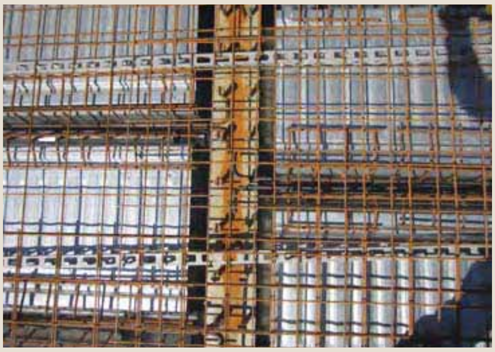
ArcelorMittal Europe – Long Products
Sections and Merchant Bars

ArcelorMittal

Slim-Floor

An innovative concept for floors


© Ing.-Büro Hauf, Gundelfingen (Do)




© Studio Suraci


© Ing.-Büro Hauf, Gundelfingen (Do)


© C. Radermacher


© C. Radermacher

Table of contents

1. The Slim-Floor concept

Developed by the ArcelorMittal group, "Slim-Floor" construction is a fast, innovative and economical solution, which combines prefabricated slabs with built-in steel beams. Created to eliminate beam downstands under the floor, this reliable and economic construction method gives new scope to the architect's imagination and guaranteed economy for beam spans up to 14 metres.

The secret of the design is a special asymmetric cross section with a lower flange that is wider than the upper flange, Figure 1.1.

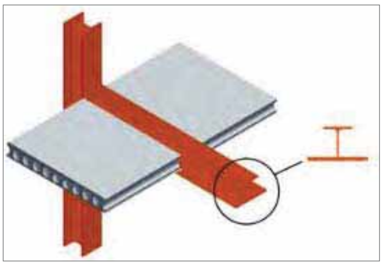


Figure 1.1: The Slim-Floor Concept

This arrangement makes it possible to place slab elements directly onto the lower flange of the beam, which results in an integrated solution characterised by a very slim floor thickness.

Slim-Floor construction has numerous technical and economical advantages and a wide range of cross sections is available, ensuring maximum freedom in layouts.
Thanks to the development of "CoSFB", a new and innovative composite Slim-Floor beam, the application range can be significantly enlarged, Figure 1.2.

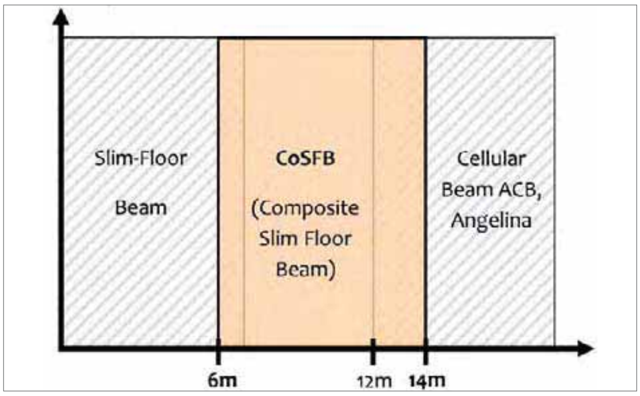


Figure 1.2: Optimal application range of floor beams

Figure 1.3: a) Galerie Kons, Luxembourg

Figure 1.3: b) Clinique d'Eich, Luxembourg

Figure 1.3: c) Floralis, Belgium

Figure 1.3: d) ArcelorMittal Office Building, Luxembourg

2. A wide range of optimal solutions: From beam sections…

Slim-Floor beam (up to 8m span)

Slim-Floor construction is a well-established and economical solution characterised by integrating the main steel beams into the floor, resulting in inherent fire resistance, limited floor thickness and efficient use of materials in combination with light and slender elements.
The span of non-composite Slim-Floor beams can reach up to 8 meters, giving new scope to architects' imagination and guaranteed economy.

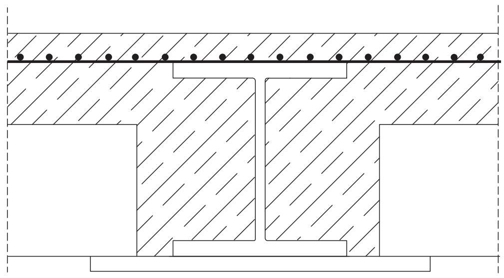


Figure 2.1 Slim-Floor beam section geometry

Figure 2.2 Slim-Floor beam application (Petrusse Building, Luxembourg)

Composite Slim-Floor beam (8 to 14m span)

In order to enlarge the application range of SFB and maintain its economical and technical advantages, an innovative composite Slim-Floor beam has been developed. CoSFB is a deep-embedded concrete dowel connecting in-situ concrete with the steel section, ensuring a composite action without an increase in the floor thickness. Concrete dowels are defined as drilled openings through the web of a steel section and standard reinforcement bars placed transversally to the beam span through the web-openings, while they are filled with in-situ concrete. The CoSFB concept is perfectly closing the gap between short span non-composite Slim-Floor beams and long span cellular beams, providing a wide range of technical solutions, Figure 1.2.

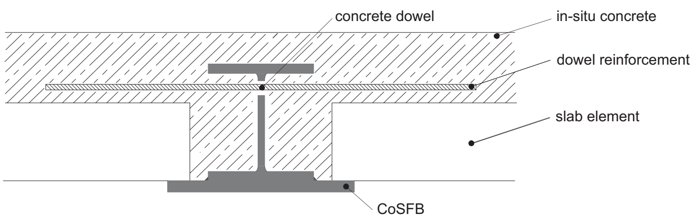


Figure 2.3 CoSFB section geometry

Figure 2.4 CoSFB application example (Dillingen a.d. Donau, Germany)

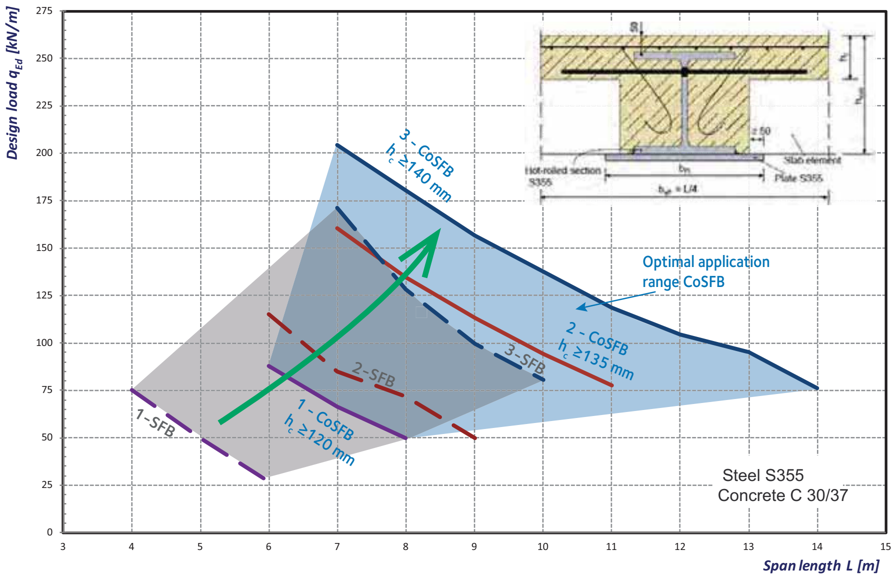


Table of sections
1- HE 160B with plate 300 x 15
2- HE 260B with plate 400 x 20
3- HE 360B with plate 425 x 20

2.5 Application range of composite Slim-Floor beams compared to non-composite Slim-Floor beams

All Slim-Floor beams are asymmetrical beams with a lower flange or a welded plate with a width bigger than the upper flange, allowing for easy and safe erection and installation of the slab elements. Asymmetrical beams with different section geometries are available in order to provide the optimal solution according to the project requirements.

IFB TYPE A

A lower flange plate welded onto a cut HE or IPE section. For a slightly higher fabrication cost compared to SFB, the weight is maintained low. The upper 'T' may be made from a cut IPE 500 or IPE 600 section, resulting in a beam height of 250mm or 300mm. The width of the lower flange must guarantee the support of the flooring slab on both sides of the steel section.

IFB TYPE B

IFB section of type B is composed of a cut HE or HP section and a welded upper flange plate. This type is suitable for smaller beam spans, because of its rather low beam stiffness. This is an ideal solution for large-scale, tailor-made projects. For example, a building 12,6m wide can be fitted with floors on a 5,4m + 7,2m frame with beams based on HP400.

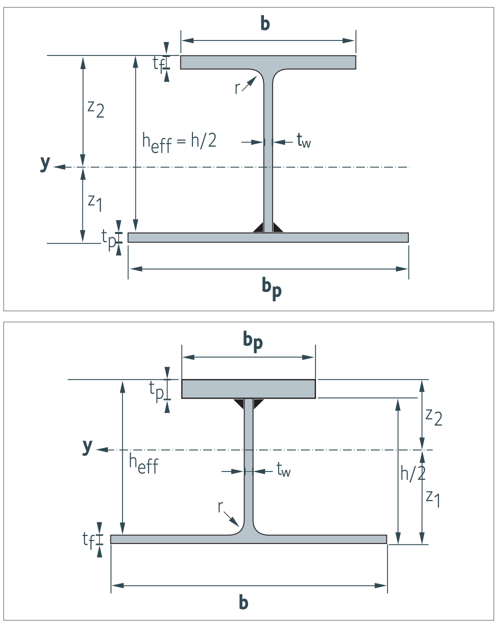


Figure 2.6 IFB type A and B and SFB

SFB

A plate is welded under an HE or an IPE section. The linear weight will be slightly higher compared to an IFB type because more material is used, but the cost of fabrication is lower. This solution is appropriate for small-scale standard projects where materials are very readily available.

Slim-Floor beam spans from 5m up to 14m with corresponding floor thicknesses from 20cm up to 40cm. The beams can be cambered and may be designed as composite beams, either with shear studs welded on the upper flange or by using the CoSFB technology.

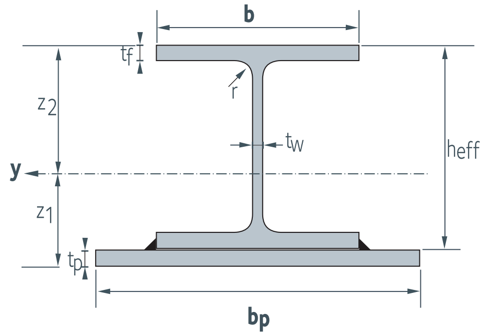


Figure 2.6 IFB type A and B and SFB

HB beam

A further alternative is the HB steel beam. Two UPE steel profiles are connected by threaded rods ensuring a composite action between the two steel profiles and the concrete in the chamber. The connections prevent slippage between the two materials when subjected to flexure. The lower flange of the UPE profile guarantees sufficient support to the flooring slab on both sides of the beam.

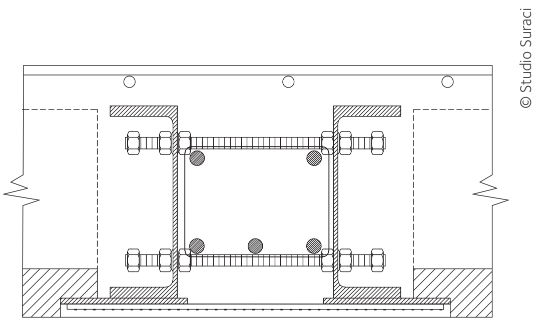


Figure 2.7 HB-beam section

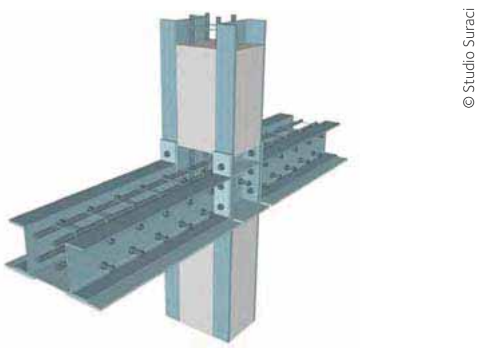


Figure 2.8 HB-beam section, 3-D model

SFB and CoSFB can be combined with various slab types with low self-weight compared to the full concrete solution, resulting in more sustainable and flexible solutions.

... to slab types

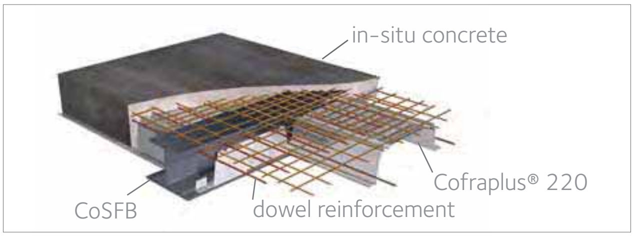


Figure 2.9 left: Cofradal slab; right: Cofraplus 220 slab

Cofradal 200/230/260

Cofradal is a partially prefabricated slab, which consists of a metal cassette deck, thermal insulation, reinforcement fixed on the metal decking and completed by in-situ concrete. With a low self weight, a high load bearing capacity, excellent thermal and sound insulation and fire resistance of up to fire resistance class REI 120, this slab is a perfect solution for hotels, offices, administrative and residential multi-storey buildings. Moreover, as "Cofradal Decibel" with a perforated steel liner, it provides outstanding acoustic performance: it absorbs sound without any additional installations.

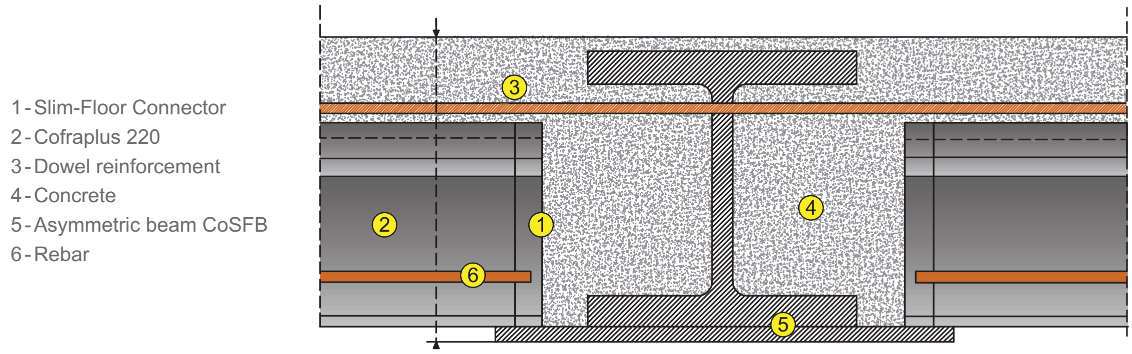


Figure 2.10 Cofraplus 220 with Slim-Floor beam

Cofraplus 220

Cofraplus 220 (Figure 2.9 and 2.10) is made up of trapezoidal steel sheets with open ribs. Thanks to their geometry they are stackable for easy storage. Cofraplus 220 is the best solution for most uses, involving slab spans of up to 6m without temporary propping.

The installation is quick and it can be done manually, allowing for savings in construction time and weight and for the flexibility required in renovation works and architectural design.

Prefab concrete slabs

Differently than concrete poured on site, this slab type is produced by casting concrete in a controlled environment and then transporting it to the working site where it is lifted into place.

Hollow core slabs

A hollow core slab is a precast slab of pre-stressed concrete. The precast concrete slab has tubular voids extending the full length of the slab. This makes the slab much lighter than a massive solid concrete slab of equal thickness, lowering the costs of transportation and material.

Case study: Galerie Kons

Galerie Kons
Location: Luxembourg Date of construction: 2016 Owner: PEF KONS Investment SA Architect: M³ Architectes Design office: Schroeder & Associés Ingénieurs-conseils Surface: 28800m² Function: offices, retail shops, residential flats, underground parkings

ArcelorMittal Solutions

Steel grade	Slab typology	Beam type	Fire Resistance	Floor thickness	Tons of Slim-Floor
S355	**Cofraplus 220**	**SFB**	**R90**	**320mm**	**300**

Case study: ArcelorMittal Office Building

AOB - Esch-sur-Alzette
Location: Luxembourg Date of construction: 1991 - 1993 Owner: ArcelorMittal Architect: Office Böhm, Cologne Design office: Schroeder & Associés, Ingénieur-conseils Surface: 15000m^2 Function: offices

ArcelorMittal Solutions		
Steel grade	Slab typology	Beam type
HISTAR® 460	**Hollow core**	**IFB**

Case study: Santa Maria della Misericordia Hospital

Santa Maria della Misericordia Hospital
Location: Udine (Italy)
Date of construction: 2013
Owner: ATON
Architect: L+Partners, Milan
Design office: Studio d'ingegneria Suraci
Surface: 4608m^2
Function: Hospital and research centre

ArcelorMittal Solutions

Steel grade	Slab typology	Beam type	Fire Resistance
S355	**Hollow core**	**SFB**	**R90**

3. The advantages of Slim-Floor construction

Slim-Floor construction allows for the optimisation of the usable volume of a building and offers several advantages.

1. Reduction of floor thickness

A reduction of the floor thickness of 25cm to 40cm - compared to traditional downstand beams – is possible. For buildings with 10 storeys or more, this results in one additional floor, which leads to a 10%-increase in the useful area of the building. This new flexibility in terms of storey height allows for additional economical savings for the façade and HVAC costs when operating the building.

