Lindab Construline ™

Lindab System Solutions – Floor

Dimensioning with assembly instructions

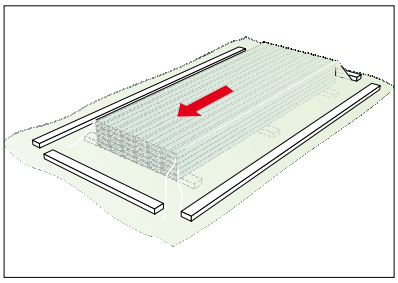
Floor system solutions

Before you start

The floor structure is designed with load bearing C-profiles at 600 centers. The C-profiles can have dimensions from 150 to 300 mm. Connections to walls are made with U-profiles or FSK60, same dimensions as corresponding C-profiles. A trapeze sheet, LLP20/0,6, is used as a secondary structure. On top of the trapeze sheet there are gypsum boards, the recommendation is one standard 13 mm and one floor board. For simpler designs it is possible to use fiber cement boards, hardboard or OSB-flooring boards. Acoustic clamps, LBY, are hanged on the lower flange lip of the C-profile to prevent sound transmission through the floor construction. Secondaries, S 25, are snapped to the LBY as support for a double standard gypsum board. In the cavity between C-profiles and secondaries there is a 30 mm rockwool board (minimum density of 25 kg/m^3).

Storage

The profiles are delivered in bundles. The bundles should be stored in a dry and clean place. If the bundles are stored outside they should be placed with a slope to let rainwater run off. The profiles should be protected from dirt and dust or brushed of before installation. Dirt and dust can effect the profiles with negative thermal conductivity performance and can also start to grow mould in the future.



The bundles can be stored on top of each other

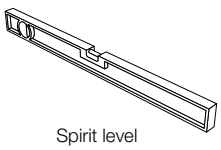
Cutting

The whole idea is to get a precut system and no cutting should be made on site. But, in case of on-site adjustments and need for a cut, use a nibbling machine.

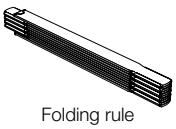
Fasteners

For all steel constructions you should use the right fasteners. By using fasteners from Lindab you will always be sure that they will work for the application and that they will be safe to use. For Lindab light gauge constructions up to 2x1,5 mm, however, there is a universal screw developed to connect the profiles in most applications, BPSK. The screw is a standard screw, using a PH2-bit (same as for gypsum boards) but with a flat head to avoid cracks on board materials. For heavier gauges or heavy loads there are screws with higher load bearing capacities – contact your local supplier for more information about fasteners for your application.

Tools

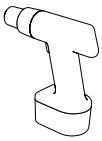


Spirit level



Folding rule

Pencil



Electric screw driver

Steel scissors

Floor system solutions

This guidance describes the Lindab floor structure. Lindab is not taking any responsibility for the design of the floor joists. By giving technical support and guidelines we share our knowledge with our customers. The use of this service does not make the designer free of responsibilities for the design.

Guidelines
Check points for floor joist design

STATICAL SYSTEM
Select C-profile, from span and load case the correct dimension can be found in tables in this chapter

SUPPORT REACTION
Check end support and mid support reactions. Reinforce if necessary.

FLOOR OPENINGS
Design lintels for the opening. Load case and geometry are input data.

WEBB HOLES
Check where the holes are wanted and if they are ok in these areas, reinforce I f necessary. For more complicated holes use DIMstud.

STRESSED SKIN DESIGN
Check floor for stressed skin design loads.

Technical assumptions
Cross section properties are derived according to StBK-N5. For design values safety class 3 is used ($_{\gamma n}$=1.2), and $_{\gamma m}$=1.0 according to StBK-N5 13:3.

Product	Yield point (fyk)	Design value (fyd)
C, FSK60	350 MPa	292 MPa
LLP 20/0.6	250 MPa	208 MPa
S25	250 MPa	208 MPa

The following section properties are calculated:

Moment of inertia for effective cross-section	I_{eff}
Section modulus for effective cross-section	W_{eff}
Horizontal distance between shear centre and web	e_s
Load carrying capacity, shear force	V_{Rd}
Load carrying capacity, support reactions	R_{Rd}
Load carrying capacity, axial force	N_{Rd}

Floor system solutions

Designing Lindab floor structures
Load tables for this chapter are valid under the following premises, load case safety factor 3.

