

## Interior shear heads in flat slabs

(For foundation slabs please contact our design team)

For more information about how to use  
the pre-dimensioning tables please  
refer to the last pages.

**Verification:**

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average longitudinal reinforcement percentage $\rho_l$ 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.	Without shear reinf.	With shear reinf.			
											<b>Concrete grade: C20/25</b>		<b><math>f_{ck} = 20 \text{ N/mm}^2</math></b>	
20	16.0	358	511	410	585	451	644	486	693					
21	17.0	411	588	471	673	518	741	558	798					
22	17.5	448	643	513	737	564	811	608	873					
23	18.5	506	729	580	835	638	919	687	990					
24	19.0	547	791	626	905	689	996	742	1.073					
25	20.0	612	885	700	1,013	770	1,115	830	1,201					
26	21.0	671	973	769	1,114	846	1,226	911	1,321					
27	22.0	734	1,065	840	1,219	925	1,341	996	1,445					
28	23.0	799	1,160	914	1,328	1,006	1,461	1,084	1,574					
29	24.0	866	1,259	991	1,441	1,091	1,586	1,175	1,709					
30	25.0	936	1,361	1,071	1,558	1,179	1,715	1,270	1,848					
31	26.0	995	1,446	1,139	1,655	1,254	1,822	1,351	1,963					
32	27.0	1,056	1,533	1,209	1,755	1,331	1,932	1,434	2,081					
33	28.0	1,119	1,623	1,281	1,858	1,410	2,045	1,519	2,203					
34	29.0	1,184	1,715	1,355	1,963	1,491	2,160	1,606	2,327					
35	30.0	1,250	1,809	1,430	2,070	1,574	2,279	1,696	2,455					
36	31.0	1,317	1,905	1,508	2,181	1,660	2,400	1,788	2,586					
37	31.5	1,359	1,966	1,556	2,251	1,712	2,477	1,845	2,669					
38	32.0	1,402	2,029	1,604	2,322	1,766	2,556	1,902	2,753					
39	33.0	1,473	2,130	1,686	2,438	1,856	2,684	1,999	2,891					
40	34.0	1,546	2,234	1,770	2,557	1,948	2,814	2,098	3,032					
41	35.0	1,620	2,340	1,855	2,678	2,042	2,948	2,199	3,175					
42	36.0	1,697	2,448	1,942	2,802	2,138	3,084	2,303	3,322					
43	37.0	1,774	2,558	2,031	2,929	2,235	3,223	2,408	3,472					
44	38.0	1,854	2,671	2,122	3,058	2,335	3,365	2,516	3,625					
45	39.0	1,935	2,786	2,215	3,189	2,438	3,510	2,626	3,781					
46	40.0	2,017	2,903	2,309	3,323	2,542	3,658	2,738	3,940					
47	41.0	2,101	3,023	2,405	3,460	2,648	3,808	2,852	4,102					
48	42.0	2,187	3,144	2,504	3,599	2,756	3,961	2,968	4,267					
49	43.0	2,274	3,268	2,604	3,741	2,866	4,117	3,087	4,435					
50	44.0	2,363	3,394	2,705	3,885	2,978	4,276	3,207	4,606					
51	44.5	2,418	3,474	2,768	3,977	3,046	4,377	3,282	4,715					
52	45.0	2,473	3,555	2,831	4,069	3,116	4,479	3,357	4,824					
53	46.0	2,566	3,686	2,937	4,219	3,232	4,644	3,482	5,002					
54	47.0	2,659	3,819	3,044	4,372	3,351	4,811	3,609	5,183					
55	48.0	2,755	3,954	3,154	4,526	3,471	4,982	3,739	5,367					
56	49.0	2,852	4,092	3,265	4,684	3,593	5,155	3,871	5,553					
57	50.0	2,951	4,231	3,378	4,844	3,718	5,331	4,005	5,743					
58	51.0	3,051	4,373	3,492	5,006	3,844	5,510	4,141	5,936					
59	52.0	3,153	4,517	3,609	5,171	3,972	5,692	4,279	6,131					
60	53.0	3,256	4,664	3,727	5,339	4,102	5,876	4,419	6,330					

Revision date 11/2016

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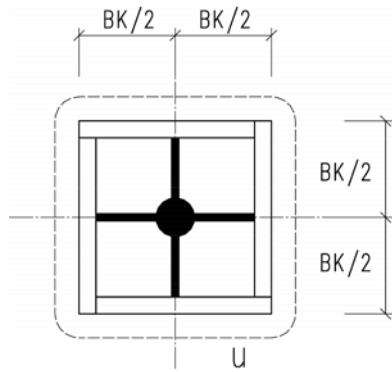
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**Verification:**

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average longitudinal reinforcement percentage $\rho_l$ of

