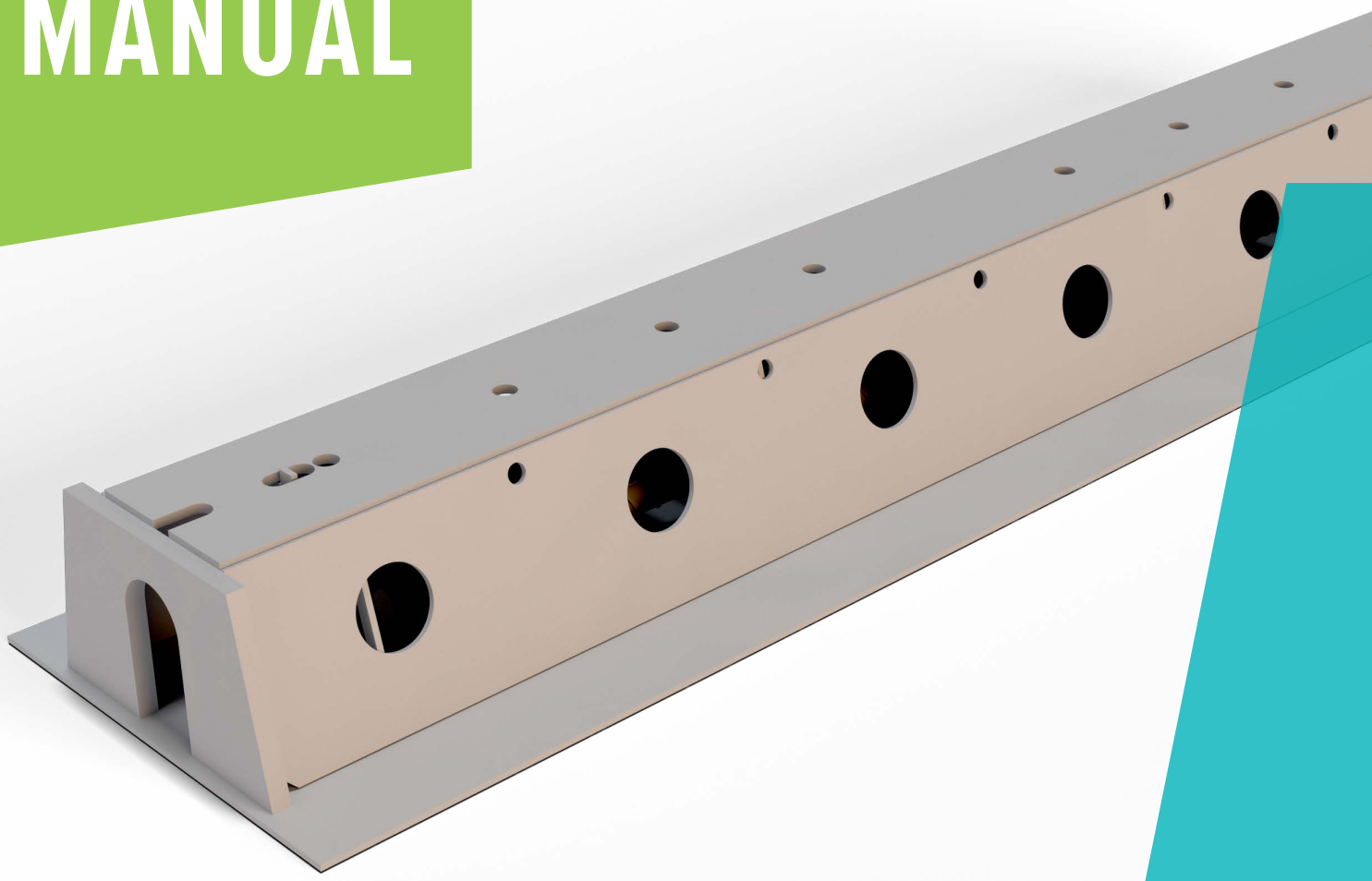
TECHNICAL MANUAL



DELTABEAM® Slim Floor Structure

Slim Floor Structure with Integrated Fireproofing

Version: North America 10/2019

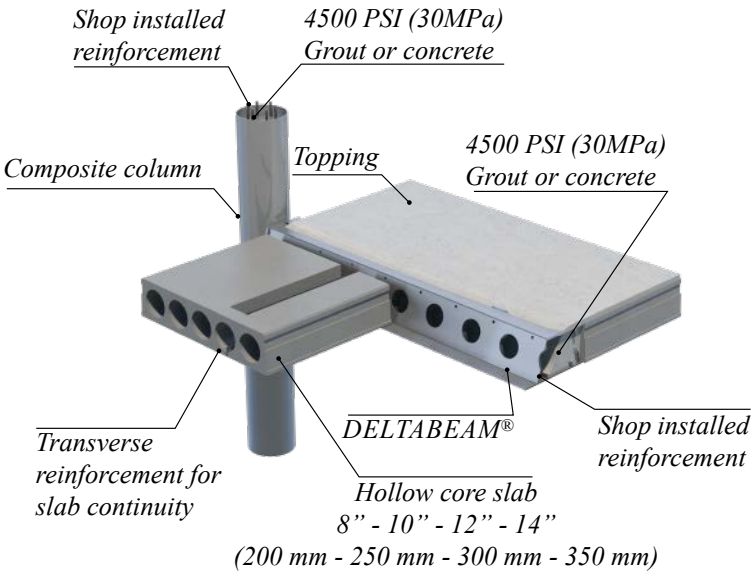
ICC ES ESR-4341

peikko®

DELTABEAM® Slim Floor Structure

Slim Floor Structure with Integrated Fireproofing

- Long spans while maintaining shallow beam section
- Cost-efficient
- Saves construction height
- Allows for cantilever and edge conditions
- Easy HVAC installation
- Standardized connections
- Quick and simple installation
- Flexible DELTABEAM® types and details
- UL / ULC fire rating up to 4 hours without additional protection
- Enables to get LEED certification points
- Local technical support



DELTABEAM® is a superior composite beam enabling slim-floors for multistory buildings of any type, whether low-rise or high-rise. Its composite action between steel and concrete allows for creative structures with large open spaces. Underwriter laboratories (UL/ULC) fire tests have proven DELTABEAM® to have excellent fire resistance without any additional protection. Its shallow design decreases the building's floor-to-floor height, while eliminating conflicts with HVAC systems.

Since 1989 DELTABEAM® has been used in thousands of buildings globally. Peikko's technical support is always available to help you to find the most suitable solution for your project.

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About DELTABEAM® Slim Floor Structure

1. Product properties

DELTABEAM® is a slim-floor composite beam which is integrated into the floor. The beam is completely filled with concrete on-site. The infill concrete and DELTABEAM® form a composite structure after the concrete has cured. DELTABEAM® acts as a steel beam before the infill concrete has reached the required strength. DELTABEAM® is made of cut steel plates and welded together at the factory (see *Figure 1*). It can be used with all common floor types. See the ideal floor types in *Figure 2*.

Figure 1. DELTABEAM® parts.

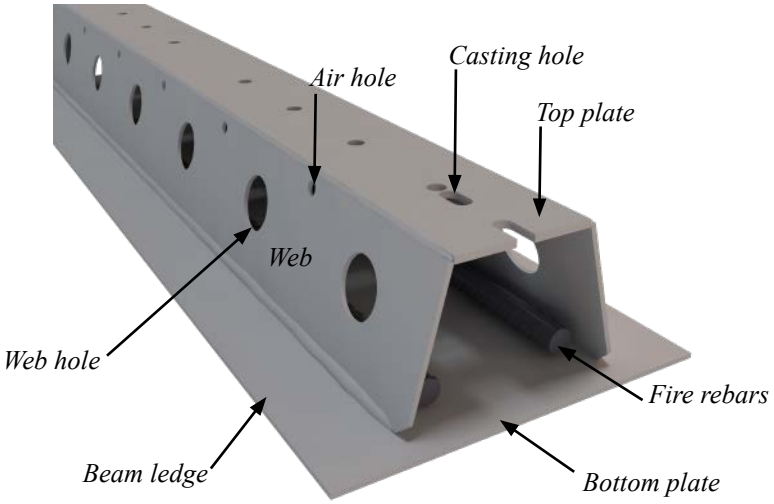


Figure 2. DELTABEAM® supports various floor types.

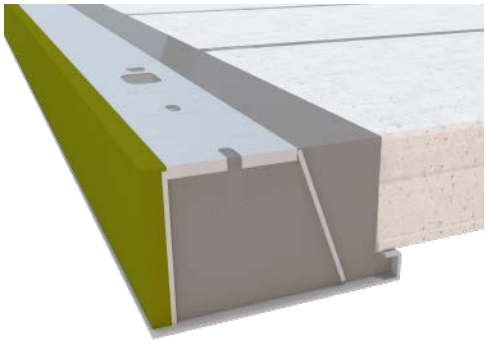
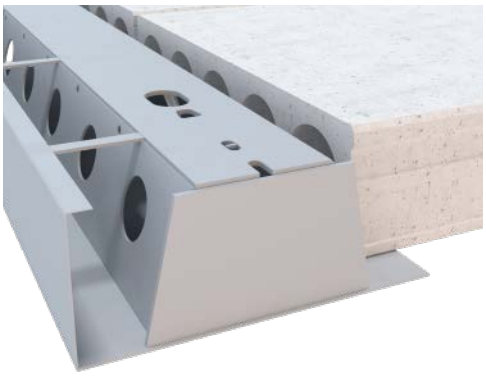
Hollow core slabs

Long span metal deck

Wood composite slab

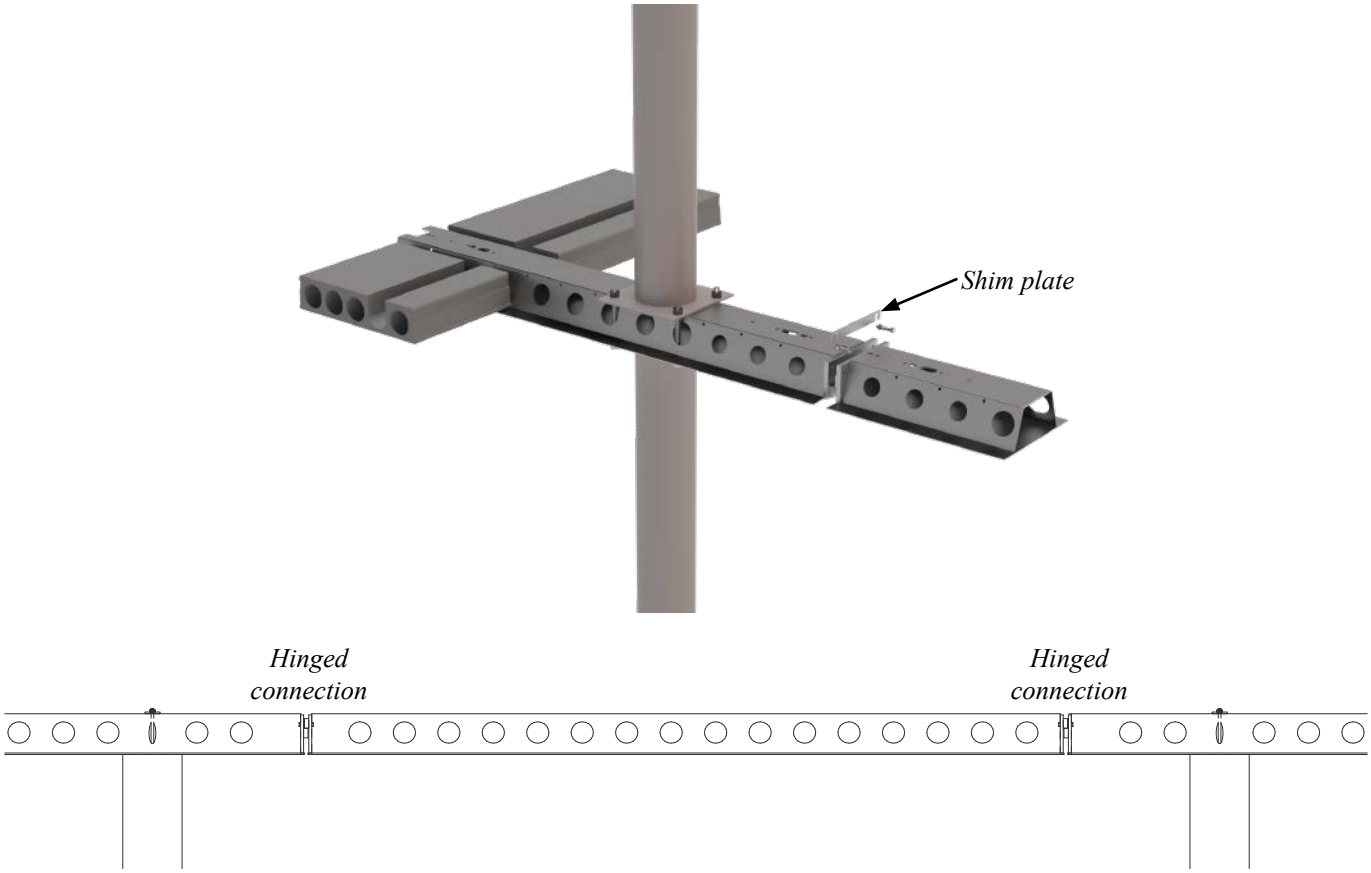
There are two types of DELTABEAM®. The IDB-type DELTABEAM® has ledges on both side of the beam. This beam type is able to carry floor units on both sides of the beam. The EDB-type DELTABEAM® has a vertical web and ledge only on one side. Both types of DELTABEAM® can be used as edge beams to carry floor units at only one side of the beam. Curved floor edges can be made by combining IDB-type beams with curved formwork. *Table 1* shows the use of DELTABEAM® types.

