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 thickness up to 22 mm and length up to 41 m without splice welding. Longer piles can be spliced by welding in factory conditions.

Tubular piles are available in numerous European steel grades. Most 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 customer's 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 loads from above structures. The intermediate 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 guidelines 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 2 to 6 are calculated by using following partial factors.

γ_{M0} = 1.00
γ_{M1} = 1.10 / 1.20

These partial factors are recommended values given in EN 1993-5 for piling and in EN 1993-6 for local buckling. The value 1.2 for γ_{M1} is used according to strong recommendation from CEN/TC250 (November 22nd 2024) in situations where the value of relative slenderness λ_x is between λ_{x0} and λ_{xp}. If appropriate National Annex has different values for partial factors, the resistance values in tables should be modified accordingly.

Local buckling of primary 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. 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 clause 5.5.4(9).

Effect of intermediate sheet piles for the bending resistance of the combined wall

Since sheet piles only fill the gap between primary elements, only the width of the sheet piles has influence on the resistance of the combined wall. Change of width of sheet piles changes the 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 situations only given weight values $G_{60\%}$ and $G_{100\%}$ are changing.

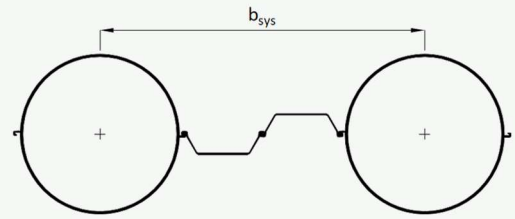
Calculation tool for retaining walls

SSAB PileWallCalc can be used to calculate the structural resistances of combined walls and other types of retaining walls. The tool allows project specific variations such as changing the connector type and inputting different corrosion allowances.

Table 1. Standard steel grades of SSAB's steel piles.

	Carbon equivalent	Chemical composition, max.				Mechanical properties				
									Impact strength	
Steel grade	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
S460MH	0.46	0.16	1.7	0.035	0.03	460	530-720	17	-20	40
S550J2H	0.47	0.12	1.9	0.02	0.02	550	605-760	14	-20	27

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



b_{sys}: 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}: Moment of inertia of combined wall
$W_{sys,pl}$: Plastic section modulus of combined wall
$W_{sys,el}$: Elastic section modulus of combined wall
M_{Rd}: Design value of bending moment resistance with specified steel grade

Primary elements			Secondary elements = Double VL603									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
		8	1.676	97	131	11 855	758	583	207	213 [257]	222 [257]	264 [321]
RR400	406.4	10	1.676	109	142	14 600	938	719	333	316	316	328 [395]
		12.5	1.676	123	157	17 914	1 157	882	411	509	532	485
		8	1.727	100	133	16 472	934	721	256	262 [317]	273 [317]	324 [396]
RR450	457.0	10	1.727	113	145	20 319	1 157	889	411	391	391	404 [489]
		12.5	1.727	128	161	24 983	1 430	1 093	508	629	481	601
		8	1.778	103	135	22 092	1 125	870	255 [309]	314 [383]	328 [383]	388 [478]
		10	1.778	117	148	27 289	1 395	1 074	381	391 [473]	409 [473]	486 [591]
RR500	508.0	12.5	1.778	133	165	33 608	1 726	1 323	613	582	582	604 [728]
		14.2	1.778	145	177	37 795	1 948	1 488	692	857	655	818
		16 **	1.778	157	188	42 131	2 179	1 659	774	959	1 002	
		8	1.829	106	137	28 740	1 328	1 028	300 [365]	369 [452]	384 [452]	454 [566]
		10	1.829	120	151	35 539	1 648	1 272	451	462 [559]	482 [559]	573 [699]
RR550	559.0	12.5	1.829	138	169	43 828	2 042	1 568	725	690	690	714 [862]
		14.2	1.829	151	181	49 333	2 305	1 765	818	777	777	806 [971]
		16 **	1.829	163	194	55 048	2 580	1 970	916	1 135	1 187	
		8	1.880	108	138	36 463	1 542	1 196	347 [424]	425 [526]	443 [526]	522 [658]
		10	1.880	124	154	45 131	1 915	1 480	434 [525]	535 [651]	559 [651]	662 [814]
		12.5	1.880	143	173	55 721	2 374	1 827	649	666 [804]	696 [804]	829 [1005]
RR600	610.0	14.2	1.880	156	186	62 768	2 682	2 058	952	906	906	938 [1132]
		16	1.880	170	200	70 097	3 004	2 298	1 066	1 011	1 011	1 264
		18	1.880	185	215	78 080	3 357	2 560	1 192	1 477	1 544	1 408
		8	1.930	110	140	45 123	1 762	1 367	395 [485]	482 [602]	502 [602]	589 [752]
		10	1.930	127	156	55 891	2 189	1 694	496 [601]	610 [745]	636 [745]	752 [932]
		12.5	1.930	147	176	69 071	2 716	2 093	743	762 [921]	795 [921]	946 [1151]
RR650	660.0	14.2	1.930	161	190	77 857	3 069	2 359	838	1 038	900 [1038]	1072 [1298]
		16	1.930	175	205	87 006	3 439	2 637	1 221	1 160	1 160	1202 [1450]
		18	1.930	191	221	96 989	3 845	2 939	1 365	1 692	1 293	1 616
		8	1.981	113	141	55 105	1 996	1 550	445 [550]	541 [682]	563 [682]	658 [853]
		10	1.981	130	158	68 300	2 481	1 921	560 [682]	688 [845]	717 [845]	846 [1057]
		12.5	1.981	151	180	84 474	3 079	2 376	844	862 [1046]	900 [1046]	1069 [1307]
RR700	711.0	14.2	1.981	166	194	95 273	3 481	2 680	951	977 [1179]	1020 [1179]	1214 [1474]
		16	1.981	181	210	106 532	3 902	2 997	1 385	1 319	1 319	1364 [1648]
		18	1.981	198	226	118 834	4 365	3 343	1 549	1 471	1 471	1526 [1838]
		20	1.981	215	243	130 919	4 822	3 683	1 712	2 122	2 218	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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

