



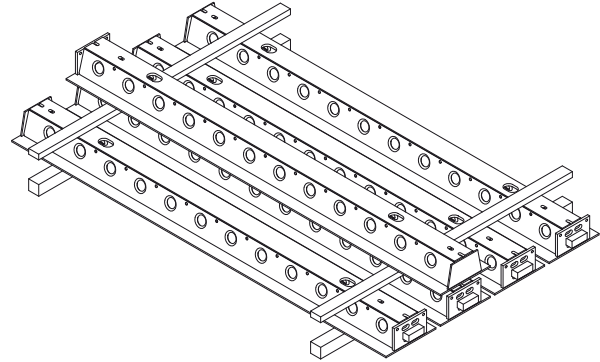
# **DELTABEAM INSTALLATION INSTRUCTIONS**

## 1. Deliveries

- Deltabeams are delivered in shipments according to agreed delivery schedule, delivery of each shipment should be confirmed two weeks prior delivery with Peikko
- It is not economical or practical to load Deltabeams in erection sequence
- In top flange of each Deltabeam can be found marks, equivalent to marks in assembly drawings





## Storage at the site

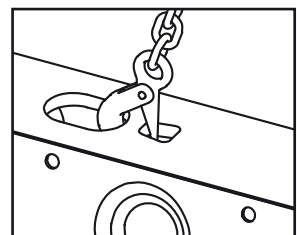
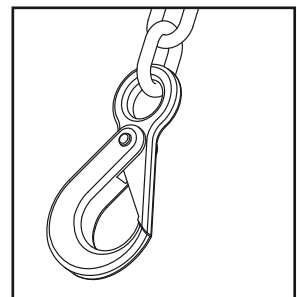
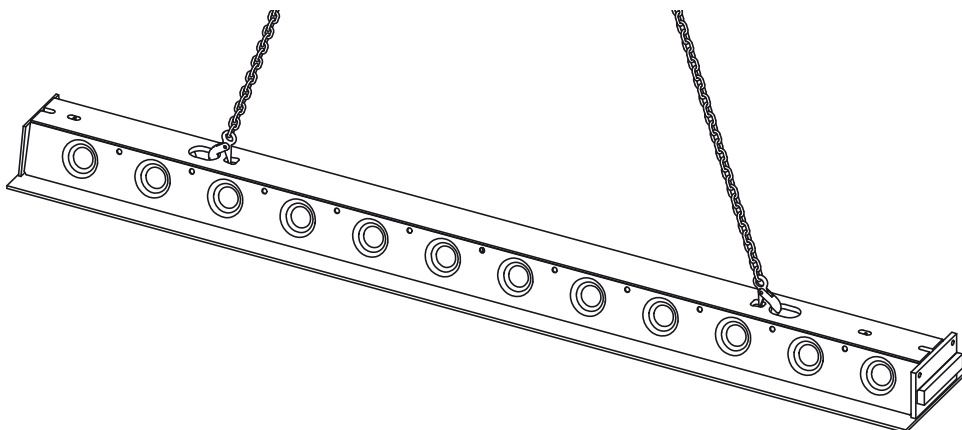
- The bottom side of the Deltabeams are treated with anticorrosive primer, though in long-term storing the Deltabeams should be covered.
- When storing Deltabeams in piles, the bearing capacity and level of the soil/ground/mark should be verified
- When storing Deltabeams in piles, it is recommended to have piling strips to protect the surface treatment



## 3. Lifting and moving at site

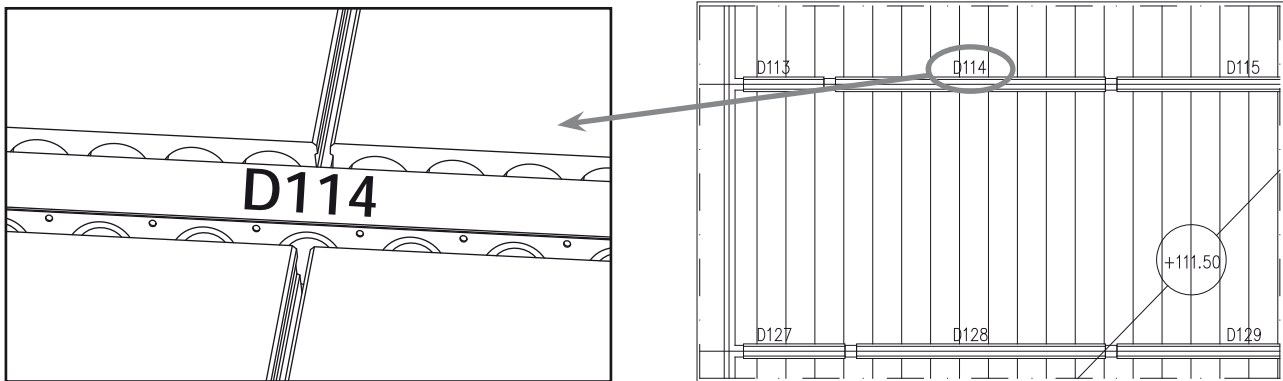
- Using crane or fork lift
- With normal lifting equipments
- Weight of each Deltabeam can be found in sticker in the beam, also in the fabrication drawings
- Lifting points: there is pair of holes for in top flange symmetrically at axis of centre of mass, lifting hooks
  - Note maximum allowed lifting angle of the chains
- In special cases, when there are no lifting holes, lifting with chains fixed to the web holes