Table 1. The use of DELTABEAM® types.

IDB-type DELTABEAM®	**EDB-type DELTABEAM®**
Intermediate DELTABEAM® with downstands for longer spans	Edge DELTABEAM® with downstand for longer spans
	
Used as an edge beam with formwork sheet. The free side of DELTABEAM® is protected against fire with concrete	Used on floor openings or floor edge. Exposed web must be fireproofed.
	

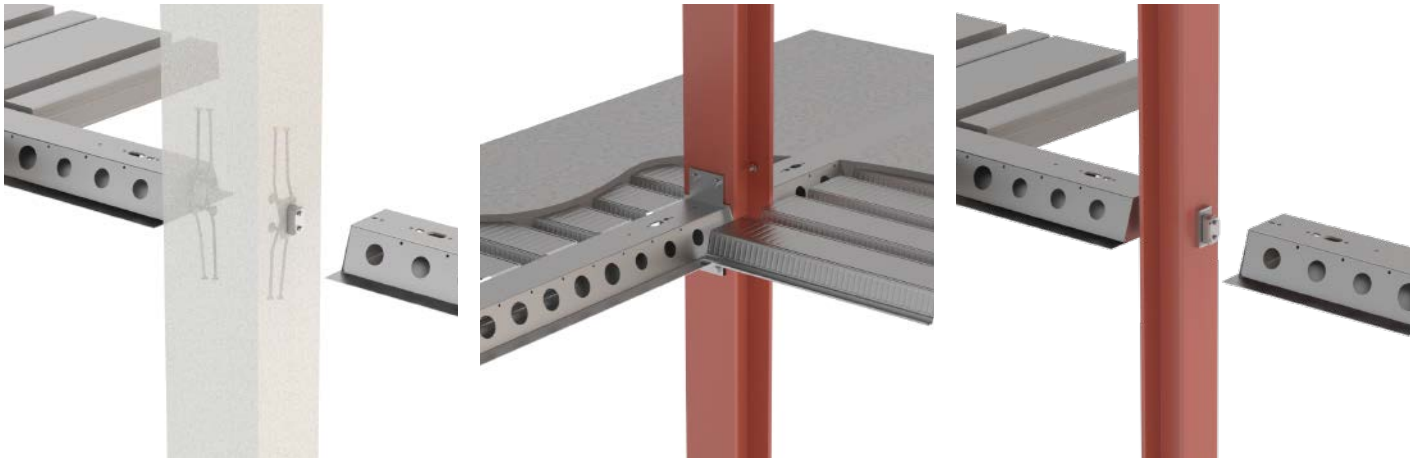
DELTABEAM® can be used as single-span beam or continuous beam construction. DELTABEAM® can also be used for cantilever beam construction. In multispan beam construction, hinged connections provide continuity to lines of DELTABEAM®s (see *Figure 3*). The beam to beam connection are designed by Peikko's engineers. Shim plates are used by default to allow for installation tolerance.

Figure 3. Continuous beam with hinged connections.



DELTABEAM® can be used with all common column types. DELTABEAM® is connected to the columns with corbels or fixed to the top of the column with bolts or welds. Peikko's PCs® Corbel is recommended for connecting DELTABEAM® to concrete column (see *Figure 4*). Connecting DELTABEAM® to steel column is possible using corbel and column plate from PCs® Corbel. PCs® Corbel is a modular hidden column corbel designed especially for DELTABEAM®. See PCs® Corbel technical manual for more information.

Figure 4. DELTABEAM® connected to steel and concrete column using Peikko's PCs Corbel or bolted end plate.

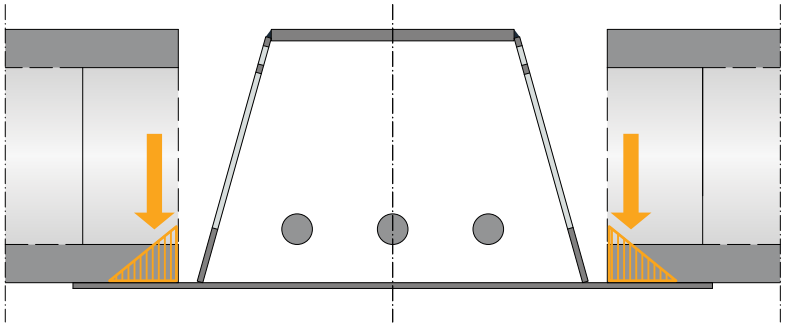


1.1 Structural behavior

1.1.1 Temporary conditions / Shoring requirements

DELTABEAM® acts as a steel beam before the infill concrete has reached the required strength. During the erection stage, all loads are transferred to DELTABEAM® through the beam ledges (see *Figure 5*). It is important to position the hollow core slab end correctly onto the beam ledge because this affects the DELTABEAM®'s design (see section 1.2.2). The erection stage design is carried out in accordance with elastic design principles, with the loads acting in the erection stage. The precamber of DELTABEAM® compensates for the deflection in the erection stage. The amount of precamber depends on the length of DELTABEAM®, on the loads in the erection stage and on the selected static system.

Figure 5. Load transfer in temporary condition.

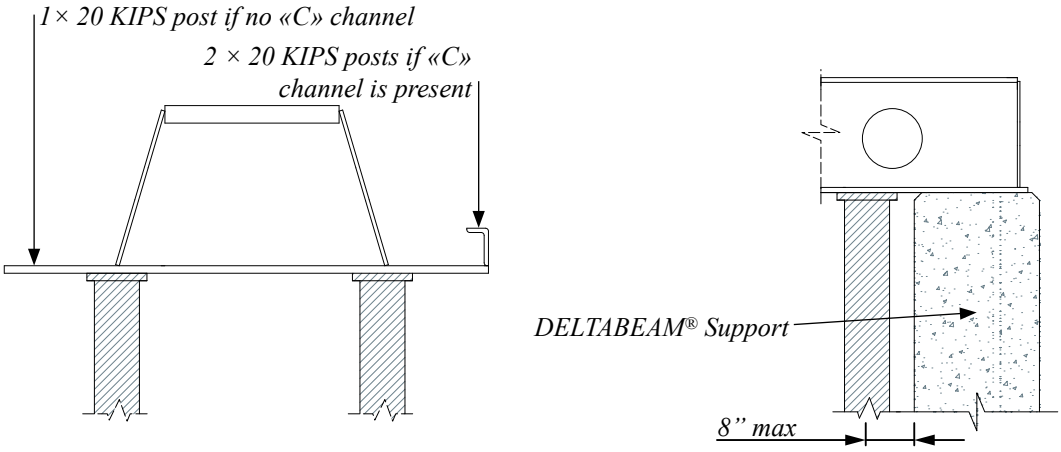


The effects of loads such as torsion during the erection stage must be taken into account when designing the connection details and the supporting structures. For example, variable beam spacing, variable load values or asymmetrically assembled floors can cause torsion.

Shoring is used with hollow core slabs only to prevent DELTABEAM® from rotating at the supports. The function of beam shoring is not to prevent deflection. No shoring is required provided that the DELTABEAM®'s connections and supporting structures are designed for the loads during the erection stage. Temporary shoring should be designed for temporary erection loads acting to them. DELTABEAM® is capable of transferring the effects of an eccentric load back to the column. More information about shoring can be found from section Installation of DELTABEAM®. Peikko's technical support is always available to help with any installation and shoring issues.

Typical shoring post shall be designed to support a minimum of 20kips (90kN) for standard beam without downstands. When DELTABEAM® has downstands, the shoring must be doubled at the support (2 × 20 kips posts under each web) to compensate for additional eccentricity (see *Figure 6*).

Figure 6. Shoring post design for DELTABEAM® with and without downstands.



DELTABEAM® shoring posts are located as close to the DELTABEAM® support as possible (see *Figure 7*). The posts must be placed below the web, on the loaded side. Shoring posts must not be removed until the infill concrete of DELTABEAM® have reached the required strength.

Figure 7. Recommended shoring method of DELTABEAM®.

Figure 8. Special shoring condition of DELTABEAM®.

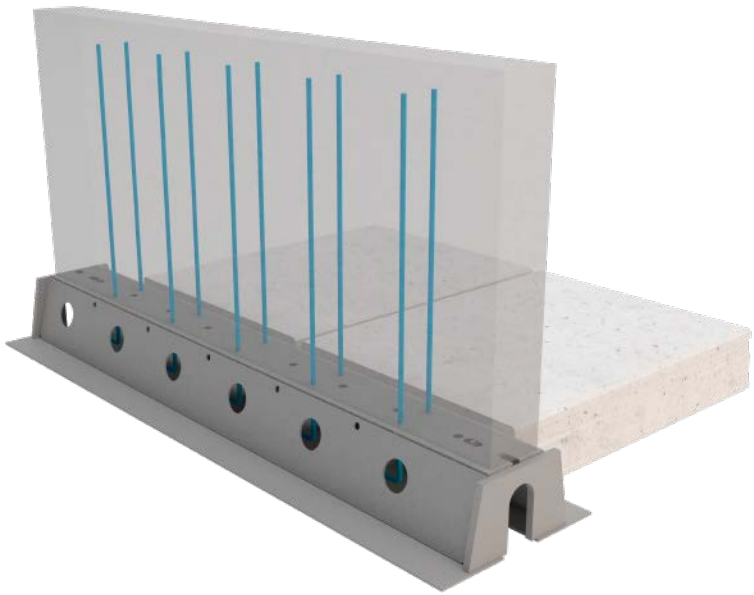
In case of solid slab types that are shored during construction phase, shoring may be necessary along DELTABEAM® to ensure that the beam and the slab do not separate while concrete grouting is done depending on the type of formwork.

Shoring is always required when DELTABEAM® is bearing on the end of a narrow wall running parallel with the beam and proper torsionally rigid connection with two bolts is not possible to be used (see *Figure 9*).

Figure 9. Shoring when DELTABEAM® is bearing on the end of a wall.

When the purpose of DELTABEAM® is to transfer floor loads to a wall-type beam above, DELTABEAM® must be correctly shored. DELTABEAM® must be shored according to the project's erection plan before the floor units are assembled. Shoring posts must not be removed until the upper wall is capable of bearing the full floor load. *Figure 10* shows detail of DELTABEAM® with a wall-type beam above.

Figure 10. The purpose of the vertical reinforcement is to tie DELTABEAM® and the wall-type beam together.

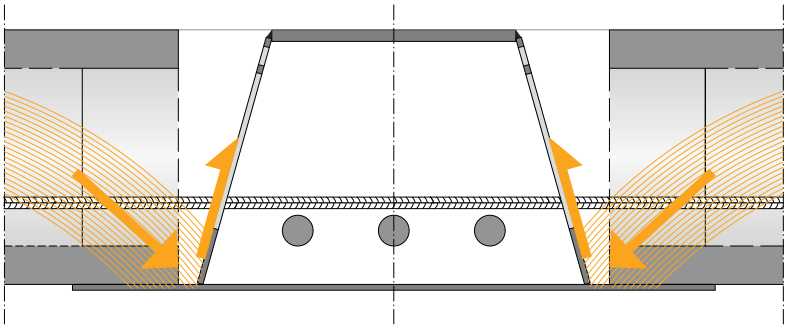


NOTE: DELTABEAM® SHORING IS USED WITH HOLLOW CORE FLOORS ONLY TO PREVENT THE BEAM FROM ROTATING AT ITS SUPPORTS.