Slab thick- ness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.23%		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.	
<b>Concrete strength: C25/30</b>												<b><math>f_{ck} = 25 \text{ N/mm}^2</math></b>
20	16.0	386	550	442	630	486	693	524	747	557	794	
21	17.0	443	633	507	725	558	798	601	859	639	913	
22	17.5	482	693	552	793	608	873	655	941	696	1,000	
23	18.5	546	785	625	899	687	990	740	1,066	787	1,133	
24	19.0	589	852	674	975	742	1,073	800	1,156	850	1,228	
25	20.0	659	953	754	1,091	830	1,201	894	1,294	950	1,375	
26	21.0	723	1,048	828	1,200	911	1,321	982	1,423	1,043	1,512	
27	22.0	790	1,147	905	1,313	996	1,445	1,073	1,557	1,140	1,654	
28	23.0	860	1,250	985	1,430	1,084	1,574	1,168	1,696	1,241	1,802	
29	24.0	933	1,356	1,068	1,552	1,175	1,709	1,266	1,840	1,345	1,956	
30	25.0	1,008	1,466	1,154	1,679	1,270	1,848	1,368	1,990	1,454	2,115	
31	26.0	1,072	1,558	1,227	1,783	1,351	1,963	1,455	2,114	1,546	2,247	
32	27.0	1,138	1,652	1,303	1,891	1,434	2,081	1,544	2,242	1,641	2,382	
33	28.0	1,206	1,748	1,380	2,001	1,519	2,203	1,636	2,373	1,739	2,521	
34	29.0	1,275	1,847	1,459	2,114	1,606	2,327	1,730	2,507	1,839	2,664	
35	30.0	1,346	1,948	1,541	2,230	1,696	2,455	1,827	2,644	1,941	2,810	
36	31.0	1,419	2,052	1,624	2,349	1,788	2,586	1,926	2,785	2,047	2,960	
37	31.5	1,464	2,118	1,676	2,425	1,845	2,669	1,987	2,875	2,112	3,055	
38	32.0	1,510	2,185	1,728	2,501	1,902	2,753	2,049	2,966	2,177	3,152	
39	33.0	1,587	2,294	1,816	2,626	1,999	2,891	2,153	3,114	2,288	3,309	
40	34.0	1,665	2,406	1,906	2,754	2,098	3,032	2,260	3,266	2,402	3,470	
41	35.0	1,745	2,520	1,998	2,885	2,199	3,175	2,369	3,421	2,517	3,635	
42	36.0	1,828	2,637	2,092	3,019	2,303	3,322	2,480	3,579	2,636	3,803	
43	37.0	1,911	2,756	2,188	3,155	2,408	3,472	2,594	3,740	2,757	3,975	
44	38.0	1,997	2,877	2,286	3,294	2,516	3,625	2,710	3,905	2,880	4,150	
45	39.0	2,084	3,001	2,386	3,435	2,626	3,781	2,828	4,073	3,006	4,328	
46	40.0	2,173	3,127	2,487	3,580	2,738	3,940	2,949	4,244	3,134	4,510	
47	41.0	2,264	3,256	2,591	3,727	2,852	4,102	3,072	4,419	3,265	4,696	
48	42.0	2,356	3,387	2,697	3,877	2,968	4,267	3,198	4,597	3,398	4,885	
49	43.0	2,450	3,520	2,805	4,030	3,087	4,435	3,325	4,778	3,534	5,077	
50	44.0	2,546	3,656	2,914	4,185	3,207	4,606	3,455	4,962	3,672	5,273	
51	44.5	2,605	3,742	2,982	4,284	3,282	4,715	3,535	5,079	3,757	5,397	
52	45.0	2,664	3,829	3,050	4,383	3,357	4,824	3,616	5,197	3,842	5,523	
53	46.0	2,764	3,970	3,164	4,545	3,482	5,002	3,751	5,389	3,986	5,726	
54	47.0	2,865	4,114	3,279	4,709	3,609	5,183	3,888	5,583	4,132	5,933	
55	48.0	2,968	4,260	3,397	4,876	3,739	5,367	4,028	5,781	4,280	6,143	
56	49.0	3,072	4,408	3,517	5,046	3,871	5,553	4,170	5,982	4,431	6,357	
57	50.0	3,179	4,558	3,639	5,218	4,005	5,743	4,314	6,186	4,584	6,574	
58	51.0	3,287	4,711	3,762	5,393	4,141	5,936	4,461	6,394	4,740	6,795	
59	52.0	3,396	4,866	3,888	5,571	4,279	6,131	4,609	6,605	4,898	7,018	
60	53.0	3,507	5,024	4,015	5,751	4,419	6,330	4,760	6,818	5,059	7,246	

Revision date 11/2016

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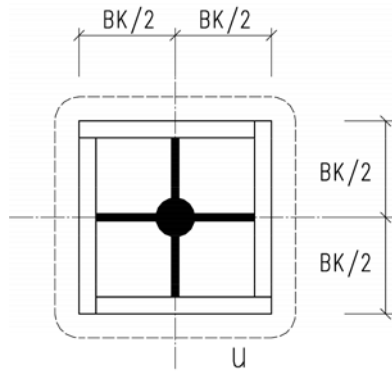
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### Verification:

