

EFP and EHD F.P.

(A Product of Fastening Plate System)

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TECHNICAL MANUAL

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1. INTRODUCTION

Fastening plates are used for connection between steel and concrete members through welding. There are two parts, one is a steel plate, and another is a steel stud welded on the plate, which is then cast into the concrete. They transfer the load from the plate to the concrete structure through welded studs.

2. PRODUCT SPECIFICATION

2.1 Product Dimension

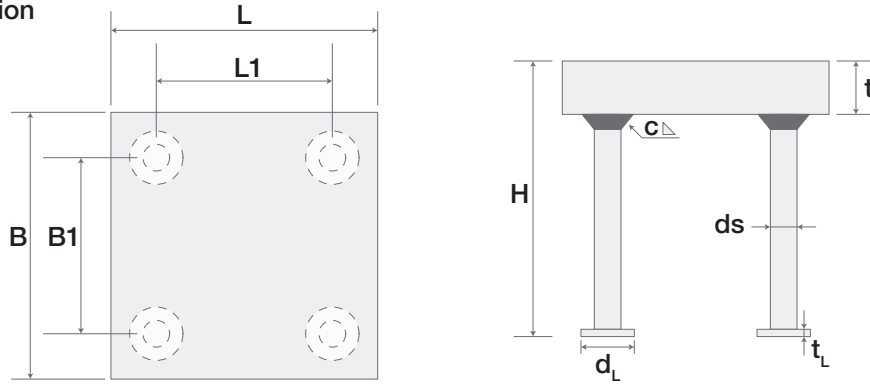


FIGURE 1. EFP FASTENING PLATE DIMENSIONS

TABLE 1. DIMENSIONS OF EFP FASTENING PLATES

L x B [mm] x [mm]	H [mm]	B1 [mm]	L1 [mm]	t [mm]	ds [mm]	d _L [mm]	t _L [mm]
EFP 100x50	68	0	60	8	10	19	7
EFP 100x50	108	0	60	8	10	19	7
EFP 100x100	68	60	60	8	10	19	7
EFP 100x100	108	60	60	8	10	19	7
EFP 150x100	70	60	90	10	10	19	7
EFP 150x100	110	60	90	10	10	19	7
EFP 200x100	72	70	120	12	13	25	8
EFP 200x100	112	70	120	12	13	25	8
EFP 200x100	162	70	120	12	13	25	8
EFP 300x100	165	60	180	15	16	32	8
EFP 150x150	70	90	90	10	10	19	7
EFP 150x150	110	90	90	10	10	19	7
EFP 150x150	162	90	90	12	13	25	8
EFP 200x200	72	120	120	12	13	25	8
EFP 200x200	112	120	120	12	13	25	8
EFP 200x200	162	120	120	12	16	32	8
EFP 300x200	165	120	180	15	16	32	8
EFP 250x250	165	170	170	15	16	32	8
EFP 300x300	165	180	180	15	16	32	8

