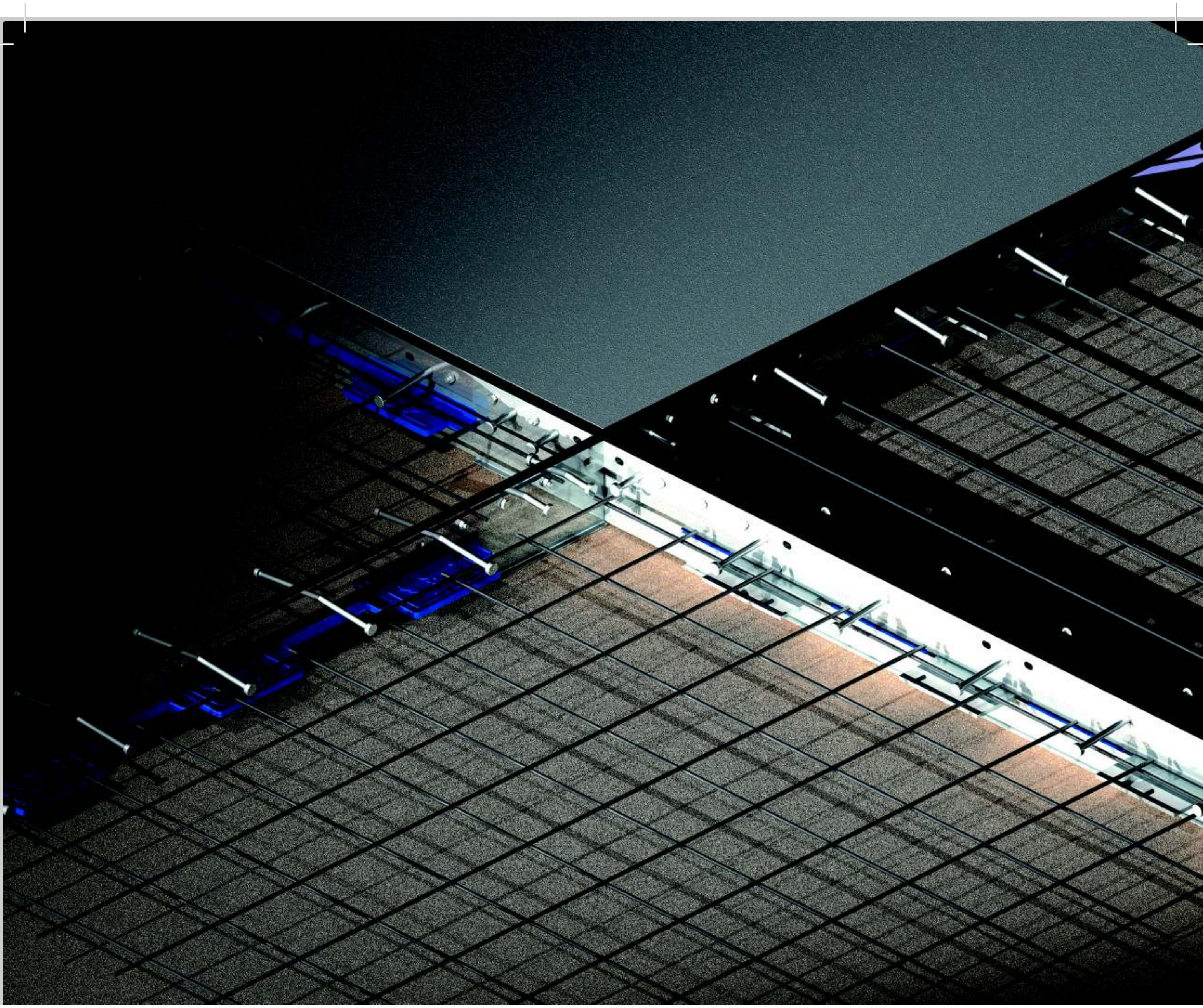

TERA Joint

High quality floor joint system

CERTIFIED inspecta ORGANIZATION
ISO 9001
ISO 14001

For Australian markets
June 2012

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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 at the edge of the concrete slab
- Fast and precise installation with accessories
- 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

peikko® group

CONCRETE CONNECTIONS

CONTENTS

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 both horizontal plane directions. The system also provides extremely durable edge protection to the concrete slabs, particularly when subjected to traffic

