CONSTRUCTION

SUMLINE
BUILDINGS

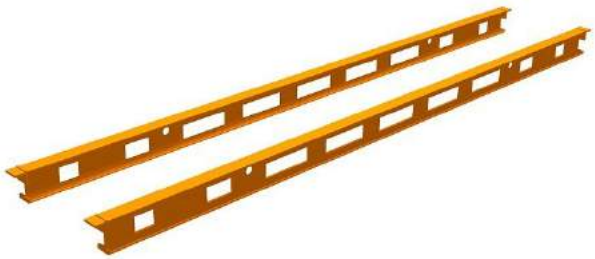
INTRODUCTION

The Slimline floor system is the integral combination of ceiling, installation space and subfloor. The solution is based on supporting steel beams, which contain a standard pattern of openings, integrated in a concrete ceiling slab. The beams and the slab are combined in prefabricated elements which are topped with the subfloor of choice.

Slimline is thinner and lighter than conventional floor systems, facilitates a fast building process and offers permanent adaptability of the building installations.

The Slimline elements are available in a range of lengths (column-free spans up to 16,2 m are possible) and widths. A number of optional provisions can be integrated to meet project demands, such as (double) thermal activation, acoustic strips, embeds and custom beam opening patterns.

Introduction Slimline



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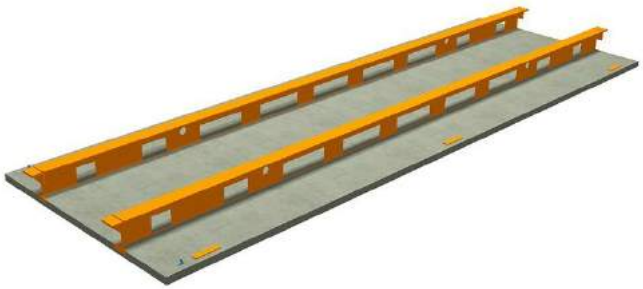


The structure of the Slimline floor system

Slimline

Slimline makes it possible to integrate construction and installations by utilizing the installation space between ceiling and subfloor. A Slimline floor element is comprised of steel beams (IPE) and a concrete slab. The beams are provided with a standard pattern of openings by default. The concrete slab can be provided with openings to allow passing pipes and cables.

The steel beam

The steel beams are provided with a standard pattern of openings. The beam spans from "structural wall to structural wall". Slimline Buildings supports the design team and acts as knowledge center during the engineering phase.

The elements are engineered on strength, deflection and self-frequency while observing all applicable standards.

The concrete slab

The concrete slab, or slab in short, is the final ceiling of the lower level and can be conveniently finished with spray plaster. The slab is walkable and acts as support for all building installations. The concrete slab provides horizontal stability for the construction. Moreover, the slab is indispensable for the fire resistance of the Slimline floor system (>145 minutes) and acoustic insulation.

Slimline floor element dimensions

The element length of the Slimline floor system is variable, and can be adjusted to the project specifications. Please refer to the span tables on pages 8, 9 and 10. The available element widths are 2400 mm, 2700 mm and 3000 mm.

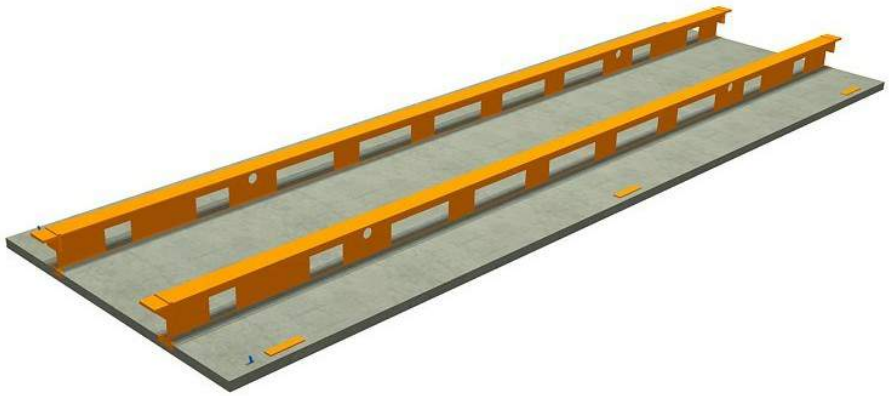
The floor package consists of a 70 mm concrete slab, in which the lower flange of the steel beams is poured in. The underside of the beam is placed at 33 mm from the underside of the concrete slab.

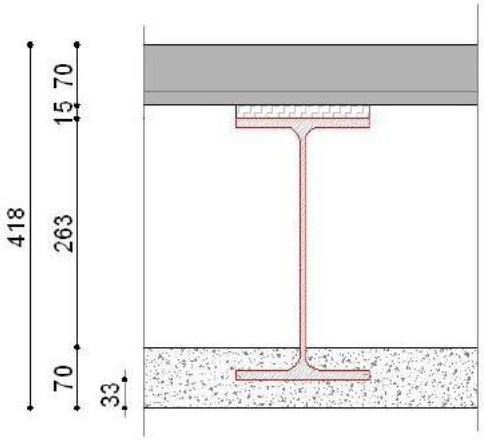
The subfloor is placed on 15 mm of rubber granulate for acoustic decoupling, and consists of a 70 mm screed on a profiled steel plate. This subfloor can span 1200 mm from beam to beam based on the indicated loads.