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average

Slab thickness h [cm]	Avg. effective depth d [cm]	longitudinal reinforcement percentage $\rho_l$ of											
		0.50%		0.75%		1.00%		1.25%		1.50%		1.75%	
		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.	Without shear reinf.	With shear reinf.
<b>Concrete strength: C30/37</b>													
<b><math>f_{ck} = 30 \text{ N/mm}^2</math></b>													
20	16.0	410	585	469	669	517	737	557	794	591	843	623	888
21	17.0	471	673	539	770	593	848	639	913	679	970	714	1,022
22	17.5	513	737	587	843	646	928	696	1,000	739	1,062	778	1,118
23	18.5	580	835	664	955	730	1,052	787	1,133	836	1,204	880	1,267
24	19.0	626	905	717	1,036	789	1,140	850	1,228	903	1,305	951	1,374
25	20.0	700	1,013	801	1,160	882	1,276	950	1,375	1,010	1,461	1,063	1,538
26	21.0	769	1,114	880	1,275	968	1,403	1,043	1,512	1,109	1,606	1,167	1,691
27	22.0	840	1,219	962	1,395	1,058	1,536	1,140	1,654	1,212	1,758	1,275	1,850
28	23.0	914	1,328	1,047	1,520	1,152	1,673	1,241	1,802	1,319	1,915	1,388	2,016
29	24.0	991	1,441	1,135	1,650	1,249	1,816	1,345	1,956	1,430	2,078	1,505	2,188
30	25.0	1,071	1,558	1,226	1,784	1,349	1,963	1,454	2,115	1,545	2,248	1,626	2,366
31	26.0	1,139	1,655	1,304	1,895	1,435	2,086	1,546	2,247	1,643	2,388	1,730	2,514
32	27.0	1,209	1,755	1,384	2,009	1,523	2,212	1,641	2,382	1,744	2,532	1,836	2,665
33	28.0	1,281	1,858	1,466	2,127	1,614	2,341	1,739	2,521	1,848	2,679	1,945	2,821
34	29.0	1,355	1,963	1,551	2,247	1,707	2,473	1,839	2,664	1,954	2,831	2,057	2,980
35	30.0	1,430	2,070	1,638	2,370	1,802	2,609	1,941	2,810	2,063	2,986	2,172	3,144
36	31.0	1,508	2,181	1,726	2,496	1,900	2,748	2,047	2,960	2,175	3,145	2,290	3,311
37	31.5	1,556	2,251	1,781	2,577	1,960	2,836	2,112	3,055	2,244	3,246	2,362	3,418
38	32.0	1,604	2,322	1,837	2,658	2,021	2,926	2,177	3,152	2,314	3,349	2,436	3,526
39	33.0	1,686	2,438	1,930	2,791	2,124	3,072	2,288	3,309	2,432	3,517	2,560	3,702
40	34.0	1,770	2,557	2,026	2,927	2,229	3,222	2,402	3,470	2,552	3,688	2,687	3,882
41	35.0	1,855	2,678	2,123	3,066	2,337	3,374	2,517	3,635	2,675	3,863	2,816	4,066
42	36.0	1,942	2,802	2,223	3,208	2,447	3,531	2,636	3,803	2,801	4,041	2,949	4,255
43	37.0	2,031	2,929	2,325	3,352	2,559	3,690	2,757	3,975	2,929	4,224	3,084	4,447
44	38.0	2,122	3,058	2,429	3,500	2,673	3,852	2,880	4,150	3,060	4,410	3,222	4,642
45	39.0	2,215	3,189	2,535	3,651	2,790	4,018	3,006	4,328	3,194	4,600	3,362	4,842
46	40.0	2,309	3,323	2,643	3,804	2,909	4,187	3,134	4,510	3,330	4,793	3,506	5,046
47	41.0	2,405	3,460	2,754	3,961	3,031	4,359	3,265	4,696	3,469	4,990	3,652	5,253
48	42.0	2,504	3,599	2,866	4,120	3,154	4,535	3,398	4,885	3,611	5,191	3,801	5,465
49	43.0	2,604	3,741	2,980	4,282	3,280	4,713	3,534	5,077	3,755	5,395	3,953	5,680
50	44.0	2,705	3,885	3,097	4,447	3,408	4,895	3,672	5,273	3,902	5,603	4,107	5,899
51	44.5	2,768	3,977	3,168	4,552	3,487	5,010	3,757	5,397	3,992	5,735	4,202	6,038
52	45.0	2,831	4,069	3,241	4,658	3,567	5,127	3,842	5,523	4,083	5,869	4,298	6,178
53	46.0	2,937	4,219	3,362	4,830	3,700	5,316	3,986	5,726	4,236	6,085	4,459	6,406
54	47.0	3,044	4,372	3,485	5,004	3,836	5,508	4,132	5,933	4,391	6,305	4,622	6,637
55	48.0	3,154	4,526	3,610	5,182	3,973	5,703	4,280	6,143	4,548	6,528	4,788	6,872
56	49.0	3,265	4,684	3,737	5,362	4,113	5,901	4,431	6,357	4,709	6,755	4,957	7,112
57	50.0	3,378	4,844	3,867	5,545	4,256	6,103	4,584	6,574	4,872	6,986	5,128	7,354
58	51.0	3,492	5,006	3,998	5,731	4,400	6,308	4,740	6,795	5,037	7,220	5,303	7,601
59	52.0	3,609	5,171	4,131	5,920	4,547	6,515	4,898	7,018	5,205	7,458	5,479	7,851
60	53.0	3,727	5,339	4,267	6,111	4,696	6,726	5,059	7,246	5,376	7,700	5,659	8,106

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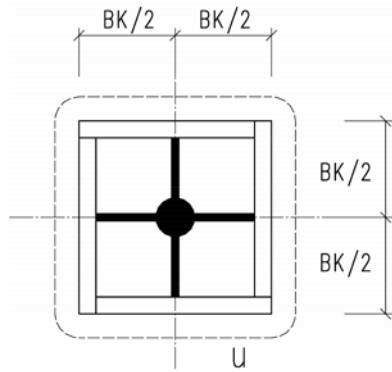
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### Verification:

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average longitudinal reinforcement percentage $\rho_l$ of

