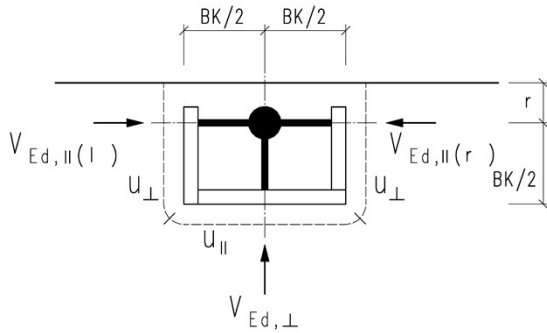


Edge shear heads in flat slabs

(For foundation slabs please contact our design team)

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Verification:

$$V_{Ed,Total} \leq V_{Rd,Total} = V_{Rd,\perp} + V_{Rd,II(l)} + V_{Rd,II(r)}$$

Design value of the shear resistance $V_{Rd,Total}$ [kN] with a distance to edge of $r \approx 10$ cm

(as a simplification $r \approx 0$ and equal span widths are used,

so that $V_{Ed,II} \approx V_{Ed,IIr} \approx V_{Ed,\perp} / 2$ and $V_{Ed,Total} \approx 2 V_{Ed,\perp}$)

and with an average reinforcement percentage ρ_{II} of

Slab thickness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		
		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	
Concrete strength: C20/25										
$f_{ck} = 20 \text{ N/mm}^2$										
20	16.0	117	235	134	269	148	296	159	319	
21	17.0	136	272	155	311	171	342	184	369	
22	17.5	150	300	172	344	189	378	204	407	
23	18.5	171	341	195	391	215	430	232	463	
24	19.0	186	373	213	427	235	470	253	506	
25	20.0	209	419	240	479	264	527	284	568	
26	21.0	231	461	264	528	291	581	313	626	
27	22.0	253	506	289	579	319	637	343	686	
28	23.0	276	552	316	632	348	696	375	749	
29	24.0	300	600	344	687	378	756	407	815	
30	25.0	325	650	372	744	410	819	441	882	
31	26.0	345	689	394	789	434	868	468	935	
32	27.0	365	729	417	835	459	919	495	990	
33	28.0	385	770	441	882	485	970	523	1,045	
34	29.0	406	812	465	930	512	1,023	551	1,102	
35	30.0	428	855	490	979	539	1,078	580	1,161	
36	31.0	450	899	515	1,030	567	1,133	610	1,221	
37	31.5	465	929	532	1,064	585	1,171	630	1,261	
38	32.0	480	959	549	1,098	604	1,209	651	1,302	
39	33.0	503	1,006	576	1,151	634	1,267	682	1,365	
40	34.0	527	1,053	603	1,205	663	1,327	715	1,429	
41	35.0	551	1,102	630	1,261	694	1,388	747	1,495	
42	36.0	575	1,151	659	1,317	725	1,450	781	1,562	
43	37.0	601	1,201	688	1,375	757	1,514	815	1,630	
44	38.0	626	1,253	717	1,434	789	1,578	850	1,700	
45	39.0	653	1,305	747	1,494	822	1,644	886	1,771	
46	40.0	679	1,358	777	1,555	856	1,711	922	1,844	
47	41.0	706	1,413	809	1,617	890	1,780	959	1,917	
48	42.0	734	1,468	840	1,680	925	1,849	996	1,992	
49	43.0	762	1,524	872	1,745	960	1,920	1,034	2,069	
50	44.0	791	1,581	905	1,810	996	1,992	1,073	2,146	
51	44.5	810	1,620	927	1,854	1,021	2,041	1,099	2,199	
52	45.0	830	1,659	950	1,899	1,045	2,090	1,126	2,252	
53	46.0	859	1,719	984	1,967	1,083	2,165	1,166	2,332	
54	47.0	890	1,779	1,018	2,036	1,121	2,241	1,207	2,415	
55	48.0	920	1,840	1,053	2,107	1,159	2,319	1,249	2,498	
56	49.0	951	1,903	1,089	2,178	1,199	2,398	1,291	2,583	
57	50.0	983	1,966	1,125	2,251	1,239	2,477	1,334	2,669	
58	51.0	1,015	2,031	1,162	2,324	1,279	2,558	1,378	2,756	
59	52.0	1,048	2,096	1,200	2,399	1,320	2,641	1,422	2,845	
60	53.0	1,081	2,162	1,238	2,475	1,362	2,724	1,467	2,935	

Revision date 11/2016

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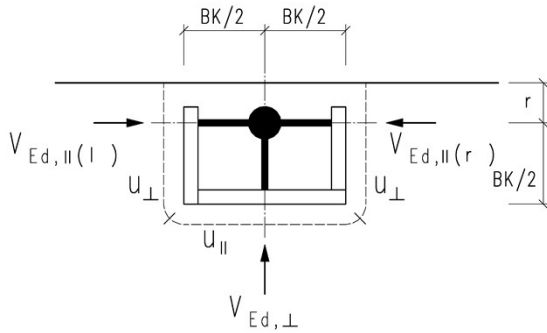
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Edge shear heads in flat slabs

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Design value of the shear resistance $V_{Rd,Total}$ [kN] with a distance to edge of $r \approx 10$ cm