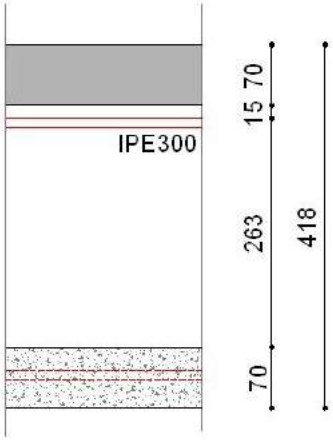
If higher floor loads are required, additional supports (with adjustable center-to-center distance) or heavier beams (HE) can be provided.

The subfloor can be fitted with floor heating.

The structure of the Slimline floor system





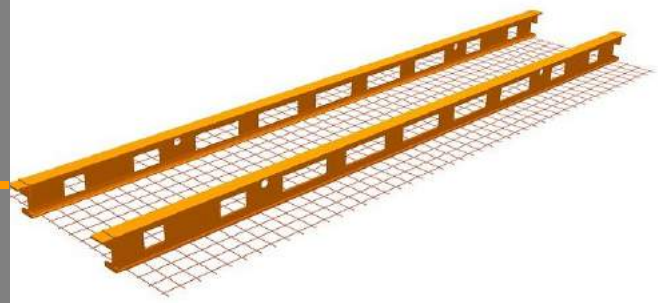


Reinforcement

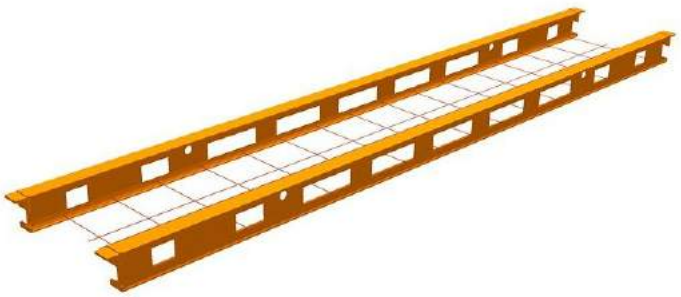
The 70 mm concrete slab is fitted with a continuous mesh under the steel profiles of ø 6-150 mm in both directions. Between the beams, a break reinforcement mesh of ø 6-450 mm is applied. This prevents the slab from ripping from the lower flanges.

If climate tubes are applied, additional reinforcement mesh ø 6-450 mm is placed the wings of the element and welded to the steel profile .

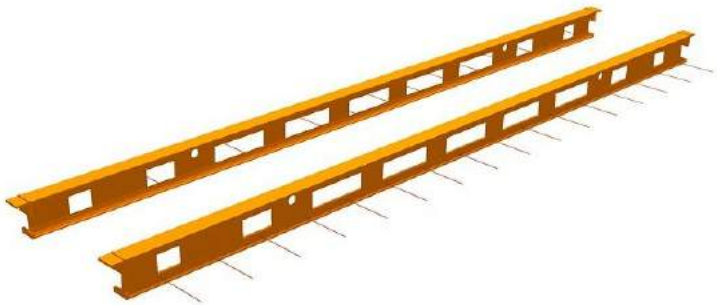
The structure of the Slimline floor system



Basic reinforcement



Break reinforcement



Wing reinforcement (thermal activation only)

Climate pipes

Climate pipes can optionally be poured in the concrete slab.

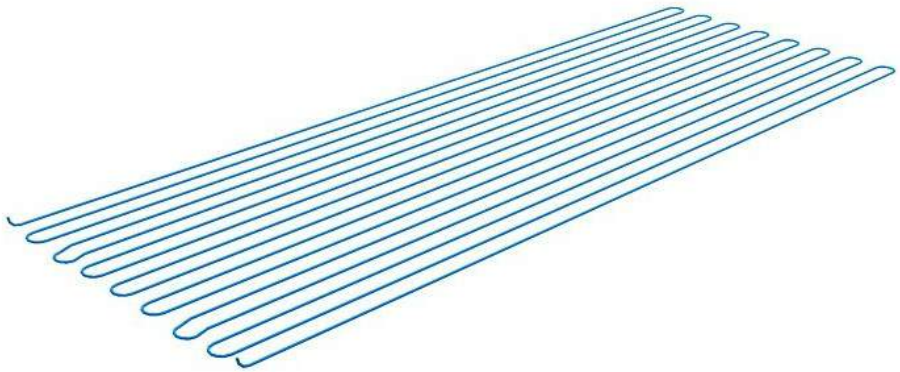
Pipe type:	UNIPIPE (with aluminum lining)
Diameter:	ø16 mm
Centre-to-Centre:	150 mm

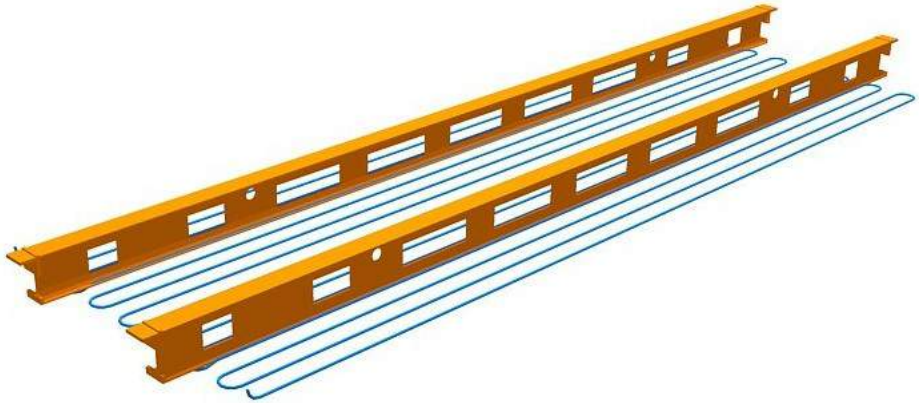
The pipes are integrated in the slab in one piece, without connections. The pipe endings are provided with a casing to avoid damage during construction. The pipe endings are sealed.