Figure 3.1 Galerie Kons (Luxembourg) – construction phase

2. Constructing floors of variable thickness

Difference in slab thickness can be adjusted by adding additional supporting plates on the lower flange of the beam, Figure 3.2

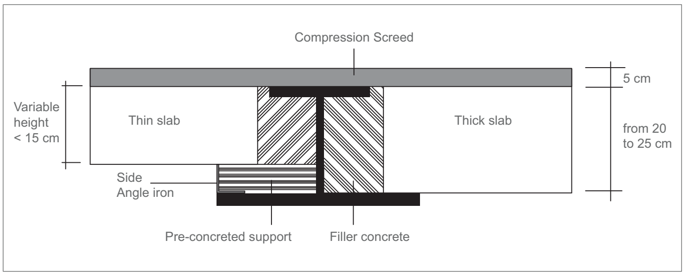


Figure 3.2 Detail of floor with variable thickness

3. Incorporating under-floor technical equipment

The integrated beams make it easier to build under-floor technical equipment (air-conditioning, piping, electrical and IT networks, etc) and simplifies the fitting of false ceilings. The under-surfaces of the prefabricated slabs may also be left on display on the ceiling as long as some prefabrication precautions are taken and certain handling techniques are used.

Figure 3.3 Built-in under floor technical equipment (Petrusse Building, Luxembourg)

4. Priority to architectural expression

Open working spaces can be created, with a reduced number of intermediate columns, due to the structural characteristics of the components. The spaces can be organised according to the aesthetic or functional requirements which may change with time. The beam span can reach up to 14 meters, thanks to the improvement provided by a new generation of Slim-Floor beams, the CoSFB.

5. Built-in fire resistance

The integration of the beam into the slab provides structural protection directly fulfilling the requirements for fire resistance class up to R90. Therefore, no additional passive fire protection is required. Further increase of the fire resistance can be achieved by simply protecting the lower flange of the beam (e.g. by fire proof boards, sprayed concrete or intumescent coating).

The fire resistance of the whole floor also depends on the fire resistance of the slab and on its capacity to adapt to the vertical deformation of the support in fire conditions.

Moreover, transverse reinforcing rebars must be used in order to ensure the transmission of loads from the slab elements to the integrated steel profile in fire conditions. Constructive provisions are given in Figure 3.4.

6. Competitive pricing

Thanks to a low steel consumption per square metre floor – typically from 15kg/m^2 to 25kg/m^2 – Slim-Floor construction is very economical and a perfect solution for multi-storey buildings. Also prefabricated or partially prefabricated slab elements are available at competitive prices.

7. Easy to build

The fast and simple assembly of the prefabricated components is almost entirely unaffected by atmospheric conditions. This makes it easier to meet deadlines and to keep construction costs at a minimum.

8. Environmentally-sensitive construction

The steel structure is re-usable and 100% recyclable and reduces the number of transportations to the site and building site nuisance.

9. Lighter structures

The steel structure is composed of elements which are light and easy to handle. With the use of modern slab elements (e.g. Cofradal 200®) the weight of the whole structure can be reduced further.

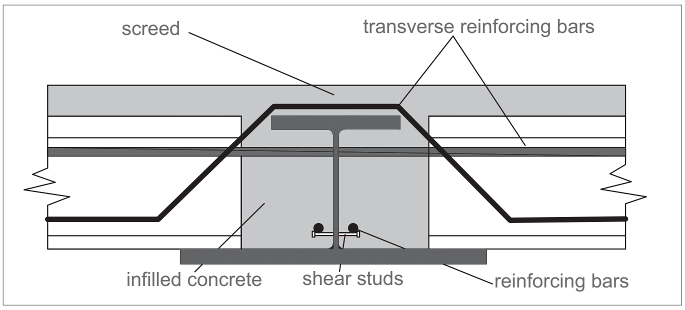


Figure 3.4a Integrated fire protection – concrete cover

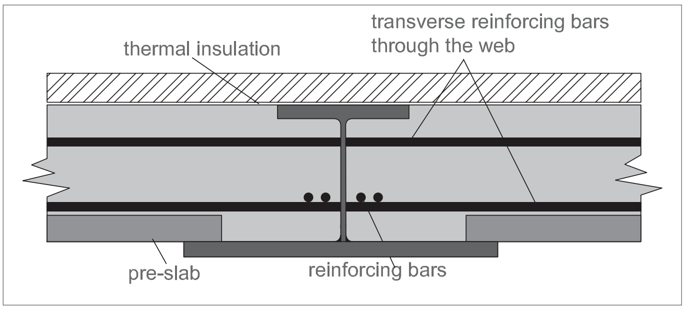


Figure 3.4b Integrated fire protection – prefabricated slab

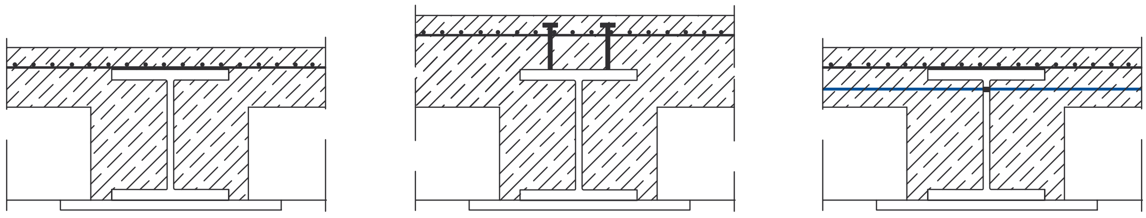
Figure 3.5 Lighter structure
(Petrusse Building, Luxembourg)

Case study: Floralis

Floralis
Location: Gent (Belgium) Date of construction: 2005 Owner: Liberty Invest n.v. Architect: Ivan van Mossevelde, D. van Impe Design office: IPES n.v. Surface: 14500m^2 Function: offices

ArcelorMittal Solutions		
Steel grade	Slab typology	Beam type
S355	**Hollow core**	**IFB**

4. CoSFB: an innovative solution



4.1 CoSFB ensures composite action by maintaining the same floor thickness of the non-composite SFB

The design of long span floor beams is usually governed by serviceability criteria. Serviceability limit states are related to deflections and vibrations and hence are mainly governed by stiffness, which is the key parameter to achieve the aimed structural design.

Composite Slim-Floor beam (CoSFB) is a new generation of Slim-Floor beams with significantly increased beam stiffness due to the activation of a composite action between the steel section and in-situ concrete. Thanks to the positioning of the shear connection in the web of the steel section, the composite action is assured without increasing the beam height or the floor thickness, as would have been required with the use of traditional shear studs, welded onto upper flange of the steel profile, Figure 4.1.

Due to the fact that the connection is made at the web and not on the upper flange, the concrete cover above the steel section can be reduced to a minimum.

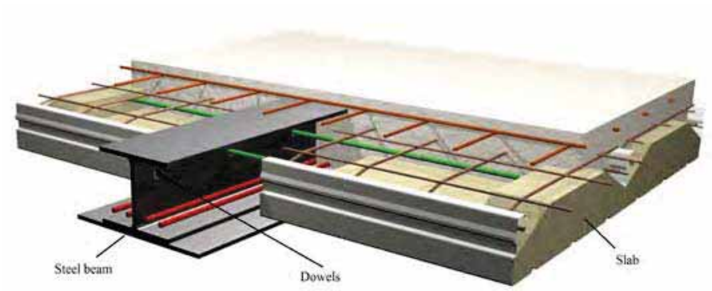


Figure 4.2 3D-model of a CoSFB

CoSFB enlarges the application range of classical SFB systems and perfectly closes the gap between SFB and cellular beams. This technical solution makes it possible to reach beam spans of up to 14m by keeping an overall construction height of 40cm, resulting in a flexible solution that can be used with any other common floor system, allowing for an optimised tailor-made solution.

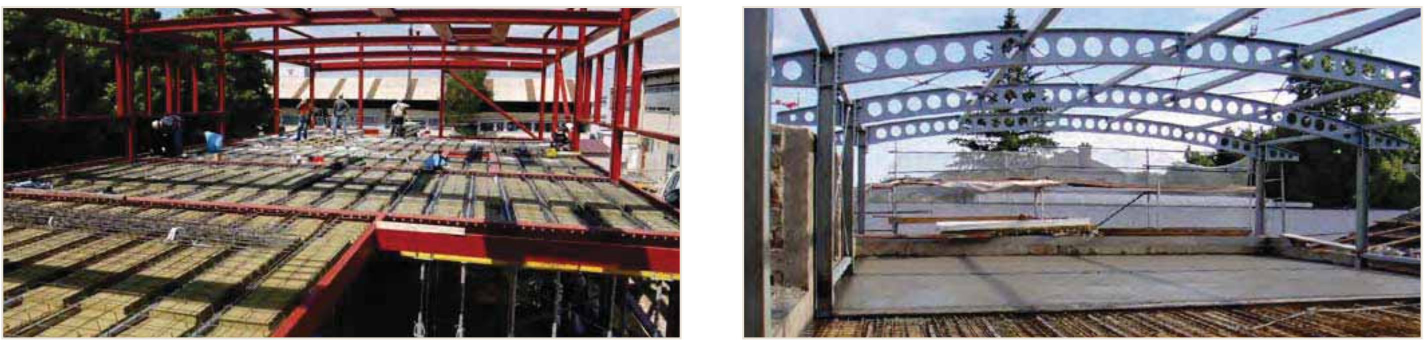


Figure 4.3 Examples of CoSFB. left: Maizières-lès-Metz (France). right: © atelier "Offermann" Mersch (Luxembourg).

The application and the design of the CoSFB in Ultimate Limit State (ULS) and Serviceability Limit State (SLS) are covered by a General Technical Approval (Germany) (see Figure 4.4). Guidelines about the resistance of the shear connection and the constructive limitations to take into account are given.

- The characteristic values of the dowel resistance in [kN] per dowel according to concrete class and thickness of the web are summarised in the table, considering a safety factor $\gamma_V = 1.25$.
- The thickness of the web t_w cannot be lower than 7,5mm
- The distance of the web-holes along the beam must be at least 125mm
- The diameter of the rebar must be not lower than 12mm
- The diameter of the holes in the web must be between 25 and 40mm
- The plastic bending resistance can be considered in the ULS verification only if the difference from the non-linear bending resistance is lower than 5%.

Concrete class / Web thickness	C25/30	C30/37	C35/45	C40/50 to C55/67
$7{,}5mm \le t_w < 15{,}5mm$	117	125	135	122
$15{,}5mm \le t_w$	148	157	166	122


Deutsches Institut für Bautechnik DIBt

Allgemeine bauaufsichtliche Zulassung

Zulassungsstelle für Bauprodukte und Bauarten
Bautechnisches Prüfamt
Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts
Mitglied der EOTA, der UEAtc und der WFTAO

Datum: 29.07.2014
Geschäftszeichen: I 31.1-1.26.4-8/10

Zulassungsnummer:
Z-26.4-59

Geltungsdauer
vom: 29. Juli 2014
bis: 29. Juli 2019

Antragsteller:
ArcelorMittal Belval & Differdange S.A.
66, rue de Luxembourg
4009 ESCH-SUR-ALZETTE
LUXEMBURG

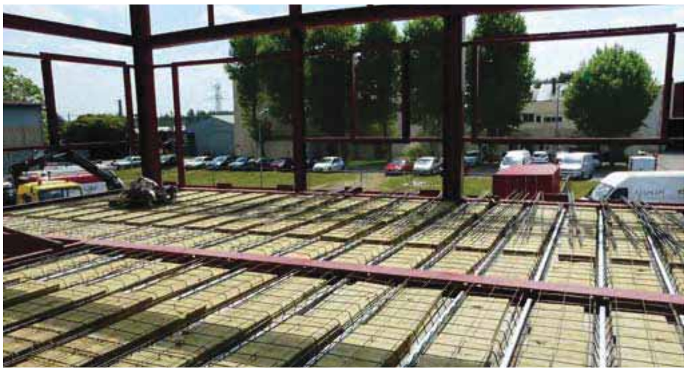
Zulassungsgegenstand:
CoSFB-Betondübel

Der oben genannte Zulassungsgegenstand wird hiermit allgemein bauaufsichtlich zugelassen.
Diese allgemeine bauaufsichtliche Zulassung umfasst sieben Seiten und zwei Anlagen.

DIBt | Kolonnenstraße 30 B | D-10829 Berlin | Tel.: +4930 78730-0 | Fax: +4930 78730-320 | E-Mail: dibt@dibt.de | www.dibt.de

Figure 4.4 CoSFB General Technical Approval – Approved guidelines for construction (Germany)

Case study: ArcelorMittal Maizières Research building



Office building
Location: Maizières-lès-Metz (France) Date of construction: 2016 Surface: 415m^2 Function: offices

ArcelorMittal Solutions		
Steel grade	Slab typology	Beam type
S355	**Cofradal 260**	**CoSFB**

5. Technical detailing and installation

5.1 Beam-to-column joint

The beams are bolted on steel "H" columns in the conventional manner, either by endplates, or by cleats, directly supported by columns or walls.

5.2 Beam-to-slab connection

The slabs are placed on the lower flange of the beam and the assembly is made solid with filler concrete and tie bars.

Beam-to-slab connection depends mainly on the static system of the associated slab, either as single span element from beam to beam or as multi-span system across several beams.

A single span slab might be easier to install, but generally provides higher deflection and requires more reinforcement to cover the bigger positive bending moment, especially according to fire design principles.

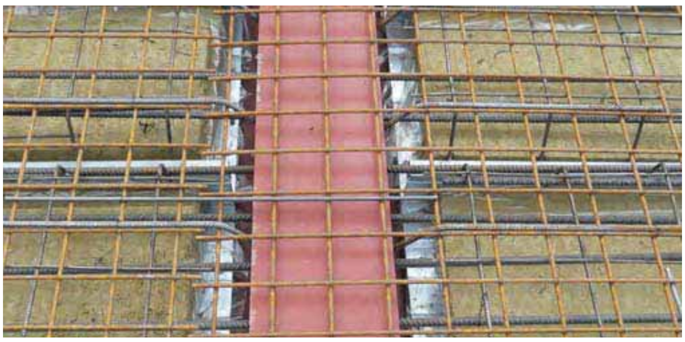


Figure 5.2 CoSFB: beam-slab connection

Figure 5.1 Beam-column joint

The continuous slab design is more complex, but it might be beneficial in terms of fire resistance and provides usually lower deflections. Further, it permits to transmit horizontal stresses ensuring the diaphragm effect of the slab.

In order to increase the strength of the floor, the slab elements being placed can be connected to each other by reinforcements, either crossing the web of the beam or overpassing the upper flange in the direction of the slabs.

In developing the column grid the slab span should always be chosen as big as possible, allowing for a maximum beam height and leading to the most economical solution. Moreover, also the option to prop the slab during concreting or to let it unpropped for different reasons, should be considered.

5.3 Beam spacing

Generally the beam spacing chosen should be as large as possible. Furthermore, regular beam spacing is recommended in order to provide symmetrical beams which are not subject to torsion.

5.4 Flooring erection

The flooring is usually erected floor by floor to facilitate the handling of the slab and the pouring of the concrete.

The steel columns, often continuous through two or three floors, can be stabilised with temporary bracings during erection. In most cases they are bolted onto the columns, then removed after concreting and installed on the next levels.

The steel beams are erected and fixed to the columns and the slabs are installed. The edge beams and those under asymmetrical loading are propped to avoid torsional effects. After the pouring and the hardening of the concrete the propping can be removed.

Figure 5.4.1 Temporary propping

Figure 5.4.2 Underside of a finished floor

Usually the structures are simple, iso-static and braced by Saint-Andrew's crosses or reinforced concrete cores (staircases, etc.).To increase the strength of the system, it is recommended taht the beams are connected to each other using devices which will resist accidental traction effects (shocks, etc., see EN 1991-1-7).

This connection can be achieved by using metal parts or frames (H or T) reduced in height embedded in the thickness of the floor. The advantage of this solution is that it provides an effective connection during assembly and reduces the number of temporary struts.

5.5 Protection against corrosion

For standard indoor climate and related corrosivity class, it is sufficient to treat the lower flange of the beam by SA 2.5 shot-blasting and to apply a conventional paint.
In general, members or parts of members which are embedded in concrete do not need treatment.

5.6 Beam Propping in Construction stage

In the construction stage the beam has to be verified for lateral-torsional buckling (LTB). In addition, the possible presence of out-of-balance loading, e.g. if the slab elements are placed on one side of the beam first and later on the other side or in case of edge beams, has to be taken into account in the beam design. To avoid these torsion actions on the beam, an adequate propping can be placed under the support of the slab elements (and not at the axis of the Slim-Floor beam). For beams at internal bays, this “out-of-balance” propping might be removed after the slab elements are fully placed at both sides of the beam, Figure 5.6.

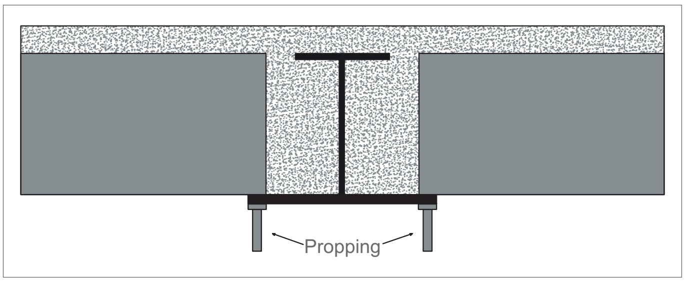


Figure 5.6: Construction stage: propping of an internal beam

For the design of composite beams it is beneficial if the propping is removed after the in-situ concrete has reached its design strength. This leads to the most economical steel consumption.