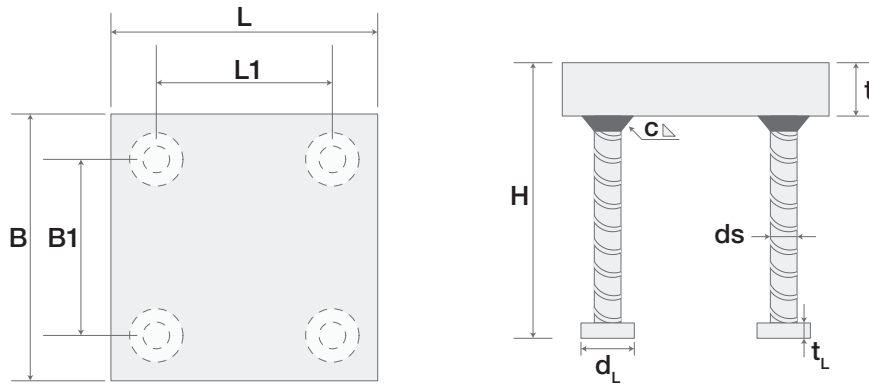


FIGURE 2. EHD FASTENING PLATE DIMENSIONS

TABLE 2. DIMENSIONS OF EFP FASTENING PLATES

L x B [mm] x [mm]	H [mm]	B1 [mm]	L1 [mm]	t [mm]	ds [mm]	d _L [mm]	t _L [mm]
EHD 150x150	220	90	90	25	16	40	6
EHD 150x150	285	90	90	25	16	40	6
EHD 200x150	220	100	120	25	20	50	8
EHD 200x150	355	100	120	25	20	50	8
EHD 250x150	220	100	190	25	20	50	8
EHD 250x150	355	100	190	25	20	50	8
EHD 200x200	220	120	120	25	20	50	8
EHD 200x200	355	120	120	25	20	50	8
EHD 250x200	220	120	190	25	20	50	8
EHD 250x200	355	120	190	25	20	50	8
EHD 300x200	280	120	200	25	25	65	10
EHD 300x200	435	120	200	25	25	65	10
EHD 250x250	220	190	190	25	20	50	8
EHD 250x250	355	190	190	25	20	50	8
EHD 300x300	280	200	200	25	25	65	10
EHD 300x300	435	200	200	25	25	65	10
EHD 300x500	435	133	200	30	25	65	10
EHD 300x500	280	133	200	30	25	65	10
EHD 400x400	280	300	300	30	25	65	10
EHD 400x400	435	300	300	30	25	65	10
EHD 500x500	280	400	400	30	25	65	10
EHD 500x500	435	400	400	30	25	65	10
EHD 600x600	280	500	500	30	25	65	10
EHD 600x600	435	500	500	30	25	65	10

2. PRODUCT SPECIFICATION

2.2 Materials

Fastening plates are available in following materials.

TABLE 2. MATERIALS OF EFP AND EHD FASTENING PLATES

Type	Component	Material	Standard
EFP, EHD	Steel Plate	S355J2+N	SFS – EN 10025
	Anchor	SD1	SFS – EN ISO 13918
EFPa, EFPSa	Steel Plate	1.4301	SFS – EN 10088
	Anchor	SD1	SFS – EN ISO 13918
EFPs, EFPSs	Steel Plate	1.4401	SFS – EN 10088
	Anchor	SD1	SFS – EN ISO 13918
EFPaa, EFPSaa	Steel Plate	1.4301	SFS – EN 10088
	Anchor	SD3	SFS – EN ISO 13918
EFPss, EFPSss	Steel Plate	1.4401	SFS – EN 10088
	Anchor	SD3	SFS – EN ISO 13918

3. RESISTANCES

3.1 Design Resistances (without supplementary reinforcement)

The resistances of EFP, EHD fastening plates have been calculated according to the following guidelines:

- SFS – EN 1992 – 4:2018 (Design of fastenings for use in concrete)
- SFS – EN 1992 (Eurocode 2 Design of concrete structures)
- SFS – EN 1993 (Eurocode 3 Design of steel structures)

The resistances have been calculated for concrete strength of C25/30 with respect to static loads. Cracking can occur in the location of the fastening plate. The design takes into consideration a tolerance of ± 15 mm for the location where load is max.