(as a simplification $r \approx 0$ and equal span widths are used,

so that $V_{Ed,II} \approx V_{Ed,IIr} \approx V_{Ed,\perp} / 2$ and $V_{Ed,Total} \approx 2 V_{Ed,\perp}$)

and with an average reinforcement percentage ρ_{II} of

Slab thickness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		1.50%	
		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.
Concrete strength: C25/30											
$f_{ck} = 25 \text{ N/mm}^2$											
20	16.0	126	252	145	290	159	318	172	344	182	364
21	17.0	146	292	167	334	184	368	199	398	211	422
22	17.5	162	324	185	370	204	408	219	438	233	466
23	18.5	184	368	210	420	232	464	250	500	265	530
24	19.0	201	402	230	460	253	506	273	546	290	580
25	20.0	225	450	258	516	284	568	306	612	325	650
26	21.0	248	496	284	568	313	626	337	674	358	716
27	22.0	272	544	312	624	343	686	370	740	393	786
28	23.0	297	594	340	680	375	750	404	808	429	858
29	24.0	323	646	370	740	407	814	439	878	466	932
30	25.0	350	700	401	802	441	882	475	950	505	1,010
31	26.0	371	742	425	850	468	936	504	1,008	535	1,070
32	27.0	393	786	450	900	495	990	533	1,066	566	1,132
33	28.0	415	830	475	950	523	1,046	563	1,126	598	1,196
34	29.0	437	874	501	1,002	551	1,102	594	1,188	631	1,262
35	30.0	461	922	527	1,054	580	1,160	625	1,250	664	1,328
36	31.0	484	968	555	1,110	610	1,220	657	1,314	699	1,398
37	31.5	500	1,000	573	1,146	630	1,260	679	1,358	722	1,444
38	32.0	517	1,034	591	1,182	651	1,302	701	1,402	745	1,490
39	33.0	542	1,084	620	1,240	682	1,364	735	1,470	781	1,562
40	34.0	567	1,134	649	1,298	715	1,430	770	1,540	818	1,636
41	35.0	593	1,186	679	1,358	747	1,494	805	1,610	856	1,712
42	36.0	620	1,240	710	1,420	781	1,562	841	1,682	894	1,788
43	37.0	647	1,294	741	1,482	815	1,630	878	1,756	933	1,866
44	38.0	675	1,350	772	1,544	850	1,700	916	1,832	973	1,946
45	39.0	703	1,406	805	1,610	886	1,772	954	1,908	1,014	2,028
46	40.0	732	1,464	837	1,674	922	1,844	993	1,986	1,055	2,110
47	41.0	761	1,522	871	1,742	959	1,918	1,033	2,066	1,097	2,194
48	42.0	791	1,582	905	1,810	996	1,992	1,073	2,146	1,140	2,280
49	43.0	821	1,642	940	1,880	1,034	2,068	1,114	2,228	1,184	2,368
50	44.0	852	1,704	975	1,950	1,073	2,146	1,156	2,312	1,228	2,456
51	44.5	873	1,746	999	1,998	1,099	2,198	1,184	2,368	1,258	2,516
52	45.0	894	1,788	1,023	2,046	1,126	2,252	1,213	2,426	1,289	2,578
53	46.0	926	1,852	1,060	2,120	1,166	2,332	1,256	2,512	1,335	2,670
54	47.0	958	1,916	1,097	2,194	1,207	2,414	1,300	2,600	1,382	2,764
55	48.0	991	1,982	1,135	2,270	1,249	2,498	1,345	2,690	1,430	2,860
56	49.0	1,025	2,050	1,173	2,346	1,291	2,582	1,391	2,782	1,478	2,956
57	50.0	1,059	2,118	1,212	2,424	1,334	2,668	1,437	2,874	1,527	3,054
58	51.0	1,094	2,188	1,252	2,504	1,378	2,756	1,484	2,968	1,577	3,154
59	52.0	1,129	2,258	1,292	2,584	1,422	2,844	1,532	3,064	1,628	3,256
60	53.0	1,165	2,330	1,333	2,666	1,467	2,934	1,581	3,162	1,680	3,360

Revision date 11/2016

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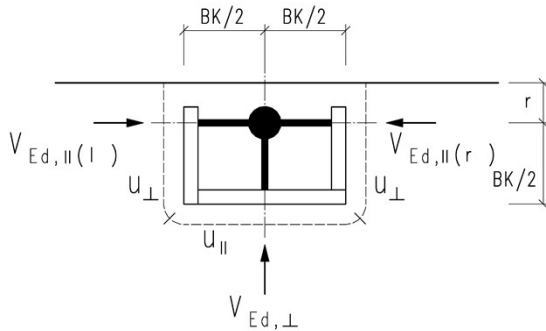
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Edge shear heads in flat slabs

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Design value of the shear resistance $V_{Rd,Total}$ [kN] with a distance to edge of $r \approx 10$ cm

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and with an average reinforcement percentage ρ_{II} of