1.1.2 Final conditions

The infill concrete and DELTABEAM® form a composite structure after the concrete has reached the required strength. In final condition, the loads are transferred to DELTABEAM® through a compression arc against an inclined web (see *Figure 11*). The load transfer is proven by load tests, where DELTABEAM® was tested without the beam ledges. Transverse reinforcement, which is assembled through the DELTABEAM®'s web holes, secures load transfer.

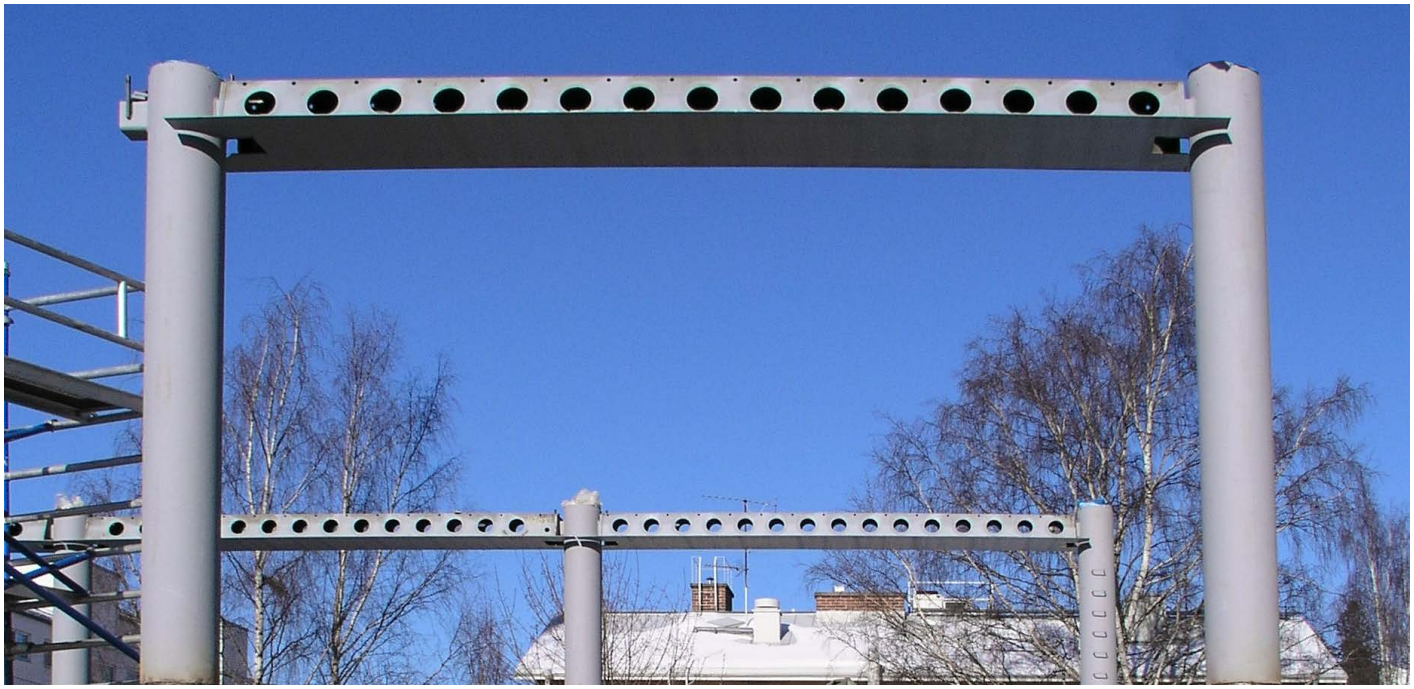
Figure 11. Load transfer in final condition.



The shear connection between the infill concrete and DELTABEAM® is formed by the dowel action of the web holes. Static loading tests have proven that the composite interaction is full.

The structural engineer designs the connections between DELTABEAM® and the supporting structure. The connection must be designed such that the DELTABEAM®'s support reactions are transferred to the supporting structure (e.g. a column, wall, or other beam). This supporting structure must be designed to bear the reactions from DELTABEAM®. Peikko designs DELTABEAM®s according to the connection details. Peikko also designs the internal beam-to-beam connections, such as Hinged and Side connections. Indicative connection details can be downloaded from the software download center on Peikko's website (www.peikkousa.com or www.peikko.ca). The appearance of the connection can be finished by cutting the DELTABEAM®'s bottom plate according to the connection detail (see *Figure 12*). If necessary, the bottom plate edge can be beveled or arched in plane of the bottom plate.

Figure 12. The DELTABEAM® bottom flange can be extended to provide support around the column.



1.1.3 In accidental situation

Fire situation

The evaluation of the fire resistance of DELTABEAM® is based on standard fire tests and design guidelines obtained from tests. DELTABEAM® is UL & ULC listed for fire resistance up to 4 hours. DELTABEAM® is dimensioned in compliance with the fire rating requirements of the project.

High fire resistance is achieved by fire rebars and infill concrete. The DELTABEAM®'s fire rebars and the webs act as tensile reinforcement in the event of fire. The rebars compensate for the strength that the bottom plate loses, meaning that additional fire protection is not needed. Shear studs are also added when necessary. Peikko engineers determine the required number of studs and their length.

Figure 13. Fire rebars inside DELTABEAM®.

UL Listing numbers: N900, N901, N902, N903
ULC Listing numbers: N904, N905, N906, N907

The vertical web of the EDB-type DELTABEAM® must be protected against fire by other structures or by protective materials/finishes. Separate fire protection is needed when there is no other structure protecting the vertical web. Peikko will determine the EDB-type DELTABEAM®'s needs for separate fire protection on a case-by-case basis. The material and thickness of the separate fire protection are determined on a case-by-case basis by the fire engineer.

1.2 Application conditions

1.2.1 Loading and environmental conditions

Each DELTABEAM® is designed separately on the basis of initial information of the project. The initial information is needed for manufacturing and designing DELTABEAM®s. The contents of the initial information are presented in *Figure 23*. Appendix A contains the list of required DELTABEAM® details and an example of a DELTABEAM® data sheet. Every DELTABEAM® has a unique identification code in the project.

The dynamic design of vibration in serviceability limit state is taken into account when designing DELTABEAM®s, if requested by the structural engineer. The structural engineer analyzes vibrations for the entire project. Peikko's technical support is always available to help with vibration issues.

It is assumed that walls bearing on DELTABEAM®s have no effect on the beams unless loading information is provided concerning those walls. It is also assumed as a default in the DELTABEAM® design that the topping concrete of the flooring is cast in a separate phase after the infill concrete of DELTABEAM® has reached the required strength. If the topping concrete is to be cast simultaneously with the infill concrete, Peikko should be informed. The order of concrete casting significantly affects the DELTABEAM®'s design. The infill concrete for DELTABEAM® must have a minimum required strength of 4500 psi (30 MPa) unless otherwise specified. DELTABEAM® should always be cast in full in one run. The HVAC system can be installed below the floor or, in some cases, inside the floor. If the DELTABEAM®'s web holes are used for HVAC installation, the impact must be taken into account when DELTABEAM® is designed. Therefore, Peikko must be informed if the DELTABEAM®'s web holes are to be used for HVAC installation in order to find the optimal location for the piping.

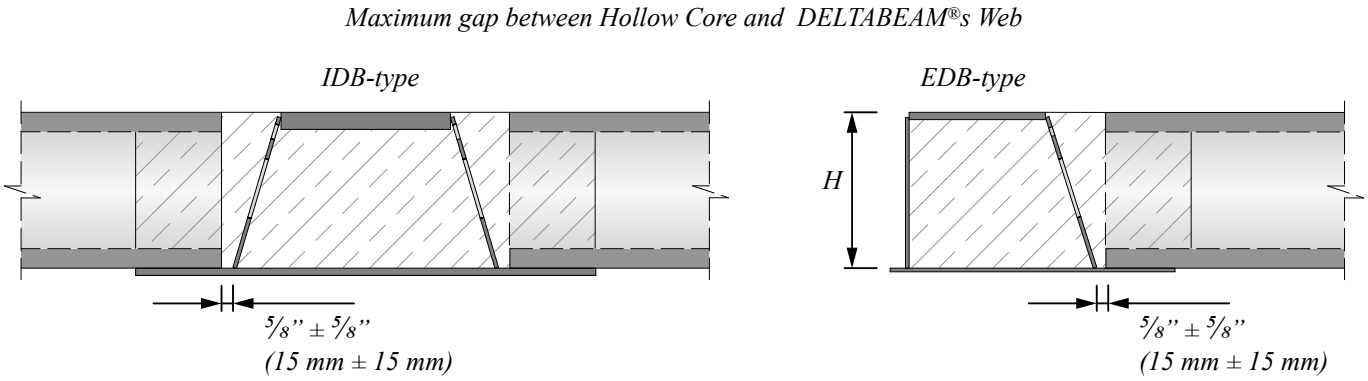
DELTABEAM®s are provided with a standard shop coat of paint on the underside of the beams. These surface coating techniques ensure durability during delivery and installation. The DELTABEAM®'s visible bottom part is primed to minimum 0.003 in (80 µm). Other surface treatments such as zinc coating or hot dip galvanizing can be provided upon agreement with the customer. The customer does the final painting on-site. When using hollow-core slabs, weep holes should always be drilled as close as possible to the end of the planks. If no weep holes are made, the hollow-core voids will fill with water which may cause premature corrosion on the DELTABEAMs, plank blowout in case of freezing or water leakage when the building is occupied.

The free water in the DELTABEAM®'s fresh infill concrete reacts with cement in the normal hardening process, as in other concrete structures. The concrete requires a certain drying time and humidity level before the surface materials of the floor can be installed. It is recommended that water-reducing admixture be used rather than high water-cement ratio to make the structural concrete mix for DELTABEAM® casting. By being able to decrease the required amount of water, the concrete's drying time is reduced. To control the concrete's drying time on-site, normal guidelines for the prevailing environmental conditions should be followed.

1.2.2 Positioning of DELTABEAM®

The bearing length of the hollow core slabs or other floor decks may vary from their standard product requirement. For the standard requirement in the DELTABEAM®'s design, see *Figure 14*. Using a smaller bearing length affects the design and the dimensioning of DELTABEAM®. If requested by the supplier of the hollow core slabs DELTABEAM® with wider ledges can be delivered.

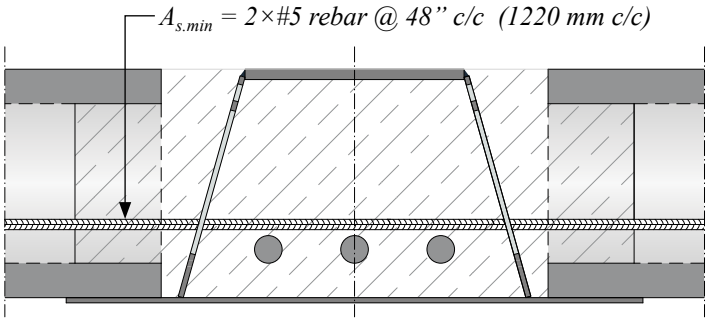
Figure 14. The minimum bearing lengths of standard DELTABEAM® profiles with hollow core slabs.



1.2.3 Interaction with floor units

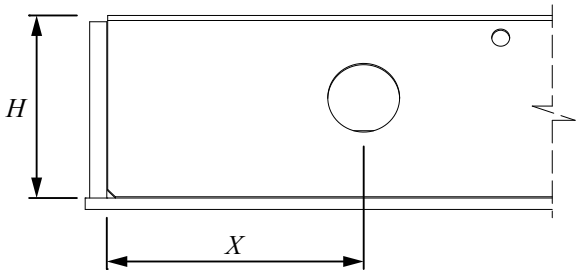
The purpose of the transverse reinforcement is to tie DELTABEAM® and the floor together. The transverse reinforcement secures the load transfer from the floor to DELTABEAM®. The minimum transverse reinforcement for structural integrity is described in *Figure 15*. The transverse reinforcement is assembled through the DELTABEAM®'s web holes.