5.7 Edge beams

The chapter 5.6 describes how out-of-balance loads lead to torsion of edge beams in construction and in final stage. Therefore it is recommended to tie edge beams against torsion. A possible method for the design of the tie bars as torsional anchorage is given here:

During construction stage (placing of the slab elements + pouring the in-situ concrete) the beams are propped at the support area of the slab elements, Figure 5.7 A minimum of two props per beam span is recommended.

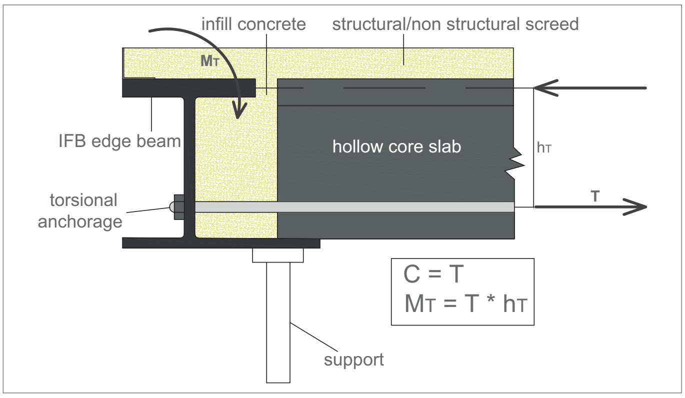


Figure 5.7: Construction stage: propping of an edge beam

Before pouring the in-situ concrete, the torsional anchorage is placed in the slab and fixed at the web of the beam. Practice has shown a distance between the anchorage bars of 0,60m or 1,20m to be adequate. The torsional anchorage acts as a tie and prevents the rotation of the edge beam and is subjected to tension. The tension force in the anchorage (T) can be calculated by dividing the acting torsional moment in longitudinal direction of the beam (M_T) by the vertical distance between the axis of the torsional anchorage and the axis of the upper flange of the hot rolled section. This upper flange is introducing a compression force (C) into the concrete slab, which has the same value as the tension force, C = T. A correct anchorage of the tie bar at the edge beam and into the slab has to be ensured.

download **Environmetal Product Declaration** from sections.arcelormittal.com:

6. Slim-Floor: the perfect solution for sustainable development

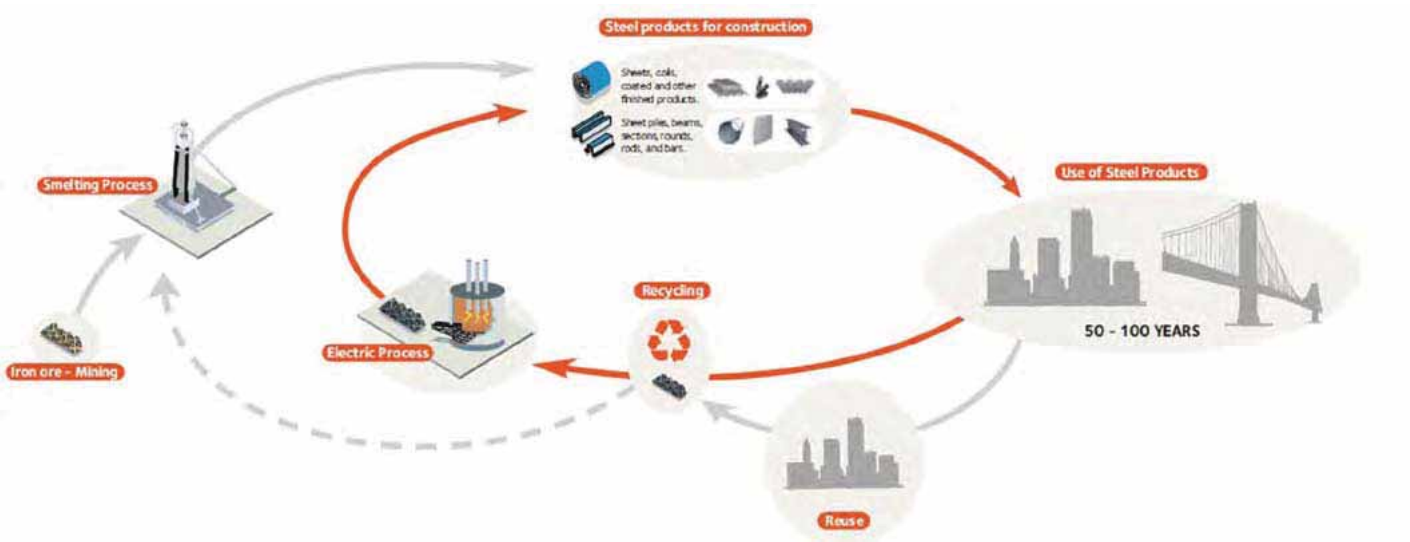


Figure 6.1: 1,2 tonnes of steel recycled by ArcelorMittal each second

Steel can be indefinitely recycled without any loss in quality. This means that the amount of scrap material from job sites or manufacturing plants, in addition to steel elements recovered from demolished building and structures, contribute to the majority of the steel material used in new high-rise structures (Figure 6.1). Steel is the most recycled material in the world.

About 65-70% of all steel needed for reinforcement bars has come from recycled material and 99% of steel beams are developed from recycled steel (approximately 88% recycled and 11% can be reused)*. Recycled steel represents currently about 40% of the steel industry's ferrous resource in the world. With 33 million tonnes of CO_2 saved each year, ArcelorMittal is the world's largest recycler of steel.

Furthermore, ArcelorMittal is striving to reduce the overall environmental impact in the manufacturing process. Waste generation, water use and air emissions are continually decreasing, as are energy consumption and greenhouse gas emissions. The European steel industry is one of the most efficient steel industries in the world. European steelmakers have reduced energy consumption and CO_2 emissions per tonne of steel by 50% since 1960 and are now close to the technically feasible minimum**. ArcelorMittal production sites of beams have all reached ISO 14001 certification, the international standard for environmental management systems.

In addition, these sites are BES 6001 certified (Responsible Sourcing). ArcelorMittal is also a proponent for a dry steel construction system and using prefabricated steel elements during construction. This can lead to a shortened total construction time and reduce various risks during the construction phase, as assembly is simpler and less labour is required. Using prefabricated elements also reduces physical environmental impacts to the surrounding land and neighbourhood nuisance. Water use, waste generation, dust emission, traffic, and noise are considerably lower than in traditional construction. Work site management is largely facilitated. All these advantages are especially valuable for congested urban areas.

* see at the top of the page: Environmental Product Declaration

**www.eurofer.org (EUROFER Sustainability Vision Paper)

7. IFB: Pre-design tables

Design parameters

L span of the IFB in meters

G Dead Load in kN/m^2

Q Live Load in kN/m^2

q_d design load in kN/m

$q_d = 1{,}35 * \Sigma G_{i,K} + 1{,}5 * \Sigma Q_{i,K}$

Validity criteria

- Steel Grade S355
- Simple supported beam
- Symmetrically loaded Beam
- Support length of the slab elements = 70mm
- Load ratio G/Q ≈ 60/40
- Beam weight included in Dead Load G_i
- Deflection under Live Load Q ≤ L / 300
- Transverse deflection of the bottom flange ≤ 1,50mm
- Elastic-plastic design
- Ideal elastic-plastic material behaviour
- Global partial safety factor γ_{M0} = 1,00

Application example

prescribed

grid:	6,5m x 10,0m
Live load Q:	5,0kN/m^2
Additional permanent load ΔG:	1,2kN/m^2
slab thickness:	approximately 26cm

users choice

IFB beam span:	6,5m
slab span:	10,0m (= beam distance)
depth of the HC slab:	26,5cm (G_0 = 3,8kN/m^2)

calculated

line load from G:	g_K = 10,0 * (3,8 + 1,2) = 50kN/m
line load from Q:	q_K = 10,0 * 5,0 = 50 kN/m
design load q_d:	q_d = 1,35 * 50 + 1,5 * 50 = 142,5kN/m

derived from the design table IFB-Slab < 300mm:

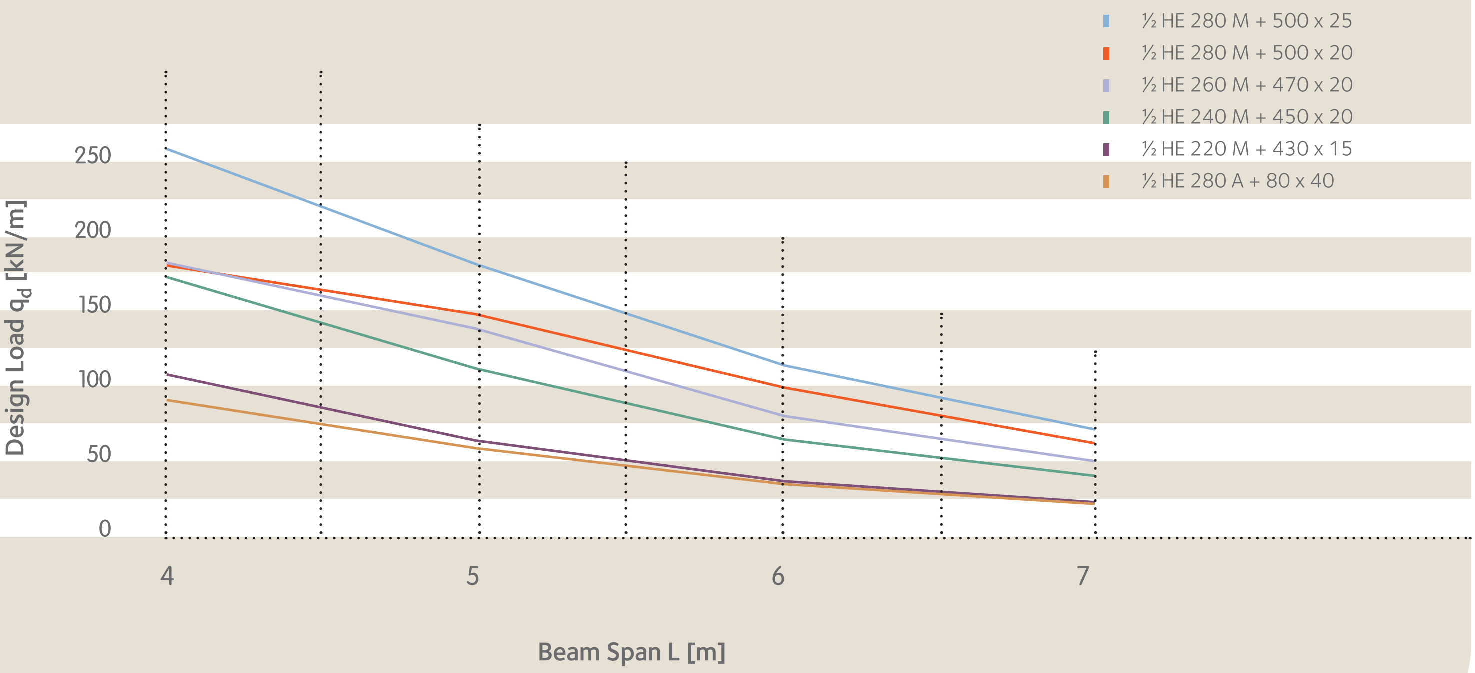
1/2 HEA 550 + 500 x 20 (g = 161,6kg/m)

N.B.: Please observe the minimum tonnage required for section delivery!
(The sections retained for diagram drawing are printed in **bold** characters!)