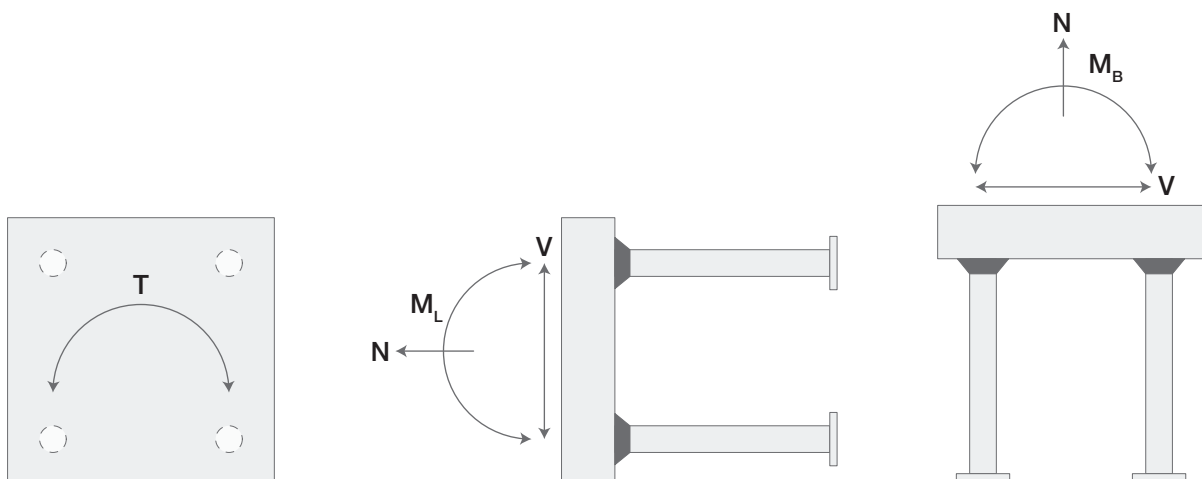


FIGURE 3

TABLE 4. RESISTANCES OF EFP FASTENING PLATES WITHOUT ADDITIONAL REINFORCEMENT

L x B [mm] x [mm]	H [mm]	N [kN]	V [kN]	M _L [kNm]	M _B [kNm]	T [kNm]
EFP 100x50	68	12.5	25.0	0.7	0.2	0.7
EFP 100x50	108	32.0	32.5	1.8	0.5	0.9
EFP 100x100	68	16.5	33.0	0.9	0.9	1.2
EFP 100x100	108	38.0	65.5	2.3	2.3	2.5
EFP 150x100	70	19.5	39.0	1.5	1.1	1.9
EFP 150x100	110	42.0	65.5	3.7	2.6	3.3
EFP 200x100	72	23.0	46.0	2.2	1.4	3.0
EFP 200x100	112	47.0	94.5	5.2	3.1	6.2
EFP 200x100	162	75.5	111.5	8.8	5.1	7.3
EFP 300x100	165	84.0	168.0	13.8	5.5	15.4
EFP 150x150	70	21.5	43.5	1.7	1.7	2.6
EFP 150x150	110	45.5	65.5	4.1	4.1	3.9
EFP 150x150	162	74.5	111.5	6.9	6.9	6.7
EFP 200x200	72	27.5	55.0	2.7	2.7	4.4
EFP 200x200	112	53.5	107.5	6.1	6.1	8.7
EFP 200x200	162	83.0	166.0	10.1	10.1	13.5
EFP 300x200	165	93.5	168.5	15.8	11.6	17.6
EFP 250x250	165	100.0	168.5	15.0	15.0	19.7
EFP 300x300	165	103.0	168.5	17.6	17.6	20.9

The values in table 4 are maximum resistances of EFP fastening plates for individual load effects. The maximum resistances given are values for concrete structures with minimum reinforcement and fastening plate locations according to tables 8 and 9 without additional reinforcement.

3. RESISTANCES

TABLE 5. RESISTANCES OF EHD FASTENING PLATES WITHOUT ADDITIONAL REINFORCEMENT

L x B [mm] x [mm]	H [mm]	N [kN]	V [kN]	M _L [kNm]	M _B [kNm]	T [kNm]
EHD 150x150	220	112.5	143.0	10.3	10.3	8.3
EHD 150x150	285	153.5	143.0	14.1	14.1	8.3
EHD 200x150	220	116.5	229.0	11.5	14.3	17.0
EHD 200x150	355	223.5	229.0	20.6	25.8	17.0
EHD 250x150	220	127.5	236.0	12.7	20.2	24.5
EHD 250x150	355	237.0	236.0	22.7	37.9	24.5
EHD 200x200	220	120.0	235.5	15.0	15.0	19.1
EHD 200x200	355	227.5	235.5	27.8	27.8	19.1
EHD 250x200	220	131.0	239.0	16.6	21.1	26.0
EHD 250x200	355	241.5	239.0	30.3	40.1	26.0
EHD 300x200	280	177.5	355.0	23.0	33.3	40.2
EHD 300x200	435	316.5	374.5	39.8	59.8	42.4
EHD 250x250	220	143.5	249.5	23.3	23.3	32.6
EHD 250x250	355	256.0	249.5	43.3	43.3	32.6
EHD 300x300	280	193.0	386.0	37.0	37.0	53.2
EHD 300x300	435	335.0	391.5	66.0	66.0	54.0
EHD 300x500	435	231.0	462.5	44.9	94.0	50.8
EHD 300x500	280	380.0	742.5	77.3	155.4	81.6
EHD 400x400	280	233.0	404.5	58.1	58.1	84.3
EHD 400x400	435	382.0	404.5	102.9	102.9	84.3
EHD 500x500	280	277.5	411.0	82.3	82.3	114.8
EHD 500x500	435	432.0	411.0	143.4	143.4	114.8
EHD 600x600	280	325.5	415.0	109.5	109.5	145.3
EHD 600x600	435	485.5	415.0	187.6	187.6	145.3

3.2 Resistance for Combined Load Effects

If multiple load effects act simultaneously on EFP, EHD fastening plate the resistance of the fastening plate shall be checked according to the following formula.

$$\left(\frac{N_{Ed}}{N_{Rd}} + 1.8 \left(\frac{M_{EdB}}{M_{RdB}} + \frac{M_{EdL}}{M_{RdL}} \right) \right)^{\frac{2}{3}} + \left(\frac{V_{EdB}}{V_{Rd}} + \frac{V_{EdL}}{V_{Rd}} + \frac{T_{Ed}}{T_{Rd}} \right)^{\frac{2}{3}} \leq 1.0$$

Where subscript Ed means the ultimate limit state value for the dimensioning value of the load effect and Rd the corresponding resistance of the fastening plate.

3.3 Fastening Area

When using resistances given in table 4 & 5, the fastening areas of the steel components to be attached on the EFP fastening plates shall have minimum values according to table 6 & 7.