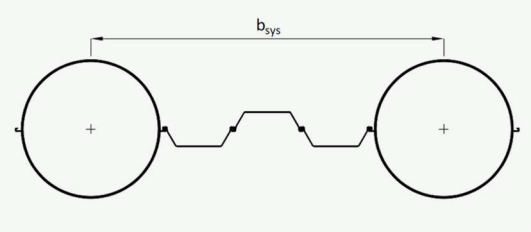
Primary elements			Secondary elements = Double VL603									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
RR750	762.0	8	2.032	115	143	66 281	2 238	1 740	495 [618]	601 [765]	624 [765]	727 [957]
		10	2.032	133	161	82 199	2 783	2 157	627 [766]	768 [949]	800 [949]	941 [1187]
		12.5	2.032	155	183	101 738	3 456	2 670	784 [948]	966 [1175]	1008 [1175]	1195 [1469]
		14.2	2.032	171	198	114 799	3 908	3 013	1 070	1096 [1326]	1144 [1326]	1360 [1657]
		16	2.032	186	214	128 432	4 383	3 371	1 197	1 483	1285 [1483]	1531 [1854]
		18	2.032	204	232	143 345	4 904	3 762	1 741	1 655	1 655	1715 [2069]
		20	2.032	222	249	158 013	5 420	4 147	1 924	1 825	1 825	
RR800	813.0	8	2.083	117	144	78 685	2 489	1 936	546 [687]	660 [852]	686 [852]	795 [1065]
		10	2.083	136	163	97 630	3 096	2 402	694 [853]	848 [1057]	884 [1057]	1037 [1321]
		12.5	2.083	159	186	120 912	3 846	2 974	871 [1056]	1072 [1309]	1118 [1309]	1323 [1636]
		14.2	2.083	175	202	136 493	4 350	3 358	1 192	1218 [1477]	1272 [1477]	1510 [1847]
		16	2.083	192	219	152 771	4 880	3 758	1 334	1369 [1654]	1430 [1654]	1702 [2067]
		18	2.083	210	237	170 595	5 463	4 197	1 939	1 847	1 847	1909 [2308]
		20	2.083	228	255	188 147	6 039	4 628	2 144	2 037	2 037	
		21 ***	2.083	238	265	196 821	6 325	4 842	2 245	2 130	2 130	
		22 ***	2.083	247	274	205 427	6 610	5 054	2 347	2 908	2 224	
RR900	914.0	10	2.184	141	167	132 851	3 742	2 907	831 [1032]	1011 [1279]	1051 [1279]	1226 [1599]
		12.5	2.184	166	192	164 702	4 652	3 604	1050 [1279]	1287 [1586]	1342 [1586]	1582 [1982]
		14.2	2.184	183	209	186 055	5 265	4 071	1193 [1445]	1468 [1791]	1532 [1791]	1813 [2239]
		16	2.184	201	227	208 398	5 908	4 560	1 619	1654 [2006]	1727 [2006]	2051 [2508]
		18	2.184	221	247	232 905	6 618	5 096	1 809	1857 [2242]	1939 [2242]	2308 [2803]
		20	2.184	241	266	257 079	7 320	5 625	2 599	2 475	2 475	
		21 ***	2.184	250	276	269 043	7 669	5 887	2 723	2 590	2 590	
		22 ***	2.184	260	286	280 924	8 017	6 147	2 846	2 705	2 705	
RR1000	1016.0	10	2.286	146	170	174 912	4 427	3 443	972 [1222]	1174 [1515]	1220 [1515]	1413 [1894]
		12.5	2.286	172	197	217 027	5 507	4 272	1235 [1517]	1509 [1880]	1572 [1880]	1845 [2350]
		14.2	2.286	190	215	245 303	6 235	4 829	1408 [1714]	1728 [2125]	1802 [2125]	2126 [2656]
		16	2.286	210	234	274 925	7 000	5 412	1587 [1921]	1953 [2381]	2038 [2381]	2414 [2977]
		18	2.286	231	255	307 460	7 843	6 052	2 149	2197 [2663]	2294 [2663]	2724 [3329]
		20	2.286	252	277	339 599	8 680	6 685	2 373	2435 [2941]	2544 [2941]	
		21 ***	2.286	262	287	355 521	9 096	6 998	2 484	2553 [3079]	2667 [3079]	
		22 ***	2.286	273	298	371 346	9 510	7 310	3 376	3 216	2789 [3216]	
RR1200	1220.0	10	2.490	154	176	279 413	5 880	4 581	1251 [1626]	1493 [2015]	1546 [2015]	1764 [2519]
		12.5	2.490	183	206	347 119	7 320	5 690	1615 [2020]	1956 [2504]	2033 [2504]	2362 [3130]
		14.2	2.490	204	226	392 677	8 292	6 437	1852 [2285]	2258 [2832]	2351 [2832]	2751 [3541]
		16	2.490	225	247	440 491	9 315	7 221	2098 [2564]	2569 [3177]	2677 [3177]	3151 [3972]
		18	2.490	248	271	493 110	10 445	8 084	2364 [2870]	2905 [3557]	3030 [3557]	3581 [4446]
		20	2.490	272	294	545 199	11 567	8 938	2624 [3173]	3233 [3933]	3374 [3933]	
		21 ***	2.490	283	306	571 045	12 126	9 361	3 323	3394 [4119]	3543 [4119]	
		22 ***	2.490	295	318	596 761	12 682	9 783	3 473	3554 [4305]	3711 [4305]	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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}: 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}: Moment of inertia of combined wall
$W_{sys,pl}$: Plastic section modulus of combined wall
$W_{sys,el}$: Elastic section modulus of combined wall
M_{Rd}: Design value of bending moment resistance with specified steel grade