Slab thickness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		1.50%	
		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.
Concrete strength: C30/37											
$f_{ck} = 30 \text{ N/mm}^2$											
20	16.0	134	268	154	308	169	338	182	364	194	388
21	17.0	155	310	178	356	196	392	211	422	224	448
22	17.5	172	344	197	394	216	432	233	466	248	496
23	18.5	195	390	224	448	246	492	265	530	282	564
24	19.0	213	426	244	488	269	538	290	580	308	616
25	20.0	240	480	274	548	302	604	325	650	345	690
26	21.0	264	528	302	604	333	666	358	716	381	762
27	22.0	289	578	331	662	365	730	393	786	417	834
28	23.0	316	632	362	724	398	796	429	858	456	912
29	24.0	344	688	393	786	433	866	466	932	495	990
30	25.0	372	744	426	852	469	938	505	1,010	537	1,074
31	26.0	394	788	451	902	497	994	535	1,070	569	1,138
32	27.0	417	834	478	956	526	1,052	566	1,132	602	1,204
33	28.0	441	882	505	1,010	555	1,110	598	1,196	636	1,272
34	29.0	465	930	532	1,064	586	1,172	631	1,262	670	1,340
35	30.0	490	980	560	1,120	617	1,234	664	1,328	706	1,412
36	31.0	515	1,030	589	1,178	649	1,298	699	1,398	742	1,484
37	31.5	532	1,064	609	1,218	670	1,340	722	1,444	767	1,534
38	32.0	549	1,098	628	1,256	692	1,384	745	1,490	792	1,584
39	33.0	576	1,152	659	1,318	725	1,450	781	1,562	830	1,660
40	34.0	603	1,206	690	1,380	759	1,518	818	1,636	869	1,738
41	35.0	630	1,260	722	1,444	794	1,588	856	1,712	909	1,818
42	36.0	659	1,318	754	1,508	830	1,660	894	1,788	950	1,900
43	37.0	688	1,376	787	1,574	866	1,732	933	1,866	992	1,984
44	38.0	717	1,434	821	1,642	903	1,806	973	1,946	1,034	2,068
45	39.0	747	1,494	855	1,710	941	1,882	1,014	2,028	1,077	2,154
46	40.0	777	1,554	890	1,780	980	1,960	1,055	2,110	1,121	2,242
47	41.0	809	1,618	926	1,852	1,019	2,038	1,097	2,194	1,166	2,332
48	42.0	840	1,680	962	1,924	1,059	2,118	1,140	2,280	1,212	2,424
49	43.0	872	1,744	999	1,998	1,099	2,198	1,184	2,368	1,258	2,516
50	44.0	905	1,810	1,036	2,072	1,140	2,280	1,228	2,456	1,305	2,610
51	44.5	927	1,854	1,061	2,122	1,168	2,336	1,258	2,516	1,337	2,674
52	45.0	950	1,900	1,087	2,174	1,196	2,392	1,289	2,578	1,370	2,740
53	46.0	984	1,968	1,126	2,252	1,239	2,478	1,335	2,670	1,419	2,838
54	47.0	1,018	2,036	1,166	2,332	1,283	2,566	1,382	2,764	1,469	2,938
55	48.0	1,053	2,106	1,206	2,412	1,327	2,654	1,430	2,860	1,519	3,038
56	49.0	1,089	2,178	1,247	2,494	1,372	2,744	1,478	2,956	1,571	3,142
57	50.0	1,125	2,250	1,288	2,576	1,418	2,836	1,527	3,054	1,623	3,246
58	51.0	1,162	2,324	1,330	2,660	1,464	2,928	1,577	3,154	1,676	3,352
59	52.0	1,200	2,400	1,373	2,746	1,511	3,022	1,628	3,256	1,730	3,460
60	53.0	1,238	2,476	1,417	2,834	1,559	3,118	1,680	3,360	1,785	3,570

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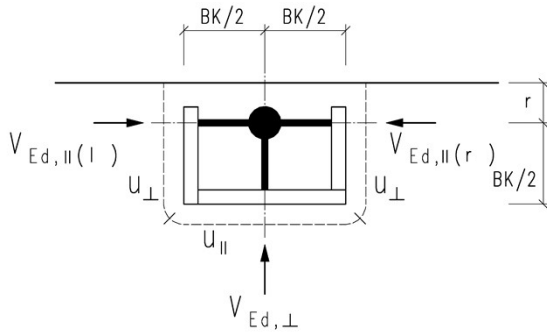
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Slab thickness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		1.50%	
		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.
Concrete strength: C35/45											
$f_{ck} = 35 \text{ N/mm}^2$											
20	16.0	141	282	162	324	178	356	192	384	204	408
21	17.0	164	328	187	374	206	412	222	444	236	472
22	17.5	181	362	207	414	228	456	245	490	261	522
23	18.5	206	412	235	470	259	518	279	558	297	594
24	19.0	225	450	257	514	283	566	305	610	324	648
25	20.0	252	504	289	578	318	636	342	684	364	728
26	21.0	278	556	318	636	350	700	377	754	401	802
27	22.0	305	610	349	698	384	768	414	828	440	880
28	23.0	333	666	381	762	419	838	451	902	480	960
29	24.0	362	724	414	828	456	912	491	982	522	1,044
30	25.0	392	784	448	896	493	986	532	1,064	565	1,130
31	26.0	415	830	475	950	523	1,046	564	1,128	599	1,198
32	27.0	439	878	503	1,006	554	1,108	596	1,192	634	1,268
33	28.0	464	928	531	1,062	585	1,170	630	1,260	669	1,338
34	29.0	489	978	560	1,120	617	1,234	664	1,328	706	1,412
35	30.0	515	1,030	590	1,180	649	1,298	699	1,398	743	1,486
36	31.0	542	1,084	620	1,240	683	1,366	735	1,470	782	1,564
37	31.5	560	1,120	641	1,282	705	1,410	760	1,520	807	1,614
38	32.0	578	1,156	662	1,324	728	1,456	784	1,568	834	1,668
39	33.0	606	1,212	694	1,388	763	1,526	822	1,644	874	1,748
40	34.0	635	1,270	726	1,452	799	1,598	861	1,722	915	1,830
41	35.0	664	1,328	760	1,520	836	1,672	901	1,802	957	1,914
42	36.0	693	1,386	794	1,588	874	1,748	941	1,882	1,000	2,000
43	37.0	724	1,448	829	1,658	912	1,824	982	1,964	1,044	2,088
44	38.0	755	1,510	864	1,728	951	1,902	1,024	2,048	1,089	2,178
45	39.0	786	1,572	900	1,800	991	1,982	1,067	2,134	1,134	2,268
46	40.0	818	1,636	937	1,874	1,031	2,062	1,111	2,222	1,180	2,360
47	41.0	851	1,702	974	1,948	1,072	2,144	1,155	2,310	1,228	2,456
48	42.0	884	1,768	1,012	2,024	1,114	2,228	1,200	2,400	1,276	2,552
49	43.0	918	1,836	1,051	2,102	1,157	2,314	1,246	2,492	1,325	2,650
50	44.0	953	1,906	1,091	2,182	1,201	2,402	1,293	2,586	1,374	2,748
51	44.5	976	1,952	1,117	2,234	1,230	2,460	1,325	2,650	1,408	2,816
52	45.0	1,000	2,000	1,144	2,288	1,259	2,518	1,357	2,714	1,442	2,884
53	46.0	1,035	2,070	1,185	2,370	1,305	2,610	1,405	2,810	1,493	2,986
54	47.0	1,072	2,144	1,227	2,454	1,351	2,702	1,455	2,910	1,546	3,092
55	48.0	1,109	2,218	1,269	2,538	1,397	2,794	1,505	3,010	1,599	3,198
56	49.0	1,147	2,294	1,312	2,624	1,445	2,890	1,556	3,112	1,654	3,308
57	50.0	1,185	2,370	1,356	2,712	1,493	2,986	1,608	3,216	1,709	3,418
58	51.0	1,224	2,448	1,401	2,802	1,542	3,084	1,661	3,322	1,765	3,530
59	52.0	1,263	2,526	1,446	2,892	1,591	3,182	1,714	3,428	1,821	3,642
60	53.0	1,303	2,606	1,491	2,982	1,641	3,282	1,768	3,536	1,879	3,758