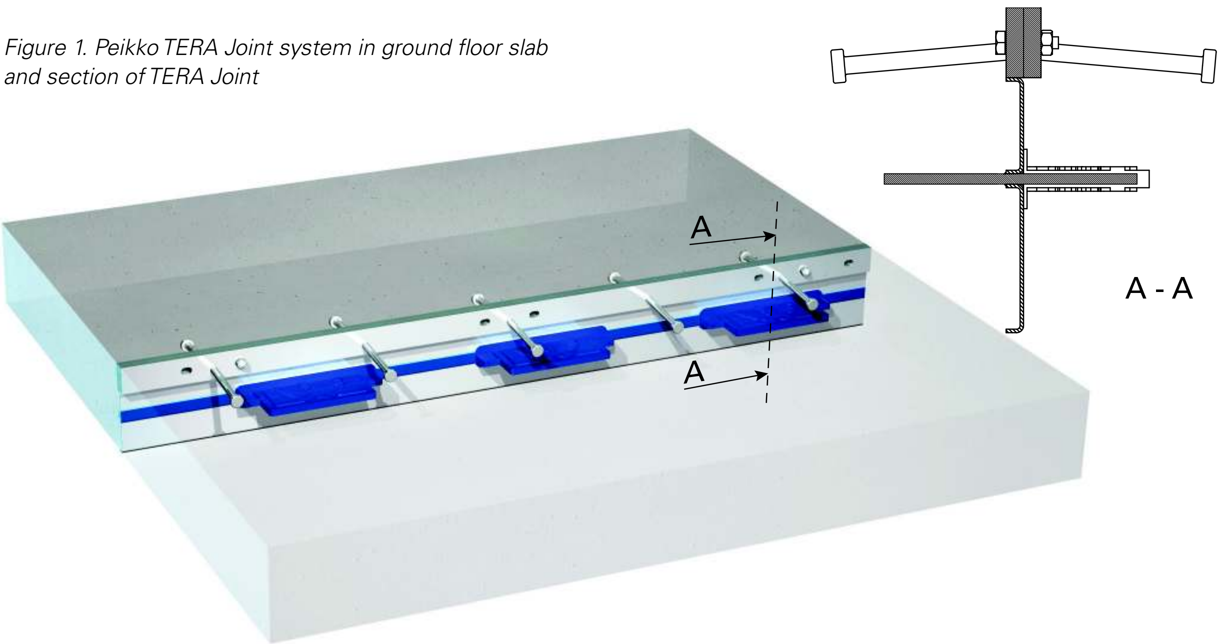
The load transfer is achieved by high strength steel plate dowels which are combined with rigid release sleeves to allow free slab movements in both longitudinal and perpendicular directions, eliminating the principle cause of shrinkage cracks.

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 or suspended slabs starting from 100 mm slab thickness.

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

The 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.

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



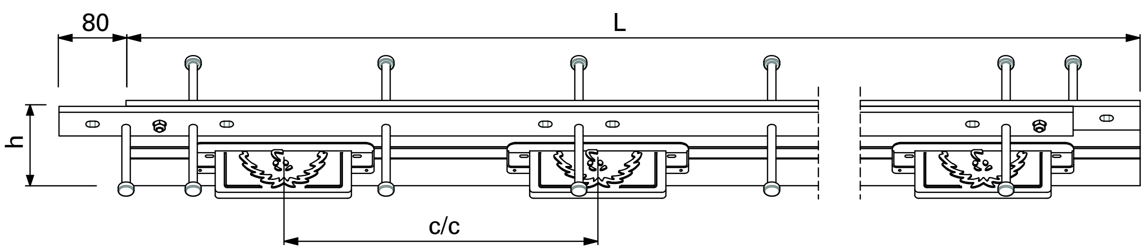
2. DIMENSIONS AND MATERIALS

Table 1. Materials and standards.