Primary elements			Secondary elements = Triple VL603									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
		8	2.276	89	125	8 730	558	430	153	157 [189]	163 [198]	195 [236]
RR400	406.4	10	2.276	97	133	10 752	690	529	245	233	243	241 [291]
		12.5	2.276	107	143	13 192	852	649	303	375	392	357
		8	2.327	91	126	12 224	693	535	190	194 [235]	203 [246]	241 [294]
RR450	457.0	10	2.327	100	136	15 080	859	660	305	290	304	300 [363]
		12.5	2.327	112	147	18 541	1 062	811	377	467	373	446
		8	2.378	93	128	16 518	841	650	191 [231]	235 [286]	245 [299]	290 [358]
		10	2.378	103	138	20 404	1 043	803	285	293 [353]	306 [370]	364 [442]
RR500	508.0	12.5	2.378	116	151	25 128	1 291	989	458	435	455	451 [544]
		14.2	2.378	124	159	28 258	1 456	1 113	517	641	512	612
		16 **	2.378	133	168	31 501	1 629	1 240	578	717	749	
		8	2.429	95	129	21 641	1 000	774	226 [275]	278 [341]	289 [356]	342 [426]
		10	2.429	106	140	26 760	1 241	957	340	348 [421]	363 [440]	431 [527]
RR550	559.0	12.5	2.429	120	154	33 002	1 537	1 181	546	520	543	537 [649]
		14.2	2.429	129	163	37 147	1 736	1 329	616	585	611	607 [731]
		16 **	2.429	139	173	41 450	1 943	1 483	690	855	894	
		8	2.480	98	131	27 642	1 169	906	263 [322]	322 [399]	336 [417]	395 [498]
		10	2.480	109	142	34 212	1 452	1 122	329 [398]	406 [494]	423 [516]	502 [617]
		12.5	2.480	124	157	42 240	1 800	1 385	492	505 [609]	528 [637]	628 [762]
RR600	610.0	14.2	2.480	134	167	47 582	2 033	1 560	722	686	718	711 [858]
		16	2.480	144	177	53 138	2 277	1 742	808	767	801	958
		18	2.480	156	189	59 190	2 544	1 941	903	1 120	1 170	1 067
		8	2.530	100	132	34 422	1 344	1 043	301 [370]	368 [459]	383 [480]	449 [574]
		10	2.530	112	144	42 637	1 670	1 292	378 [459]	465 [568]	485 [594]	574 [711]
		12.5	2.530	128	160	52 690	2 072	1 597	567	581 [703]	607 [734]	722 [878]
RR650	660.0	14.2	2.530	138	170	59 393	2 341	1 800	639	792	686 [828]	818 [990]
		16	2.530	149	182	66 372	2 623	2 011	931	885	925	917 [1106]
		18	2.530	161	194	73 987	2 933	2 242	1 041	1 291	1 031	1 233
		8	2.581	101	133	42 295	1 532	1 190	341 [422]	415 [523]	432 [547]	505 [654]
		10	2.581	115	146	52 422	1 904	1 475	430 [523]	528 [649]	550 [678]	650 [811]
		12.5	2.581	131	163	64 837	2 363	1 824	647	662 [802]	691 [839]	820 [1003]
RR700	711.0	14.2	2.581	142	174	73 125	2 672	2 057	730	750 [905]	783 [946]	932 [1131]
		16	2.581	154	186	81 767	2 995	2 300	1 063	1 012	1 058	1047 [1265]
		18	2.581	167	199	91 209	3 350	2 566	1 189	1 129	1 180	1171 [1411]
		20	2.581	180	212	100 485	3 701	2 827	1 314	1 628	1 702	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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.