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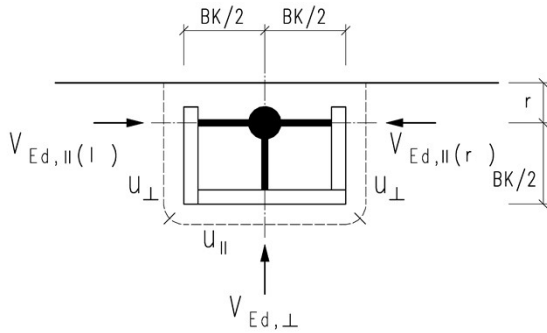
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Edge shear heads in flat slabs

(For foundation slabs please contact our design team)

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the pre-dimensioning tables please
refer to the last pages.



Verification:

$$V_{Ed,Total} \leq V_{Rd,Total} = V_{Rd,\perp} + V_{Rd,II(l)} + V_{Rd,II(r)}$$

Design value of the shear resistance $V_{Rd,Total}$ [kN] with a distance to edge of $r \approx 10$ cm

(as a simplification $r \approx 0$ and equal span widths are used,

so that $V_{Ed,II} \approx V_{Ed,IIr} \approx V_{Ed,\perp} / 2$ and $V_{Ed,Total} \approx 2 V_{Ed,\perp}$)

and with an average reinforcement percentage ρ_{II} of

Slab thickness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		1.50%	
		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.
Concrete strength: C40/50											
$f_{ck} = 40 \text{ N/mm}^2$											
20	16.0	148	296	169	338	186	372	201	402	213	426
21	17.0	171	342	196	392	216	432	232	464	247	494
22	17.5	189	378	216	432	238	476	257	514	273	546
23	18.5	215	430	246	492	271	542	292	584	310	620
24	19.0	235	470	269	538	296	592	319	638	339	678
25	20.0	264	528	302	604	332	664	358	716	380	760
26	21.0	291	582	333	666	366	732	394	788	419	838
27	22.0	319	638	365	730	401	802	432	864	460	920
28	23.0	348	696	398	796	438	876	472	944	502	1,004
29	24.0	378	756	433	866	476	952	513	1,026	545	1,090
30	25.0	410	820	469	938	516	1,032	556	1,112	591	1,182
31	26.0	434	868	497	994	547	1,094	589	1,178	626	1,252
32	27.0	459	918	526	1,052	579	1,158	623	1,246	662	1,324
33	28.0	485	970	555	1,110	611	1,222	658	1,316	700	1,400
34	29.0	512	1,024	586	1,172	645	1,290	694	1,388	738	1,476
35	30.0	539	1,078	617	1,234	679	1,358	731	1,462	777	1,554
36	31.0	567	1,134	649	1,298	714	1,428	769	1,538	817	1,634
37	31.5	585	1,170	670	1,340	737	1,474	794	1,588	844	1,688
38	32.0	604	1,208	692	1,384	761	1,522	820	1,640	872	1,744
39	33.0	634	1,268	725	1,450	798	1,596	860	1,720	914	1,828
40	34.0	663	1,326	759	1,518	836	1,672	900	1,800	957	1,914
41	35.0	694	1,388	794	1,588	874	1,748	942	1,884	1,001	2,002
42	36.0	725	1,450	830	1,660	913	1,826	984	1,968	1,046	2,092
43	37.0	757	1,514	866	1,732	953	1,906	1,027	2,054	1,091	2,182
44	38.0	789	1,578	903	1,806	994	1,988	1,071	2,142	1,138	2,276
45	39.0	822	1,644	941	1,882	1,036	2,072	1,116	2,232	1,186	2,372
46	40.0	856	1,712	980	1,960	1,078	2,156	1,161	2,322	1,234	2,468
47	41.0	890	1,780	1,019	2,038	1,121	2,242	1,208	2,416	1,283	2,566
48	42.0	925	1,850	1,059	2,118	1,165	2,330	1,255	2,510	1,334	2,668
49	43.0	960	1,920	1,099	2,198	1,210	2,420	1,303	2,606	1,385	2,770
50	44.0	996	1,992	1,140	2,280	1,255	2,510	1,352	2,704	1,437	2,874
51	44.5	1,021	2,042	1,168	2,336	1,286	2,572	1,385	2,770	1,472	2,944
52	45.0	1,045	2,090	1,196	2,392	1,317	2,634	1,418	2,836	1,507	3,014
53	46.0	1,083	2,166	1,239	2,478	1,364	2,728	1,469	2,938	1,561	3,122
54	47.0	1,121	2,242	1,283	2,566	1,412	2,824	1,521	3,042	1,616	3,232
55	48.0	1,159	2,318	1,327	2,654	1,461	2,922	1,574	3,148	1,672	3,344
56	49.0	1,199	2,398	1,372	2,744	1,510	3,020	1,627	3,254	1,729	3,458
57	50.0	1,239	2,478	1,418	2,836	1,561	3,122	1,681	3,362	1,786	3,572
58	51.0	1,279	2,558	1,464	2,928	1,612	3,224	1,736	3,472	1,845	3,690
59	52.0	1,320	2,640	1,511	3,022	1,664	3,328	1,792	3,584	1,904	3,808
60	53.0	1,362	2,724	1,559	3,118	1,716	3,432	1,849	3,698	1,964	3,928