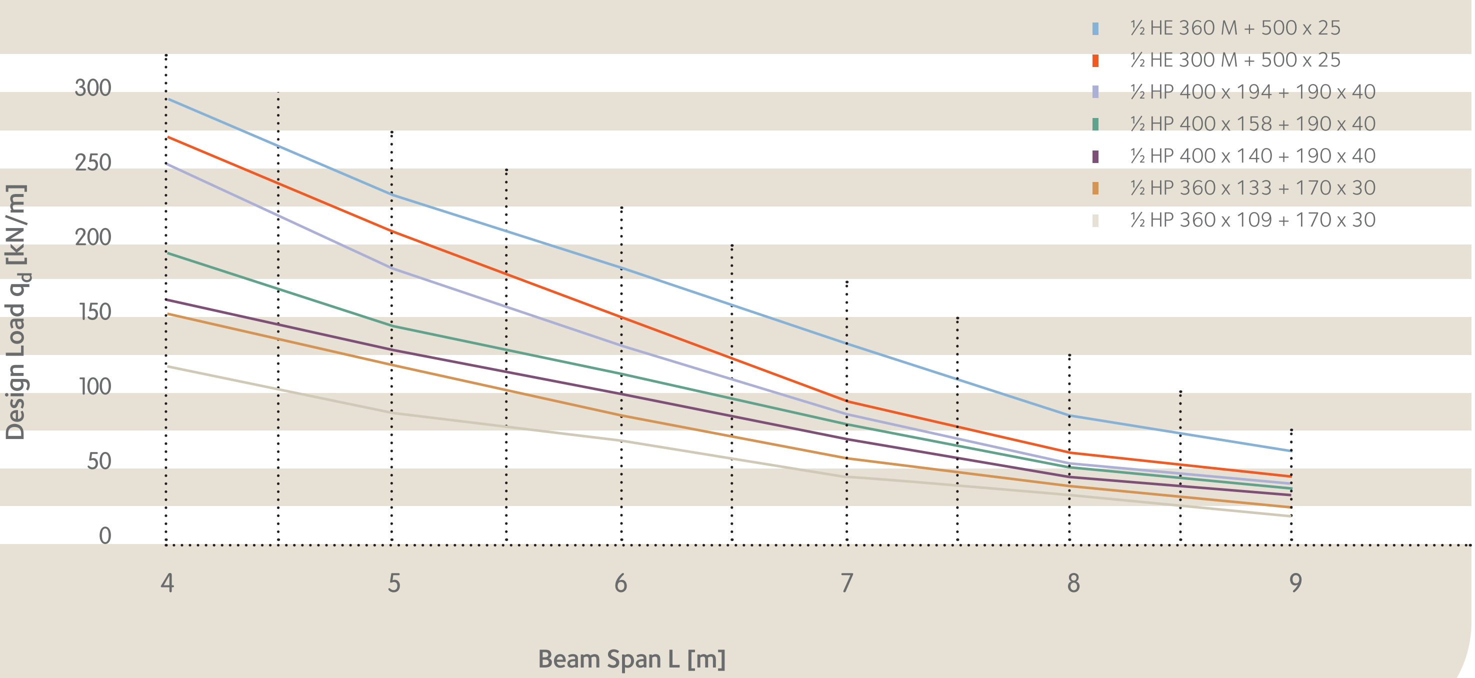
	Section	Plate	Type	G	h	b	t_w	t_f	r	A	I_y	W_y	y_1	y_2
		B x t		kg/m	mm	mm	mm	mm	mm	cm^2	cm^4	cm^3	cm	cm
½	IPE O 500	410 x 15	A	102,1	506,0	202,0	12,0	19,0	21,0	130,0	16702	1072	11,2	15,6
	IPE O 550	420 x 15	A	110,7	556,0	212,0	12,7	20,2	24,0	141,0	21826	1317	12,7	16,6
½	IPE 550	410 x 15	A	100,9	550,0	210,0	11,1	17,2	24,0	128,5	19499	1143	11,9	17,1
½	IPE 600	420 x 15	A	110,7	600,0	220,0	12,0	19,0	24,0	141,0	25375	1419	13,6	17,9
½	IPE O 600	430 x 15	A	128,0	610,0	224,0	15,0	24,0	24,0	163,0	29831	1749	14,9	17,1
		430 x 20	A	144,8	610,0	224,0	15,0	24,0	24,0	184,5	34207	1817	13,7	18,8
½	HE 220 M	430 x 15	A	109,3	240,0	226,0	15,5	26,0	18,0	139,2	4209	581	6,2	7,3
½	HE 240 M	450 x 20	A	149,0	270,0	248,0	18,0	32,0	21,0	189,8	7323	872	7,1	8,4
½	HE 260 M	470 x 20	A	160,0	290,0	268,0	18,0	32,5	24,0	203,8	9088	1036	7,7	8,8
½	HE 280 M	500 x 20	A	172,8	310,0	288,0	18,5	33,0	24,0	220,1	11219	1217	8,3	9,2
		500 x 25	A	192,4	310,0	288,0	18,5	33,0	24,0	245,1	12854	1274	7,9	10,1
½	HE 300 M	500 x 25	A	217,1	340,0	310,0	21,0	39,0	27,0	276,6	17045	1672	9,3	10,2
½	HE 320 M	500 x 25	A	220,6	359,0	309,0	21,0	40,0	27,0	281,0	19209	1809	9,8	10,6
		500 x 30	A	240,2	359,0	309,0	21,0	40,0	27,0	306,0	21544	1883	9,5	11,4
½	HE 340 M	500 x 25	A	222,1	377,0	309,0	21,0	40,0	27,0	282,9	21299	1925	10,3	11,1
		500 x 30	A	241,7	377,0	309,0	21,0	40,0	27,0	307,9	23849	2001	9,9	11,9
½	HE 360 M	500 x 25	A	223,3	395,0	308,0	21,0	40,0	27,0	284,4	23467	2036	10,7	11,5
		500 x 30	A	242,9	395,0	308,0	21,0	40,0	27,0	309,4	26234	2113	10,3	12,4
½	HE 400 B	500 x 20	A	156,1	400,0	300,0	13,5	24,0	27,0	198,9	17420	1407	9,6	12,4
½	HE 400 M	500 x 25	A	226,0	432,0	307,0	21,0	40,0	27,0	287,9	28311	2271	11,6	12,5
		500 x 30	A	245,6	432,0	307,0	21,0	40,0	27,0	312,9	31559	2352	11,2	13,4
½	HE 450 B	500 x 20	A	164,1	450,0	300,0	14,0	26,0	27,0	209,0	22963	1707	11,0	13,5
½	HE 450 M	500 x 25	A	229,8	478,0	307,0	21,0	40,0	27,0	292,7	35066	2575	12,8	13,6
		500 x 30	A	249,4	478,0	307,0	21,0	40,0	27,0	317,7	38978	2661	12,3	14,6
½	HE 500 A	500 x 20	A	156,0	490,0	300,0	12,0	23,0	27,0	198,8	25945	1721	11,4	15,1
½	HE 500 B	500 x 20	A	172,2	500,0	300,0	14,5	28,0	27,0	219,3	29448	2034	12,5	14,5
½	HE 500 M	500 x 25	A	233,3	524,0	306,0	21,0	40,0	27,0	297,2	42530	2876	13,9	14,8
		500 x 30	A	252,9	524,0	306,0	21,0	40,0	27,0	322,2	47155	2968	13,3	15,9
½	HE 550 A	500 x 20	A	161,6	540,0	300,0	12,5	24,0	27,0	205,9	32357	1990	12,7	16,3
½	HE 550 B	500 x 20	A	178,2	550,0	300,0	15,0	29,0	27,0	227,1	36480	2334	13,9	15,6
		500 x 25	A	197,9	550,0	300,0	15,0	29,0	27,0	252,1	40972	2406	13,0	17,0
½	HE 550 M	500 x 25	A	237,2	572,0	306,0	21,0	40,0	27,0	302,2	51214	3203	15,1	16,0
		500 x 30	A	256,9	572,0	306,0	21,0	40,0	27,0	327,2	56660	3301	14,4	17,2
		500 x 35	A	276,5	572,0	306,0	21,0	40,0	27,0	352,2	61669	3387	13,9	18,2
½	HE 600 A	500 x 20	A	167,4	590,0	300,0	13,0	25,0	27,0	213,3	39636	2275	14,1	17,4
½	HE 600 B	500 x 20	A	184,5	600,0	300,0	15,5	30,0	27,0	235,0	44424	2652	15,2	16,8
		500 x 25	A	204,1	600,0	300,0	15,5	30,0	27,0	260,0	49851	2733	14,3	18,2
½	HE 600 M	500 x 30	A	260,5	620,0	305,0	21,0	40,0	27,0	331,9	66995	3629	15,5	18,5
		500 x 35	A	280,1	620,0	305,0	21,0	40,0	27,0	356,9	72792	3720	14,9	19,6
½	HE 650 A	500 x 20	A	173,3	640,0	300,0	13,5	26,0	27,0	220,8	47826	2577	15,4	18,6
½	HE 650 B	500 x 25	A	210,5	650,0	300,0	16,0	31,0	27,0	268,2	59792	3076	15,6	19,4
½	HE 650 M	500 x 25	A	244,8	668,0	305,0	21,0	40,0	27,0	311,9	71098	3860	17,5	18,4
		500 x 30	A	264,4	668,0	305,0	21,0	40,0	27,0	336,9	78375	3971	16,7	19,7
		500 x 35	A	284,1	668,0	305,0	21,0	40,0	27,0	361,9	85035	4068	16,0	20,9
½	HE 280 A	80 x 40	B	63,3	270	280,0	8,0	13,0	24,0	80,65	4004	396	7,399	10,101
½	HE 300 A	100 x 30	B	67,7	290	300,0	8,5	14,0	27,0	86,25	4375	417	7,002	10,498
½	HP 360 x 109	170 x 20	B	81,2	346,4	371,0	12,8	12,9	15,2	103,50	6739	606	8,201	11,119
		170 x 30	B	94,6	346,4	371,0	12,8	12,9	15,2	120,50	8716	832	9,841	10,479
½	HP 360 x 133	170 x 20	B	93,0	352	373,8	15,6	15,7	15,2	118,50	7527	634	7,734	11,866
		170 x 30	B	106,4	352	373,8	15,6	15,7	15,2	135,50	9795	866	9,284	11,316
½	HP 360 x 152	170 x 30	B	116,2	356,4	376	17,8	17,9	15,2	148,00	10585	895	8,993	11,827
		170 x 40	B	129,5	356,4	376	17,8	17,9	15,2	165,00	12909	1117	10,264	11,556
½	HP 400 x 122	190 x 20	B	91,1	348	390	14,0	14,0	15,0	116,00	7597	678	8,192	11,208
		190 x 30	B	106,0	348	390	14,0	14,0	15,0	135,00	9837	932	9,840	10,560
½	HP 400 x 140	190 x 30	B	115,0	352	392	16	16	15	146,50	10658	960	9,494	11,106
		190 x 40	B	129,9	352	392	16	16	15	165,50	12931	1194	10,828	10,772
½	HP 400 x 158	190 x 30	B	123,6	356	394	18	18	15	157,50	11435	983	9,171	11,629
		190 x 40	B	138,6	356	394	18	18	15	176,50	13926	1230	10,475	11,325
½	HP 400 x 176	190 x 30	B	132,7	360	396	20	20	15	169,00	12179	1009	8,932	12,068
		190 x 40	B	147,6	360	396	20	20	15	188,00	14874	1261	10,201	11,799
½	HP 400 x 194	190 x 30	B	142,1	364	398,0	22,0	22,0	15,0	181,00	12899	1037	8,765	12,435
		190 x 40	B	157,0	364	398,0	22,0	22,0	15,0	200,00	15786	1293	9,995	12,205

IFB

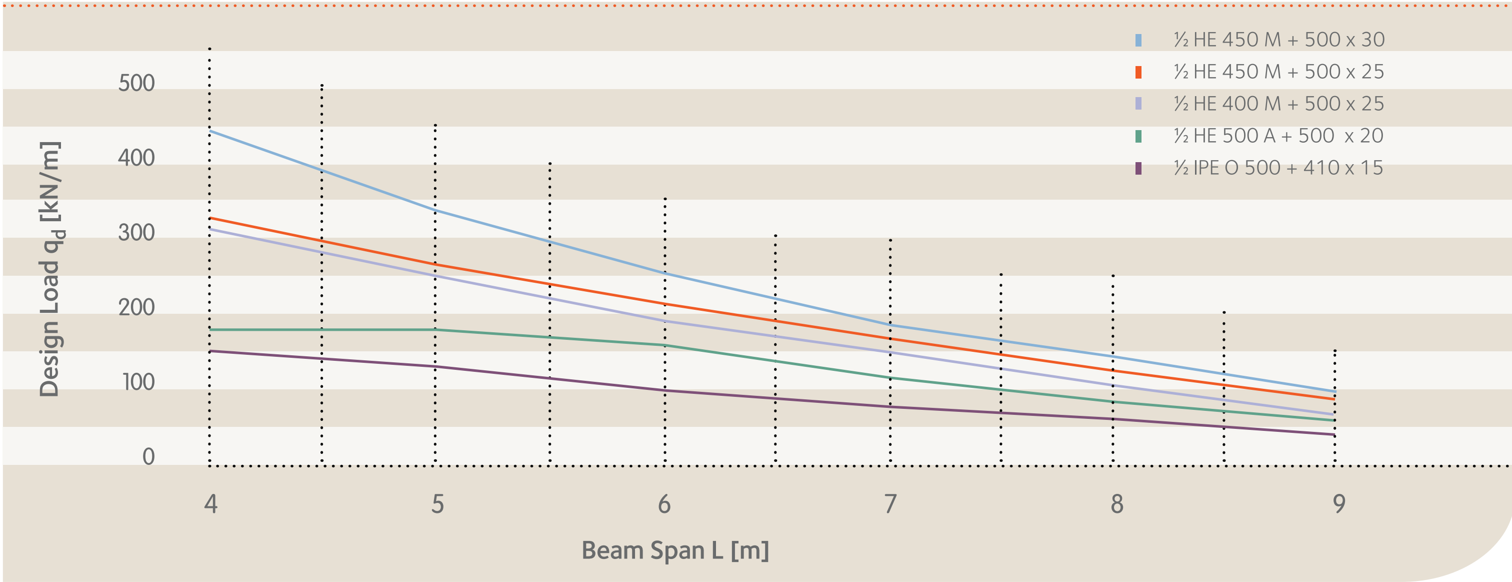
IFB – Slab thickness < 160 mm



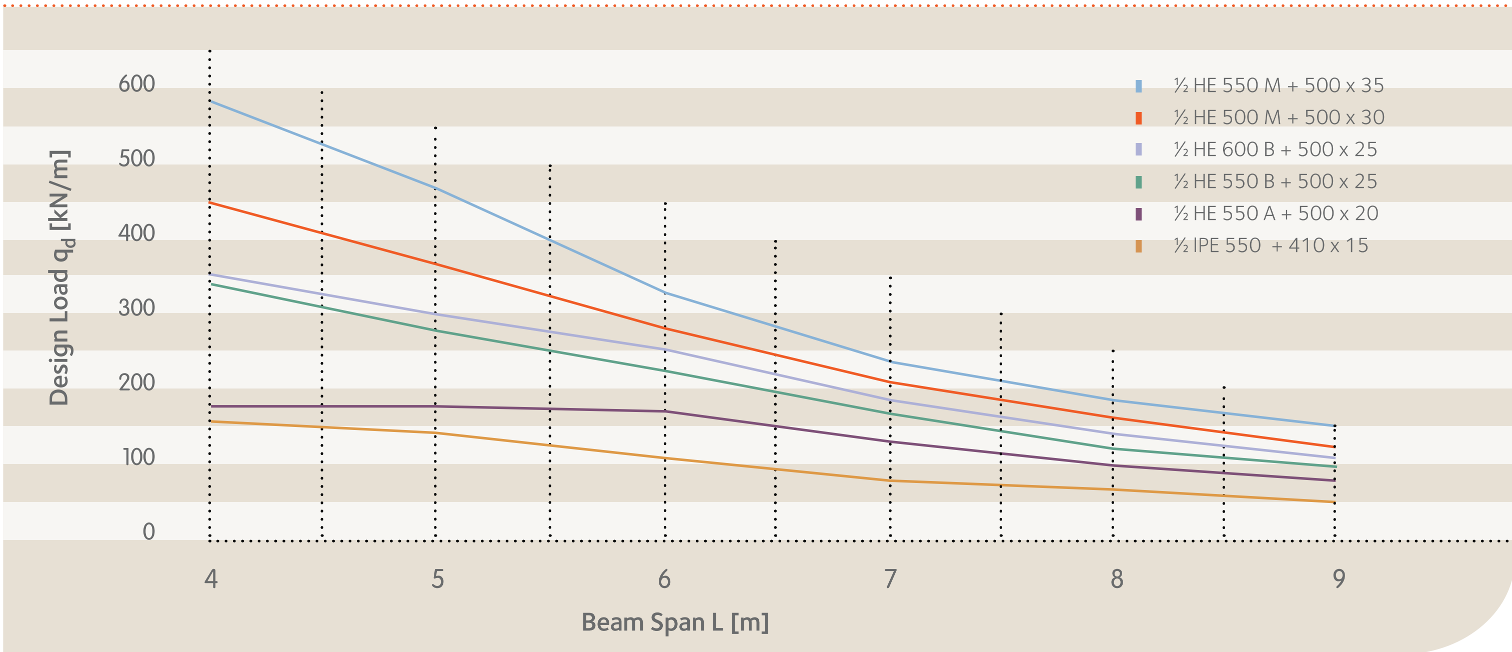
IFB – Slab thickness < 200 mm



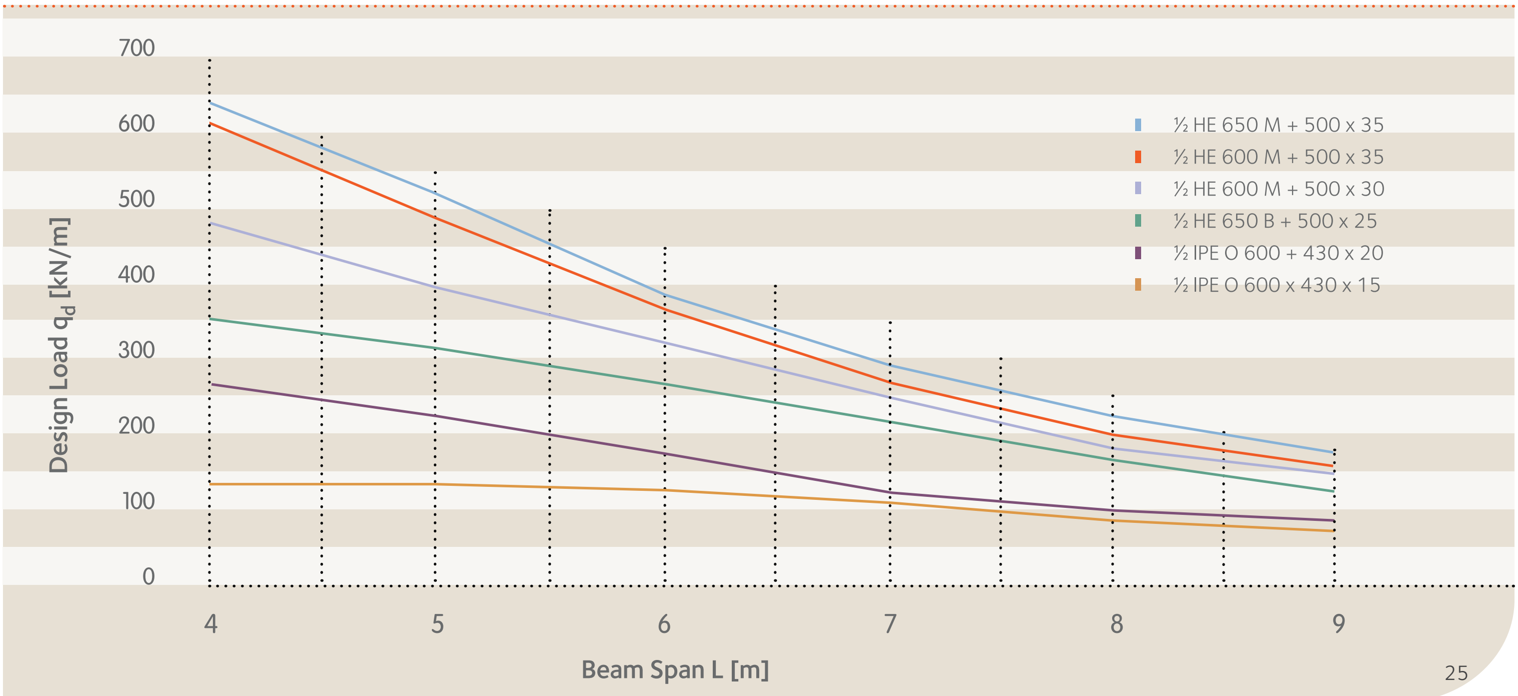
IFB – Slab thickness < 260 mm



IFB – Slab thickness < 300 mm



IFB – Slab thickness < 340 mm



8. SFB: Pre-design tables

Design parameters :

L Span of the SFB in meters

G Dead Load in kN/m^2

Q Live Load in kN/m^2

q_d Design load in kN/m

$q_d = 1,35 * \Sigma G_{i,K} + 1\ 5 * \Sigma Q_{i,K}$

Validity criteria :

- Steel Grade S355
- Simple supported beam
- Symmetrically loaded Beam
- Support length of the Cofradal® 200 slab elements = 50mm
- Load ratio G/Q ≈ 60/40
- Beam weight included in Dead Load G_i
- Deflection under Live Load Q ≤ L / 300
- Transverse deflection of the bottom flange ≤ 1,50mm
- Elastic-plastic design
- Ideal elastic-plastic material behaviour
- Global partial safety factor $\gamma_{M0} = 1,00$

Application example :

Prescribed

Grid:	7,0m x 7,0m
Live load Q:	2,5kN/m^2
Additional permanent load ΔG:	1,0kN/m^2
Slab thickness:	approximately 20cm

Users choice

SFB beam span:	7,0m
Prefabricated slab span:	7,0m (= beam distance)

Depth of the Cofradal® 200 prefabricated slabs: 20.0 cm (G_0 = 2,0kN/m^2)

Calculated

Line load from G:	$g_K = 7,0 * (2,0 + 1,0) = 21,0$ kN/m
Line load from Q:	$q_K = 7,0 * 2\ 5 = 17,5$ kN/m
Design load q_d:	$q_d = 1,35 * 21,0 + 1,5 * 17,5 = 54,6$ kN/m

Derived from the design table SFB-Slab < 200mm:

