

TERA Joint

High quality floor joint system



ISO 9001
ISO 14001

6/2008

Peikko® TERA Joint



Benefits of Peikko® TERA Joint

- Advanced 'leave-in-place' concrete slab formwork system with integral load transfer capability and edge protection
- Excellent straightness tolerances
- High precision cold-drawn steel edge protection rails with 'sharp' edges are used to eliminate any weakness or friability in the edge of the concrete slab
- Fast installation with accessories and completely without welding
- Helps to ensure a trouble-free floor for the life-cycle of the building
- Joint uses a significant percentage of sustainable material in its construction



CONCRETE CONNECTIONS

Peikko benefits

- reliable: passed demanding test program
- competitive price and delivery time
- economical and easy to use in designing, manufacturing and installation of the elements

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TERA Joint

1. DESCRIPTION OF THE SYSTEM

Peikko® TERA Joint floor joint system offers the best practical and technical solution for today's high quality concrete ground floor slabs. The system ensures adequate load transfer in expansion, contraction and construction joints and eliminates resistance to joint opening and movement in two directions in horizontal plane. The system also provides extremely durable edge protection to the concrete slabs, particularly when subjected to traffic

The load transfer is achieved by high strength steel circular plate dowels which are combined with rigid release sleeves to allow free slab movements in both longitudinal and perpendicular directions, eliminating the principle cause of shrinkage cracks.

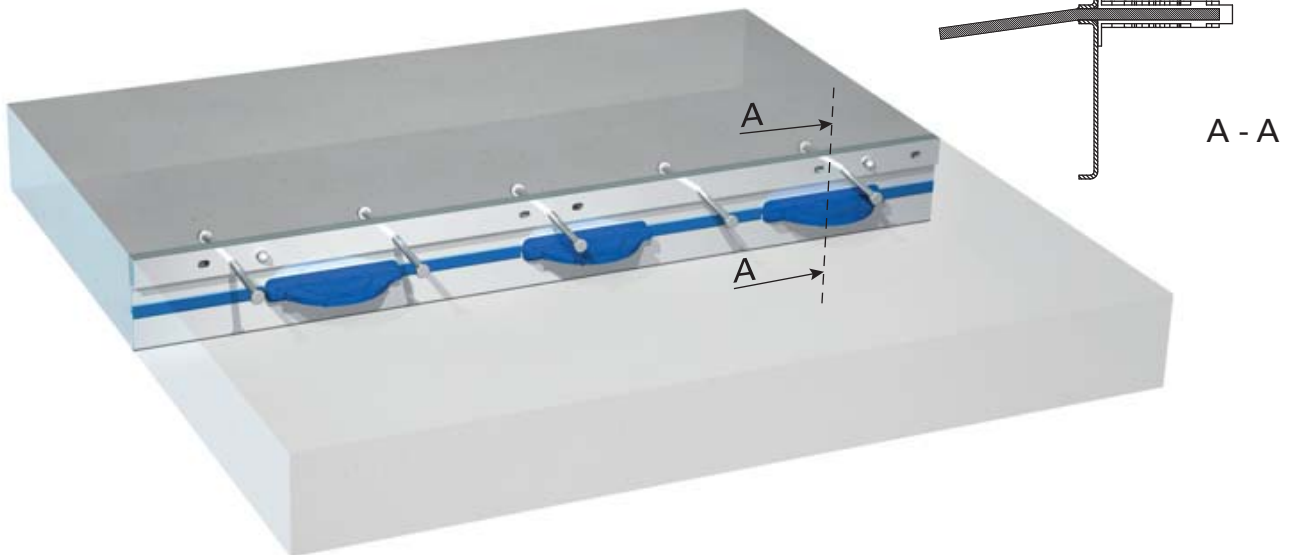
The TERA Joint system also acts as self-contained leave-in-place formwork requiring no stripping after pouring saving significant time and manpower. Using this system means faster and easier floor slab construction, better quality floors and maintenance-free joints. They can be used in ground-supported slabs starting from 100 mm slab thickness.

The system consists of the armoured joints themselves along with easy to use junction pieces and installation parts.

The circular plate dowels and sleeves are also available separately for use with traditional timber formwork as a solution to the problem of slab locking caused by conventional dowels.

Circular dowels pictured are not available in the UK. Please contact your Peikko representative for details of UK specifications.

