ICC-ES Evaluation Report

ESR-4019

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DIVISION: 03 00 00—CONCRETE
Section: 03 15 00—Concrete Accessories

REPORT HOLDER:

SCHÖCK BAUTEILE GMBH

EVALUATION SUBJECT:

SCHÖCK ISOKORB LOAD BEARING THERMAL BREAK ASSEMBLIES

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015 *International Building Code®* (IBC)
- 2015 *International Residential Code®* (IRC)

Properties evaluated:

- Structural
- Fire resistance

2.0 USES

Schöck Isokorb Load Bearing Thermal Break Assemblies (LBTBAs) are insulated, load-bearing assemblies used to minimize thermal bridging when connecting external reinforced concrete balconies to internal reinforced concrete floor slabs and walls. Schöck Isokorb LBTBAs are intended to transfer bending moments, shear forces, or a combination of bending moments and shear forces.

3.0 DESCRIPTION

See TABLE 1 for description of the Schöck Isokorb LBTBA nomenclature.

3.1 Schöck Isokorb LBTBA

The Schöck Isokorb LBTBAs consists of an insulating layer of expanded polystyrene (EPS) with thickness of 80 mm (3.15 inches) or 120 mm (4.72 inches) depending on the type of LBTBA. Steel reinforcing bars pass through the EPS insulation and are retained in place by a nonstructural plastic rail. The LBTBAs depends on the internal forces transferred through the expansion joint. The Schöck Isokorb LBTBAs transmit forces to the adjacent reinforced concrete members by bond and surface pressure.

3.2 Isokorb Types

Scköck Isokorb LBTBAs are organized by the type of forces resisted, structural orientation and EPS insulation thickness.

3.2.1 CM, CK and K Types

The CM, CK and K types are used in cantilever reinforced concrete balconies to resist bending moments and shear forces, and consist of 80 mm (3.15 inches) or 120 mm (4.72 inches) thick EPS insulation, tension and shear steel reinforcing bars and concrete compression bearing (CCB) modules.

Separate tension and shear steel reinforcing bars are embedded in the concrete, and the CCB module bears against the reinforced concrete elements on either side of the expansion joint. The CM, CK and K types are used for connecting reinforced concrete slabs to reinforced concrete balconies under several conditions including connections between slabs with no step (CM, CK and K), with a step vertically up (CK-OD) to the balcony, or a step vertically down (CK-UD) to the balcony, and connections between reinforced concrete slabs and walls, with a wall above (CK-WA), and a wall below (CK-WU) respectively. See TABLE 1 for depictions of all types and TABLE 12 for dimensions and design parameters.

3.2.2 CQ, CQ-W, CQ-P and Q Types

The CQ, CQ-W, CQ-P and Q types are used to resist shear forces. They consist of steel shear reinforcing bars and concrete compression bearing modules, with EPS insulation thicknesses of 80 mm (3.15 inches) or 120 mm (4.72 inches). The shear reinforcing bars are embedded in the concrete and the concrete compression bearing modules (CCB) bear against the reinforced concrete on either side of the expansion joint. The CQ-P type contains shear steel reinforcing bars and a steel compression bearing (SCB) module in order to resist higher shear forces. See TABLE 1 for depictions of types CQ, CQ-W, CQ-P, and Q, and TABLE 13 and 14 for dimensions and design parameters.

3.2.3 CD and D Types

The CD and D types are used to resist both positive and negative bending moments and shear forces. The CD and D types consist of 80 mm (3.15 inches) or 120 mm (4.72 inches) thick EPS insulation, tension, shear and compression steel reinforcing bars, without concrete compression bearing (CCB) modules. All steel reinforcing bars are embedded in the concrete. See TABLE 1 for depictions of CD and D types and TABLE 13 for dimensions and design parameters.

3.2.4 K-F Type

The K-F type is used in precast reinforced concrete cantilever balconies to resist bending moments and shear forces. It consists of 80 mm (3.15 inches) or 120 mm (4.72 inches) thick EPS insulation, tension and shear steel reinforcement bars and concrete compression bearing (CCB) modules. The K-F type is provided in two components. The bottom component is precast into the reinforced concrete balcony bottom and consists of a CCB module and shear steel reinforcing bars. The top component consists of tension steel reinforcing bars which are connected to the top reinforcement in the reinforced concrete balcony and floor slab. Concrete poured at the project site completes the K-F type LBTBA balcony connection. See TABLE 1 for a depiction of K-F type and TABLE 12 for dimensions and design parameters.

3.2.5 CA Type

The CA type is used in reinforced concrete parapets to resist both positive and negative bending moments, shear forces and normal forces. It consists of 80 mm (3.15 inches) or 120 mm (4.72 inches) thick EPS insulation, tension, shear and compression steel reinforcing bars. All steel reinforcing bars are embedded in the concrete. See TABLE 1 for a depiction of CA type and TABLE 13 for dimensions and design parameters.

3.3 Materials

The Schöck Isokorb LBTBAs consist of the following component materials:

3.3.1 Compression Bearing Modules

3.3.1.1 Concrete Compression Bearing (CCB)

Concrete Compression Bearing (CCB) modules are fiber reinforced ultra-high performance concrete with a compressive strength as defined in TABLE 8 and TABLE 9. The end faces have a specific geometry to facilitate movement between the external reinforced concrete balcony and internal reinforced concrete floor slabs and walls. See FIGURE 2 - FIGURE 5 for depiction and dimensions of the CCB modules.

3.3.1.2 Steel Compression Bearing (SCB)

The Steel Compression Bearing (SCB) modules transmit compression forces via welded steel compression plates. This type of bearing is not used to transmit tensile forces. In the EPS insulation joint that is either 80 mm (3.15 inches) or 120 mm (4.72 inches) thick, and along a length of at least 50 mm (1.97 inches) within the adjacent reinforced concrete members, the SCB consist of stainless steel or stainless steel reinforcing bars. The steel compression plate is connected by welding with the compression reinforcing steel bars on the bearing side of the connected reinforced concrete members. The steel compression plate may be carbon steel or stainless steel. The SCB conforms with EN 10025-1 and EN 10025-2 or EN 10088-1. Headed bars used with the SCB module comply with ASTM A970. See FIGURE 8 for depiction of the SCB module, TABLE 3 for dimensions and TABLE 10 and TABLE 11 for yield strengths and design parameters.

3.3.2 Thermal Insulation Material

Thermal insulation material consists of Expanded Polystyrene (EPS) according to EN 13163, classified as Euro Class E according to EN 13501-1 and conforms with ASTM C578 Type II or VIII.

3.3.3 Steel Reinforcing Bars

Tension and compression steel reinforcing bars consist of a stainless steel reinforcing bar or a welded reinforcing bar connection, which is a combination of carbon steel reinforcing bars welded on each side of a stainless steel reinforcing bar. The stainless steel reinforcing bar is fixed within the EPS insulation joint 80 mm (3.15 inches) or 120 mm (4.72 inches), and along a length of at least 100 mm (3.94 inches) within the adjacent reinforced concrete elements. See TABLE 4 for depictions of tension and compression steel reinforcing bar configurations, and TABLE 5 for reinforcing bar diameter combinations and overlap lengths of tension and compression steel reinforcing bars.

Shear steel reinforcing bars consist of stainless steel reinforcing bars or a welded reinforcing bar connection, which is a combination of a carbon steel reinforcing bar welded on each side of a stainless steel reinforcing bar. The stainless steel reinforcing bar is fixed within the EPS insulating joint for a minimum length of 100 mm (3.94 inches). See TABLE 6 for depictions of shear steel reinforcing bar configurations, and TABLE 7 for dimensional variations of shear steel reinforcing bars.

3.3.3.1 Stainless Steel Reinforcing Bars

Stainless steel reinforcing bars comply with EN 10088-1 B500B NR / B500 NR or equivalent ASTM A955 with yield strength ≥ 500 N/mm² (72,519 psi) or stainless steel Grade S355/S460/S690 with yield strength ≥ /355/460/690 N/mm² (100,076 psi), material no. 1.4571 (S31635) or 1.4362 (S32304) or 1.4462 (S31803) or 1.4482 (S32001). Design values of reinforcing bar yield strengths are given in TABLE 10.

Compression load buckling capacities of compression steel reinforcing bars for use in design of Isokorb CD type connections must comply with TABLE 11.

3.3.3.2 Carbon Steel Reinforcing Bars

Carbon steel reinforcing bars comply with EN 1992-1-1 B500B or equivalent ASTM A615 / A706 with yield strength ≥ 500 N/mm² (72,519 psi). Design values of reinforcing bar yield strengths are given in TABLE 10.

3.3.3.3 Welded Reinforcing Bar Connections

Welded reinforcing bar connections are flash butt-welded using process 21, 24, or 25 according to EN ISO 17660-1, and comply with AWS D1.4/D1.4M Structural Welding Code-Reinforcing Steel and Section 1705.3.1 of the IBC. See TABLE 4 and 6 for steel reinforcement layouts for Schöck Isokorb LBTBAs.

3.3.4 Plastic Casings

Plastic casings are manufactured from polyvinylchloride (PVC) according to EN ISO 1163 (ASTM D1784) and are used to enclose and protect the EPS insulation and fire protection plates from impact damage. The plastic casing does not contribute to the load bearing capacity of the Isokorb LBTBA. Plastic shape casings of the CCB modules are manufactured from High Density Polyethylene or Polypropylene according to EN ISO 1873 (ASTM D5857).

3.3.5 Concrete

Normal weight concrete must comply with ACI 318 with a minimum compressive strength f'_c = 20 N/mm² (2,900 psi).

3.3.6 Fire Protection Plates

Fire protection plates on the top and bottom of the Schöck Isokorb LBTBAs are minimum 10 mm (0.39 inches) thick cement based mill boards or high temperature fiberboards, moisture repellent, weather and UV resistant panels, class A1 as per EN 13501-1 complying with fireblocking requirements of IBC Section 718.2.1.

4.0 DESIGN AND INSTALLATION

4.1 Design

Design of reinforced concrete floor slabs and reinforced concrete balconies must comply with ACI 318.

Structural analysis of the Schöck Isokorb LBTBAs must be performed using strut-and-tie models according to TABLE 15 **–** TABLE 17**.** LRFD design calculations for controlling limit states including bending moment, shear, tension and compression in steel reinforcement, and bearing resistance must be in accordance with TABLE 15 **–** TABLE 17.

Design calculations for bending deformations and rotation of the Schöck Isokorb LBTBA joints must be calculated in accordance with procedures noted in Section A.7.