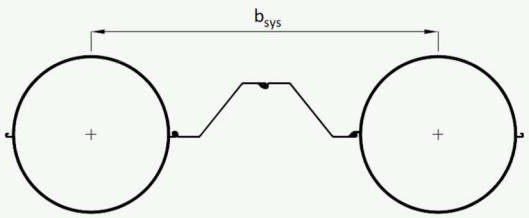
Primary elements			Secondary elements = Triple VL603									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
RR750	762.0	8	2.632	103	134	51 171	1 728	1 343	382 [477]	464 [591]	482 [618]	561 [739]
		10	2.632	117	148	63 461	2 149	1 666	484 [591]	593 [733]	618 [766]	727 [916]
		12.5	2.632	135	166	78 545	2 668	2 062	605 [732]	746 [907]	778 [948]	923 [1134]
		14.2	2.632	146	177	88 629	3 017	2 326	826	846 [1024]	883 [1070]	1050 [1279]
		16	2.632	159	190	99 154	3 384	2 602	924	1 145	992 [1197]	1182 [1431]
		18	2.632	172	203	110 667	3 786	2 905	1 344	1 278	1 336	1324 [1598]
		20	2.632	186	217	121 992	4 185	3 202	1 486	1 409	1 473	
RR800	813.0	8	2.683	105	136	61 089	1 932	1 503	424 [533]	513 [661]	532 [691]	617 [827]
		10	2.683	120	150	75 797	2 403	1 865	539 [662]	659 [820]	686 [858]	805 [1026]
		12.5	2.683	138	168	93 873	2 986	2 309	676 [820]	832 [1016]	868 [1062]	1027 [1270]
		14.2	2.683	150	181	105 969	3 377	2 607	925	946 [1147]	987 [1199]	1172 [1434]
		16	2.683	163	194	118 607	3 789	2 918	1 036	1063 [1284]	1110 [1342]	1321 [1605]
		18	2.683	177	208	132 445	4 241	3 258	1 506	1 434	1 499	1482 [1792]
		20	2.683	192	222	146 071	4 689	3 593	1 664	1 581	1 653	
		21 ***	2.683	199	229	152 806	4 911	3 759	1 743	1 654	1 729	
		22 ***	2.683	206	236	159 488	5 132	3 923	1 822	2 258	1 805	
RR900	914.0	10	2.784	124	154	104 220	2 936	2 281	652 [810]	793 [1003]	825 [1049]	962 [1254]
		12.5	2.784	144	174	129 206	3 649	2 827	823 [1004]	1010 [1244]	1053 [1301]	1241 [1555]
		14.2	2.784	157	187	145 957	4 130	3 194	936 [1134]	1152 [1405]	1202 [1469]	1422 [1757]
		16	2.784	172	201	163 485	4 635	3 577	1 270	1298 [1574]	1355 [1646]	1609 [1968]
		18	2.784	187	217	182 710	5 191	3 998	1 419	1456 [1759]	1521 [1839]	1810 [2199]
		20	2.784	203	232	201 674	5 743	4 413	2 039	1 942	2 030	
		21 ***	2.784	210	240	211 059	6 016	4 618	2 136	2 032	2 124	
		22 ***	2.784	218	248	220 380	6 289	4 822	2 233	2 122	2 218	
RR1000	1016.0	10	2.886	129	157	138 548	3 507	2 727	770 [968]	930 [1200]	966 [1255]	1120 [1500]
		12.5	2.886	150	178	171 907	4 362	3 384	978 [1201]	1196 [1489]	1245 [1557]	1461 [1861]
		14.2	2.886	164	193	194 304	4 938	3 825	1115 [1358]	1369 [1683]	1427 [1759]	1684 [2104]
		16	2.886	179	208	217 768	5 544	4 287	1257 [1522]	1547 [1886]	1614 [1972]	1912 [2358]
		18	2.886	196	225	243 539	6 213	4 794	1 702	1740 [2109]	1817 [2205]	2158 [2637]
		20	2.886	213	241	268 997	6 876	5 295	1 880	1929 [2330]	2015 [2436]	
		21 ***	2.886	221	250	281 608	7 205	5 543	1 968	2022 [2439]	2112 [2550]	
		22 ***	2.886	230	258	294 143	7 533	5 790	2 674	2 548	2209 [2663]	
RR1200	1220.0	10	3.090	136	163	225 158	4 738	3 691	1008 [1310]	1203 [1624]	1246 [1698]	1421 [2030]
		12.5	3.090	160	187	279 717	5 898	4 586	1301 [1628]	1576 [2018]	1638 [2109]	1903 [2522]
		14.2	3.090	176	203	316 429	6 682	5 187	1493 [1842]	1820 [2282]	1894 [2386]	2217 [2853]
		16	3.090	194	220	354 958	7 507	5 819	1690 [2066]	2070 [2560]	2157 [2677]	2539 [3200]
		18	3.090	213	239	397 361	8 417	6 514	1905 [2313]	2341 [2866]	2442 [2996]	2886 [3583]
		20	3.090	231	258	439 335	9 321	7 202	2115 [2557]	2605 [3169]	2719 [3313]	
		21 ***	3.090	241	267	460 163	9 771	7 544	2 678	2735 [3319]	2855 [3470]	
		22 ***	3.090	250	277	480 885	10 219	7 883	2 799	2864 [3469]	2990 [3626]	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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 pile 700 mm.



