Typical characteristic and design resistance performance with 5.8 grade studding and associated installation data

Stud Ø (mm)	Characteristic Resistance (kN)		Design Resistance (kN)		Recommended Load (kN)		Characteristic Distances (kN)			Min Edge & Spacing (mm)		Nominal Embedment (mm)	Hole Diameter concrete (mm)	Hole Diameter fixture (mm)	Max. Torque (mm)
	Tension	Shear	Tension	Shear	Tension	Shear	Edge	Spacing	Edge						
	N_{rk}	V_{rk}	N_{rd}	V_{rd}	N_{rec}	V_{rec}	$C_{cr,N}$	$S_{cr,N}$	$C_{cr,V}$	C_{min}	S_{min}				
M 8	19.00	9.00	12.70	7.20	9.07	5.14	80	160	80	40		80	10	09	10
M 10	30.20	15.00	20.10	12.00	14.36	8.57	100	200	90	50		90	12	12	20
M 12	43.80	21.00	29.20	16.80	20.86	12.00	120	240	110	60		110	14	14	40
M 16	81.60	39.00	54.40	31.20	38.86	22.29	160	320	125	80		125	18	18	80
M 20	127.40	61.00	84.90	48.80	60.64	34.86	200	400	180	100		170	24	22	120
M 24	183.60	88.00	122.40	70.40	87.43	50.29	240	480	220	120		210	28	26	160
M 27	238.00	115.00	159.10	92.00	109.52	65.71	270	540	240	135		240	32	30	180
M 30	292.00	142.50	194.50	114.00	133.33	81.43	300	600	280	150		280	35	32	200
M 33	342.12	173.50	162.91	138.80	116.36	99.14	330	660	310	165		300	37	36	250
M 36	396.07	212.50	188.60	170.00	134.72	121.43	360	720	330	180		340	40	38	300

High bond reinforcing bars Fyk=500N/mm2

Rebar Diameter	Hole Diameter	Embedment Depth hef																				h_{ef} failure	Steel failure load (kN)
(mm)	(mm)	60	70	80	90	100	110	120	130	140	160	200	240	280	320	400	500	560	640	720	800	(mm)	(kN)
8	10	11.7	13.7	15.6	17.6	19.6	21.5	23.5	25.2													129	25.2
10	12	14.7	17.1	19.6	22.0	24.4	26.9	29.3	31.8	34.2	39.1	39.3										161	39.3
12	15		19.1	21.8	24.5	27.2	30.0	32.7	35.4	38.1	43.6	54.5	56.6									208	56.6
16	20			26.8	30.2	33.5	36.9	40.2	43.6	46.9	53.6	67.0	80.4	93.8	100.6							300	100.6
20	25			28.7	32.3	35.9	39.5	43.1	46.7	50.3	57.5	71.9	86.2	100.5	114.9	143.6						438	157.1
25	30					41.1	45.3	49.4	53.5	57.6	65.8	82.3	98.7	115.2	131.7	164.6	205.7					549	226.0
28	35						50.7	55.3	59.9	64.5	73.7	92.2	110.6	129.0	147.5	184.3	230.4	258.1				668	308.0
32	40								68.5	73.7	84.3	105.3	126.4	147.5	168.5	210.7	263.3	294.9	337.1			763	402.1
36	44									79.2	90.5	113.1	135.7	158.4	181.0	226.0	282.8	316.7	362.0	407.2		902	510.0
40	50										95.8	119.7	143.6	167.6	191.5	239.4	299.2	335.1	383.0	430.9	478.8	1050	628.3
Depth (mm)		60	70	80	90	100	110	120	130	140	160	200	240	280	320	400	500	560	640	720	800		

Characteristic and Design Load resistances based on characteristic bond strengths for hef 4d (minimum embedment) to 20d