TABLE 6. MINIMUM FASTENING AREAS OF EFP FASTENING PLATES

Fastening Plate		Minimum Fastening Area			
		EFP		EFPa, EFPs, EFPaa	
		L [mm]	B [mm]	L [mm]	B [mm]
L x B [mm] x [mm]	H [mm]				
EFP 100x50	68	50	20	55	20
EFP 100x50	108	60	20	65	20
EFP 100x100	68	45	45	50	50
EFP 100x100	108	55	55	60	60
EFP 150x100	70	55	45	70	45
EFP 150x100	110	80	45	85	50
EFP 200x100	72	70	45	90	45
EFP 200x100	112	100	45	110	50
EFP 200x100	162	115	50	120	60
EFP 300x100	165	165	45	175	45
EFP 150x150	70	45	45	60	60
EFP 150x150	110	70	70	80	80
EFP 150x150	162	75	75	85	85
EFP 200x200	72	45	45	70	70
EFP 200x200	112	85	85	100	100
EFP 200x200	162	100	100	110	110
EFP 300x200	165	150	75	165	95
EFP 250x250	165	130	130	150	150
EFP 300x300	165	135	135	155	155

3. RESISTANCES

TABLE 7. MINIMUM FASTENING AREAS OF EHD FASTENING PLATES

Fastening Plate L x B [mm] x [mm]		Minimum Fastening Area			
		EHD		EFPSa, EFPsS	
		L [mm]	B [mm]	L [mm]	B [mm]
EHD 150x150	220	40	40	65	20
EHD 150x150	285	60	60	95	20
EHD 200x150	220	35	70	65	50
EHD 200x150	355	70	100	85	60
EHD 250x150	220	25	140	60	45
EHD 250x150	355	65	170	80	50
EHD 200x200	220	55	55	85	45
EHD 200x200	355	90	90	105	50
EHD 250x200	220	45	125	80	60
EHD 250x200	355	85	160	100	45
EHD 300x200	280	55	155	85	60
EHD 300x200	435	90	180	105	80
EHD 250x250	220	115	115	150	85
EHD 250x250	355	155	155	170	70
EHD 300x300	280	135	135	165	100
EHD 300x300	435	170	170	185	110
EHD 300x500	280	65	335	125	95
EHD 300x500	435	125	365	160	150
EHD 400x400	280	185	185	235	155
EHD 400x400	435	240	240	265	20
EHD 500x500	280	265	265	325	20
EHD 500x500	435	325	325	360	360
EHD 600x600	280	350	350	415	415
EHD 600x600	435	415	415	455	455

If the fastening area of the component to be mounted on the fastening plate is smaller than value given in table 3, the resistances of EHD fastening plate need to be reduced according to formula as below:

$$N_{\text{Red.}} = N \times \frac{c - a_0}{c - a_1}$$

where,

$N_{\text{Red.}}$ = Reduced value of resistance

N – Actual value of resistance as per table 4/5

C – Center-to-center distance between anchor studs

a_0 – Length of minimum fastening area (table 6/7)

a_1 – Length of actual fastening area ($a_0 > a_1$)

3.4 Effect of Edge and Center Distance on Resistances

The resistance values of the fastening plates need to be reduced if the distance between EFP, EHD fastening plates at the center or edge are smaller than the values given in table 16 & 17 as per the information below in Table 8 & 9.

TABLE 8. FASTENING PLATE (EFP) RESISTANCE REDUCTION FACTOR WHEN EDGE DISTANCE $C = C_{\text{CR.MIN}}$

Load Effect	Reduction factor when edge distance is $c_{\text{cr.X.min}}$		
	On single side (EFP in edge of structure)	On two sides (EFP in corner or in narrow structure)	On three sides (EFP in edge of narrow structure)
N	0.50	0.33	0.21
M_L and M_R	0.50	0.33	0.21
V and T	0.10	0.07	0.06

TABLE 9. FASTENING PLATE (EHD) RESISTANCE REDUCTION FACTOR WHEN EDGE DISTANCE $C = C_{\text{CR.MIN}}$

Load Effect	Reduction factor when edge distance is $c_{\text{cr.X.min}}$		
	On single side (EHD in edge of structure)	On two sides (EHD in corner or in narrow structure)	On three sides (EHD in edge of narrow structure)
N	0.43	0.25	0.17
M_L and M_R	0.43	0.25	0.17
V and T	0.06	0.05	0.04

3. RESISTANCES

TABLE 10. MINIMUM EDGE DISTANCES OF EFP FASTENING PLATES FOR REDUCTION FACTORS AS PER TABLE 8

Fastening Plate		Minimum edge distances for reduction factors of N, M _L and M _B	Minimum edge distances for reduction factors of V and T
L x B [mm] x [mm]	H [mm]	c _{cr.min} [mm]	c _{cr.min} [mm]
EFP 100x50	68	50	150
EFP 100x50	108	50	150
EFP 100x100	68	50	150
EFP 100x100	108	50	150
EFP 150x100	70	50	150
EFP 150x100	110	50	150
EFP 200x100	72	50	150
EFP 200x100	112	50	150
EFP 200x100	162	50	150
EFP 300x100	165	60	150
EFP 150x150	70	50	150
EFP 150x150	110	50	150
EFP 150x150	162	50	150
EFP 200x200	72	50	150
EFP 200x200	112	50	150
EFP 200x200	162	50	150
EFP 300x200	165	60	150
EFP 250x250	165	50	150
EFP 300x300	165	60	150