- C-joists at 600mm centers.
- Both flanges of the C-joist supported.
- Dead load — Floor 0.8 – 1.2 kN/m^2; Partition walls 0.5 kN/m^2
- Load cases according to BKR 2003.
- Deflection limit set to L/400 for unfactored load.
- Maximum deflection for a point load of 1kN < 1.0mm in mid span
- Lowest frequency 12 Hz

Design load in ultimate limit state is calculated as:

Qd = 1.3 x load + dead load

Design load in serviceability limit state is calculated as:

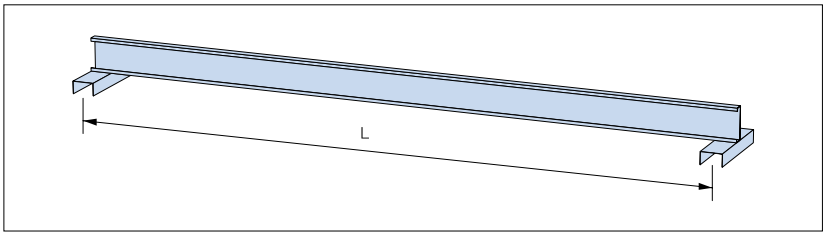
Qd = 1.0 x load + dead load

Support reactions have to be checked separately, especially important for double span designs.

Floor system solutions

Design load tables

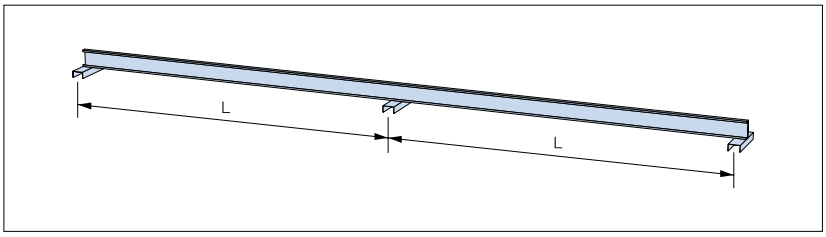
Load span tables below can be used to design actual floors depending on span and number of supports. Support reactions have to be checked separately and if they are not strong enough there have to be reinforced.



Single span *)

FLOOR JOIST		Load case 5:2	Load case 1	Load case 2	Load case 3	Load case 4
C150	1.5	3000	3000	3000	2800	2600
	2.0	3300	3300	3300	3000	2800
C200	1.2	3500	3500	3500	3000	2700
	1.5	3800	3800	3800	3500	3200
	2.0	4200	4200	4200	3800	3500
C250	2.0	5500	5500	5500	5000	4700
	2.5	5900	5900	5900	5400	5000
C300	2.5	7100	7100	7100	6500	6000
	3.0	7700	7700	7700	6900	6400

*) Support reactions must be checked separately



Double span *)

FLOOR JOIST		Load case 5:2	Load case 1	Load case 2	Load case 3	Load case 4
C150	1.5	3300	3300	3300	3000	2700
	2.0	3700	3700	3700	3600	3200
C200	1.2	3900	3800	3500	3200	2600
	1.5	4200	4200	4200	3500	3200
	2.0	4700	4700	4700	4200	3800
C250	2.0	6100	6100	6100	5400	4900
	2.5	6600	6600	6600	6400	5800
C300	2.5	7800	7800	7800	7300	6700
	3.0	8400	8400	8400	8400	8400

*) Support reactions must be checked separately

Floor system solutions

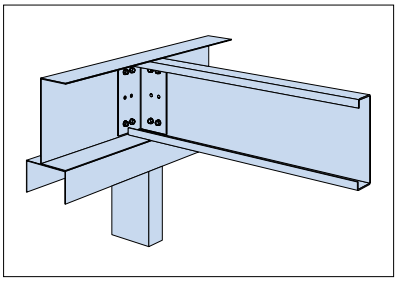
Support design

The connection between floor and wall can be made in different ways, the most commonly used and by Lindab recommended is a system were the floor joists are placed on top of the walls, see picture below. If the studs in the wall lines up with the C-joists and the studs from second floor, there is no need to do any specific calculations for that, if they don't line up the floor has to be reinforced and the FSK60 has to be designed for the combination of loads from walls and floor.

The other alternative is to hang up the floors in the walls. In this case there is no need to check the FSK60 for more than the loads from the floor.

Support reactions

	t [mm]	RRd [kN]
FSK60 150 / C 150	1.5	4.47
	2.0	7.51
FSK60 200 / C 200	1.2	3.00
	1.5	4.47
	2.0	7.51
	2.5	11.22
FSK60 250 / C250	2.0	7.51
	2.5	11.22
FSK60 300 / C300	2.5	11.22
	3.0	15.68



Values given in the tables are valid for the end support, if the support is placed more than 1,5x h (profile height) the values can be doubled. If the maximum support reaction is more than above, extra reinforcements have to be designed; this can be done by using VBY-angles. Quantity of screws is given in the table below.