b_{sys}: 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}: Moment of inertia of combined wall
$W_{sys,pl}$: Plastic section modulus of combined wall
$W_{sys,el}$: Elastic section modulus of combined wall
M_{Rd}: Design value of bending moment resistance with specified steel grade

Primary elements			Secondary elements = Double ZZ18-700									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
		8	1.876	95	130	10 592	677	521	185	190 [229]	198 [240]	257 [287]
RR400	406.4	10	1.876	105	141	13 044	838	642	297	282	295	319 [353]
		12.5	1.876	118	153	16 004	1 034	788	367	455	476	433
		8	1.927	98	132	14 762	837	646	229	234 [284]	245 [297]	317 [355]
RR450	457.0	10	1.927	109	143	18 210	1 037	797	368	351	367	395 [438]
		12.5	1.927	123	157	22 390	1 282	980	455	564	451	539
		8	1.978	100	134	19 858	1 011	782	229 [278]	282 [344]	294 [360]	380 [430]
		10	1.978	112	146	24 530	1 254	966	343	352 [425]	367 [444]	477 [531]
RR500	508.0	12.5	1.978	128	161	30 210	1 552	1 189	551	523	547	592 [654]
		14.2	1.978	138	171	33 973	1 751	1 338	622	770	615	736
		16 **	1.978	149	182	37 871	1 959	1 491	695	862	901	
		8	2.029	103	135	25 907	1 197	927	271 [329]	332 [408]	347 [426]	446 [510]
		10	2.029	116	149	32 036	1 486	1 146	407	416 [504]	435 [527]	563 [630]
RR550	559.0	12.5	2.029	132	165	39 508	1 840	1 414	653	622	650	702 [777]
		14.2	2.029	143	176	44 471	2 078	1 591	738	700	732	792 [875]
		16 **	2.029	155	187	49 622	2 326	1 775	826	1 023	1 070	
		8	2.080	105	137	32 957	1 394	1 081	314 [384]	384 [475]	401 [497]	514 [594]
		10	2.080	119	151	40 792	1 731	1 337	393 [475]	484 [588]	505 [615]	653 [736]
		12.5	2.080	136	168	50 363	2 146	1 651	586	602 [727]	629 [760]	817 [908]
RR600	610.0	14.2	2.080	148	180	56 733	2 424	1 860	860	818	856	924 [1023]
		16	2.080	161	192	63 356	2 715	2 077	964	914	956	1 142
		18	2.080	174	206	70 572	3 034	2 314	1 077	1 335	1 396	1 273
		8	2.130	107	138	40 886	1 597	1 239	358 [440]	437 [545]	455 [570]	582 [681]
		10	2.130	122	153	50 643	1 984	1 535	449 [545]	552 [675]	576 [706]	744 [844]
		12.5	2.130	140	172	62 585	2 461	1 897	673	690 [834]	721 [872]	935 [1043]
RR650	660.0	14.2	2.130	153	184	70 546	2 781	2 138	759	941	815 [983]	1060 [1176]
		16	2.130	166	197	78 836	3 116	2 389	1 106	1 051	1 099	1188 [1314]
		18	2.130	181	212	87 882	3 484	2 663	1 237	1 533	1 225	1 465
		8	2.181	109	140	50 051	1 813	1 408	404 [500]	492 [619]	511 [648]	652 [774]
		10	2.181	125	155	62 036	2 253	1 745	509 [619]	625 [768]	651 [803]	839 [960]
		12.5	2.181	144	175	76 728	2 797	2 158	766	783 [950]	818 [993]	1059 [1187]
RR700	711.0	14.2	2.181	158	188	86 536	3 162	2 434	864	887 [1071]	927 [1120]	1203 [1339]
		16	2.181	171	202	96 763	3 544	2 722	1 258	1 198	1 252	1351 [1497]
		18	2.181	187	217	107 937	3 964	3 036	1 407	1 336	1 397	1512 [1670]
		20	2.181	202	232	118 914	4 380	3 345	1 555	1 927	2 015	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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.