	Sheet metal	Flat bars	Plate dowels	Headed studs	Plastic sleeves
TERA Joint	AS 3679 GRADE 200	AS 3679 GRADE 200	AS 3679 GRADE 400	AS 3679 GRADE 200	ABS
TERA Joint HDG	AS 3679 GRADE 200 EZP	AS 3679 GRADE 200 HDG	AS 3679 GRADE 400 HDG	AS 3679 GRADE 200 HDG	ABS
TERA Joint stainless	AS 3679 GRADE 200 EZP	UNS S30400 / S31600	AS 3679 GRADE 400 HDG	UNS S30400 / S31600	ABS

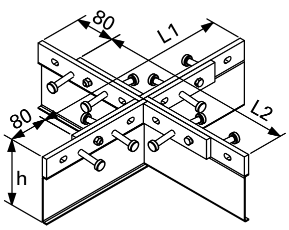
EZP = electro zinc plated, HDG = hot dip galvanized.

Table 2. Dimensions [mm] of TERA Joint



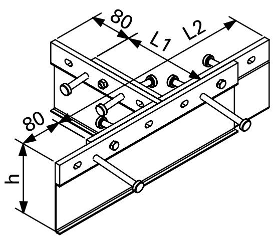
type	height h	dowel size	dowel centres c/c	length L	weight [kg]	advisable slab depth
TJ6-90-3000-RD	90	6 x 130 x 150	375 or 430 or 500	3000	31,2	100-120
TJ6-115-3000-RD	115				32,4	125-140
TJ6-135-3000-RD	135				33,9	145-170
TJ6-160-3000-RD	160				35,1	170-195
TJ6-185-3000-RD	185				36,3	195-225
TJ6-215-3000-RD	215				37,8	225-250
TJ6-230-3000-RD	230				38,5	240-270
TJ6-245-3000-RD	245				39,2	255-300
TJ12-135-3000-RD	135	12 x 150 x 150	375 or 430 or 500	3000	40,7	145-170
TJ12-160-3000-RD	160				41,9	170-195
TJ12-185-3000-RD	185				43,1	195-225
TJ12-215-3000-RD	215				44,6	225-250
TJ12-230-3000-RD	230				45,3	240-270
TJ12-245-3000-RD	245				46,0	255-300

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

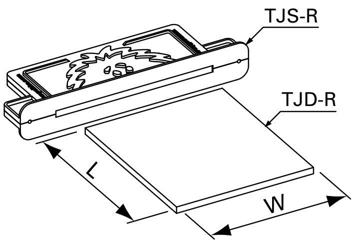
Table 4. Dimensions [mm] of TERA T-Junction



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	length l	width w	sleeve type	advisable joint opening
TJD-R6	6	130	150	TJS-R6	0-15
TJD-R12	12	150	150	TJS-R12	15-20

3. MANUFACTURING

3.1 Manufacturing method

Flat bars	Cold drawn to size, 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 (vertical direction)	±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-R6	10	150	110	83,3	**75**
TJD-R12	10	300	**130**	333,4	221,1
TJD-R6	20	150	90	**41,7**	45,7
TJD-R12	20	300	**110**	166,7	150