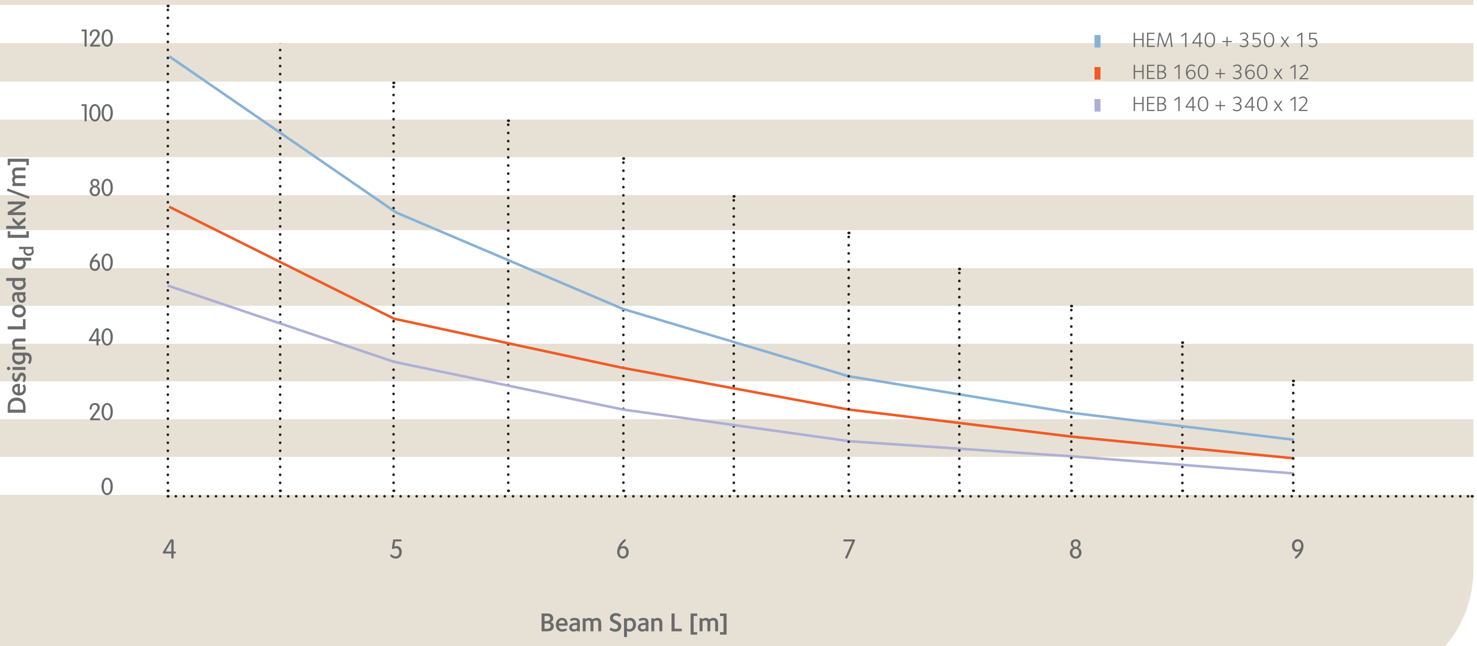
HEM 180 + 390 x 15 (g = 165,5kg/m)

N.B.: Please observe the minimum tonnage required for section delivery!
(The sections retained for diagram drawing are printed in **bold** characters!)

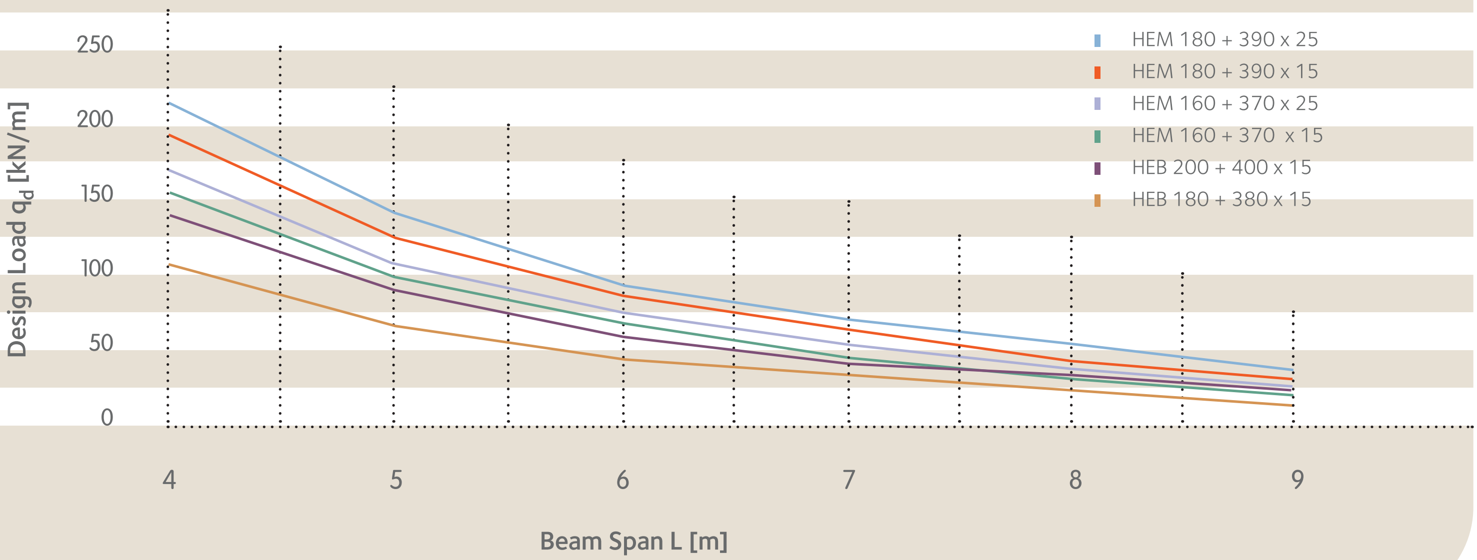
Section	Plate	G	h	b	t_w	t_f	r	A	I_y	W_y	y_1	y_2
	B x t	kg/m		mm	mm	mm	mm	cm^2	cm^4	cm^3	cm	cm
HEB 140	340 x 12	65,7	140,0	140,0	7,0	12,0	12,0	83,8	2723	254	4,9	10,3
HEM 140	350 x 15	104,5	160,0	146,0	13,0	22,0	12,0	133,1	5735	501	6,0	11,5
HEM 140	350 x 20	118,2	160,0	146,0	13,0	22,0	12,0	150,6	6349	521	5,8	12,2
HEB 160	360 x 12	72,0	160,0	160,0	8,0	13,0	15,0	97,5	4176	362	5,8	11,4
HEM 160	370 x 15	119,8	180,0	166,0	14,0	23,0	15,0	152,6	8466	675	7,0	12,5
HEM 160	370 x 20	134,3	180,0	166,0	14,0	23,0	15,0	171,1	9322	700	6,7	13,3
HEM 160	370 x 25	148,8	180,0	166,0	14,0	23,0	15,0	189,6	10123	723	6,5	14,0
HEB 180	380 x 15	96,0	180,0	180,0	8,5	14,0	15,0	122,3	6735	497	6,0	13,5
HEM 180	390 x 15	134,9	200,0	186,0	14,5	24,0	15,0	171,8	11952	875	7,8	13,7
HEM 180	390 x 20	150,2	200,0	186,0	14,5	24,0	15,0	191,3	13099	904	7,5	14,5
HEM 180	390 x 25	165,5	200,0	186,0	14,5	24,0	15,0	210,8	14166	932	7,3	15,2
HEB 200	400 x 15	108,4	200,0	200,0	9,0	15,0	18,0	138,1	9629	656	6,8	14,7
HEM 200	410 x 15	151,3	220,0	206,0	15,0	25,0	18,0	192,8	16434	1114	8,8	14,7
HEM 200	410 x 20	167,4	220,0	206,0	15,0	25,0	18,0	213,3	17936	1149	8,4	15,6
HEM 200	410 x 25	183,5	220,0	206,0	15,0	25,0	18,0	233,8	19331	1181	8,1	16,4
HEM 200	410 x 30	199,6	220,0	206,0	15,0	25,0	18,0	254,3	20655	1212	8,0	17,0
HEB 220	420 x 15	120,9	220,0	220,0	9,5	16,0	18,0	154,0	13243	838	7,7	15,8
HEB 220	420 x 20	137,4	220,0	220,0	9,5	16,0	18,0	175,0	14409	860	7,2	16,8
HEM 220	430 x 15	167,9	240,0	226,0	15,5	26,0	18,0	213,9	21936	1384	9,7	15,8
HEM 220	430 x 20	184,8	240,0	226,0	15,5	26,0	18,0	235,4	23853	1424	9,3	16,7
HEM 220	430 x 25	201,7	240,0	226,0	15,5	26,0	18,0	256,9	25632	1461	9,0	17,5
HEM 220	430 x 30	218,5	240,0	226,0	15,5	26,0	18,0	278,4	27313	1496	8,7	18,3
HEB 240	440 x 15	135,0	240,0	240,0	10,0	17,0	21,0	172,0	17885	1059	8,6	16,9
HEB 240	440 x 20	152,3	240,0	240,0	10,0	17,0	21,0	194,0	19415	1085	8,1	17,9
HEM 240	450 x 15	209,7	270,0	248,0	18,0	32,0	21,0	267,1	34545	2020	11,4	17,1
HEM 240	450 x 20	227,3	270,0	248,0	18,0	32,0	21,0	289,6	37362	2075	11,0	18,0
HEM 240	450 x 25	245,0	270,0	248,0	18,0	32,0	21,0	312,1	40002	2126	10,7	18,8
HEM 240	450 x 30	262,7	270,0	248,0	18,0	32,0	21,0	334,6	42511	2174	10,4	19,6
HEM 240	450 x 35	280,3	270,0	248,0	18,0	32,0	21,0	357,1	44924	2221	10,3	20,2
HEM 240	450 x 40	298,0	270,0	248,0	18,0	32,0	21,0	379,6	47269	2267	10,2	20,8
HEB 260	460 x 20	165,2	260,0	260,0	10,0	17,5	24,0	210,4	25098	1313	8,9	19,1
HEM 260	470 x 20	246,2	290,0	268,0	18,0	32,5	24,0	313,6	47156	2463	11,9	19,1
HEM 260	470 x 25	264,6	290,0	268,0	18,0	32,5	24,0	337,1	50359	2519	11,5	20,0
HEM 260	470 x 30	283,1	290,0	268,0	18,0	32,5	24,0	360,6	53398	2573	11,2	20,8
HEM 260	470 x 35	301,5	290,0	268,0	18,0	32,5	24,0	384,1	56313	2624	11,0	21,5
HEM 260	470 x 40	320,0	290,0	268,0	18,0	32,5	24,0	407,6	59136	2675	10,9	22,1
HEB 280	480 x 20	178,5	280,0	280,0	10,5	18,0	24,0	227,4	31783	1563	9,7	20,3
HEM 280	500 x 20	267,1	310,0	288,0	18,5	33,0	24,0	340,2	58806	2890	12,6	20,4
HEM 280	500 x 25	286,7	310,0	288,0	18,5	33,0	24,0	365,2	62682	2952	12,3	21,2
HEM 280	500 x 30	306,3	310,0	288,0	18,5	33,0	24,0	390,2	66348	3011	12,0	22,0
HEM 280	500 x 35	325,9	310,0	288,0	18,5	33,0	24,0	415,2	69854	3068	11,7	22,8
HEM 280	500 x 40	345,6	310,0	288,0	18,5	33,0	24,0	440,2	73238	3123	11,5	23,5
HEB 300	500 x 20	195,5	300,0	300,0	11,0	19,0	27,0	249,1	40526	1892	10,6	21,4
HEB 300	500 x 25	215,2	300,0	300,0	11,0	19,0	27,0	274,1	43190	1927	10,1	22,4
HEM 300	500 x 20	316,4	340,0	310,0	21,0	39,0	27,0	403,1	83596	3894	14,5	21,5
HEM 300	500 x 25	336,1	340,0	310,0	21,0	39,0	27,0	428,1	88742	3974	14,2	22,3
HEM 300	500 x 30	355,7	340,0	310,0	21,0	39,0	27,0	453,1	93655	4050	13,9	23,1
HEM 300	500 x 35	375,3	340,0	310,0	21,0	39,0	27,0	478,1	98383	4123	13,6	23,9
HEM 300	500 x 40	394,9	340,0	310,0	21,0	39,0	27,0	503,1	102965	4194	13,4	24,6
HEB 320	500 x 20	205,1	320,0	300,0	11,5	20,5	27,0	261,3	48693	2164	11,5	22,5
HEB 320	500 x 25	224,7	320,0	300,0	11,5	20,5	27,0	286,3	51841	2203	11,0	23,5