Revision date 11/2016

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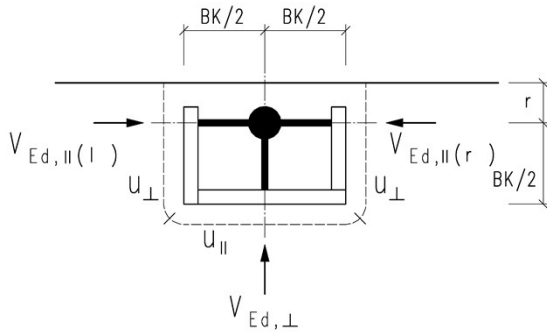
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Verification:

$$V_{Ed,Total} \leq V_{Rd,Total} = V_{Rd,\perp} + V_{Rd,II(l)} + V_{Rd,II(r)}$$

Design value of the shear resistance $V_{Rd,Total}$ [kN] with a distance to edge of $r \approx 10$ cm

(as a simplification $r \approx 0$ and equal span widths are used,

so that $V_{Ed,II} \approx V_{Ed,IIr} \approx V_{Ed,\perp} / 2$ and $V_{Ed,Total} \approx 2 V_{Ed,\perp}$)

and with an average reinforcement percentage ρ_{II} of

Slab thick- ness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		1.50%	
		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.
Concrete strength: C45/55											
$f_{ck} = 45 \text{ N/mm}^2$											
20	16.0	154	308	176	352	194	388	209	418	222	444
21	17.0	178	356	204	408	224	448	242	484	257	514
22	17.5	197	394	225	450	248	496	267	534	284	568
23	18.5	224	448	256	512	282	564	304	608	323	646
24	19.0	244	488	280	560	308	616	332	664	352	704
25	20.0	274	548	314	628	345	690	372	744	395	790
26	21.0	302	604	346	692	381	762	410	820	436	872
27	22.0	331	662	379	758	417	834	450	900	478	956
28	23.0	362	724	414	828	456	912	491	982	522	1,044
29	24.0	393	786	450	900	495	990	534	1,068	567	1,134
30	25.0	426	852	488	976	537	1,074	578	1,156	614	1,228
31	26.0	451	902	517	1,034	569	1,138	613	1,226	651	1,302
32	27.0	478	956	547	1,094	602	1,204	648	1,296	689	1,378
33	28.0	505	1,010	578	1,156	636	1,272	685	1,370	728	1,456
34	29.0	532	1,064	609	1,218	670	1,340	722	1,444	768	1,536
35	30.0	560	1,120	641	1,282	706	1,412	761	1,522	808	1,616
36	31.0	589	1,178	675	1,350	742	1,484	800	1,600	850	1,700
37	31.5	609	1,218	697	1,394	767	1,534	826	1,652	878	1,756
38	32.0	628	1,256	719	1,438	792	1,584	853	1,706	906	1,812
39	33.0	659	1,318	754	1,508	830	1,660	894	1,788	950	1,900
40	34.0	690	1,380	790	1,580	869	1,738	936	1,872	995	1,990
41	35.0	722	1,444	826	1,652	909	1,818	979	1,958	1,041	2,082
42	36.0	754	1,508	863	1,726	950	1,900	1,023	2,046	1,088	2,176
43	37.0	787	1,574	901	1,802	992	1,984	1,068	2,136	1,135	2,270
44	38.0	821	1,642	939	1,878	1,034	2,068	1,114	2,228	1,184	2,368
45	39.0	855	1,710	979	1,958	1,077	2,154	1,160	2,320	1,233	2,466
46	40.0	890	1,780	1,019	2,038	1,121	2,242	1,208	2,416	1,284	2,568
47	41.0	926	1,852	1,059	2,118	1,166	2,332	1,256	2,512	1,335	2,670
48	42.0	962	1,924	1,101	2,202	1,212	2,424	1,305	2,610	1,387	2,774
49	43.0	999	1,998	1,143	2,286	1,258	2,516	1,355	2,710	1,440	2,880
50	44.0	1,036	2,072	1,186	2,372	1,305	2,610	1,406	2,812	1,494	2,988
51	44.5	1,061	2,122	1,215	2,430	1,337	2,674	1,441	2,882	1,531	3,062
52	45.0	1,087	2,174	1,244	2,488	1,370	2,740	1,475	2,950	1,568	3,136
53	46.0	1,126	2,252	1,289	2,578	1,419	2,838	1,528	3,056	1,624	3,248
54	47.0	1,166	2,332	1,334	2,668	1,469	2,938	1,582	3,164	1,681	3,362
55	48.0	1,206	2,412	1,380	2,760	1,519	3,038	1,637	3,274	1,739	3,478
56	49.0	1,247	2,494	1,427	2,854	1,571	3,142	1,692	3,384	1,798	3,596
57	50.0	1,288	2,576	1,475	2,950	1,623	3,246	1,748	3,496	1,858	3,716
58	51.0	1,330	2,660	1,523	3,046	1,676	3,352	1,806	3,612	1,919	3,838
59	52.0	1,373	2,746	1,572	3,144	1,730	3,460	1,864	3,728	1,981	3,962
60	53.0	1,417	2,834	1,622	3,244	1,785	3,570	1,923	3,846	2,043	4,086