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

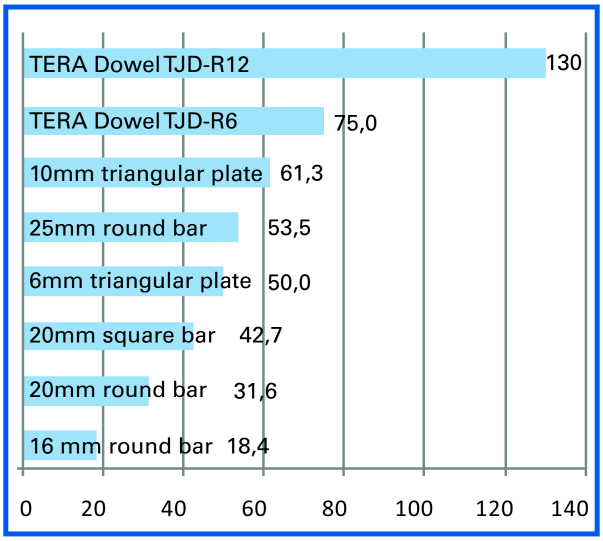
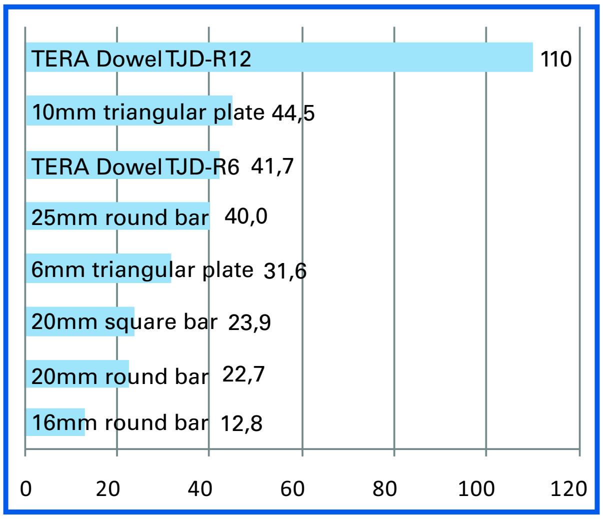


Table 8. Comparison of the most common dowels with 20 mm joint opening



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

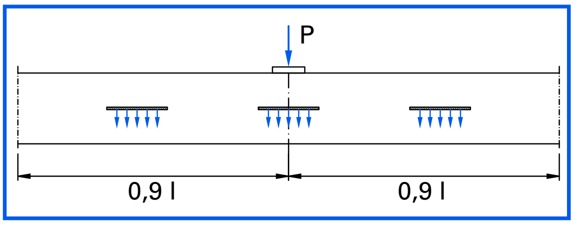
The capacity values of the dowels do not take account of the sub-base support pressure which is the worst-case scenario.

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.

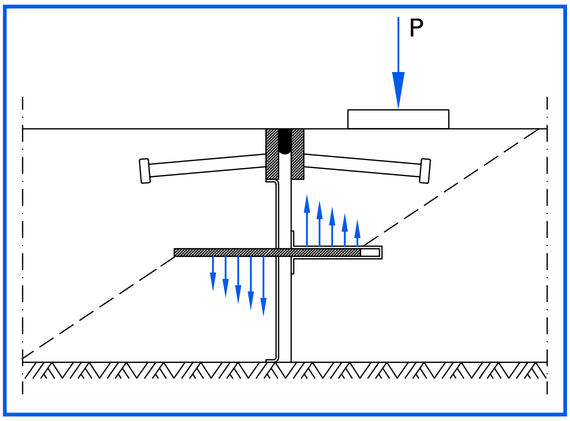
TERA dowels are selected according to designed joint opening. Joints TJ6 and dowels TJD6 are for openings up to 15 mm. Types TJ12 and TJD12 are for openings from 15 to 20 mm. It is recommended to use the thicker dowels always in suspended slabs. Wider joint opening is also possible however account must be taken of reduced capacity.

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 edges is about 50% of the capacity at the centre of the slab. At corners the capacity is about 25%.

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

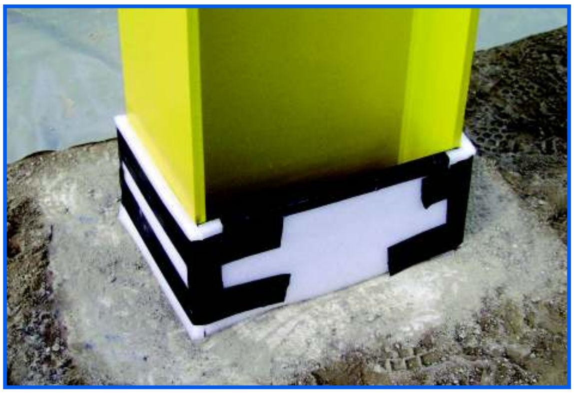
Slabs should also ideally be no more than 50 m in length/width. Greater sizes than this require specialist techniques and materials.

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.