Slab thickness h [cm]	Avg. effective depth d [cm]	Design value of the shear resistance $V_{Rd}$ [kN] with an average longitudinal reinforcement percentage $\rho_l$ of											
		0.50%		0.75%		1.00%		1.25%		1.50%		1.75%	
		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.	Without shear reinf.	With shear reinf.
<b>Concrete strength: C35/45</b>													
<b><math>f_{ck} = 35 \text{ N/mm}^2</math></b>													
20	16.0	432	616	494	705	544	776	586	836	623	888	656	935
21	17.0	495	708	567	811	624	892	672	961	714	1,022	752	1,075
22	17.5	540	775	618	888	680	977	732	1,052	778	1,118	819	1,177
23	18.5	610	879	699	1,006	769	1,107	828	1,193	880	1,267	927	1,334
24	19.0	659	953	755	1,090	830	1,200	895	1,293	951	1,374	1,001	1,446
25	20.0	737	1,067	844	1,221	928	1,344	1,000	1,448	1,063	1,538	1,119	1,619
26	21.0	809	1,173	926	1,342	1,019	1,477	1,098	1,591	1,167	1,691	1,228	1,780
27	22.0	884	1,283	1,012	1,469	1,114	1,616	1,200	1,741	1,275	1,850	1,343	1,948
28	23.0	962	1,398	1,102	1,600	1,213	1,761	1,306	1,897	1,388	2,016	1,461	2,122
29	24.0	1,044	1,517	1,195	1,737	1,315	1,911	1,416	2,059	1,505	2,188	1,584	2,303
30	25.0	1,128	1,641	1,291	1,878	1,421	2,067	1,530	2,227	1,626	2,366	1,712	2,491
31	26.0	1,199	1,743	1,373	1,995	1,511	2,196	1,628	2,365	1,730	2,514	1,821	2,646
32	27.0	1,273	1,848	1,457	2,115	1,604	2,328	1,728	2,508	1,836	2,665	1,933	2,806
33	28.0	1,349	1,956	1,544	2,239	1,699	2,464	1,830	2,654	1,945	2,821	2,048	2,969
34	29.0	1,426	2,066	1,633	2,365	1,797	2,603	1,936	2,804	2,057	2,980	2,166	3,137
35	30.0	1,506	2,180	1,724	2,495	1,897	2,746	2,044	2,958	2,172	3,144	2,286	3,309
36	31.0	1,588	2,296	1,817	2,628	2,000	2,892	2,155	3,116	2,290	3,311	2,410	3,486
37	31.5	1,638	2,370	1,875	2,712	2,064	2,985	2,223	3,216	2,362	3,418	2,487	3,598
38	32.0	1,689	2,445	1,933	2,798	2,128	3,080	2,292	3,318	2,436	3,526	2,564	3,711
39	33.0	1,775	2,567	2,032	2,938	2,236	3,234	2,409	3,484	2,560	3,702	2,695	3,897
40	34.0	1,863	2,692	2,132	3,081	2,347	3,391	2,528	3,653	2,687	3,882	2,828	4,087
41	35.0	1,953	2,820	2,235	3,228	2,460	3,552	2,650	3,827	2,816	4,066	2,965	4,281
42	36.0	2,044	2,950	2,340	3,377	2,576	3,717	2,775	4,004	2,949	4,255	3,104	4,479
43	37.0	2,138	3,083	2,448	3,529	2,694	3,884	2,902	4,184	3,084	4,447	3,246	4,681
44	38.0	2,234	3,219	2,557	3,685	2,814	4,056	3,032	4,369	3,222	4,642	3,392	4,887
45	39.0	2,331	3,357	2,669	3,843	2,937	4,230	3,164	4,557	3,362	4,842	3,540	5,097
46	40.0	2,431	3,499	2,783	4,005	3,063	4,408	3,299	4,748	3,506	5,046	3,691	5,312
47	41.0	2,532	3,642	2,899	4,169	3,190	4,589	3,437	4,943	3,652	5,253	3,845	5,530
48	42.0	2,636	3,789	3,017	4,337	3,321	4,774	3,577	5,142	3,801	5,465	4,002	5,753
49	43.0	2,741	3,938	3,137	4,508	3,453	4,962	3,720	5,345	3,953	5,680	4,161	5,979
50	44.0	2,848	4,090	3,260	4,682	3,588	5,153	3,865	5,551	4,107	5,899	4,324	6,210
51	44.5	2,914	4,186	3,335	4,792	3,671	5,274	3,955	5,682	4,202	6,038	4,424	6,356
52	45.0	2,980	4,284	3,412	4,904	3,755	5,397	4,045	5,814	4,298	6,178	4,525	6,504
53	46.0	3,092	4,442	3,539	5,084	3,895	5,596	4,196	6,028	4,459	6,406	4,694	6,744
54	47.0	3,205	4,602	3,669	5,268	4,038	5,798	4,350	6,246	4,622	6,637	4,866	6,987
55	48.0	3,320	4,765	3,800	5,455	4,183	6,004	4,506	6,467	4,788	6,872	5,041	7,235
56	49.0	3,437	4,931	3,934	5,644	4,330	6,213	4,665	6,692	4,957	7,112	5,218	7,487
57	50.0	3,556	5,099	4,070	5,837	4,480	6,425	4,826	6,921	5,128	7,354	5,399	7,742
58	51.0	3,677	5,270	4,209	6,033	4,632	6,640	4,990	7,153	5,303	7,601	5,582	8,002
59	52.0	3,799	5,444	4,349	6,232	4,787	6,859	5,156	7,388	5,479	7,851	5,768	8,265
60	53.0	3,924	5,620	4,492	6,433	4,944	7,081	5,325	7,628	5,659	8,106	5,957	8,533

Revision date 11/2016

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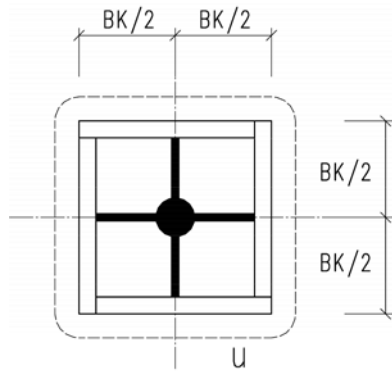
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## Interior shear heads in flat slabs

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

Verification:

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average longitudinal reinforcement percentage $\rho_l$ of