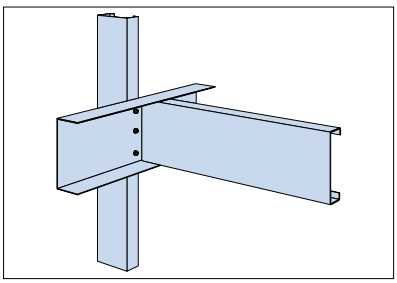
Design load for VBY

If the floor is hanged into the profiles the screws in the connection has to be designed with the values below. Support reaction / shear capacity per screw = number of screws.

Material thickness	No of screws 4.8mm			
	2	4	6	8
1.0	3.20	6.40	8.73	12.81
1.2	4.26	8.53	11.63	17.05
1.5	6.04	12.08	16.47	24.15
2.0	6.66	13.32	18.16	26.64
2.5	6.66	13.32	18.16	26.64
3.0	6.66	13.32	18.16	26.64

Connection floor to wall

Material thickness	Shear force / screw d=4.8mm
1.0	1.33
1.2	1.78
1.5	2.52
2.0	2.78
2.5	2.78
3.0	2.78



Floor system solutions

Mid support design

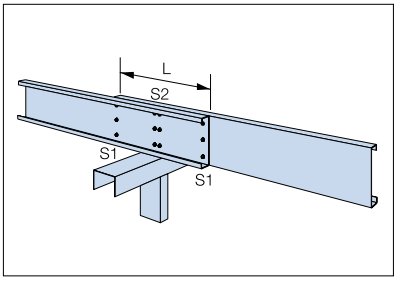
The mid support has to be checked for bending moment, shear force and support reaction. The load carrying wall has to have studs to line up just above and under the C-profiles. A local reinforcement of the C-profiles is very often necessary, it can be done by using an extra C-profile attached to the back of the C-profiles, see figure below. An alternative is to make an overlap connection over the support. Anyway, the reinforcement has to be checked for moment and support reaction. The quantity of screws and overlap lengths depending on reinforcement can be found below.

Mid support reaction

	t [mm]	RRd [kN]
FSK60 150 / C 150	1.5	8.94
	2.0	15.02
FSK60 200 / C 200	1.2	6.00
	1.5	8.94
	2.0	15.02
	2.5	22.44
FSK60 250 / C250	2.0	15.02
	2.5	22.44
FSK60 300 / C300	2.5	22.44
	3.0	31.36

Mid support overlap

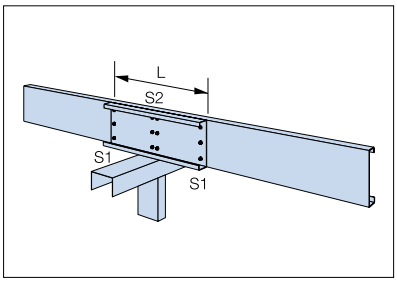
	t [mm]	4.8 mm & 5.5 mm		Overlap l [mm]
		S1	S2	
C150	1,50	3	6	450
	2,00	4	6	450
C200	1,20	2	6	600
	1,50	3	6	600
	2,00	4	6	600
C250	2,00	4	8	1000
	2,50	5	8	1000
C300	2,50	5	10	1500
	3,00	6	10	1500



Floor system solutions

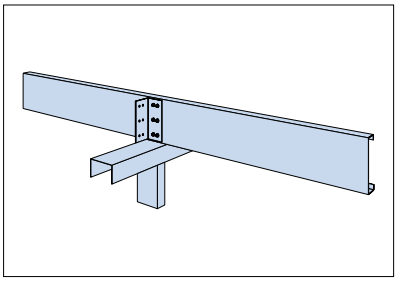
Mid support reinforcement

	t [mm]	4.8 mm & 5.5 mm		Overlap [mm]
		S1	S2	
C150	1,50	2	6	450
	2,00	2	6	450
C200	1,20	2	6	600
	1,50	2	6	600
	2,00	2	6	600
C250	2,00	2	8	750
	2,50	2	8	750
C300	2,50	2	10	900
	3,00	2	10	900



VBY for mid support

	t [mm]	4.8 mm & 5.5 mm
		S2
150	1,50	6
	2,00	6
C200	1,20	6
	1,50	6
	2,00	6
C250	2,00	8
	2,50	8
C300	2,50	10
	3,00	10



Support widths over 150 mm require two VBY.

