TECHNICAL MANUAL

TERAJOINT® and TERAJOINT® Strong Free Movement Joints

Robust Free Movement Joint Systems

Version PEIKKO GROUP 06/2020

peikko®

TERAJOINT® and TERAJOINT® Strong Free Movement Joints

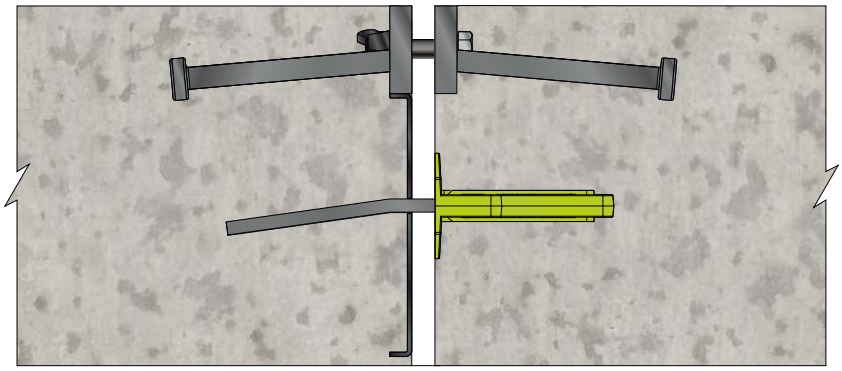
Robust Free Movement Joint Systems

- Prefabricated leave-in-place free movement joint system with a variety of integral load transfer mechanisms to suit all floor loadings.
- Excellent performance with 40mm x 10mm cold drawn steel for extreme armoring of joint arrises.
  - **TERAJOINT®** is specially designed for moderate and medium loads
  - **TERAJOINT®** Strong is specially developed to meet heavy duty requirements
- Suitable for the high flatness category floor and superflat floor construction.
- Fast track installation with a selection of fixing methods and accessories.
- All materials used in this product are 100% recyclable.

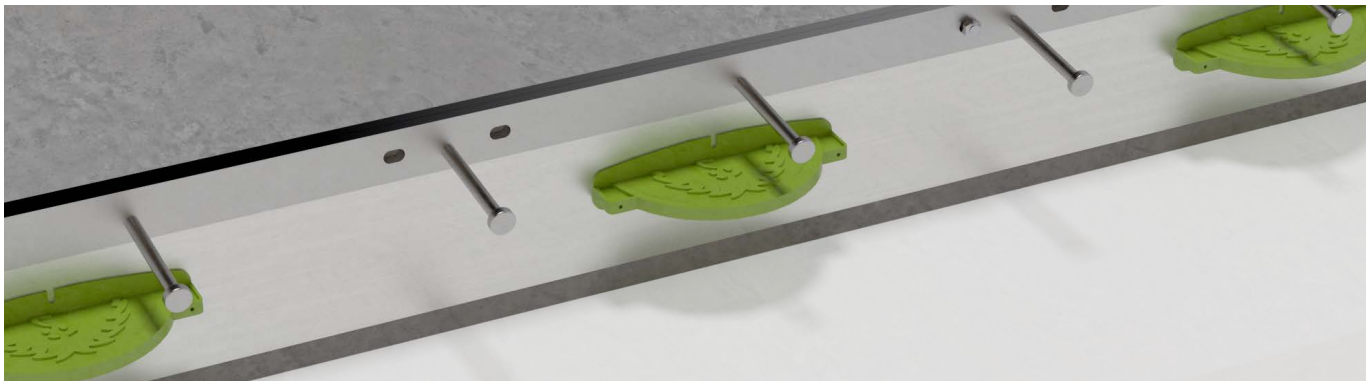
TERAJOINT® is the industry standard in the range of prefabricated heavy-duty movement joint systems, suitable for all large area construction methods for ground and pile supported (or ground-bearing and pile-supported) concrete floors. The cold drawn steel rails provide extremely durable protection to the slab arrises, making it ideal for floors in a heavy-duty traffic environment.

The system ensures reliable load transfer in formed free movement joints with openings of up to 30 mm wide, and suitable for slab depths from 100 mm to 300 mm.

Available in Plain Steel, Hot Dip Galvanized finish or Stainless Steel versions, which means that the TERAJOINT® system offers a solution for all operational environments.



The TERAJOINT® system range includes a selection of prefabricated intersections, including “T” sections, “X” sections and rounded “R” sections.



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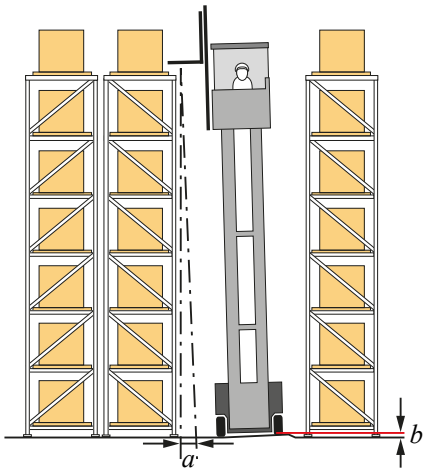
About TERAJOINT® Free Movement Joint

1. Product Properties

TERAJOINT® is a prefabricated leave-in-place joint system designed to create (construct) formed shrinkage free movement joints, consisting of heavy duty arris armoring, permanent formwork, and a load transfer system. The arris armoring is provided by 40 × 10 mm cold drawn steel profiles, which are connected by yieldable plastic bolts. The profiles are anchored into the slab by means of a number of 10 × 100 mm welded anchors, and one of the profiles is welded onto the steel divider plate, which has the load transfer system positioned and attached to it.

