Combined wall structures

QUICK DESIGN TABLES

Combined wall is a retaining wall solution when high horizontal or vertical bearing resistance is required. A combined wall combines pipes (primary elements) with intermediate sheet piles (secondary elements). Pre-calculated tables in this manual offer an easy and quick way to select a combined wall structure with adequate resistance for project.

Applications:
- harbor quay walls
- structures under combined lateral and vertical loads

COMBINED WALL WITH TUBULAR PILES

SSAB supplies spirally welded tubular piles from its mill in Oulainen (FI) delivered with EN 10219 certification and ETA approval as bearing piles. Spirally welded piles can be delivered with diameters up to 1220 mm, wall thicknesses up to 23 mm and lengths up to 39 m without splice welding. Longer piles can be spliced by welding on factory conditions.
Tubular piles are available in numerous European and US steel grades. Most commonly used steel grades, their chemical compositions and mechanical properties are presented in Table 1. Steel and coils are produced in SSAB's own steel mill in Raahe (FI). The piles can be coated on request and are provided with connectors upon customers need. Most often used connector types are E21 and E22. Tubular piles are the main retaining elements of the combined wall, carrying horizontal loads from soil and water pressures and vertical foundation loads. The intermediary sheet piles can be either U-type or Z-type. Sheet piles transfer horizontal loads to the tubular piles. The tables below give an overview of some of the possible combined wall systems. The tables are valid for E21 connectors.

Equivalent moment of inertia and elastic section modulus of combined wall

The design of combined walls is based on guide lines given in EN 1993-5 and it's based on functionality of primary and secondary elements:

- the primary elements act as retaining elements against the earth and water pressures and may act as bearing piles for vertical loads;
- the secondary elements only fill the gap between the primary elements and transmit the loads resulting from earth and water pressures to the primary elements.

This leads to following equations:

$$I_{sys} = \frac{I_{primary\ element}}{b_{sys}}$$

$$W_{sys} = \frac{W_{primary\ element}}{b_{sys}}$$

Design resistances in tables

Design resistances in tables are calculated by using following safety factors.

$\gamma_{M0} = 1.00$
$\gamma_{M1} = 1.10$

These safety factors are recommended values given in EN 1993-5 for piling. If appropriate National Annex has different values for safety factors, the resistance values in tables should be modified accordingly.

Local buckling of piles belonging to cross-section class 4

For primary piles belonging to cross-section class 4 the local buckling resistance has been checked according to EN 1993-1-6:2007 + AC:2009 + A1:2017. In tables this value is given as primary value. For piles belonging to cross-section class 4 also elastic bending resistance has been given in brackets [] as secondary value. Elastic bending resistance can be used if piles meet the requirements given in EN 1993-5:2007 + AC:2009 clause 5.5.4(9).

Effect of intermediary sheet piles for resistance of the combined wall

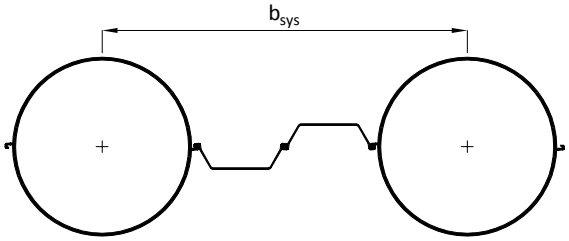
Since sheet piles only fill the gap between primary elements, only the width of the sheet piles have influence on the resistance of the combined wall. Change of width of sheet piles change b_{sys} value. Even if sheet piles to be used have different thicknesses than the ones given in tables, the resistance of the wall remains the same. In such situation only given weight values $G_{60\%}$ and $G_{100\%}$ are changing.

Table 1. Standard steel grades of SSAB's steel piles. Against special order, the piles may also be delivered in MH steel grades according to standard EN 10219 or X grades according to API5L.

Steel grade	Carbon equivalent	Chemical composition, max.				Mechanical properties				
									Impact strength	
	CEV max. [%]	C [%]	Mn [%]	P [%]	S [%]	f_y min [MPa]	f_u [MPa]	A_5 min [%]	T*) [°C]	KV min [J]
S355J2H	0.45	0.22	1.6	0.03	0.03	355	470-630	20	-20	27
S440J2H	0.45	0.16	1.6	0.02	0.02	440	490-630	17	-20	27
S550J2H	0.47	0.12	1.9	0.02	0.02	550	605-760	14	-20	27

*) Testing temperature may also be -40 °C. Demanded impact energy remains the same.

Table 2. Combined walls with double U sheet piles as secondary elements, width of single sheet pile 600 mm



b_{sys} [m]: System width
$G_{60\%}$: Length of sheet piles is 60 % of length of king piles
$G_{100\%}$: Length of sheet piles is 100 % of length of king piles
I_{sys} [cm⁴/m]: Moment of inertia of combined wall
W_{sys} [cm³/m]: Elastic/Plastic section modulus of combined wall
M_{Rd} [kNm/m]: Design value of bending moment resistance with specified steel grade