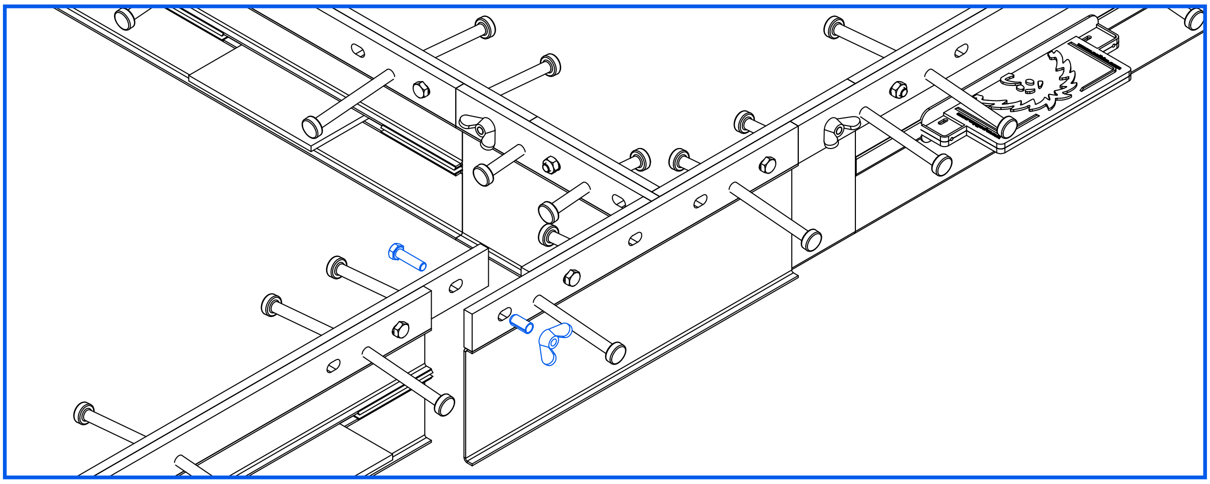
Figure 5. TERA dowels and sleeves

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/mm^2
- Radius of relative stiffness, l=744 mm
- Minimum ultimate capacity per dowel, P_p=11,2 kN

Effective number of dowels according to TR34:

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

Ultimate design load:

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

Required load transfer capacity:

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

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.

6.2 Installation of the floor joints

The joints shown include optional reinforcing bar fitted to the shear studs which is available if required.

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 (Figure 11). 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 (Figures 9 and 20).

- 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.

- Other pin arrangements are also acceptable including placing pins on both sides of the joint.

Figure 7. Step 1 - Sub-base level

Figure 8. Step 2 - Joint location

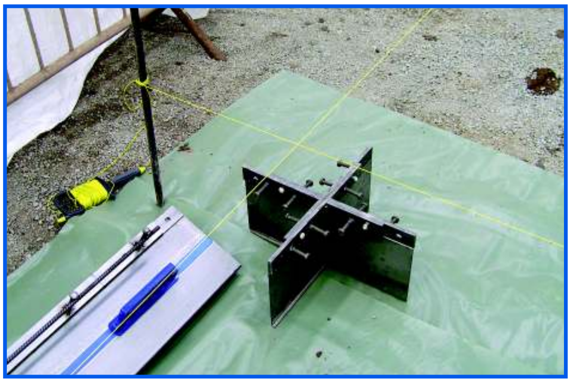
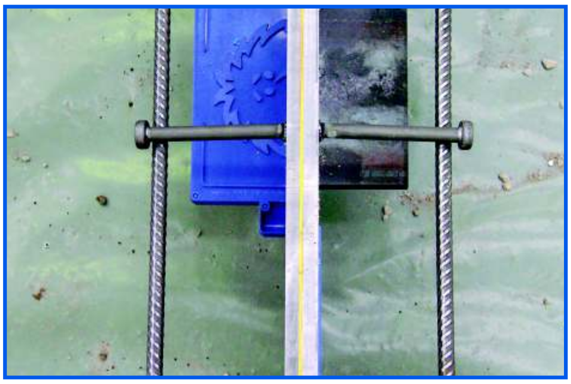


Figure 9. Step 3 - Joint installation.