Definitions of terms for design calculations and strut-and-tie models:

a_{CCB}	center distance of the CCB
$a_{CCB,cal}$	calculated center distance of the CCB
a_{cd}	Modification coefficient for CCB design
$A_{s,req}$	required steel reinforcement
b	length of the Schöck Isokorb LBTBA
b_{uz}	beam width
c_1	edge distance of the resultant loads
CC	clear cover (see cv)
c_{CCB}	concrete cover of CCB
c_{HO}	lateral nominal cover within the height offset or wall
$c_{nom,o}$	concrete cover of the steel reinforcing bars at the top
$c_{nom,s}$	concrete cover of the tension reinforcing bars
$c_{nom,u}$	concrete cover of the steel reinforcing bars at the bottom
cv	concrete cover of reinforcement of the slabs
D	applied compression force
d_{HB}	diameter of the horizontal reinforcing bar
d_{HO}	diameter of the stirrup
D_{Rd}	design value of transmissible compression force
$D_{Rd,c}$	design value of the load bearing capacity of the concrete edge per bearing pair
$D_{Rd,HTE}$	design value of the load bearing capacity of one HTE pair
$D_{Rd,n}$	design value of the transmissible compression force per bearing pair
$d_{s,1}$	diameter of the tension / compression reinforcing bars
$d_{s,2}$	diameter of the stainless steel part of the tension / compression reinforcing bars
d_{SB}	diameter of the shear reinforcing bar
e	horizontal distance between section I and j
f'_c	compressive strength of the concrete
$f_{ck,cube}$	characteristic cube resistance strength
$F_{Rd,u}$	design value of transmissible compression force of the concrete under partial surface load
f_y	yield stress of the reinforcing steel
f_{yd}	design value of yield strength for tension loads
h	element height
l_1	length of stainless steel
l_b	existing bond length
$l_{bd,IK}$	required bond length
M	applied moment
M_{Rd}	design value of transmissible bending moment
n_{CCB}	number of concrete compression bearings per meter
$N_{ki,d}$	design value of compression force for stainless steel
n_{SB}	number of shear bars per meter
n_{SCB}	number of steel compression bearings per meter
$R_{p,02}$	0.2% yield strength
t	insulation thickness
V_E	applied shear force
V_{Rd}	design value of transmissible shear force
x	distance from section I to design section j_B
y	distance from design section j_B and section j
Z	applied tensile force
z	inner lever arm
Z_{Rd}	design value of transmissible tensile force
Z_V	applied tensile force inside shear reinforcing bar
$Zv_{,Rd}$	design value of transmissible tensile force inside the shear reinforcing bars
α	angle of the shear reinforcing bars
α_{bd}	reduction factor for the lack of bond length
α_{SB}	angle of shear reinforcing bar
Δl_s	addition for overlap length

4.2 Fire resistance

Schöck Isokorb LBTBAs are classified by fire testing in conformance with EN 13501-2, EN 1363-1, EN 1365-2, EN 1366-4 and ASTM E119 as 2-hour fire resistance rated assemblies when installed with a minimum concrete slab thickness of 160 mm (6.3 inches), and steel reinforcing bar cover requirements in accordance with ACI 318 and Schöck Isokorb LBTBA installation instructions.

4.3 Installation

Schöck Isokorb LBTBAs must be installed in accordance with this evaluation report and the manufacturer's installation instructions.

If there is a conflict, the more restrictive requirements governs. IBC requirements for special inspection of steel reinforcement including Section 1705.1.1, Section 1705.3.1 and Table 1705.3 of the IBC must be followed.

5.0 CONDITIONS OF USE

The Schöck Isokorb LBTBAs described in this evaluation report comply with, or are a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Design of reinforced concrete floor slabs and balconies must comply with ACI 318.

5.2 Design and installation of the Schöck Isokorb LBTBAs must be in accordance with this evaluation report and the manufacturer's installation instructions. If there is a conflict, the more restrictive requirements governs.

5.3 Project site specific inspections must conform to Section 1705.1.1, Section 1705.3.1 and Table 1705.3 of the IBC and applicable portions of ACI 318 as noted in Table 1705.3 of the IBC, including specific requirements for the Schöck Isokorb LBTBAs.

5.4 The Schöck Isokorb LBTBAs may be used in structures assigned to Seismic Design Categories (SDC) A – F, but are not part of seismic force-resisting systems.

5.5 Dynamic actions causing fatigue are outside the scope of this evaluation report.

5.6 Thermal resistance is outside the scope of this evaluation report.

5.7 Impact sound insulation properties are outside the scope of this evaluation report.

5.8 Complete construction documents, including plans and calculations verifying compliance with this evaluation report, must be submitted to the code official for each project at the time of permit application. The construction documents and calculations must be prepared and sealed by a registered design professional.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with ICC-ES Acceptance Criteria for Load Bearing Thermal Break Assemblies Installed Between Concrete Balconies and Concrete Floors (AC464), approved June 2017.

6.2 Data in accordance with ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12), approved June 2015 (editorially revised October 2017).

7.0 IDENTIFICATION

7.1 Schöck Isokorb LBTBA product packaging includes the product name and nomenclature, the evaluation report number (ESR-4019), and the Schöck Isokorb name or identifying mark. the Schöck Isokorb LBTBA shipment pallet also includes a label with the steel reinforcing bar lot numbers used in manufacture of the Schöck Isokorb LBTBAs on the pallet**.**

7.2 The report holder's contact information is the following:

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www.schoeck.com

A.0 APPENDIX – TABLE OF CONTENTS

A.1 SCHÖCK ISOKORB LBTBA TYPE OVERVIEW

TABLE 1—SCHÖCK ISOKORB LBTBA TYPE OVERVIEW

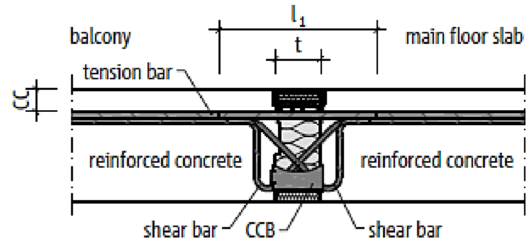
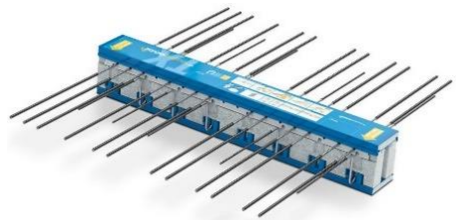
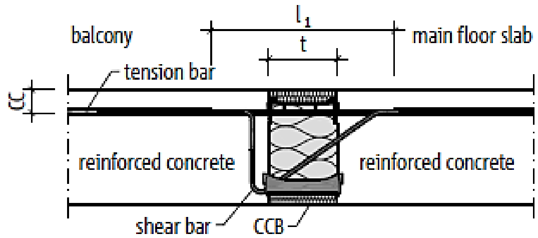
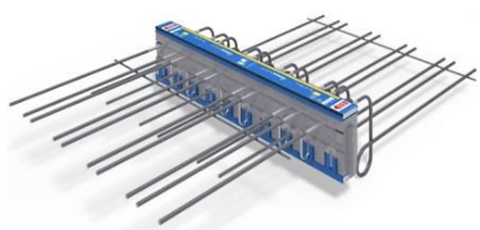
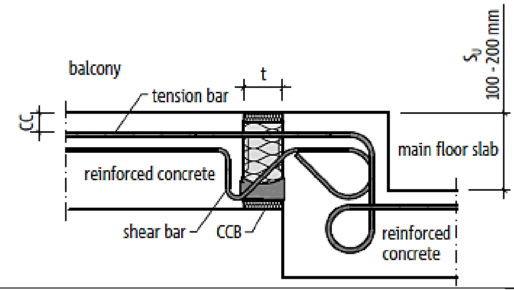
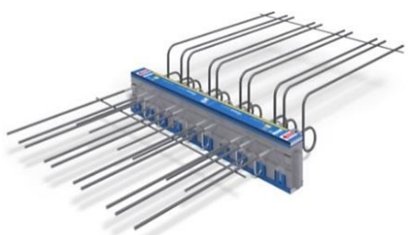
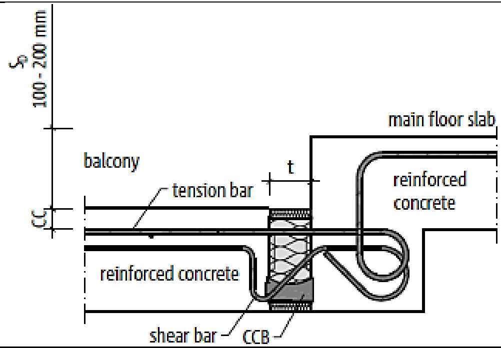
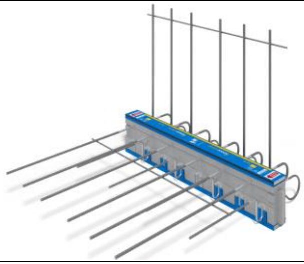
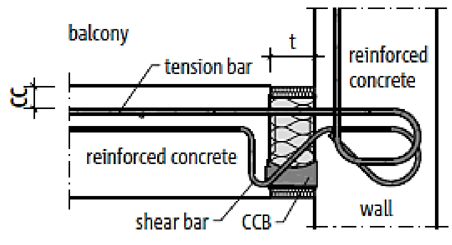
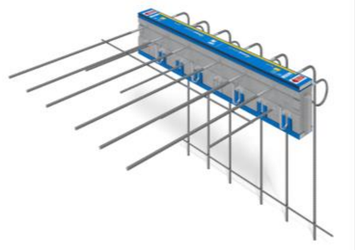
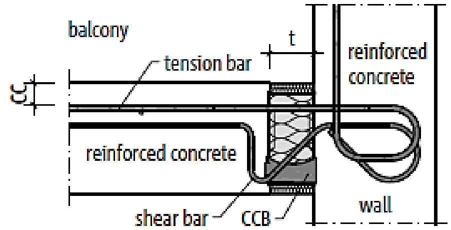
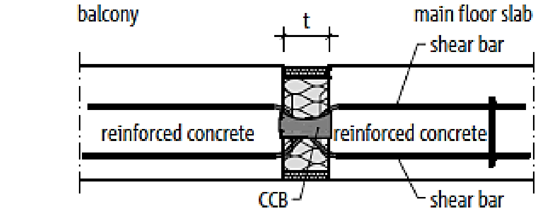
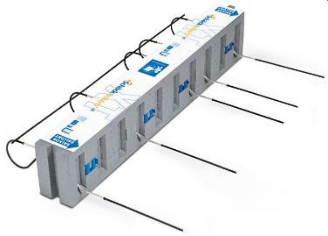
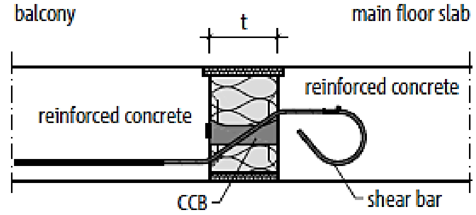
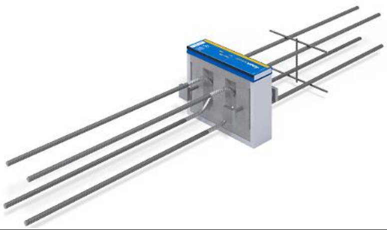
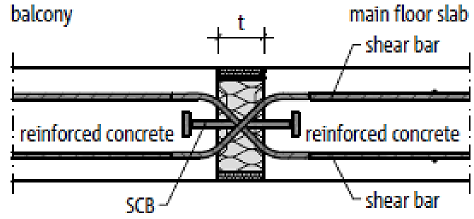
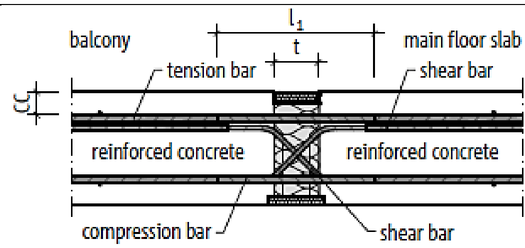
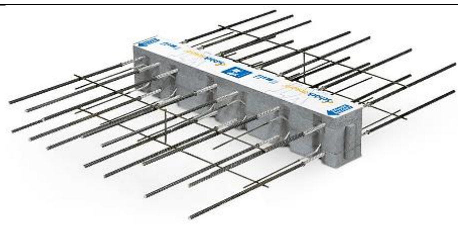
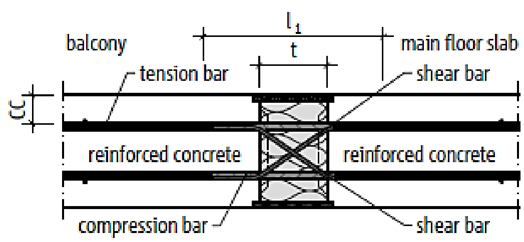
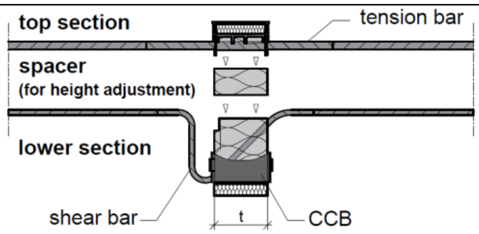
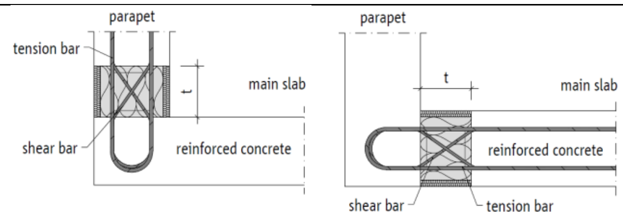
	Example Rendering	Example Section View
CM		
CK, K		
CK-OD		
CK-UD		
CK-WA		
CK-WU		