SFB

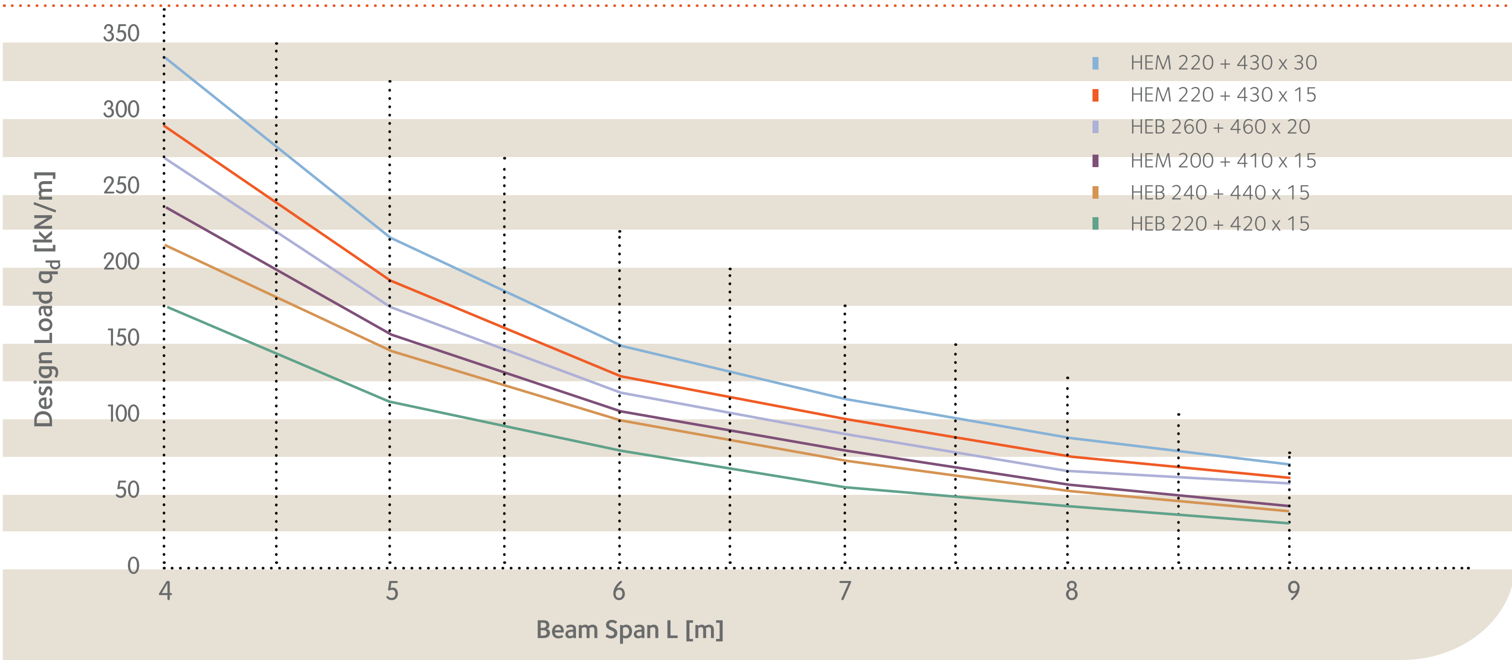
SFB – Slab thickness < 160mm



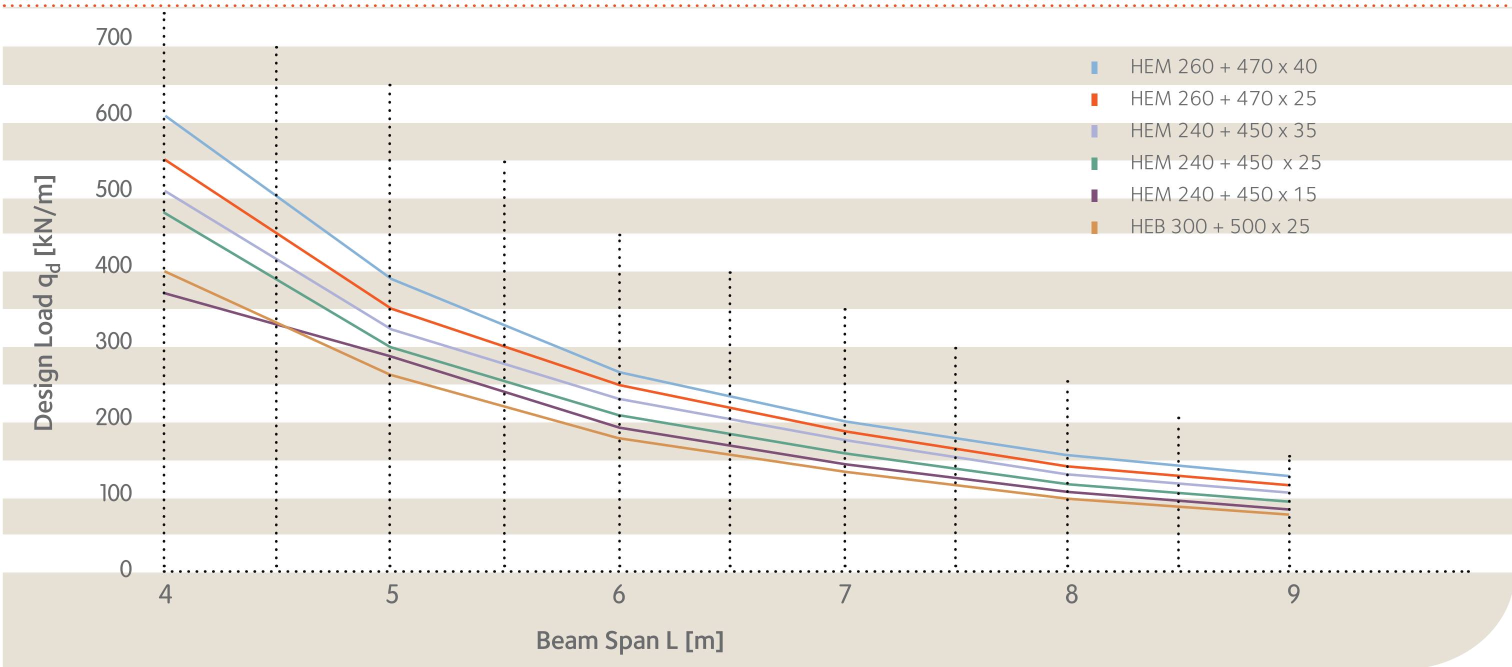
SFB – Slab thickness < 200mm



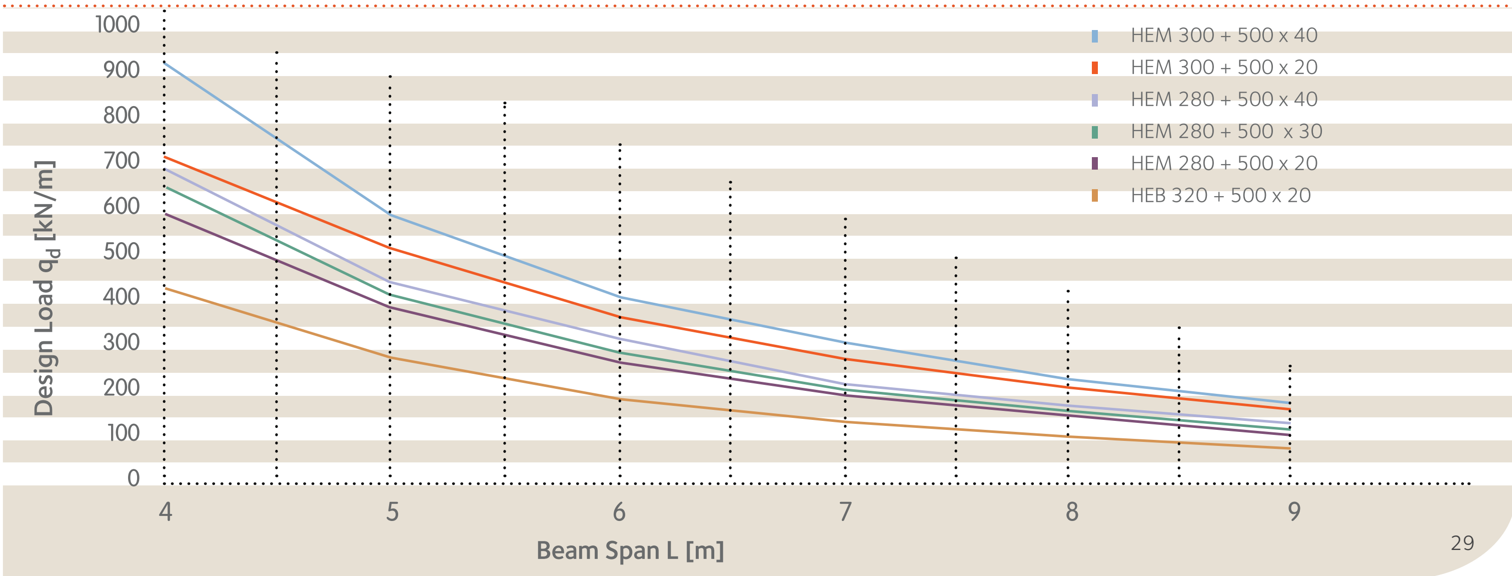
SFB – Slab thickness < 260 mm



SFB – Slab thickness < 300 mm



SFB – Slab thickness < 340 mm



9. CoSFB: Pre-design tables

Design parameters:

L	span of the CoSFB in meters
G	Dead Load in kN/m^2
Q	Live Load in kN/m^2
q_d	design load in kN/m
	$q_d = 1{,}35 * \Sigma\, G_{i,K} + 1{,}5 * \Sigma\, Q_{i,K}$

Validity criteria:

- Hot rolled section: Steel Grade S355 or S460; Lower plate: Steel Grade S355 or S460
- Simple supported beam
- Symmetrically loaded Beam
- Number of propping devices : 2
- Equally separated 2 props during construction phase ($Qc=0{,}75kN/m^2$)
- Dowel Shear Connection distance between dowels a_D = 125mm
- Support length of the slab element ≥50mm
- Concrete cover above the steel flange must not be lower than 50mm
- Beam weight included in Dead Load G_i
- Deflection under Live Load $Q_K \leq L / 300$
- Loads ratio G/Q was defined to be equal to 1,00 for the searching of the chart limit loads of ULS and SLS combinations. Real limit loads are not expected to differ from the loads in the charts, but slightly, if this factor is not equal to 1,00, but it should be checked for the particular case with the dedicated ArcelorMittal software.
- Elastic-plastic design
- Ideal elastic-plastic material behaviour
- Global partial safety factor γ_{m0}= 1,00
- Load combination for eigenfrequency: $q = 1{,}00 * \Sigma\, G_{i,K} + 0{,}20 * \Sigma\, Q_{i,K}$
- Natural Frequency of the beam with mass assumed to be distributed ≥ 2,60Hz
- The slab span a is assumed equal to 5m in the charts

Application example

prescribed:

grid:	10,0m x 8,1m
Live load Q:	$3{,}0kN/m^2$
Additional permanent load ΔG:	$1{,}2kN/m^2$
slab thickness:	approximately 36cm

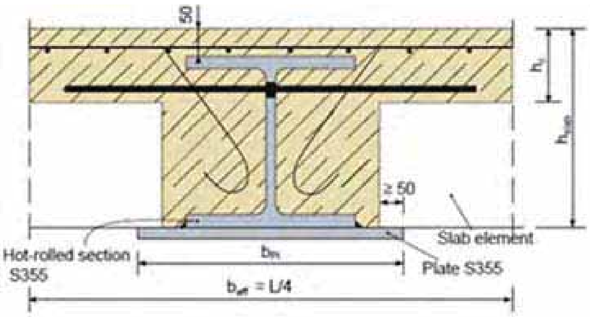
users choice:

steel grade:	S355
CoSFB span length L:	10,0m
slab span a:	8,1m (= beam distance)
Depth of the slab h_c:	14,0cm (Cofraplus 220 + 14cm concrete, $G_0 \sim 4{,}5kN/m^2$)
Self weight of the CoSFB:	$g_{CoSFB} \sim 3{,}0kN/m$ (assumption)

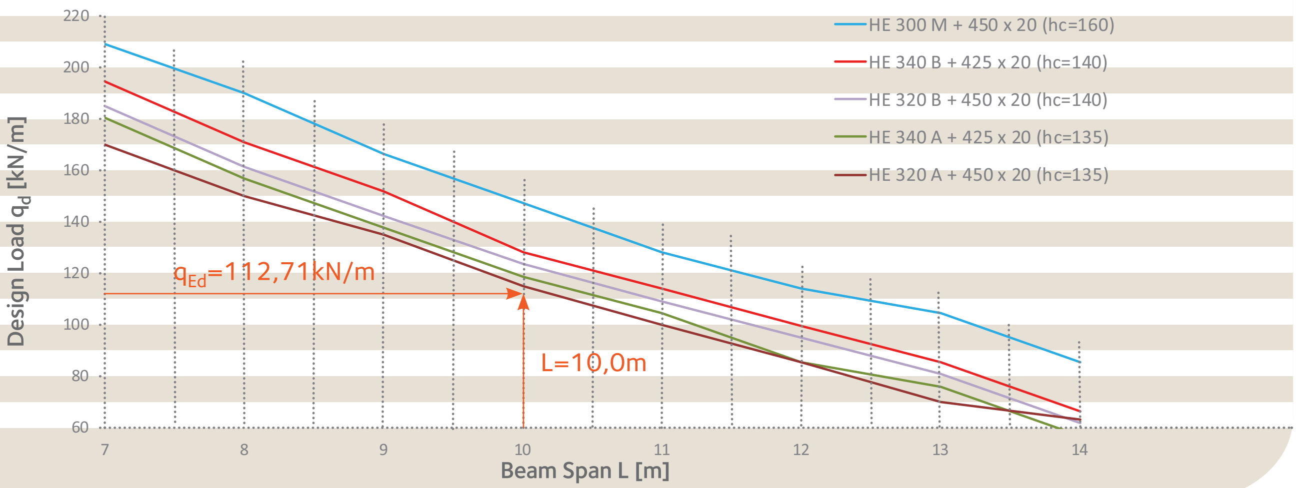
calculated

line load from ΣG:	$g_K = 8{,}1 * (1{,}1*4{,}5 + 1{,}2*1{,}1) + 3{,}0 = 53{,}79kN/m$
line load from Q:	$q_K = 8{,}1 * 1{,}1 * 3{,}0 = 26{,}73kN/m$
design load q_d:	$q_d = 1{,}35 * 53{,}79 + 1{,}5 * 26{,}73 = 112{,}7kN/m$

Note: 1.1 factor has been used for final stage loads allowing for the reaction value of loads at intermediate beams in continuous slabs.



CoSFB - 350mm ≤ Slab thickness ≤ 400mm - Steel S355



Derived from the design table

CoSFB - 350mm < Slab thickness ≤ 400mm - Steel S355

HE 320 A + 450 x 20 (h_c ≥ 135mm)

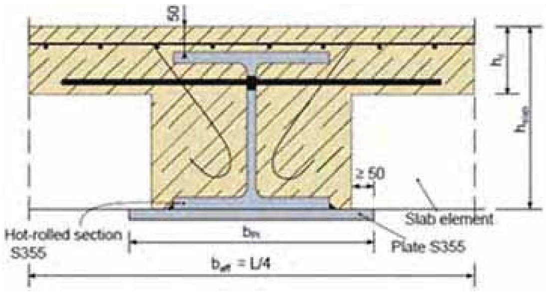
N.B.: Please observe the minimum tonnage required for section delivery!

Local deflection limit verifications are not included in the charts. The user needs to check them with the dedicated software or by other means. Plate deflection recommended limit is ≤ 1,5mm and bottom flange ≤ 0,2mm. The user has to check whether the deflections are acceptable according to the project requirements and to consider a pre-cambering if necessary. The Pre-design tables have been computed in consideration of a concrete cover above the steel flange equal to 50mm.

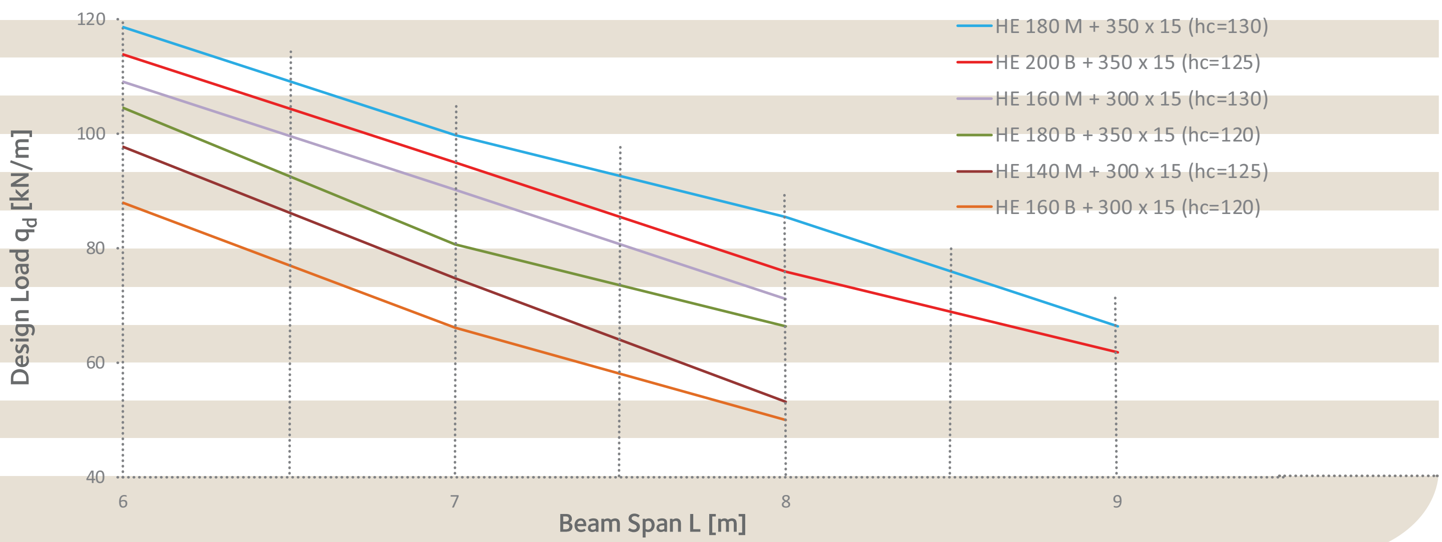
The application of the beams of these Pre-design tables to a particular case or project should be analysed in detail by the user to ensure that all the parameters are correctly considered. The Pre-design tables are a first estimation information of some typical cases that require further analysis by the user.

CoSFB

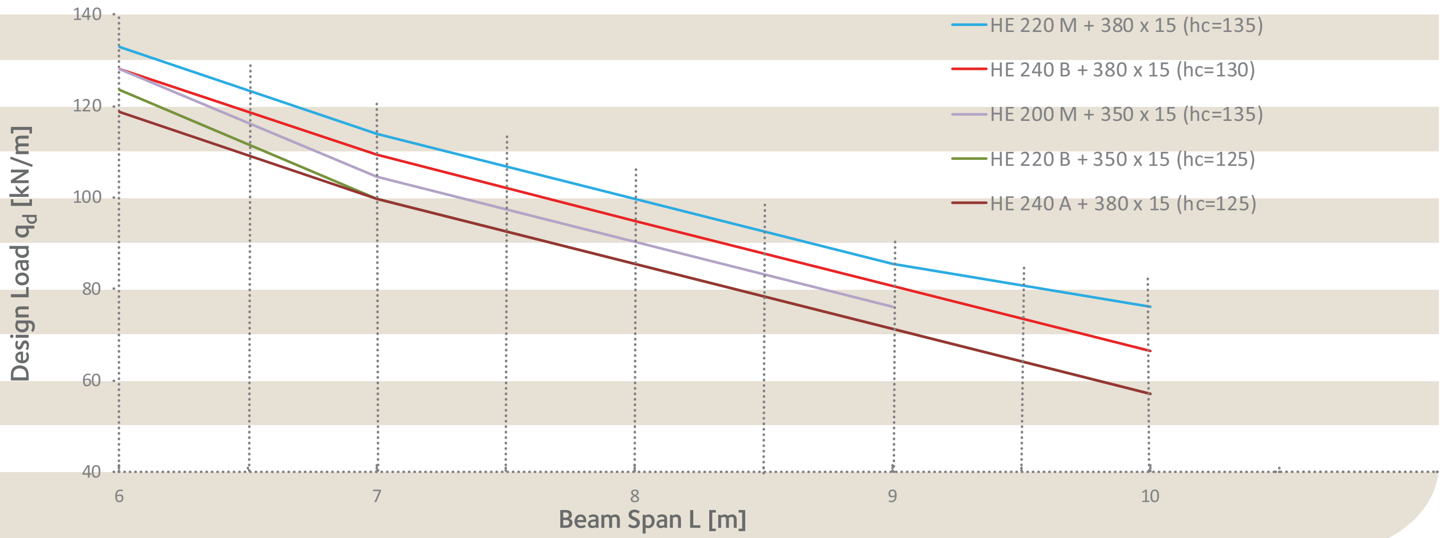
Steel S355



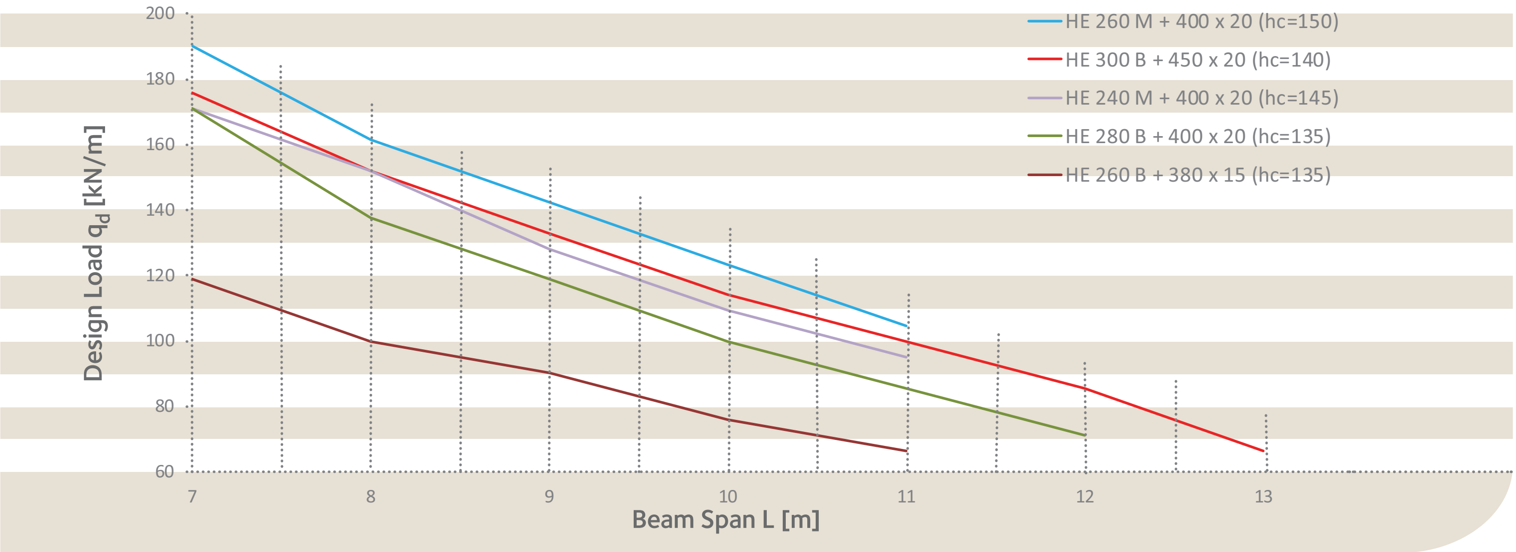
CoSFB – 200mm ≤ Slab thickness ≤ 250mm – Steel S355