Figure 10. Step 3.2 - Positioning joint



If pins are placed on both sides then care must be taken to ensure minimal restraint of the joint in the finished floor.

- 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.
- If required further vertical support can be provided without additional lateral restraint by the use of 'T' supports which can be placed and welded to the studs in the same manner as the support pins. These 'T' supports are deliberately overlength so they can be held above the pin while welding preventing possible weld-spatter burns to the hands. Once fixed in place the tops can easily be cut to the same height as the studs (Figure 12).
- Pins can be simply driven into place with a suitable impact gun and chuck (Figure 13).
    - 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 (Figure 14).

4. The joints must be adequately fixed so that the divider plates can not move under the pressure of the applied concrete. This may require bracing the divider plates on the opposite side to the first pour to prevent them being able to move when the concrete is poured. The need for bracing is very dependant on joint (and slab) depth. Shallow joints (<150mm) may not require bracing at all but its importance increases with depth of joint.

Figure 11. Step 3.2. Adjusting height level

Figure 12. 'T' support as vertical support.

Figure 13. Placing pins.

Figure 14. Welding the pins.

TERA Joint

One method of bracing is to simply use timber spacers placed between the support pins and divider plates. These spacers can easily be made from the Joint packaging materials but must be removed prior to pouring the second side. They can of course be re-used and then discarded at the end of the project (Figure 15).

A further method is to use the Peikko metal 'T' supports which can be welded between support pins and the divider plate providing bracing in two directions unlike the timber blocks which only resist the concrete pressure against them. These pins remain in-situ eliminating the need to remove them before pouring the second side however they must only be fixed on the opposite side of the joint to the sleeves to prevent any connection between the slabs and so possible restraint on the joint opening (Figure 16).

5. Subsequent joints are aligned, fixed at the overlap using dowel bushes, plastic bolts and nuts, adjusted and fixed in the same manner (Figure 17). 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 (Figure 18).

6. 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.

7. 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 (Figure 19).
   - 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 **Lr** (the length of joint to be removed in mm).
   - The final joint should have a section cut from the centre equal to **Lr** 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.

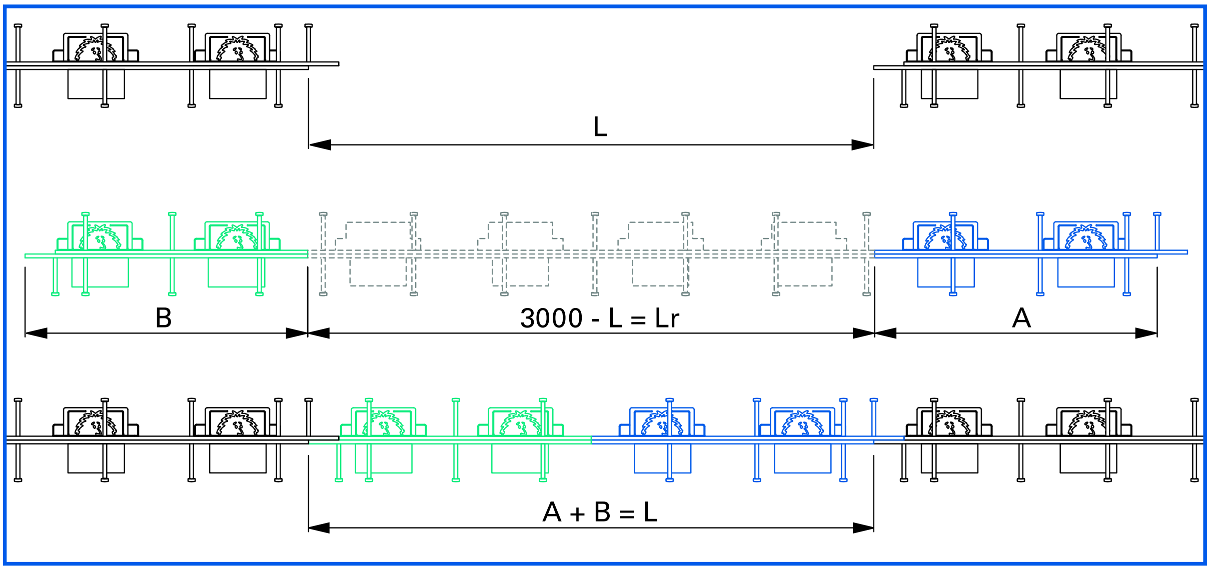
Figure 15. Using timber spacers

Figure 16. 'T' support as spacer.