Revision date 11/2016

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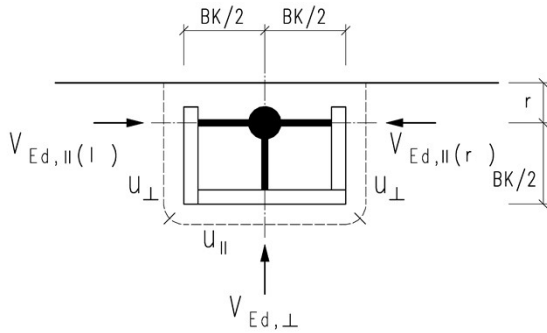
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and with an average reinforcement percentage ρ_{II} of

Slab thickness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		1.50%	
		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.
Concrete strength: C50/60											
$f_{ck} = 50 \text{ N/mm}^2$											
20	16.0	159	318	182	364	201	402	216	432	230	460
21	17.0	184	368	211	422	232	464	250	500	266	532
22	17.5	204	408	233	466	257	514	276	552	294	588
23	18.5	232	464	265	530	292	584	314	628	334	668
24	19.0	253	506	290	580	319	638	343	686	365	730
25	20.0	284	568	325	650	358	716	385	770	410	820
26	21.0	313	626	358	716	394	788	425	850	451	902
27	22.0	343	686	393	786	432	864	466	932	495	990
28	23.0	375	750	429	858	472	944	508	1,016	540	1,080
29	24.0	407	814	466	932	513	1,026	553	1,106	587	1,174
30	25.0	441	882	505	1,010	556	1,112	599	1,198	636	1,272
31	26.0	468	936	535	1,070	589	1,178	635	1,270	674	1,348
32	27.0	495	990	566	1,132	623	1,246	672	1,344	714	1,428
33	28.0	523	1,046	598	1,196	658	1,316	709	1,418	754	1,508
34	29.0	551	1,102	631	1,262	694	1,388	748	1,496	795	1,590
35	30.0	580	1,160	664	1,328	731	1,462	788	1,576	837	1,674
36	31.0	610	1,220	699	1,398	769	1,538	828	1,656	880	1,760
37	31.5	630	1,260	722	1,444	794	1,588	856	1,712	909	1,818
38	32.0	651	1,302	745	1,490	820	1,640	883	1,766	939	1,878
39	33.0	682	1,364	781	1,562	860	1,720	926	1,852	984	1,968
40	34.0	715	1,430	818	1,636	900	1,800	970	1,940	1,031	2,062
41	35.0	747	1,494	856	1,712	942	1,884	1,014	2,028	1,078	2,156
42	36.0	781	1,562	894	1,788	984	1,968	1,060	2,120	1,126	2,252
43	37.0	815	1,630	933	1,866	1,027	2,054	1,106	2,212	1,176	2,352
44	38.0	850	1,700	973	1,946	1,071	2,142	1,154	2,308	1,226	2,452
45	39.0	886	1,772	1,014	2,028	1,116	2,232	1,202	2,404	1,277	2,554
46	40.0	922	1,844	1,055	2,110	1,161	2,322	1,251	2,502	1,329	2,658
47	41.0	959	1,918	1,097	2,194	1,208	2,416	1,301	2,602	1,383	2,766
48	42.0	996	1,992	1,140	2,280	1,255	2,510	1,352	2,704	1,437	2,874
49	43.0	1,034	2,068	1,184	2,368	1,303	2,606	1,404	2,808	1,492	2,984
50	44.0	1,073	2,146	1,228	2,456	1,352	2,704	1,457	2,914	1,548	3,096
51	44.5	1,099	2,198	1,258	2,516	1,385	2,770	1,492	2,984	1,586	3,172
52	45.0	1,126	2,252	1,289	2,578	1,418	2,836	1,528	3,056	1,624	3,248
53	46.0	1,166	2,332	1,335	2,670	1,469	2,938	1,583	3,166	1,682	3,364
54	47.0	1,207	2,414	1,382	2,764	1,521	3,042	1,639	3,278	1,741	3,482
55	48.0	1,249	2,498	1,430	2,860	1,574	3,148	1,695	3,390	1,801	3,602
56	49.0	1,291	2,582	1,478	2,956	1,627	3,254	1,753	3,506	1,862	3,724
57	50.0	1,334	2,668	1,527	3,054	1,681	3,362	1,811	3,622	1,924	3,848
58	51.0	1,378	2,756	1,577	3,154	1,736	3,472	1,870	3,740	1,987	3,974
59	52.0	1,422	2,844	1,628	3,256	1,792	3,584	1,930	3,860	2,051	4,102
60	53.0	1,467	2,934	1,680	3,360	1,849	3,698	1,991	3,982	2,116	4,232