Figure 15. The minimum transverse reinforcement.



The location of the web holes is adjusted either to the joints between the hollow core units or to the voids of the hollow core units. For solid concrete slabs, the exact location of the web holes along the DELTABEAM®'s span is normally not important. *Figure 16* shows the minimum distance of DELTABEAM® web holes from the end of the web.

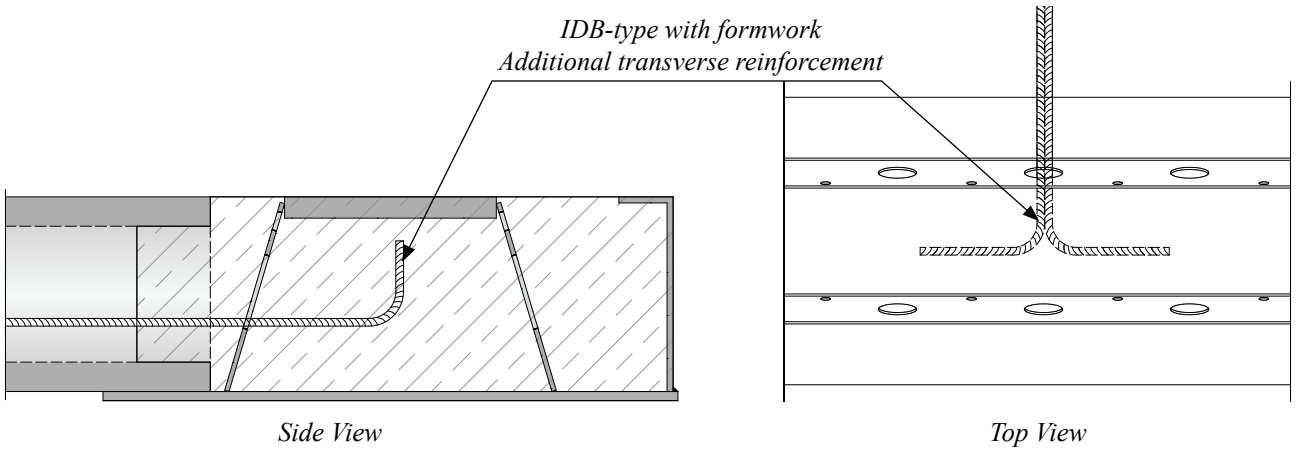
Figure 16. The minimum distance of DELTABEAM® web holes.



When H < 10" (225 mm) ⇨ X ≥ 6-¼" (160 mm)
When H ≥ 10" (225 mm) ⇨ X ≥ 7-¾" (195 mm)

With the IDB-type DELTABEAM®, straight rebars are assembled through the web holes (see *Figure 15*). The reinforcement is anchored with full development length to the slabs on both sides of the IDB-type DELTABEAM®. The anchorage length of the reinforcement starts from the end of the floor unit. When DELTABEAM® is used as an edge beam, the reinforcement should be anchored inside the beam. It is recommended that hook ends be assembled inside DELTABEAM®. Mechanical connection is not recommended. If there is ring reinforcement at the edge of the floor, the IDB-type DELTABEAM® should be used as it allows more space for reinforcement between DELTABEAM® and the formwork sheet (see *Figure 17*).

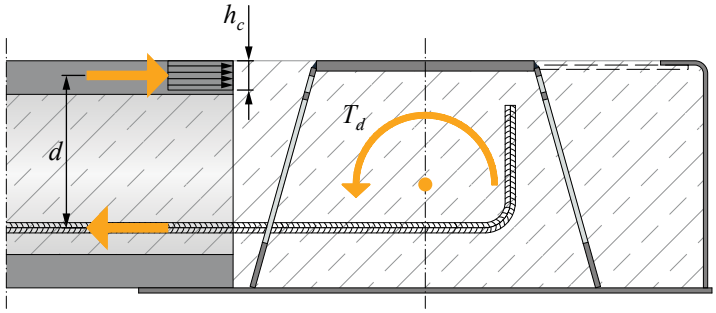
Figure 17. IDB-type DELTABEAM® used as an edge beam with transverse reinforcement.



Tensile or compression forces acting parallel to beam axis are usually transferred by ring reinforcement located in the area between the hollow core slab end and the inclined web of DELTABEAM®. Peikko must be informed if it is required to transfer normal forces through DELTABEAM® profile.

The magnitude of the torsion varies depending on the spans and the loading. *Figure 18* shows the design principal for torsion. With hollow core slabs, dimension h_c is the minimum thickness of the top hull. In the case of structural topping on the hollow core slabs, the topping may be taken into account in h_c, according to the judgment of the structural engineer. For solid concrete slabs, a normal distribution of compressive stresses may be used.

Figure 18. The design principal for torsion.

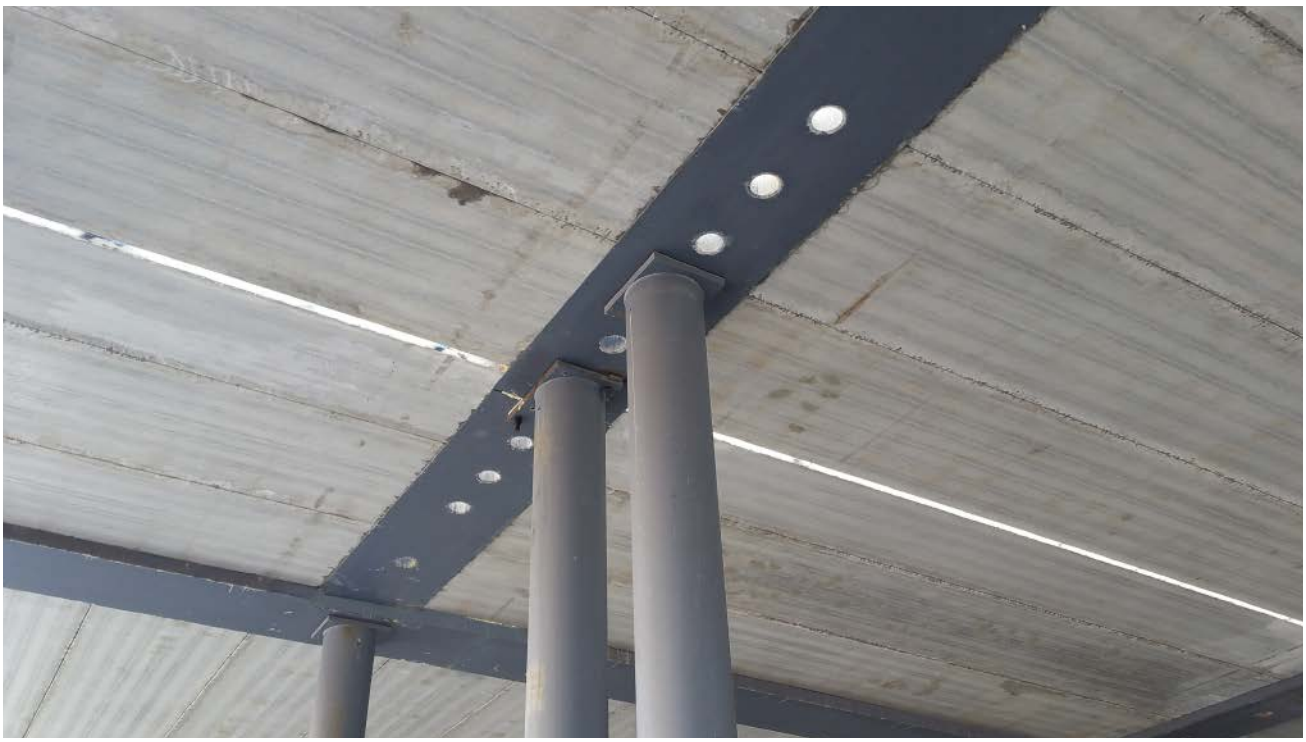


1.2.4 Penetrations and additional connections

It is preferable to have all plumbing or HVAC penetrations made at the factory. Information on holes and attachments should be included in the initial information (see *Figure 19*). Peikko must be always contacted if any changes are to be made.

All on-site connections in DELTABEAM®s are to be installed in compliance with the instructions provided by the structural engineer. If additional connections are required, Peikko must be contacted. No drilling or coring can be made in DELTABEAM without Peikko's approval.

Figure 19. Factory installed sleeve for plumbing penetrations.



1.3 Other properties

DELTABEAM®s are fabricated from cut steel plates and welded together at the factory. The required number of fire rebars is also assembled inside DELTABEAM®. The properties of the materials are as follows:

Parts	Standard		Yield Strength	
	USA	Canada	ksi	MPa
Steel plates	ASTM A572	CSA G40.20/G40.21	50	345
Reinforcement	ASTM A706	G30.18	60	414
Studs	ANSI 1010-1020		51	352

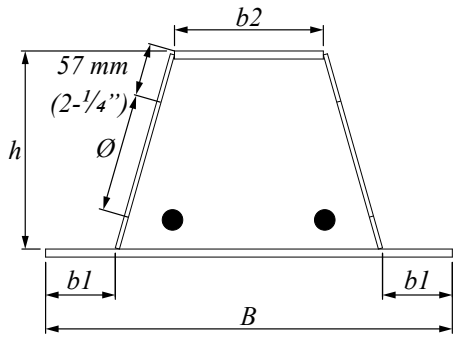
Steel plates are cut thermally or mechanically. Rebars are cut mechanically. Welding is done with metal active gas welding (MAG). DELTABEAM® is welded according to AWS or CWB standards.

Manufacturing tolerance are shown in table below:

Manufacturing Tolerence Table									
Unit	Length (L)			Width (B)	Height (h)	Holes Size & Location	Location of additional Parts	Precamber	Lateral flexure
	Standard End plate	Bolted End plate							
Imperial	± 3⁄16”	+0”	-1⁄16”	± 3⁄16”	± 1⁄8”	± 3⁄16”	± 3⁄16”	L/650	L/650
Metric	± 5mm	+0mm	-1.5mm	± 5mm	± 3 mm	± 5mm	± 5mm		

The standard IDB-type DELTABEAM® profiles with dimensions can be seen in *Table 2*. The standard EDB-type DELTABEAM® profiles with dimensions can be seen in *Table 3*.

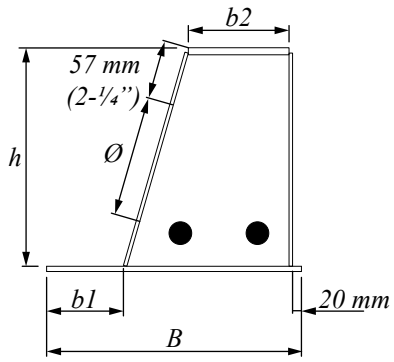
Table 2. The standard Intermediate DELTABEAM® profiles.



Profile ID	*h*		*B*		*b2*		*b1*		*Ø* **	
	In	mm	In	mm	In	mm	In	mm	In	mm
IDB8-20	8	203	19-5/8	498	7	178	4	102	3-1/8	80
IDB8-24			23-5/8	600	8-11/16	221	5	127	3-1/8	80
IDB8-30			29-5/8	752	14-1/2	368	5	127	3-1/8	80
IDB10-20	10	254	19-5/8	498	5-1/2	140	4	102	5-1/8	150
IDB10-24			23-5/8	600	7-1/2	191	5	127	5-1/8	150
IDB10-30			29-5/8	752	12-13/16	326	5	127	5-1/8	150
IDB12-20	12	305	19-5/8	498	4-1/2	114	4	102	5-1/8	150
IDB12-24			23-5/8	600	6-1/8	156	5	127	5-1/8	150
IDB12-30			29-5/8	752	12-13/16	326	5	127	5-1/8	150
IDB14-24	14	356	23-5/8	600	5-1/2	140	5	127	5-1/8	150
IDB14-30			29-5/8	752	11-1/2	284	5	127	5-1/8	150
IDB16-30	16	406	29-5/8	752	10-1/4	258	5	127	5-1/8	150

* Plate thicknesses varies from 3/16" to 2" (5 mm to 50 mm)
** c/c distribution for web holes is always 12" (305 mm)

Table 3. The standard Edge DELTABEAM® profiles.