Figure 1. Peikko TERA Joint system in ground floor slab and section of TERA Joint



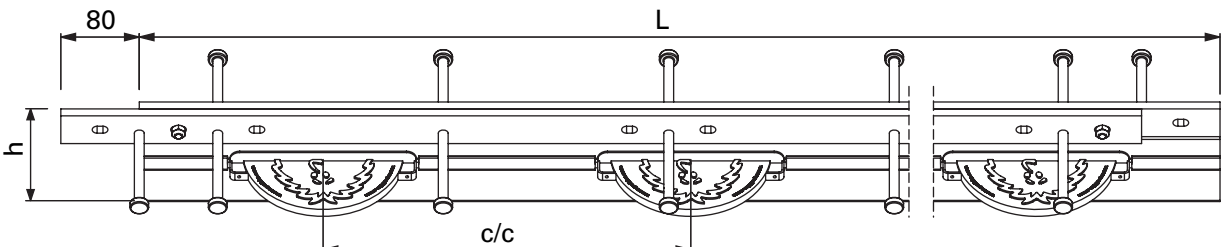
2. DIMENSIONS AND MATERIALS

Table 1. Materials and standards.

	Sheet metal	Flat bars	Plate dowels	Headed studs	Plastic sleeves
TERA Joint	S235JR	S235JRC+C	S355J2+N	S235J2+C450	ABS
TERA Joint HDG	S235JR EZP	S235JRC+C HDG	S355J2+N HDG	S235J2+C450 HDG	ABS
TERA Joint stainless	S235JR EZP	1.4301/1.4401	S355J2+N HDG	1.4301/1.4303	ABS

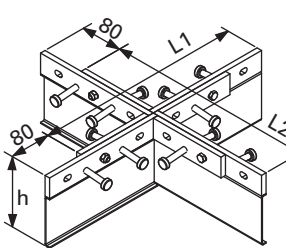
EZP = electro zinc plated, HDG = hot dip galvanized. Standard for black steel is EN 10025 and EN 10088 for stainless.

Table 2. Dimensions [mm] of TERA Joint



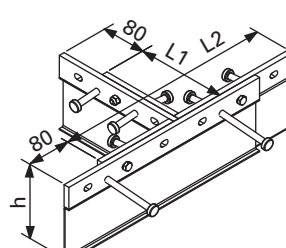
type	height h	dowel size	dowel centres c/c	length L	weight [kg]	advisable slab depth
TJ6-90-3000	90	6 x d150	375	3000	31,2	100-120
TJ6-115-3000	115				32,4	125-140
TJ6-135-3000	135				33,9	145-165
TJ6-160-3000	160				35,1	170-190
TJ6-185-3000	185				36,3	195-220
TJ6-215-3000	215				37,8	225-250
TJ6-230-3000	230				38,5	240-270
TJ6-245-3000	245	39,2	255-295			
TJ12-140-3000	140	(6+6) x d150	375	3000	40,7	150-170
TJ12-165-3000	165				41,9	175-195
TJ12-190-3000	190				43,1	200-225
TJ12-220-3000	220				44,6	230-250
TJ12-235-3000	235				45,3	250-270
TJ12-250-3000	250				46,0	265-300

Table 3. Dimensions [mm] of TERA X-Junction



type	height h	width L1	width L2	weight [kg]	compatible with
TJX-90	90	400	400	6,3	TJ6-90
TJX-115	115			6,7	TJ6-115
TJX-135	135			7,0	TJ6-135/TJ12-140
TJX-160	160			7,4	TJ6-160/TJ12-165
TJX-185	185			7,8	TJ6-185/TJ12-190
TJX-215	215			8,2	TJ6-215/TJ12-220
TJX-230	230			8,5	TJ6-230/TJ12-235
TJX-245	245			8,7	TJ6-245/TJ12-250

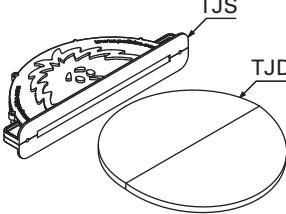
Table 4. Dimensions [mm] of TERA T-Junction



type	height h	width L1	width L2	weight	compatible with
TJT-90	90	160	400	4,9	TJ6-90
TJT-115	115			5,3	TJ6-115
TJT-135	135			5,6	TJ6-135/TJ12-140
TJT-160	160			5,9	TJ6-160/TJ12-165
TJT-185	185			6,3	TJ6-185/TJ12-190
TJT-215	215			6,7	TJ6-215/TJ12-220
TJT-230	230			6,9	TJ6-230/TJ12-235
TJT-245	245			7,1	TJ6-245/TJ12-250

TERA Joint

Table 5. Dimensions [mm] of TERA Dowel and Sleeve

	dowel type	thickness t	diameter d	sleeve type	advisable joint opening
	TJD-C6	6	150	TJS-C6	0-15
	TJD-C12	6+6	150	TJS-C12	15-20