Figure 17. Connecting joints.

Figure 18. Clearance gap.

Figure 19. Cut joint run



8. 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.

9. 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.

Figure 20. Line of Joints fixed with pins placed both sides.

Figure 21. Line of joints fixed with concrete 'dabs'.

TERA Joint

<u>Step 4. Pouring concrete</u>

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 (h/2) and mark the required spacing (d) 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

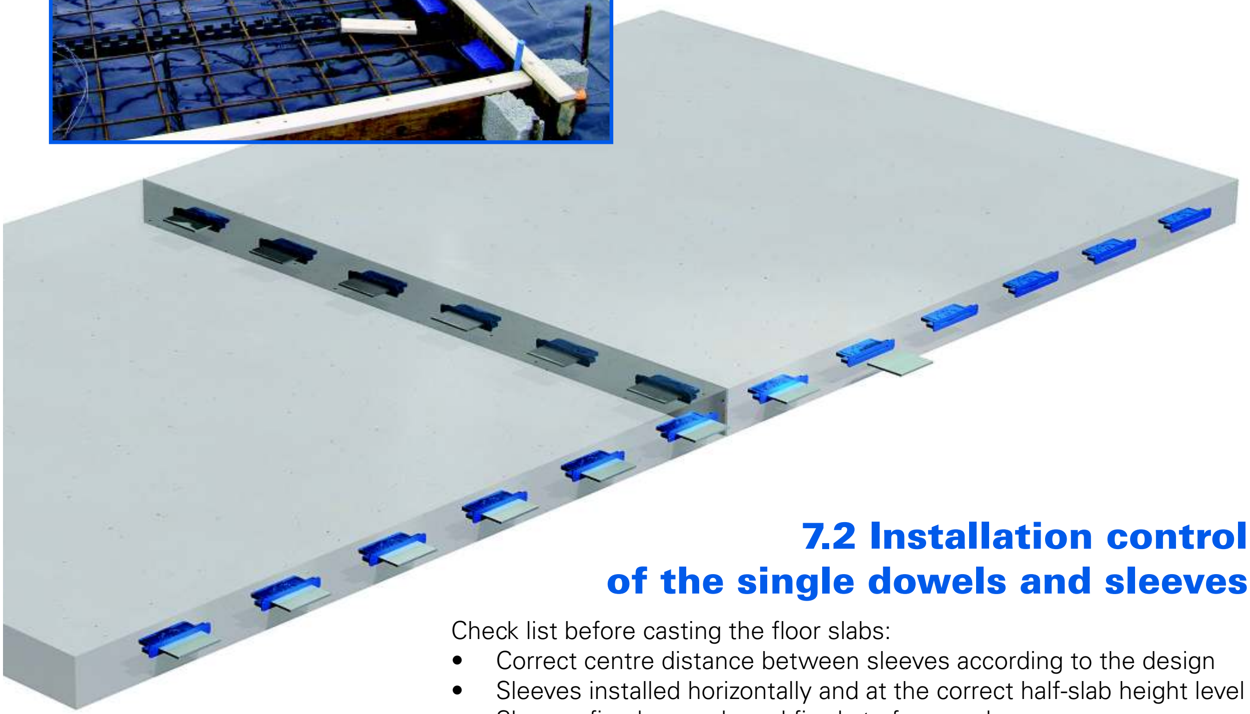
Step 4. After concrete has hardened adequately and the formwork removed, the nails should be flattened and the dowels inserted into the sleeve pockets. The dowels should be inserted fully into the sleeves.

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
- Where required the joint divider plates should be braced to prevent the possibility of movement under the pressure of the poured concrete as outlined in section 6.2
- 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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