TABLE 1 (CONTINUED)—SCHÖCK ISOKORB LBTBA TYPE OVERVIEW

	Example rendering	Example section view
CQ / CQ-W		
Q		
CQ-P		
CD		
D		
K-F		
CA		

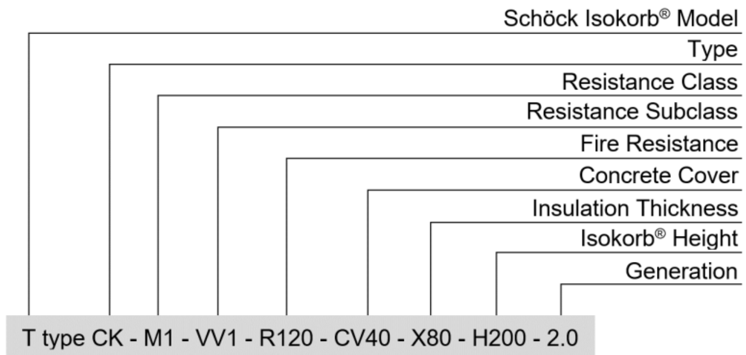


FIGURE 1—EXAMPLE TYPE DESIGNATION FOR SCHÖCK ISOKORB LBTBA CK TYPE

TABLE 2—SCHÖCK ISOKORB LBTBA NOMENCLATURE – SELECTION WITH EXAMPLE PARAMETERS

Product Type		Resistance Class		Fire Rating	Concrete Cover (mm)	Insulation Thickness (mm)	Height (mm)
		Moment	Shear Force				
CM	Moment-Shear	M1	VV1	R120	CV40	X80	H200
CK-OD	Moment-Shear	MM1	V1	R120	CV40	X80	H200
CK-WA	Moment-Shear	MM1	V3	R120	CV40	X80	H200
CQ	Shear	-	VV1	R120	CV40	X80	H200
CQ-P	Punctual Shear	-	VV2	R120	CV40	X80	H250
D	Double Moment-Shear	MM3	VV2	R120	CV35	X120	H250
K-F	Moment-Shear Precast	M2	V1	R120	CV35	X80	H180

[1]Capacity level refers to the strength classification of the Isokorb LBTBA. The capacity level begins with the abbreviation of the respective internal forces (M, V). If these forces occur in both directions, the letter abbreviations are doubled (MM, VV). The load ratings are numbered, starting with 1 for the smallest rating. Refer to Section 4.3.
[2]Refer to Section 4.2 for Isokorb LBTBA fire resistance ratings.
[3]Punctual Shear refers to the Isokorb LBTBA purpose in resisting a point shear load as in a shear beam

A.2 LOAD BEARING ELEMENTS OF SCHÖCK ISOKORB LBTBA TYPES

A.2.1 Concrete Compression Bearing (CCB)