Slab thickness h [cm]	Avg. effective depth d [cm]	0.50%		0.75%		1.00%		1.25%		1.50%		1.75%	
		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.	Without shear reinf.	With shear reinf.
<b>Concrete strength: C40/50</b>													
<b><math>f_{ck} = 40 \text{ N/mm}^2</math></b>													
20	16.0	451	644	517	737	569	811	613	874	651	928	685	977
21	17.0	518	741	593	848	653	933	703	1,005	747	1,068	786	1,124
22	17.5	564	811	646	928	711	1,021	766	1,100	814	1,169	857	1,231
23	18.5	638	919	730	1,052	804	1,157	866	1,247	920	1,325	969	1,395
24	19.0	689	996	789	1,140	868	1,255	935	1,352	994	1,436	1,046	1,512
25	20.0	770	1,115	882	1,276	971	1,405	1,046	1,513	1,111	1,608	1,170	1,693
26	21.0	846	1,226	968	1,403	1,066	1,545	1,148	1,664	1,220	1,768	1,284	1,861
27	22.0	925	1,341	1,058	1,536	1,165	1,690	1,255	1,821	1,333	1,935	1,404	2,037
28	23.0	1,006	1,461	1,152	1,673	1,268	1,841	1,366	1,984	1,451	2,108	1,528	2,219
29	24.0	1,091	1,586	1,249	1,816	1,375	1,998	1,481	2,153	1,574	2,287	1,656	2,408
30	25.0	1,179	1,715	1,349	1,963	1,485	2,161	1,600	2,328	1,700	2,474	1,790	2,604
31	26.0	1,254	1,822	1,435	2,086	1,580	2,296	1,702	2,473	1,808	2,628	1,904	2,767
32	27.0	1,331	1,932	1,523	2,212	1,677	2,434	1,806	2,622	1,919	2,786	2,021	2,933
33	28.0	1,410	2,045	1,614	2,341	1,776	2,576	1,914	2,775	2,034	2,949	2,141	3,104
34	29.0	1,491	2,160	1,707	2,473	1,879	2,722	2,024	2,932	2,151	3,116	2,264	3,280
35	30.0	1,574	2,279	1,802	2,609	1,984	2,871	2,137	3,093	2,271	3,287	2,391	3,460
36	31.0	1,660	2,400	1,900	2,748	2,091	3,024	2,253	3,258	2,394	3,462	2,520	3,644
37	31.5	1,712	2,477	1,960	2,836	2,158	3,121	2,324	3,362	2,470	3,573	2,600	3,761
38	32.0	1,766	2,556	2,021	2,926	2,225	3,220	2,397	3,469	2,547	3,686	2,681	3,880
39	33.0	1,856	2,684	2,124	3,072	2,338	3,381	2,519	3,642	2,676	3,870	2,817	4,075
40	34.0	1,948	2,814	2,229	3,222	2,454	3,546	2,643	3,820	2,809	4,059	2,957	4,273
41	35.0	2,042	2,948	2,337	3,374	2,572	3,714	2,771	4,001	2,944	4,252	3,100	4,476
42	36.0	2,138	3,084	2,447	3,531	2,693	3,886	2,901	4,186	3,083	4,448	3,245	4,683
43	37.0	2,235	3,223	2,559	3,690	2,817	4,061	3,034	4,375	3,224	4,649	3,394	4,894
44	38.0	2,335	3,365	2,673	3,852	2,943	4,240	3,170	4,568	3,368	4,854	3,546	5,110
45	39.0	2,438	3,510	2,790	4,018	3,071	4,423	3,308	4,764	3,515	5,063	3,701	5,329
46	40.0	2,542	3,658	2,909	4,187	3,202	4,609	3,449	4,964	3,666	5,275	3,859	5,554
47	41.0	2,648	3,808	3,031	4,359	3,336	4,798	3,593	5,168	3,818	5,492	4,020	5,782
48	42.0	2,756	3,961	3,154	4,535	3,472	4,991	3,740	5,376	3,974	5,713	4,184	6,015
49	43.0	2,866	4,117	3,280	4,713	3,610	5,188	3,889	5,588	4,133	5,938	4,351	6,251
50	44.0	2,978	4,276	3,408	4,895	3,752	5,388	4,041	5,804	4,294	6,167	4,521	6,492
51	44.5	3,046	4,377	3,487	5,010	3,838	5,514	4,135	5,940	4,394	6,313	4,625	6,645
52	45.0	3,116	4,479	3,567	5,127	3,926	5,643	4,229	6,078	4,494	6,459	4,731	6,800
53	46.0	3,232	4,644	3,700	5,316	4,073	5,851	4,387	6,302	4,662	6,697	4,908	7,050
54	47.0	3,351	4,811	3,836	5,508	4,222	6,062	4,548	6,530	4,833	6,939	5,087	7,305
55	48.0	3,471	4,982	3,973	5,703	4,373	6,277	4,711	6,762	5,006	7,185	5,270	7,564
56	49.0	3,593	5,155	4,113	5,901	4,527	6,495	4,877	6,997	5,183	7,435	5,456	7,827
57	50.0	3,718	5,331	4,256	6,103	4,684	6,717	5,046	7,236	5,362	7,689	5,645	8,095
58	51.0	3,844	5,510	4,400	6,308	4,843	6,942	5,217	7,478	5,544	7,947	5,836	8,366
59	52.0	3,972	5,692	4,547	6,515	5,005	7,171	5,391	7,725	5,729	8,209	6,031	8,642
60	53.0	4,102	5,876	4,696	6,726	5,169	7,403	5,568	7,975	5,917	8,475	6,229	8,921

Revision date 11/2016

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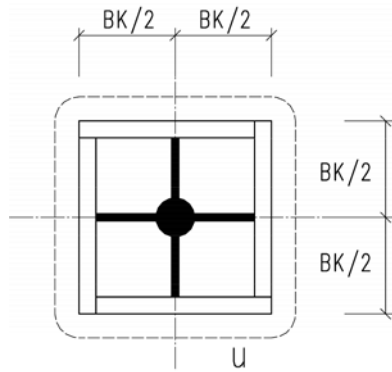
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## Interior shear heads in flat slabs