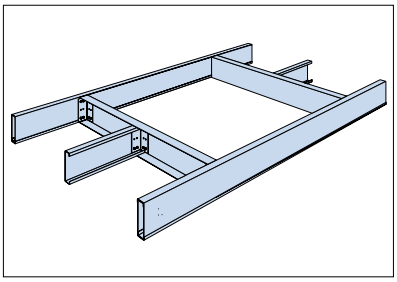
Floor system solutions

Lintel for openings

Openings in the floor can be made. The loads from the cut C-joists have to be transferred to the U-profiles, FSK60. The U-profiles has to be designed for the extra load (support reaction forces from the C-joists) and the C-joists aside must be reinforced to be able to handle the extra load from the cut C-joists. All the connections are done with VBY. Capacities for the VBY are presented below.

Design loads for VBY

Material thickness U-profile	No of screws diameter 4.8mm			
	2	4	6	8
1.0	3.20	6.40	8.73	12.81
1.2	4.26	8.53	11.63	17.05
1.5	6.04	12.08	16.47	24.15
2.0	6.66	13.32	18.16	26.64
2.5	6.66	13.32	18.16	26.64
3.0	6.66	13.32	18.16	26.64



Holes in C-joists

Web holes in the C-joists can be done without any extra checks if the diameter of the hole is less than _ of the profile height and the following conditions are checked:

- Smallest distance between holes and concentrated loads

  l > Span / 6

  l > 3 x Profile height

- Smallest centre distance between holes is more than 3d.
- Valid for circular holes in the neutral layer of the beam (i.e. close to the centre of the web)

Holes that are larger or not fulfill the above shall be checked in the software DIMstud for eventual reinforcements.

Floor system solutions

Stressed skin design

The floor can be designed as a stressed skin member if the trapeze sheet is properly fastened to the C and U-profiles. The floor can work as a beam if the width is less than 2/3 of the length. In the example given the bending moment can be transferred as an axial force into the U-profiles and shear force into the trapeze sheets if the fasteners are designed correct. Below you can find maximum axial force in the U-profiles and quantified screws for the trapeze sheets.

The following has to be checked:

- Trapeze sheet screwed in all side- and length overlap and support. Side lap screws are designed with help from the table below.
- Connection between floor and wall has to be designed for the wind loads to be transferred from the wall into the floor.
- Support reactions from the floor have to be transferred to stabilizing walls.
- U- and C-profiles has to be designed for the axial force. If they have a joint, the joint has to be designed as for the axial force, the joint has to be considered rigid in order not to affect the axial forces. Otherwise the floor has to be divided and designed as two separate floor-parts.
- Board width less than 2/3 of the length

Axial load in U-profiles *)

	t [mm]	NRd [kN]	Product	t [mm]	NRd [kN]
FSK60 150	1.5	31	C 150	1.5	73
	2.0	60		2.0	108
FSK60 200	1.2	14	C 200	1.2	48
	1.5	25		1.5	73
	2.0	50		2.0	110
FSK60 250	2.0	39	C250	2.0	133
	2.5	69		2.5	202
FSK60 300	2.5	57	C300	2.5	202
	3.0	93		3.0	286

Shear load

	Screw diameter	Screws per profile bottom		S_{Rd} [kN/m] t_{balk} = 1.2 mm	S_{Rd} [kN/m] t_{balk} = 1.5 mm	S_{Rd} [kN/m] t_{balk} > 1.5 mm
LLP20/0.6	4.8 mm	1	Every second	2.4	4.16	4.16
	4.8 mm	1	Every	4.79	8.32	8.32
	4.8 mm	2	Every	9.58	16.64	16.64
	5.5 mm	1	Every second	2.56	4.77	4.77
	5.5 mm	1	Every	5.13	9.53	9.53
	5.5 mm	2	Every	10.26	19.07	19.07
LLP20/0.7	4.8 mm	1	Every second	2.97	4.80	4.80
	4.8 mm	1	Every	5.94	9.60	9.60
	4.8 mm	2	Every	11.88	19.20	19.20
	5.5 mm	1	Every second	3.18	5.5	5.5
	5.5 mm	1	Every	6.36	11.0	11.0
	5.5 mm	2	Every	12.72	22.0	22.0

Floor system solutions

Sound reduction

If the details are made according to the solutions presented on the Web, the following sound performance can be achieved.

Airborne noise reduction R'w > 60 dB

Step noise reduction L'n,w < 55 dB

It is important to prevent vibrations to be transferred from one apartment to another, this can be done by using separated floors and apartment dividing walls.

Soft carpets gives better step noise reduction than hard floors of oak or ceramics.

Profile heights over 200 mm can give better values on both step and airborne noise reduction. To achieve the values above the LBY has to be used correctly.

Fire

By using two 15 mm fireboards and 30 mm rockwool in the cavity below the C-profiles REI 60 can be achieved. But since the floor is very often designed according to the deflection criteria the ultimate limit state usage is very low, and the extra capacity can sometimes allow a change from fire boards to standard gypsum. This has to be done in a separate fire design which can be performed by specialists in this area.