3. MANUFACTURING

3.1 Manufacturing method

Flat bars	Mechanical cutting and punching
Plates	Mechanical cutting and precision folding
Welding	Spot welding and drawn arc stud welding
Sleeves	Injection moulding
Welding class	C (ISO-EN 5817)

3.2 Manufacturing tolerances

Straightness	±2.0 mm/m
Length	±2.0 mm
Height	±3.0 mm

3.3 Quality control

The quality control involved in producing the steel parts conforms to the requirements set by the Finnish Code of Building Regulations. Peikko Finland Oy is under the Inspecta Certification for quality control.

4. CAPACITIES

TERA dowels are designed according to the Technical Report No. 34 of British Concrete Society. The ultimate load transfer capacities are calculated for shear, bearing and bending. Combined shear and bending has to be checked case by case with following equation.

$$\frac{P_{app}}{P_{sh}} + \frac{P_{app}}{P_{bend}} \leq 1.4$$

P_{app}	= applied load per dowel
P_{sh}	= ultimate shear capacity per dowel
P_{bend}	= ultimate bending capacity per dowel

The ultimate punching shear capacities are based on full scale tests and include partial safety factors 1,6 for loads and 1,5 for concrete. These provide global safety factor 2,4 against concrete failure. All values are for plain concrete without additional shear reinforcement. In punching shear capacity values it is assumed that the dowel is located at the level of half slab thickness. Punching shear calculation method for reinforced concrete by TR34 is not suitable for defining punching capacity for TERA dowel. The same capacities are valid for armoured rails and single dowels with sleeves.

Allowed load transfer capacities are obtained by dividing the ultimate capacity values by 1.6.

4.1 Capacities of the TERA Dowel

The following tables show the ultimate capacities for a single plate dowel. If capacities for other joint openings or concrete grades are needed please contact your local Peikko Technical Support.

Table 6. Design capacities in shear, bearing and bending [kN] of the TERA Dowels according to TR34

Dowel type	joint opening x	Shear P_{sh}	Bearing P_{bear} (C32/40)	Bending P_{bend}	Combined P_{sh} and P_{bend}
TJD-C6	10	144,0	78,3	80,0	72,0
TJD-C12	10	288,0	78,3	160,0	144,0
TJD-C6	20	137,0	59,4	38,1	41,7
TJD-C12	20	274,0	59,4	76,2	83,4

Table 7. Comparison of the most common dowels with 10 mm joint opening

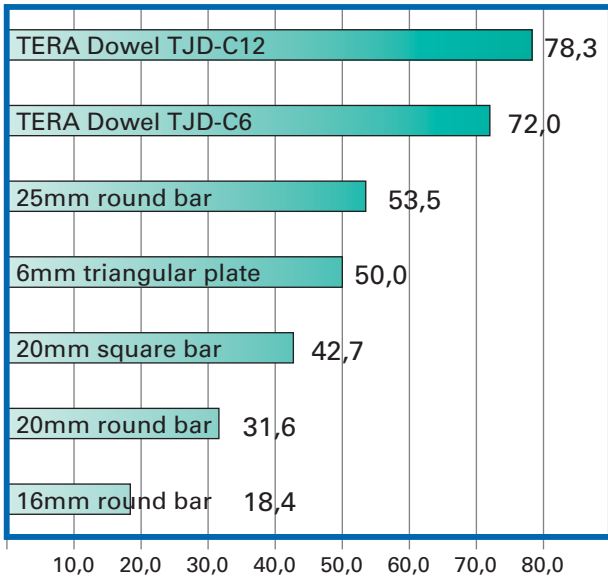
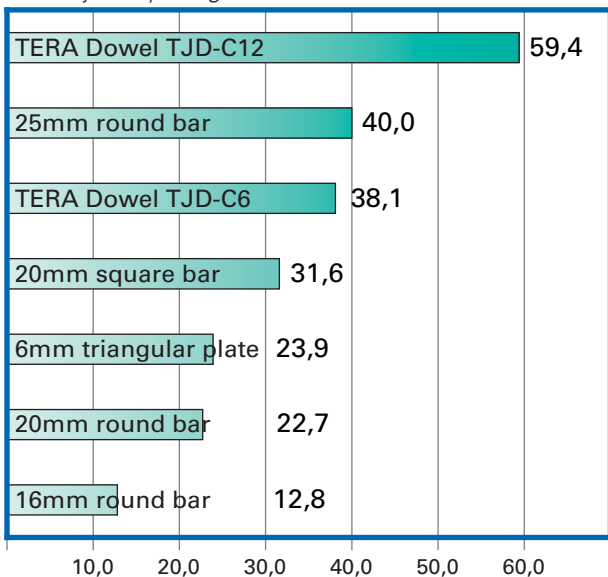


Table 8. Comparison of the most common dowels with 20 mm joint opening



Measuring design capacity [kN] of single dowels in shear, bearing C32/40, bending and combined shear and bending acc. to TR34. Punching capacity is not included in the comparison charts.