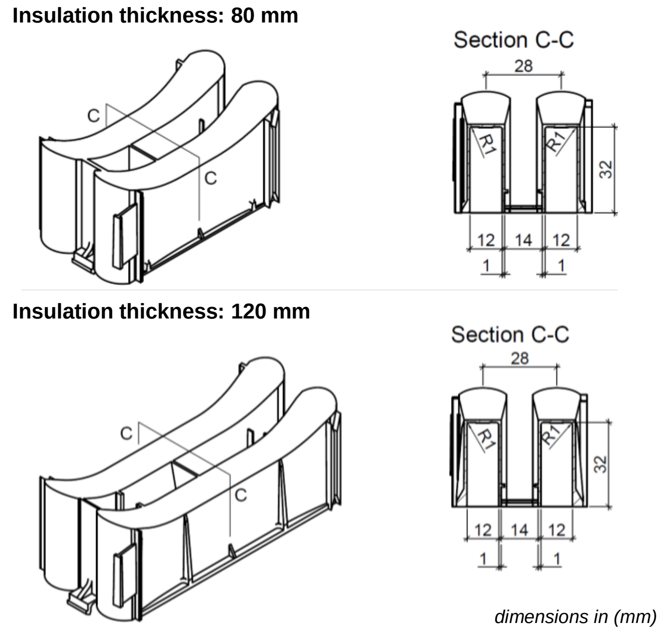


FIGURE 2 – FORMWORK OF HTE30

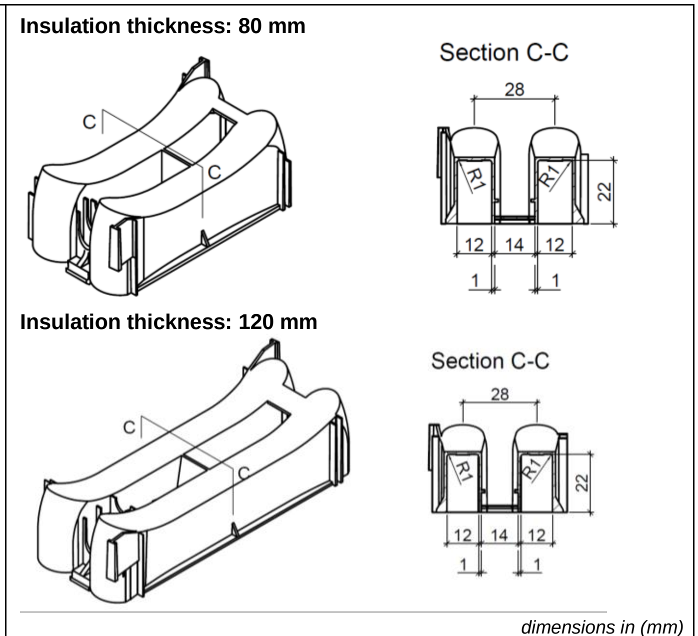


FIGURE 3 – FORMWORK OF HTE20

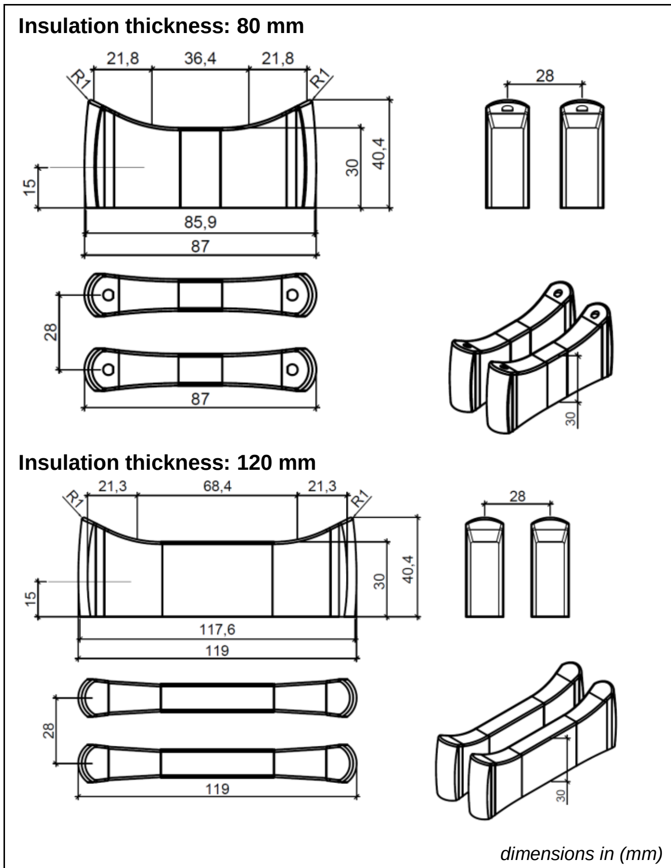


FIGURE 4 – CONCRETE BODY OF HTE30

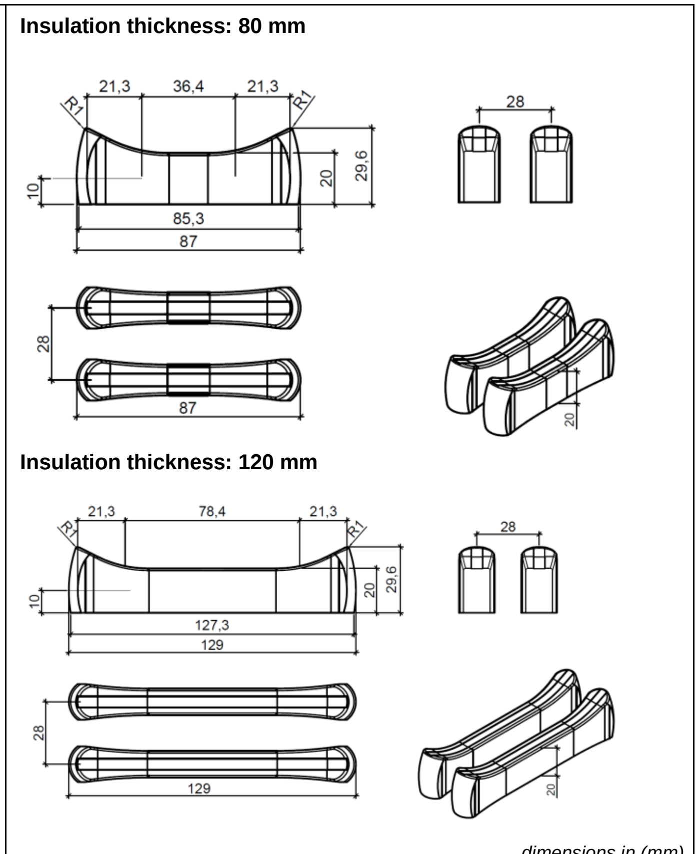


FIGURE 5 – CONCRETE BODY OF HTE20

A.2.2 Special stirrup reinforcement

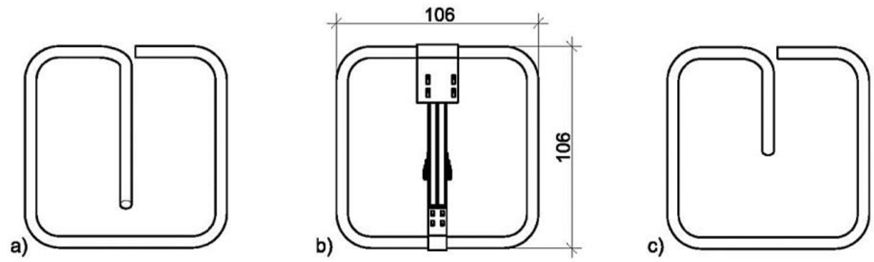


FIGURE 6—STAINLESS STEEL SPECIAL STIRRUP (DIMENSIONS IN MM)

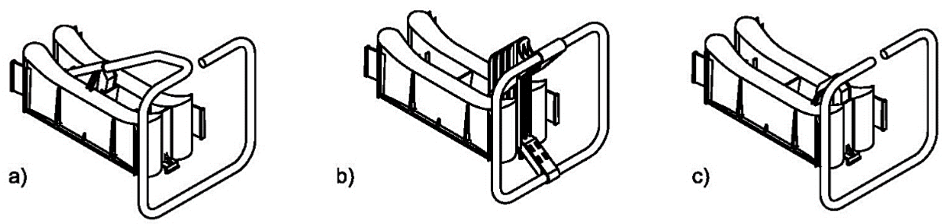


FIGURE 7—CONCRETE COMPRESSION BEARING (CCB) WITH SPECIAL STIRRUP

A.2.3 Steel Compression Bearing (SCB)

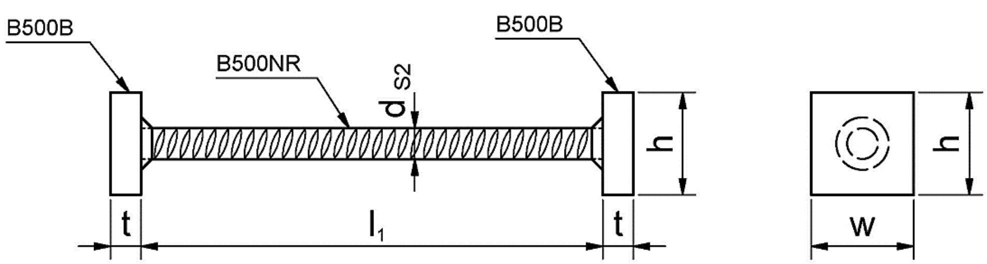


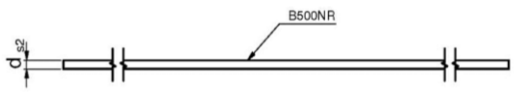
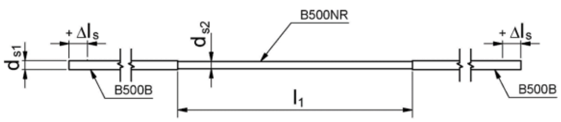
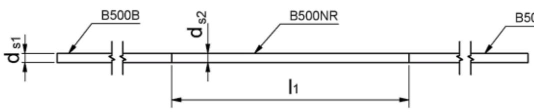
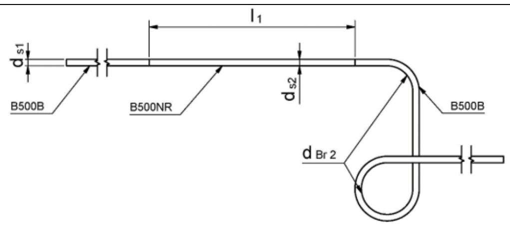
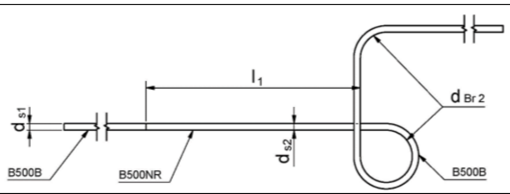
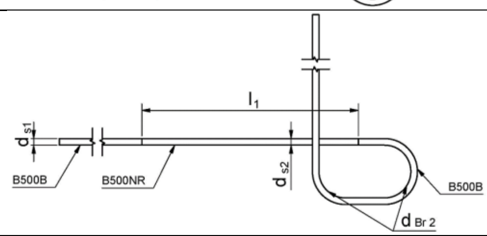
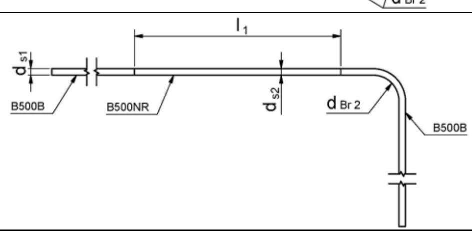
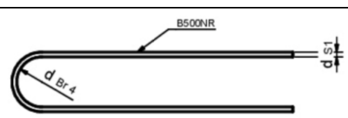
FIGURE 8—STEEL COMPRESSION BEARING (SCB)

TABLE 3—DIMENSIONAL VARIATIONS OF SCHÖCK ISOKORB LBTBA STEEL COMPRESSION BEARING (SCB)

compression steel bar diameter d_{s2} (mm)	length of stainless steel l_1 according to EPS insulation thickness		steel plate size (w x h x t)
	80 mm (3.15 in.)	120 mm (4.72 in.)	
8	180 mm (7.09 in.)	220 mm (8.66 in.)	40 mm x 40 mm x 12 mm (1.57 in. x 1.57 in. x 0.47 in.)
10			
12			
14			60 mm x 40 mm x 15 mm (1.57 in. x 2.36 in. x 0.59 in.)

A.2.4 Tension and Compression Steel Reinforcing Bars – Variations and Dimensions

TABLE 4—TENSION AND COMPRESSION STEEL REINFORCING BARS (SELECTION)

#	Depiction	Material	Description
1		B500 NR	stainless steel reinforcing bar
2		B500 NR & B500B	welded reinforcing steel connection *with diameter change and additions Δls for overlap length*
3		B500 NR & B500B	welded reinforcing steel connection
4		B500 NR & B500B	welded reinforcing steel connection *for height offset*
5		B500 NR & B500B	welded reinforcing steel connection *for height offset*
6		B500 NR & B500B	welded reinforcing steel connection *for wall connection*
7		B500 NR & B500B	welded reinforcing steel connection *for wall connection*
8		B500 NR	stainless steel reinforcing bar

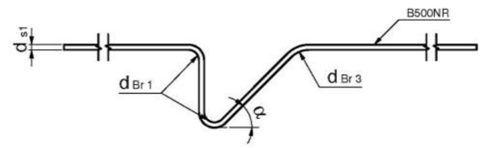
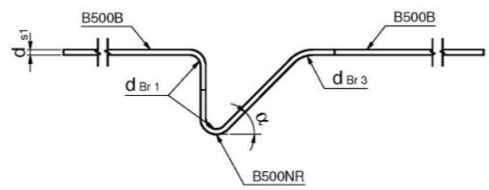
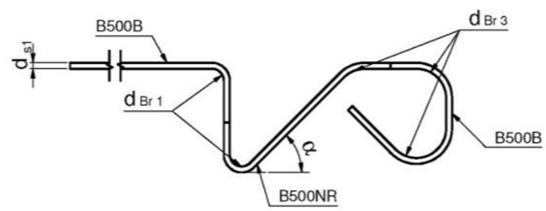
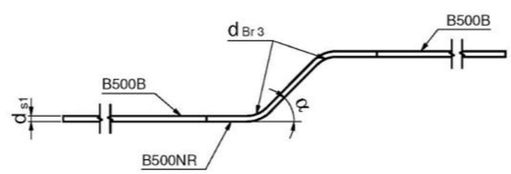
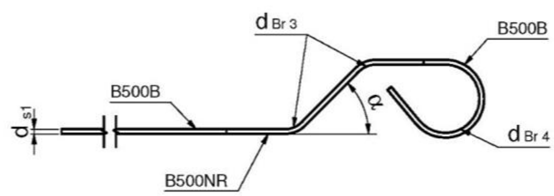
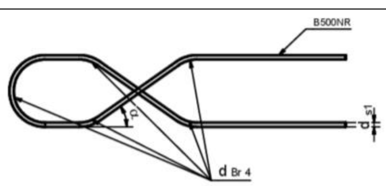
[1]Alternatively, a continuous stainless steel reinforcing bar may be used in place of welded reinforcing steel bar combinations.