			
Deltabeam	300/622/2001	05/4204	060-025279
Peikko Group		Peikko Finland Oy	
Serial Number:			
06264_6-3			
Beam type:		Customer:	
D20-200		Hotelli Suomutunturi	
Weight:	94,00	Length:	2300
			25.11.2009



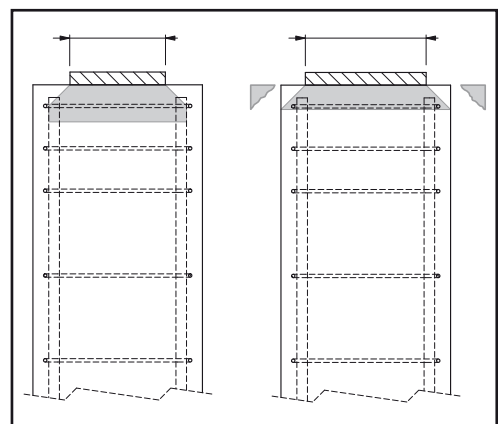
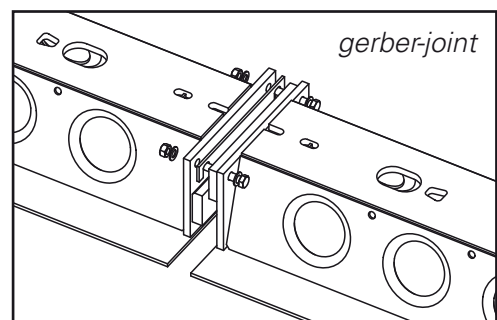
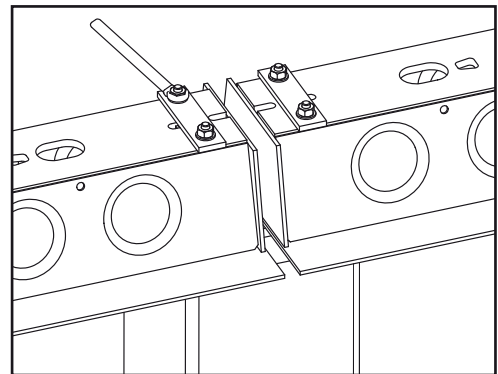
## 4. Assembly

- Follow in all the situations the method statement for erection of the project
- In the top flange of every Deltabeam is identification code i.e. the beam mark used in the assembly plan drawing, notice the direction of the mark



### 4.1 Fixing of the Deltabeams

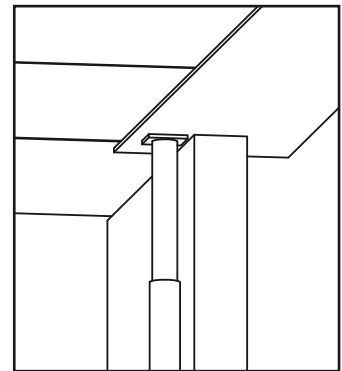
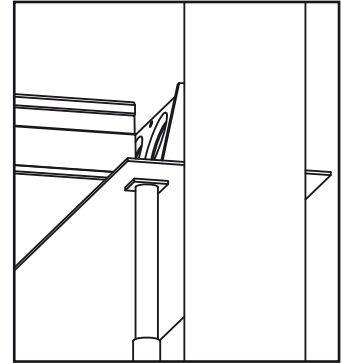
- Follow the method and sequence stated in the method statement and advice erection plans and details
- Shims and steel packs etc. should be placed according to the method statement for erection
- Deltabeams should be fixed prior assembling the props and the floor panels
- If site welding should be required, process and qualification of the welders should be according to the method statement for erection
- Deltabeam delivery includes installation material only for the connections between Deltabeams
- The shim in gerber- and side connections should be used as default to achieve the planned total length of the beam line, the beam lengths have been designed with the shim, possible variations to the designed total length should be taken into account by modifying thickness of the shims
  - Assembly tolerance is +5 mm / -10 mm
  - Max thickness of the shims is 15 mm
- When assembling continuous Deltabeams, the location of each beam and total length of the line should be confirmed prior tightening of the bolts in the connections and gerber-joints
- Placing of the steel packs on reinforced concrete structure
  - It behoves to place the steel pack so that the effect of the contact stress remains inside the perimeter of the stir-up reinforcement, see figure below
  - Risk of spalling can be reduced by applying chamfers to edges of the concrete structure
  - The usage of neoprene is not recommended between Deltabeam and the support