Table 9. Design punching shear capacities [kN] of the TERA Dowels according to full scale tests

Slab depth [mm]	Punching P_p C25/30	Punching P_p C28/35	Punching P_p C30/37	Punching P_p C32/40	Punching P_p C35/45
100	4,0	4,3	4,4	4,6	4,8
150	7,7	8,1	8,4	8,7	9,1
200	12,5	13,2	13,6	14,1	14,7
250	18,3	19,4	20,1	20,7	21,7

Intermediate values of the punching shear can be interpolated.

5. APPLICATION

5.1 Limitations for application

The load transfer capacities of the floor joints have been calculated for static loads. In the case of dynamic and fatigue loads, greater safety factors have to be used individually for each case.

TERA Joints are designed to open up to 20mm. If wider joint openings are designed the capacities have to be reduced appropriately.

The standard joints are without any surface treatment. If protective painted, hot dip galvanized, stainless or acid proof joints are needed due to exposure conditions please contact your local Peikko Sales Office.

5.2 Design principles

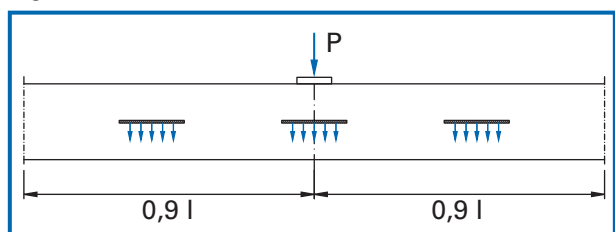
The capacity values of the dowels do not take account of the sub-base support pressure which is the worst-case scenario.

The effective number of dowels can be defined according to sections 9.10.1 and 9.4.6 of the UK Concrete Society TR34 Third Edition published March 2003.

TR34 recommends that the load transfer should be determined from the capacity of the dowels within a distance of $0,9l$ either side of the centre-line of the applied load.

For defining the number of effective dowels the modulus of subgrade reaction [k] and radius of relative stiffness [l] are required.

Figure 2. The effective number of dowels



TERA Joint

5.3 Joint and dowel types

The correct joint type is selected according to slab depth. It is recommended to order joints at least 10 mm shallower than the slab depth to ensure easy installation.

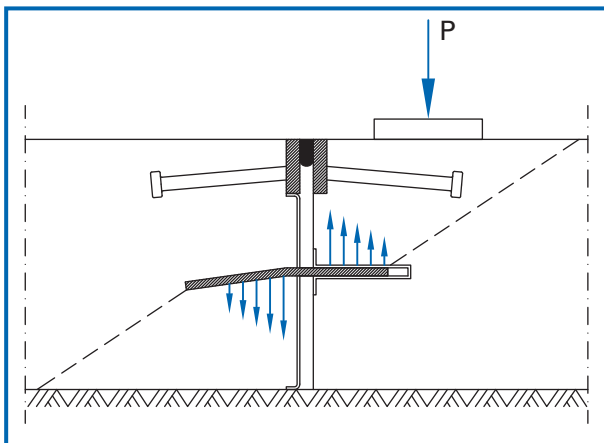
TERA dowels are selected according to designed joint opening. Joints TJ6 and dowels TJD6 are for openings up to 15 mm. Types TJ12 and TJD12 are for openings from 15 to 20 mm. It is recommended to use the stronger dowels always in suspended slabs.

5.4 Load-transfer

The punching shear capacity of the concrete is the limiting factor in most cases. All punching capacities given in this brochure are for un-reinforced concrete. If additional reinforcement or fibre reinforced concrete is used, the punching capacity can be increased and should be considered by the slab designer in each case.

In TR34, section 9.10.1 it is recommended that no more than half of the applied load should be transferred via dowels. The slab itself should be designed to carry the rest of the load. In practice the capacity of a slab at joints is about 50% (25% at corners) of the capacity at the centre of the slab.

