

**SPHERICAL HEAD LIFTING SYSTEMS
(LIFTING SYSTEM)**

RIGHTS TO CHANGES AND ERRORS RESERVED

**TECHNICAL
MANUAL**

EXM-SHLA-DC-1001
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SPHERICAL HEAD LIFTING ANCHOR

The Spherical Lifting System consists of lifting anchors made of a round steel bar with forged ends with rubber recess formers and lifting clutches for easy movement of precast elements.

The key benefits and features of The Spherical Head Lifting System are as below:

- Safe, time-saving, and easy lifting of precast elements.
- Wide range of anchors in different load classes (13 to 320kN).
- Different lengths for each load size help in the selection of an economical anchor for the necessary application.
- Lifting is possible in all load directions (axial, lateral, and diagonal).
- Useful identification of anchor through marking on each forged head of the anchor.
- Easy installation of anchors in the mould using reusable recess former.
- Quick lifting both in the factory and on-site by using a lifting clutch.

1.1 Introduction

EXMET Spherical head lifting system consists of Lifting anchors and lifting clutches. Lifting Anchors are forged round steel bars with studded ends. Lifting clutches are means to move precast elements by attaching the same with suitable lifting anchors. The lifting anchors and lifting clutches are available in different variants depending on the type, use and load capacity.

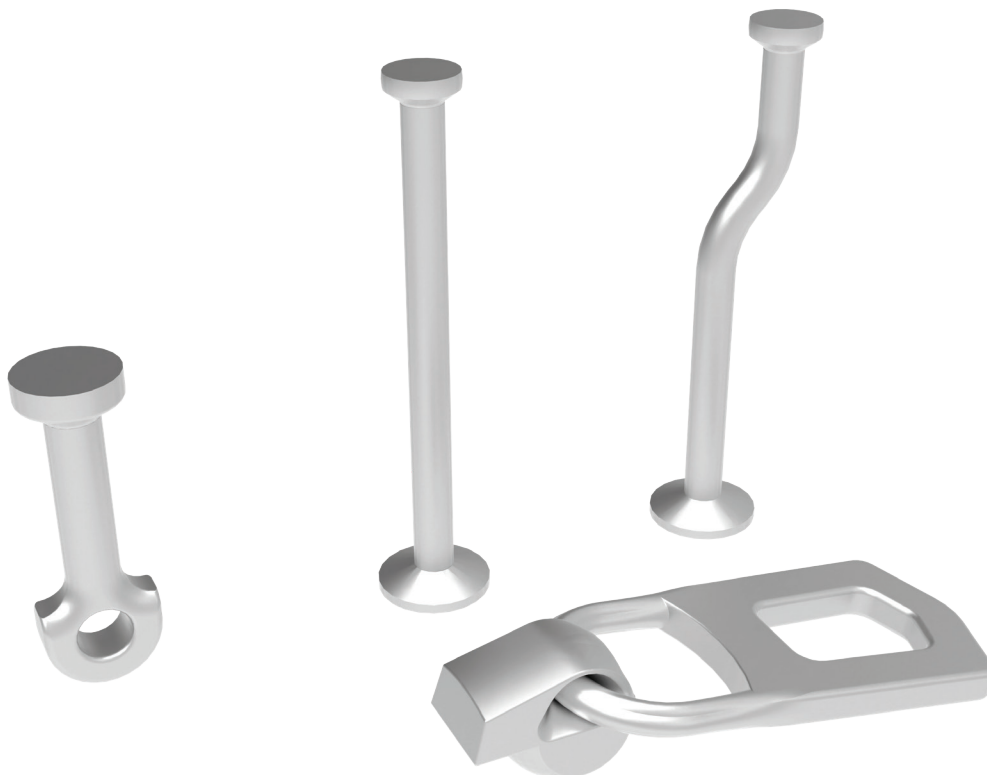


Figure 1. Spherical Head Lifting Anchors

1.2 Materials

EXMET Spherical head lifting anchors are available in following materials.

Table 1. Materials

Liftings	Material	Material Type	Standard
ESB, ESBB, ESE	S355J2	Electro Zinced	EN 10025
ESBs, ESBBs, ESEs	1.4301	Stainless Steel	EN 10088
ESBa, ESBBa, ESEa	1.4401	Acid Resistant Steel	EN 10088

1.3 Colour Coding System

A colour coding system for different diameters of lifting insert is used for easy identification.

Table 2. Colour Codes for Spherical Head Lifting System

Load Group (t)	Colour
1.3	Pale Green
2.5	Light Coral
4.0	Baby Blue
5.0	Plum
7.5	Khaki
10.0	Lucky Orange
15.0	Antique Steel
20.0	Burly Wood
32.0	Steel Blue

1.4 Safety Features

EXMET Spherical Head Lifting System has been tested for a high safety level. The general safety factor given to concrete failure mechanisms is 2.5 against the characteristic strength of the concrete. The value is lower than steel (Safety factor 3) as it is generally unaffected by multiple uses.

1.5 Product Marking

Product marking includes Load Class, Height, Product Name, and Year of Manufacturing as shown in below figures:



Figure 2. Marking

ESB LIFTING ANCHOR

Table 3. Materials

Part Name	Material	Material Type	Standard
ESB	S355J2	Uncoated	EN 10025
ESBez	S355J2	Electro-Zincd	EN 10025
ESBhdg	S355J2	Hot-Dip Galvanized	EN 10025
ESBs	1.4301	Stainless Steel	EN 10088
ESBa	1.4401	Acid Resistant Steel	EN 10088

Components Recommendation

✓ Pipe	✓ Column
✓ Slab	✓ Balcony
✓ Wall	✓ Foundation
✓ Beam	✓ Manhole

Table 4. ESB Lifting Anchor Dimensions (Figure 3)

Color Code							
Load Group		1.3t					
Size		1.3-40	1.3-50	1.3-65	1.3-85	1.3-120	1.3-240
	H [mm]	40	50	65	85	120	240
	D1 [mm]	18	18	18	18	18	18
	D2 [mm]	25	25	25	25	25	25
	d [mm]	10	10	10	10	10	10
Color Code							
Load Group		2.5t					
Size		2.5-55	2.5-65	2.5-85	2.5-120	2.5-170	2.5-280
	H [mm]	55	65	85	120	170	280
	D1 [mm]	25	25	25	25	25	25
	D2 [mm]	35	35	35	35	35	35
	d [mm]	14	14	14	14	14	14
Color Code							
Load Group		4.0t					
Size		4.0-75	4.0-100	4.0-120	4.0-170	4.0-210	4.0-340
	H [mm]	75	100	120	170	210	340
	D1 [mm]	36	36	36	36	36	36
	D2 [mm]	45	45	45	45	45	45
	d [mm]	18	18	18	18	18	18

Color Code								
Load Group		5.0t						
Size		5.0-85	5.0-95	5.0-120	5.0-180	5.0-240	5.0-340	5.0-480
	H [mm]	85	95	120	180	240	340	480
	D1 [mm]	36	36	36	36	36	36	36
	D2 [mm]	50	50	50	50	50	50	50
	d [mm]	20	20	20	20	20	20	20
Color Code								
Load Group		7.5t						
Size		7.5-100	7.5-120	7.5-140	7.5-165	7.5-200	7.5-300	7.5-540
	H [mm]	100	120	140	165	200	300	540
	D1 [mm]	46	46	46	46	46	46	46
	D2 [mm]	60	60	60	60	60	60	60
	d [mm]	24	24	24	24	24	24	24
Color Code								
Load Group		10.0t						
Size		10.0-115	10.0-135	10.0-150	10.0-170	10.0-250	10.0-340	10.0-680
	H [mm]	115	135	150	170	250	340	680
	D1 [mm]	46	46	46	46	46	46	46
	D2 [mm]	70	70	70	70	70	70	70
	d [mm]	28	28	28	28	28	28	28
Color Code								
Load Group		15.0t						
Size		15.0-140	15.0-165	15.0-200	15.0-300	15.0-400	15.0-840	
	H [mm]	140	165	200	300	400	840	
	D1 [mm]	69	69	69	69	69	69	
	D2 [mm]	85	85	85	85	85	85	
	d [mm]	34	34	34	34	34	34	
Color Code								
Load Group		20.0t						
Size		20.0-200	20.0-240	20.0-250	20.0-340	20.0-500	20.0-1000	
	H [mm]	200	240	250	340	500	1000	
	D1 [mm]	69	69	69	69	69	69	
	D2 [mm]	98	98	98	98	98	98	
	d [mm]	38	38	38	38	38	38	