TABLE 5—DIAMETER COMBINATIONS AND OVERLAP LENGTH OF TENSION AND COMPRESSION STEEL REINFORCING BARS

Diameter combination $d_{s1} – d_{s2} – d_{s1}$ (mm)	Reinforcing steel d_{s1} (mm | in.) / $R_{p0.2}$ (N/mm² | ksi)	Stainless steel d_{s2} (mm | in.) / $R_{p0.2}$ (N/mm² | ksi)	Overlap length Δl_s (mm | in.)
8 – 6.5 – 8	8 | 0.315 / 500 | 72.5	6.5 | 0.256 / 800 | 116.0	20 | 0.787
8 – 7 – 8	8 | 0.315 / 500 | 72.5	7 | 0.276 / 700 | 101.5	13 | 0.512
8 – 8 – 8	8 | 0.315 / 500 | 72.5	8 | 0.315 / 500 | 72.5	–
10 – 8 – 10	10 | 0.393 / 500 | 72.5	8 | 0.315 / 700 | 101.5 820 | 118.9	20 | 0.787
10 – 10 – 10	10 | 0.393 / 500 | 72.5	10 | 0.393 / 500 | 72.5	–
12 – 9.5 – 12	12 | 0.472 / 500 | 72.5	9.5 | 0.374 / 820 | 118.9	20 | 0.787
12 – 10 – 12	12 | 0.472 / 500 | 72.5	10 | 0.393 / 700 | 101.5	17 | 0.669
12 – 11 – 12	12 | 0.472 / 500 | 72.5	11 | 0.433 / 700 | 101.5	9 | 0.354
12 – 12 – 12	12 | 0.472 / 500 | 72.5	12 | 0.472 / 500 | 72.5	–
14 – 12 – 14	14 | 0.551 / 500 | 72.5	12 | 0.472 / 700 | 101.5	14 | 0.551
14 – 14 – 14	14 | 0.551 / 500 | 72.5	14 | 0.551 / 500 | 72.5	–

A.2.5 Shear Steel Reinforcing Bars – Variations and Dimensions

TABLE 6—SHEAR STEEL REINFORCING BARS (SELECTION)

#	Depiction	Material	Description
1		B500 NR	stainless steel reinforcing bar
2		B500 NR & B500B	Welded reinforcing steel connection
3		B500 NR & B500B	welded reinforcing steel connection *stainless steel reinforcing bar with loop in upper leg, made of reinforcing steel*
4		B500 NR & B500B	welded reinforcing steel connection *stainless steel reinforcing bar with straight reinforcing bar on both sides*
5		B500 NR & B500B	welded reinforcing steel connection *stainless steel reinforcing bar with straight reinforcing bar on balcony side and reinforcing steel hook on floor slab side*
6		B500 NR	stainless steel reinforcing bar

[1]Alternatively, a continuous stainless steel reinforcing bar may be used in place of welded reinforcing steel bar combinations.

TABLE 7—DIMENSIONAL VARIATIONS OF SHEAR STEEL REINFORCING BARS

d_{SB} (mm) (B500B, B500 NR)	bending diameter				bending angle [1]
	d_{Br1}	d_{Br2}	d_{Br3}	d_{Br4}	α
6	4 d_s	8 d_s	10 d_s	15 d_s	35° or 45°
8					
10					
12					
14					

[1]35° bend angles must be used for 120 mm (4.72 in.) EPS insulation thickness. 45° bend angles must be used for 80 mm (3.15 in.) EPS insulation thickness.

A.3 LOAD BEARING CAPACITY OF THE CONCRETE COMPRESSION BEARING (CCB)

The design value of the transmissible compression force D_{Rd} results from and depends on the variant of the compression bearing:

$$D_{Rd} = n_{CCB} \cdot D_{Rd,n}$$

$$D_{Rd,n} = \min\begin{cases} D_{Rd,c} \\ D_{Rd,HTE} \end{cases}$$

Where: D_{Rd} design value of transmissible compression force in (kN/m)

n_{CCB} existing number of bearing pairs (pairs/m)

$D_{Rd,n}$ design value of the transmissible compression force per bearing pair in (kN/bearing pair)

$D_{Rd,c}$ design value of the load bearing capacity of the concrete edge per bearing pair in (kN)

$D_{Rd,HTE}$ design value of the load bearing capacity of one bearing pair (kN/pair)

A.3.1 HTE30 and HTE20

$$D_{Rd,c} = \frac{1}{1000} \cdot a_{cd} \cdot a_{c,uz} \cdot c_1 \cdot \min\begin{pmatrix} a_{CCB,cal} \\ 2 \cdot c_1 + 44\text{ mm} \end{pmatrix} \cdot \sqrt{f_{ck,cube}}$$

Where: a_{cd} see

TABLE 8

c_1 edge distance of the load resultants in (mm); see

TABLE 8

$a_{CCB,cal}$ $a_{CCB,cal} \geq a_{CCB,min}$

calculated center distance of the concrete compression bearing (mm) as a specification of Schöck, related to the mode of failure / allocation (regular / irregular)

$f_{ck,cube}$ characteristic cube resistance strength in N/mm² ≤ 30 N/mm^2 (4,351 psi)

$a_{c,uz}$ in general: $a_{c,uz} = 1.0$

for connection situations as shown in TABLE 1 with vertical step

$a_{c,uz} = (b/220)^2 \leq 1.0$

$b \geq 175$ mm

b … Main beam width (mm)

TABLE 8—DESIGN VALUES FOR HTE20 AND HTE30

CCB type[1]	HTE20	HTE30	
special stirrups	-	-	yes[2]
a_{cd}	1.70	1.80	2.23
minimum center distance $a_{CCB,min}$ —— number of CCB per meter (39.37 in.) n_{CCB}	100 mm (3.94 in.) 4 – 10	100 mm (3.94 in.) 4 – 10	80 mm (3.15 in.) 9 – 12
c_1 (mm | in.)	33 | 1.30	38 | 1.50	38 | 1.50
$D_{Rd,HTE}$ (kN/CCB | kip/CCB)	38.0 | 8.54	45.0 | 10.12	45.0 | 10.12

[1]CCB refers to concrete compression bearing, see Section A.2.1 (FIGURE 2 - FIGURE 5).
[2]Assembly of four stirrups per meter (39.37 in.) according to Section A.2.2 on the bearing side, evenly along the entire length of the Schöck Isokorb LBTBA.

A.3.2 HTE30 (optional)

The following design values for HTE30 are based on an optional calculation model, which allows a maximum amount of 18 HTE30 per meter (Section A.3.1 is limited to a maximum of 12 HTE30).

$D_{Rd,HTE}$ = 34.4 kN

TABLE 9—DESIGN VALUES FOR HTE30

minimum center distance CCB[1]	**CCB[1] number per meter** n_{CCB}/m	**minimum concrete compressive strength** (N/mm² | psi)	$D_{Rd,c}$ (kN/CCB | kip/CCB)
50 mm (1.97 in.)	11 – 18	20 | 2,900 25 | 3,625 ≥ 30 | 4,351	25.5 | 5.62 31.8 | 7.15 34.4 | 7.73
55 mm (2.56 in.)	11 – 16	20 | 2,900 25 | 3,625 ≥ 30 | 4,351	26.6 | 5.98 33.3 | 7.49 34.4 | 7.73
60 mm (2.36 in.)	11 – 14	20 | 2,900 25 | 3,625 ≥ 30 | 4,351	27.8 | 6.25 34.4 | 7.73 34.4 | 7.73
100 mm (3.94 in.)	4 – 10	20 | 2,900 25 | 3,625 ≥ 30 | 4,351	34.4 | 7.73 34.4 | 7.73 34.4 | 7.73

[1]CCB refers to concrete compression bearing, see Section A.2.1 (FIGURE 2 - FIGURE 5).

For connection situations with height offset as shown in TABLE 1 the design values as per TABLE 9 must be determined taking $a_{c,uz}$ into account and a maximum of 16 compression bearings must be used.

Where: $a_{c,uz}$ … $a_{c,uz} = (b/220)^2 \leq 1,0$ for 175 ≤ b < 220 mm

$a_{c,uz} = 1.0$ for b ≥ 220 mm

b ... Main beam width in mm

If the design values exceeds a compression force of 350 kN/m, four stirrups per meter must be installed evenly on the bearing side in accordance to Section A.2.2 along the length of the connection.

A.4 LOAD BEARING CAPACITY OF TENSION AND COMPRESSION BARS

Verification of the tensile bars and shear force bars (ultimate limit state)

- The design values that can be applied for verification are given in TABLE 10.
- Load-bearing capacity of the welded joint between reinforcing steel and stainless reinforcing steel or round steel does not need to be performed separately.

TABLE 10—DESIGN VALUES OF REINFORCING BAR YIELD STRENGTHS FOR TENSION LOADS

Material	f_{yd}	
	[N/mm^2]	[psi]
B500B NR	435	63,091
S355 round steel	323	46,847
S460 round steel	418	60,625
S690 round steel	627	90,938
B500 NR $R_{p0.2}$ 700	609 *(for tension bars)*	88,328 *(for tension bars)*
B500 NR $R_{p0.2}$ 800	661 *(for tension bars)*	95,870 *(for tension bars)*
B500 NR $R_{p0.2}$ 820	678 *(for tension bars)*	98,336 *(for tension bars)*

Verification of the compression bars (ultimate limit state)

- The design values that can be applied for verification are given in TABLE 11.
- With use of the compression bars with welded-on compression plates the introduction of the compressive stresses into the concrete as a partial surface load must be verified.
- Superimposition of adjacent load distribution surfaces must be taken into consideration.
- It must be verified that the occurring tensile forces can be transferred.

TABLE 11—DESIGN VALUES OF THE COMPRESSION FORCES FOR STAINLESS STEEL

Diameter	Insulation thickness	System Buckling length	$N_{ki,d}$ B500 NR $R_{p0,2}$ 700	$N_{ki,d}$ S460	$N_{ki,d}$ S690	$N_{ki,d}$ B500B NR
(mm | in.)	(mm | in.)	(mm | in.)	(kN | kip)	(kN | kip)	(kN | kip)	(kN | kip)
6 (0.24)	60 | 2.36	72 | 2.83	11.0 | 2.47	-	-	-
	80 | 3.15	92 | 3.62	10.7 | 2.41	-	-	-
	120 | 4.72	132 | 5.20	8.2 | 1.84	-	-	-
8 (0.31)	60 | 2.36	76 | 2.99	21.3 | 4.79	-	-	-
	80 | 3.15	96 | 3.78	21.7 | 4.88	-	-	-
	120 | 4.72	136 | 5.35	17.8 | 4.00	-	-	-
10 (0.39)	60 | 2.36	80 | 3.15	35.0 | 7.87	27.4 | 6.16	-	-
	80 | 3.15	100 | 3.94	36.3 | 8.16	26.0 | 5.85	-	-
	120 | 4.72	140 | 5.51	31.5 | 7.08	23.3 | 5.24	-	-
12 (0.47)	60 | 2.36	84 | 3.31	52.1 | 11.71	40.5 | 9.10	-	-
	80 | 3.15	104 | 4.09	53.6 | 12.05	38.8 | 8.72	-	-
	120 | 4.72	144 | 5.67	49.5 | 11.13	35.4 | 7.96	-	-
14 (0.55)	80 | 3.15	108 | 4.25	-	54.1 | 12.16	70.7 | 15.89	53.4 | 12.00
	120 | 4.72	148 | 5.83	-	50.1 | 11.26	64.4 | 14.48	49.2 | 11.06
16 (0.63)	80 | 3.15	112 | 4.41	-	72.1 | 16.21	-	-
	120 | 4.72	152 | 5.98	-	67.4 | 15.15	-	-
20 (0.79)	80 | 3.15	120 | 4.72	-	115.7 | 26.01	152.4 | 34.26	-
	120 | 4.72	160 | 6.30	-	110.0 | 24.73	143.0 | 32.15	-

A.5 DIMENSIONS AND DESIGN PARAMETERS OF SCHÖCK ISOKORB LBTBA TYPES

TABLE 12—DIMENSION AND DESIGN PARAMETERS FOR CM, CK, CK-OD, CK-UD, CK-WA, CK-WU, K, AND K-F TYPES WITH CCB[1]

Parameter	Dimensions
Element height h	160 mm (6.3 in.) ≤ h ≤ 500 mm (19.7 in.)
Number of concrete compression bearings per one meter (39.4 in.) element n_{CCB}	≥ 4
Concrete cover of the concrete compression bearings c_{CCB}	≥ 20 mm (0.79 in.)
Center distance of the concrete compression bearings to the lateral component edge	≥ 50 mm (1.97 in.)
Center distance of the concrete compression bearings	≤ 250 mm (9.84 in.)
Number of tension bars per one meter (39.4 in.) element n_{TB}	≥ 4
Diameter of the tension bars $d_{s,1}$	≤ 20 mm (0.79 in.)
Concrete cover of tension bars $c_{nom,s}$	≥ 30 mm (1.18 in.)
Center distance of the tension bars to the lateral component edge	≥ 50 mm (1.97 in.)
Center distance of the tension bars	≤ 300 mm (11.8 in.). on average ≤ 250 mm (9.84 in.)
Number of shear bars per one meter (39.4 in.) element n_{SB}	≥ 4
Diameter of the shear bars d_{SB}	≤ 10 mm (0.315 in.)
Angle of the shear bars α_{SB} in the insulation layer insulation thickness 80 mm (3.15 in.) insulation thickness 120 mm (4.72 in.)	 45° 35°
Center distance of the shear bars to the lateral component edge	≥ 100 mm (3.94 in.)
Center distance of the shear bars	≤ 300 mm (11.8 in.). on average ≤ 250 mm (9.84 in.)