TABLE 11. MINIMUM EDGE DISTANCES OF EHD FASTENING PLATES FOR REDUCTION FACTORS AS PER TABLE 9

Fastening Plate		Minimum edge distances for reduction factors of N, M _L and M _B	Minimum edge distances for reduction factors of V and T
L x B [mm] x [mm]	H [mm]	c _{cr.min} [mm]	c _{cr.min} [mm]
EHD 150x150	220	50	325
EHD 150x150	285	50	420
EHD 200x150	220	60	320
EHD 200x150	355	60	525
EHD 250x150	220	60	405
EHD 250x150	355	60	640
EHD 200x200	220	75	320
EHD 200x200	355	75	525
EHD 250x200	220	60	405
EHD 250x200	355	60	640
EHD 300x200	280	75	405
EHD 300x200	435	75	640
EHD 250x250	220	75	405
EHD 250x250	355	75	640
EHD 300x300	280	75	405
EHD 300x300	435	75	640
EHD 300x500	280	75	405
EHD 300x500	435	75	640
EHD 400x400	280	75	640
EHD 400x400	435	75	405
EHD 500x500	280	75	405
EHD 500x500	435	75	640
EHD 600x600	280	75	405
EHD 600x600	435	75	640

4. ADDITIONAL REINFORCEMENT REQUIREMENTS

4.1 Additional Reinforcement for Tensile and Bending Resistance

Additional reinforcement for tensile resistance and bending moments must be placed in the concrete structure in location of the EFP fastening plate as presented in figure 4. The additional reinforcement is to be added as close as possible to the steel plate and anchors of the EFP fastening plate. In lateral direction, the additional reinforcement can be located a maximum distance of $0.5H$ from center of an anchor in EFP fastening plate as presented in figure 4. The additional reinforcement must be anchored to full tensile capacity outside of the failure cone of the EFP fastening plate as presented in figure 4.

c_b = concrete cover (Asm. 20mm)

l_b = anchorage length according to SFS – EN 1992 – 1 – 1

R = interior bend radius of additional reinforcement according to SFS – EN 1992 – 1 – 1

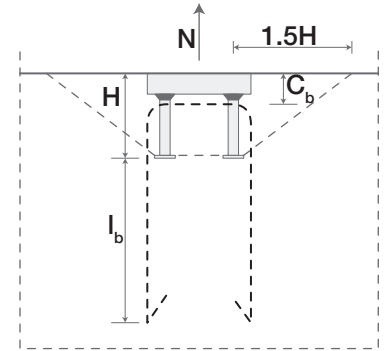


FIGURE 4. ADDITIONAL REINFORCEMENT OF EFP FASTENING PLATE FOR TENSILE FORCE AND BENDING MOMENT RESISTANCE

Table 6 gives the anchorage capacities of additional reinforcement of EFP fastening plates in the failure cone of a fastening plate with additional reinforcement positioned as in figure 4. Values in table 6 are calculated in bad bond conditions. Resistance of a EFP fastening plate with additional reinforcement is calculated by multiplying the value for single additional reinforcement link given in table 6 with the number of additional reinforcement links at the location of the fastening plate.

TABLE 12. TENSILE RESISTANCES OF ADDITIONAL REINFORCEMENTS OF EFP FASTENING PLATES

Fastening Plate L x B [mm] x [mm]		H [mm]	Tensile resistance of additional reinforcement $N_{Rd,s}$ [kN]			
			Bar Diameter \varnothing_s [mm]			
			T6	T8	T10	T12
EFP 100x50	68	3.2	–	–	–	
EFP 100x50	108	3.2	–	–	–	
EFP 100x100	68	3.2	–	–	–	
EFP 100x100	108	3.2	–	–	–	
EFP 150x100	70	3.4	4.5	–	–	
EFP 150x100	110	3.4	4.5	–	–	
EFP 200x100	72	11.2	14.9	18.7	22.4	
EFP 200x100	112	11.2	14.9	18.7	22.4	
EFP 200x100	162	11.2	14.9	18.7	22.4	
EFP 300x100	165	11.5	15.3	19.1	22.9	
EFP 150x150	70	11.2	14.9	–	–	
EFP 150x150	110	11.2	14.9	–	–	
EFP 150x150	162	11.2	14.9	–	–	
EFP 200x200	72	11.2	14.9	18.7	22.4	
EFP 200x200	112	11.2	14.9	18.7	22.4	
EFP 200x200	162	11.2	14.9	18.7	22.4	
EFP 300x200	165	11.5	15.3	19.1	22.9	
EFP 250x250	165	11.5	15.3	19.1	22.9	
EFP 300x300	165	11.5	15.3	19.1	22.9	