Stud Ø (mm)	Non Craked Concrete						Craked Concrete						Nominal Embedment (mm)
	Characteristic Resistance (kN)		Design Resistance (kN)		Recommended Load (kN)		Characteristic Resistance (kN)		Design Resistance (kN)		Recommended Load (kN)		
	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	
	N_{rk}	V_{rk}	N_{rd}	V_{rd}	N_{rec}	V_{rec}	N_{rk}	V_{rk}	N_{rd}	V_{rd}	N_{rec}	V_{rec}	
M 8	30.16	9.00	16.76	7.20	11.97	5.14	Not Applicable		Not Applicable		Not Applicable		80
M 10	42.41	15.00	23.56	12.00	16.83	8.57							90
M 12	62.20	21.00	34.56	16.80	24.68	12.00	31.10	21.00	17.28	16.80	12.34	12.00	110
M 16	87.96	39.00	48.87	31.20	34.91	22.29	42.22	39.00	23.46	31.20	16.75	22.29	125
M 20	138.86	61.00	66.12	48.80	47.23	34.86	63.90	61.00	30.41	48.80	21.72	34.86	170
M 24	190.00	88.00	90.48	70.40	64.63	50.29	85.50	88.00	40.71	70.40	29.10	50.29	210
M 27	244.29	115.00	116.33	92.00	83.09	65.71	107.49	115.00	51.18	92.00	36.56	65.71	240
M 30	316.67	142.50	150.80	114.00	107.71	81.43	133.00	142.50	63.33	114.00	45.24	81.43	280
M 33	342.12	173.50	162.91	138.80	116.37	99.14	140.27	173.50	66.80	138.80	47.71	99.14	300
M 36	396.07	212.50	188.60	170.00	134.72	121.43	154.47	212.50	73.56	170.00	52.54	121.43	340

Bond Strength Factors
Influence of concrete strength on combined pull out and concrete cone resistance

Concrete Strength N/mm2 (Mpa)	C15/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
fc =	0.98	1.00	1.02	1.04	1.06	1.08	1.09	1.10

Characteristic and Design Load resistance for Rebar based on characteristic bond strengths for hef 10d (min. embedment)

Rebar Ø (mm)	Non Craked Concrete						Craked Concrete						Nominal Embedment (mm)
	Characteristic Resistance (kN)		Design Resistance (kN)		Recommended Load (kN)		Characteristic Resistance (kN)		Design Resistance (kN)		Recommended Load (kN)		
	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	
	N_{rk}	V_{rk}	N_{rd}	V_{rd}	N_{rec}	V_{rec}	N_{rk}	V_{rk}	N_{rd}	V_{rd}	N_{rec}	V_{rec}	
8	22.12	13.95	12.29	9.30	8.78	6.64	Not Applicable		Not Applicable		Not Applicable		80
10	31.10	21.45	17.28	14.30	12.34	10.21							100
12	41.47	31.05	23.04	20.70	16.45	14.79	22.81	31.05	12.67	20.70	9.05	14.79	110
16	59.69	55.50	33.16	37.00	23.69	26.43	28.05	55.50	15.58	37.00	11.13	26.13	125
20	96.13	86.55	45.78	57.70	32.70	41.21	42.30	86.55	20.14	57.70	14.39	41.21	170
25	148.44	135.00	70.69	90.00	50.49	64.29	63.83	135.00	30.40	90.00	21.71	64.29	210
28	209.36	168.75	99.69	112.50	71.21	80.36	87.93	163.75	41.87	112.50	29.90	80.36	280
32	273.44	220.95	130.21	147.30	93.01	105.21	112.11	220.95	53.39	147.30	38.13	105.21	320

Bond Strength Factors - Rebar
Influence of concrete strength on combined pull out and concrete cone resistance

Concrete Strength N/mm2 (Mpa)	C15/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60	C55/67	C60/75
fc =	0.98	1.00	1.02	1.04	1.06	1.08	1.09	1.10	1.10	1.12

Rebar Diameter (mm)	Rebar Bst 500 to DIN 488		Rebar Bst 500 to DIN 488	
	$N_{rk,s}$	$N_{rd,s}$	$V_{rk,s}$	$V_{rd,s}$
8	28.0	20.0	14.0	9.3
10	43.0	30.7	21.5	14.3
12	62.0	44.3	31.0	20.7
14	85.0	60.7	42.5	28.3
16	111.0	79.3	55.5	37.0
18	140.0	100.0	70.0	46.7
20	173.0	123.6	86.5	57.7
22	209.0	149.3	104.5	69.7
25	270.0	192.9	135.0	90.0
28	339.0	242.1	169.0	112.7
32	442.0	315.7	221.0	147.3
36	563.2	443.5	281.6	187.7
40	693.8	546.3	346.9	231.3