Detecting climate pipes

The climate pipes are traceable using a line locator. We recommend using the BOSCH Wallscanner D-tect 100 Professional locator.

The structure of the Slimline floor system





Floor element spans

Slimline elements can be varied with regards to type of beam and their mutual distance. The span tables show the maximum spans for the Slimline floor elements.

The maximum length is shown. The element dimensions and the position of beam openings can potentially reduce the maximum possible length.

* For 'Offices 2', the load for light, non-load bearing interior walls under permanent loads is 0,00kN/m!

Floor table assumptions

In order to determine the maximum span, the following loads are assumed:

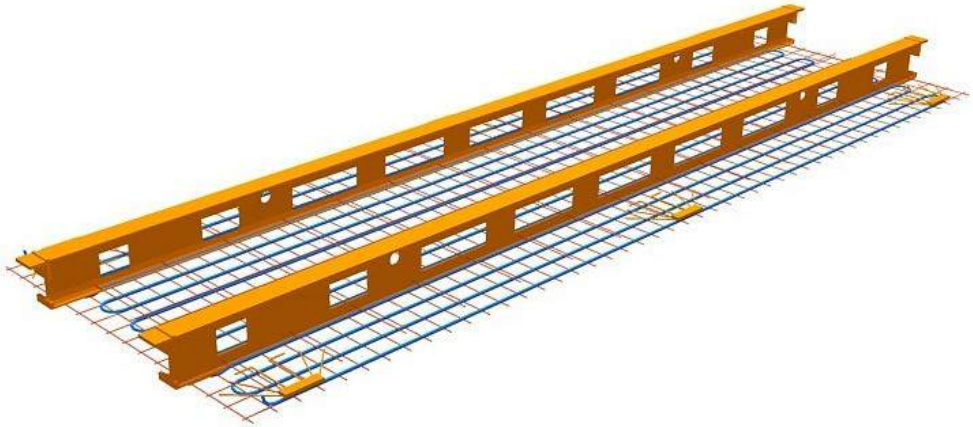
Permanent loads:

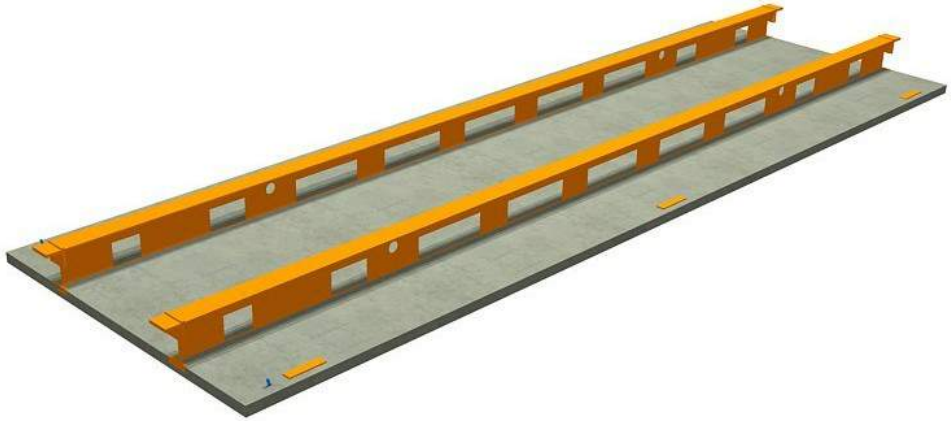
• Self-weight steel:		variable	kN/m²
• Self-weight concrete:	70 mm thick	1,75	kN/m²
• Self-weight topfloor:	70 mm thick	1,20	kN/m²
• Installations in the floor:		0,20	kN/m²