Figure 3. Load transfer



5.5 Joint spacing and detailing

The joint spacing and aspect ratio of slab areas should be designed according to usual recommendations. For example individual slabs should ideally have an aspect ratio of 1:1 (square) but if this is not possible then the ratio should never exceed 1:1.5. Slabs should also ideally be no more than 50 m in length/width.

TERA Joint is recommended for all types of free-movement joints and also as a substitute for sawn joints. If used in place of saw cuts, the joint openings will be small and the load-transfer capacity higher and similar everywhere. Also the importance of timing of sawing can be ignored. The joints are designed to open up to 20mm during shrinkage of adjacent slabs.

5.6 Isolation details

Fixed elements such as columns and walls should be isolated to avoid any restraint on the slab. The fixed elements should be separated from the slab by a flexible compressible filler material of at least 20 mm in thickness.

Figure 4. Example of isolation



5.7 Single dowels and sleeves

Single TJD dowels and TJS sleeves can be used with formwork as a substitute for traditional dowel systems. They allow better slab movements in both longitudinal and perpendicular directions. The sleeves are delivered with nails and protective tape.

Figure 5. TERA dowels and sleeves

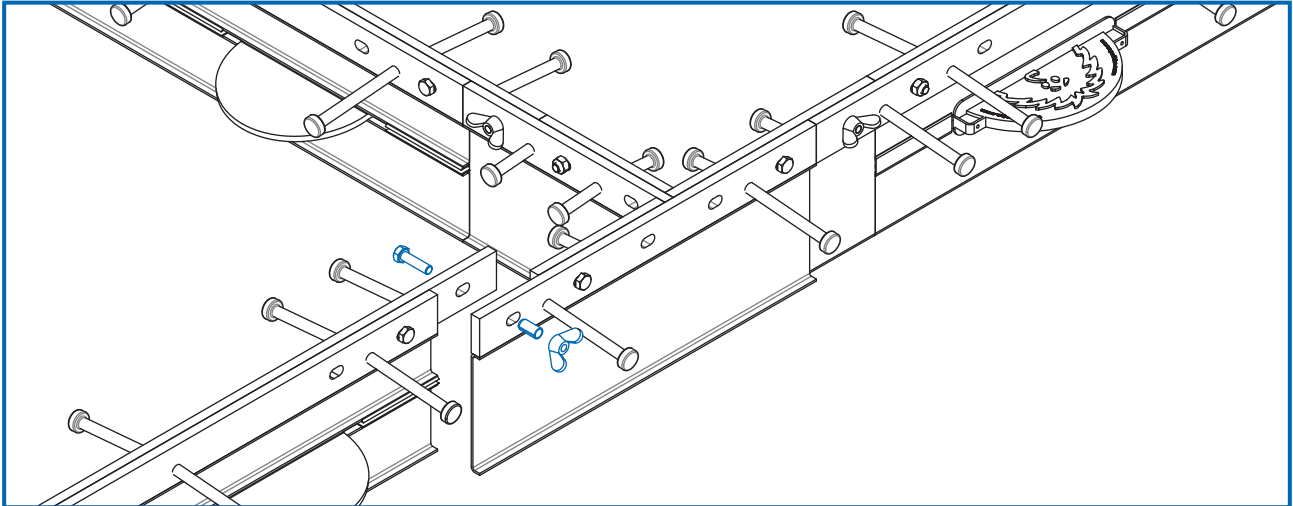


5.8 Accessories

TERA junction pieces are selected according to joint type. Prefabricated junction pieces allow easy and fast installation in difficult joint intersections.

Modular X- and T-pieces are connected to rails with standard bolt and nut connections.

Figure 6. TERA T-junction



5.9 Example

This example demonstrates how the load transfer capacity of the TERA dowels can be checked. It is assumed that there is one point load at the joint. The loadings and design data for the example are as follows:

- Slab depth, $h=175$ mm, concrete C32/40
- Joint opening, $x=10$ mm
- Dowel centres, $c/c=375$ mm
- Maximum wheel load, $P=50$ kN, safety factor for dynamic actions 1,6
- Value of modulus of subgrade reaction for well compacted sand, $k=0,05$ N/mm²
- Radius of relative stiffness, $l=744$ mm
- Minimum ultimate capacity per dowel, $P_p=11,2$ kN

Effective number of dowels according to TR34:

$$n = \frac{2 \times 0,9 \times l}{c/c} = \frac{2 \times 0,9 \times 744 \text{ mm}}{375 \text{ mm}} \approx \underline{\underline{3}}$$

Ultimate design load:

$$P_d = \gamma \times P = 1,6 \times 50 \text{ kN} = \underline{\underline{80 \text{ kN}}}$$

Required load transfer capacity:

$$P_d \leq n \times P_p \rightarrow 80 \text{ kN} - 3 \times 11,2 \text{ kN} = \underline{\underline{46,4 \text{ kN}}}$$

Thus the dowels cannot carry the full load 80 kN, the edge of the slab itself should be checked for its capacity to carry the remaining load 46,4 kN.