Primary element dimensions			Secondary elements = Double VL603								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR400	406,4	8	1,676	97	131	11 855	758	583	207	232 [257]	288 [321]
		10	1,676	109	142	14 600	938	719	333	316	358 [395]
		12,5	1,676	123	157	17 914	1 157	882	411	509	485
RR450	457,0	8	1,727	100	133	16 472	934	721	256	285 [317]	354 [396]
		10	1,727	113	145	20 319	1 157	889	411	391	441 [489]
		12,5	1,727	128	161	24 983	1 430	1 093	508	629	601
RR500	508,0	8	1,778	103	135	22 092	1 125	870	278 [309]	342 [383]	423 [478]
		10	1,778	117	148	27 289	1 395	1 074	381	427 [473]	531 [591]
		12,5	1,778	133	165	33 608	1 726	1 323	613	582	658 [728]
		14,2	1,778	145	177	37 795	1 948	1 488	692	857	818
		16 **	1,778	157	188	42 131	2 179	1 659	774	959	
RR550	559,0	8	1,829	106	137	28 740	1 328	1 028	328 [365]	402 [452]	495 [566]
		10	1,829	120	151	35 539	1 648	1 272	451	504 [559]	625 [699]
		12,5	1,829	138	169	43 828	2 042	1 568	725	690	778 [862]
		14,2	1,829	151	181	49 333	2 305	1 765	818	777	879 [971]
		16 **	1,829	163	194	55 048	2 580	1 970	916	1 135	
RR600	610,0	8	1,880	108	138	36 463	1 542	1 196	379 [424]	464 [526]	569 [658]
		10	1,880	124	154	45 131	1 915	1 480	474 [525]	584 [651]	722 [814]
		12,5	1,880	143	173	55 721	2 374	1 827	649	727 [804]	904 [1005]
		14,2	1,880	156	186	62 768	2 682	2 058	952	906	1023 [1132]
		16	1,880	170	200	70 097	3 004	2 298	1 066	1 011	1 264
		18	1,880	185	215	78 080	3 357	2 560	1 192	1 477	1 408
RR650	660,0	8	1,930	110	140	45 123	1 762	1 367	431 [485]	526 [602]	643 [752]
		10	1,930	127	156	55 891	2 189	1 694	541 [601]	665 [745]	821 [932]
		12,5	1,930	147	176	69 071	2 716	2 093	743	831 [921]	1032 [1151]
		14,2	1,930	161	190	77 857	3 069	2 359	838	1 038	1170 [1298]
		16	1,930	175	205	87 006	3 439	2 637	1 221	1 160	1312 [1450]
		18	1,930	191	221	96 989	3 845	2 939	1 365	1 692	1 616
RR700	711,0	8	1,981	113	141	55 105	1 996	1 550	485 [550]	590 [682]	718 [853]
		10	1,981	130	158	68 300	2 481	1 921	611 [682]	750 [845]	923 [1057]
		12,5	1,981	151	180	84 474	3 079	2 376	844	941 [1046]	1166 [1307]
		14,2	1,981	166	194	95 273	3 481	2 680	951	1065 [1179]	1325 [1474]
		16	1,981	181	210	106 532	3 902	2 997	1 385	1 319	1488 [1648]
		18	1,981	198	226	118 834	4 365	3 343	1 549	1 471	1664 [1838]
		20	1,981	215	243	130 919	4 822	3 683	1 712	2 122	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)
** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales
*** = Wall thickness not in normal production, check availability from SSAB sales

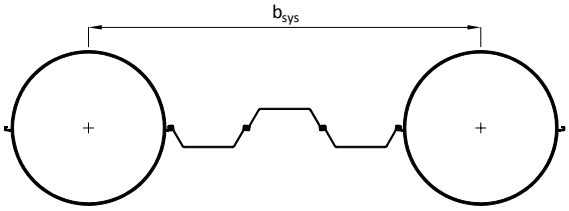
Primary element dimensions			Secondary elements = Double VL603								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR750	762,0	8	2,032	115	143	66 281	2 238	1 740	540 [618]	655 [765]	793 [957]
		10	2,032	133	161	82 199	2 783	2 157	684 [766]	837 [949]	1027 [1187]
		12,5	2,032	155	183	101 738	3 456	2 670	855 [948]	1054 [1175]	1304 [1469]
		14,2	2,032	171	198	114 799	3 908	3 013	1 070	1195 [1326]	1484 [1657]
		16	2,032	186	214	128 432	4 383	3 371	1 197	1 483	1670 [1854]
		18	2,032	204	232	143 345	4 904	3 762	1 741	1 655	1870 [2069]
		20	2,032	222	249	158 013	5 420	4 147	1 924	1 825	
RR800	813,0	8	2,083	117	144	78 685	2 489	1 936	596 [687]	720 [852]	867 [1065]
		10	2,083	136	163	97 630	3 096	2 402	758 [853]	926 [1057]	1131 [1321]
		12,5	2,083	159	186	120 912	3 846	2 974	950 [1056]	1169 [1309]	1444 [1636]
		14,2	2,083	175	202	136 493	4 350	3 358	1 192	1329 [1477]	1647 [1847]
		16	2,083	192	219	152 771	4 880	3 758	1 334	1494 [1654]	1856 [2067]
		18	2,083	210	237	170 595	5 463	4 197	1 939	1 847	2083 [2308]
		20	2,083	228	255	188 147	6 039	4 628	2 144	2 037	
		21 ***	2,083	238	265	196 821	6 325	4 842	2 245	2 130	
		22 ***	2,083	247	274	205 427	6 610	5 054	2 347	2 908	
RR900	914,0	10	2,184	141	167	132 851	3 742	2 907	907 [1032]	1102 [1279]	1338 [1599]
		12,5	2,184	166	192	164 702	4 652	3 604	1145 [1279]	1404 [1586]	1726 [1982]
		14,2	2,184	183	209	186 055	5 265	4 071	1301 [1445]	1601 [1791]	1978 [2239]
		16	2,184	201	227	208 398	5 908	4 560	1 619	1805 [2006]	2237 [2508]
		18	2,184	221	247	232 905	6 618	5 096	1 809	2025 [2242]	2517 [2803]
		20	2,184	241	266	257 079	7 320	5 625	2 599	2 475	
		21 ***	2,184	250	276	269 043	7 669	5 887	2 723	2 590	
		22 ***	2,184	260	286	280 924	8 017	6 147	2 846	2 705	
RR1000	1016,0	10	2,286	146	170	174 912	4 427	3 443	1060 [1222]	1281 [1515]	1542 [1894]
		12,5	2,286	172	197	217 027	5 507	4 272	1348 [1517]	1646 [1880]	2013 [2350]
		14,2	2,286	190	215	245 303	6 235	4 829	1536 [1714]	1885 [2125]	2319 [2656]
		16	2,286	210	234	274 925	7 000	5 412	1731 [1921]	2131 [2381]	2633 [2977]
		18	2,286	231	255	307 460	7 843	6 052	2 149	2397 [2663]	2972 [3329]
		20	2,286	252	277	339 599	8 680	6 685	2 373	2657 [2941]	
		21 ***	2,286	262	287	355 521	9 096	6 998	2 484	2785 [3079]	
		22 ***	2,286	273	298	371 346	9 510	7 310	3 376	3 216	
		23 ***	2,286	283	308	387 072	9 923	7 620	3 523	3 353	
RR1200	1220,0	10	2,490	154	176	279 413	5 880	4 581	1365 [1626]	1629 [2015]	1924 [2519]
		12,5	2,490	183	206	347 119	7 320	5 690	1761 [2020]	2134 [2504]	2577 [3130]
		14,2	2,490	204	226	392 677	8 292	6 437	2021 [2285]	2464 [2832]	3002 [3541]
		16	2,490	225	247	440 491	9 315	7 221	2288 [2564]	2802 [3177]	3437 [3972]
		18	2,490	248	271	493 110	10 445	8 084	2579 [2870]	3169 [3557]	3907 [4446]
		20	2,490	272	294	545 199	11 567	8 938	2863 [3173]	3526 [3933]	
		21 ***	2,490	283	306	571 045	12 126	9 361	3 323	3702 [4119]	
		22 ***	2,490	295	318	596 761	12 682	9 783	3 473	3877 [4305]	
		23 ***	2,490	307	329	622 345	13 236	10 202	3 622	4049 [4489]	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)

** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales

*** = Wall thickness not in normal production, check availability from SSAB sales

Table 3. Combined walls with triple U sheet piles as secondary elements, width of single sheet pile 600 mm



b_{sys} [m]: System width
$G_{60\%}$: Length of sheet piles is 60 % of length of king piles
$G_{100\%}$: Length of sheet piles is 100 % of length of king piles
I_{sys} [cm⁴/m]: Moment of inertia of combined wall
W_{sys} [cm³/m]: Elastic/plastic section modulus of combined wall
M_{Rd} [kNm/m]: Design value of bending moment resistance with specified steel grade

Primary element dimensions			Secondary elements = Triple VL603								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR400	406,4	8	2,276	89	125	8 730	558	430	153	171 [189]	212 [236]
		10	2,276	97	133	10 752	690	529	245	233	263 [291]
		12,5	2,276	107	143	13 192	852	649	303	375	357
RR450	457,0	8	2,327	91	126	12 224	693	535	190	212 [235]	262 [294]
		10	2,327	100	136	15 080	859	660	305	290	327 [363]
		12,5	2,327	112	147	18 541	1 062	811	377	467	446
RR500	508,0	8	2,378	93	128	16 518	841	650	208 [231]	256 [286]	316 [358]
		10	2,378	103	138	20 404	1 043	803	285	319 [353]	397 [442]
		12,5	2,378	116	151	25 128	1 291	989	458	435	492 [544]
		14,2	2,378	124	159	28 258	1 456	1 113	517	641	612
		16 **	2,378	133	168	31 501	1 629	1 240	578	717	
RR550	559,0	8	2,429	95	129	21 641	1 000	774	247 [275]	303 [341]	373 [426]
		10	2,429	106	140	26 760	1 241	957	340	379 [421]	470 [527]
		12,5	2,429	120	154	33 002	1 537	1 181	546	520	586 [649]
		14,2	2,429	129	163	37 147	1 736	1 329	616	585	662 [731]
		16 **	2,429	139	173	41 450	1 943	1 483	690	855	
RR600	610,0	8	2,480	98	131	27 642	1 169	906	287 [322]	352 [399]	431 [498]
		10	2,480	109	142	34 212	1 452	1 122	359 [398]	443 [494]	548 [617]
		12,5	2,480	124	157	42 240	1 800	1 385	492	551 [609]	685 [762]
		14,2	2,480	134	167	47 582	2 033	1 560	722	686	775 [858]
		16	2,480	144	177	53 138	2 277	1 742	808	767	958
		18	2,480	156	189	59 190	2 544	1 941	903	1 120	1 067
RR650	660,0	8	2,530	100	132	34 422	1 344	1 043	329 [370]	401 [459]	490 [574]
		10	2,530	112	144	42 637	1 670	1 292	413 [459]	507 [568]	626 [711]
		12,5	2,530	128	160	52 690	2 072	1 597	567	634 [703]	787 [878]
		14,2	2,530	138	170	59 393	2 341	1 800	639	792	892 [990]
		16	2,530	149	182	66 372	2 623	2 011	931	885	1001 [1106]
		18	2,530	161	194	73 987	2 933	2 242	1 041	1 291	1 233
RR700	711,0	8	2,581	101	133	42 295	1 532	1 190	372 [422]	453 [523]	551 [654]
		10	2,581	115	146	52 422	1 904	1 475	469 [523]	576 [649]	709 [811]
		12,5	2,581	131	163	64 837	2 363	1 824	647	722 [802]	895 [1003]
		14,2	2,581	142	174	73 125	2 672	2 057	730	818 [905]	1017 [1131]
		16	2,581	154	186	81 767	2 995	2 300	1 063	1 012	1142 [1265]
		18	2,581	167	199	91 209	3 350	2 566	1 189	1 129	1277 [1411]
		20	2,581	180	212	100 485	3 701	2 827	1 314	1 628	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)
** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales
*** = Wall thickness not in normal production, check availability from SSAB sales