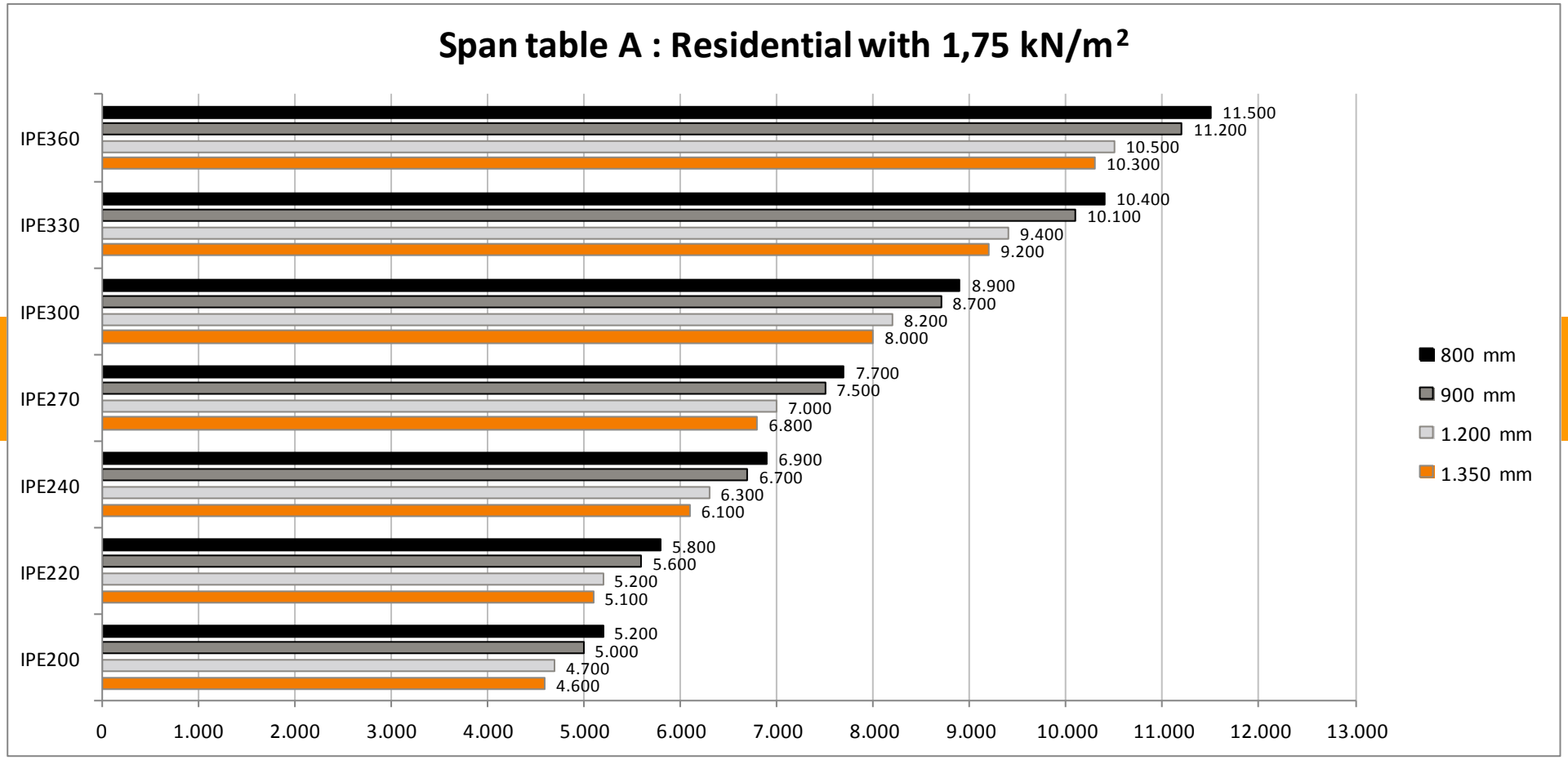
Variable loads:

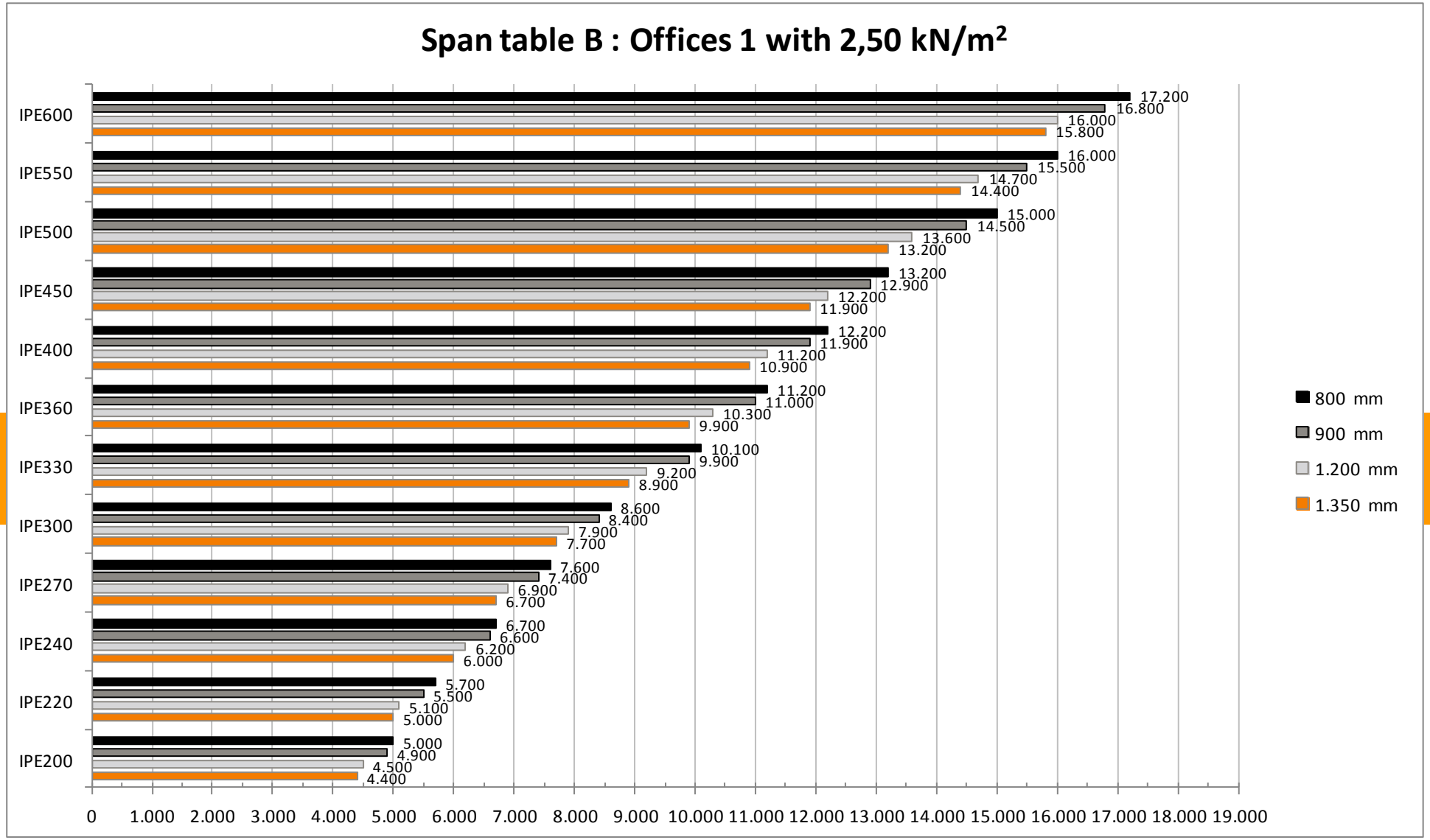
• Category A: Residential	1,75	kN/m²
• Category B: Offices 1	2,50	kN/m²
• Category C: Offices 2	4,00	kN/m²
• Light non-load bearing interior walls*:	0,80	kN/m²