TABLE 13. TENSILE RESISTANCES OF ADDITIONAL REINFORCEMENTS OF EHD FASTENING PLATES

Fastening Plate		Tensile resistance of additional reinforcement $N_{Rd,s}$ [kN]			
		Bar Diameter \varnothing_s [mm]			
L x B [mm] x [mm]	H [mm]	T6	T8	T10	T12
EHD 150x150	220	23.6	31.5	39.3	47.2
EHD 150x150	285	23.6	31.5	39.3	47.2
EHD 200x150	220	23.6	31.5	39.3	47.2
EHD 200x150	355	23.6	31.5	39.3	47.2
EHD 250x150	220	23.6	31.5	39.3	47.2
EHD 250x150	355	23.6	31.5	39.3	47.2
EHD 200x200	220	23.6	31.5	39.3	47.2
EHD 200x200	355	23.6	31.5	39.3	47.2
EHD 250x200	220	23.6	31.5	39.3	47.2
EHD 250x200	355	23.6	31.5	39.3	47.2
EHD 300x200	280	24.6	41.1	51.4	61.7
EHD 300x200	435	24.6	41.1	51.4	61.7
EHD 250x250	220	24.6	41.1	51.4	61.7
EHD 250x250	355	24.6	41.1	51.4	61.7
EHD 300x300	280	24.6	41.1	51.4	61.7
EHD 300x300	435	24.6	41.1	51.4	61.7
EHD 300x500	435	24.6	41.1	51.4	61.7
EHD 300x500	280	24.6	41.1	51.4	61.7
EHD 400x400	280	24.6	41.1	51.4	61.7
EHD 400x400	435	24.6	41.1	51.4	61.7
EHD 500x500	280	24.6	41.1	51.4	61.7
EHD 500x500	435	24.6	41.1	51.4	61.7
EHD 600x600	280	24.6	41.1	51.4	61.7
EHD 600x600	435	24.6	41.1	51.4	61.7

Under good bond conditions the resistance values given in table 12 & 13 can be multiplied by factor 1.42

4.2 Additional Reinforcement for Shear and Torsion Resistance

If the EFP and EHD fastening plates are closer to the edge, then additional reinforcement for shear force and torsional moment must be placed into concrete. Additional reinforcement for shear force is placed perpendicular against the shear force and as close as possible to the steel plate of the EFP, EHD fastening plate in the vertical direction.

C_b = concrete cover

l_b = anchorage length according to SFS-EN 1992-1-1

4. ADDITIONAL REINFORCEMENT REQUIREMENTS

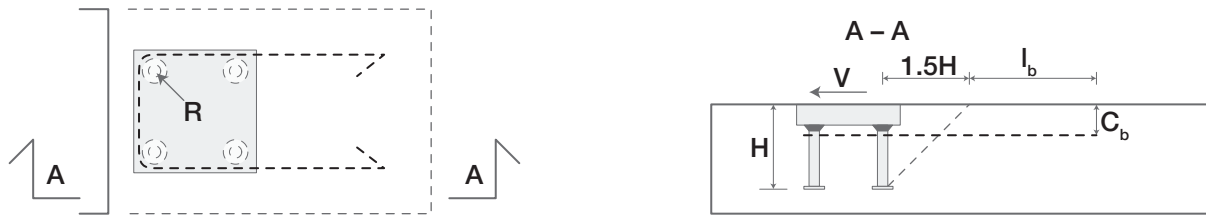


FIGURE 5. ADDITIONAL REINFORCEMENT OF EFP, EHD FASTENING PLATE FOR SHEAR FORCE AND TORSIONAL MOMENT

TABLE 14. SHEAR RESISTANCES OF EFP FASTENING PLATES WITH ADDITIONAL REINFORCEMENT

Fastening Plate		Tensile resistance of additional reinforcement $V_{Rd,s}$ [kN]			
		Bar Diameter \varnothing_s [mm]			
		T6	T8	T10	T12
L x B [mm] x [mm]	H [mm]				
EFP 100x50	68	4.5	7.9	12.3	17.4
EFP 100x50	108	4.5	7.9	12.3	17.4
EFP 100x100	68	4.5	7.9	12.3	17.4
EFP 100x100	108	4.5	7.9	12.3	17.4
EFP 150x100	70	4.5	7.9	12.3	17.4
EFP 150x100	110	4.5	7.9	12.3	17.4
EFP 200x100	72	4.5	7.9	12.3	17.4
EFP 200x100	112	4.5	7.9	12.3	17.4
EFP 200x100	162	4.5	7.9	12.3	17.4
EFP 300x100	165	4.5	7.9	12.3	17.4
EFP 150x150	70	4.8	8.4	13.0	18.6
EFP 150x150	110	4.8	8.4	13.0	18.6
EFP 150x150	162	4.8	8.4	13.0	18.6
EFP 200x200	72	5.0	8.8	13.6	19.4
EFP 200x200	112	5.0	8.8	13.6	19.4
EFP 200x200	162	5.0	8.8	13.6	19.4
EFP 300x200	165	5.0	8.8	13.6	19.4
EFP 250x250	165	5.0	8.8	13.6	19.4
EFP 300x300	165	5.3	9.2	14.4	20.5