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**Verification:**

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average

Slab thickness h [cm]	Avg. effective depth d [cm]	longitudinal reinforcement percentage $\rho_l$ of											
		0.50%		0.75%		1.00%		1.25%		1.50%		1.75%	
		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.	Without shear reinf.	With shear reinf.
<b>Concrete strength: C45/55</b>													
<b><math>f_{ck} = 45 \text{ N/mm}^2</math></b>													
20	16.0	469	669	537	766	591	843	637	909	677	965	713	1,016
21	17.0	539	770	617	882	679	970	731	1,045	777	1,111	818	1,169
22	17.5	587	843	672	965	739	1,062	796	1,144	846	1,216	891	1,280
23	18.5	664	955	760	1,094	836	1,204	901	1,297	957	1,378	1,008	1,451
24	19.0	717	1,036	820	1,186	903	1,305	973	1,406	1,034	1,494	1,088	1,573
25	20.0	801	1,160	917	1,328	1,010	1,461	1,088	1,574	1,156	1,673	1,217	1,761
26	21.0	880	1,275	1,007	1,460	1,109	1,606	1,194	1,730	1,269	1,839	1,336	1,936
27	22.0	962	1,395	1,101	1,597	1,212	1,758	1,305	1,893	1,387	2,012	1,460	2,118
28	23.0	1,047	1,520	1,198	1,740	1,319	1,915	1,420	2,063	1,509	2,192	1,589	2,308
29	24.0	1,135	1,650	1,299	1,888	1,430	2,078	1,540	2,239	1,637	2,379	1,723	2,505
30	25.0	1,226	1,784	1,403	2,042	1,545	2,248	1,664	2,421	1,768	2,573	1,862	2,708
31	26.0	1,304	1,895	1,493	2,169	1,643	2,388	1,770	2,572	1,881	2,733	1,980	2,877
32	27.0	1,384	2,009	1,584	2,300	1,744	2,532	1,879	2,727	1,996	2,898	2,102	3,051
33	28.0	1,466	2,127	1,679	2,434	1,848	2,679	1,990	2,886	2,115	3,067	2,227	3,229
34	29.0	1,551	2,247	1,775	2,572	1,954	2,831	2,105	3,049	2,237	3,240	2,355	3,411
35	30.0	1,638	2,370	1,874	2,713	2,063	2,986	2,222	3,217	2,362	3,418	2,486	3,598
36	31.0	1,726	2,496	1,976	2,858	2,175	3,145	2,343	3,388	2,490	3,600	2,621	3,790
37	31.5	1,781	2,577	2,039	2,949	2,244	3,246	2,417	3,497	2,569	3,716	2,704	3,912
38	32.0	1,837	2,658	2,102	3,043	2,314	3,349	2,493	3,608	2,649	3,834	2,788	4,036
39	33.0	1,930	2,791	2,209	3,195	2,432	3,517	2,619	3,788	2,784	4,025	2,930	4,238
40	34.0	2,026	2,927	2,319	3,351	2,552	3,688	2,749	3,973	2,921	4,221	3,075	4,444
41	35.0	2,123	3,066	2,431	3,510	2,675	3,863	2,882	4,161	3,062	4,422	3,224	4,655
42	36.0	2,223	3,208	2,545	3,672	2,801	4,041	3,017	4,354	3,206	4,626	3,375	4,870
43	37.0	2,325	3,352	2,661	3,838	2,929	4,224	3,156	4,550	3,353	4,835	3,530	5,090
44	38.0	2,429	3,500	2,781	4,007	3,060	4,410	3,297	4,750	3,503	5,048	3,688	5,314
45	39.0	2,535	3,651	2,902	4,179	3,194	4,600	3,441	4,955	3,656	5,265	3,849	5,543
46	40.0	2,643	3,804	3,026	4,355	3,330	4,793	3,587	5,163	3,812	5,487	4,013	5,776
47	41.0	2,754	3,961	3,152	4,534	3,469	4,990	3,737	5,375	3,971	5,712	4,181	6,013
48	42.0	2,866	4,120	3,281	4,716	3,611	5,191	3,890	5,592	4,133	5,942	4,351	6,255
49	43.0	2,980	4,282	3,412	4,902	3,755	5,395	4,045	5,812	4,298	6,176	4,525	6,502
50	44.0	3,097	4,447	3,545	5,091	3,902	5,603	4,203	6,036	4,466	6,414	4,702	6,752
51	44.5	3,168	4,552	3,627	5,211	3,992	5,735	4,300	6,178	4,570	6,565	4,811	6,911
52	45.0	3,241	4,658	3,710	5,332	4,083	5,869	4,398	6,322	4,674	6,718	4,920	7,072
53	46.0	3,325	4,830	3,848	5,529	4,236	6,085	4,563	6,555	4,849	6,966	5,104	7,333
54	47.0	3,485	5,004	3,989	5,728	4,391	6,305	4,730	6,792	5,026	7,217	5,291	7,598
55	48.0	3,610	5,182	4,133	5,931	4,548	6,528	4,900	7,032	5,207	7,473	5,481	7,867
56	49.0	3,737	5,362	4,278	6,138	4,709	6,755	5,072	7,277	5,390	7,733	5,674	8,141
57	50.0	3,867	5,545	4,426	6,347	4,872	6,986	5,248	7,525	5,577	7,997	5,871	8,419
58	51.0	3,998	5,731	4,576	6,560	5,037	7,220	5,426	7,778	5,766	8,265	6,070	8,701
59	52.0	4,131	5,920	4,729	6,776	5,205	7,458	5,607	8,034	5,958	8,537	6,272	8,988
60	53.0	4,267	6,111	4,884	6,996	5,376	7,700	5,791	8,294	6,153	8,814	6,478	9,279

Revision date 11/2016

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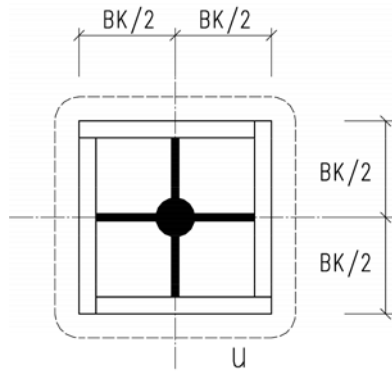
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**Verification:**

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average longitudinal reinforcement percentage $\rho_l$ of