TERAJOINT® can be used even in the highest floor class FM1 [1], where very high standards of flatness and levelness are required. Floor class FM1 allows reach trucks operating at above 13 m without side-shift.
[1] See: TR34 Concrete Industrial Ground Floors 4th Edition. *Table 3.1.*

Figure 1. Static lean (a) because of variation in floor level (b).



TERAJOINT® is installed into position on the sub-base at the correct height, before the slab is cast. Once the concrete is cast, the shrinkage forces generated by the drying concrete slabs cut the plastic bolts connecting the two steel profiles together, which causes the joint to open. TERAJOINT® permits the minor free slab movements, caused by drying shrinkage and thermal variations in both longitudinal and perpendicular directions of the slab plane.

TERAJOINT® transfers vertical loads between adjacent slabs and minimizes vertical displacement of the slabs. The load transfer system is accomplished by utilizing high strength steel discrete plate dowels, moving within rigid plastic release sleeves.

TERAJOINT® with round TDC 5 or TDC 6 dowels is an eco-friendly free movement joint solution for maximum 15 mm openings. Round shape of TDC dowels allows longitudinal and small perpendicular movement.

TERAJOINT® Strong with rectangular TDR 6 or TDR 8 dowels is designed for higher loads and bigger openings.

The limiting factor of load transfer in most cases is the punching shear resistance of the concrete. These resistances can be found in section 2. It is recommended that no more than 50% of the applied load should be transferred by the load transfer system and the slab itself should be designed to carry the rest of the load.

Figure 2. Load transfer.

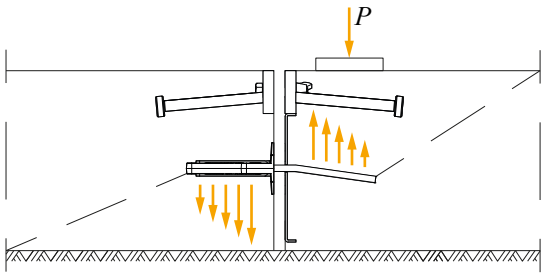
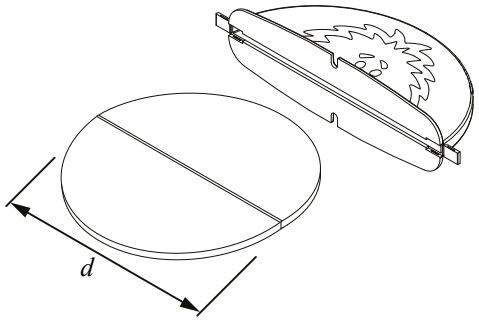
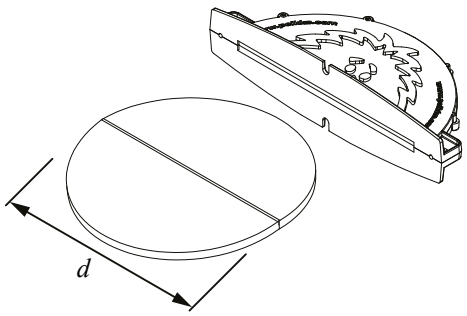


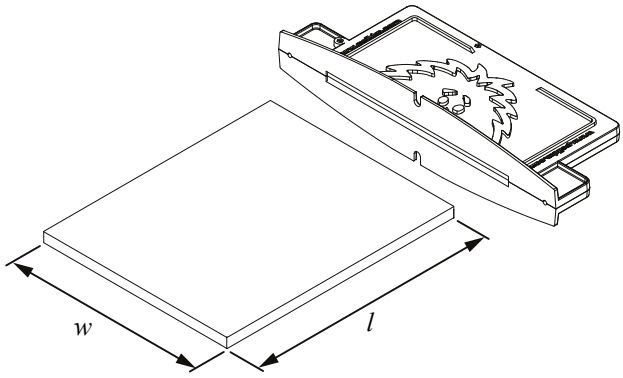
Table 1. TERAJOINT® Dowel Types.



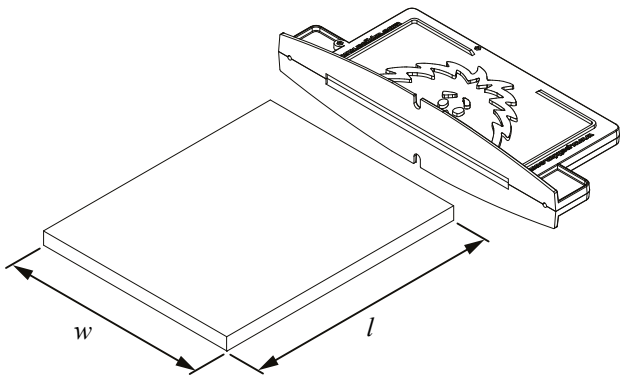
Dowel Type	TERADOWEL Circular 5 mm TDC-5
Thickness	5 mm
Diameter *d*	150 mm
Sleeve Color	Orange
Adjustable Joint Opening	0 ~ 15 mm



Dowel Type	TERADOWEL Circular 6 mm TDC-6
Thickness	6 mm
Diameter *d*	150 mm
Sleeve Color	Green
Adjustable Joint Opening	0 ~ 15 mm



Dowel Type	TERADOWEL Rectangular 6 mm TDR-6
Thickness	6 mm
Dimensions *w* × *l*	150 mm x 135 mm
Sleeve Color	Green
Adjustable Joint Opening	0 ~ 20 mm



Dowel Type	TERADOWEL Rectangular 8 mm TDR-8
Thickness	8 mm
Dimensions *w* × *l*	145 mm x 175 mm
Sleeve Color	Black
Adjustable Joint Opening	0 ~ 30 mm 0 ~ 20 mm Recommended

1.1 Materials and Dimensions

1.1.1 Materials

Table 2. Materials and standards of TERAJOINT® TJ5, TJ6, TJS6, TJS8.