Color Code				
Load Group		32.0t		
Size		32.0-320	32.0-700	32.0-1200
	H [mm]	320	700	1200
	D1 [mm]	88	88	88
	D2 [mm]	135	135	135
	d [mm]	50	50	50

Table 5. Safe Working Load (SWL) for ESB Lifting Anchor in Wall Elements (Figure 4)

Load Group		1.3t								
Lifting Anchor		1.3-85			1.3-120			1.3-240		
Wall Thickness, B [mm]		60	80	100	60	80	100	60	80	100
$\beta = 0^\circ - 45^\circ$	C12/15	10.33	10.93	11.54	10.18	10.64	11.10	9.52	9.75	9.99
	C16/20	11.94	13.00	13.00	11.94	13.00	13.00	11.94	13.00	13.00
	C20/25	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
	C28/35	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
$\gamma = 0^\circ - 90^\circ$	C12/15	5.16	5.47	5.77	5.09	5.32	5.55	4.76	4.88	4.99
	C16/20	5.97	6.50	6.50	5.97	6.50	6.50	5.97	6.50	6.50
	C20/25	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
	C28/35	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
Load Group		2.5t								
Lifting Anchor		2.5-120			2.5-170			2.5-280		
Wall Thickness, B [mm]		80	100	120	80	100	120	80	100	120
$\beta = 0^\circ - 45^\circ$	C12/15	18.33	19.12	19.91	19.43	20.76	21.41	19.10	19.51	19.91
	C16/20	21.16	22.08	22.99	22.44	25.00	25.00	22.44	25.00	25.00
	C20/25	23.66	24.68	25.00	25.00	25.00	25.00	25.00	25.00	25.00
	C28/35	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
$\gamma = 0^\circ - 90^\circ$	C12/15	9.16	9.56	9.95	9.72	10.38	10.71	9.55	9.75	9.96
	C16/20	10.58	11.04	11.49	11.22	12.50	12.50	11.22	12.50	12.50
	C20/25	11.83	12.34	12.50	12.50	12.50	12.50	12.50	12.50	12.50
	C28/35	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50

Load Group		4.0t									
Lifting Anchor		4.0-170			4.0-210			4.0-340			
Wall Thickness, B [mm]		120	140	160	120	140	160	120	140	160	
	$\beta = 0^\circ - 45^\circ$	C12/15	31.37	32.31	33.26	34.66	35.55	36.43	31.48	32.71	33.27
		C16/20	36.22	37.31	38.40	40.00	40.00	40.00	36.36	40.00	40.00
		C20/25	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
		C28/35	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
	$\gamma = 0^\circ - 90^\circ$	C12/15	15.69	16.16	16.63	17.33	17.77	18.21	15.74	16.35	16.63
		C16/20	18.11	18.66	19.20	20.00	20.00	20.00	18.18	20.00	20.00
		C20/25	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
		C28/35	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Load Group		5.0t									
Lifting Anchor		5.0-240			5.0-340			5.0-480			
Wall Thickness, B [mm]		160	180	200	120	140	160	100	20	140	
	$\beta = 0^\circ - 45^\circ$	C12/15	45.46	46.45	47.44	41.78	42.49	43.20	35.58	40.57	41.08
		C16/20	50.00	50.00	50.00	49.31	50.00	50.00	41.09	49.31	50.00
		C20/25	50.00	50.00	50.00	50.00	50.00	50.00	45.94	50.00	50.00
		C28/35	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
	$\gamma = 0^\circ - 90^\circ$	C12/15	22.73	23.23	23.72	20.89	21.25	21.60	17.79	20.28	20.54
		C16/20	25.00	25.00	25.00	24.65	25.00	25.00	20.54	24.65	25.00
		C20/25	25.00	25.00	25.00	25.00	25.00	25.00	22.97	25.00	25.00
		C28/35	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Load Group		7.5t									
Lifting Anchor		7.5-200			7.5-300			7.5-540			
Wall Thickness, B [mm]		160	180	200	160	180	200	140	160	180	
	$\beta = 0^\circ - 45^\circ$	C12/15	39.97	40.98	42.00	63.27	64.43	65.59	58.56	59.21	59.87
		C16/20	46.16	47.32	48.49	75.00	75.00	75.00	69.00	75.00	75.00
		C20/25	51.60	52.91	54.22	75.00	75.00	75.00	75.00	75.00	75.00
		C28/35	61.06	62.60	64.15	75.00	75.00	75.00	75.00	75.00	75.00
	$\gamma = 0^\circ - 90^\circ$	C12/15	19.99	20.49	21.00	31.63	32.21	32.79	29.28	29.61	29.93
		C16/20	23.08	23.66	24.25	37.50	37.50	37.50	34.50	37.50	37.50
		C20/25	25.80	26.46	27.11	37.50	37.50	37.50	37.50	37.50	37.50
		C28/35	30.53	31.30	32.08	37.50	37.50	37.50	37.50	37.50	37.50

Load Group		10.0t												
Lifting Anchor		10.0-170			10.0-250			10.0-340			10.0-680			
Wall Thickness, B [mm]		200	240	280	200	240	280	200	240	280	160	180	200	
	$\beta = 0^\circ - 45^\circ$	C12/15	34.67	36.54	38.41	55.17	57.43	59.68	81.65	84.27	86.88	81.40	83.36	84.10
		C16/20	40.03	42.19	44.36	63.71	66.31	68.91	94.28	97.30	100.00	94.00	100.00	100.00
		C20/25	44.75	47.17	49.59	71.23	74.14	77.04	100.00	100.00	100.00	100.00	100.00	100.00
		C28/35	52.95	55.81	58.68	84.28	87.72	91.16	100.00	100.00	100.00	100.00	100.00	100.00
	$\gamma = 0^\circ - 90^\circ$	C12/15	17.33	18.27	19.21	27.59	28.71	29.84	40.83	42.13	43.44	40.70	41.68	42.05
		C16/20	20.01	21.10	22.18	31.85	33.16	34.46	47.14	48.65	50.00	47.00	50.00	50.00
		C20/25	22.38	23.59	24.80	35.61	37.07	38.52	50.00	50.00	50.00	50.00	50.00	50.00
		C28/35	26.48	27.91	29.34	42.14	43.86	45.58	50.00	50.00	50.00	50.00	50.00	50.00
Load Group		15.0t												
Lifting Anchor		15.0-300			15.0-400			15.0-840						
Wall Thickness, B [mm]		300	400	500	300	400	500	200	220	240				
	$\beta = 0^\circ - 45^\circ$	C12/15	75.16	81.29	87.42	107.65	114.71	121.77	96.98	97.68	98.39			
		C16/20	86.78	93.86	100.95	124.31	132.46	140.61	127.22	130.24	131.19			
		C20/25	97.03	104.94	112.86	138.98	148.09	150.00	142.23	150.00	150.00			
		C28/35	114.80	124.17	133.54	150.00	150.00	150.00	150.00	150.00	150.00			
	$\gamma = 0^\circ - 90^\circ$	C12/15	37.58	40.64	43.71	53.83	57.36	60.88	48.49	48.84	49.19			
		C16/20	43.39	46.93	50.47	62.15	66.23	70.30	63.61	65.12	65.59			
		C20/25	48.51	52.47	56.43	69.49	74.05	75.00	71.12	75.00	75.00			
		C28/35	57.40	62.09	66.77	75.00	75.00	75.00	75.00	75.00	75.00			
Load Group		20.0t												
Lifting Anchor		20.0-340			20.0-500			20.0-1000						
Wall Thickness, B [mm]		400	500	600	400	500	600	240	260	280				
	$\beta = 0^\circ - 45^\circ$	C12/15	93.72	100.23	106.73	151.03	158.89	166.75	162.38	163.37	164.37			
		C16/20	108.22	115.73	123.24	174.39	183.47	192.55	197.46	200.00	200.00			
		C20/25	121.00	129.39	137.79	194.98	200.00	200.00	200.00	200.00	200.00			
		C28/35	143.17	153.10	163.04	200.00	200.00	200.00	200.00	200.00	200.00			
	$\gamma = 0^\circ - 90^\circ$	C12/15	46.86	50.11	53.37	75.51	79.44	83.38	81.19	81.69	82.19			
		C16/20	54.11	57.87	61.62	87.20	91.73	96.27	98.73	100.00	100.00			
		C20/25	60.50	64.70	68.90	97.49	100.00	100.00	100.00	100.00	100.00			
		C28/35	71.58	76.55	81.52	100.00	100.00	100.00	100.00	100.00	100.00			