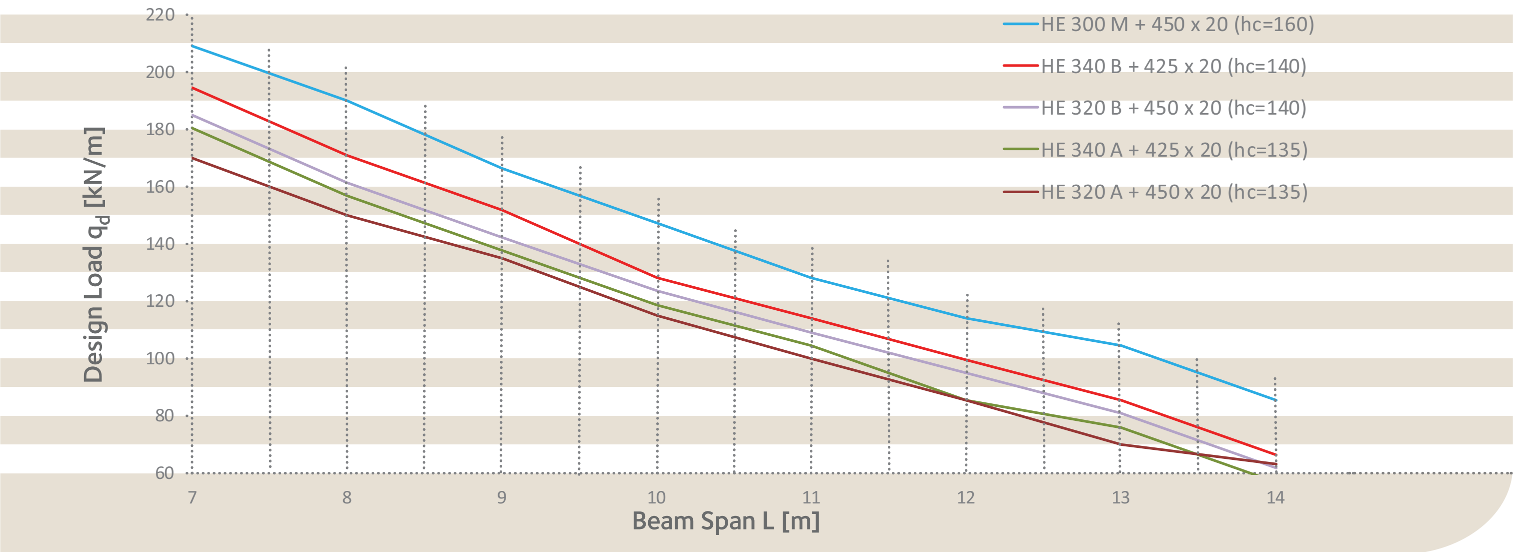
CoSFB – 250mm ≤ Slab thickness ≤ 300mm – Steel S355



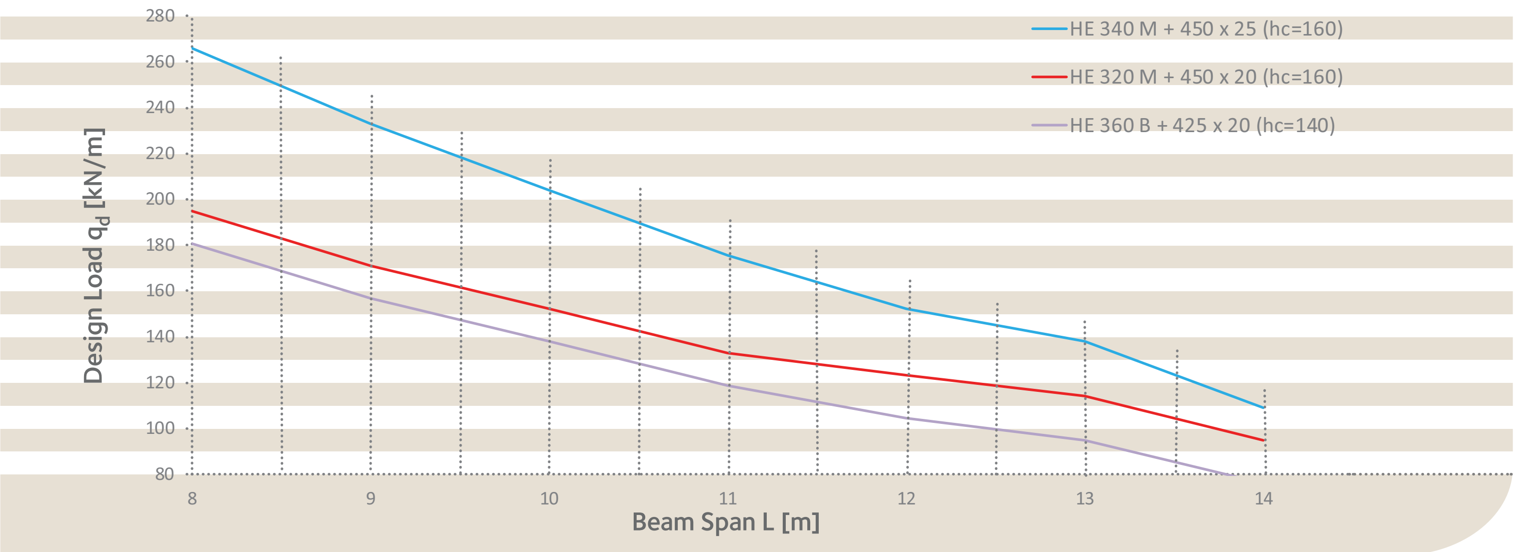
CoSFB – 300mm ≤ Slab thickness ≤ 350mm – Steel S355



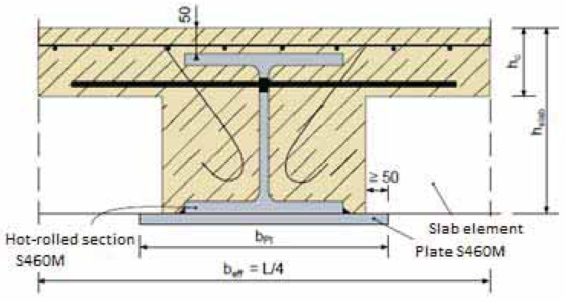
CoSFB – 350mm ≤ Slab thickness ≤ 400mm – Steel S355



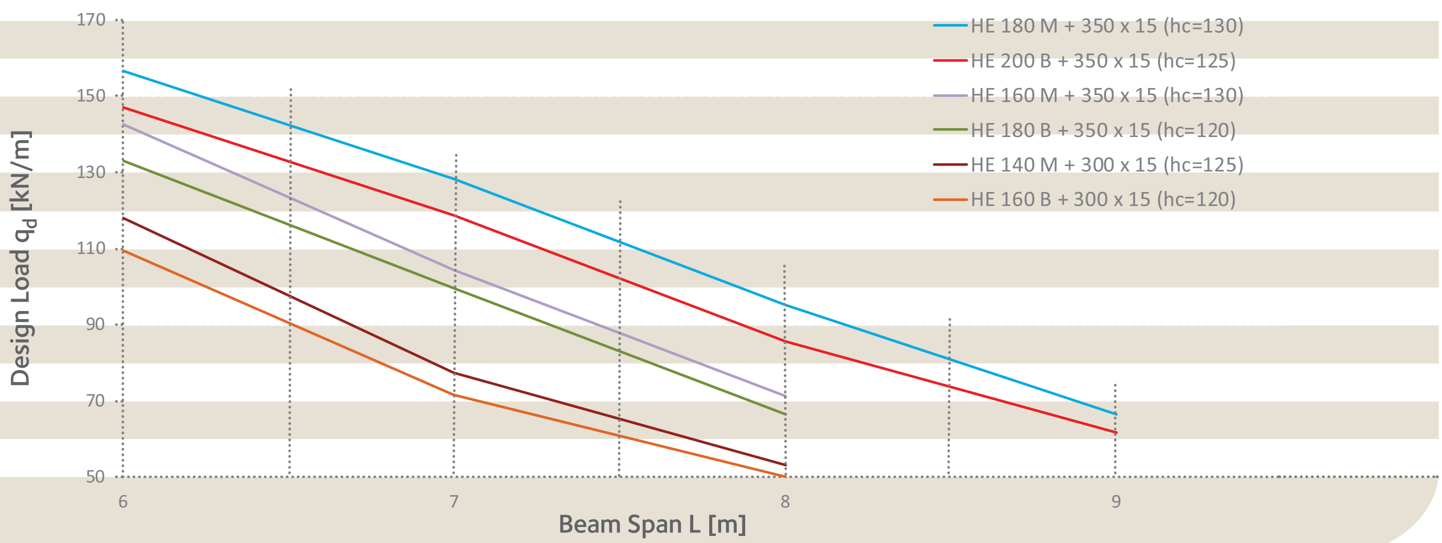
CoSFB – 400mm ≤ Slab thickness ≤ 450mm – Steel S355



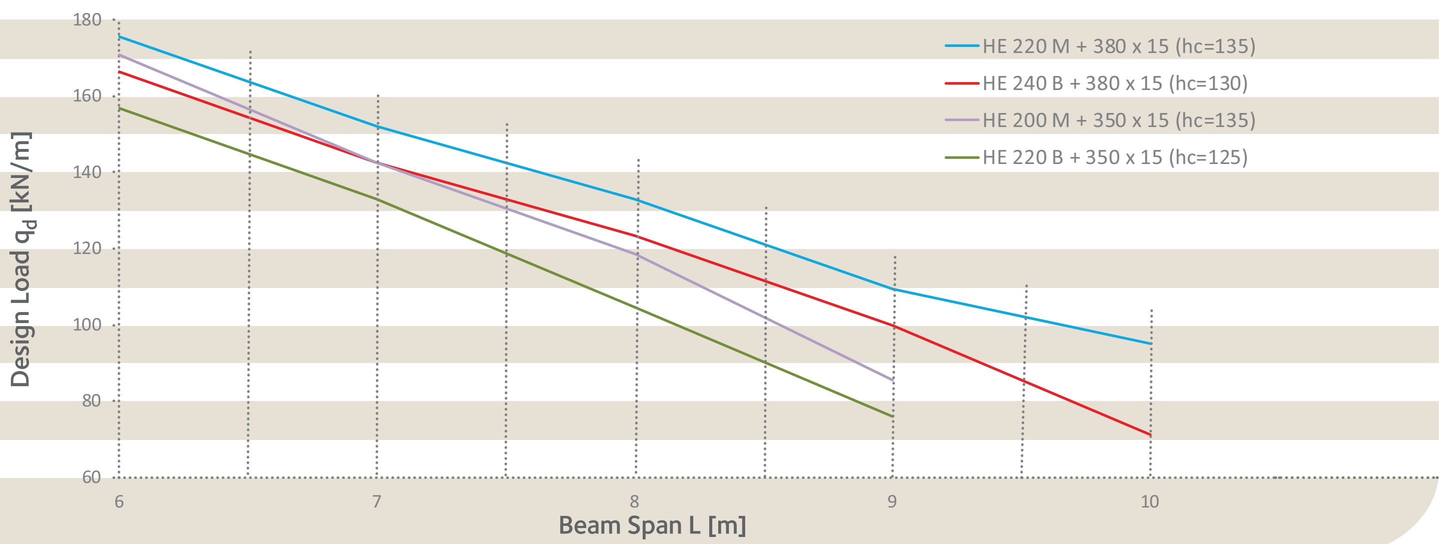
CoSFB



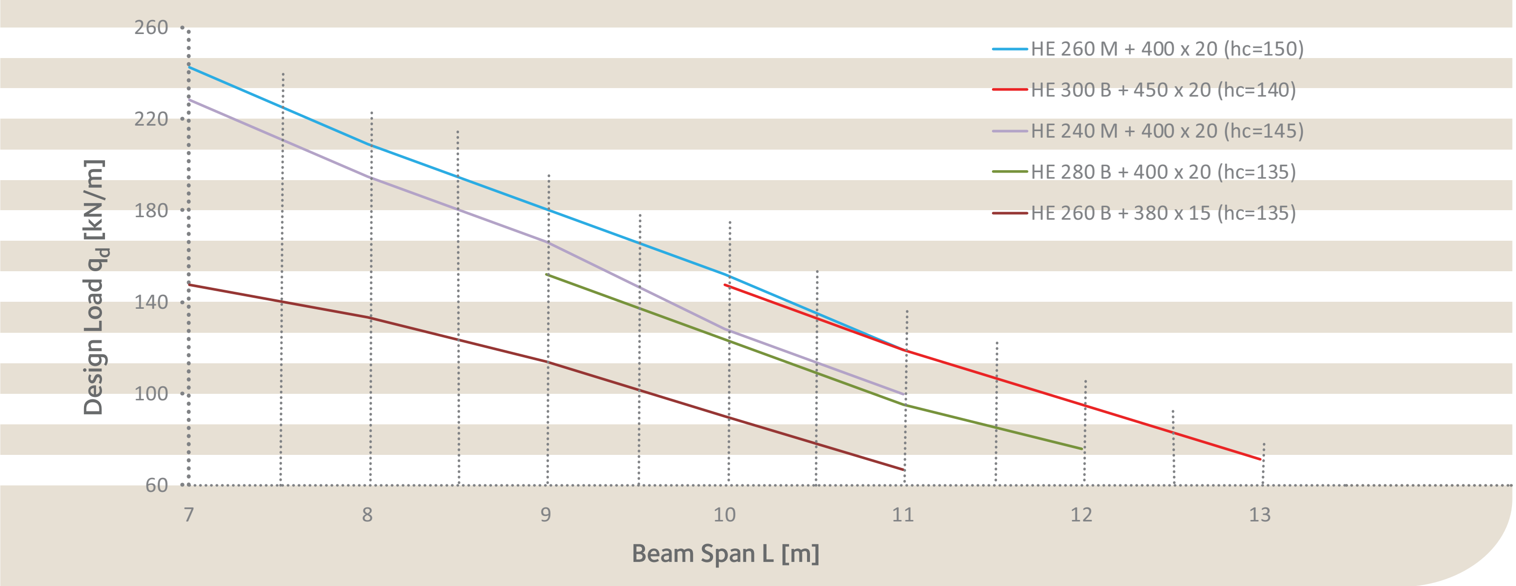
CoSFB - 200mm ≤ Slab thickness ≤ 250mm - Steel S460