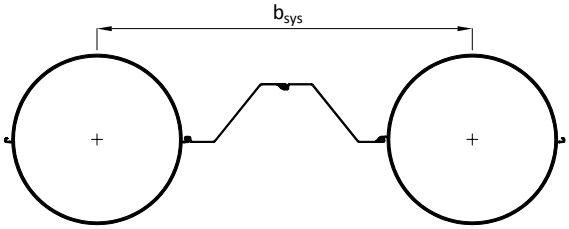
Primary element dimensions			Secondary elements = Triple VL603								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR750	762,0	8	2,632	103	134	51 171	1 728	1 343	417 [477]	506 [591]	612 [739]
		10	2,632	117	148	63 461	2 149	1 666	528 [591]	646 [733]	793 [916]
		12,5	2,632	135	166	78 545	2 668	2 062	660 [732]	813 [907]	1007 [1134]
		14,2	2,632	146	177	88 629	3 017	2 326	826	923 [1024]	1146 [1279]
		16	2,632	159	190	99 154	3 384	2 602	924	1 145	1289 [1431]
		18	2,632	172	203	110 667	3 786	2 905	1 344	1 278	1444 [1598]
		20	2,632	186	217	121 992	4 185	3 202	1 486	1 409	
RR800	813,0	8	2,683	105	136	61 089	1 932	1 503	463 [533]	559 [661]	673 [827]
		10	2,683	120	150	75 797	2 403	1 865	588 [662]	719 [820]	878 [1026]
		12,5	2,683	138	168	93 873	2 986	2 309	738 [820]	908 [1016]	1121 [1270]
		14,2	2,683	150	181	105 969	3 377	2 607	925	1032 [1147]	1279 [1434]
		16	2,683	163	194	118 607	3 789	2 918	1 036	1160 [1284]	1441 [1605]
		18	2,683	177	208	132 445	4 241	3 258	1 506	1 434	1617 [1792]
		20	2,683	192	222	146 071	4 689	3 593	1 664	1 581	
		21 ***	2,683	199	229	152 806	4 911	3 759	1 743	1 654	
		22 ***	2,683	206	236	159 488	5 132	3 923	1 822	2 258	
RR900	914,0	10	2,784	124	154	104 220	2 936	2 281	711 [810]	865 [1003]	1049 [1254]
		12,5	2,784	144	174	129 206	3 649	2 827	898 [1004]	1102 [1244]	1354 [1555]
		14,2	2,784	157	187	145 957	4 130	3 194	1021 [1134]	1256 [1405]	1552 [1757]
		16	2,784	172	201	163 485	4 635	3 577	1 270	1416 [1574]	1755 [1968]
		18	2,784	187	217	182 710	5 191	3 998	1 419	1589 [1759]	1975 [2199]
		20	2,784	203	232	201 674	5 743	4 413	2 039	1 942	
		21 ***	2,784	210	240	211 059	6 016	4 618	2 136	2 032	
		22 ***	2,784	218	248	220 380	6 289	4 822	2 233	2 122	
RR1000	1016,0	10	2,886	129	157	138 548	3 507	2 727	840 [968]	1015 [1200]	1221 [1500]
		12,5	2,886	150	178	171 907	4 362	3 384	1067 [1201]	1304 [1489]	1594 [1861]
		14,2	2,886	164	193	194 304	4 938	3 825	1217 [1358]	1493 [1683]	1837 [2104]
		16	2,886	179	208	217 768	5 544	4 287	1371 [1522]	1688 [1886]	2086 [2358]
		18	2,886	196	225	243 539	6 213	4 794	1 702	1898 [2109]	2354 [2637]
		20	2,886	213	241	268 997	6 876	5 295	1 880	2104 [2330]	
		21 ***	2,886	221	250	281 608	7 205	5 543	1 968	2206 [2439]	
		22 ***	2,886	230	258	294 143	7 533	5 790	2 674	2 548	
		23 ***	2,886	238	266	306 600	7 860	6 035	2 790	2 656	
RR1200	1220,0	10	3,090	136	163	225 158	4 738	3 691	1100 [1310]	1313 [1624]	1551 [2030]
		12,5	3,090	160	187	279 717	5 898	4 586	1419 [1628]	1720 [2018]	2076 [2522]
		14,2	3,090	176	203	316 429	6 682	5 187	1628 [1842]	1985 [2282]	2419 [2853]
		16	3,090	194	220	354 958	7 507	5 819	1844 [2066]	2258 [2560]	2770 [3200]
		18	3,090	213	239	397 361	8 417	6 514	2078 [2313]	2554 [2866]	3148 [3583]
		20	3,090	231	258	439 335	9 321	7 202	2307 [2557]	2842 [3169]	
		21 ***	3,090	241	267	460 163	9 771	7 544	2 678	2984 [3319]	
		22 ***	3,090	250	277	480 885	10 219	7 883	2 799	3124 [3469]	
		23 ***	3,090	260	286	501 501	10 666	8 221	2 919	3263 [3617]	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)

** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales

*** = Wall thickness not in normal production, check availability from SSAB sales

Table 4. Combined walls with double Z sheet piles as secondary elements, width of single sheet piles 700 mm



b_{sys} [m]: System width
$G_{60\%}$: Length of sheet piles is 60 % of length of king piles
$G_{100\%}$: Length of sheet piles is 100 % of length of king piles
I_{sys} [cm⁴/m]: Moment of inertia of combined wall
W_{sys} [cm³/m]: Elastic/plastic section modulus of combined wall
M_{Rd} [kNm/m]: Design value of bending moment resistance with specified steel grade

Primary element dimensions			Secondary elements = Double ZZ18-700								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR400	406,4	8	1,876	95	130	10 592	677	521	185	207 [229]	257 [287]
		10	1,876	105	141	13 044	838	642	297	282	319 [353]
		12,5	1,876	118	153	16 004	1 034	788	367	455	433
RR450	457,0	8	1,927	98	132	14 762	837	646	229	256 [284]	317 [355]
		10	1,927	109	143	18 210	1 037	797	368	351	395 [438]
		12,5	1,927	123	157	22 390	1 282	980	455	564	539
RR500	508,0	8	1,978	100	134	19 858	1 011	782	250 [278]	308 [344]	380 [430]
		10	1,978	112	146	24 530	1 254	966	343	384 [425]	477 [531]
		12,5	1,978	128	161	30 210	1 552	1 189	551	523	592 [654]
		14,2	1,978	138	171	33 973	1 751	1 338	622	770	736
		16 **	1,978	149	182	37 871	1 959	1 491	695	862	
RR550	559,0	8	2,029	103	135	25 907	1 197	927	295 [329]	363 [408]	446 [510]
		10	2,029	116	149	32 036	1 486	1 146	407	454 [504]	563 [630]
		12,5	2,029	132	165	39 508	1 840	1 414	653	622	702 [777]
		14,2	2,029	143	176	44 471	2 078	1 591	738	700	792 [875]
		16 **	2,029	155	187	49 622	2 326	1 775	826	1 023	
RR600	610,0	8	2,080	105	137	32 957	1 394	1 081	342 [384]	419 [475]	514 [594]
		10	2,080	119	151	40 792	1 731	1 337	428 [475]	528 [588]	653 [736]
		12,5	2,080	136	168	50 363	2 146	1 651	586	657 [727]	817 [908]
		14,2	2,080	148	180	56 733	2 424	1 860	860	818	924 [1023]
		16	2,080	161	192	63 356	2 715	2 077	964	914	1 142
		18	2,080	174	206	70 572	3 034	2 314	1 077	1 335	1 273
RR650	660,0	8	2,130	107	138	40 886	1 597	1 239	390 [440]	477 [545]	582 [681]
		10	2,130	122	153	50 643	1 984	1 535	490 [545]	603 [675]	744 [844]
		12,5	2,130	140	172	62 585	2 461	1 897	673	753 [834]	935 [1043]
		14,2	2,130	153	184	70 546	2 781	2 138	759	941	1060 [1176]
		16	2,130	166	197	78 836	3 116	2 389	1 106	1 051	1188 [1314]
		18	2,130	181	212	87 882	3 484	2 663	1 237	1 533	1 465
RR700	711,0	8	2,181	109	140	50 051	1 813	1 408	441 [500]	536 [619]	652 [774]
		10	2,181	125	155	62 036	2 253	1 745	555 [619]	682 [768]	839 [960]
		12,5	2,181	144	175	76 728	2 797	2 158	766	854 [950]	1059 [1187]
		14,2	2,181	158	188	86 536	3 162	2 434	864	968 [1071]	1203 [1339]
		16	2,181	171	202	96 763	3 544	2 722	1 258	1 198	1351 [1497]
		18	2,181	187	217	107 937	3 964	3 036	1 407	1 336	1512 [1670]
		20	2,181	202	232	118 914	4 380	3 345	1 555	1 927	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)
** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales
*** = Wall thickness not in normal production, check availability from SSAB sales