Load Group		32.0t								
Lifting Anchor		32.0-320			32.0-700			32.0-1200		
Wall Thickness, B [mm]		450	550	650	450	550	650	300	350	400
$\beta = 0^\circ - 45^\circ$	C12/15	92.32	98.70	105.07	241.38	250.70	260.03	305.07	320.00	320.00
	C16/20	106.61	113.96	121.32	278.72	289.49	300.25	320.00	320.00	320.00
	C20/25	119.19	127.42	135.64	311.62	320.00	320.00	320.00	320.00	320.00
	C28/35	141.03	150.76	160.49	320.00	320.00	320.00	320.00	320.00	320.00
$\gamma = 0^\circ - 90^\circ$	C12/15	46.16	49.35	52.53	120.69	125.35	130.01	152.53	160.00	160.00
	C16/20	53.30	56.98	60.66	139.36	144.74	150.13	160.00	160.00	160.00
	C20/25	59.59	63.71	67.82	155.81	160.00	160.00	160.00	160.00	160.00
	C28/35	70.51	75.38	80.25	160.00	160.00	160.00	160.00	160.00	160.00

Table 6. Safe Working Load (SWL) for ESB Lifting Anchor in Slab Elements (Figure 4)

Load Group		1.3t					
Lifting Anchor		1.3-40	1.3-50	1.3-65	1.3-85	1.3-120	1.3-240
Slab Thickness, B [mm]		70	80	95	115	150	270
$\beta = 0^\circ - 45^\circ$	C12/15	6.97	9.25	13.00	13.00	13.00	13.00
	C16/20	8.04	10.69	13.00	13.00	13.00	13.00
	C20/25	8.99	11.95	13.00	13.00	13.00	13.00
	C28/35	10.64	13.00	13.00	13.00	13.00	13.00
Load Group		2.5t					
Lifting Anchor		2.5-55	2.5-65	2.5-85	2.5-120	2.5-170	2.5-280
Slab Thickness, B [mm]		86	96	116	151	201	311
$\beta = 0^\circ - 45^\circ$	C12/15	10.48	13.07	18.79	25.00	25.00	25.00
	C16/20	12.10	15.09	21.70	25.00	25.00	25.00
	C20/25	13.52	16.87	24.26	25.00	25.00	25.00
	C28/35	16.00	19.96	25.00	25.00	25.00	25.00
Load Group		4.0t					
Lifting Anchor		4.0-75	4.0-100	4.0-120	4.0-170	4.0-210	4.0-340
Slab Thickness, B [mm]		110	135	155	205	245	375
$\beta = 0^\circ - 45^\circ$	C12/15	17.00	24.83	31.77	40.00	40.00	40.00
	C16/20	19.63	28.67	36.69	40.00	40.00	40.00
	C20/25	21.95	32.06	40.00	40.00	40.00	40.00
	C28/35	25.97	37.93	40.00	40.00	40.00	40.00

Load Group		5.0t						
Lifting Anchor		5.0-85	5.0-95	5.0-120	5.0-180	5.0-240	5.0-340	5.0-480
Slab Thickness, B [mm]		120	130	155	215	275	375	515
	$\beta = 0^\circ - 45^\circ$	C12/15	20.01	23.19	31.77	50.00	50.00	50.00
		C16/20	23.11	26.77	36.69	50.00	50.00	50.00
		C20/25	25.84	29.93	41.02	50.00	50.00	50.00
		C28/35	10.64	35.42	48.53	50.00	50.00	50.00
Load Group		7.5t						
Lifting Anchor		7.5-100	7.5-120	7.5-140	7.5-165	7.5-200	7.5-300	7.5-540
Slab Thickness, B [mm]		135	155	175	200	235	335	575
	$\beta = 0^\circ - 45^\circ$	C12/15	24.17	31.05	38.49	48.50	63.75	75.00
		C16/20	27.91	35.86	44.44	56.00	73.62	75.00
		C20/25	31.20	40.09	49.69	62.61	75.00	75.00
		C28/35	36.92	47.43	58.79	74.08	75.00	75.00
Load Group		10.0t						
Lifting Anchor		10.0-115	10.0-135	10.0-150	10.0-170	10.0-250	10.0-340	10.0-680
Slab Thickness, B [mm]		150	170	185	205	285	375	715
	$\beta = 0^\circ - 45^\circ$	C12/15	29.28	36.58	42.40	50.59	87.83	100.00
		C16/20	33.81	42.24	48.96	58.42	100.00	100.00
		C20/25	37.80	47.22	54.74	65.31	100.00	100.00
		C28/35	44.72	55.87	64.77	77.28	100.00	100.00
Load Group		15.0t						
Lifting Anchor		15.0-140	15.0-165	15.0-200	15.0-300	15.0-400	15.0-840	
Slab Thickness, B [mm]		175	200	235	335	435	875	
	$\beta = 0^\circ - 45^\circ$	C12/15	37.91	47.88	63.07	113.52	150.00	150.00
		C16/20	43.78	55.28	72.83	131.08	150.00	150.00
		C20/25	48.94	61.81	81.43	146.55	150.00	150.00
		C28/35	57.91	73.13	96.34	150.00	150.00	150.00
Load Group		20.0t					32.0t	
Lifting Anchor		20.0-200	20.0-240	20.0-250	20.0-340	20.0-500	32.0-320	
Slab Thickness, B [mm]		235	275	285	375	535	363	
	$\beta = 0^\circ - 45^\circ$	C12/15	62.39	81.32	86.31	135.42	200.00	127.30
		C16/20	72.04	93.91	99.67	156.36	200.00	147.00
		C20/25	80.55	104.99	111.43	174.82	200.00	164.35
		C28/35	95.31	124.22	131.84	200.00	200.00	194.46

Table 7. Minimum Thickness & Spacing of Anchors for ESB Lifting for Wall (Figure 4)

Load Group		1.3t			2.5t			4.0t			
Lifting Anchor		1.3-85	1.3-120	1.3-240	2.5-120	2.5-170	2.5-280	4.0-170	4.0-210	4.0-340	
Wall Thickness, B [mm]		60	60	60	80	80	80	120	120	100	
	Minimum Edge Distance, X/2 [mm]	140	195	375	195	270	435	275	335	530	
	Minimum Centre to Centre Distance, X [mm]	280	390	750	390	540	870	550	670	1060	
Load Group		5.0t			7.5t			10.0t			
Lifting Anchor		5.0-240	5.0-340	5.0-480	7.5-200	7.5-300	7.5-540	10.0-170	10.0-250	10.0-340	10.0-680
Wall Thickness, B [mm]		160	120	100	160	160	140	200	200	200	160
	Minimum Edge Distance, X/2 [mm]	380	530	740	315	465	825	270	390	525	1035
	Minimum Centre to Centre Distance, X [mm]	760	1060	1480	630	930	1650	540	780	1050	2070
Load Group		15.0t			20.0t			32.0t			
Lifting Anchor		15.0-300	15.0-400	15.0-840	20.0-340	20.0-500	20.0-1000	32.0-320	32.0-700	32.0-1200	
Wall Thickness, B [mm]		300	300	200	400	400	240	450	450	300	
	Minimum Edge Distance, X/2 [mm]	465	615	1275	525	765	1515	500	1070	1820	
	Minimum Centre to Centre Distance, X [mm]	930	1230	2550	1050	1530	3030	1000	2140	3640	

Table 8. Minimum Thickness & Spacing of Anchors for ESB Lifting for Slab (Figure 4)