Profile ID	*h*		*B*		*b2*		*b1*		*Ø* **	
	In	mm	In	mm	In	mm	In	mm	In	mm
EDB8-15	8	203	14-⅝	371	7	178	4	102	3-⅛	80
EDB10-15	10	254	14-⅝	371	7	178	4	102	5-⅛	150
EDB12-15	12	305	14-⅝	371	7	178	4	102	5-⅛	150
EDB14-16	14	356	15-⅝	397	7	178	4	102	5-⅛	150
EDB16-20	16	406	19-⅝	498	9-½	241	5	127	5-⅛	150

* Plate thicknesses varies from 3⁄16" to 2" (5 mm to 50 mm)
** c/c distribution for web holes is always 12" (305 mm)

2. Resistances

DELTABEAM®s are design to meet the requirements specified in applicable standards and/or building codes, including but not limited to:

- USA
  - ASCE 7
  - ACI-318
  - ASTM 360
  - International building code and State annexes

- Canada
  - CSA S-16
  - CSA A23.1
  - Canadian National Building Code

Selecting DELTABEAM® Slim Floor Structure

DELTABEAM® Preselection Table

DELTABEAM® preselection tables give an estimate for the longest span that DELTABEAM® can reach while matching the hollow core depth. Spans longer than those shown in table below are possible by using beam downstands (see *Figure 18*).

Those tables are based on standard rectangular grid using interior DELTABEAM®. In general it is more economical to use DELTABEAM®s for the short span and floor slabs in the direction of the long span. Special loading cases including point load must be evaluated by Peikko's engineers.

Figure 20. IDB-type DELTABEAM® for preselection tables.

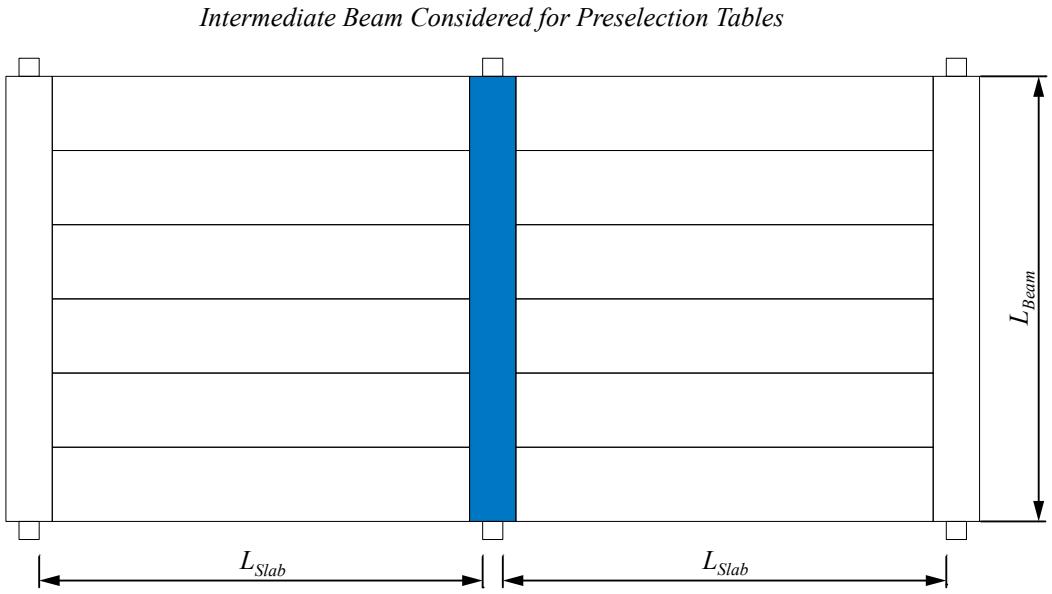


Table 4. Imperial value for the maximum span of DELTABEAM® depending on span of hollow core having same depth as the DELTABEAM®.

DELTABEAM® MAXIMUM CLEAR SPAN CHART (FT)									
DELTABEAM® & Hollowcore Depth	Hollowcore Span (ft)								
	15	20	25	30	35	40	45	50	55
8 Inches	28 / 27	28 / 26	27 / 24	25 / 21					
10 Inches	32 / 28	29 / 28	29 / 26	27 / 24	25 / 22				
12 Inches	34 / 30	33 / 30	31 / 28	29 / 26	27 / 24	25 / 23			
14 Inches	39 / 36	35 / 32	33 / 30	30 / 27	28 / 25	26 / 23	25 / 22		
16 Inches	40 / 37	36 / 33	33 / 30	30 / 27	28 / 26	26 / 24	25 / 22	24 / 21	23 / 20

Notes:
Top Left Corner: DELTABEAM® Span (ft) with 50 psf Live Load
Bottom Right Corner: DELTABEAM® Span (ft) with 100 *psf* Live Load
2" Topping and 30 psf miscellaneous superimposed dead load assumed for all cases

Table 5. Metric value for the maximum span of DELTABEAM® depending on span of hollow core having same depth as the DELTABEAM®.

DELTABEAM® MAXIMUM CLEAR SPAN CHART (METRIC)								
DELTABEAM® & Hollowcore Depth	Hollowcore Span (m)							
	4	6	8	10	12	14	15	16.5
200 mm	10.7 / 9.5	8.7 / 7.7	7.7 / 6.0	7.0 / 6.0				
250 mm	11.5 / 10.2	9.5 / 8.5	8.2 / 6.7	7.5 / 6.7	7.0 / 6.0			
300 mm	12.5 / 11.2	10.5 / 9.2	9.2 / 7.2	8.2 / 7.2	7.5 / 6.7	7.0 / 6.2		
350 mm	13.0 / 11.7	10.7 / 9.7	9.5 / 7.7	8.5 / 7.7	7.7 / 7.0	7.2 / 6.5		
400 mm	13.0 / 11.7	11.0 / 10.0	9.7 / 8.7	8.7 / 7.9	7.9 / 7.0	7.4 / 6.7	7.3 / 6.3	7.0 / 6.0

Notes:
Top Left Corner: DELTABEAM® Span (m) with 2.4 kPa Live Load
Bottom Right Corner: DELTABEAM® Span (m) with 4.8 kPa Live Load
50mm Topping and 1.5kPa miscellaneous superimposed dead load for all cases

Longer DELTABEAM® spans can be achieved depending on the floor configuration. Contact Peikko's engineering department for additional information.

The preliminary DELTABEAM® profile selection is made on the basis of *Tables 4* and *5*. If a special DELTABEAM® profile is needed, please contact Peikko's technical support.

The standard depth of DELTABEAM® is 8" to 16" (200 mm to 400 mm). DELTABEAM® profiles are usually with beam depths equal to the depth of the flooring units. If a deeper DELTABEAM® profile is needed, it is possible to use a downstand on the beam ledge (see *Figure 18*). The DELTABEAM®'s downstand depth may vary to accommodate differing slab profiles.

Table 6. Imperial value for the maximum span of DELTABEAM® for Deep Steel Deck.

	Based on: 145NW/110LW	DELTABEAM® MAXIMUM CLEAR SPAN CHART (FT)						
	Slab weight (*psf*)	DELTABEAM® depth (in)	Deep Steel Deck + Concrete Slab Depths (in)	15ft	20ft	25ft	30ft	35ft
1hr	50	7.25"	4.75" + 2.5"	27 / 23	24 / --			
2hr LW	46	8"	4.75" + 3.25"	29 / 26	26 / 23			
2hr NW	71	9"	4.75" + 4.25"	29 / 26	26 / 24	25 / --		
1hr	55	10.5"	8" + 2.5"	32 / 30	29 / 26	28 / 25	26 / --	
2hr LW	50	11.25"	8" + 3.25"	35 / 32	31 / 28	29 / 26	27 / --	
2hr NW	78	12.25"	8" + 4.25"	35 / 32	31 / 28	28 / 26	27 / 24	
3hr NW	89	13.25"	8" + 5.25"	36 / 32	33 / 30	30 / 27	27 / 25	25 / --
Max table	98	14"	8" + 6"	36 / 33	32 / 29	29 / 27	29 / 26	26 / --

Notes:
Top Left Corner : DELTABEAM® Span (ft) with 50 *psf* Live Load
Bottom right Corner : DELTABEAM® Span (ft) with 100 *psf* Live Load
Includes Self Weight of the Deep Steel Deck + 30 *psf* of Miscellanous Superimposed Dead Load
NW: Normal weight concrete
LW: Light weight concrete

Table 7. Metric value for the maximum span of DELTABEAM® for Deep Steel Deck.

	Based on: 23.0NW/17.0LW	DELTABEAM® MAXIMUM CLEAR SPAN CHART (M)						
	Slab weight (*kPa*)	DELTABEAM® depth (mm)	Deep Steel Deck + Concrete Slab Depths (mm)	4.5 m	6.0 m	7.5 m	9.0 m	10.5 m
1hr	2.4kPa	185 mm	120mm + 65mm	8.2 / 7.0	7.3 / --			
2hr LW	2.2kPa	203 mm	120mm + 83mm	8.9 / 7.9	7.9 / 7.0			
2hr NW	3.4kPa	229 mm	120mm + 109mm	8.9 / 7.9	7.9 / 7.3	7.6 / --		
1hr	2.6kPa	267 mm	203mm + 64mm	9.8 / 9.1	8.8 / 7.9	8.5 / 7.6	7.9 / --	
2hr LW	2.4kPa	286 mm	203mm + 83mm	10.7 / 9.8	9.4 / 8.5	8.8 / 7.9	8.2 / --	
2hr NW	3.7kPa	311 mm	203mm + 108mm	10.7 / 9.8	9.4 / 8.5	8.5 / 7.9	8.2 / 7.3	
3hr NW	4.3kPa	337 mm	203mm + 134mm	11.0 / 9.8	10.1 / 9.1	9.1 / 9.1	8.2 / 7.6	7.6 / --
Max table	4.7kPa	356 mm	203mm + 153mm	11.0 / 10.1	9.8 / 8.8	8.8 / 8.8	8.8 / 7.9	7.9 / --

Notes:
Top Left Corner: DELTABEAM® Span (m) with 2.4 kPa Live Load
Bottom Right Corner: DELTABEAM® Span (m) with 4.8 kPa Live Load
50mm Topping and 1.5kPa miscellaneous superimposed dead load for all cases
NW: Normal weight concrete
LW: Light weight concrete

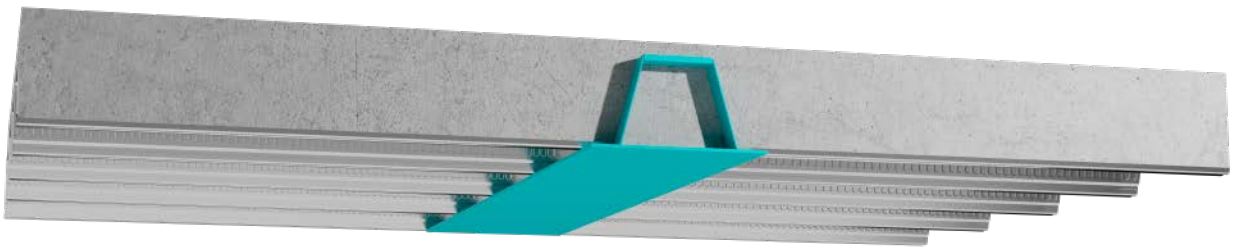


Figure 21. DELTABEAM® with downstand on the beam ledge.