TABLE 15. SHEAR RESISTANCES OF EHD FASTENING PLATES WITH ADDITIONAL REINFORCEMENT

Fastening Plate		Tensile resistance of additional reinforcement $N_{Rd,s}$ [kN]			
		Bar Diameter \varnothing_s [mm]			
L x B [mm] x [mm]	H [mm]	T6	T8	T10	T12
EHD 150x150	220	9.1	12.2	15.2	18.3
EHD 150x150	285	9.1	12.2	15.2	18.3
EHD 200x150	220	9.1	12.2	15.2	18.3
EHD 200x150	355	9.1	12.2	15.2	18.3
EHD 250x150	220	9.1	12.2	15.2	18.3
EHD 250x150	355	12.2	16.2	20.3	24.4
EHD 200x200	220	12.2	16.2	20.3	24.4
EHD 200x200	355	12.2	16.2	20.3	24.4
EHD 250x200	220	12.2	16.2	20.3	24.4
EHD 250x200	355	12.2	16.2	32.2	38.6
EHD 300x200	280	12.2	16.2	32.2	38.6
EHD 300x200	435	12.3	21.9	33.8	40.6
EHD 250x250	220	12.3	21.9	33.8	40.6
EHD 250x250	355	12.3	21.9	34.1	49.2
EHD 300x300	280	12.3	21.9	34.1	49.2
EHD 300x300	435	12.3	21.9	34.1	49.2
EHD 300x500	280	12.3	21.9	34.1	49.2
EHD 300x500	435	12.3	21.9	34.1	49.2
EHD 400x400	280	12.3	21.9	34.1	49.2
EHD 400x400	435	12.3	21.9	34.1	49.2
EHD 500x500	280	12.3	21.9	34.1	49.2
EHD 500x500	435	12.3	21.9	34.1	49.2
EHD 600x600	280	12.3	21.9	34.1	49.2
EHD 600x600	435	12.3	21.9	34.1	49.2

Under good bond conditions the resistance values given in table 7 can be multiplied by factor 1,42.

5. MINIMUM DIMENSION REQUIREMENTS

5.1 Minimum Allowable Edge and Center Distance

Minimum edge distance of fastening plates in concrete element for resistances given in table 16 & 17 are mentioned in the tables below.

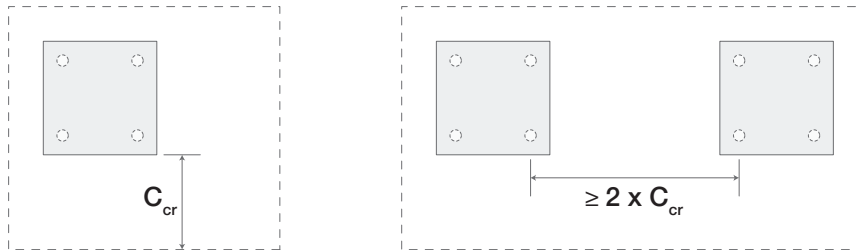


FIGURE 6. THE EDGE DISTANCE C_{cr} OF EFP, EHD FASTENING PLATE FROM THE EDGE OF THE CONCRETE STRUCTURE AND THE CENTER DISTANCE BETWEEN ADJACENT FASTENING PLATES.

TABLE 16. MINIMUM EDGE DISTANCES OF EFP FASTENING PLATES

Fastening Plate		Minimum edge distance for resistances N_{Rd} , M_{RdL} and M_{RdB} in table 2	Minimum edge distance for resistances V_{Rd} and T_{Rd} in table 2
L x B [mm] x [mm]	H [mm]	$C_{cr,N}$ [mm]	$C_{cr,V}$ [mm]
EFP 100x50	68	91.50	600
EFP 100x50	108	151.50	600
EFP 100x100	68	91.50	600
EFP 100x100	108	151.0	600
EFP 150x100	70	94.50	600
EFP 150x100	110	154.50	600
EFP 200x100	72	96.00	660
EFP 200x100	112	156.00	780
EFP 200x100	162	231.00	780
EFP 300x100	165	235.50	960
EFP 150x150	70	94.50	600
EFP 150x150	110	154.50	600
EFP 150x150	162	231.00	780
EFP 200x200	72	96.00	660
EFP 200x200	112	156.00	780
EFP 200x200	162	231.00	960
EFP 300x200	165	235.50	960
EFP 250x250	165	235.50	960
EFP 300x300	165	235.50	960