## 4.2 Propping of the Deltabeams

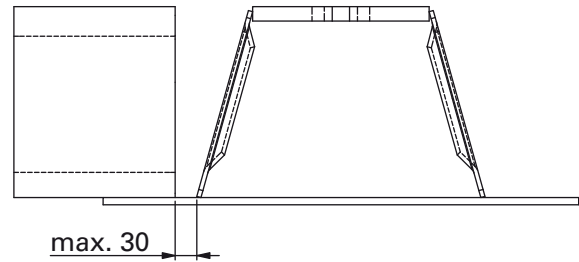
No propping is required, provided that Deltabeam connections and vertical supporting structures are designed for the temporary condition. Special notice should be taken in cases with asymmetrically supported beams, long beam spans or tall propping height.

- Propping should be carried out according to the method statement prior assembling the floor slabs
  - Fix the beams according to the erection details and plans
  - Locations of the props and loads to the props according to the engineer
- To be confirmed while assembling the props:
  - Stability of the props
  - Secure solid foundation for the props
- The props should be assembled as close to the beam support as possible, see figure on right
  - The prop should be placed at the loaded side of the beam, below the web
- The props may be removed only when the joint and infill concrete has reached required strength
- In hollow core floors the beam propping is to prevent the rotation of the beam at the support, not to prevent the deflection
- Propping is required always when Deltabeam is supported on end of a wall, see figure on right
- Hollow core plans should not be propped without permission from the manufacturer
- Tall propping heights
  - Use traditional methods i.e. temporary columns or towers
  - Peikko can offer special solution for propping problem, though it has to be taken into account in design of Deltabeams



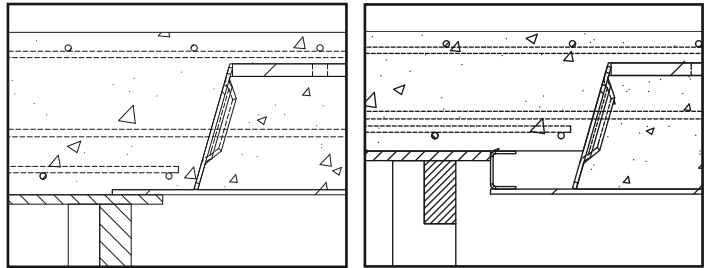
### 4.3 Assembly of the floor units

- Secure connections and props of beams prior assembly of floor units
- Floor units should be assembled directly on the steel bottom plate, usage of neoprene is not recommended
- Floor units should be assembled so that there is max 30 mm gap between Deltabeam web and end of the floor unit
- Block all holes at bottom side of Deltabeam i.e. locations of consoles, side connections and gerber joints
- Install joint and ring reinforcement



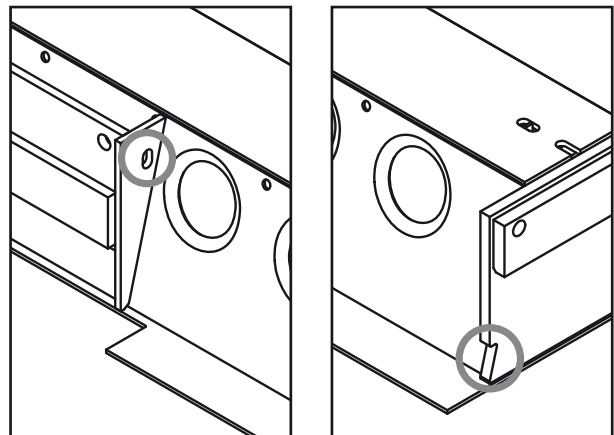
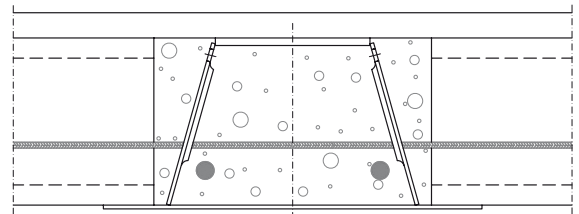
### 4.4 In-situ concrete slab