Load Group		1.3t					
Lifting Anchor		1.3-40	1.3-50	1.3-65	1.3-85	1.3-120	1.3-240
Slab Thickness, B [mm]		70	80	95	115	150	270
	Minimum Edge Distance, X/2 [mm]	75	90	110	140	195	375
	Minimum Centre to Centre Distance, X [mm]	150	180	220	280	390	750
Load Group		2.5t					
Lifting Anchor		2.5-55	2.5-65	2.5-85	2.5-120	2.5-170	2.5-280
Slab Thickness, B [mm]		86	96	116	151	201	311
	Minimum Edge Distance, X/2 [mm]	95	110	140	195	270	435
	Minimum Centre to Centre Distance, X [mm]	190	220	280	390	540	870

Load Group		4.0t						
Lifting Anchor		4.0-75	4.0-100	4.0-120	4.0-170	4.0-210	4.0-340	
Slab Thickness, B [mm]		110	135	155	205	245	375	
	Minimum Edge Distance, X/2 [mm]	135	170	200	275	335	530	
	Minimum Centre to Centre Distance, X [mm]	270	340	400	550	670	1060	
Load Group		5.0t						
Lifting Anchor		5.0-85	5.0-95	5.0-120	5.0-180	5.0-240	5.0-340	5.0-480
Slab Thickness, B [mm]		120	130	155	215	275	375	515
	Minimum Edge Distance, X/2 [mm]	150	165	200	290	380	530	740
	Minimum Centre to Centre Distance, X [mm]	300	330	400	580	760	1060	1480
Load Group		7.5t						
Lifting Anchor		7.5-100	7.5-120	7.5-140	7.5-165	7.5-200	7.5-300	7.5-540
Slab Thickness, B [mm]		135	155	175	200	235	335	575
	Minimum Edge Distance, X/2 [mm]	165	195	225	265	315	465	825
	Minimum Centre to Centre Distance, X [mm]	330	390	450	530	630	930	1650
Load Group		10.0t						
Lifting Anchor		10.0-115	10.0-135	10.0-150	10.0-170	10.0-250	10.0-340	10.0-680
Slab Thickness, B [mm]		150	170	185	205	285	375	715
	Minimum Edge Distance, X/2 [mm]	190	220	240	270	390	525	1035
	Minimum Centre to Centre Distance, X [mm]	380	440	480	540	780	1050	2070
Load Group		15.0t						
Lifting Anchor		15.0-140	15.0-165	15.0-200	15.0-300	15.0-400	15.0-840	
Slab Thickness, B [mm]		175	200	235	335	435	875	
	Minimum Edge Distance, X/2 [mm]	225	265	315	465	615	1275	
	Minimum Centre to Centre Distance, X [mm]	450	530	630	930	1230	2550	
Load Group		20.0t					32.0t	
Lifting Anchor		20.0-200	20.0-240	20.0-250	20.0-340	20.0-500	32.0-320	
Slab Thickness, B [mm]		235	275	285	375	535	363	
	Minimum Edge Distance, X/2 [mm]	315	375	390	525	765	500	
	Minimum Centre to Centre Distance, X [mm]	630	750	780	1050	1530	1000	

Table 9. Diagonal Reinforcement for ESB Lifting Anchor (Figure 5)

Load Group (t)	1.3	2.5	4.0	5.0	7.5	10.0	15.0	20.0	32.0-700	32.0-1200
Mesh Reinforcement, 1 [mm ² /m]	2 x 80	2 x 100	2 x 130	2 x 140	2 x 180	2 x 200	2 x 240	2 x 350	2 x 500	2 x 500
Stirrup, 2	Pcs.	2	2	2	2	4	4	4	6	8
	Diameter [mm]	6	8	8	10	10	10	12	12	12
	Length [mm]	400	500	600	700	700	700	800	1000	1700
Edge Reinforcement, 3 (both sides)	10	10	10	12	12	12	16	16	16	16
Angle Pull Reinforcement, 4 (∅ - L)	8-895	10-1120	12-1350	16-1450	16-1590	20-1990	25-2255	25-2655	28-3425	28-3425

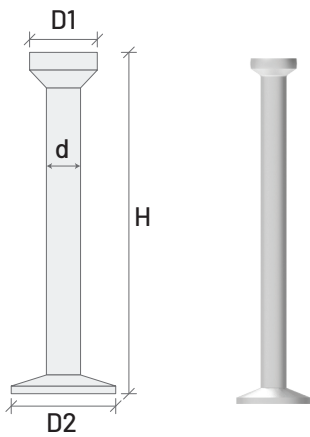


Figure 3

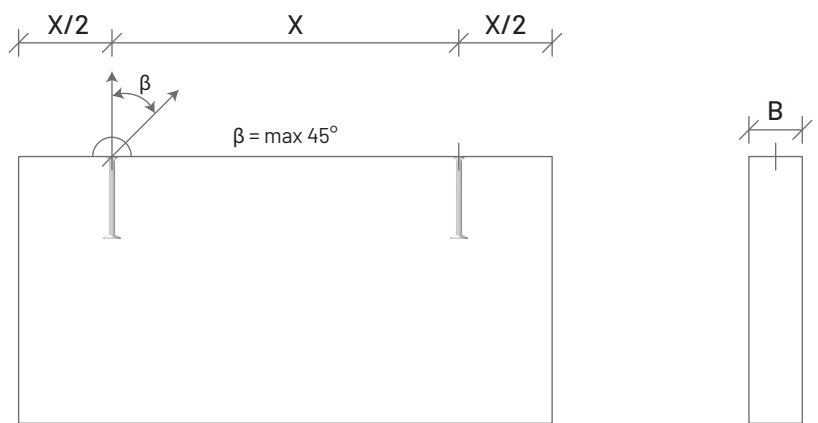


Figure 4

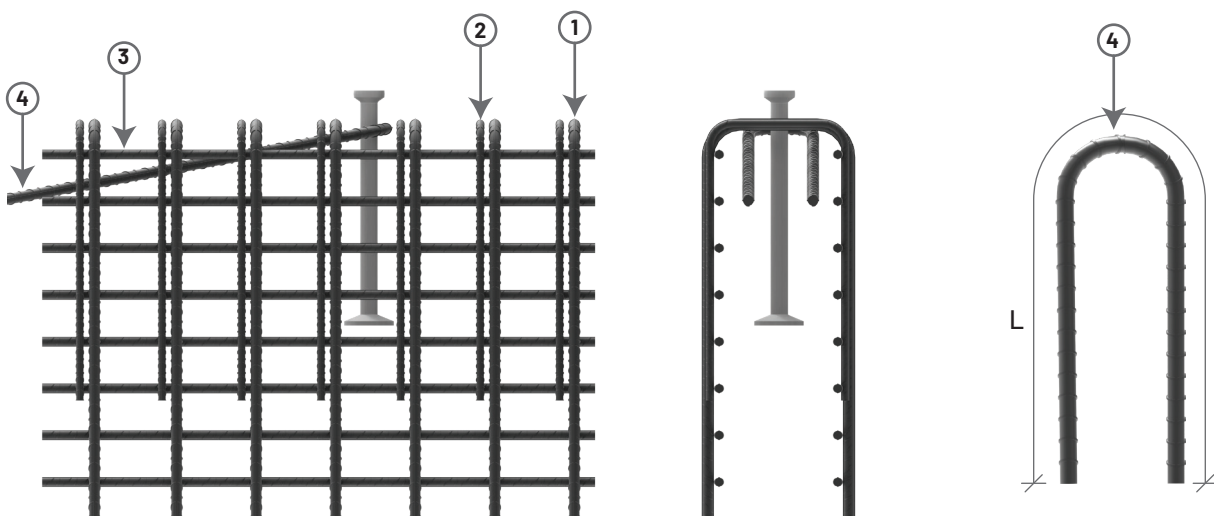


Figure 5

ESBB LIFTING ANCHOR

Table 10. Materials

Part Name	Material	Material Type	Standard
ESBB	S355J2	Uncoated	EN 10025
ESBBez	S355J2	Electro-Zincd	EN 10025
ESBBhdg	S355J2	Hot-Dip Galvanized	EN 10025
ESBBs	1.4301	Stainless Steel	EN 10088
ESBBa	1.4401	Acid Resistant Steel	EN 10088