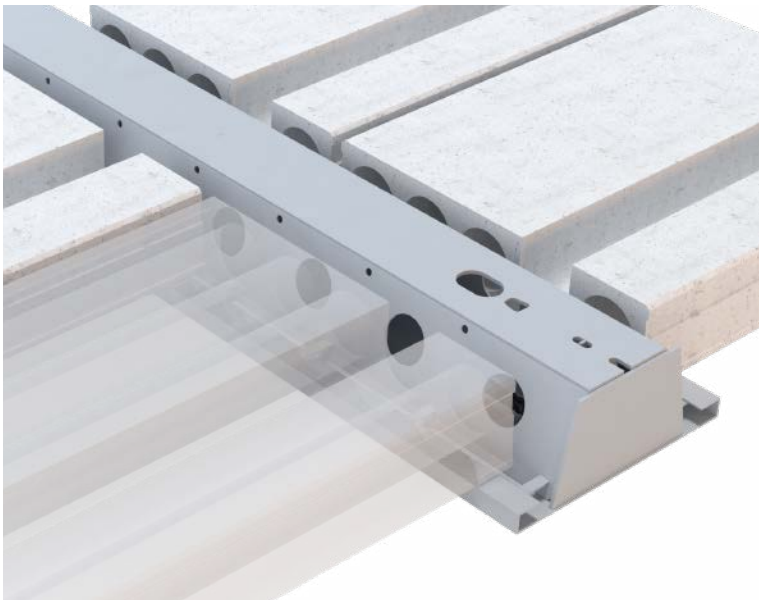
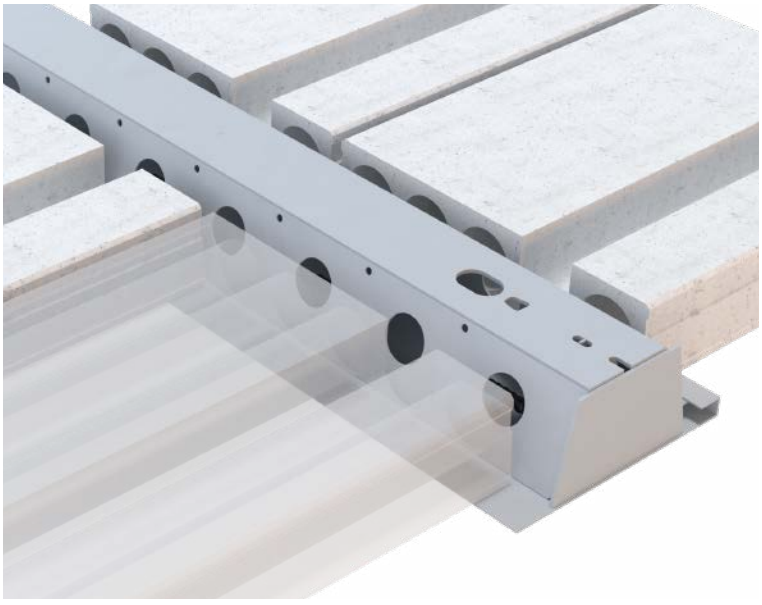


Figure 22. DELTABEAM® with single downstand on the beam ledge to accomodate varying slab depths.

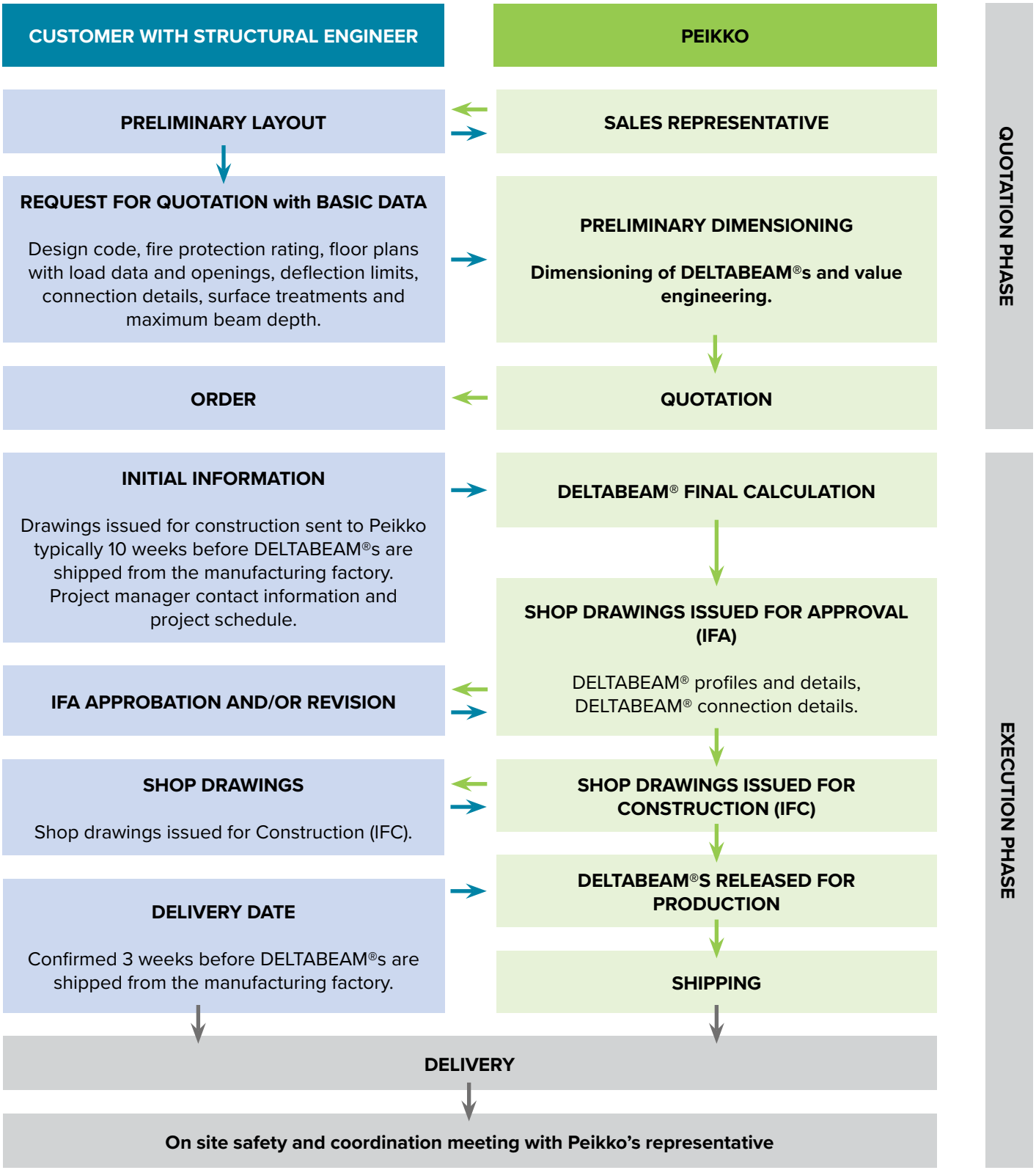


The standard maximum DELTABEAM® length is 45 ft (13.5 m). If DELTABEAM®s longer than 45 ft (13.5 m) are needed, please contact Peikko's technical support. Longer DELTABEAM®s usually require special shipping arrangements.

Design phases and delivery processes

Peikko's website (www.peikkousa.com, www.peikko.ca) contains DELTABEAM® information for designers. *Figure 23* shows the typical workflow. Delivery dates are agreed with the project manager/engineer of the local Peikko unit.

Figure 23. The typical workflow.

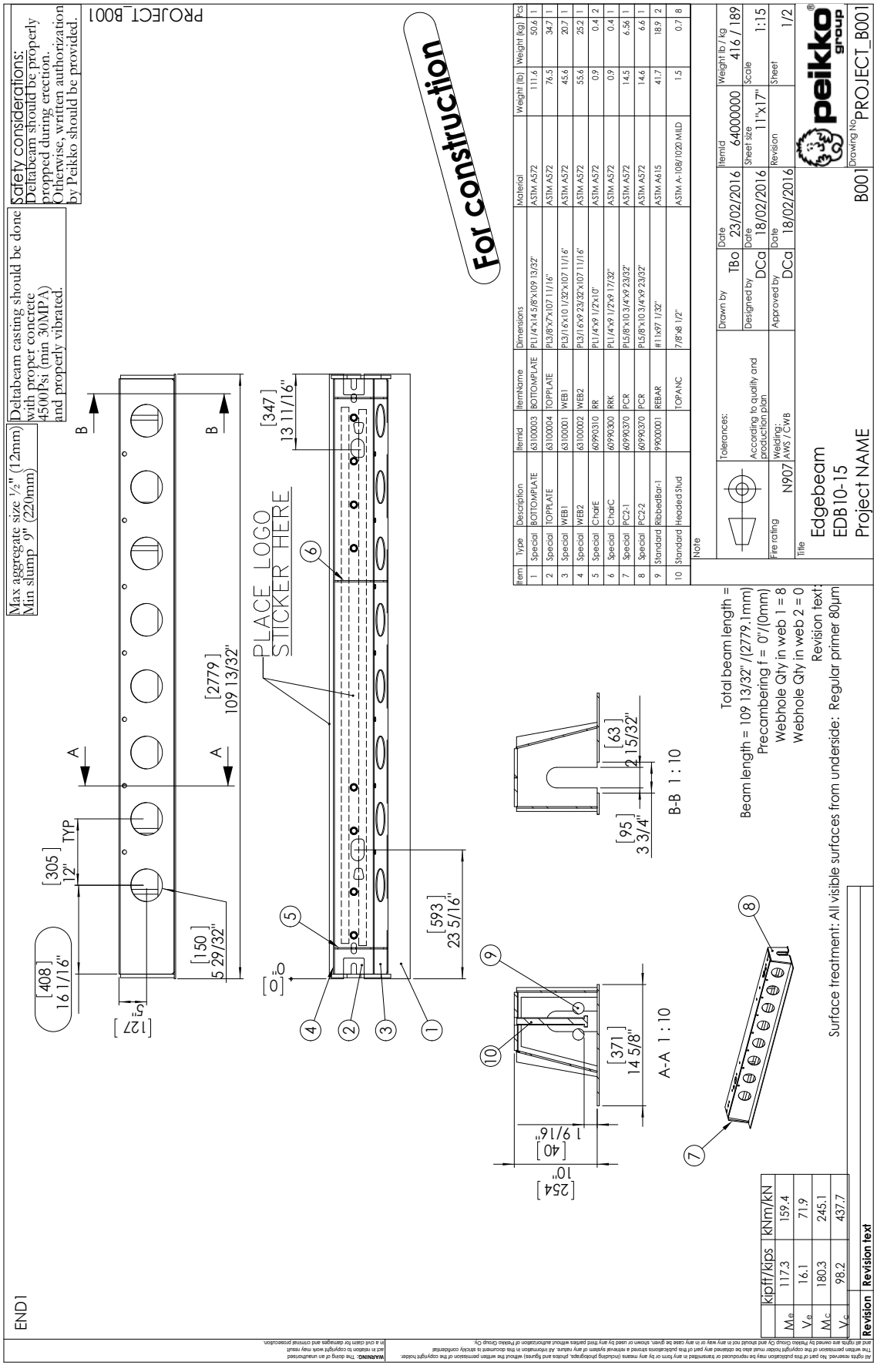


Annex A – Initial Information

The following information is required for manufacturing DELTABEAM®s and making design calculations:

- Structural drawings in PDF and DWG, Architectural drawings in PDF
- Hollow core or metal deck depth
- Design code and load data
  - Loads
  - Loading class (occupancies)
  - Risk category / Importance factor
  - Fire rating
- Connection required
- DELTABEAM® special requirement (i.e. maximum depth, surface finish etc.)
- Project & contact information (Project Manager, Location, Preliminary schedule)

A typical DELTABEAM® shop drawing:

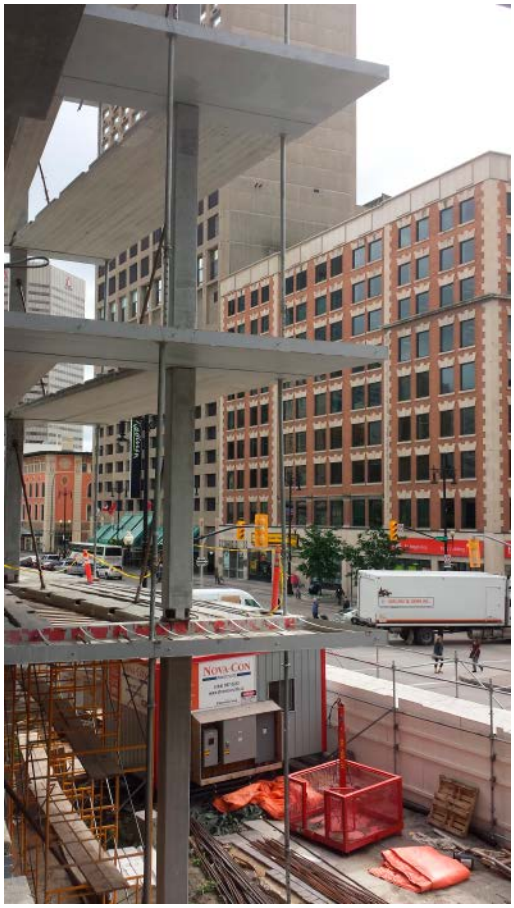


Annex B – The possibilities DELTABEAM® offers/Project references

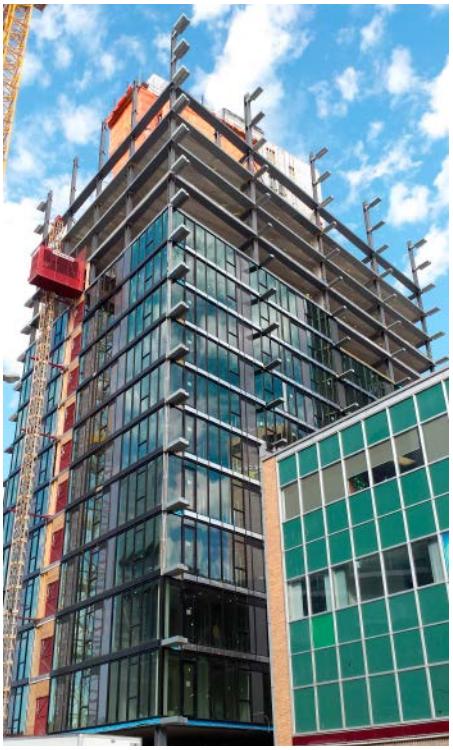
DELTABEAM®s have been successfully used in close to 10.000 projects around the world. Demanding façade shapes, curves and cantilevers, can be made with DELTABEAM®s using in-built formwork and also prefabricated elements. See the following examples:

Example 1. Customize shapes with formwork sheets can be done with DELTABEAM® to meet architechural needs.