- To achieve flush bottom surface to the in-situ slab, it is recommended build the formwork under the bottom flange, see figure on right
- With downstand build the form work against the web of the U-profile, see furthest figure on right



### 4.5 Reinforcement

- Deltabeam minimum joint reinforcement is D12 c/c 1200, in UK D16 c/c 600
- Joint reinforcement should always be through Deltabeam web holes
- The reinforcement specified above has to be assembled even if there would be used rebars bent over Deltabeam
- Assembling the ring reinforcement, see pictures on the right
  - There is a hole in the side connection for the rebar, see figure furthest on right
  - Notch in gerber joint for the rebars



**IT IS NOT ALLOWED TO CUT DELTABEAM WITHOUT PERMISSION AND INSTRUCTIONS FROM PEIKKO; i.e. OPEN OUT BOLT HOLES etc.**

**IT IS NOT ALLOWED TO STORE MATERIAL ON THE FLOOR BEFORE THE INFILL CONCRETE HAS MATURED**



## 4.6 Casting the concrete

- Fill Deltabeams simultaneously when casting joints of HC planks or in-situ slab, Deltabeam is designed for temporary live load of 0.5 kN/m<sup>2</sup> – period of time prior the infill concrete has matured
- Use always structural concrete, minimum grade C25/30
- Properties of the concrete according to the method used in casting
- Recommended max aggregate size is 8 mm (not more than 16 mm)
- Deltabeam has to be filled with concrete in one run
- Take care that the lower parts of gerber and side connections are properly filled with concrete
- Topping concrete should be casted in separate phase when the infill concrete has matured

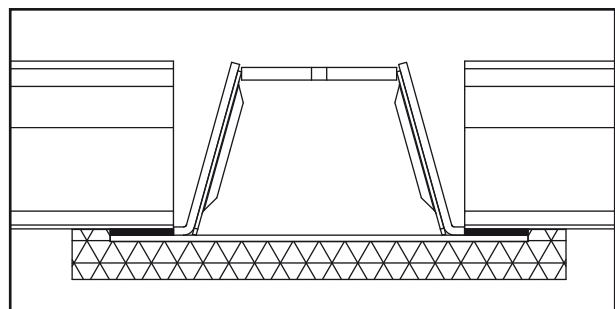
### Casting the concrete:

1. Confirm that formwork and reinforcement are according to design, fixed and clean
2. Infill:
  - Initial infill of the steel box up to web holes may be done through the holes in the top flange
  - After initial infill, feed concrete only from one side of the beam
  - Secure that Deltabeam is filled totally with concrete through air holes at opposite side of Deltabeam, it is full when concrete runs through them
  - Be careful not to run concrete over the Deltabeam, it will make harder to observe either it is full or not
  - Compact the concrete with poker while concreting
  - The whole infill process may be done through the holes in top plate, but it will be slower and require more work with the poker to run the concrete
3. Mind the formwork plate and the vertical web when using poker



## 4.7 Fire proofing

- Deltabeams with movement joints has to be fire proofed from below
- In the case when the movement joint is on the bottom plate, the whole length has to be proofed, see figure on right
- In the case when the movement joint is at end or side connection, the proofed length has to be estimated case by case
- The vertical web of DR-type Deltabeam has to be fire proofed at site in cases where it is not protected by permanent structure i.e. wall, which would act like permanent structural fire protection
- In the case of connection between Deltabeam and fire proofed steel structure, the extent of fire proofing has to be estimated case by case; unprotected Deltabeam will conduct heat to the steel structure through the joint