6. INSTALLATION

6.1 Installation tolerances

Joints should be installed as precisely vertical as practical and checked with a spirit level to ensure proper function of the dowels during slab movement. The levelness and straightness of the joint installation should be according to the requirements of the floor slab design and again checked using a standard laser level device.

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6.2 Installation of the floor joints

To install TERA Joints:

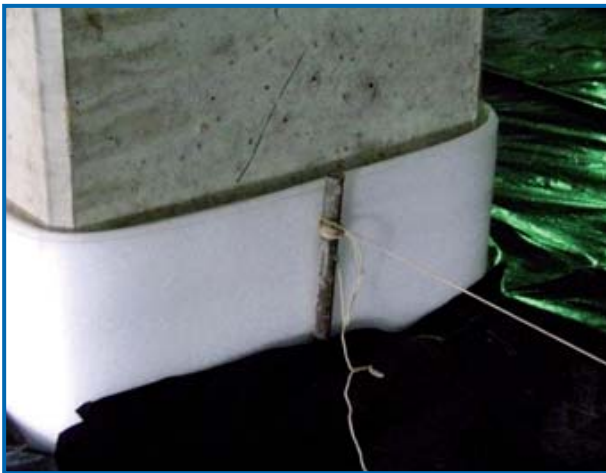
Step 1. Sub-base level

The sub-base must be made as accurate and level as possible to the requirements on the slab drawing. The tolerance of the level has to be taken into account when ordering joints. Typically the Joint height will be 10 mm to 25 mm less than the slab depth.



Step 2. Joint location

The required layout, position and height of the joints will be specified on the floor slab drawing which must be followed closely. String lines are placed to identify the position of joints according to the slab layout drawings. String lines usually run between columns or from junction pieces to column/wall.

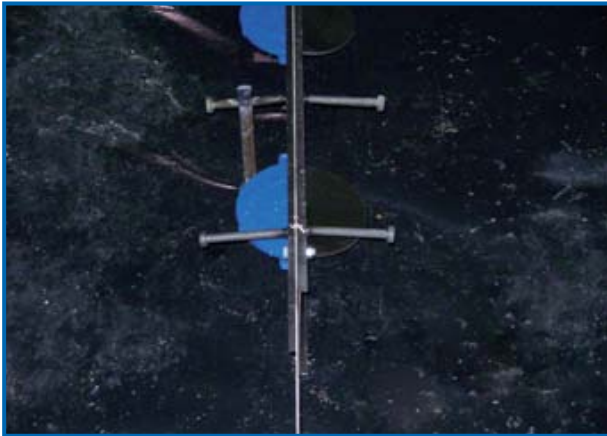


Step 3. Joint installation

1. Joints are placed sequentially away from junction pieces or from column/wall
 - a. If Junction pieces are used the first joint is connected to the junction piece at the overlap section using a dowel bush, plastic bolt and steel nut.
 - b. If junction pieces are not used the first joint is placed adjacent to column or wall (allowing for isolation material (min. 20 mm closed cell foam)).



2. The joints are placed in the correct position according to the string line and the height adjusted using spacers, wedges or equivalent means until correct. The height should be verified by laser level at both ends and the joint should be set vertical using a spirit level which can be placed across the top edges.



3. The joint can then be fixed in position using pins. Fixing pins should be 14 mm – 16 mm diameter and at least 300 mm longer than the joint height.

- For slabs up to 200 mm deep 4 pins per joint are required, (up to 300 mm 6 pins per joint). The pins should be spaced equally along one side of the joint, (ideally the side without sleeves) and if possible on the opposite side to the first pour if applicable.
- Alternate pins should be placed vertically and fixed approximately half-way along the length of the studs and at an angle of approximately 30 degrees to the vertical away from the joint and fixed at the end of the studs. This ensures excellent stability and if it is possible to do the first pour on the opposite side to the pins then it will allow them to be sawn through before pouring the second side reducing any resistance to joint opening.
- Pins should always be placed so that they finish level with the stud and if necessary any excess pin above the level of the stud should be removed prior to pouring.