Version	Top Rails + Anchors	Divider Plate	Plate Dowels	Anchors	Sleeves
TERAJOINT®	S235JRC + C	DX51D + Z Z275	S355J2 + N	S235J2 + C450	ABS/HDPS
TERAJOINT® HDG	S235JRC + C HDG	DX51D + Z Z275	S355J2 + N HDG	S235J2 + C450 HDG	ABS/HDPS
TERAJOINT® Stainless	1.4301	DX51D + Z Z275	S355J2 + N HDG	1.4301	ABS/HDPS
TERAJOINT® Acid Proof *	1.4401	1.4401	1.4401	1.4301	ABS/HDPS
HDG = Hot dip galvanized. Standard for black steel EN 10025 and stainless steel EN 10088.					

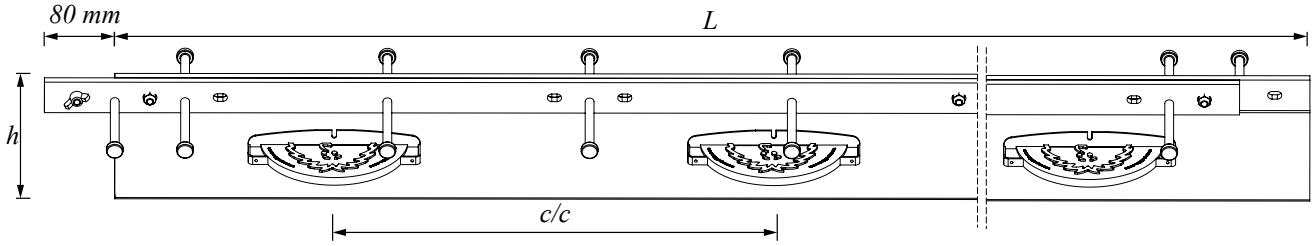
* If slab thickness h > 150 mm, please contact to Peikko Technical Support.

Table 3. TERAJOINT® versions and suitable environmental conditions.

Version	Environmental condition
TERAJOINT®	Dry internal
TERAJOINT® HDG	Occasionally wet
TERAJOINT® Stainless	Water + aesthetically demanding
TERAJOINT® Acid Proof	Salt/water/acid + aesthetically demanding

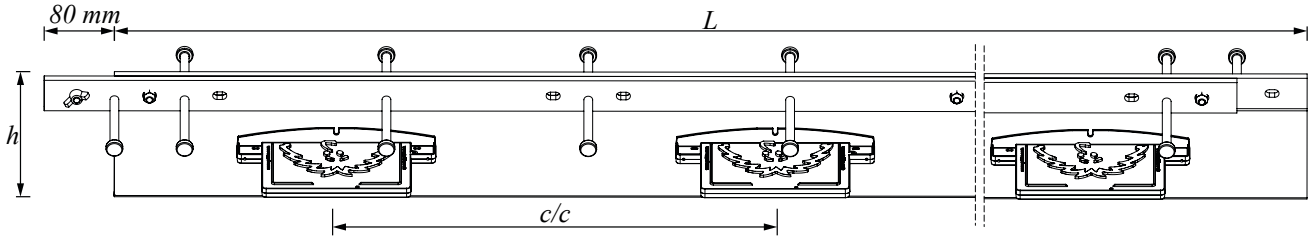
1.1.2 Dimensions

Table 4. Dimensions [mm] of TERAJOINT® TJ5 and TJ6.



Type	Height h	Dowel Type	Dowel Centers c/c	Length L	Weight [kg]	Adjustable Slab Depth	Sleeve Color
TJ5-90-3000	90 mm	TDC-5	600 mm	3000 mm	27.4	100 ~ 120 mm	Orange
TJ5-115-3000	115 mm				28.6	125 ~ 145 mm	
TJ5-135-3000	135 mm				29.5	145 ~ 170 mm	
TJ5-160-3000	160 mm				30.7	170 ~ 195 mm	
TJ6-185-3000	185 mm	TDC-6	600 mm	3000 mm	32.5	195 ~ 225 mm	Green
TJ6-215-3000	215 mm				33.9	225 ~ 250 mm	
TJ6-230-3000	230 mm				34.6	245 ~ 270 mm	
TJ6-245-3000	245 mm				35.3	260 ~ 300 mm	

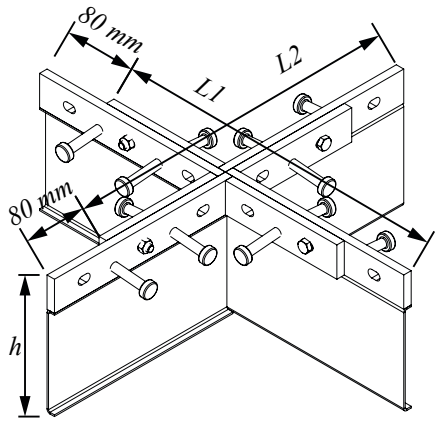
Table 5. Dimensions [mm] of TERAJOINT® Strong TJS6 and TJS8.