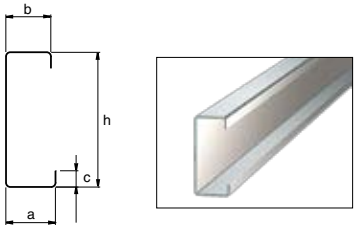
The home page offers a complete package of detailed drawings for the floor and connections to walls. See www.lindab.se/byggteknik (only Swedish details).

Floor system solutions

Components

C-profile

The C-profiles are the main load carrying structure and should be designed for the strength and deflection. Advanced designs can be made in the software DIM-stud.



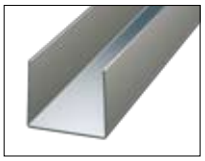
Cross section properties for C-purlins, both flanges supported
Note: All values calculated according to Swedish Code and STBK-N5.

Product	t [mm]	a	b	h	Ieff [10^4 mm^4]	Ibr [10^4 mm^4]	Weff [10^3 mm^3]	VRd [kN]	Allowable support reaction (L=55mm)		Md [kNm]
									Mid support	End support	
C70 (HU, SE)	0.70	47	41	70	7.00	8.90	1.69	3.60	2.20	1.10	0.59
	1.00	47	41	70	12.8	13.7	3.42	13.5	4.90	2.40	1.20
	1.50	47	41	70	20.6	20.6	5.80	23.3	6.90	3.40	2.03
C100 (HU, SE)	1.00	47	41	100	28.7	31.7	5.28	9.50	5.10	2.60	1.85
	1.20	47	41	100	37.6	38.2	7.36	15.3	7.20	3.60	2.58
	1.50	47	41	100	48.4	48.4	9.61	24.2	10.7	5.40	3.36
	2.00	47	41	100	63.7	63.7	12.7	43.8	18.0	9.00	4.45
C120 (HU, SE)	1.00	47	41	120	42.7	48.5	6.41	7.90	5.10	2.60	2.24
	1.20	47	41	120	56.3	58.5	9.00	14.1	7.20	3.60	3.15
	1.50	47	41	120	74.2	74.2	12.3	24.2	10.7	5.40	4.30
	2.00	47	41	120	98.0	98.0	16.3	43.8	18.0	9.00	5.70
C150 (HU, SE)	1.00	47	41	150	69.5	82.1	8.13	6.30	5.10	2.60	2.85
	1.20	47	41	150	91.9	99.1	11.4	11.3	7.20	3.60	3.99
	1.50	47	41	150	123	126	15.9	22.4	10.7	5.40	5.58
	2.00	47	41	150	166	166	22.1	43.8	18.0	9.00	7.74
	2.50	47	41	150	212	212	28.1	69.1	26.3	13.1	9.83
C200 (SE)	1.00	47	41	200	130	163	11.0	4.70	5.10	2.60	3.86
	1.20	47	41	200	173	197	15.5	8.50	7.20	3.60	5.41
	1.50	47	41	200	232	251	21.6	16.8	10.7	5.40	7.55
	2.00	47	41	200	325	333	31.6	41.0	18.0	9.00	11.1
C200 (HU)	1.00	74	66	200	152	217	12.0	4.70	4.90	2.40	4.21
	1.20	74	66	200	205	264	17.1	8.50	6.90	3.40	6.00
	1.50	74	66	200	288	331	25.7	16.8	10.4	5.20	8.98
	2.00	74	66	200	430	444	41.3	41.0	17.5	8.70	14.5
	2.50	74	66	200	556	556	55.1	69.1	26.3	13.1	19.3

Floor system solutions

Components

U-profiles



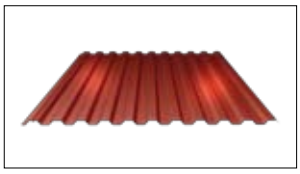
U-profiles connects the C-profiles and distributes the load over the supporting wall. Normally the U-profiles are selected in same dimension and thickness as the C-profile on the safe side but for more complicated cases analyzes can be made with the software DIMstud. U-profiles are coded differently due to different thicknesses and can have the article code KSK (t=1,0 in dimension 100/120/150/200), FSK 60 (t=1,5 in dimension 100/120/150/200) or U (all thicknesses and dimensions).