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- a. Pins can be simply driven into place with a suitable impact gun and chuck.
 - b. Alternatively holes can be drilled to suit the pin and permit easy installation with a hammer. The holes should be drilled with a bit approximately 2 mm smaller than the pin diameter and to a depth of at most 100 mm less than the final depth of the pin. For example a 250 mm slab using 235 mm joints and 600 mm pins should use a hole drilled to approximately 250 mm – 270 mm deep.
- Pins are then welded to the adjacent stud securing the joint into position.



4. Subsequent joints are aligned, fixed at the overlap using dowel bushes, plastic bolts and nuts, adjusted and fixed in the same manner. The joints should be fixed so that the ends of adjacent top strips are not touching but have a clearance gap of between 1 mm and 2 mm to allow for longitudinal movement.



5. The final joint in any run will usually require being cut to length.

- The gap between the column/wall and the penultimate joint is measured taking account of suitable isolation material.
- The final joint is cut to length and installed in the same manner as previous joints.

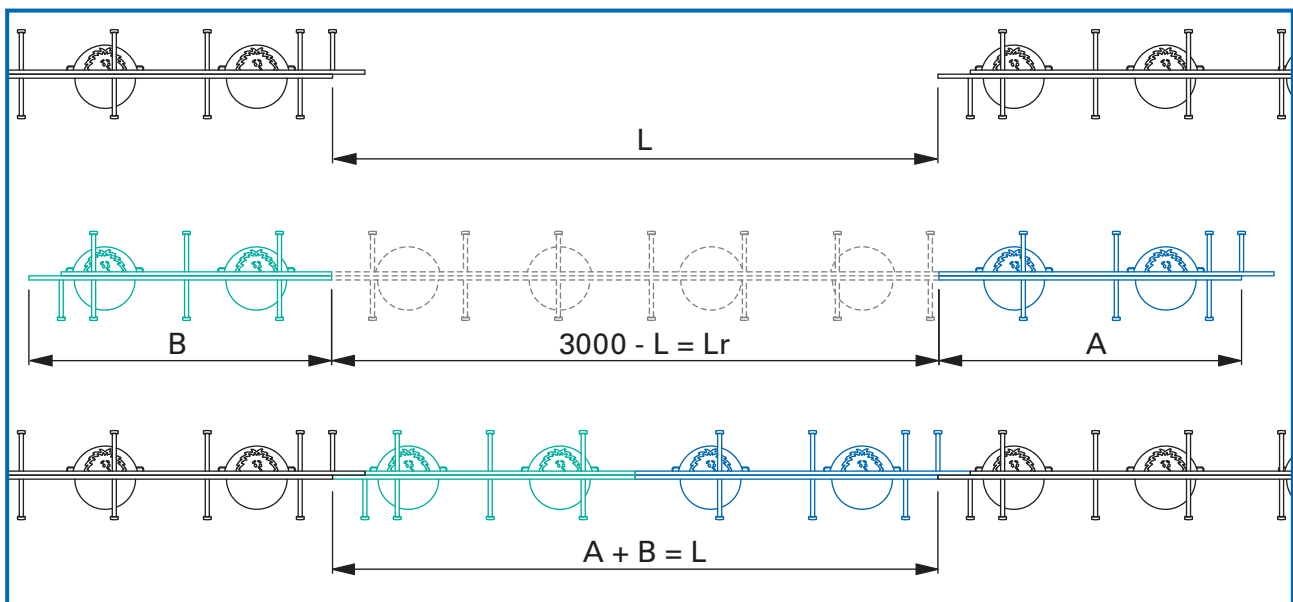
6. If the joint layout requires a run of joints between two junction pieces and the distance between them is not a full multiple of 3 metres then there will need to be a cut joint in the run.

- Joints should be placed running from the junction pieces to some point approximately equidistant from both when the gap is less than 3 m.

- The gap should be measured accurately between the top strips on either side of the joint and the measured value subtracted from 3000 mm to give **L_r** (the length of joint to be removed in mm).

- The final joint should have a section cut from the centre equal to **L_r** keeping both overlap sections at the ends intact.

- The two pieces are then installed in the usual manner to each side of the gap and the square ends of pieces A and B simply butt-welded together at the joint. It is advised to clamp the square ends carefully during welding to ensure a perfectly straight connection between the two pieces. Centre section should be retained for further use for example in doorways.



7. If required by the design 'X' or 'T' junctions should be placed according to the required layout and set to the correct height using a laser level or equivalent.

- The junction pieces are placed in the correct position and the height adjusted using spacers, wedges or equivalent means until correct
- The height should be verified by laser level and the junction should be set horizontal using a spirit level in two perpendicular directions
- The junction pieces can then be fixed in position using pins as described in section 3 (p. 11). 'X' junctions require 4 pins and 'T' junctions 3 pins.