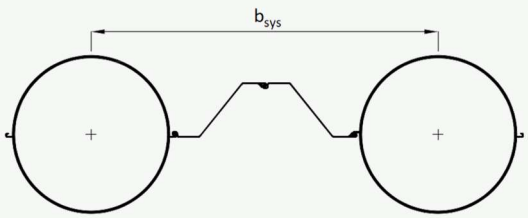
Primary elements			Secondary elements = Double ZZ18-700									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
RR750	762.0	8	2.232	111	141	60 342	2 038	1 584	451 [562]	547 [697]	569 [729]	722 [871]
		10	2.232	128	157	74 833	2 534	1 964	571 [697]	699 [864]	728 [904]	935 [1080]
		12.5	2.232	148	178	92 621	3 146	2 431	714 [863]	879 [1070]	918 [1118]	1187 [1337]
		14.2	2.232	162	192	104 512	3 558	2 743	974	998 [1207]	1042 [1262]	1351 [1509]
		16	2.232	177	206	116 924	3 990	3 069	1 089	1 350	1170 [1412]	1520 [1688]
		18	2.232	193	222	130 500	4 465	3 425	1 585	1 507	1 576	1703 [1884]
		20	2.232	209	238	143 854	4 935	3 776	1 752	1 661	1 737	
RR800	813.0	8	2.283	113	142	71 792	2 271	1 766	498 [627]	602 [777]	626 [812]	791 [971]
		10	2.283	130	159	89 077	2 825	2 191	634 [778]	774 [964]	806 [1008]	1032 [1205]
		12.5	2.283	152	181	110 320	3 509	2 714	795 [963]	978 [1194]	1020 [1248]	1317 [1493]
		14.2	2.283	166	195	124 536	3 969	3 064	1 088	1111 [1348]	1160 [1409]	1503 [1685]
		16	2.283	181	210	139 388	4 452	3 429	1 217	1249 [1509]	1305 [1577]	1694 [1886]
		18	2.283	198	227	155 650	4 984	3 829	1 769	1 685	1 761	1900 [2106]
		20	2.283	215	244	171 664	5 510	4 223	1 956	1 858	1 943	
		21 ***	2.283	223	252	179 578	5 771	4 418	2 049	1 944	2 032	
		22 ***	2.283	232	261	187 431	6 031	4 611	2 141	2 654	2 121	
RR900	914.0	10	2.384	135	163	121 706	3 428	2 663	762 [945]	926 [1172]	963 [1225]	1226 [1465]
		12.5	2.384	158	186	150 884	4 262	3 302	962 [1172]	1179 [1453]	1229 [1519]	1581 [1816]
		14.2	2.384	174	202	170 447	4 823	3 730	1093 [1324]	1345 [1641]	1403 [1716]	1812 [2051]
		16	2.384	190	218	190 915	5 413	4 178	1 483	1516 [1838]	1582 [1922]	2050 [2298]
		18	2.384	209	236	213 366	6 062	4 669	1 657	1701 [2054]	1777 [2148]	2306 [2568]
		20	2.384	227	255	235 512	6 706	5 153	2 381	2 268	2 371	
		21 ***	2.384	236	264	246 472	7 026	5 393	2 494	2 373	2 481	
		22 ***	2.384	245	273	257 356	7 344	5 631	2 607	2 478	2 590	
RR1000	1016.0	10	2.486	140	167	160 841	4 071	3 166	893 [1124]	1080 [1393]	1122 [1456]	1418 [1741]
		12.5	2.486	165	191	199 567	5 064	3 928	1136 [1395]	1388 [1729]	1446 [1807]	1851 [2161]
		14.2	2.486	181	208	225 568	5 733	4 440	1295 [1576]	1589 [1954]	1657 [2043]	2132 [2442]
		16	2.486	199	225	252 807	6 437	4 977	1459 [1767]	1796 [2190]	1874 [2289]	2421 [2737]
		18	2.486	218	245	282 725	7 212	5 565	1 976	2020 [2449]	2109 [2560]	2733 [3061]
		20	2.486	238	264	312 278	7 982	6 147	2 182	2239 [2705]	2339 [2828]	
		21 ***	2.486	247	274	326 919	8 364	6 435	2 285	2347 [2832]	2452 [2960]	
		22 ***	2.486	257	284	341 471	8 745	6 722	3 105	2 958	2564 [3092]	
RR1200	1220.0	10	2.690	148	173	258 639	5 443	4 240	1158 [1505]	1382 [1866]	1431 [1950]	1781 [2332]
		12.5	2.690	175	200	321 311	6 776	5 267	1495 [1870]	1811 [2318]	1882 [2423]	2385 [2897]
		14.2	2.690	194	219	363 481	7 676	5 959	1715 [2115]	2090 [2622]	2176 [2741]	2778 [3277]
		16	2.690	214	238	407 740	8 623	6 684	1942 [2373]	2378 [2941]	2478 [3075]	3182 [3676]
		18	2.690	235	260	456 448	9 669	7 483	2188 [2656]	2689 [3292]	2805 [3442]	3616 [4116]
		20	2.690	257	282	504 664	10 707	8 273	2429 [2937]	2992 [3640]	3123 [3806]	
		21 ***	2.690	268	293	528 588	11 224	8 665	3 076	3142 [3813]	3280 [3986]	
		22 ***	2.690	279	303	552 392	11 739	9 056	3 215	3289 [3984]	3435 [4166]	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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}: 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}: Moment of inertia of combined wall
$W_{sys,pl}$: Plastic section modulus of combined wall
$W_{sys,el}$: Elastic section modulus of combined wall
M_{Rd}: Design value of bending moment resistance with specified steel grade

