wide formbrace makes handling very easy as it provides a stable footing.

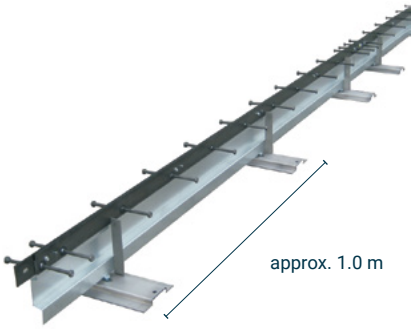
Stable against concrete pressure

- Due to the design of the dimensions, the formbraces only need to be prevented from moving sideways. They are placed at a distance of approx. 1.0 m.

Easy and exact height adjustment

- The adjustment in height is exact to the millimeter with set-screws type M12.

Keyboard installation



- Place one Keyboard formbrace approx. every metre in line with the joint. Please note sticker pointing out direction.
- Insert Keyboard unit into the formbrace and connect lap joints with the included plastic screws.
- Align Keyboard units in a straight line and exact direction.
- Fix Keyboard formbraces with fixing pegs or, in the case of an existing blinding layer, with nail gun to prevent them from moving sideways.
- Exact height adjustment of the Keyboard units with set-screws.

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