Type	Height *h*	Dowel Type	Dowel Centers *c/c*	Length *L*	Weight [kg]	Adjustable Slab Depth	Sleeve Color
TJS6-90-3000	90 mm	TDR-6	500 mm	3000 mm	29.9	100 ~ 120 mm	Green
TJS6-115-3000	115 mm				31.1	125 ~ 145 mm	
TJS6-135-3000	135 mm				32.0	145 ~ 170 mm	
TJS6-160-3000	160 mm				33.2	170 ~ 195 mm	
TJS6-185-3000	185 mm				34.3	195 ~ 225 mm	
TJS6-215-3000	215 mm				35.7	225 ~ 250 mm	
TJS6-230-3000	230 mm				36.4	245 ~ 270 mm	
TJS6-245-3000	245 mm				37.1	260 ~ 300 mm	
TJS8-135-3000	135 mm	TDR-8	500 mm	3000 mm	36.0	145 ~ 170 mm	Black
TJS8-160-3000	160 mm				37.1	170 ~ 195 mm	
TJS8-185-3000	185 mm				38.3	195 ~ 225 mm	
TJS8-215-3000	215 mm				39.7	225 ~ 250 mm	
TJS8-230-3000	230 mm				40.4	245 ~ 270 mm	
TJS8-245-3000	245 mm				41.4	260 ~ 300 mm	

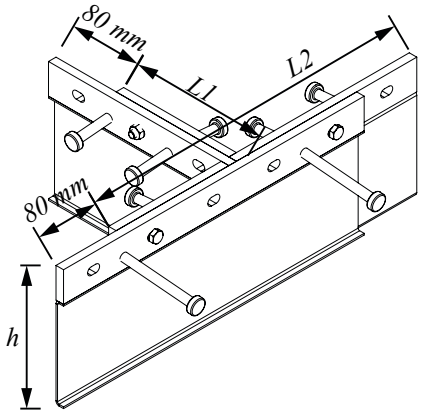
If the height requirements are different from those indicated in *Tables 4* and *5*, Peikko Technical Support will design TERAJOINT® with a custom height for clients.

Table 6. Dimensions [mm] of TERAJOINT® X-Junction.



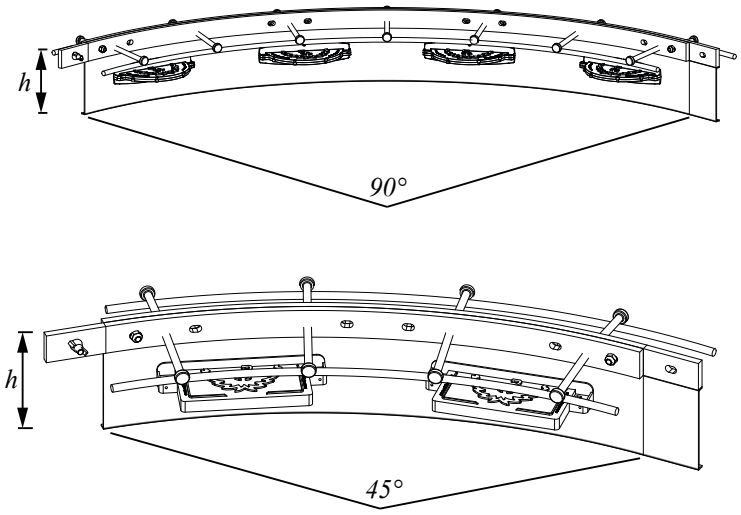
Type	Height *h*	Width *L1*	Width *L2*	Weight [kg]
TJX-90	90 mm	400 mm	400 mm	6.3
TJX-115	115 mm			6.7
TJX-135	135 mm			7.0
TJX-160	160 mm			7.4
TJX-185	185 mm			7.8
TJX-215	215 mm			8.2
TJX-230	230 mm			8.5
TJX-245	245 mm			8.7

Table 7. Dimensions [mm] of TERAJOINT® T-Junction.



Type	Height *h*	Width *L1*	Width *L2*	Weight [kg]
TJT-90	90 mm	160 mm	400 mm	4.9
TJT-115	115 mm			5.3
TJT-135	135 mm			5.6
TJT-160	160 mm			5.9
TJT-185	185 mm			6.3
TJT-215	215 mm			6.7
TJT-230	230 mm			6.9
TJT-245	245 mm			7.1

Table 8. Dimensions [mm] of TERAJOINT® R-Section.

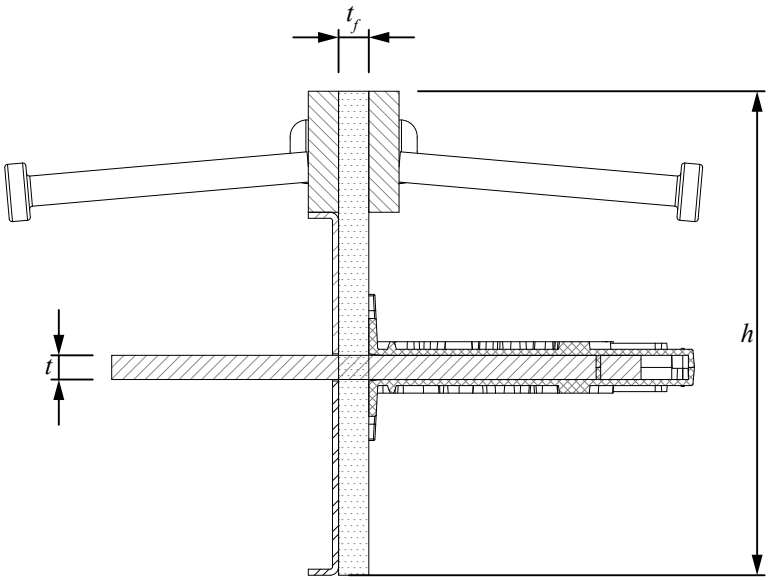


Type	Angle	Radius
TJR6-90	45°, 90°	900 mm
TJR6-115		
TJR6-135		
TJR6-160		
TJR6-185		
TJR6-215		
TJR6-230		
TJR6-245		
TJR8-135		
TJR8-160		
TJR8-185		
TJR8-215		
TJR8-245		

NOTE: TERAJOINT® R-Sections are not standard products to be stored. They will be manufactured according to order.

TERAJOINT® with foam

Peikko can deliver TERAJOINT® with closed cell polyethylene foam to the places where slabs are cast in the cool condition and thermal expansion is significant. The thickness of the foam (t_f) can be 5 / 10 / 15 mm.