Primary elements			Secondary elements = Double ZZ14-770									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
		8	2.016	90	124	9 856	630	485	172	177 [213]	185 [223]	220 [267]
RR400	406.4	10	2.016	100	134	12 138	779	597	277	263	275	272 [329]
		12.5	2.016	111	145	14 893	962	733	342	423	443	403
		8	2.067	93	126	13 762	780	602	214	219 [265]	228 [277]	271 [331]
RR450	457.0	10	2.067	103	136	16 977	967	743	343	327	342	338 [409]
		12.5	2.067	116	149	20 873	1 195	913	424	526	420	502
		8	2.118	95	128	18 546	944	730	214 [259]	263 [321]	275 [336]	326 [402]
		10	2.118	107	139	22 909	1 171	902	320	329 [397]	343 [415]	408 [496]
RR500	508.0	12.5	2.118	121	153	28 213	1 449	1 111	515	489	511	507 [611]
		14.2	2.118	130	163	31 727	1 635	1 249	581	720	575	687
		16 **	2.118	140	173	35 368	1 829	1 392	649	805	841	
		8	2.169	98	129	24 235	1 120	867	253 [308]	311 [382]	324 [399]	383 [477]
		10	2.169	110	142	29 968	1 390	1 072	381	389 [472]	407 [493]	483 [590]
RR550	559.0	12.5	2.169	125	157	36 958	1 721	1 322	611	582	608	602 [727]
		14.2	2.169	135	167	41 600	1 944	1 488	690	655	685	679 [819]
		16 **	2.169	146	178	46 419	2 176	1 661	772	957	1 001	
		8	2.220	100	131	30 879	1 306	1 012	294 [359]	360 [445]	375 [466]	442 [557]
		10	2.220	113	144	38 219	1 622	1 253	368 [445]	453 [551]	473 [576]	561 [689]
RR600	610.0	12.5	2.220	129	160	47 187	2 010	1 547	549	564 [681]	589 [712]	702 [851]
		14.2	2.220	140	171	53 155	2 271	1 743	806	767	802	794 [959]
		16	2.220	152	183	59 361	2 544	1 946	903	856	895	1 070
		18	2.220	165	196	66 122	2 842	2 168	1 009	1 251	1 308	1 192
		8	2.270	102	132	38 365	1 498	1 163	336 [413]	410 [512]	427 [535]	501 [639]
		10	2.270	116	146	47 520	1 861	1 440	422 [511]	518 [634]	541 [662]	640 [792]
RR650	660.0	12.5	2.270	133	164	58 725	2 309	1 780	632	648 [783]	676 [819]	804 [979]
		14.2	2.270	145	175	66 195	2 609	2 006	712	883	765 [923]	912 [1103]
		16	2.270	157	188	73 974	2 924	2 242	1 038	986	1 031	1022 [1233]
		18	2.270	171	201	82 462	3 269	2 499	1 161	1 438	1 149	1 374
		8	2.321	104	134	47 032	1 704	1 323	379 [470]	462 [582]	481 [609]	562 [728]
		10	2.321	119	149	58 294	2 117	1 640	478 [582]	587 [722]	612 [754]	722 [902]
		12.5	2.321	137	167	72 100	2 628	2 028	720	736 [892]	768 [933]	912 [1115]
RR700	711.0	14.2	2.321	150	179	81 316	2 971	2 287	812	834 [1006]	871 [1052]	1036 [1258]
		16	2.321	163	192	90 926	3 330	2 558	1 182	1 125	1 177	1164 [1407]
		18	2.321	177	207	101 426	3 725	2 853	1 322	1 255	1 312	1302 [1569]
		20	2.321	191	221	111 741	4 116	3 143	1 461	1 811	1 893	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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.