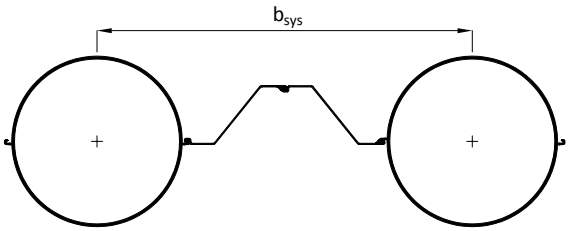
Primary element dimensions			Secondary elements = Double ZZ18-700								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR750	762,0	8	2,232	111	141	60 342	2 038	1 584	492 [562]	597 [697]	722 [871]
		10	2,232	128	157	74 833	2 534	1 964	622 [697]	762 [864]	935 [1080]
		12,5	2,232	148	178	92 621	3 146	2 431	779 [863]	959 [1070]	1187 [1337]
		14,2	2,232	162	192	104 512	3 558	2 743	974	1088 [1207]	1351 [1509]
		16	2,232	177	206	116 924	3 990	3 069	1 089	1 350	1520 [1688]
		18	2,232	193	222	130 500	4 465	3 425	1 585	1 507	1703 [1884]
		20	2,232	209	238	143 854	4 935	3 776	1 752	1 661	
RR800	813,0	8	2,283	113	142	71 792	2 271	1 766	544 [627]	657 [777]	791 [971]
		10	2,283	130	159	89 077	2 825	2 191	691 [778]	845 [964]	1032 [1205]
		12,5	2,283	152	181	110 320	3 509	2 714	867 [963]	1067 [1194]	1317 [1493]
		14,2	2,283	166	195	124 536	3 969	3 064	1 088	1212 [1348]	1503 [1685]
		16	2,283	181	210	139 388	4 452	3 429	1 217	1363 [1509]	1694 [1886]
		18	2,283	198	227	155 650	4 984	3 829	1 769	1 685	1900 [2106]
		20	2,283	215	244	171 664	5 510	4 223	1 956	1 858	
		21 ***	2,283	223	252	179 578	5 771	4 418	2 049	1 944	
		22 ***	2,283	232	261	187 431	6 031	4 611	2 141	2 654	
RR900	914,0	10	2,384	135	163	121 706	3 428	2 663	831 [945]	1010 [1172]	1226 [1465]
		12,5	2,384	158	186	150 884	4 262	3 302	1049 [1172]	1286 [1453]	1581 [1816]
		14,2	2,384	174	202	170 447	4 823	3 730	1192 [1324]	1467 [1641]	1812 [2051]
		16	2,384	190	218	190 915	5 413	4 178	1 483	1653 [1838]	2050 [2298]
		18	2,384	209	236	213 366	6 062	4 669	1 657	1855 [2054]	2306 [2568]
		20	2,384	227	255	235 512	6 706	5 153	2 381	2 268	
		21 ***	2,384	236	264	246 472	7 026	5 393	2 494	2 373	
		22 ***	2,384	245	273	257 356	7 344	5 631	2 607	2 478	
RR1000	1016,0	10	2,486	140	167	160 841	4 071	3 166	975 [1124]	1178 [1393]	1418 [1741]
		12,5	2,486	165	191	199 567	5 064	3 928	1239 [1395]	1514 [1729]	1851 [2161]
		14,2	2,486	181	208	225 568	5 733	4 440	1412 [1576]	1733 [1954]	2132 [2442]
		16	2,486	199	225	252 807	6 437	4 977	1592 [1767]	1959 [2190]	2421 [2737]
		18	2,486	218	245	282 725	7 212	5 565	1 976	2204 [2449]	2733 [3061]
		20	2,486	238	264	312 278	7 982	6 147	2 182	2443 [2705]	
		21 ***	2,486	247	274	326 919	8 364	6 435	2 285	2561 [2832]	
		22 ***	2,486	257	284	341 471	8 745	6 722	3 105	2 958	
		23 ***	2,486	267	293	355 932	9 124	7 007	3 239	3 083	
RR1200	1220,0	10	2,690	148	173	258 639	5 443	4 240	1264 [1505]	1508 [1866]	1781 [2332]
		12,5	2,690	175	200	321 311	6 776	5 267	1630 [1870]	1975 [2318]	2385 [2897]
		14,2	2,690	194	219	363 481	7 676	5 959	1871 [2115]	2280 [2622]	2778 [3277]
		16	2,690	214	238	407 740	8 623	6 684	2118 [2373]	2594 [2941]	3182 [3676]
		18	2,690	235	260	456 448	9 669	7 483	2387 [2656]	2933 [3292]	3616 [4116]
		20	2,690	257	282	504 664	10 707	8 273	2650 [2937]	3264 [3640]	
		21 ***	2,690	268	293	528 588	11 224	8 665	3 076	3427 [3813]	
		22 ***	2,690	279	303	552 392	11 739	9 056	3 215	3588 [3984]	
		23 ***	2,690	289	314	576 074	12 252	9 444	3 353	3748 [4155]	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)

** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales

*** = Wall thickness not in normal production, check availability from SSAB sales

Table 5. Combined walls with double Z sheet piles as secondary elements, width of single sheet pile 770 mm



b_{sys} [m]: System width
$G_{60\%}$: Length of sheet piles is 60 % of length of king piles
$G_{100\%}$: Length of sheet piles is 100 % of length of king piles
I_{sys} [cm⁴/m]: Moment of inertia of combined wall
W_{sys} [cm³/m]: Elastic/plastic section modulus of combined wall
M_{Rd} [kNm/m]: Design value of bending moment resistance with specified steel grade

Primary element dimensions			Secondary elements = Double ZZ14-770								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR400	406,4	8	2,016	90	124	9 856	630	485	172	193 [213]	240 [267]
		10	2,016	100	134	12 138	779	597	277	263	297 [329]
		12,5	2,016	111	145	14 893	962	733	342	423	403
RR450	457,0	8	2,067	93	126	13 762	780	602	214	238 [265]	295 [331]
		10	2,067	103	136	16 977	967	743	343	327	369 [409]
		12,5	2,067	116	149	20 873	1 195	913	424	526	502
RR500	508,0	8	2,118	95	128	18 546	944	730	234 [259]	287 [321]	355 [402]
		10	2,118	107	139	22 909	1 171	902	320	358 [397]	445 [496]
		12,5	2,118	121	153	28 213	1 449	1 111	515	489	553 [611]
		14,2	2,118	130	163	31 727	1 635	1 249	581	720	687
		16 **	2,118	140	173	35 368	1 829	1 392	649	805	
RR550	559,0	8	2,169	98	129	24 235	1 120	867	276 [308]	339 [382]	418 [477]
		10	2,169	110	142	29 968	1 390	1 072	381	425 [472]	527 [590]
		12,5	2,169	125	157	36 958	1 721	1 322	611	582	656 [727]
		14,2	2,169	135	167	41 600	1 944	1 488	690	655	741 [819]
		16 **	2,169	146	178	46 419	2 176	1 661	772	957	
RR600	610,0	8	2,220	100	131	30 879	1 306	1 012	321 [359]	393 [445]	482 [557]
		10	2,220	113	144	38 219	1 622	1 253	401 [445]	494 [551]	612 [689]
		12,5	2,220	129	160	47 187	2 010	1 547	549	615 [681]	766 [851]
		14,2	2,220	140	171	53 155	2 271	1 743	806	767	866 [959]
		16	2,220	152	183	59 361	2 544	1 946	903	856	1 070
		18	2,220	165	196	66 122	2 842	2 168	1 009	1 251	1 192
RR650	660,0	8	2,270	102	132	38 365	1 498	1 163	366 [413]	447 [512]	546 [639]
		10	2,270	116	146	47 520	1 861	1 440	460 [511]	566 [634]	698 [792]
		12,5	2,270	133	164	58 725	2 309	1 780	632	706 [783]	877 [979]
		14,2	2,270	145	175	66 195	2 609	2 006	712	883	994 [1103]
		16	2,270	157	188	73 974	2 924	2 242	1 038	986	1115 [1233]
		18	2,270	171	201	82 462	3 269	2 499	1 161	1 438	1 374
RR700	711,0	8	2,321	104	134	47 032	1 704	1 323	414 [470]	504 [582]	613 [728]
		10	2,321	119	149	58 294	2 117	1 640	522 [582]	640 [722]	788 [902]
		12,5	2,321	137	167	72 100	2 628	2 028	720	803 [892]	995 [1115]
		14,2	2,321	150	179	81 316	2 971	2 287	812	909 [1006]	1131 [1258]
		16	2,321	163	192	90 926	3 330	2 558	1 182	1 125	1270 [1407]
		18	2,321	177	207	101 426	3 725	2 853	1 322	1 255	1421 [1569]
		20	2,321	191	221	111 741	4 116	3 143	1 461	1 811	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)
** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales
*** = Wall thickness not in normal production, check availability from SSAB sales