Revision date 11/2016

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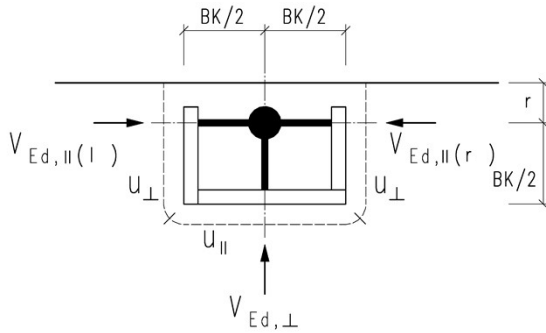
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		Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.	Without shear reinf.	With shear reinf.
Concrete strength: C55/67											
$f_{ck} = 55 \text{ N/mm}^2$											
20	16.0	164	329	188	377	207	414	223	446	237	474
21	17.0	190	381	218	436	240	479	258	516	274	549
22	17.5	210	420	241	481	265	530	285	571	303	606
23	18.5	239	478	274	547	301	603	325	649	345	690
24	19.0	261	522	299	598	329	658	354	709	377	753
25	20.0	293	586	336	671	369	739	398	796	423	846
26	21.0	323	646	370	740	407	814	439	877	466	932
27	22.0	354	709	406	811	446	893	481	962	511	1,022
28	23.0	387	773	443	885	487	974	525	1,050	558	1,116
29	24.0	420	841	481	963	530	1,059	571	1,141	606	1,213
30	25.0	455	911	521	1,043	574	1,147	618	1,236	657	1,313
31	26.0	483	965	553	1,105	608	1,216	655	1,310	696	1,392
32	27.0	511	1,022	585	1,169	644	1,287	693	1,386	737	1,473
33	28.0	540	1,079	618	1,235	680	1,359	732	1,464	778	1,556
34	29.0	569	1,138	651	1,303	717	1,434	772	1,544	821	1,641
35	30.0	599	1,198	686	1,372	755	1,510	813	1,626	864	1,728
36	31.0	630	1,260	721	1,442	794	1,588	855	1,710	909	1,817
37	31.5	651	1,302	745	1,490	820	1,640	883	1,767	939	1,877
38	32.0	672	1,344	769	1,538	847	1,693	912	1,824	969	1,938
39	33.0	704	1,409	806	1,613	888	1,775	956	1,912	1,016	2,032
40	34.0	738	1,475	844	1,689	929	1,859	1,001	2,002	1,064	2,128
41	35.0	772	1,543	883	1,767	972	1,944	1,047	2,094	1,113	2,226
42	36.0	806	1,612	923	1,846	1,016	2,032	1,094	2,188	1,163	2,326
43	37.0	842	1,683	963	1,927	1,060	2,120	1,142	2,284	1,214	2,427
44	38.0	877	1,755	1,004	2,009	1,106	2,211	1,191	2,382	1,266	2,531
45	39.0	914	1,828	1,046	2,093	1,152	2,304	1,241	2,481	1,318	2,637
46	40.0	952	1,903	1,089	2,178	1,199	2,398	1,291	2,583	1,372	2,745
47	41.0	990	1,979	1,133	2,266	1,247	2,494	1,343	2,686	1,427	2,854
48	42.0	1,028	2,057	1,177	2,354	1,296	2,591	1,396	2,791	1,483	2,966
49	43.0	1,068	2,135	1,222	2,444	1,345	2,690	1,449	2,898	1,540	3,080
50	44.0	1,108	2,216	1,268	2,536	1,396	2,792	1,504	3,007	1,598	3,195
51	44.5	1,135	2,270	1,299	2,598	1,430	2,860	1,540	3,080	1,637	3,273
52	45.0	1,162	2,324	1,330	2,661	1,464	2,928	1,577	3,155	1,676	3,352
53	46.0	1,204	2,408	1,378	2,756	1,517	3,034	1,634	3,268	1,736	3,473
54	47.0	1,246	2,492	1,427	2,853	1,570	3,140	1,691	3,383	1,797	3,595
55	48.0	1,289	2,579	1,476	2,952	1,624	3,249	1,750	3,500	1,859	3,719
56	49.0	1,333	2,666	1,526	3,052	1,679	3,359	1,809	3,618	1,923	3,845
57	50.0	1,377	2,755	1,577	3,153	1,735	3,471	1,869	3,739	1,987	3,973
58	51.0	1,422	2,845	1,628	3,257	1,792	3,584	1,931	3,861	2,052	4,103
59	52.0	1,468	2,936	1,681	3,361	1,850	3,700	1,993	3,985	2,118	4,235
60	53.0	1,515	3,029	1,734	3,468	1,908	3,817	2,056	4,111	2,184	4,369

Revision date 11/2016

These results constitute only indicative information in order to pre-dimension the slabs. They cannot be used as the definitive structural design. The definitive structural design is to be carried out by spannverbund. Without a previous contractual arrangement with spannverbund, we assume no liability derived from the misuse of these indications.

Contact us:

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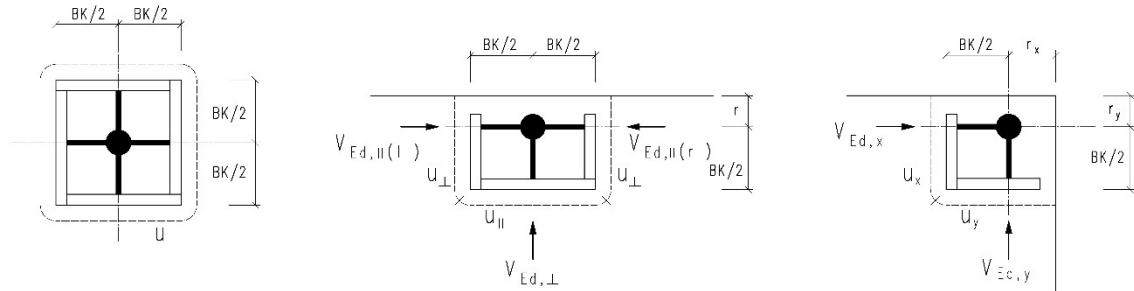
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Europilz® shear head

How to use the pre-dimensioning tables



The tables are valid for homogeneously loaded solid concrete slabs in concrete C20/25 to C55/67 with slab thicknesses between 20.0 and 60.0 cm and longitudinal reinforcement percentage between 0.5 and 1.75% (1.5% in interior Europilz®). In flat concrete slabs, the bottom flange of the Europilz® is 2.0 cm above the bottom formwork.