SPAN TABLES






Span table A : Residential with 1,75 kN/m²
IPE360
IPE330
IPE300
IPE270
IPE240
IPE220
IPE200
11.500
11.200
10.500
10.300
10.400
10.100
9.400
9.200
8.900
8.700
8.200
8.000
7.700
7.500
7.000
6.800
6.900
6.700
6.300
6.100
5.800
5.600
5.200
5.100
5.200
5.000
4.700
4.600
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
10.000
11.000
12.000
13.000
800 mm
900 mm
1.200 mm
1.350 mm


Span table B : Offices 1 with 2,50 kN/m²
IPE600
17.200
16.800
16.000
15.800
IPE550
16.000
15.500
14.700
14.400
IPE500
15.000
14.500
13.600
13.200
IPE450
13.200
12.900
12.200
11.900
IPE400
12.200
11.900
11.200
10.900
IPE360
11.200
11.000
10.300
9.900
IPE330
10.100
9.900
9.200
8.900
IPE300
8.600
8.400
7.900
7.700
IPE270
7.600
7.400
6.900
6.700
IPE240
6.700
6.600
6.200
6.000
IPE220
5.700
5.500
5.100
5.000
IPE200
5.000
4.900
4.500
4.400
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
10.000
11.000
12.000
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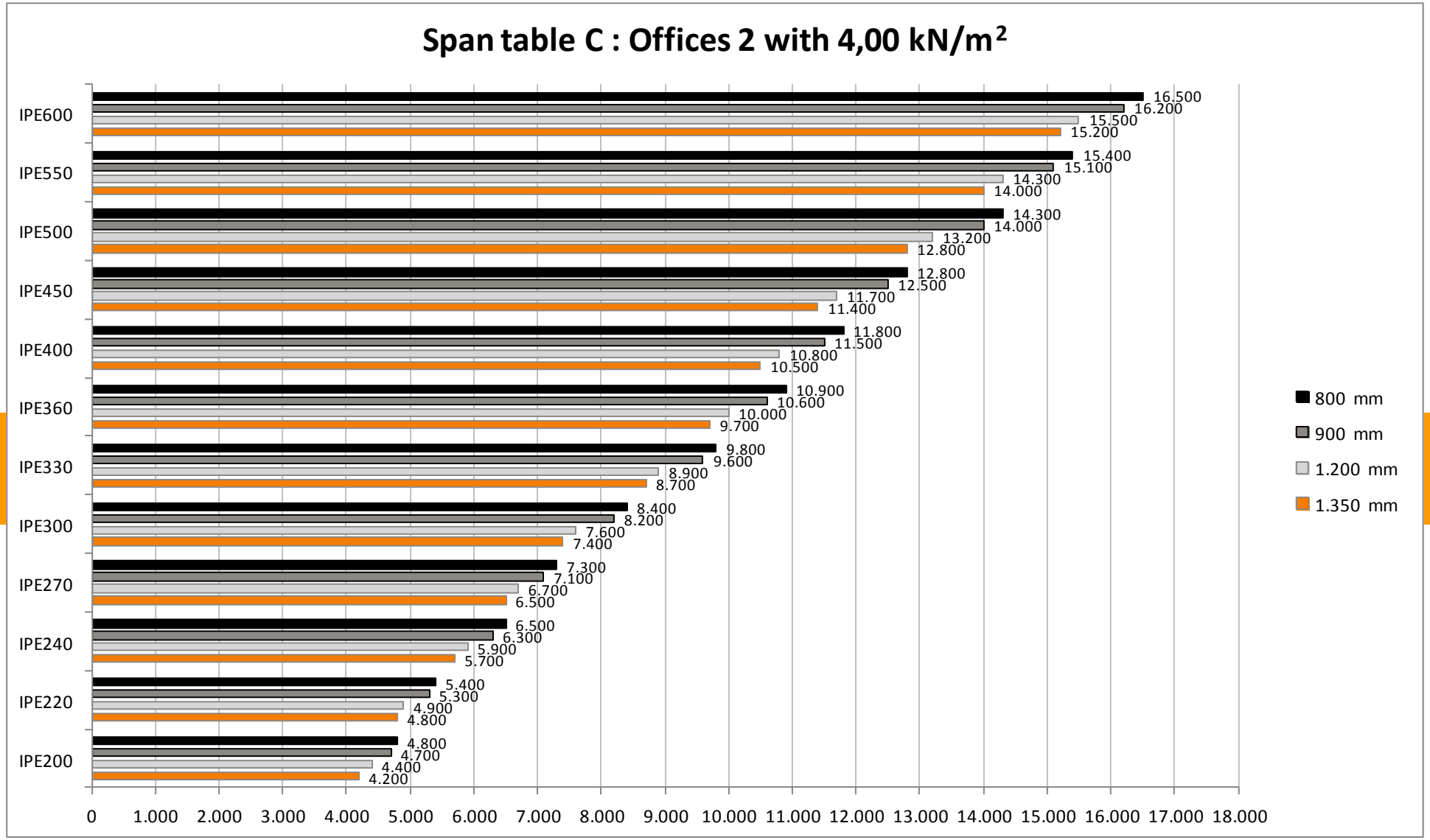
16.000
17.000
18.000
19.000
800 mm
900 mm
1.200 mm
1.350 mm