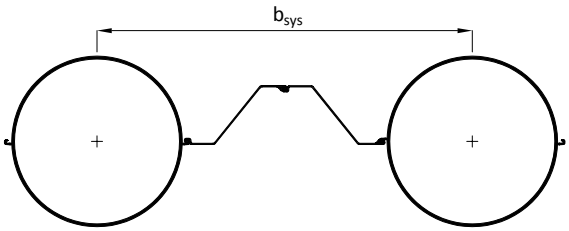
Primary element dimensions			Secondary elements = Double ZZ14-770								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR750	762,0	8	2,372	106	135	56 780	1 917	1 490	463 [529]	561 [656]	679 [820]
		10	2,372	122	151	70 417	2 384	1 848	586 [656]	717 [813]	880 [1017]
		12,5	2,372	141	170	87 155	2 961	2 288	733 [812]	903 [1007]	1117 [1258]
		14,2	2,372	154	183	98 344	3 348	2 581	916	1024 [1136]	1271 [1420]
		16	2,372	168	197	110 022	3 754	2 888	1 025	1 271	1430 [1588]
		18	2,372	183	212	122 798	4 201	3 223	1 491	1 418	1602 [1773]
		20	2,372	198	227	135 364	4 643	3 553	1 648	1 563	
RR800	813,0	8	2,423	108	136	67 644	2 140	1 664	512 [591]	619 [732]	745 [915]
		10	2,423	124	153	83 931	2 661	2 065	651 [733]	796 [908]	973 [1136]
		12,5	2,423	144	173	103 946	3 306	2 557	817 [908]	1005 [1125]	1241 [1406]
		14,2	2,423	158	186	117 340	3 740	2 887	1 025	1142 [1270]	1416 [1588]
		16	2,423	172	201	131 334	4 195	3 231	1 147	1284 [1422]	1596 [1777]
		18	2,423	188	217	146 657	4 696	3 608	1 667	1 587	1790 [1984]
		20	2,423	204	232	161 745	5 192	3 979	1 843	1 751	
		21 ***	2,423	212	240	169 202	5 438	4 162	1 930	1 831	
		22 ***	2,423	220	248	176 602	5 682	4 344	2 017	2 500	
RR900	914,0	10	2,524	129	156	114 955	3 238	2 515	785 [893]	954 [1107]	1158 [1383]
		12,5	2,524	151	178	142 515	4 025	3 118	991 [1107]	1215 [1372]	1493 [1715]
		14,2	2,524	166	193	160 992	4 555	3 523	1126 [1251]	1386 [1550]	1712 [1938]
		16	2,524	181	208	180 326	5 112	3 946	1 401	1562 [1736]	1936 [2170]
		18	2,524	198	226	201 531	5 726	4 410	1 566	1753 [1940]	2178 [2425]
		20	2,524	216	243	222 449	6 334	4 868	2 249	2 142	
		21 ***	2,524	224	251	232 801	6 636	5 094	2 356	2 241	
		22 ***	2,524	233	260	243 081	6 937	5 319	2 463	2 340	
RR1000	1016,0	10	2,626	134	160	152 266	3 854	2 997	923 [1064]	1115 [1319]	1342 [1649]
		12,5	2,626	157	183	188 927	4 794	3 719	1173 [1320]	1433 [1636]	1752 [2045]
		14,2	2,626	173	199	213 542	5 427	4 204	1337 [1492]	1641 [1850]	2019 [2312]
		16	2,626	190	216	239 330	6 093	4 711	1507 [1672]	1855 [2073]	2292 [2591]
		18	2,626	208	234	267 652	6 828	5 269	1 870	2086 [2318]	2587 [2898]
		20	2,626	226	252	295 630	7 556	5 819	2 066	2313 [2561]	
		21 ***	2,626	235	262	309 490	7 918	6 092	2 163	2424 [2681]	
		22 ***	2,626	245	271	323 266	8 279	6 363	2 939	2 800	
		23 ***	2,626	254	280	336 956	8 638	6 633	3 066	2 919	
RR1200	1220,0	10	2,830	142	166	245 844	5 174	4 030	1201 [1431]	1433 [1773]	1693 [2217]
		12,5	2,830	168	192	305 416	6 440	5 007	1550 [1777]	1878 [2203]	2267 [2754]
		14,2	2,830	186	210	345 500	7 296	5 664	1778 [2011]	2168 [2492]	2641 [3115]
		16	2,830	204	229	387 569	8 196	6 354	2013 [2256]	2466 [2796]	3024 [3494]
		18	2,830	225	249	433 867	9 190	7 113	2269 [2525]	2788 [3130]	3438 [3912]
		20	2,830	246	270	479 698	10 178	7 864	2519 [2792]	3103 [3460]	
		21 ***	2,830	256	280	502 439	10 669	8 237	2 924	3258 [3624]	
		22 ***	2,830	266	290	525 065	11 158	8 608	3 056	3411 [3787]	
		23 ***	2,830	276	301	547 576	11 646	8 977	3 187	3563 [3950]	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)

** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales

*** = Wall thickness not in normal production, check availability from SSAB sales

Table 6. Combined walls with double Z sheet piles as secondary elements, width of single sheet pile 800 mm



b_{sys} [m]: System width
$G_{60\%}$: Length of sheet piles is 60 % of length of king piles
$G_{100\%}$: Length of sheet piles is 100 % of length of king piles
I_{sys} [cm⁴/m]: Moment of inertia of combined wall
W_{sys} [cm³/m]: Elastic/plastic section modulus of combined wall
M_{Rd} [kNm/m]: Design value of bending moment resistance with specified steel grade

Primary element dimensions			Secondary elements = Double AZ18-800								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR400	406,4	8	2,076	88	122	9 571	612	471	167	187 [207]	233 [259]
		10	2,076	97	131	11 788	757	580	269	255	289 [319]
		12,5	2,076	109	142	14 463	934	712	332	411	391
RR450	457,0	8	2,127	91	123	13 374	758	585	208	232 [258]	287 [322]
		10	2,127	101	134	16 498	940	722	334	318	358 [397]
		12,5	2,127	114	146	20 284	1 161	888	412	511	488
RR500	508,0	8	2,178	93	125	18 035	918	710	227 [252]	280 [312]	345 [391]
		10	2,178	104	136	22 277	1 139	877	311	349 [386]	433 [482]
		12,5	2,178	118	150	27 436	1 409	1 080	500	475	538 [594]
		14,2	2,178	127	159	30 853	1 590	1 215	565	700	668
		16 **	2,178	137	169	34 393	1 779	1 354	632	783	
RR550	559,0	8	2,229	96	127	23 582	1 090	844	269 [300]	330 [371]	406 [464]
		10	2,229	108	139	29 162	1 352	1 043	370	413 [459]	513 [574]
		12,5	2,229	122	154	35 963	1 675	1 287	595	566	639 [708]
		14,2	2,229	132	164	40 480	1 891	1 448	671	637	721 [797]
		16 **	2,229	143	174	45 170	2 117	1 616	752	932	
RR600	610,0	8	2,280	98	128	30 066	1 272	986	312 [350]	383 [434]	469 [542]
		10	2,280	111	141	37 213	1 579	1 220	391 [433]	481 [537]	596 [671]
		12,5	2,280	127	157	45 945	1 958	1 506	535	599 [663]	745 [829]
		14,2	2,280	137	168	51 756	2 211	1 697	785	747	843 [933]
		16	2,280	149	179	57 799	2 477	1 895	879	834	1 042
		18	2,280	161	192	64 382	2 768	2 111	983	1 218	1 161
RR650	660,0	8	2,330	100	130	37 377	1 460	1 133	357 [402]	436 [498]	532 [623]
		10	2,330	114	143	46 296	1 813	1 403	448 [498]	551 [617]	680 [772]
		12,5	2,330	130	160	57 213	2 250	1 734	615	688 [763]	855 [954]
		14,2	2,330	142	172	64 491	2 542	1 954	694	860	969 [1075]
		16	2,330	154	184	72 069	2 849	2 184	1 011	961	1086 [1201]
		18	2,330	167	197	80 338	3 185	2 434	1 131	1 401	1 339
RR700	711,0	8	2,381	102	131	45 847	1 661	1 290	404 [458]	491 [567]	597 [709]
		10	2,381	116	146	56 825	2 064	1 598	509 [567]	624 [703]	768 [879]
		12,5	2,381	134	164	70 283	2 562	1 977	702	783 [870]	970 [1087]
		14,2	2,381	146	176	79 267	2 896	2 230	792	886 [981]	1102 [1226]
		16	2,381	159	188	88 635	3 246	2 493	1 152	1 097	1238 [1371]
		18	2,381	173	202	98 870	3 631	2 781	1 289	1 224	1385 [1530]
		20	2,381	187	216	108 925	4 012	3 064	1 424	1 765	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)
** = Diameter - wall thickness combination not in normal production, check availability from SSAB sales
*** = Wall thickness not in normal production, check availability from SSAB sales