Components Recommendation

✓ Sandwich Panels

Table 11. ESBB Lifting Anchor Dimensions (Figure 6)

Color Code							
Load Group		2.5t	5.0t			7.5t	10.0t
	H [mm]	265	406	466-1	466-2	664	667
	ØD1 [mm]	25	36	36	36	46	46
	ØD2 [mm]	35	50	50	50	60	70
	d [mm]	14	20	20	20	24	28

Table 12. Safe Working Load (SWL) for ESBB Lifting Anchor in Wall Elements (Figure 7)

Load Group		2.5t			5.0t					
Lifting Anchor		2.5-265			5.0-406			5.0-466-1		
Wall Thickness, B [mm]		80	100	120	120	140	160	120	140	160
$\beta = 0^\circ - 45^\circ$	C12/15	17.84	17.84	17.84	41.43	41.43	41.43	40.98	40.98	40.98
	C16/20	21.63	21.63	21.63	49.50	49.50	49.50	49.50	49.50	49.50
	C20/25	24.19	24.19	24.19	50.00	50.00	50.00	50.00	50.00	50.00
	C28/35	25.00	25.00	25.00	50.00	50.00	50.00	50.00	50.00	50.00
$\gamma = 0^\circ - 90^\circ$	C12/15	8.92	8.92	8.92	20.71	20.71	20.71	20.49	20.49	20.49
	C16/20	10.82	10.82	10.82	24.75	24.75	24.75	24.75	24.75	24.75
	C20/25	12.09	12.09	12.09	25.00	25.00	25.00	25.00	25.00	25.00
	C28/35	12.50	12.50	12.50	25.00	25.00	25.00	25.00	25.00	25.00

Load Group		5.0t			7.5t			10.0t		
Lifting Anchor		5.0-466-2			7.5-664			10.0-667		
Wall Thickness, B [mm]		160	180	200	160	180	200	200	240	280
$\beta = 0^\circ - 45^\circ$	C12/15	42.03	42.03	42.03	61.65	61.65	61.65	81.69	81.69	81.69
	C16/20	50.00	50.00	50.00	75.00	75.00	75.00	100.00	100.00	100.00
	C20/25	50.00	50.00	50.00	75.00	75.00	75.00	100.00	100.00	100.00
	C28/35	50.00	50.00	50.00	75.00	75.00	75.00	100.00	100.00	100.00
$\gamma = 0^\circ - 90^\circ$	C12/15	21.02	21.02	21.02	30.83	30.83	30.83	40.85	40.85	40.85
	C16/20	25.00	25.00	25.00	37.50	37.50	37.50	50.00	50.00	50.00
	C20/25	25.00	25.00	25.00	37.50	37.50	37.50	50.00	50.00	50.00
	C28/35	25.00	25.00	25.00	37.50	37.50	37.50	50.00	50.00	50.00

Table 13. Minimum Thickness & Spacing of Anchors for ESBB Lifting for Wall (Figure 7)

Load Group		2.5t			5.0t		
Lifting Anchor		2.5-265	2.5-265	2.5-265	5.0-406	5.0-406	5.0-406
Wall Thickness, B [mm]		80	100	120	120	140	160
	Minimum Edge Distance, X/2 [mm]	410	410	410	630	630	630
	Minimum Centre to Centre Distance, X [mm]	820	820	820	1260	1260	1260
Load Group		5.0t			5.0t		
Lifting Anchor		5.0-466-1	5.0-466-1	5.0-466-1	5.0-466-2	5.0-466-2	5.0-466-2
Wall Thickness, B [mm]		120	140	160	160	180	200
	Minimum Edge Distance, X/2 [mm]	720	720	720	720	720	720
	Minimum Centre to Centre Distance, X [mm]	1440	1440	1440	1440	1440	1440
Load Group		7.5t			10.0t		
Lifting Anchor		7.5-664	7.5-664	7.5-664	10.0-667	10.0-667	10.0-667
Wall Thickness, B [mm]		160	180	200	200	240	280
	Minimum Edge Distance, X/2 [mm]	1015	1015	1015	1020	1020	1020
	Minimum Centre to Centre Distance, X [mm]	2030	2030	2030	2040	2040	2040

Table 14. Diagonal Reinforcement for ESBB Lifting Anchor (Figure 8)

Load Group	2.5	5.0	5.0	5.0	7.5	10.0
Stirrups, 1 (Ø - L1)	8 - 600	10 - 750	10 - 750	10 - 750	10 - 1000	12 - 1200
Edge Reinforcement, 2 (Both sides)	Ø10	Ø12	Ø12	Ø12	Ø12	Ø12
Mesh Reinforcement, 3 [mm ² /m]	2 x 100	2 x 140	2 x 140	2 x 140	2 x 180	2 x 180
Reinforcement, 4 [Ø - L]	12 - 600	16 - 800	16 - 800	16 - 800	20 - 1000	20 - 1500

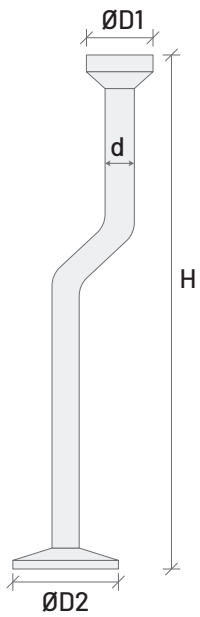


Figure 6

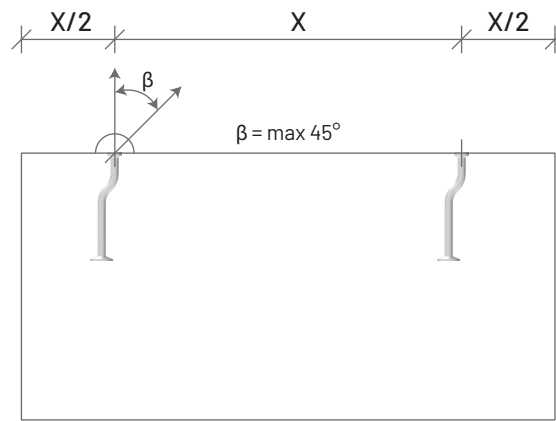


Figure 7

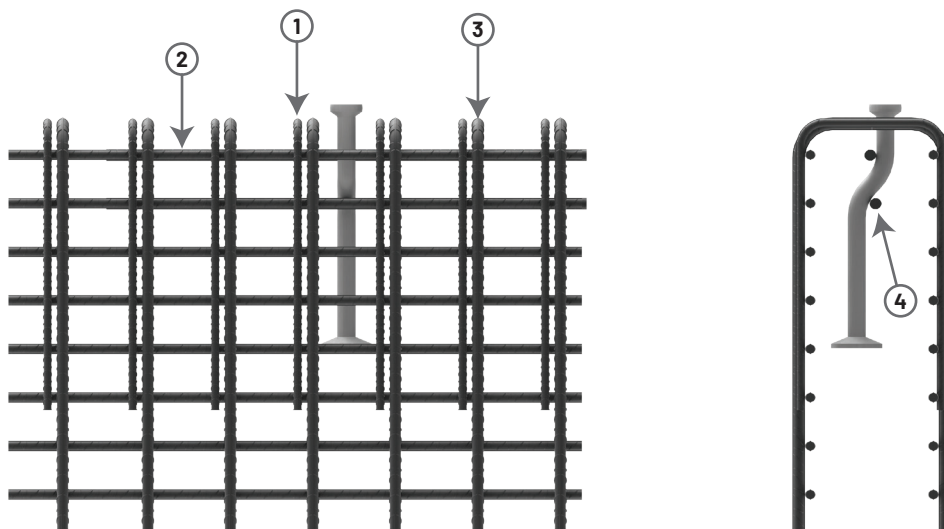


Figure 8

ESE LIFTING ANCHOR

Table 15. Materials

Part Name	Material	Material Type	Standard
ESE	S355J2	Uncoated	EN 10025
ESEez	S355J2	Electro-Zincd	EN 10025
ESEhdg	S355J2	Hot-Dip Galvanized	EN 10025
ESEs	1.4301	Stainless Steel	EN 10088
ESEa	1.4401	Acid Resistant Steel	EN 10088