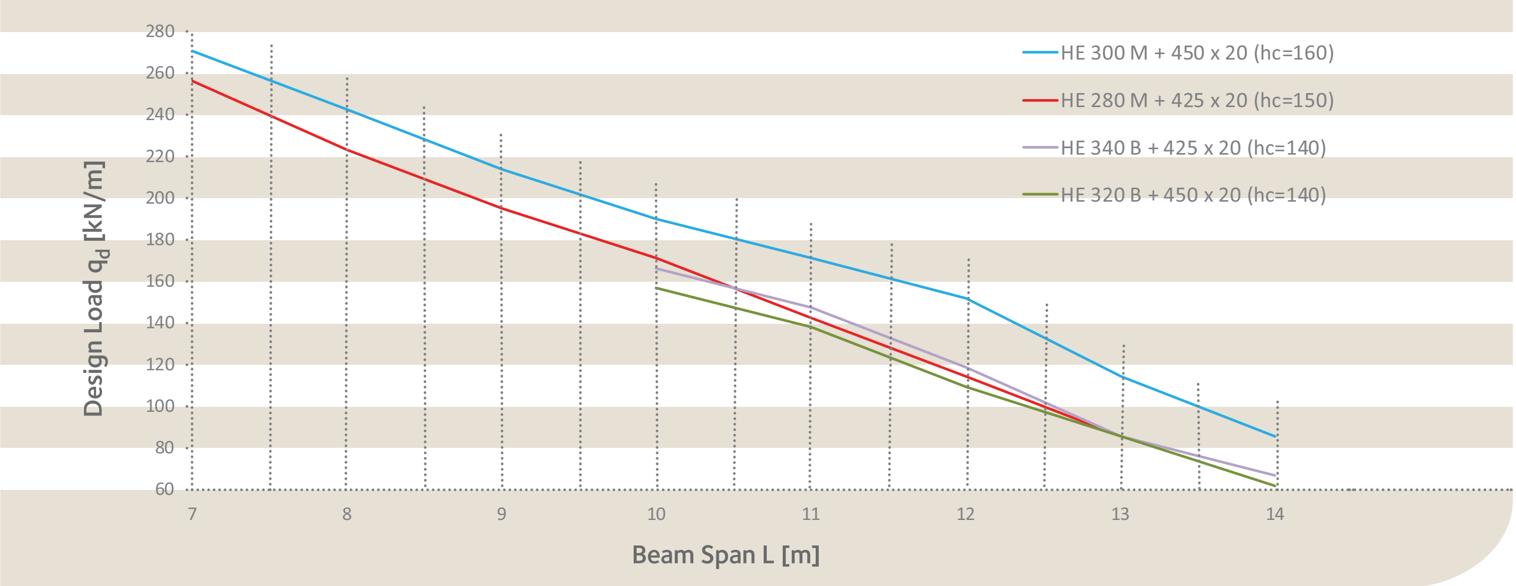
CoSFB - 250mm ≤ Slab thickness ≤ 300mm - Steel S460



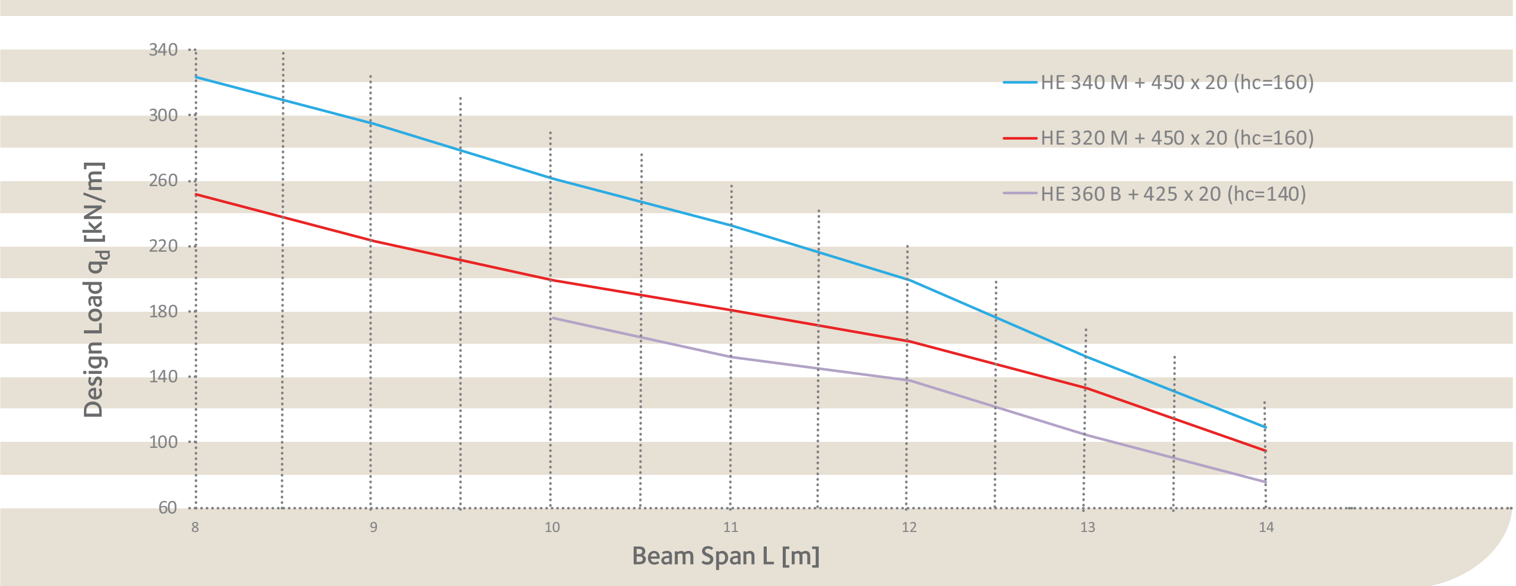
CoSFB - 300mm ≤ Slab thickness ≤ 350mm - Steel S460



CoSFB - 350mm ≤ Slab thickness ≤ 400mm - Steel S460



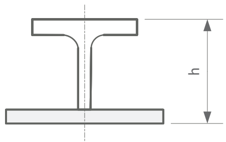
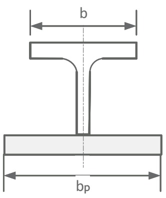
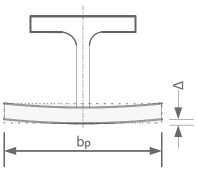
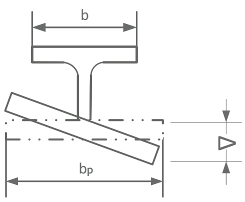
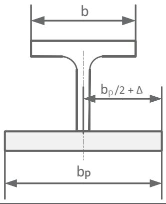
CoSFB - 400mm ≤ Slab thickness ≤ 450mm - Steel S460



10. Tolerances for Slim-Floor beams

IFB Type A

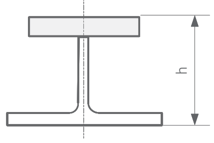
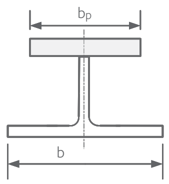
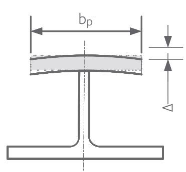
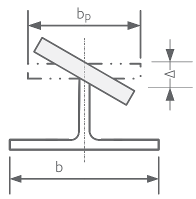
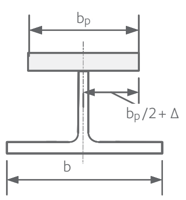
The tolerances related to the fabrication refer to EN 1090-2 and EN 10034.

	Description	EXC 2 $b_p / t_p \leq 30$ $a/t_w \leq 0.5$ max a = 6mm	EXC 3/ EXC 4 $b_p / t_p \leq 20$ $a/t_w \leq 0.5$ max a = 6mm
	Section height h	$\Delta = \pm 3$mm	$\Delta = \pm 2$mm
	Flange width b Lower plate width b_p	b according to EN 10034 General case $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert \geq 3$mm	b according to EN 10034 General case $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert \geq 2$mm
	Straightness of the welded plate	General case $\Delta = \pm b_p/150$mm but $\lvert\Delta\rvert \geq 3$mm	General case $\Delta = \pm b_p/150$mm but $\lvert\Delta\rvert \geq 2$mm
	Out-of-squareness	b according to EN 10034 General case for lower plate b_p : $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert \geq 5$mm	b according to EN 10034 General case for lower plate b_p : $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert \geq 5$mm
	Web off-centre	b according to EN 10034 General case $\Delta = \pm 5$mm	b according to EN 10034 General case $\Delta = \pm 5$mm

Different values of ratio b_p/t_p and fillet weld can be provided upon agreement only.

IFB Type B

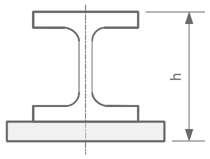
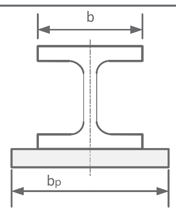
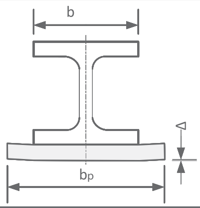
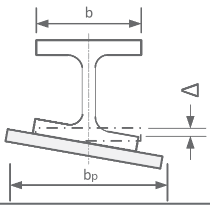
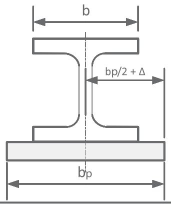
The tolerances related to the fabrication refer to EN 1090-2 and EN 10034.

	Description	EXC 2 $b_p / t_p \leq 30$ $a/t_w \leq 0.5$ max a = 6mm	EXC 3/ EXC 4 $b_p / t_p \leq 20$ $a/t_w \leq 0.5$ max a = 6mm
	Section height h	$\Delta = \pm 3$mm	$\Delta = \pm 2$mm
	Upper plate width b_p Flange width b	General case $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert$ 2mm b according to EN 10034	General case $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert \geq 2$mm b according to EN 10034
	Straightness of the welded plate	General case $\Delta = \pm b_p/150$mm but $\lvert\Delta\rvert \geq 3$mm	General case $\Delta = \pm b_p/150$mm but $\lvert\Delta\rvert \geq 2$mm
	Out-of-squareness	General case for upper plate bp : $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert \geq 5$mm b according to EN 10034	General case for upper plate bp : $\Delta = \pm b_p/100$mm but $\lvert\Delta\rvert \geq 5$mm b according to EN 10034
	Web off-centre	b according to EN 10034 General case $\Delta = \pm 5$mm	b according to EN 10034 General case $\Delta = \pm 5$mm

Different values of ratio b_p/t_p and fillet weld can be provided upon agreement only.

SFB

The tolerances related to the fabrication refer to EN 1090-2 and EN 10034.

	Description	EXC 2 $b_p / t_p \leq 30$ $a/t_w \leq 0.5$ max a = 6mm	EXC 3/ EXC 4 $b_p / t_p \leq 20$ $a/t_w \leq 0.5$ max a = 6mm
	Section height h	h: according to EN 10034 and EN 10029	h: according to EN 10034 and EN 10029
	Flange width b Lower plate width b_p	b according to EN 10034 General case $\Delta = \pm b_p/100$mm but $\|\Delta\| \geq 3$mm	b according to EN 10034 General case $\Delta = \pm b_p/100$mm but $\|\Delta\| \geq 2$mm
	Straightness of the welded plate	General case $\Delta = \pm b_p/150$mm but $\|\Delta\| \geq 3$mm	General case $\Delta = \pm b_p/150$mm but $\|\Delta\| \geq 2$mm
	Out-of-squareness	b according to EN 10034 General case for lower plate b_p : $\Delta = \pm b_p/100$mm max $\|\Delta\| \geq 6.5$mm (EN 10034)	b according to EN 10034 General case for lower plate b_p : $\Delta = \pm b_p/100$mm max $\|\Delta\| \geq 6.5$mm (EN 10034)
	Web off-centre	b according to EN 10034 General case $\Delta = \pm 5$mm	b according to EN 10034 General case $\Delta = \pm 5$mm

Different values of ratio b_p/t_p and fillet weld can be provided upon agreement only.

11. ArcelorMittal services

• Technical Advisory

ArcelorMittal provides you with technical advice to optimise the use of our products and solutions in your projects for free. The technical advice covers basic and elaborated concepts, counterproposals, predesigned of structural elements, construction details, assistance in value engineering, surface protection advisory, metallurgy, welding procedure and fire protection. Our specialists are ready to support your initiatives all over the world.

To facilitate the design of your projects, we also offer software and technical documentation that you can consult and download for free from our website:
sections.arcelormittal.com

Contact us at: **sections.tecom@arcelormittal.com**

• Beam Finishing Centre

As a complement to the technical capacities of its partners, ArcelorMittal is equipped with high-performance finishing tools and can provide a wide range of fabrication services, including the following:

- drilling of materials up to 140mm in thickness
- flame cutting
- T cut-outs
- notching
- cambering
- curving
- straightening
- cold sawing to exact length
- welding and fitting of studs
- shot blasting
- surface treatment

Contact us at: **cs.eurostructures@arcelormittal.com**

• Sales Network

Our sales network works closely with all ArcelorMittal mills. We provide you with a seamless interface with mills offering world-class products and services throughout the globe. You can find the complete list of our agencies on the next page and on our website.

• R&D

With 1 400 full-time researchers employed across the globe, our research centers are at the heart of developing new steel products and solutions. To keep us at the forefront of innovation in steelmaking and mining technology, ArcelorMittal has 12 research centers located in Europe and North America.

In 2016 we invested $239 million in R&D, with ≈40% of that money targeted on processes, ≈55% on products and solutions and 5% on exploratory research.

• ArcelorMittal in Construction

ArcelorMittal has also a website dedicated to a full range of products for the construction market (structures, façades, roofing, etc.): **constructalia.arcelormittal.com**

ArcelorMittal Commercial Sections

Headquarters

LUXEMBOURG
ArcelorMittal Commercial Sections
66, rue de Luxembourg
LU-4221 Esch sur Alzette
T : +352 5313 3010

SPAIN
ArcelorMittal Comercial Perfiles España S.L.
Ctr. Toledo. Km. 9,200
ES-28021 Madrid
T : +34 91 797 23 00

Sales agencies

AUSTRIA
ArcelorMittal Commercial Sections Austria GmbH
Vogelweiderstraße 66
AT-5020 Salzburg
T : +43 662 88 67 44

BELGIUM + THE NETHERLANDS
ArcelorMittal Commercial Netherlands B.V.
Eemhavenweg 70
NL-3089 KH Rotterdam
T : +31 (0)10 487 09 22

BOSNIA HERZEGOWINA
ArcelorMittal Zenica
Bulevar kralja Tvrtka, no. 17
BA-72000 Zenica
T : +384 32 467 268

BULGARIA
ArcelorMittal Commercial Long Bulgaria
26 Antim I str, office 6
BG-1303 Sofia
T : +359 287 09 028

CZECH REPUBLIC
ArcelorMittal Europe CZ s.r.o.
Francouzská 6167
CZ-708 00 Ostrava Poruba
T : +420 553 401 005

DENMARK
ArcelorMittal Commercial Long Denmark A/S
Artillerivej 90, stuen
DK-2300 Copenhagen S
T : +45 33 74 17 11

ESTONIA
ArcelorMittal Commercial Baltics OÜ
Roosikrantsi 2
EE-10119 Tallinn, Estonia
T : +372 51979170

FINLAND
ArcelorMittal Commercial Long Finland OY
Topeliuksenkatu 15
FI-00250 Helsinki
T : +358 9 74 222 460

FRANCE
ArcelorMittal Commercial Long France S.A.S.
Domaine de Pelus
16, Avenue de Pythagore
FR-33700 Merignac
T : +33 5 57 92 09 10

GERMANY
ArcelorMittal Commercial Long Deutschland GmbH
Gereonstraße 58
50670 Köln
T : +49 221 572 90

Augustenstraße 7
DE-70178 Stuttgart
T: +49 711 489 80 0

GREECE AND CYPRUS
ArcelorMittal Europe - Long Products
9, Karagiorga Saki Str
GR-16675 Glyfada Athens
T : +30 210 960 42 79

ITALY
ArcelorMittal Commercial Italy
Strada Torino 43
IT -10043 Orbassano (Torino)
T : +39 011 906 3931

NORWAY AND ICELAND
ArcelorMittal Commercial Long Norway A/S
Holmenveien 20,
NO-0374 Oslo
T : +47 22 83 78 20

POLAND
ArcelorMittal Commercial Long Poland
Al. Pilsudskiego 92
PL-41 308 Dabrowa Gornicza
T : +48 32 776 92 45

ROMANIA
ArcelorMittal Commercial Long Romania S.R.L.
7 9 Intrarea Tudor Stefan
2nd Floor, AP. 4
Sector 1, 011 655 Bucharest
T : +40 31 405 47 93

SWEDEN
ArcelorMittal Commercial Sweden AB
Västmannagatan 6
S-11124 Stockholm
T : +46 8 534 80 94 0

SWITZERLAND
ArcelorMittal Commercial Schweiz AG
Industriestrasse 19
CH-8112 Otelfingen
T : +41 56 437 16 70

TURKEY
ArcelorMittal CL Çelik Deş Ticaret A.Ş.
Esentepe Mah. Büyükdere Cad.
Metrocity A Blok 171/A Kat:16 - Şişli
TR-34394 Istanbul
T : +90 212 317 4980

UNITED KINGDOM
ArcelorMittal Commercial UK Ltd
3rd Floor, Fore 2
Huskisson Way, Shirley
Solihull B90 4SS - Great Britain
T : +44 121 713 6600

Services

Steligence® Fabrication Centre
Z.I. Gadderscheier
L-4984 Sanem
Tel.: +352 5313 3057
cs.eurostructures@arcelormittal.com

Find also your local agency at
sections.arcelormittal.com/About us.

sections.sales@arcelormittal.com