TABLE 17. MINIMUM EDGE DISTANCES OF EHD FASTENING PLATES

Fastening Plate		Minimum edge distance for resistances N_{Rd} , M_{RdL} and M_{RdB} in table 2	Minimum edge distance for resistances V_{Rd} and T_{Rd} in table 2
L x B [mm] x [mm]	H [mm]	$C_{cr,N}$ [mm]	$C_{cr,V}$ [mm]
EHD 150x150	220	214	960
EHD 150x150	285	279	960
EHD 200x150	220	212	1200
EHD 200x150	355	347	1200
EHD 250x150	220	212	1200
EHD 250x150	355	347	1200
EHD 200x200	220	212	1200
EHD 200x200	355	347	1200
EHD 250x200	220	212	1200
EHD 250x200	355	347	1200
EHD 300x200	280	270	1500
EHD 300x200	435	425	1500
EHD 250x250	220	212	1200
EHD 250x250	355	347	1200
EHD 300x300	280	270	1500
EHD 300x300	435	425	1500
EHD 300x500	280	270	1500
EHD 300x500	435	425	1500
EHD 400x400	280	270	1500
EHD 400x400	435	425	1500
EHD 500x500	280	270	1500
EHD 500x500	435	425	1500
EHD 600x600	280	270	1500
EHD 600x600	435	425	1500

5. MINIMUM DIMENSION REQUIREMENTS

5.2 Minimum Thickness of Base Concrete

Minimum thickness of concrete element for resistances given in table 18 & 19 are mentioned in the tables below. With smaller thicknesses of the base, the resistances of EFP, EHD fastening plates need to be reduced.

TABLE 18. MINIMUM THICKNESSES FOR CONCRETE FOR EHD FASTENING PLATES

Fastening Plate		Maximum thickness h_{max} of concrete when concrete cover $C_b = 70$ mm		Minimum thickness h_{min} of concrete for resistances according to table 4
L x B [mm] x [mm]	H [mm]	[mm]	[mm]	[mm]
EHD 150x150	220	290		240
EHD 150x150	285	355		305
EHD 200x150	220	290		240
EHD 200x150	355	425		375
EHD 250x150	220	290		240
EHD 250x150	355	425		375
EHD 200x200	220	290		240
EHD 200x200	355	425		375
EHD 250x200	220	290		240
EHD 250x200	355	425		375
EHD 300x200	280	350		300
EHD 300x200	435	505		455
EHD 250x250	220	290		240
EHD 250x250	355	425		375
EHD 300x300	280	350		300
EHD 300x300	435	505		455
EHD 300x500	280	350		300
EHD 300x500	435	505		455
EHD 400x400	280	350		300
EHD 400x400	435	505		455
EHD 500x500	280	350		300
EHD 500x500	435	505		455
EHD 600x600	280	350		300
EHD 600x600	435	505		455

TABLE 19. MINIMUM THICKNESS OF CONCRETE FOR EFP FASTENING PLATES

Fastening Plate		Maximum thickness h_{\max} of the base (concrete structure) when concrete cover $C_b = 70$ mm		Minimum edge distance for resistances V_{Rd} and T_{Rd} in table 2
L x B [mm] x [mm]	H [mm]	[mm]	[mm]	$C_{cr,V}$ [mm]
EFP 100x50	68	138		88
EFP 100x50	108	178		128
EFP 100x100	68	138		88
EFP 100x100	108	178		128
EFP 150x100	70	140		90
EFP 150x100	110	180		130
EFP 200x100	72	142		92
EFP 200x100	112	182		132
EFP 200x100	162	232		182
EFP 300x100	165	235		185
EFP 150x150	70	140		90
EFP 150x150	110	180		130
EFP 150x150	162	232		182
EFP 200x200	72	142		92
EFP 200x200	112	182		132
EFP 200x200	162	232		182
EFP 300x200	165	235		185
EFP 250x250	165	235		185
EFP 300x300	165	235		185

The effect of base thickness h_c to EFP, EHD fastening plate resistance can be taken into account by using reduction factor $k_{h,red}$. Given in the following formula. Base thicknesses smaller than minimum value $h_{\min,cb}$ given in table 10 may not be used with the fastening plates.

$$k_{h,red} = \left(\frac{h_c}{h_{\min}} \right) \leq 1.0$$

h_c = thickness of the concrete structure (minimum value of the concrete structure is $h_{\min,cb}$ given in table 6)

h_{\min} = Value of h_{\min} according to table 10



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