Type	Thickness mm	Width mm	Height mm	Min/Max Length mm	Mass kg/100m
KSK-100	1.0	100	50	1000/10500	144
U-100	1.2	100	60	1000/10500	188
FSK60-100	1.5	100	60	1000/10500	241
U-100	2.0	100	60	1000/10500	320
KSK-120	1.0	120	50	1000/10500	170
U-120	1.2	120	60	1000/10500	206
FSK60-120	1.5	120	60	1000/10500	264
U-120	2.0	120	60	1000/10500	350
KSK-150	1.0	150	50	1000/10500	192
U-150	1.2	150	60	1000/10500	233
FSK60-150	1.5	150	60	1000/10500	298
U-150	2.0	150	60	1000/10500	396
U-150	2.5	150	60	1000/10500	520
KSK-200	1.0	200	50	1000/10500	229
U-200	1.2	200	60	1000/10500	277
FSK60-200	1.5	200	60	1000/10500	355
U-200	2.0	200	60	1000/10500	472
U-200	2.5	200	60	1000/10500	608
U-200	3.0	200	60	1000/10500	742
U-250	1.5	250	60	1000/10500	393
U-250	2.0	250	60	1000/10500	524
U-250	2.5	250	60	1000/10500	655
U-250	3.0	250	60	1000/10500	787
U-300	1.5	300	60	1000/10500	490
U-300	2.0	300	60	1000/10500	653
U-300	2.5	300	60	1000/10500	816
U-300	3.0	300	60	1000/10500	980

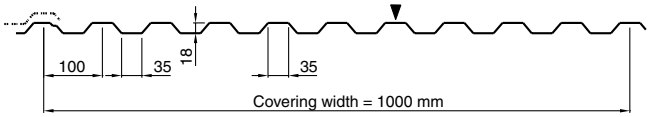
Floor system solutions

Components

LLP20, Profiled sheeting



The profiled sheeting is a support for the floor boards. Galvanized material in 0.6 or 0.7 depending on loads. Static design can be made in the software DIMroof.

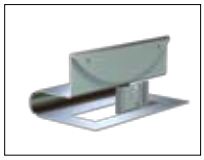


S, Secondary

Hat profile for ceilings

Type	Width mm	Height mm	Min/Max Length mm	Mass kg/100m
S-25	85	25	1000/8000	49
S-45	93	45	1000/8000	65

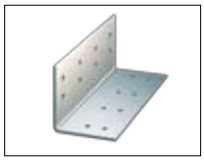
LBY, Acoustic clip



Connection clip between the C-profiles and the secondaries, S, reduces step noise through the floor. LBY should have a load of approximately 13 kg/clip – this corresponds to the weight of two standard gypsum boards and 30 mm of mineral wool, clips placed at centre distance 1200 mm (on every second c-purlin – alternate to distribute the load for all C-purlins) and at 600 mm centre between the secondaries.

Type	Thickness mm	Width mm	Height mm	Mass kg/100pcs
LBY	1.0	130	70	18

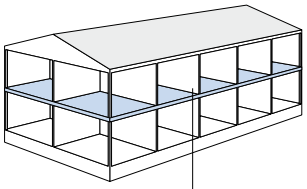
VBY, Bracket

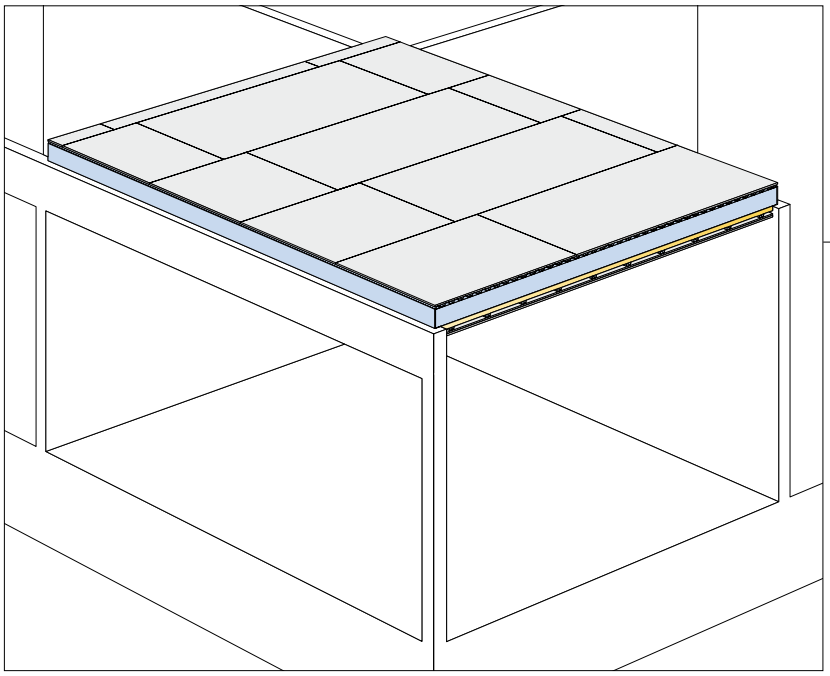


Reinforcement over supports and bracket in connection between C and U-profiles.