Components Recommendation

✓ Wall
✓ Column
✓ Joist
✓ Foundation

Table 16. ESE Lifting Anchor

Color Code					
Load Group		1.3t	2.5t	5.0t	10.0t
Dimensions (Figure 9)					
	H [mm]	65	90	120	180
	ØD [mm]	18	25	36	46
	ØD1 [mm]	22	32	43	57
	Øds [mm]	10	14	20	28
Safe Working Load (SWL) in Wall Elements (Figure 10)					
	$\beta = 0^\circ - 30^\circ$	13.0	25.0	50.0	100.0
Minimum Thickness & Spacing of Anchors for Wall (Figure 10)					
	Wall Thickness, B [mm]	80	100	120	150
	Minimum Edge Distance, X/2 [mm]	195	265	380	525
	Minimum Centre to Centre Distance, X [mm]	390	530	760	1050
Reinforcement (Figure 11)					
	Mesh Reinforcement 1 [mm ² /m]	2 x 131	2 x 188	2 x 188	2 x 188
	Edge Reinforcement (both sides) 2	Ø8	Ø8	Ø10	Ø12
	Diagonal pull Reinforcement, 3 (Ø - L2)	8 - 375	10 - 580	16 - 780	20 - 1220

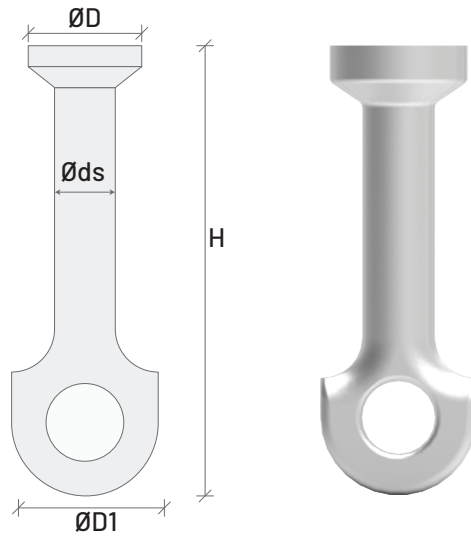


Figure 9

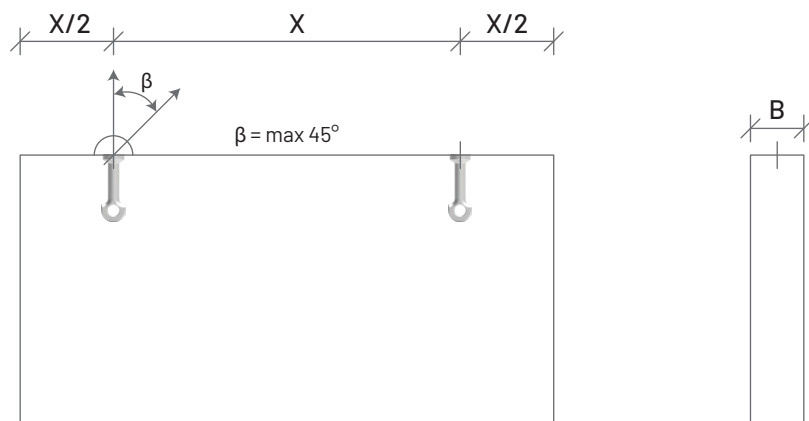


Figure 10

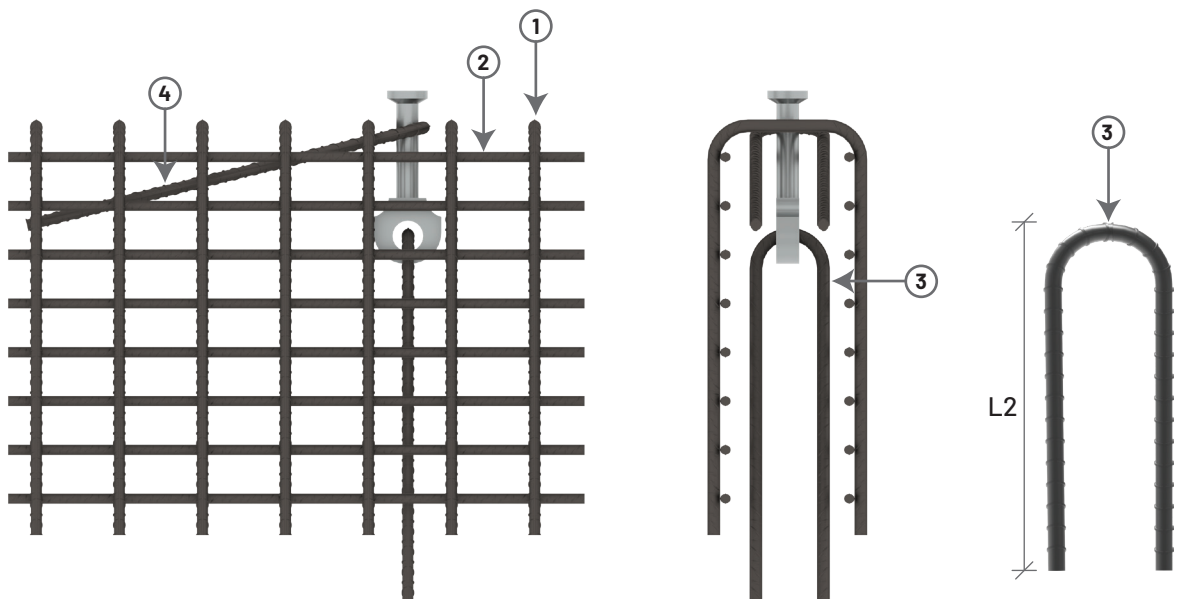
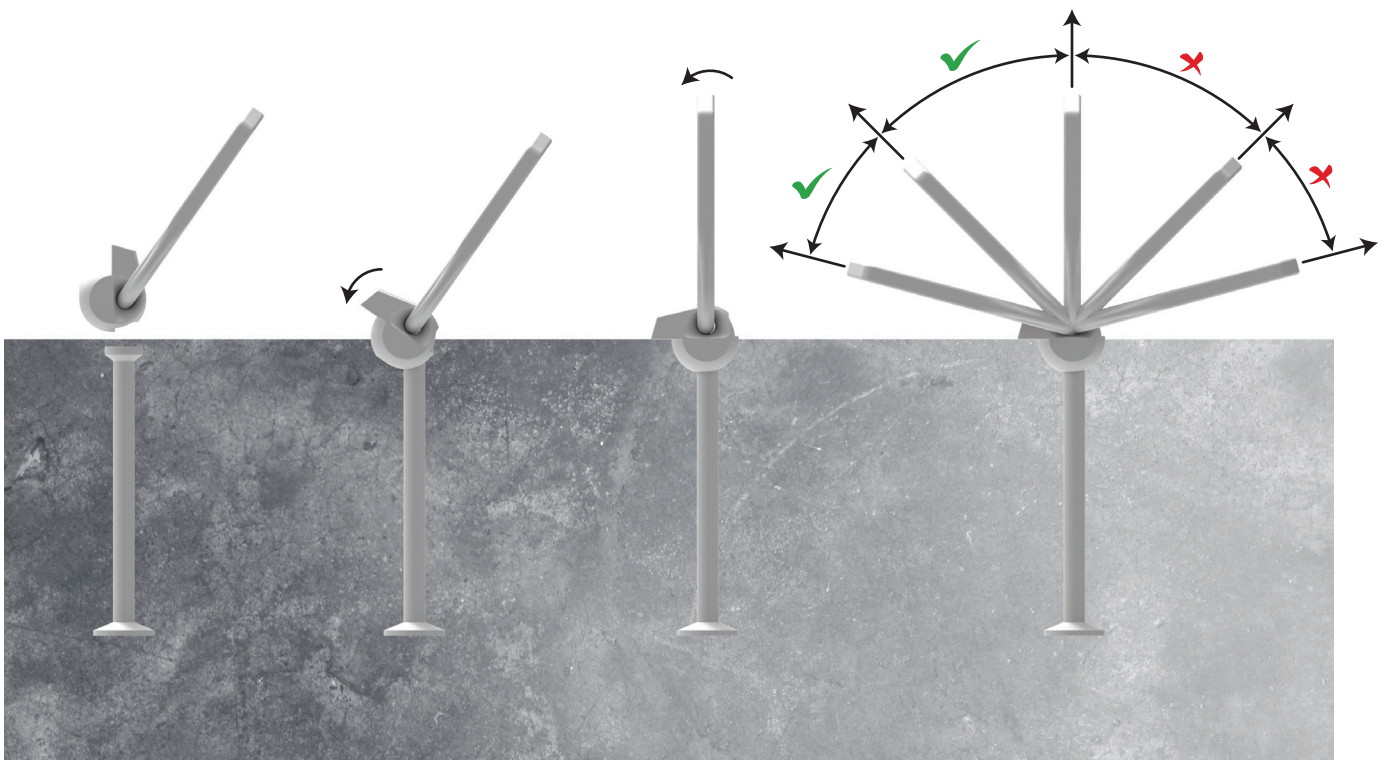