Span table C : Offices 2 with 4,00 kN/m²
IPE600
16.500
16.200
15.500
15.200
IPE550
15.400
15.100
14.300
14.000
IPE500
14.300
14.000
13.200
12.800
IPE450
12.800
12.500
11.700
11.400
IPE400
11.800
11.500
10.800
10.500
IPE360
10.900
10.600
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IPE240
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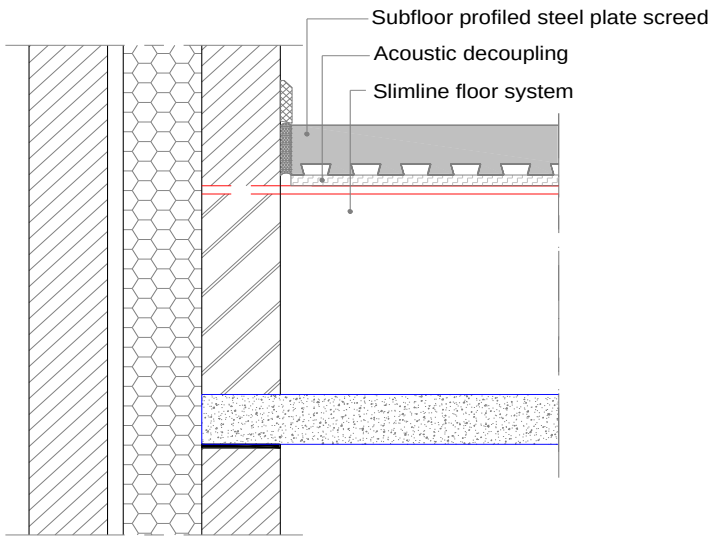
9.000
10.000
11.000
12.000
13.000
14.000
15.000
16.000
17.000
18.000
800 mm
900 mm
1.200 mm
1.350 mm

Traditional masonry

The positioning of Slimline elements on traditional masonry or glued sand-lime bricks is possible, and requires the imposition to be level.

Felt or rubber strips on the structural walls level out small differences in height.



Imposition of a Slimline floor element

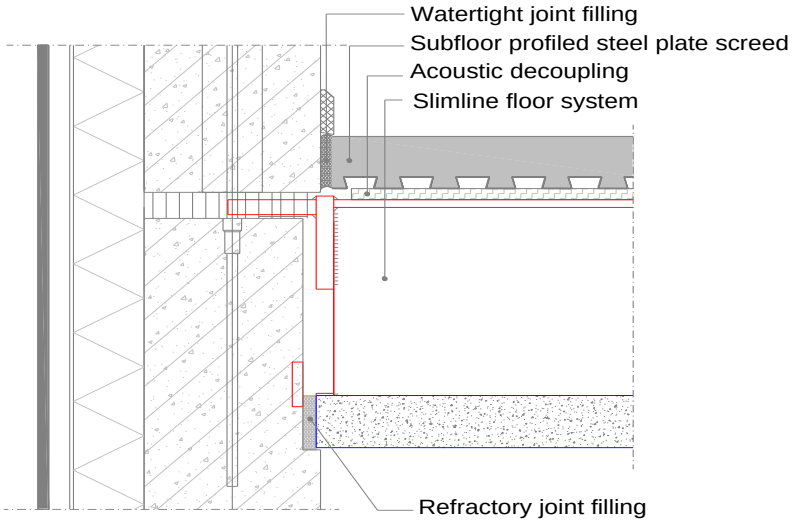
Imposition of a Slimline floor element

Precast concrete

Slimline can be combined with precast concrete. In conjunction with precast concrete manufacturers, an imposition detail has been developed. The details offers freedom of design and efficient progress in production.

This 'support lip' attached to the beam makes placement of the Slimline floor elements very practical.