1.2 Quality

Peikko Group's production units are externally controlled and periodically audited on the basis of production certifications and product approvals by various independent organizations.

2. Resistances

Resistances of the TERAJOINT® dowels are determined according to UK Concrete Society TR34.4 published August 2013.

Table 9. Load transfer and required verifications for single plate dowels.

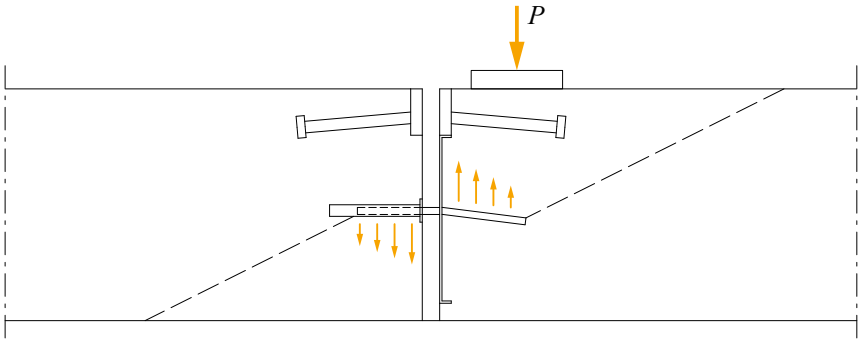
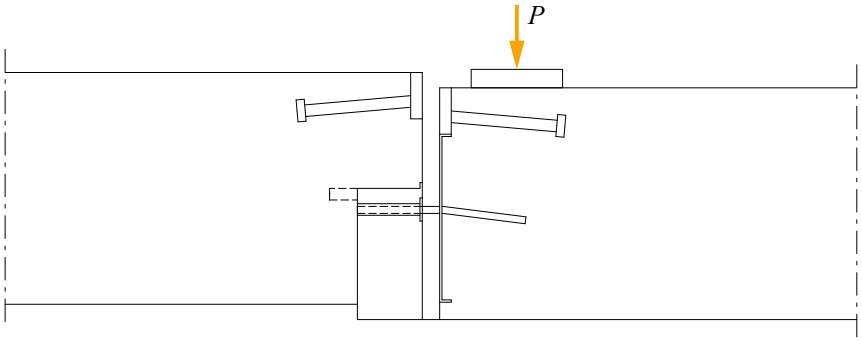
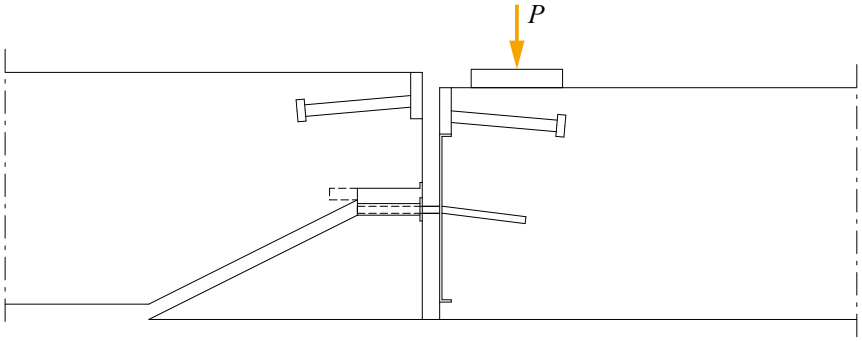
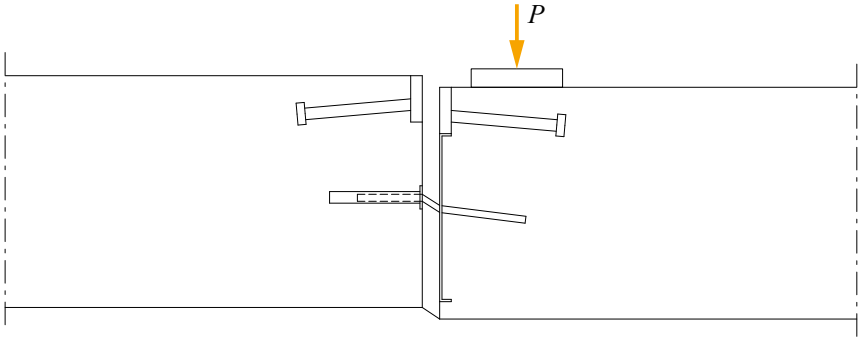
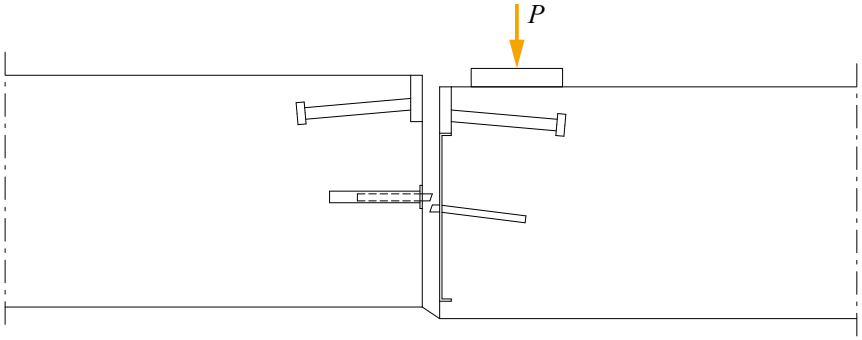
Load transfer	
Punching shear at the face of the loaded area	
Punching shear on the critical perimeter	
Bearing/bending capacity of dowel	
Shear capacity of dowel	

Table 10. Design resistance of single dowel in shear P_{sh} and bearing/bending $P_{max,plate}$ [kN] according TR34.4 for C32/40.