Figure 11

DO'S AND DON'TS



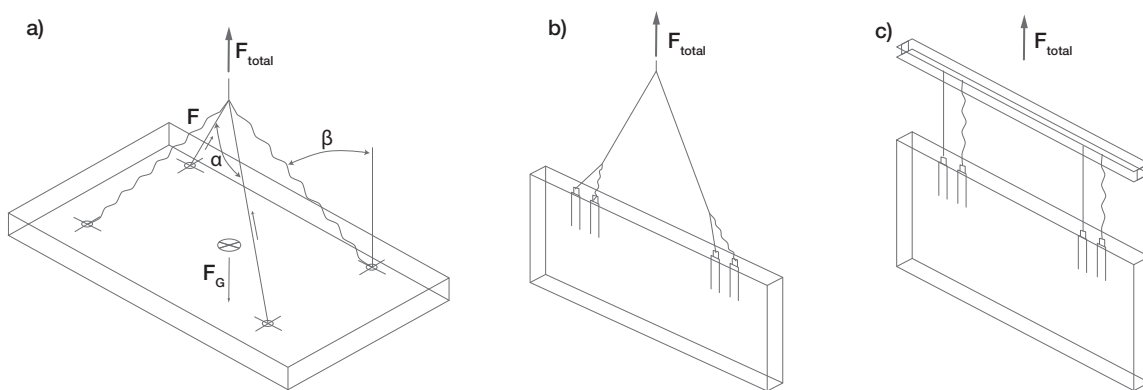
ACTIONS ON LIFTING ANCHOR (AS PER VDI/BV-BS 6205)

The loads acting on a lifting insert shall be determined considering the following factors:

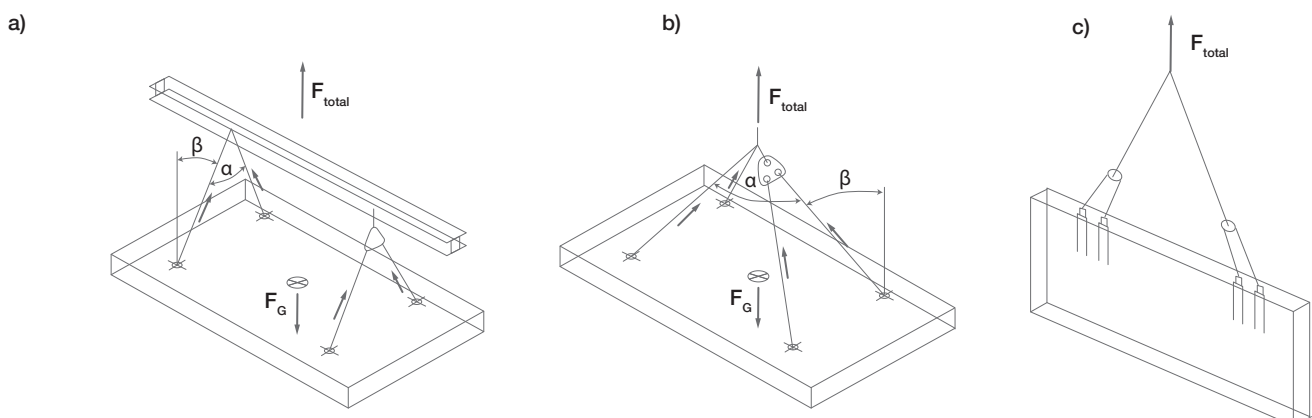
- Statical system
- Element self-weight
- Adhesion and form friction
- Dynamic effects
- Position and number of lifting inserts and type of lifting equipment

4.1 Statistical System

The lifting equipment shall allow a statically determinate load distribution to all present lifting inserts and lifting insert systems. Figures below give examples of statically indeterminate systems where only two lifting inserts carry the load. The load distribution is not clearly defined in these applications. Therefore, statically indeterminate systems shall be avoided.

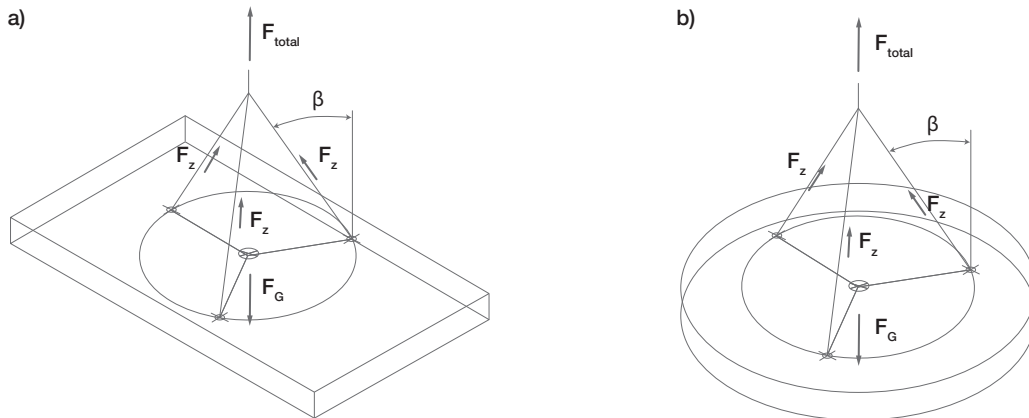


To ensure a statically determinate system and that all lifting inserts carry their required part of the load in case of applications with more than two lifting inserts transport aids such as sliding or rolling couplings or balancing beams shall be used. In below figure, more transportation aids for slabs and wall elements are illustrated.



In case of inclined lifting slings the lifting inserts are loaded by combined tension and shear loads. The inclination β according to figure above (on previous page) governs the level of combined tension and shear loads to be taken into account in the design.

In the special case of three lifting inserts located in a slab located and situated in a star pattern with the same distance to the centre of gravity with equal inclinations of 120° it is ensured that all three lifting inserts experience the same load.



4.2 Element Self-Weight

The weight F_G of precast elements shall be determined as given by equation below

$$F_G = V \cdot \rho_G \text{ where,}$$

F_G Weight of the precast element, in kN

V Volume of the precast element, in m^3

ρ_G Density of the concrete, in kN/m^3

4.3 Adhesion and Form Friction

Adhesion and form friction are assumed to act simultaneously during the lifting of the precast element from the formwork. The actions for demoulding situations shall be determined from equation below

$$F_{adh} = q_{adh} \cdot A_f \text{ where,}$$

F_{adh} Action due to adhesion and form friction, in kN

q_{adh} Basic value of combined adhesion and form friction as per table below, in kN/m^2

A_f Contact area between concrete and formwork, in m^2

Formwork and Condition ^{a)}	q_{adh} kN/m ^{2b)}
Oiled Steel Mould, Oiled Plastic-Coated Plywood	≥ 1.0
Varnished Wooden Mould with Panel Boards	≥ 2.0
Rough Wooden Mould	≥ 3.0

a) Structured surfaces should be considered separately.

b) The area to be used in the calculations is the total contact area between the concrete and the form.

Note: The minimum values of Table above are valid only if suitable measures to reduce adhesion and form friction are taken e.g. casting on tilting or vibrating the formwork during the demoulding process.