Primary element dimensions			Secondary elements = Double AZ18-800								
Pile	Diameter [mm]	Thickness [mm]	b_{sys} [m]	$G_{60\%}$ [kg/m²]	$G_{100\%}$ [kg/m²]	I_{sys} [cm⁴/m]	$W_{sys,pl}$ [cm³/m]	$W_{sys,el}$ [cm³/m]	$M_{Rd,S355}$ [kNm/m]*	$M_{Rd,S440}$ [kNm/m]*	$M_{Rd,S550}$ [kNm/m]*
RR750	762,0	8	2,432	104	133	55 380	1 870	1 454	451 [516]	547 [640]	662 [799]
		10	2,432	119	148	68 679	2 325	1 803	571 [640]	700 [793]	858 [991]
		12,5	2,432	138	167	85 005	2 888	2 231	715 [792]	880 [982]	1089 [1227]
		14,2	2,432	151	179	95 917	3 265	2 518	894	999 [1108]	1240 [1385]
		16	2,432	164	193	107 308	3 662	2 816	1 000	1 239	1395 [1549]
		18	2,432	179	207	119 768	4 098	3 144	1 455	1 383	1563 [1729]
		20	2,432	193	222	132 024	4 529	3 465	1 608	1 525	
RR800	813,0	8	2,483	106	134	66 009	2 088	1 624	500 [576]	604 [714]	727 [893]
		10	2,483	122	150	81 902	2 597	2 015	635 [715]	776 [887]	949 [1108]
		12,5	2,483	141	169	101 434	3 226	2 495	797 [886]	981 [1098]	1211 [1372]
		14,2	2,483	155	183	114 505	3 650	2 817	1 000	1115 [1239]	1382 [1549]
		16	2,483	169	197	128 160	4 094	3 153	1 119	1253 [1387]	1557 [1734]
		18	2,483	184	212	143 113	4 583	3 521	1 627	1 549	1747 [1936]
		20	2,483	200	228	157 837	5 066	3 883	1 799	1 708	
		21 ***	2,483	207	235	165 114	5 306	4 062	1 884	1 787	
		22 ***	2,483	215	243	172 334	5 545	4 239	1 969	2 440	
RR900	914,0	10	2,584	127	154	112 286	3 163	2 457	766 [872]	932 [1081]	1131 [1351]
		12,5	2,584	148	175	139 206	3 932	3 046	968 [1081]	1187 [1340]	1459 [1675]
		14,2	2,584	162	189	157 254	4 450	3 441	1100 [1222]	1354 [1514]	1672 [1893]
		16	2,584	178	204	176 138	4 994	3 854	1 368	1525 [1696]	1891 [2120]
		18	2,584	194	221	196 852	5 593	4 307	1 529	1712 [1895]	2128 [2369]
		20	2,584	211	238	217 284	6 187	4 755	2 196	2 092	
		21 ***	2,584	219	246	227 395	6 482	4 976	2 301	2 189	
		22 ***	2,584	228	255	237 437	6 776	5 196	2 405	2 286	
RR1000	1016,0	10	2,686	131	157	148 864	3 768	2 930	902 [1040]	1090 [1289]	1312 [1612]
		12,5	2,686	154	180	184 707	4 687	3 636	1147 [1291]	1401 [1600]	1713 [2000]
		14,2	2,686	169	195	208 772	5 306	4 110	1307 [1459]	1604 [1808]	1974 [2260]
		16	2,686	186	212	233 983	5 957	4 606	1473 [1635]	1813 [2027]	2241 [2533]
		18	2,686	204	230	261 673	6 675	5 151	1 829	2040 [2266]	2529 [2833]
		20	2,686	222	248	289 026	7 388	5 689	2 020	2261 [2503]	
		21 ***	2,686	231	257	302 577	7 741	5 956	2 114	2370 [2621]	
		22 ***	2,686	240	266	316 045	8 094	6 221	2 873	2 737	
		23 ***	2,686	249	274	329 429	8 445	6 485	2 998	2 853	
RR1200	1220,0	10	2,890	139	163	240 740	5 066	3 947	1176 [1401]	1403 [1736]	1658 [2171]
		12,5	2,890	165	189	299 075	6 307	4 903	1518 [1741]	1839 [2157]	2220 [2697]
		14,2	2,890	182	206	338 327	7 144	5 546	1741 [1969]	2123 [2440]	2586 [3050]
		16	2,890	201	225	379 523	8 026	6 222	1972 [2209]	2415 [2738]	2962 [3422]
		18	2,890	221	245	424 859	8 999	6 965	2222 [2473]	2730 [3065]	3366 [3831]
		20	2,890	241	265	469 739	9 966	7 701	2466 [2734]	3038 [3388]	
		21 ***	2,890	251	275	492 008	10 447	8 066	2 863	3190 [3549]	
		22 ***	2,890	261	285	514 164	10 927	8 429	2 992	3340 [3709]	
		23 ***	2,890	271	295	536 207	11 404	8 790	3 121	3489 [3868]	

* = Design bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section classes 3 and value with local buckling considered in cross-section class 4) (in cross-section class 4 M_{el} is shown in brackets [] for situations where the requirements given in EN 1993-5 clause 5.5.4(9) are fulfilled)

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