Dowel Type	Joint Opening x	Shear P_{sh}	$P_{max,plate}$
TDC 5	15 mm	120.9	30.6
TDC 6	15 mm	145.0	41.4
TDR 6	20 mm	150.0	35.2
TDR 8	30 mm	193.4	41.5

Table 11. Design resistance [kN/m] for TERAJOINT® TJ5 according TR34.4 for 15 mm joint opening.

Slab Thickness	C25/30	C28/35	C30/37	C32/40	C35/45
100 mm	15.8	16.8	17.3	17.9	18.7
150 mm	28.3	29.9	31.0	32.0	33.5
200 mm	46.7	49.4	50.5	51.0	51.7
250 mm	49.0	49.9	50.5	51.0	51.7

Table 12. Design resistance [kN/m] for TERAJOINT® TJ6 according TR34.4 for 15 mm joint opening.

Slab Thickness	C25/30	C28/35	C30/37	C32/40	C35/45
100 mm	15.8	16.8	17.3	17.9	18.7
150 mm	28.3	29.9	31.0	32.0	33.5
200 mm	46.7	49.4	51.2	52.8	55.3
250 mm	65.8	67.3	68.2	69.1	70.2

Table 13. Design resistance [kN/m] for TERAJOINT® Strong TJS6 according TR34.4 for 20 mm joint opening.

Slab Thickness	C25/30	C28/35	C30/37	C32/40	C35/45
100 mm	21.0	22.2	23.0	23.8	24.9
150 mm	36.8	38.9	40.3	41.6	43.5
200 mm	50.8	53.7	55.6	57.4	60.1
250 mm	68.0	69.1	69.8	70.4	71.3

Table 14. Design resistance [kN/m] for TERAJOINT® Strong TJS8 according TR34.4 for 30 mm joint opening.

Slab Thickness	C25/30	C28/35	C30/37	C32/40	C35/45
100 mm	22.2	23.5	24.4	25.2	26.3
150 mm	38.5	40.8	42.2	43.6	45.6
200 mm	52.3	55.3	57.3	59.1	61.8
250 mm	71.4	75.6	78.2	80.8	83.9

Design resistance [kN/m] covers all required verifications listed in *Table 9*.

The punching shear resistances are calculated for plain concrete without any kind of additional reinforcement and according to TR34.4 the same approach should also be used for steel and macro-synthetic fiber reinforced concrete.

If resistances for other joint openings or concrete grades, or slabs thicker than 250 mm are needed, please contact Peikko Technical Support.

Selecting TERAJOINT® Free Movement Joint

TERAJOINT® is selected according to following criteria:

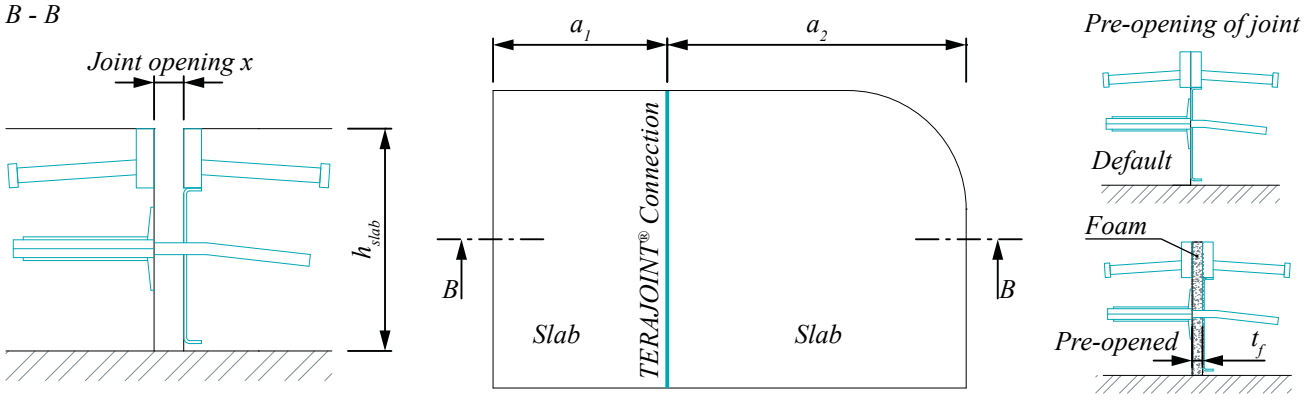
- **Slab depth.** It is recommended that the joint depth, TERAJOINT® height, is at least 10 mm shallower than the slab depth. Advisable slab depths are stated in *Tables 4* and *5*.
- **Designed joint opening.** For joint openings of up to 15 mm wide, we recommend TERAJOINT® TJ5 or TERAJOINT® TJ6. For joint openings from 20 to 30 mm wide, TERAJOINT® TJS8 is recommended. Whereas for pile supported slabs, we would only recommend the use of TERAJOINT® TJS8.
- **Environment.** For internal floors, we would suggest the plain steel TERAJOINT® version. When corrosion resistance is required, TERAJOINT® HDG (Hot Dipped Galvanized) version is recommended, and for a more aggressive external environment or high hygienic requirement, TERAJOINT® in Stainless Steel is recommended. For an extremely corrosive environment such as coastal salty or acidic, TERAJOINT® Acid Proof is recommended, which is manufactured from a high corrosion resistance grade of Stainless Steel (1.4401).
- **20 mm designed joint opening.** This refers generally to 50 x 50 m slab size limiting dimensions of jointed floors, and a 35 x 35 m of jointless floors. A wider joint opening is possible, but resistances must be reduced accordingly, however, this is not practical due to the increase of dynamic impact during joint transition. If there is a design requirement for wider joint openings, Peikko can offer a suitable solution from its extensive flooring product range.
- **Joint aspect ratio.** Individual slabs should ideally have an aspect ratio of 1:1; this may not always be possible, but the ratio should never exceed 1:1.5.
- **Use of TERAJOINT® rounded sections.** These are recommended to avoid sharp corners in the floor slab where cracking would normally be expected.