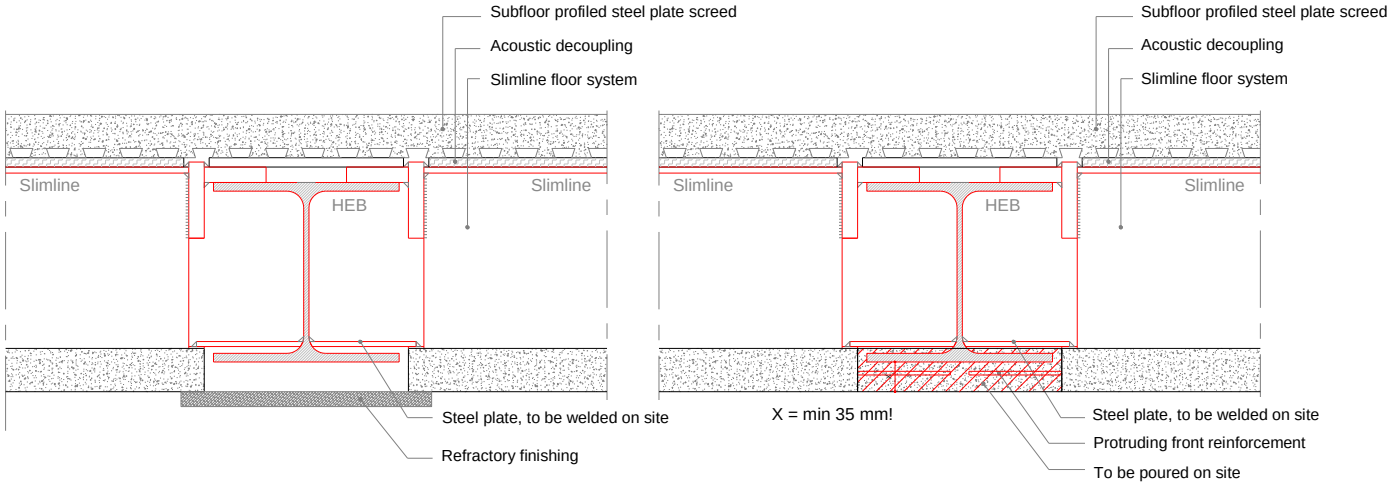
By applying a tension bar to the precast concrete facade elements, the stability of the floor can be easily transferred to the facades.



Steel frame

In order to place Slimline elements on a steel frame, the steel beams can be fitted with support lips. This results in the main support beam being on the same level as the floor package.

In most cases, the main structure will require refractory lining.

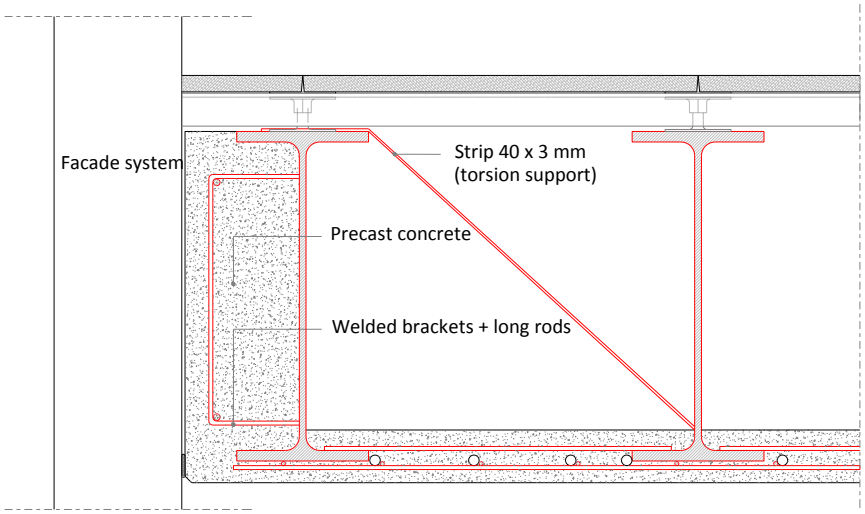


Imposition of a Slimline floor element

Edge beam

Slimline offers the possibility to fit the edge beam with a concrete rim. This option results in a smooth finishing of the transition between ceiling and facade, without the need for carpentry. Moreover, this solution holds additional benefits with regards to fire resistance and acoustic insulation.

The edge beam is fitted with anchors to attach fall protection.



Edge beam with concrete rim

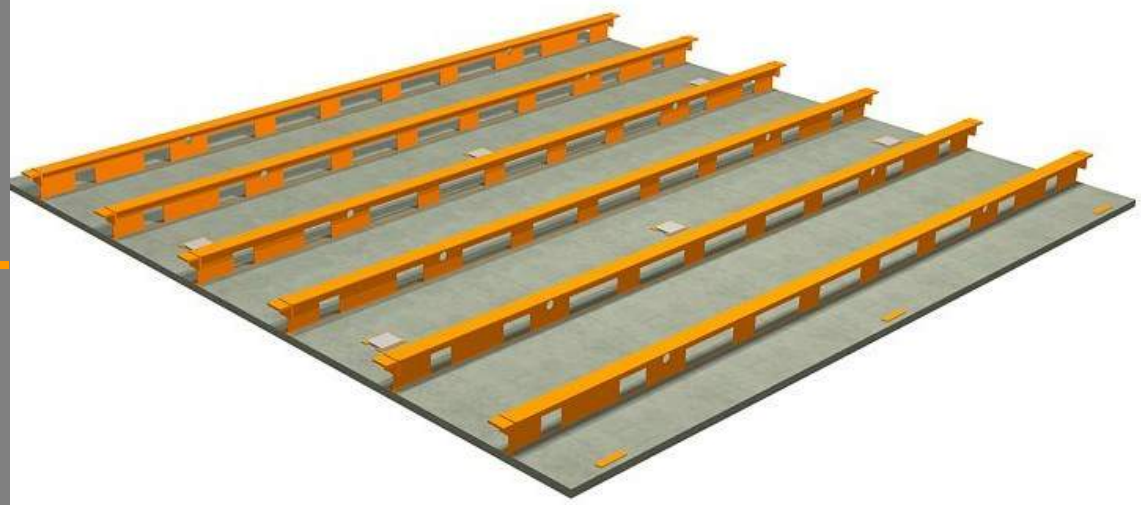
Principles of diaphragm action

The wind load on the facade is absorbed through the steel profiles or the concrete slab directly. The load is removed to the stability elements through diaphragm action.