The punching shear resistance is calculated according to our technical approval (Z-15.1-234) as well as to BS EN 1992-1-1+NA.

The table values V_{Rd} are design values of the maximal possible punching shear resistance for a specific slab thickness. The width of the Europilz® (BK) varies and will be optimized by us depending on the slab thickness and the boundary conditions. The thicker the slab is and the higher the reinforcement grade is, the smaller and consequently cheaper is the Europilz®. The maximum width of the shear head for a specific slab thickness is limited to a fixed value for structural and constructive reasons.

In edge and corner Europilz® only a verification of the shear resistance instead of a verification of the punching shear will be conducted. The punching shear load can be determined as the addition of the loads in every quadrant with no additional β . For this reason, if the spans and the shear force distribution in the critical section are homogeneous, the total support reaction determined with FE software can be used with factor $\beta=1$.

Furthermore, for the calculation of the edge and corner Europilz®, the distances r , r_x and r_y are not considered in the calculation (safe estimation).

Besides the results of this calculation, further requirements regarding the minimum slab thickness due to deflection criteria as well as the minimum slab reinforcement must be considered.

If your data deviates from the assumptions in this pre-dimensioning, i.e., other slab thicknesses, effective depths, loads, percentage of slab reinforcement, concrete grades, wall or wall corner situations, heterogeneously distributed loads (i.e., line or concentrated loads), bigger distances to edge or heterogeneous span widths in edge and corner Europilz® as well as **Europilz® in slab foundations**, please contact us.

Slab openings also in the interior of the Europilz®, are possible. Their location, sizes and the effect on the design results can be discussed in detail with our technical team.

Contact us:

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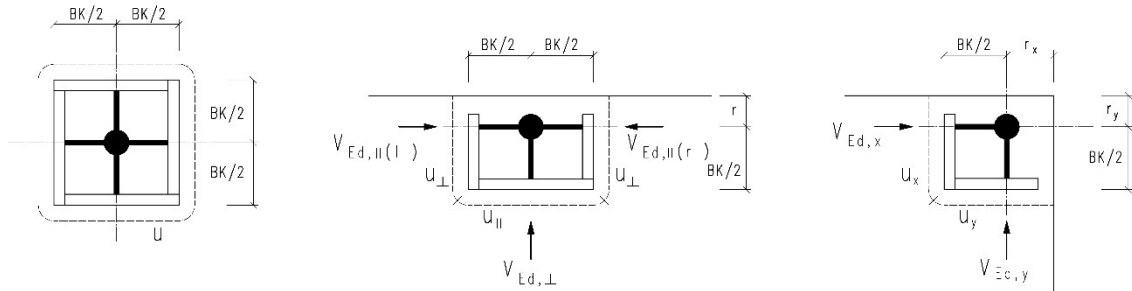
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Europilz® shear head Pre-dimensioning examples



Examples of interior shear head:

Parameter: Flat slab in C30/37 with punching shear load: $V_{Ed} = 1,220 \text{ kN}$, $\beta = 1.10$, thus: $\beta \cdot V_{Ed} = 1,342 \text{ kN}$

Desired: Min. slab thickness with $\rho_l = 1.0\%$, without additional shear/punching shear reinforcement

Result: $h = 30 \text{ cm}$ ($d = 25 \text{ cm}$) with $V_{Rd} = 1,349 \text{ kN} > 1,342 \text{ kN}$

Or:

Parameter: Flat slab in C30/37 with punching shear load: $V_{Ed} = 1,220 \text{ kN}$, $\beta = 1.10$, thus: $\beta \cdot V_{Ed} = 1,342 \text{ kN}$

Desired: Min. slab thickness with $\rho_l = 0.75\%$, **with** additional shear/punching shear reinforcement.

Result: $h = 27 \text{ cm}$ ($d = 22 \text{ cm}$) with $V_{Rd} = 1,395 \text{ kN} > 1,342 \text{ kN}$

Example of edge shear head: (Punching shear load = Addition of quadrant loads without β)

Parameter: Flat slab in C30/37 with punching shear load: $V_{Ed, \text{total}} = 410 \text{ kN}$, $L_{x1} \approx L_{x2} \approx L_y$, $r = \text{very small}$

Desired: Min. slab thickness with $\rho_l = 0.75\%$, without additional shear/punching shear reinforcement

Result: $h = 30 \text{ cm}$ ($d = 25 \text{ cm}$) with $V_{Rd, \text{total}} = 426 \text{ kN} > 410 \text{ kN}$

Example of corner shear head: (Punching shear load = Addition of quadrant loads without β)

Parameter: Flat slab in C30/37 with punching shear load: $V_{Ed, \text{total}} = 210 \text{ kN}$, $L_x \approx L_y$, $r_x \approx r_y = \text{very small}$

Desired: Min. slab thickness with $\rho_l = 0.75\%$, without additional shear/punching shear reinforcement

Result: $h = 30 \text{ cm}$ ($d = 25 \text{ cm}$) mit $V_{Rd, \text{total}} = 213 \text{ kN} > 210 \text{ kN}$



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