Example 2. Continuous DELTABEAM®s with cantilever slabs to create an unique facade.



Example 3. DELTABEAM®s allows for slim floor structure reducing floor to floor height.

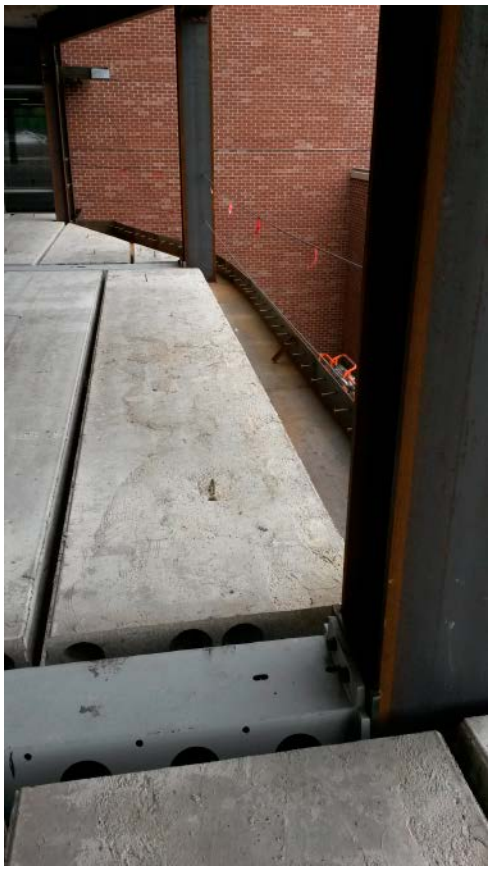


Example 4. Multiple type of connection possible with DELTABEAM® such as bolted, welded or PCs® Corbel connections.

Example 5. Using DELTABEAM® with wood composite deck.

ANNEX B

Example 6. DELTABEAM®s can also be connected to steel columns.



Example 7. Using DELTABEAM®s with deep metal deck for long spans.

Installing DELTABEAM® Slim Floor Structure

These DELTABEAM® installation instructions are intended to complement the project's erection plan. Peikko's technical support can help with the erection plan if required. If there are differences between the erection plan and this document, the differences should be approved by the structural engineer.

NOTE: IF THE INSTALLATION TOLERANCES OF DELTABEAM® ARE EXCEEDED, PEIKKO MUST BE CONTACTED. DELTABEAM® OR CONNECTIONS BETWEEN DELTABEAM®S CANNOT BE MODIFIED WITHOUT PERMISSION FROM PEIKKO.

Deliveries

DELTABEAM®s are delivered to the site according to the agreed project schedule. Delivery of each shipment should be confirmed with Peikko three weeks prior to shipping. DELTABEAM®s of different lengths are not loaded in the order of installation at the factory because it is not economical or practical. The beams are marked with identification codes in accordance with the drawings.

Storage on-site

The DELTABEAM®'s visible bottom plate is painted with anticorrosive primer. For long-term storage, the beams must be covered. Piling strips are used under the beams to protect the surface treatment. Piling strips should be free from grease or other substances that may damage the surface treatment. When storing beams in piles, the bearing capacity and the level of the surface should be verified.

Any damage to the surface treatment should be repaired as soon as possible. The surface treatment should be completed with the top layers as soon as possible.

Lifting and moving

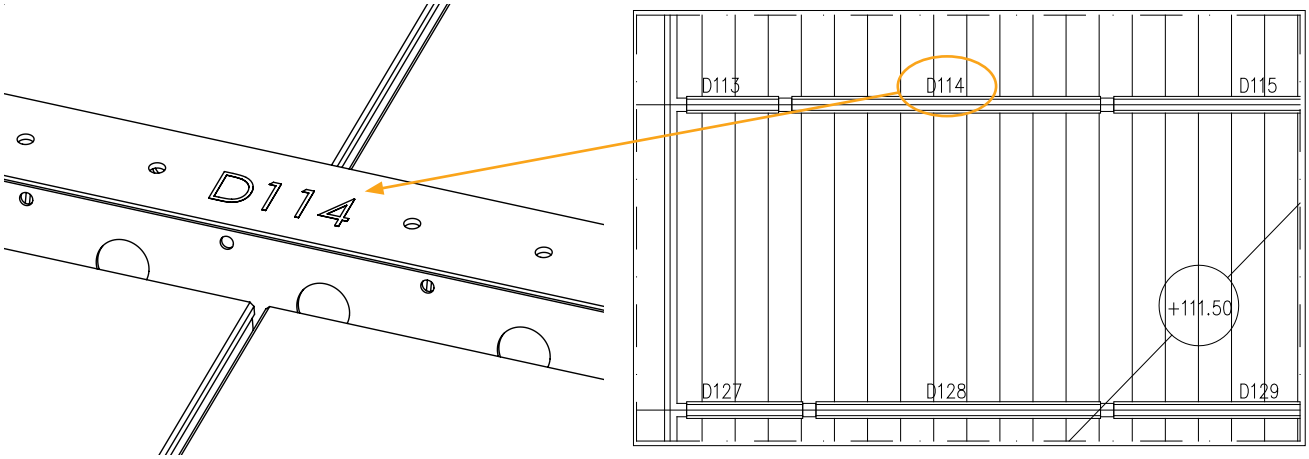
DELTABEAM®s can be lifted and moved using ordinary lifting equipment, such as cranes or forklifts. DELTABEAM® characteristic such as weight, beam number and project number can be found on the identification sticker as shown below. DELTABEAM®s must be lifted using the lifting holes on the top plate symmetrically to the axis of the center of mass. The maximum allowed lifting angle of the chains must be notified.

In special cases, when there are no lifting holes, DELTABEAM®s can be lifted with chains attached to the web holes. In some cases, a third chain is needed in order to lift DELTABEAM® and maintain its balance. For example, DELTABEAM®s with wide formwork sheets should be lifted using the lifting holes and a third chain should be assembled to the sheet.

NOTE: ALWAYS USE APPROVED LIFTING CHAINS AND LOCK THE CHAIN HOOKS.
NO LIFTING STRAPS / CHAINS AROUND DELTABEAM®: THIS IS A SAFETY RISK.

Assembling DELTABEAM®s

The project's erection plan must be followed at all times. Every DELTABEAM® has an identification code on the top plate. The beams are installed in such a way that the identification code on the top plate of DELTABEAM® can be read in the same direction as marked in the element lay-out drawing.

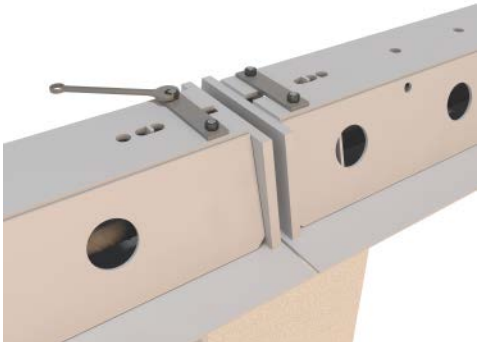


Connecting DELTABEAM®s

DELTABEAM®s are connected according to the project's erection plan, the installation plans, and the connection details. The connection details are specified in the construction plan for each project. Shim plates and steel packs should be placed according to the erection plan. The DELTABEAM® delivery only includes installation material for the connections between DELTABEAM®s (Hinged and Side connections).

The DELTABEAM®'s weight is not effective enough to stabilize the frame during installation of the slabs. Therefore, DELTABEAM®s should be connected prior to assembling the shoring posts and floor units. This prevents the beams from moving. If on-site welding is required, the process and the qualification of the welders should be in accordance with the erection plan.

Shim plates in Hinged and Side connections are used by default to allow installation tolerance. Installation tolerance is + 3⁄16" / -3⁄8" (+5 mm / -10 mm) and the maximum thickness of the shim plates is 5⁄8" (15 mm). DELTABEAM® lengths have been designed with the shim plate so that a 3⁄16" (5 mm) shim plate is set to every connection after DELTABEAM® is installed but before the bolts are tightened. Possible variations to the designed total length of the beam line are taken into account by adding or removing the number of shim plates from other connections within the allowed tolerances.

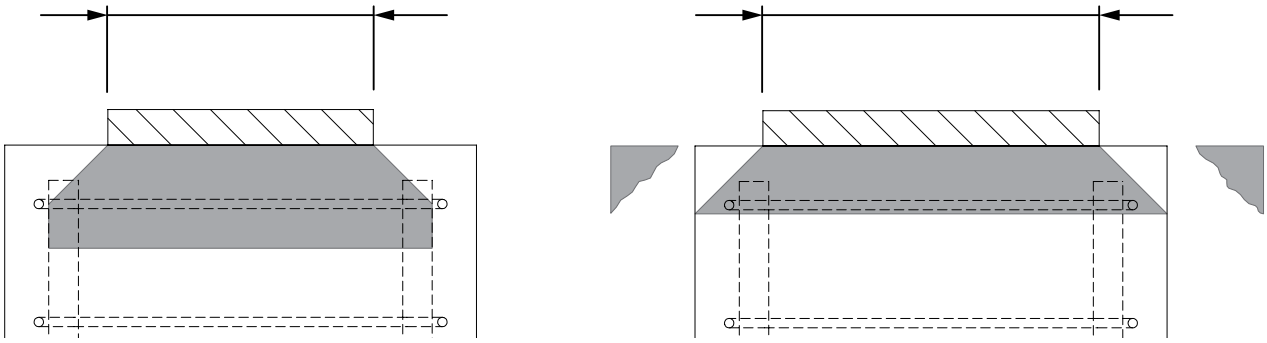


Hinged Connection

INSTALLING

When assembling continuous DELTABEAM®s, the location of each DELTABEAM® and total length of the beam line should be confirmed prior to tightening the bolts in the hinged connections and other connections. The ends of the continuous beam lines must be prevented from uplifting during installation.

Steel packs are placed on the reinforced concrete structure so that the effect of the contact stress remains inside the perimeter of the stirrup reinforcement. The risk of spalling can be reduced by applying chamfers to the edges of the concrete structure. The usage of neoprene is not recommended between DELTABEAM® and the support.



NOTE: DELTABEAM® MUST NOT BE CUT WITHOUT PERMISSION AND INSTRUCTIONS FROM PEIKKO, OPEN OUT BOLT HOLES, etc.

Shoring DELTABEAM®s

Shoring should be carried out according to the project's erection plan prior to assembling the floor units. DELTABEAM®s must be connected according to the erection plan and the connection details before shoring. The locations of the shoring posts and the loads to the posts must be in accordance with the structural engineer's instructions.

The stability of the shoring posts must be confirmed when they are assembled. The foundation for the posts must also be secure and solid. The posts should be assembled as close to the beam support as possible. The shoring posts must be placed at the loaded side of the beam, below the web. The shoring can only be removed when the joint grout and the infill concrete of DELTABEAM® has reached a minimal strength of 3000 psi (20 MPa) unless specified otherwise by Peikko's engineers.