[1]CCB refers to concrete compression bearing, see Section A.2.1 (FIGURE 2 - FIGURE 5).

TABLE 13—DIMENSION AND DESIGN PARAMETERS FOR CD, D, CQ-P AND CA TYPES WITH SCB OR STEEL COMPRESSION BARS[1]

Parameter	Dimensions		
	Type CD / D	Type CQ-P	Type CA
Element height h	160 mm (6.3 in.) ≤ h ≤ 500 mm (19.7 in.)		
Width	1000 mm (39.37 in.)	300 mm (11.81 in.)	250 mm (9.84 in.)
Number of tension and compression bars (Type CD, D, CA) per one meter (39.4 in.) / Number of SCB per element (Type CQ-P)	≥ 4	≥ 2	≥ 2
Diameter of the tension and compression bars $d_{s,1}$	≤ 20 mm (0.79 in.)		
Concrete cover of tension and compression bars $c_{nom,o}$ ($c_{nom,u}$)	≥ 30 mm (1.18 in.)		
Center distance of the tension and compression bars to the lateral component edge	≥ 50 mm (1.97 in.)		
Center distance of the tension and compression bars	≤ 300 mm (11.8 in.).		
Number of shear bars per one meter (39.4 in.) or element (see Type CQ-P) n_{SB}	≥ 4	≥ 2	≥ 1
Diameter of the shear bars d_{SB}	≤ 14 mm (0.55 in.)		
Bending diameter of shear bars	≥ 10 d_{SB}		
Center distance of the shear bars to the lateral component edge	≥ 100 mm		
Center distance of the shear bars	≤ 300 mm (11.8 in.). on average ≤ 250 mm (9.84 in.)		
Angle of the shear bars α_{SB} in the insulation layer: insulation thickness 80 mm (3.15 in.) insulation thickness 120 mm (4.72 in.)	 45° 35°		 35° 35°
Vertical offset between the shear bars and longitudinal reinforcement	s_{SB} ≤ 100 mm (3.94 in.)		

[1]SCB refers to steel compression bearing, see Section A.2.3 (FIGURE 8).

TABLE 14—DIMENSION AND DESIGN PARAMETERS FOR CQ, CQ-W AND Q TYPES WITH CCB[1]

Parameter	Dimensions
Element height h	160 mm (6.3 in.) ≤ h ≤ 500 mm (19.69 in.)
Number of concrete compression bearings per one meter (39.4 in.) element n_{CB}	≥ 4
Concrete cover of the concrete compression bearings c_{CCB}	≥ 70 mm (2.76 in.)
Center distance of the concrete compression bearings to the lateral component edge	≥ 50 mm (3.15 in.)
Center distance of the concrete compression bearings	≥ 50 mm (1.97 in.)
Number of shear bars per one meter (39.4 in.) element n_{SB}	≥ 4
Diameter of the shear bars d_{SB}	≤ 14 mm (0.55 in.)
Bending diameter of shear bars	≥ 10 d_{SB}
Center distance of the shear bars to the lateral component edge	≥ 100 mm (3.94 in.)
Center distance of the shear bars	≤ 300 mm (11.8 in.). on average ≤ 250 mm (9.84 in.)
Angle of the shear bars α_{SB} in the insulation layer: insulation thickness 80 mm (3.15 in.) insulation thickness 120 mm (4.72 in.)	 45° 35°
Vertical offset between the shear bars and longitudinal reinforcement	s_{SB} ≤ 100 mm (3.94 in.)

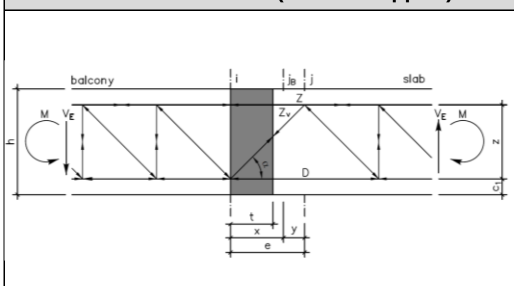
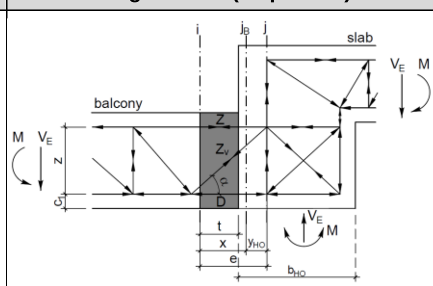
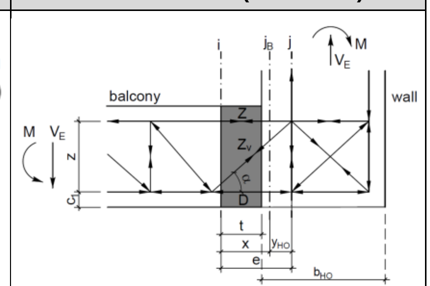
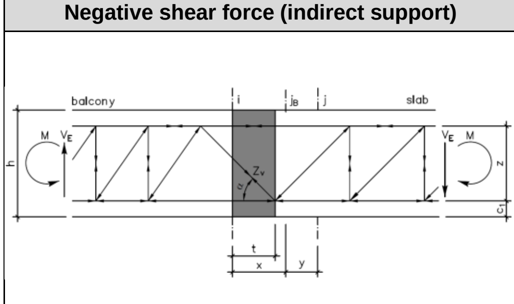
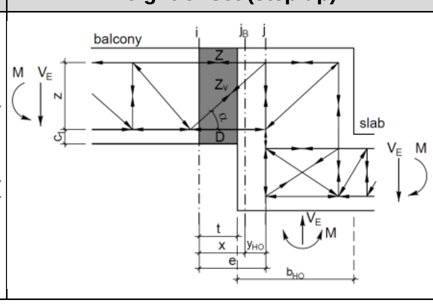
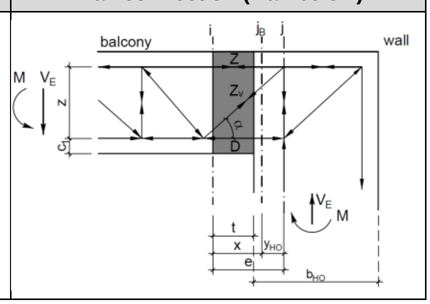
[1]CCB refers to concrete compression bearing, see Section A.2.1 (FIGURE 2 - FIGURE 5).

A.6 STRUT-AND-TIE MODELS AND CALCULATION PROCEDURE FOR LOAD RESISTANCE FACTOR DESIGN (LRFD)

A.6.1 Schöck Isokorb LBTBA cantilever connection with concrete compression bearing (CCB)

A.6.1.1 Strut-and-tie models

TABLE 15—STRUT-AND-TIE MODELS

Positive shear force (indirect support)	Height offset (step down)	Wall connection (wall above)
		
Negative shear force (indirect support)	**Height offset (step up)**	**Wall connection (wall below)**
		

A.6.1.2 Dimensions of the strut-and-tie models and position of the design section

The design section is set in section j_B of the shown strut-and-tie models in Section A.6.1.1. The main dimensions of the strut-and-tie models are given below.

The vertical inner lever arm z is the center distance of the tension bar and the resulting force of the compression element:

$$z = h - c_1 - cv - d_{s2}/2$$

The horizontal distance e between section i and j:

$$e = \frac{z}{\tan\alpha} = x + y$$

with:

h	…	element height
c_1	…	edge distance of the resulting compression force inside the compression element; see A.3
cv	…	concrete cover of reinforcement of the slabs
d_{s2}	…	diameter of the tension reinforcing bar
α	…	angle of the shear bars
x	…	distance from section i to design section j_B
y	…	distance from design section j_B to section j
t	…	insulation thickness
y_{HO}	…	horizontal distance y_{HO} between section j_B and member axis of stirrup $y_{HO} = t - x + c_{HV} + d_{HV}/2$
c_{HO}	…	lateral nominal cover within the height offset or wall
d_{HO}	…	diameter of the stirrup

A.6.1.3 Determination of the inner forces

According to the strut-and-tie models from Section A.6.1.1 the inner forces are given below.