A further recommendation is to separate fixed elements from the slab with the use of flexible compressible foam filler, with a thickness of at least 20 mm, also by avoiding re-entrant corners and avoiding point loads at joints.

Appendix A – TERAJOINT® Design form

Basic dimensions

Thickness of the slab h_{slab} =		mm	
Joint opening x =		mm	(recommended value 0 ~ 20 mm, maximum allowed value 30 mm)
Pre-opening of joint: Thickness of foam t_f =		mm	(default value 0 mm, available 5/10/15 mm)
Type of Peikko flooring product =			**TERAJOINT®** for joint opening ≤ 15 mm or **TERAJOINT® Strong** for joint opening ≤ 30 mm
Maximum length of slab A_{max} =		m	(maximum length of slab perpendicular to TERAJOINT® connection) - maximum A_1 or A_2
Difference of temperatures of slab Δt =		°C	Example 1: +10°C to -15°C ⇨ t = -25°C Example 2: +10°C to 40°C ⇨ t = 30°C



Material options

Concrete grade of slab =			C20/25 ~ C40/50
Partial safety factor for concrete γ_c =			recommended value = 1.50
Version of TERAJOINT® =			Standard, HDG, Stainless or Acid proof
Partial safety factor for steel γ_s =			recommended value = 1.15
Modulus of subgrade reaction k =		N/mm³	(based on soil type)

Soil type	k value [N/mm³]	
	Lower value	Upper value
Fine or slightly compacted sand	0.015	0.030
Well compacted sand	0.050	0.100
Very well compacted sand	0.100	0.150
Loam or clay (moist)	0.030	0.060
Loam or clay (dry)	0.080	0.100
Clay with sand	0.080	0.100
Crushed stone with sand	0.100	0.150
Coarse crushed stone	0.200	0.250
Well compacted crushed stone	0.200	0.300

ANNEX A

Loads

Permanent loads

Characteristic permanent load g_k =		kN/m^2	
Partial safety factor for permanent load γ_g =			Recommended value = 1.35

Imposed loads

Characteristic imposed load q_k =		kN/m^2	
Partial safety factor for imposed load γ_q =			recommended value = 1.50

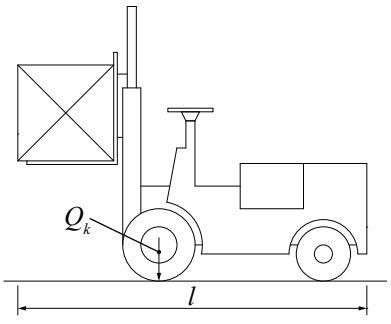
Point load

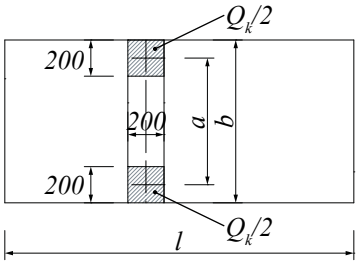
Characteristic value of point load Q_p =		kN	
Partial safety factor for point load γ_{Qp} =			recommended value = 1.50

Dynamic loads (forklift)

Partial safety factor for dynamic load γ_{Qk} =			recommended value = 1.60
Dynamic magnification factor φ =			value 1.4 for pneumatic tires and value 2.0 for solid tires
Characteristic axle load of forklift Q_k =		kN	based on type of forklift (FL 1~6)
Width of contact area =		mm	recommended value 200 mm
Distance between middle of contact areas a =		mm	based on type of forklift (FL 1~6)

Class of forklifts	Axle load Q_k [kN]	Net weight [kN]	Hoisting load [kN]	Width of axle a [mm]	Overall width b [mm]	Overall length l [mm]
FL 1	26	21	10	850	1000	2600
FL 2	40	31	15	950	1100	3000
FL 3	63	44	25	1000	1200	3300
FL 4	90	60	40	1200	1400	4000
FL 5	140	90	60	1500	1900	4600
FL 6	170	110	80	1800	2300	5100





Installing TERAJOINT® Free Movement Joint

General

The handling of TERAJOINT Free Movement Joins must be done by following safety instructions. The free movement joints on site must be protected from weather, damage during handling and possible damage during removal on the packing. Joints should be stored in dry and sheltered conditions.

Before use, the free movement joints are inspected visually for completeness and any signs of damage that might have occurred during transport or storage.

The assessment of the products is based on the assumption that during the estimated working life no maintenance is required, though regular check should be carried out on the slab surface to ensure that any damage is detected and repaired as soon as possible. In case of a repair, it is necessary to perform an assessment for mechanical resistance.

Installation tolerances

Joints should be installed as precisely vertical as possible 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 relevant requirements of the floor slab design, and again checked using a standard laser level device or optical sight level.

Installation

Step 1. Sub-base level

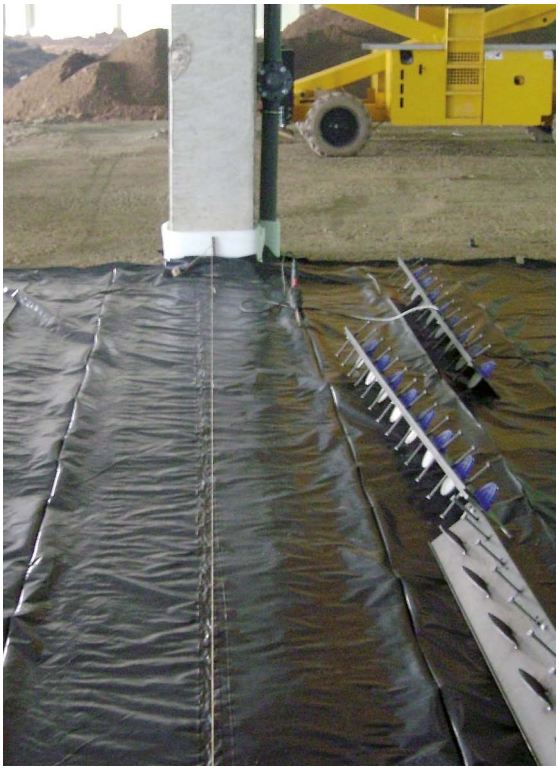
The sub-base must be made as accurate and level as possible to the requirements on the slab drawing. The tolerance of the level must be considered when ordering joints. Typically, the joint height will be 10 mm to 35 mm less than the slab depth.