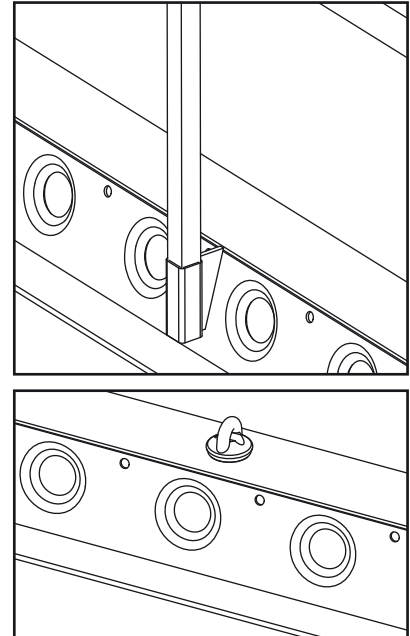


## 5. After the erection

- Any damages in the surface treatment should be repaired as soon as possible
- The surface treatment should be completed with the top layers as soon as possible

## 6. Safety

- All valid Health&Safety rules has to be followed
- It is possible to have fixing points for safety products with additional order, see sketches below



## FITTER CHECK LIST

### 1. Storage at site

- Use piling strips to protect the surface treatment
- Cover Deltabeams in long term storage at site

### 2. Hoisting and transporting

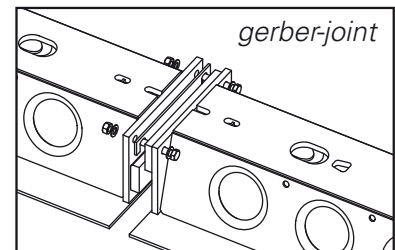
- Intermediate beams (holes in both webs): lock chains into holes in top flange
- Edge beams (holes only in one web): lock chains into holes in top flange

**NO LIFTING STRAPS / CHAINS AROUND DELTABEAM!  
HEALTH AND SAFETY RISK!**

### 3. Erection

#### Deltabeams

- Check first instructions and requirements in the method statement
- Beam should be assembled in the same way as it is drawn in the erection plan, the mark is read from same direction
- Beams has to be fixed to supports prior starting the assembly of the floor units (with bolts or welds)
- When assembling beams on reinforced concrete columns, use either one wide steel spacer pack or two smaller, one small in the middle is not enough
- Prior tightening the bolts in gerber joints, check total length and location of the beams of the line of beams



#### Floor units

- Assemble the floor units directly on the steel bottom plate without any layers between, end of the unit max 30 mm from Deltabeam web
- To minimize the rotation of the beam, assemble floor units alternately on different sides of the beam

#### Propping

- As close as possible to support of the beam, below the web
- Remove only after the concrete has matured

#### Reinforcement

- Minimum reinforcement through Deltabeam D12 c/c 1200, from slab to slab in joints or voids
- In edge beams use L or U shape rebars

#### Casting the concrete

- Fill with one go, fill only from one side, observe from the other side, beam is full when concrete starts to run through the small air holes in the upper part of web, mind the formwork plates when using poker
- Secure that concrete fills the gap between gerber joints

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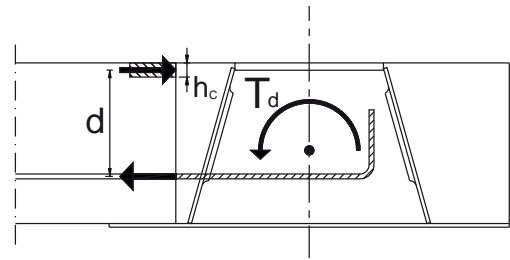
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# DESIGNING THE JOINT REINFORCEMENT

## 1. General

- According to Deltabeam technical approval, there has to be a certain amount of reinforcement connecting Deltabeam and the floor slab. This joint reinforcement should be minimum  $\varnothing 12$  c/c 1200.
- The purpose of the joint reinforcement is to tie Deltabeam and the floor together and prevent any separation between in ambient and fire temperatures and secure the load transfer from floor slab to Deltabeam.
- It is possible to have additional holes in webs of deep Deltabeams ( $h \geq 320$  mm) for the joint reinforcement, to allow bigger arm for the joint reinforcement, location of the additional holes should be shown in detail drawings from the engineer. Lower edge of the additional hole should be minimum 70 mm above the bottom flange with max 60 mm diameter. Additional holes are always placed between the web holes.
- The joint reinforcement should be designed against the torsion effecting in Deltabeam [kNm/m], the torsion varies depending if propping is used or not. With hollow core slabs dimension  $h_c$  is the minimum thickness of the top hull; in the cases of solid concrete slabs normal distribution of compressive stresses may be used. Amount of required reinforcement is estimated with normal method for concrete cross-section in bending.
- Reinforcement against torsion should be estimated in cases of edge beams or when the spans or loads differ significantly at opposite sides of Deltabeam.
- In the un-propped construction the loads used in torsional analyses are the loads effecting after casting Deltabeams and the floor joints; when neither the beam or the floor slab are propped.
- In all other cases it on safe side to use total load (DL+LL) estimating the torsion.
- In accidental design case the joint reinforcement may be designed for tension, rebars should be able to hang the dead weight of the floor. Loads in this design case are in minimum: dead weight of the floor and small live load ( $\geq 0.5$  kN/m<sup>2</sup>).
- Arms when estimation torsion moments, horizontal dimension from centre line of Deltabeam to:
  - For loads during erection period: to the centre of the bearing of the HC unit
  - For other loads: bottom edge at outer surface of the web plate