a) applied moment in section i and j:

$$M_i = M_j - V_E \cdot e$$

$$M_j = M_i + V_E \cdot e$$

b) applied tensile force in the tension bars:

$$Z = \frac{M_i}{z} \quad \text{or} \quad Z = \frac{M_j}{z} - \frac{V_E}{\tan\alpha}$$

c) applied compression force in the compression chord:

$$D = \frac{M_j}{z} \quad \text{or} \quad D = \frac{M_i}{z} + \frac{V_E}{\tan\alpha}$$

d) applied tensile force in the shear bars:

$$Z_V = \frac{V_E}{\sin\alpha}$$

with: V_E … applied shear force

A.6.1.4 Design values of resistance

a) design value of transmissible bending moment M_{Rd}:

$$M_{Rd,j_B} = \min\begin{cases} M_{Rd,j_B}(Z_{Rd}) \\ M_{Rd,j_B}(D_{Rd}) \end{cases}$$

$$M_{Rd,j_B}(Z_{Rd}) = Z_{Rd} \cdot z + V_E \cdot x$$

$$M_{Rd,j_B}(D_{Rd}) = D_{Rd} \cdot z - V_E \cdot y$$

b) design value of transmissible shear force V_{Rd}:

$$V_{Rd} = Z_{V,Rd} \cdot \sin\alpha$$

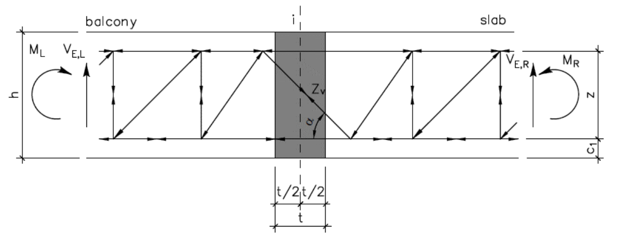
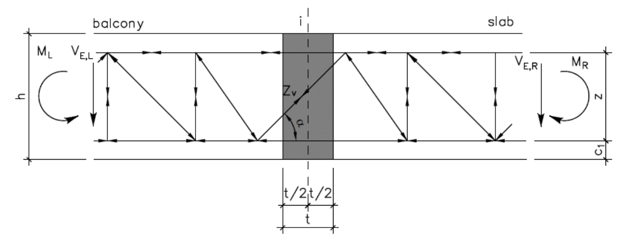
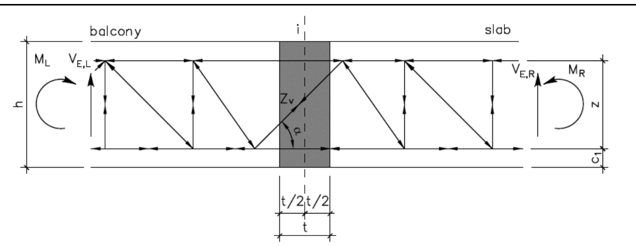
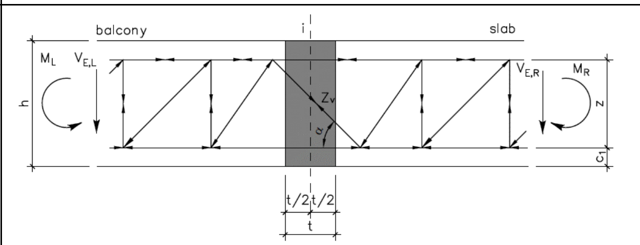
with:

Z_{Rd}	…	design value of transmissible tensile force of the horizontal bars
D_{Rd}	…	design value of transmissible compression force of the horizontal bars (see TABLE 11)
$Z_{V,Rd}$	…	design value of transmissible tensile force in the shear bars $Z_{V,Rd} = n_{SB} \cdot A_s \cdot f_{yd} \cdot \alpha_7$
α_{bd}	…	reduction factor for the lack of bond length $\alpha_{bd} = l_{bd,prov}/l_{bd,rqd}$
$l_{bd,prov}$	…	existing bond length according to Schöck specification
$l_{bd,rqd}$	…	required bond length

A.6.2 Schöck Isokorb LBTBA cantilever connection with compression steel reinforcing bars or steel compression bearings (SCB)

A.6.2.1 Strut-and-tie models

TABLE 16—STRUT-AND-TIE MODELS

	Positive moment	Negative moment
$V_{E,L} > V_{E,R}$		
$V_{E,L} < V_{E,R}$		

A.6.2.2 Dimensions of the strut-and-tie models and position of the design section

The design section is set in section i of the shown strut-and-tie models in Section A.6.2.1. The main dimensions of the strut-and-tie models are given below.

The vertical inner lever arm z is the center distance of the tension bar and the compression bar:

$$z = h - c_{nom,o} - c_{nom,u} - d_{HB}$$

with:

h	…	element height
$c_{nom,o}$	…	nominal cover (top)
$c_{nom,u}$	…	nominal cover (bottom)
d_{HB}	…	diameter of the horizontal bars (reinforcing steel bars)
α	…	angle of the shear bars

A.6.2.3 Determination of the inner forces

According to the strut-and-tie models from Section A.6.2.1, the inner forces are given below.

a) applied tensile force in the tension bars:

$$Z = \frac{M_i}{z} - \frac{1}{2} \cdot \frac{V_E}{\tan \alpha}$$

b) applied compression force in the compression chord:

$$D = \frac{M_i}{z} + \frac{1}{2} \cdot \frac{V_E}{\tan \alpha}$$

c) applied tensile force in the shear bars:

$$Z_V = \frac{V_E}{\sin \alpha}$$

with: V_E … applied shear force

A.6.2.4 Design values of resistance

a) design value of transmissible bending moment M_{Rd}:

$$m_{Rd} = \min \begin{cases} \left(Z_{Rd} + \frac{1}{2} \cdot \frac{v_{Rd}}{\tan \alpha} \right) \cdot z \\ \left(D_{Rd} - \frac{1}{2} \cdot \frac{v_{Rd}}{\tan \alpha} \right) \cdot z \end{cases}$$

b) design value of transmissible shear force v_{Rd}:

$$v_{Rd} = Z_{V,Rd} \cdot \sin \alpha$$

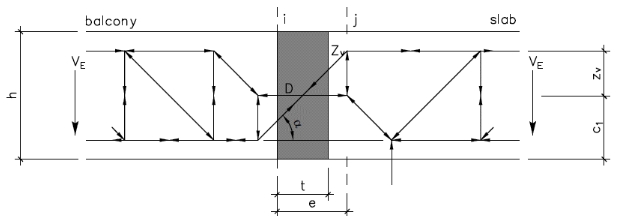
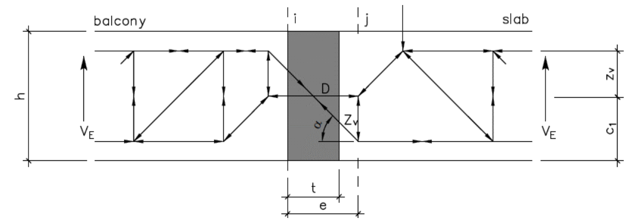
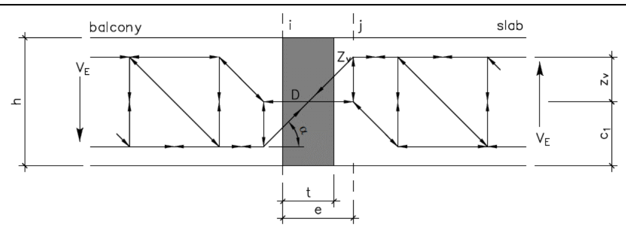
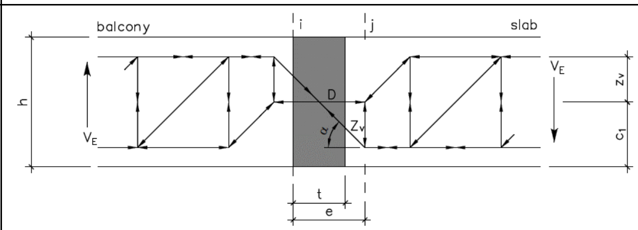
with:

Z_{Rd}	…	design value of transmissible tensile force in the the horizontal bars
D_{Rd}	…	design value of transmissible compression force in the horizontal bars
$Z_{V,Rd}$	…	design value of transmissible tensile force in the shear bars (see Section A.6.1.4)
b	…	length of the Schöck Isokorb LBTBA

A.6.3 Schöck Isokorb LBTBA shear connection

A.6.3.1 Strut-and-tie models

TABLE 17—STRUT-AND-TIE MODELS

<table>
<tr><th></th><th>Positive shear force</th><th>Negative shear force</th></tr>
<tr><th>Direct support</th><td>
</td><td>
</td></tr>
<tr><th>Indirect support</th><td>
</td><td>
</td></tr>
</table>

A.6.3.2 Dimensions of the strut-and-tie models and position of the design section

The design section is set in section j of the shown strut-and-tie models in Section A.6.3.1. The main dimensions of the strut-and-tie models are given below.

The vertical inner lever arm z_v is the center distance of the shear bar and the resulting force of the compression element:

$$z_v = h_{SB} - (c_1 - c_{nom,u}) - d_{SB}/2$$

The horizontal distance e between section i and j:

$$e = \frac{z_v}{\tan\alpha} + \frac{t}{2}$$

with:

- h_{SB} … height of the shear bar
- c_1 … edge distance of the resulting compression force inside the compression module
- $c_{nom,u}$ … nominal cover (underside)
- d_{SB} … shear bar diameter
- α … angle of the shear bar
- t … insulation thickness

A.6.3.3 Determination of the inner forces

According to the strut-and-tie models from Section A.6.3.1 the inner forces are given below:

a) Applied compression force in the compression chord:

$$D = \frac{V_E}{\tan\alpha}$$

b) applied tensile force in the shear bars:

$$Z_V = \frac{V_E}{\sin\alpha}$$

with: V_E … applied shear force

A.6.3.4 Design values of resistance

The design value of transmissible compression force of concrete compression bearing CCB can be found in Section A.3. For steel compression bearing SCB see TABLE 11.

a) design value of transmissible shear force V_{Rd}:

$$V_{Rd} = \min\begin{cases} Z_{V,Rd} \cdot \sin\alpha \\ D_{Rd} \cdot \tan\alpha \end{cases}$$

b) applied value of transmissible compression force D_{Rd}:

$$D_{Rd} = n_{CCB} \cdot D_{Rd,n}$$ (CCB) or $$D_{Rd} = \min\begin{cases} n_{SCB} \cdot F_{Rd,u} \\ n_{SCB} \cdot D_{Rd,SCB} \end{cases}$$ (SCB)

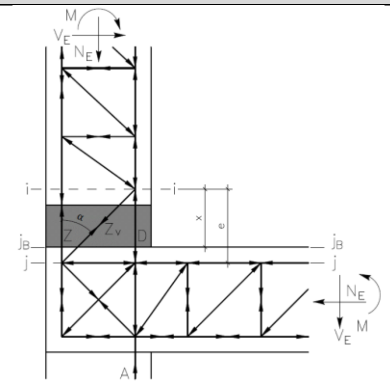
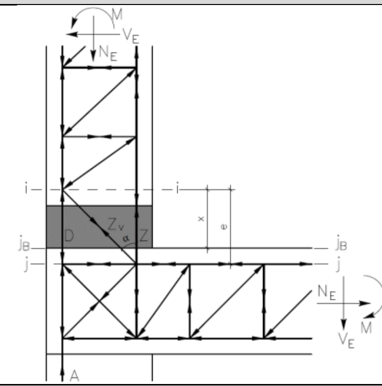
with:

- $Z_{V,Rd}$ … design value of transmissible tensile force in the shear bars (see Section A.6.1.4)
- $F_{Rd,u}$ … design value of transmissible compression force of the concrete under partial surface load

A.6.4 Schöck Isokorb LBTBA parapet connection

A.6.4.1 Strut-and-tie models

TABLE 18—STRUT-AND-TIE MODELS

Positive moment	Negative moment
	

A.6.4.2 Dimensions of the strut-and-tie models and position of the design section

The design section is set in section j_B of the shown strut-and-tie models in Section A.6.4.1. The main dimensions of the strut-and-tie models are given below.