Step 2. Joint location

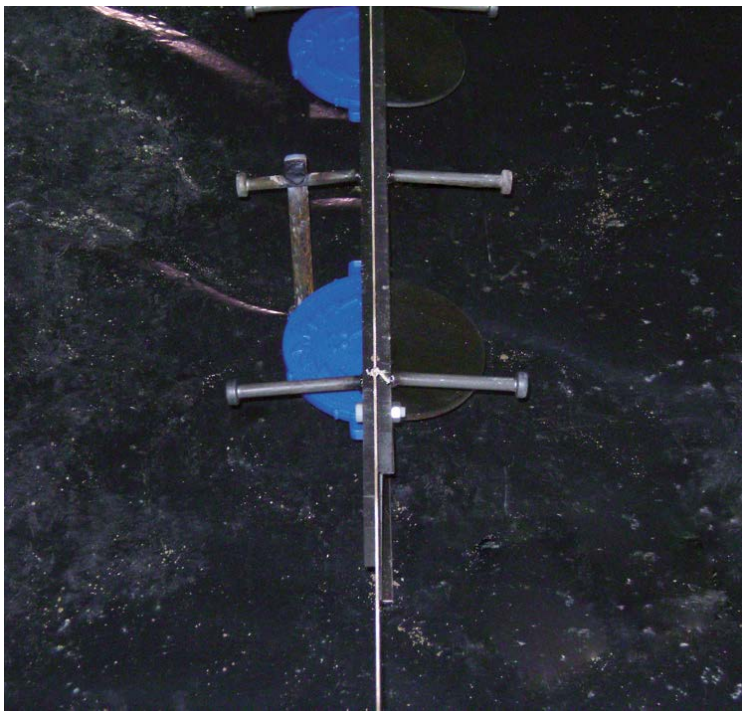
The required layout, position and height of the joints will be specified on the floor slab drawing which must be followed closely. String lines are placed to identify the position of joints according to the slab layout dimensioned drawings.

Step 3. Joint Installation

1. Joints are placed sequentially away from junction pieces or from vertical 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, the connection overlap is cut away.



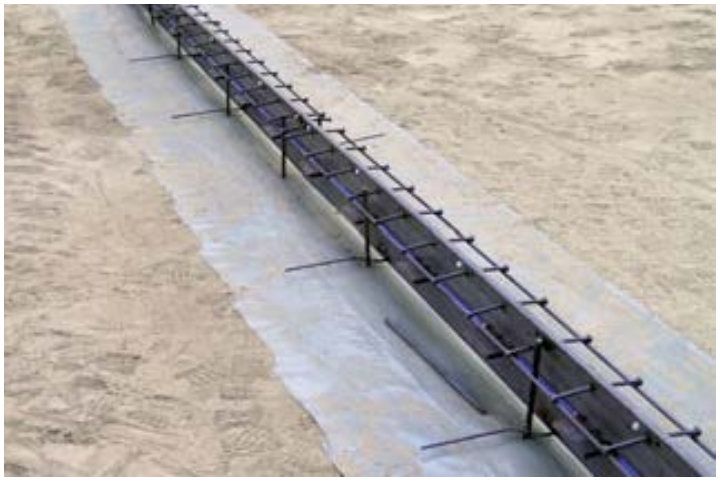
2. The joints are placed in the correct position according to the string line, and the height is adjusted. The height should be verified by laser level or similar at both ends, and the joint should be set vertical using a spirit level which can be placed across the top edges.



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. A good practice is to use 14 × 600 mm fixing pins.

   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, on the opposite side to the first pour.

   Pins can be simply driven into place with a suitable impact gun or hammer.



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 meters, then a cut joint in the run will be necessary. 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. The final joint should have a section cut from the center equal to the distance between the joints, 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 simply butt-welded together at the joint.

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 is adjusted. 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. '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 center 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.

Step 4. Pouring concrete

Once the rails are correctly positioned, pouring of concrete can commence. Concrete should be poured to the level of the rails with 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 vibrating poker. Both sides of joints can be poured at the same time if so required.

NOTES

Revisions

Version: PEIKKO GROUP 06/2020. Revision: 004

- Table 2. Sleeve material amended and note added regarding slab thickness of TERAJOINT® Acid Proof
- TERAJOINT® foam renamed to closed cell polyethylene
- Tables 11 - 14. Captions amended
- Appendix A. Design form amended
- Added General section to Installation
- Removed paragraph from item 3 of Step 3 in installation section.

Version: PEIKKO GROUP 03/2020. Revision: 004

- Dowel types changed/added
- TERAJOINT® types updated
- TERAJOINT® Strong types added
- TERAJOINT® with foam added
- Resistances updated
- TERAJOINT® Design form added.

Version: PEIKKO GROUP 12/2018. Revision: 003

- Dowel resistance tables updated
- Illustration updates for clarity
- Updated layout to latest branding

Version: PEIKKO GROUP 08/2017. Revision: 002*

- New cover design for 2018 added

Resources

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