## 2. Intermediate beams

- Minimum joint reinforcement is  $\varnothing 12$  c/c 1200. Use straight rebars which run through the web holes and are anchored with full development length to slab on both sides of the Deltabeam.
  - In the case of topping laid directly on top of the slab, the above mentioned minimum reinforcement may be replaced by the transversal reinforcement in the topping.
- Choose the maximum from the following cases:
  - minimum reinforcement + reinforcement due to torsion
  - reinforcement due to accidental design case

## 3. Edge beams

- Edge beams are: all DR- and D-type Deltabeams, which carry floor units only at one side, also cases where floor units span along the beam at the opposite side of Deltabeam.
- Minimum joint reinforcement is D12 c/c 1200.
- The joint reinforcement should be anchored inside Deltabeam, hook ends inside Deltabeam are recommended. Mechanical connection is not normally required.
  - In the case of topping laid directly on top of the slab, the above mentioned minimum reinforcement may be replaced by the transversal reinforcement in the topping. Note the anchoring of the reinforcement in the topping.
- Choose the maximum from the following cases:
  - minimum reinforcement + reinforcement due to torsion
  - reinforcement due to accidental design case

# DESIGN OF DELTABEAM PROPPING

## 1. General

- It is assumed that the reaction from the beam is transferred to the support and the prop prevents the rotation due to torsion.
- Propping should be designed to prevent rotation during erection.
- Propping should not prevent Deltabeam from deflecting.
- The prop should be as close to the support of the beam as possible.
- Deltabeam has to be fixed according to connection details.
- In case 2: design the location, size and thickness of steel packs  $V_1$  and  $V_2$ .
- Bolt  $K_1$  is assumed to balance the torsion due to difference in length or arms  $e_p$  and  $e_N$ , second bolt is symmetrically about the centre line.
- Following formulas apply to simply supported beam with equal end conditions
- Temporary condition is the period after floor plank assembly until the joint and infill concrete has matured.
- Torsion  $T_d$  [kNm]:

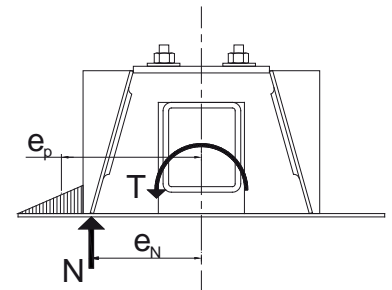
$$T_d = \frac{1}{4} \times L_p \times L_L \times (\gamma_G \times p_g + \gamma_Q \times p_q) \times e_p, \text{ where}$$

$L_p$	span of the beam [m]
$L_L$	span of the longer slab [m]
$e_p$	eccentricity of the reaction from the floor planks [m]
$\gamma_G$	safety factor of the dead weight
$p_g$	dead weight of the floor [kN/m <sup>2</sup> ]
$\gamma_Q$	safety factor of the live load
$p_q$	live load in temporary condition [kN/m <sup>2</sup> ]

## 2. Case 1, one support on centre line of Deltabeam

- Force N in prop [kN]

$$N_d = \frac{T_d}{e_N}$$



## 3. Case 2, two supports symmetrically

- Beam rotates around point  $V_1$ , the rotation is resisted by bolt  $K_1$  and prop N
- When bolt  $K_1$  is not taken into account in prop design:

$$N_d = \frac{T_d}{e_N}$$

- If bolt  $K_1$  will be taken into account in prop design:

$$I_p = e^2 + (2e_0 + e_N)^2$$

$$N_d = \frac{(2e_0 + e_N)^2}{(2e_0 + e_N)^3 + e^3} T_d$$

$$K_{1d} = \frac{I_p}{(2e_0 + e_N)^3 + e^3} T_d$$

$$\text{and } V_{1d} = \frac{e^2}{(2e_0 + e_N)^3 + e^3} T_d$$