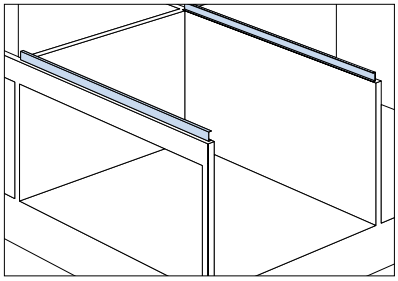
Type	Thickness mm	Width mm	Length mm	Mass kg/100pcs
VBY150	2.0	150	140	37
VBY200	2.0	200	190	51

Assembly – Floor system solutions

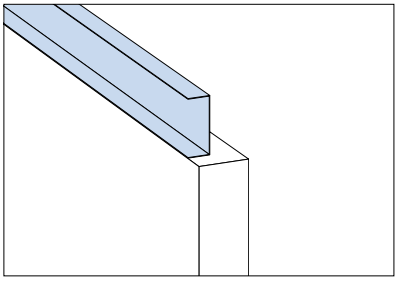




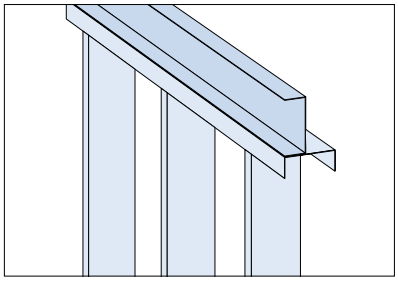
The runners



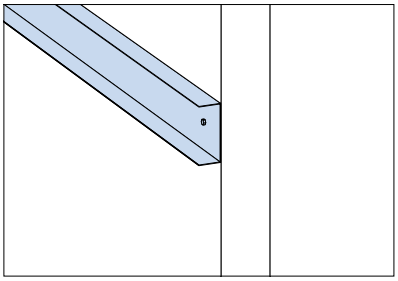
Assemble the reinforced runners FSK 60 on the walls



The FSK runners can be mounted directly on top of a concrete wall.



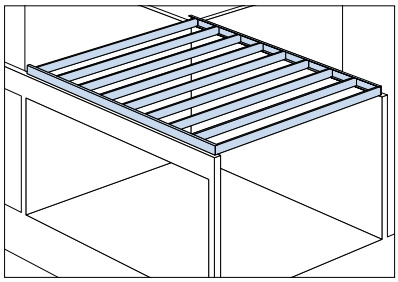
The FSK runners can also be mounted directly on top of a light weight steel wall.



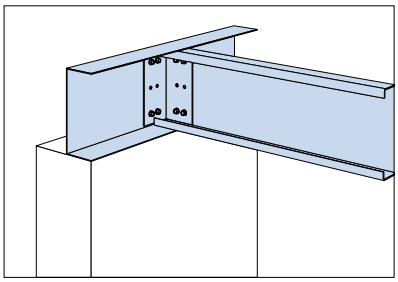
The FSK runner can also be mounted “hanging” on concrete or light weight steel wall.

Assembly – Floor system solutions

The c-purlins

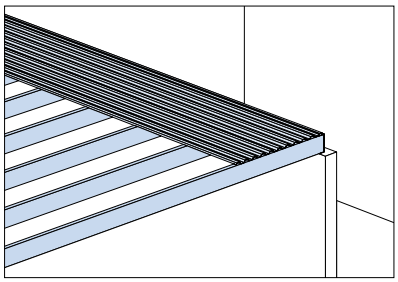


Assemble the C-purlins with the FSK 60 runners.

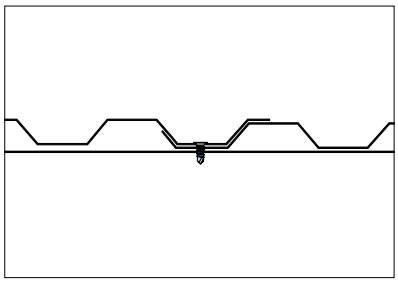


Connect the C-purlin to the runners by using VBY angle fitting.

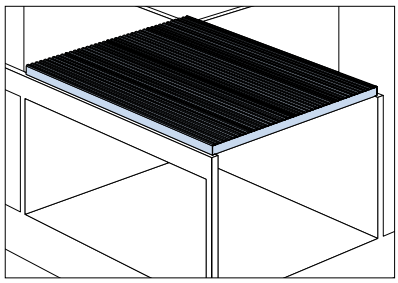
The floor



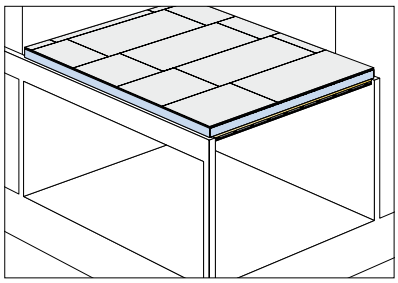
Fasten the profile sheeting LLP20 on top of the purlins.