8. As an alternative and if pins are not available then the joints and junction pieces can be positioned and held in place by concrete 'dabs'

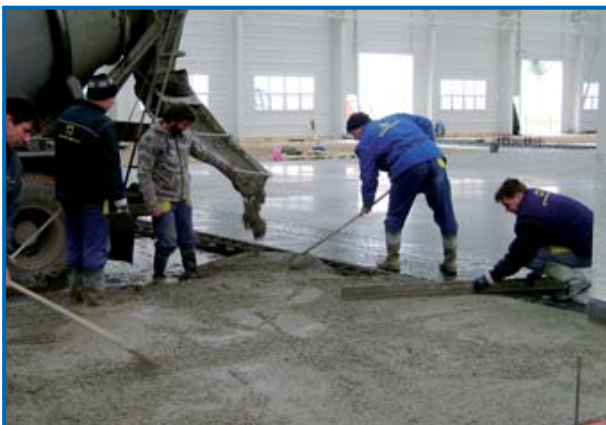
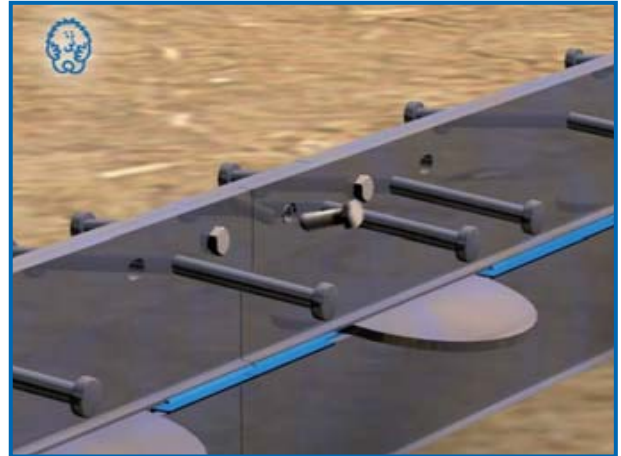
- The joints and intersections must be positioned accurately and supported.
- The dabs should be placed at 1 m spacing along the joint lengths or at the centre of the intersection pieces.
- Dabs should be sufficient to support the rails during pouring and levelling of the concrete ideally conical in shape and poured up to at least half the depth of the rail.
- Dabs should be allowed to harden sufficiently before removing support.

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Step 4. Pouring concrete

Once rails are correctly positioned pouring of concrete can commence. Concrete should be poured to the level of the rails with particular attention to consolidation around the dowels and sleeves. All plate type dowels require close attention to filling around the dowels to eliminate the possibility of air entrapment. This should be done with a suitable vibratory poker. Both sides of joints can be poured at the same time if required.

Clarifying installation animation is available from www.peikko.com or from your local Peikko Sales Office.

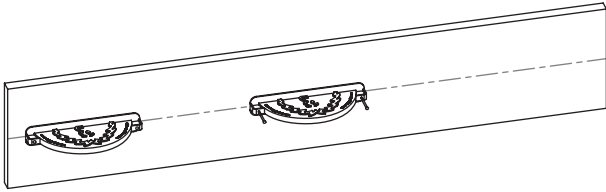


6.3 Installation of the single dowels and sleeves

To install single dowels and sleeves:

Step 1. Mark a horizontal line on the formwork at the level of half slab thickness and mark the required spacing of the sleeves along this line.

Step 2. Nail the sleeves firmly through the nail holes at the marked locations on the formwork. Remember to check the installation control check list before pouring concrete.



Step 3. Pour concrete as normal around dowel sleeves paying particular attention to the fill around the sleeves. All plate type dowels require adequate vibratory poking around them to eliminate the possibility of air entrapment

Step 4. After concrete has hardened adequately and the formwork removed, the nails should be flattened and the dowels inserted into the sleeve pockets. The dowels should be inserted fully into the sleeves and the folded ends should point downwards.

7. INSTALLATION CONTROL

7.1 Installation control of the floor joint

Check list before casting the floor slabs:

- Correct location and height level of rails and junction pieces
- Rails are adequately fixed in position to sub-base in vertical and horizontal direction
- Sleeves are placed on each dowel properly with the flange flat against the divider plates
- Isolation material correctly placed around columns and other fixtures

7.2 Installation control of the single dowels and sleeves

Check list before casting the floor slabs:

- Correct centre distance between sleeves according to the design
- Sleeves installed horizontally and at the correct half-slab height level
- Sleeves fixed properly and firmly to formwork





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