The horizontal inner lever arm z is the center distance of the tension bar and the compression bar:

$$z = h - 2 \cdot cv - d_s$$

The vertical distance e between section i and j:

$$e = \frac{z_h}{\tan\alpha} = 2 \cdot x - t$$

with:

- h … element height
- cv … concrete cover
- d_s … diameter of the tension / compression bars
- α … angle of the shear bars
- x … distance from section i to design section j_B
- t … insulation thickness

A.6.4.3 Determination of the inner forces

According to the strut-and-tie models from A.6.4.1. the inner forces are given below.

a) applied tensile force in the tension bars:

$$Z = \frac{M_i}{z} - \frac{N_E}{2}$$

$$Z = \frac{M_j}{z} - \frac{N_E}{2} - \frac{V_E}{\tan\alpha}$$

b) applied compression force in the compression chord:

$$D = \frac{M_i}{z} + \frac{N_E}{2} + \frac{V_E}{\tan\alpha}$$

$$D = \frac{M_j}{z} + \frac{N_E}{2}$$

c) applied tensile force in the shear bars:

$$Z_V = \frac{V_E}{\sin\alpha}$$

d) applied moment in section i, j and j_B

$$M_i = M_j - V_E \cdot e$$

$$M_j = M_i + V_E \cdot e$$

$$M_{jB} = M_i + V_E \cdot x$$

with:

- V_E … applied shear force
- N_E … applied normal force

A.6.4.4 Design values of resistance

a) design value of transmissible bending moment M_{Rd}:

$$M_{Rd,jB} = \pm \min \begin{cases} \left(Z_{Rd} + \frac{N_{Ed}}{2}\right) \cdot z + |V_{Ed}| \cdot x \\ \left(|D_{Rd}| - \frac{N_{Ed}}{2} - \frac{|V_{Ed}|}{\tan\alpha}\right) \cdot z + |V_{Ed}| \cdot x \end{cases}$$

b) design value of transmissible shear force V_{Rd}:

$$V_{Rd} = Z_{V,Rd} \cdot \sin\alpha$$

with:

- Z_{Rd} … design value of transmissible tensile force in the the horizontal bars
- D_{Rd} … design value of transmissible compression force in the horizontal bars
- $Z_{V,Rd}$ … design value of transmissible tensile force in the shear bars (see Section A.6.1.4)

A.6.5 Verification

a) Verification of shear load:

$|V_E| \leq V_{Rd}$

b) Verification of moment load:

$M \leq M_{Rd}$

c) Verification of required tension bar reinforcement:

$A_{s,req} = \frac{F_s}{f_{yd}}$ **where:** $f_{yd} = f_y / 1.15$

A.7 DETERMINATION OF SCHOCK ISOKORB LBTBA DEFORMATION

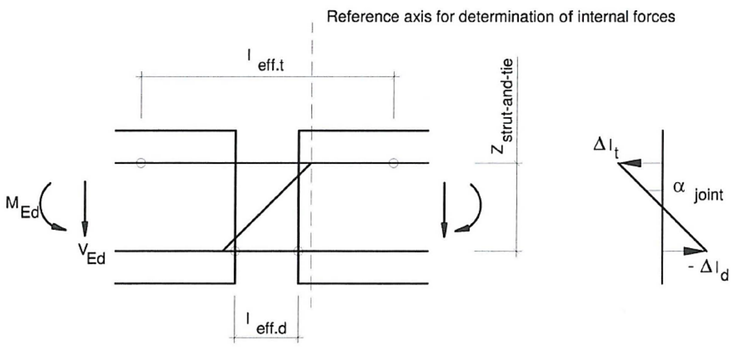
In the calculation of the vertical deformations, the following influencing factors must be taken into account:

- Elastic deformations of the LBTBA insulation element and of the adjacent concrete member
- Thermal expansion

Verification of the deflections:

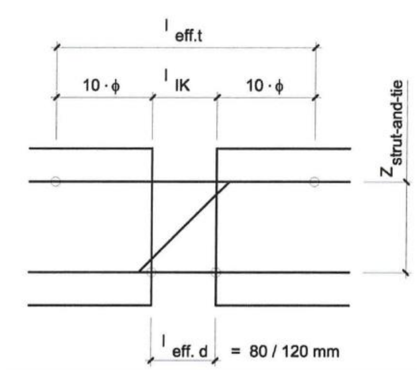
- Quasi-continuous combination in accordance with the following models and calculations
- Model for determining the bending deformation in the joint in accordance with TABLE 19 and TABLE 20.
- Calculation of the elastic deformations of the tension bars depending on the yield strength that can be applied (see TABLE 10*)*

TABLE 19—DEFORMATION ANALYSIS FOR CANTILEVER CONNECTION WITH CONCRETE COMPRESSION BEARINGS

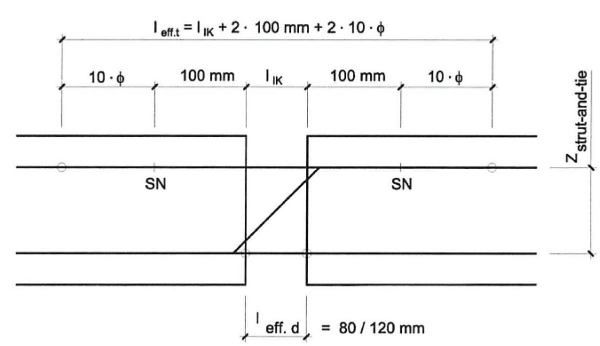


Tension strap:	$\Delta l_t = \varepsilon_t \cdot l_{eff,t}$
Compression bearing:	$\Delta l_{d1} = \varepsilon_d \cdot l_{eff,d}$ with E_d = 45,000 N/mm^2
Adjacent materials:	$\Delta l_{d2,SLS}$ **= 0.275 mm**
Compression flange:	$\Delta l_d = \Delta l_{d1} + \Delta l_{d2}$
Angle of rotation in the joint:	$\tan \alpha_{joint} = \frac{\Delta l_t - \Delta l_d}{z}$

Model for determining the bending deformation in the joint



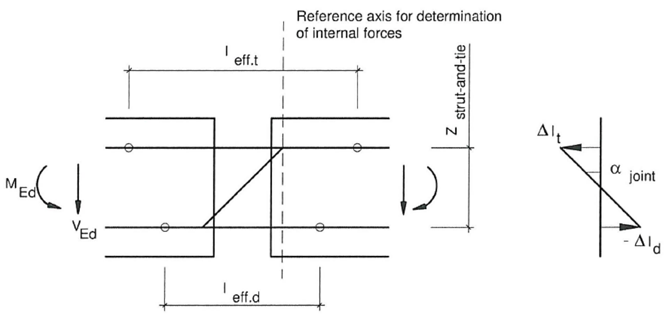
l_{eff} for ribbed stainless steel bar, as per Section 3.3 and CCB



SN = welded joint

l_{eff} for plain stainless steel bar with strength classes S355, S460, S690 as per Section 3.3 and CCB

TABLE 20—DEFORMATION ANALYSIS FOR CANTILEVER CONNECTION WITH COMPRESSION STEEL REINFORCING BARS OR STEEL COMPRESSION BEARINGS

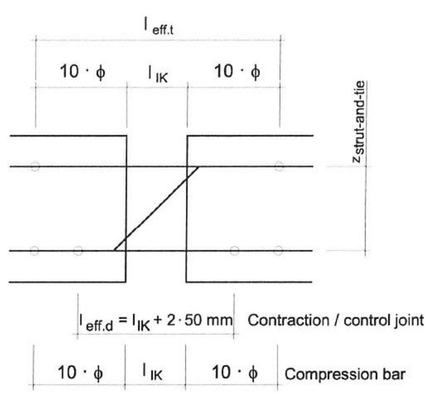


Elongation of tension strap: $\Delta l_t = \varepsilon_t \cdot l_{eff,t}$

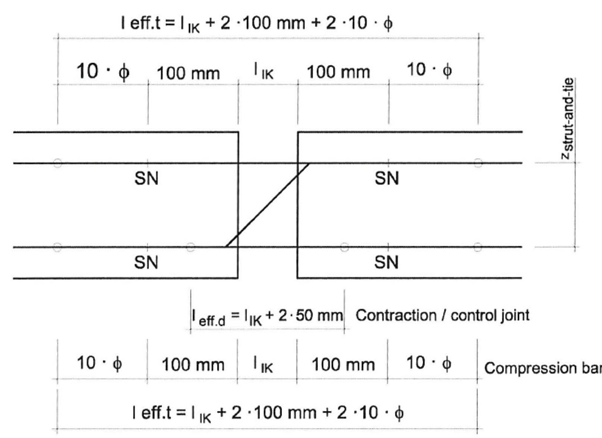
Elongation of compression flange: $\Delta l_d = \varepsilon_d \cdot l_{eff,d}$

Angle of rotation in the joint: $\tan \alpha_{joint} = \frac{\Delta l_t - \Delta l_d}{z}$

Model for determining the bending deformation in the joint



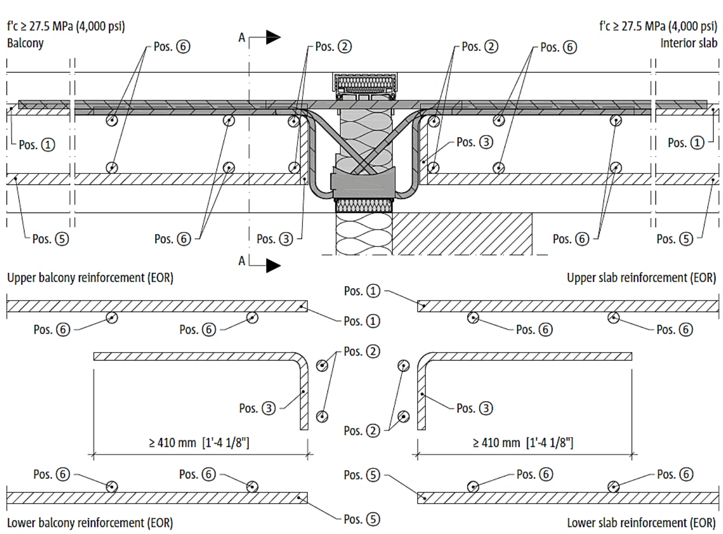
l_{eff} for ribbed stainless steel bar, as per Section 3.3



SN = welded joint

l_{eff} for plain stainless steel bar with strength classes S355, S460, S690 as per Section 3.3

A.8 ON-SITE REINFORCEMENT



Pos. 1
slab reinforcement

Pos. 2
longitudinal bars parallel to insulation

Pos. 3
constructive edge reinforcement at Isokorb joint

Pos. 4
constructive edge reinforcement at free slab edges

Pos. 5
bottom layer reinforcement

Pos. 6
longitudinal reinforcement

FIGURE 9—EXAMPLE CROSS-SECTION OF RECOMMENDED CAST-IN-PLACE STEEL REINFORCING BARS