Side overlap the profiled sheets according to figure. End overlap shall be minimum 100 mm over a C-purlin.

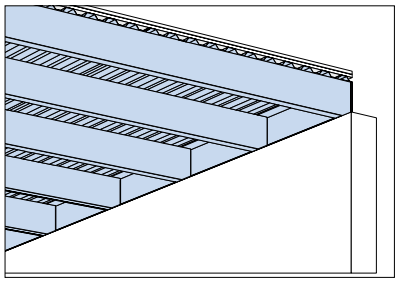


Complete the surface with the profile sheeting.

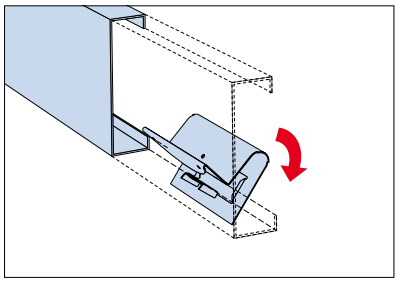


Assemble a board material on top of the profiled sheeting in two layers.

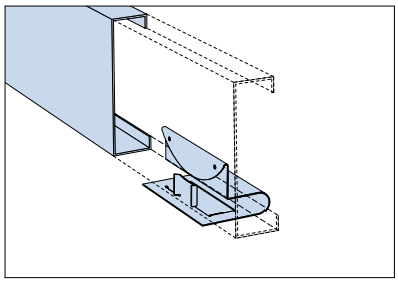
The ceiling

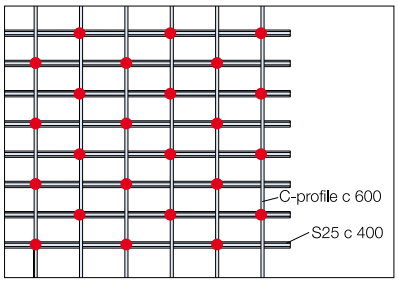


By using the acoustic clamp LBY on the C-purlins a hanging ceiling can be applied.

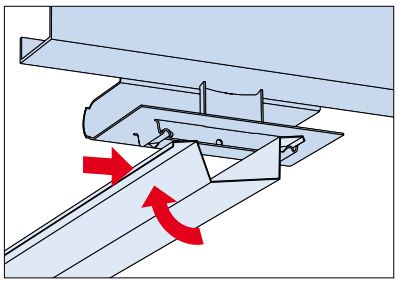


Snap the clamps into position on the C purlins.

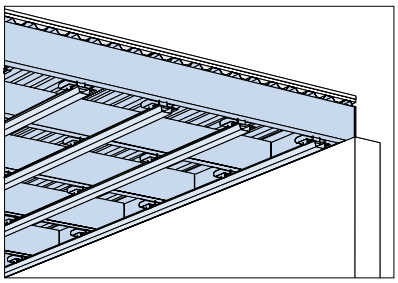




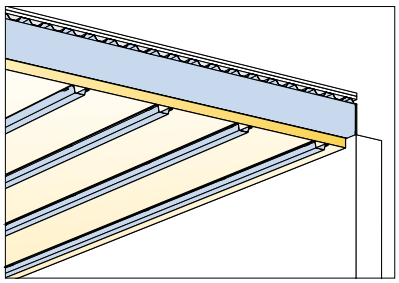
When fastening the LBY clamps on the C purlins. Use c/c 1200 mm across the C purlin and c/c 800 along the C purlins.



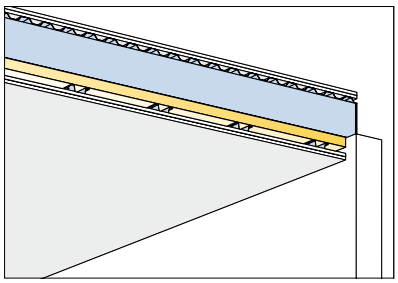
Snap the Secondary S25 into the clamps LBY.



Place the Secondary S25 with c/c 400 mm. Maximum 300 mm from the wall.



Insert insulation boards, 30 mm in the floor joist cavity.



Assemble the ceiling material. e.g gypsum board in two layers.

Lindab Profile is a business area within the Lindab Group that develops, manufactures, and markets efficient, economical and aesthetic steel and sheet-metal solutions for the building industry.

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Lindab Profile is represented in over 25 countries throughout Europe. Our head office is in Förslöv, in the south of Sweden.

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