The individual concrete slabs are connected using provisions which are to be fitted on site, which allow the force to be transferred to the stability elements.

The tension bar is formed by the main load bearing structure.

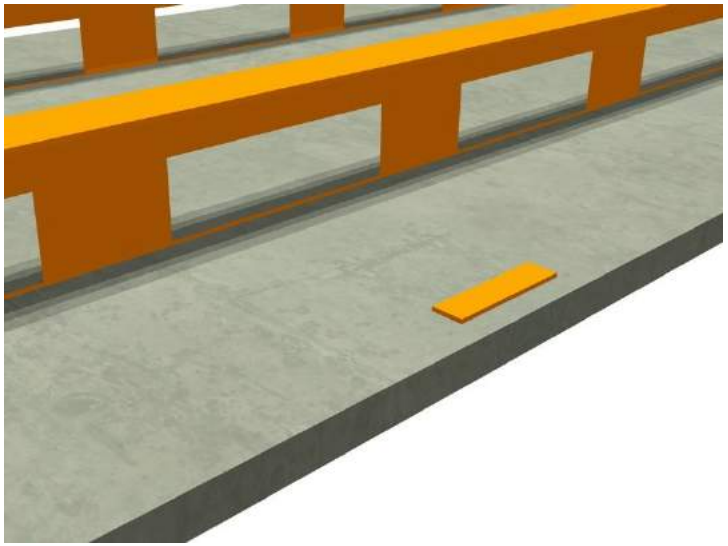
Diaphragm action with the Slimline



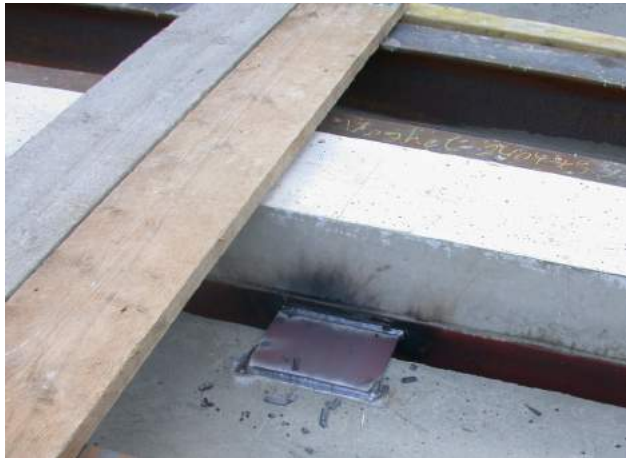
Diaphragm action connections

To mutually link the elements, so called 'spiders' are used. These steel, poured-in provisions are fitted with reinforcements and are situated on the edge of the concrete slab.

The slabs are connected using a connection plate. The thickness of the plate is at least 8 mm and a weld a=5 is used for fixation.



Diaphragm action with the Slimline

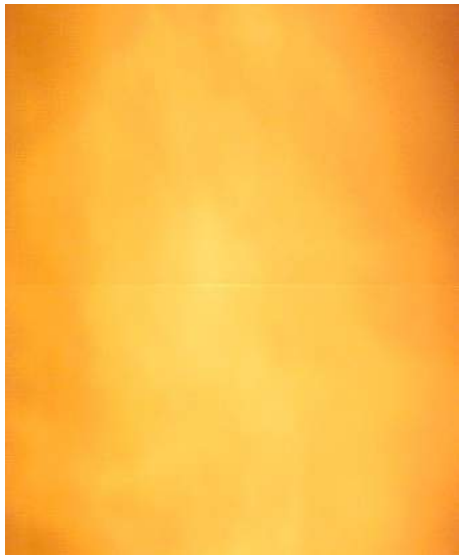


Slimline and fire

The Slimline floor system (formerly known as INFRA+), has been tested by Dutch authority TNO Construction in accordance with the NEN6069:1997 standard at the Centre for Fire Safety lab. The Slimline floor used for the trial consisted of IPE240 steel beams with 1200 mm spacing and a span of 7,42 m. The test results are summarized in a TNO-report with reference 2000-CVB-R02194. The trial construction achieved a fire resistance for the separating function (resistance to fire penetration and fire transfer) of over 145 minutes, both for the criterion flame resistance based on the sealing as for the criterion thermal isolation based on the temperature. On the criterion collapse (structural safety) the report shows a result of over 145 minutes.

In September 2008, Efectis Netherlands B.V. conducted subsequent analysis –Report 008 R -645- of the Slimline floor system with longer beams than in the 2000 trial setup, which proved the fire resistance for larger spans and fire. This resulted in a new formula, which is used to calculate the floor system during engineering based on the existing requirements for fire resistance. It's concluded that the beams in the ceiling slab are always sufficiently protected by the approximate 33 mm of concrete under the steel beams.

Fire resistance of the Slimline floor system



Fire resistance > 145 minutes

The fire resistance of the Slimline floor system has been tested in accordance with the NEN6069:1997 standard. This resulted in a fire resistance rating of > 145 minutes.

Soundproofing

The two-layered construction of the Slimline floor system results in a soundproofing rating of I_{luc} and I_{co} of > +10 dB, confirmed in both lab as on-site measurements.

General considerations

SlimCalc

Slimline Buildings has developed proprietary calculation software: SlimCalc. This software helps you to conveniently determine necessary floor thickness, profile dimensions and beam patterns.

Additional information is available on the website: www.SlimCalc.nl.

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