Slab thickness h [cm]	Avg. effective depth d [cm]	Design value of the shear resistance $V_{Rd}$ [kN] with an average longitudinal reinforcement percentage $\rho_l$ of											
		0.50%		0.75%		1.00%		1.25%		1.50%		1.75%	
		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.	Without shear reinf.	With shear reinf.
<b>Concrete strength: C50/60</b>													
<b><math>f_{ck} = 50 \text{ N/mm}^2</math></b>													
20	16.0	486	693	557	794	613	874	660	941	701	1,000	738	1,053
21	17.0	558	798	639	913	703	1,005	757	1,083	805	1,151	847	1,211
22	17.5	608	873	696	1,000	766	1,100	825	1,185	877	1,259	923	1,326
23	18.5	687	990	787	1,133	866	1,247	933	1,343	991	1,427	1,044	1,503
24	19.0	742	1,073	850	1,228	935	1,352	1,008	1,456	1,071	1,547	1,127	1,629
25	20.0	830	1,201	950	1,375	1,046	1,513	1,126	1,630	1,197	1,732	1,260	1,824
26	21.0	911	1,321	1,043	1,512	1,148	1,664	1,237	1,792	1,314	1,905	1,384	2,005
27	22.0	996	1,445	1,140	1,654	1,255	1,821	1,352	1,961	1,436	2,084	1,512	2,194
28	23.0	1,084	1,574	1,241	1,802	1,366	1,984	1,471	2,137	1,563	2,271	1,646	2,390
29	24.0	1,175	1,709	1,345	1,956	1,481	2,153	1,595	2,319	1,695	2,464	1,784	2,594
30	25.0	1,270	1,848	1,454	2,115	1,600	2,328	1,723	2,508	1,831	2,665	1,928	2,805
31	26.0	1,351	1,963	1,546	2,247	1,702	2,473	1,833	2,664	1,948	2,831	2,051	2,980
32	27.0	1,434	2,081	1,641	2,382	1,806	2,622	1,946	2,825	2,068	3,002	2,177	3,160
33	28.0	1,519	2,203	1,739	2,521	1,914	2,775	2,061	2,989	2,191	3,177	2,306	3,344
34	29.0	1,606	2,327	1,839	2,664	2,024	2,932	2,180	3,158	2,317	3,356	2,439	3,533
35	30.0	1,696	2,455	1,941	2,810	2,137	3,093	2,302	3,332	2,446	3,540	2,575	3,727
36	31.0	1,788	2,586	2,047	2,960	2,253	3,258	2,427	3,509	2,579	3,729	2,715	3,926
37	31.5	1,845	2,669	2,112	3,055	2,324	3,362	2,504	3,622	2,660	3,849	2,801	4,052
38	32.0	1,902	2,753	2,177	3,152	2,397	3,469	2,582	3,737	2,743	3,971	2,888	4,180
39	33.0	1,999	2,891	2,288	3,309	2,519	3,642	2,713	3,923	2,883	4,169	3,035	4,389
40	34.0	2,098	3,032	2,402	3,470	2,643	3,820	2,847	4,115	3,026	4,372	3,185	4,603
41	35.0	2,199	3,175	2,517	3,635	2,771	4,001	2,985	4,310	3,172	4,580	3,339	4,821
42	36.0	2,303	3,322	2,636	3,803	2,901	4,186	3,125	4,509	3,321	4,792	3,496	5,044
43	37.0	2,408	3,472	2,757	3,975	3,034	4,375	3,268	4,713	3,473	5,008	3,656	5,272
44	38.0	2,516	3,625	2,880	4,150	3,170	4,568	3,415	4,920	3,628	5,228	3,820	5,504
45	39.0	2,626	3,781	3,006	4,328	3,308	4,764	3,564	5,132	3,787	5,453	3,987	5,741
46	40.0	2,738	3,940	3,134	4,510	3,449	4,964	3,716	5,348	3,949	5,683	4,157	5,982
47	41.0	2,852	4,102	3,265	4,696	3,593	5,168	3,871	5,568	4,113	5,916	4,330	6,228
48	42.0	2,968	4,267	3,398	4,885	3,740	5,376	4,029	5,792	4,281	6,154	4,507	6,479
49	43.0	3,087	4,435	3,534	5,077	3,889	5,588	4,189	6,020	4,452	6,397	4,687	6,734
50	44.0	3,207	4,606	3,672	5,273	4,041	5,804	4,353	6,252	4,626	6,643	4,870	6,994
51	44.5	3,282	4,715	3,757	5,397	4,135	5,940	4,454	6,399	4,733	6,800	4,983	7,158
52	45.0	3,357	4,824	3,842	5,523	4,229	6,078	4,556	6,548	4,841	6,958	5,096	7,325
53	46.0	3,482	5,002	3,986	5,726	4,387	6,302	4,726	6,789	5,022	7,215	5,287	7,595
54	47.0	3,609	5,183	4,132	5,933	4,548	6,530	4,899	7,034	5,206	7,475	5,480	7,869
55	48.0	3,739	5,367	4,280	6,143	4,711	6,762	5,075	7,284	5,393	7,740	5,677	8,148
56	49.0	3,871	5,553	4,431	6,357	4,877	6,997	5,254	7,537	5,583	8,009	5,877	8,432
57	50.0	4,005	5,743	4,584	6,574	5,046	7,236	5,435	7,794	5,776	8,283	6,080	8,720
58	51.0	4,141	5,936	4,740	6,795	5,217	7,478	5,620	8,056	5,972	8,561	6,287	9,012
59	52.0	4,279	6,131	4,898	7,018	5,391	7,725	5,807	8,321	6,171	8,843	6,497	9,309
60	53.0	4,419	6,330	5,059	7,246	5,568	7,975	5,998	8,591	6,373	9,129	6,709	9,610

Revision date 11/2016

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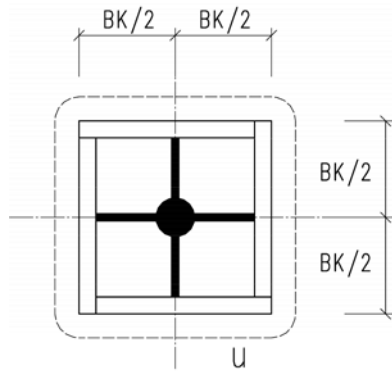
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## Interior shear heads in flat slabs

(For foundation slabs please contact our design team)

For more information about how to use  
the pre-dimensioning tables please  
refer to the last pages.

Verification:

$$\beta \cdot V_{Ed} \leq V_{Rd}$$

### Design value of the shear resistance $V_{Rd}$ [kN] with an average

Slab thickness h [cm]	Avg. effective depth d [cm]	longitudinal reinforcement percentage $\rho_l$ of											
		0.50%		0.75%		1.00%		1.25%		1.50%		1.75%	
		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.	Without shear reinf.	With shear reinf.
<b>Concrete strength: C55/67</b>													
<b><math>f_{ck} = 55 \text{ N/mm}^2</math></b>													
20	16.0	502	716	575	819	632	902	681	971	724	1,032	762	1,087
21	17.0	576	823	659	943	726	1,038	782	1,118	831	1,188	874	1,250
22	17.5	627	901	718	1,032	790	1,136	852	1,223	905	1,300	953	1,369
23	18.5	710	1,022	812	1,169	894	1,287	963	1,386	1,023	1,473	1,077	1,551
24	19.0	766	1,108	877	1,268	966	1,395	1,040	1,503	1,105	1,597	1,164	1,682
25	20.0	857	1,240	981	1,419	1,079	1,562	1,163	1,683	1,236	1,788	1,301	1,883
26	21.0	941	1,363	1,077	1,561	1,185	1,718	1,277	1,850	1,357	1,966	1,428	2,070
27	22.0	1,028	1,492	1,177	1,707	1,295	1,879	1,395	2,024	1,483	2,151	1,561	2,265
28	23.0	1,119	1,625	1,281	1,860	1,410	2,048	1,519	2,206	1,614	2,344	1,699	2,467
29	24.0	1,213	1,764	1,389	2,019	1,529	2,222	1,647	2,394	1,750	2,544	1,842	2,678
30	25.0	1,311	1,907	1,501	2,183	1,652	2,403	1,779	2,589	1,891	2,751	1,990	2,896
31	26.0	1,394	2,026	1,596	2,319	1,757	2,553	1,892	2,750	2,011	2,922	2,117	3,076
32	27.0	1,480	2,148	1,694	2,459	1,865	2,707	2,009	2,916	2,134	3,098	2,247	3,262
33	28.0	1,568	2,274	1,795	2,603	1,975	2,865	2,128	3,086	2,261	3,279	2,381	3,452
34	29.0	1,658	2,402	1,898	2,750	2,089	3,027	2,251	3,260	2,392	3,465	2,518	3,647
35	30.0	1,751	2,534	2,004	2,901	2,206	3,193	2,376	3,439	2,525	3,655	2,658	3,847
36	31.0	1,846	2,669	2,113	3,055	2,325	3,363	2,505	3,622	2,662	3,849	2,802	4,052
37	31.5	1,904	2,755	2,180	3,154	2,399	3,471	2,584	3,739	2,746	3,973	2,891	4,183
38	32.0	1,964	2,842	2,248	3,253	2,474	3,581	2,665	3,857	2,832	4,099	2,981	4,315
39	33.0	2,064	2,984	2,362	3,416	2,600	3,760	2,801	4,050	2,976	4,304	3,133	4,531
40	34.0	2,166	3,129	2,479	3,582	2,729	3,943	2,939	4,247	3,123	4,513	3,288	4,751
41	35.0	2,270	3,278	2,599	3,752	2,860	4,130	3,081	4,449	3,274	4,728	3,447	4,977
42	36.0	2,377	3,430	2,721	3,926	2,995	4,321	3,226	4,655	3,428	4,946	3,609	5,207
43	37.0	2,486	3,584	2,846	4,103	3,132	4,516	3,374	4,865	3,585	5,170	3,774	5,442
44	38.0	2,597	3,742	2,973	4,284	3,272	4,715	3,525	5,079	3,746	5,397	3,943	5,682
45	39.0	2,710	3,903	3,103	4,468	3,415	4,918	3,679	5,298	3,909	5,629	4,115	5,926
46	40.0	2,826	4,067	3,235	4,656	3,561	5,125	3,836	5,520	4,076	5,866	4,291	6,176
47	41.0	2,944	4,235	3,370	4,847	3,709	5,335	3,996	5,747	4,246	6,107	4,470	6,429
48	42.0	3,064	4,405	3,508	5,042	3,861	5,550	4,159	5,979	4,419	6,353	4,652	6,688
49	43.0	3,186	4,578	3,648	5,241	4,015	5,768	4,325	6,214	4,596	6,603	4,838	6,951
50	44.0	3,311	4,755	3,790	5,443	4,172	5,991	4,494	6,453	4,775	6,858	5,027	7,219
51	44.5	3,388	4,867	3,878	5,571	4,268	6,132	4,598	6,606	4,886	7,019	5,143	7,390
52	45.0	3,465	4,980	3,966	5,701	4,366	6,275	4,703	6,759	4,997	7,183	5,261	7,561
53	46.0	3,594	5,164	4,115	5,911	4,529	6,506	4,878	7,008	5,184	7,447	5,457	7,840
54	47.0	3,726	5,350	4,265	6,125	4,694	6,741	5,057	7,261	5,374	7,716	5,657	8,123
55	48.0	3,860	5,540	4,418	6,342	4,863	6,980	5,239	7,519	5,567	7,990	5,860	8,411
56	49.0	3,996	5,733	4,574	6,562	5,034	7,223	5,423	7,780	5,763	8,268	6,067	8,704
57	50.0	4,134	5,928	4,732	6,786	5,209	7,469	5,611	8,046	5,962	8,550	6,277	9,001
58	51.0	4,274	6,127	4,893	7,014	5,385	7,720	5,801	8,316	6,165	8,837	6,490	9,303
59	52.0	4,417	6,329	5,056	7,245	5,565	7,974	5,995	8,590	6,370	9,128	6,706	9,609
60	53.0	4,562	6,534	5,222	7,480	5,747	8,232	6,191	8,868	6,579	9,424	6,926	9,920

Revision date 11/2016

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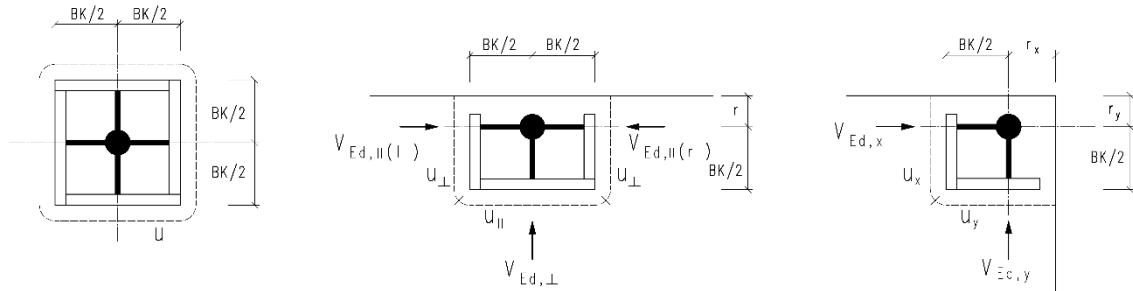
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## Europilz® shear head How to use the pre-dimensioning tables



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  $\beta$ . 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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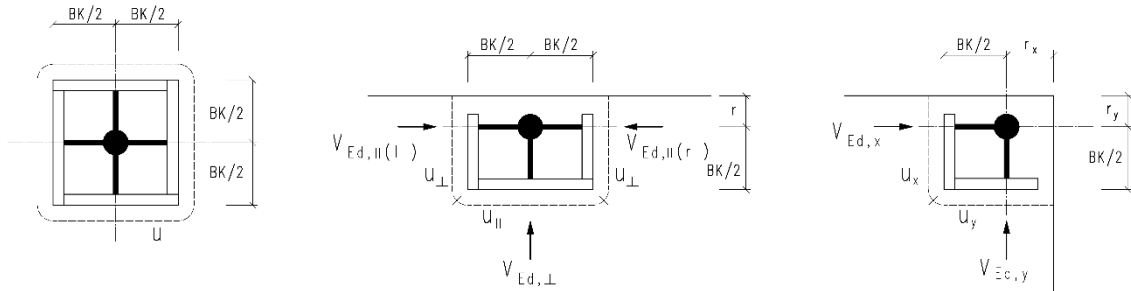
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## Europilz® shear head Pre-dimensioning examples



### 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 $\beta$ )

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

Parameter: Flat slab in C30/37 with punching shear load:  $V_{Ed, \text{total}} = 210 \text{ kN}$ ,  $L_x \approx L_y$ ,  $r_x \approx r_y$ , = 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  $V_{Rd, \text{total}} = 213 \text{ kN} > 210 \text{ kN}$