4.4 Dynamic Effects

During lifting and handling of the precast elements, the lifting devices are subjected to dynamic actions. The magnitude of the dynamic actions depends on the type of lifting machinery. Dynamic effects shall be taken into account by the dynamic factor ψ_{dyn} . For further guidance values of ψ_{dyn} depending on the lifting machinery and characteristics of the terrain are given in table below.

Condition	Dynamic Factor ψ_{dyn}
Tower Crane, Portal Crane, Mobile Crane	1.3
Lifting and Moving on Flat Terrain	2.5
Lifting and Moving on Rough Terrain	≥ 4

Note: Other values of ψ_{dyn} than given in Table above based on reproducible tests or verified experience can be used in the design. In case of other lifting and handling conditions than reported in Table above the factor ψ_{dyn} shall be determined on the base of tests or engineering judgement.

4.5 Distribution of Load for Asymmetrical Elements

For non-symmetrical installation of lifting anchors (using spreader beam only), the load distribution is as in the equations below

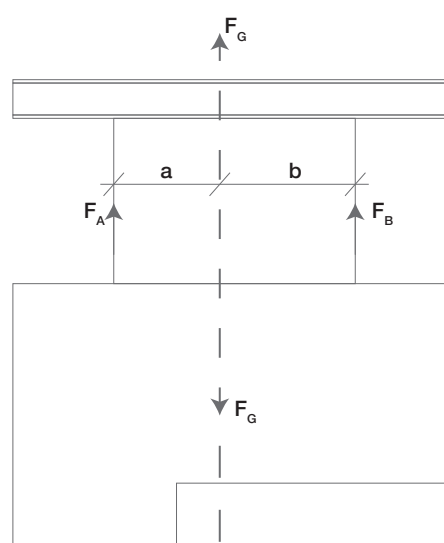
$$F_A = F_G \cdot b / (a + b)$$

$$F_B = F_G \cdot a / (a + b) \text{ where,}$$

F_G Weight of the pre-cast element, in kN

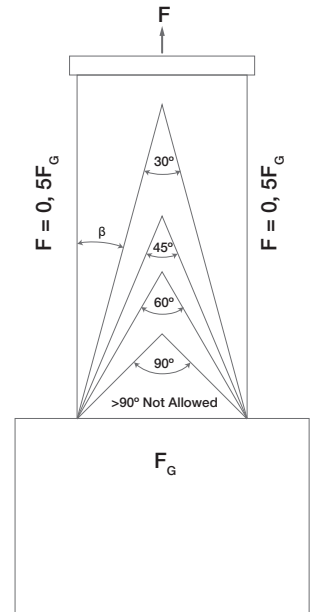
A Distance from insert to centre of gravity, in m

B Distance from insert to centre of gravity, in m



4.6 Spread Angle

Cable Angle (β)	Cable Angle (β)	Cable Angle (β)
0°	-	1.00
7.5°	15°	1.01
15°	30°	1.04
22.5°	45°	1.08
30°	60°	1.15
37.5°	75°	1.26
45°	90°	1.41



4.7 Number and Actions of Lifting Anchors

The number of and the load acting on the lifting insert shall be determined corresponding with the individual lifting situations in accordance with Equations given in the different situations below. The most unfavorable relation from action to resistance resulting from these equations governs the design.

4.7.1 Load Condition "Erection in Combination with Adhesion and Form Friction"

It is assumed that the precast element does not rest one-sided on the form. Then the action F_0 is:

$$F_0 = (F_G + F_{adh}) \cdot z/n \text{ where,}$$

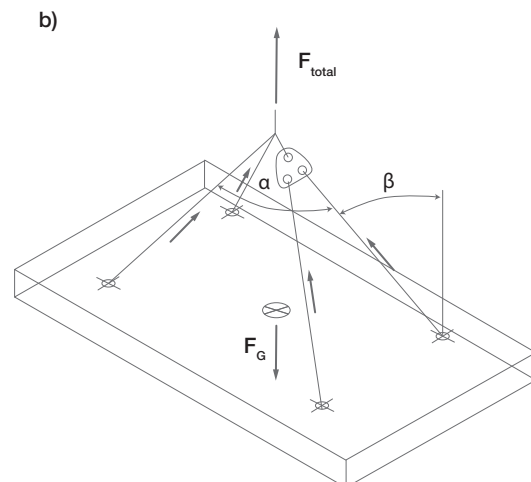
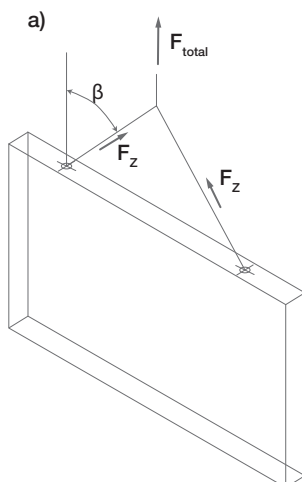
F_0 Load acting on the lifting insert, in kN

F_G Weight of the precast element

F_{adh} Action due to adhesion and form friction

z Factor for combined tension and shear, $z = 1/\cos \beta$ In case of tension $z = 1$

n Number of load carrying lifting inserts



4.7.2 Load Condition "Erection"

It is assumed that the precast element rests one-sided on the form. Then the action F_0 is:

$$F_0 = (F_G / 2) \cdot \Psi_{\text{dyn}} / n \text{ where,}$$

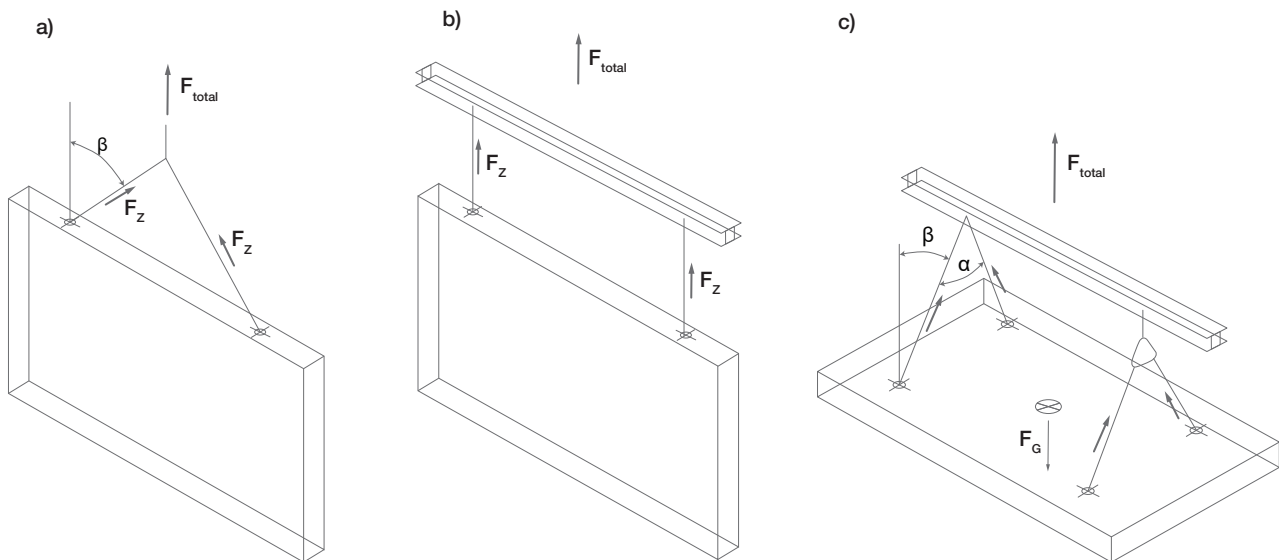
F_0 Shear load acting on the lifting insert (shear) directed perpendicular to the longitudinal axis of the concrete component

F_G Weight of the precast element

Ψ_{dyn} Dynamic factor

n Number of load carrying lifting inserts

4.7.3 Load Condition "Lifting and Handling Under Combined Tension and Shear"



The load condition is shown in the figure below. The action F_z is:

$$F_z = F_G \cdot \Psi_{\text{dyn}} \cdot z / n \text{ where,}$$

F_z Load acting on the lifting insert in direction of the sling axis, in kN

F_G Weight of the precast element

Ψ_{dyn} Dynamic factor as per Table 2

z Factor for combined tension and shear, $z = 1/\cos \beta$ In case of tension $z = 1$

n Number of load carrying lifting inserts



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