With hollow core slabs, DELTABEAM® shoring is used only to prevent the rotation of the beam at the supports. The function of DELTABEAM® shoring posts are not to prevent deflection. DELTABEAM® should never be shored at mid-span. The hollow core slabs should not be shored without permission from the manufacturer.

When DELTABEAM® is bearing on the end of a wall running parallel with the beam the shoring plan prepared by structural engineer should be followed.

Location of shoring post with PCs® Corbel connection

Location of shoring posts with DELTABEAM® bearing on a wall

The DELTABEAM®'s wide formwork must always be shored. The shoring posts must be placed at maximum 4ft (1.2m) c/c.

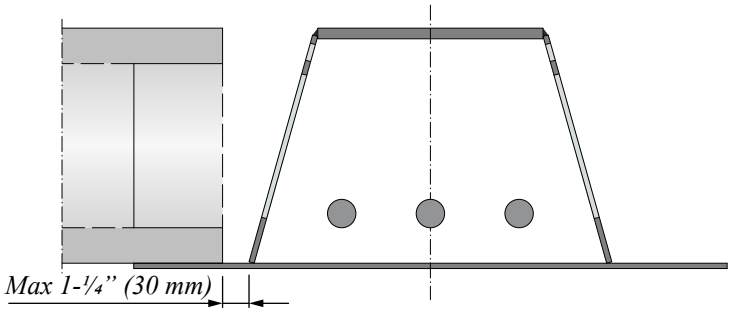
Special attention should be paid to asymmetrically supported beams, long beam spans, or tall shoring posts. Peikko can offer special solutions to shoring problems, although this must be taken into account in the DELTABEAM®s' design.

NOTE: DELTABEAM® SHORING IS USED WITH ALL TYPE OF FLOORS ONLY TO PREVENT THE BEAM FROM ROTATING AT ITS SUPPORTS.

Assembling floor units

The DELTABEAM®s' connections and the shoring posts must be securely installed, tightened, or welded before assembling the floor units. To minimize the rotation of the beam, the floor units should be assembled alternately on different sides of the beam. After the slabs are installed, the necessary formwork, edge forming, and slab reinforcement will be carried out.

Floor units should be assembled directly on the beam ledge. Usage of neoprene is not recommended. Floor units should be assembled so that there is a gap of a maximum of 1-1/4” (30 mm) between the DELTABEAM®’s web and the end of the floor unit. If this gap is exceeded, contact Peikko or the structural engineer. Finally, all holes on the bottom side of DELTABEAM® (locations of consoles, Side connections and Gerber connections) should be blocked. The joint and ring reinforcement are also assembled.



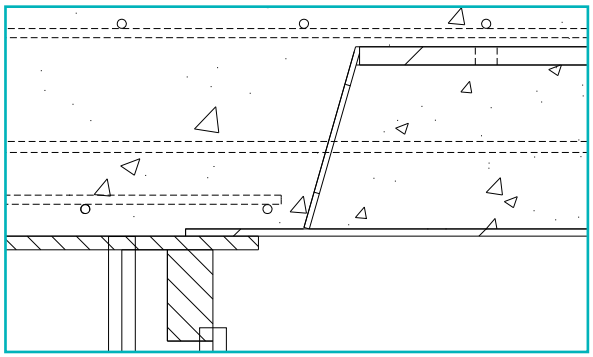
The composite steel sheet should be assembled according to the erection plan. The composite steel deck should be supported at the same elevation as the beam following the precamber shape. No room for settlement should be allowed. The precambering is fabricated to DELTABEAM® to ensure that DELTABEAM® is level after the floor is installed.

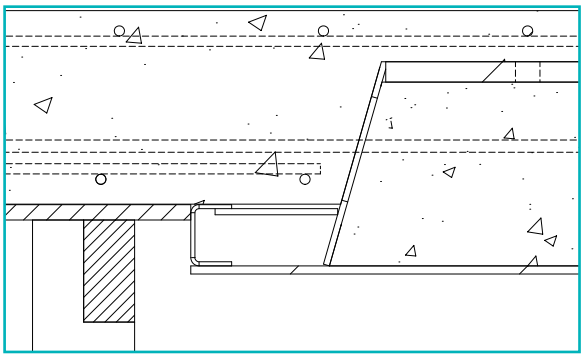
NOTE: MATERIAL MUST NOT BE STORED ON THE FLOOR BEFORE THE INFILL CONCRETE HAS REACH REQUIRED STRENGTH.

THE FLOOR ABOVE MUST NOT BE BUILT UNTIL THE INFILL CONCRETE HAS REACH REQUIRED STRENGTH.

Cast in place concrete slab

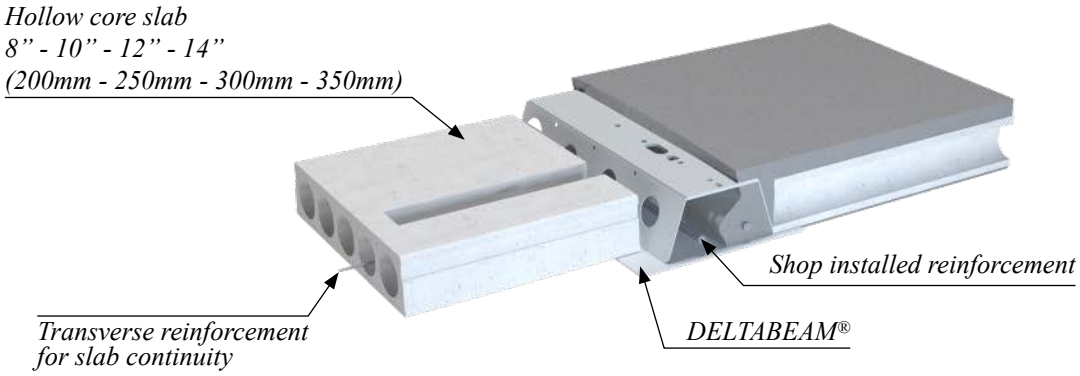
Cast in place concrete slabs are built to the nominal level. To achieve a flush bottom surface with a cast in place slab, it is recommended that the formwork be built under the bottom plate. When the beam has a downstand on the beam ledge, the formwork is built against the web of the downstand.

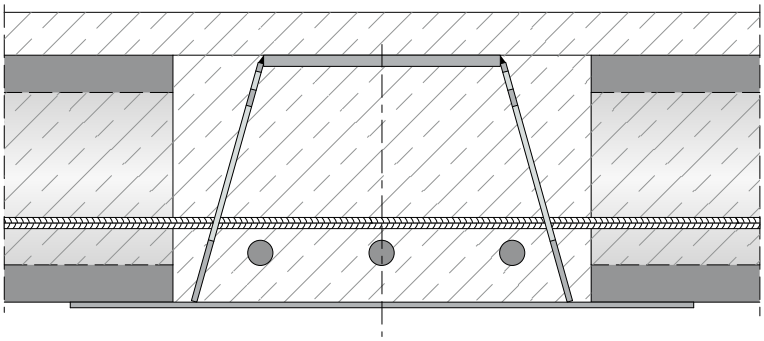




Reinforcement

Reinforcement is installed in accordance with the erection plan. The DELTABEAM®'s minimum transverse reinforcement is 2×#5 rebar @ 48" c/c (15 M @ 1220 mm c/c). The transverse reinforcement must be assembled even if rebars are being bent over DELTABEAM®. The transverse reinforcement should always pass through the DELTABEAM®'s web holes or through the additional web holes (with deep DELTABEAM®s).





Casting the concrete

DELTABEAM®s are cast with concrete simultaneously with the slab or the joints of the hollow core slabs. DELTABEAM® must be filled with concrete in one run. DELTABEAM® must be cast completely in order for it to secure the properties of a composite beam. DELTABEAM® is designed for a temporary live construction load of 10 psf (0.5 kN/m2).

Structural concrete is always used when casting the concrete. The maximum aggregate size shall not exceed ½" (13mm) with a recommended maximum size of 5⁄16" (8mm). It is recommended that the concrete have at least a 9" slump to allow for proper placement. The minimum concrete strength shall be 4500 psi (30MPa). The lower parts of hinged and Side connections must be properly filled with concrete. Topping concrete is cast according to the erection method statement.

Casting the concrete:

1. Confirm that DELTABEAM® is clean for casting.
2. Confirm that the formwork and the reinforcement are in accordance with the design.
3. Initial infill may be done through the casting holes in the top plate. DELTABEAM® is filled with concrete up to the bottom edge of the web holes.
4. After the initial infill, the final concreting is done only from one side of DELTABEAM®.
5. Ensure that DELTABEAM® is completely filled with concrete by checking the air holes on the opposite side of DELTABEAM®. The beam is full when concrete runs through the air holes. Concrete spillage over the beam must be avoided as this will make it harder to observe whether the beam is full.
6. Compact the concrete with a vibrator while concreting. The entire infill process may be done through the casting holes in the top plate, but it will be slower and require more work with the vibrator to run the concrete. Mind the formwork plate and the vertical web when using a vibrator.

Additional fire protection

The vertical web of the EDB-type DELTABEAM® must be protected against fire on-site if the vertical web is not protected against fire by permanent structures such as walls. A wall would act as permanent structural fire protection.
If DELTABEAM® is being connected to a fire-protected steel structure, the extent of fire protection must be done according to the erection plan.

On-site check list

1. **Storage on-site**
   - Use piling strips to protect the surface treatment
   - Cover DELTABEAM®s in long-term storage on-site

2. **Lifting and moving**
   - DELTABEAM®s are lifted by the lifting holes located in the top plate. Always lock the chains.
   - Note the maximum allowed lifting angle of the chains

NO LIFTING STRAPS / CHAINS AROUND DELTABEAM®: SAFETY RISK

3. **Assembling DELTABEAM®s**
   - First check the instructions and the requirements in the erection plan
   - DELTABEAM®s are installed in such a way that the identification codes of the beams read in the same direction as marked in the element lay-out drawing
   - The beams must be connected to shoring posts prior to beginning the assembly of the floor units (hollow core slabs)
   - When assembling DELTABEAM®s on reinforced concrete columns, use either one wide steel pack or two smaller packs: one small pack in the middle is not sufficient
   - Prior to tightening the bolts on the hinged connections, check the location of each DELTABEAM® and the total length of the beam line

4. **Shoring**
   - Each beam should have four shoring posts, two at both ends.
   - With hollow core slabs: Place shoring posts as close as possible to the DELTABEAM® supports.
   - Posts must be placed under both web of the beam.
   - With other floor types the erection plan must be followed
   - Remove shoring posts only after the concrete has reached required strength

5. **Assembling floor units**
   - Assemble the floor units directly on the beam ledge
   - Max. 1-¼” (30 mm) gap between the DELTABEAM®’s web and the end of the hollow core slab
   - To minimize the rotation of the beam, assemble floor units alternately on each side of the beam

6. **Reinforcement**
   - The minimum transverse reinforcement through DELTABEAM®s is rebar #5 @ 48” c/c (15 M @ 1220 mm c/c), from slab to slab in joints or voids
   - In edge beams use L-shaped rebars

7. **Casting the concrete**
   - Fill in one run, fill only from one side, observe from the other side. The beam is full when concrete starts to run through the small air holes in the upper part of the web. Mind the formwork plates when using a vibrator.
   - Ensure that concrete fills the gap between hinged and Side connections

DELTABEAM®S MUST NOT BE CUT WITHOUT PERMISSION AND INSTRUCTIONS FROM PEIKKO, OPEN OUT BOLT HOLES, etc. MATERIAL MUST NOT BE STORED ON THE FLOOR BEFORE THE INFILL CONCRETE HAS REACHED REQUIRED STRENGTH. THE FLOOR ABOVE MUST NOT BE BUILT BEFORE THE INFILL CONCRETE HAS REACHED REQUIRED STRENGTH.

NOTES

NOTES

Technical Manual Revisions

Version: NORTH AMERICA 10/2019. Revision: 002

- Illustrations created for US market
- Updated to 2018 branding styles

Version: NORTH AMERICA 11/2018. Revision: 001*

- New cover design for 2018 added

Resources

DESIGN TOOLS

Use our powerful software every day to make your work faster, easier and more reliable. Peikko design tools include design software, 3D components for modeling programs, installation instructions, technical manuals and product approvals of Peikko's products.

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Environmental Product Declarations and management system certificates can be found at the quality section of our websites.

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