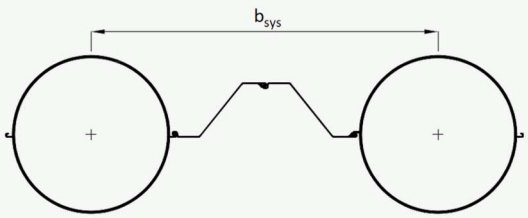
Primary elements			Secondary elements = Double ZZ14-770									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
RR750	762.0	8	2.372	106	135	56 780	1 917	1 490	424 [529]	515 [656]	535 [686]	622 [820]
		10	2.372	122	151	70 417	2 384	1 848	537 [656]	658 [813]	685 [850]	807 [1017]
		12.5	2.372	141	170	87 155	2 961	2 288	672 [812]	827 [1007]	864 [1052]	1024 [1258]
		14.2	2.372	154	183	98 344	3 348	2 581	916	939 [1136]	980 [1187]	1165 [1420]
		16	2.372	168	197	110 022	3 754	2 888	1 025	1 271	1101 [1328]	1311 [1588]
		18	2.372	183	212	122 798	4 201	3 223	1 491	1 418	1 483	1469 [1773]
		20	2.372	198	227	135 364	4 643	3 553	1 648	1 563	1 634	
RR800	813.0	8	2.423	108	136	67 644	2 140	1 664	470 [591]	568 [732]	590 [765]	683 [915]
		10	2.423	124	153	83 931	2 661	2 065	597 [733]	729 [908]	760 [950]	892 [1136]
		12.5	2.423	144	173	103 946	3 306	2 557	749 [908]	921 [1125]	961 [1176]	1138 [1406]
		14.2	2.423	158	186	117 340	3 740	2 887	1 025	1047 [1270]	1093 [1328]	1298 [1588]
		16	2.423	172	201	131 334	4 195	3 231	1 147	1177 [1422]	1229 [1486]	1463 [1777]
		18	2.423	188	217	146 657	4 696	3 608	1 667	1 587	1 660	1641 [1984]
		20	2.423	204	232	161 745	5 192	3 979	1 843	1 751	1 830	
		21 ***	2.423	212	240	169 202	5 438	4 162	1 930	1 831	1 915	
		22 ***	2.423	220	248	176 602	5 682	4 344	2 017	2 500	1 998	
RR900	914.0	10	2.524	129	156	114 955	3 238	2 515	719 [893]	874 [1107]	910 [1157]	1061 [1383]
		12.5	2.524	151	178	142 515	4 025	3 118	908 [1107]	1114 [1372]	1161 [1435]	1369 [1715]
		14.2	2.524	166	193	160 992	4 555	3 523	1032 [1251]	1270 [1550]	1325 [1620]	1569 [1938]
		16	2.524	181	208	180 326	5 112	3 946	1 401	1432 [1736]	1495 [1815]	1775 [2170]
		18	2.524	198	226	201 531	5 726	4 410	1 566	1607 [1940]	1678 [2029]	1997 [2425]
		20	2.524	216	243	222 449	6 334	4 868	2 249	2 142	2 239	
		21 ***	2.524	224	251	232 801	6 636	5 094	2 356	2 241	2 343	
		22 ***	2.524	233	260	243 081	6 937	5 319	2 463	2 340	2 447	
RR1000	1016.0	10	2.626	134	160	152 266	3 854	2 997	846 [1064]	1022 [1319]	1062 [1379]	1230 [1649]
		12.5	2.626	157	183	188 927	4 794	3 719	1075 [1320]	1314 [1636]	1368 [1711]	1606 [2045]
		14.2	2.626	173	199	213 542	5 427	4 204	1226 [1492]	1504 [1850]	1568 [1934]	1850 [2312]
		16	2.626	190	216	239 330	6 093	4 711	1381 [1672]	1700 [2073]	1774 [2167]	2101 [2591]
		18	2.626	208	234	267 652	6 828	5 269	1 870	1912 [2318]	1997 [2424]	2372 [2898]
		20	2.626	226	252	295 630	7 556	5 819	2 066	2120 [2561]	2214 [2677]	
		21 ***	2.626	235	262	309 490	7 918	6 092	2 163	2222 [2681]	2321 [2802]	
		22 ***	2.626	245	271	323 266	8 279	6 363	2 939	2 800	2428 [2927]	
RR1200	1220.0	10	2.830	142	166	245 844	5 174	4 030	1101 [1431]	1314 [1773]	1360 [1854]	1552 [2217]
		12.5	2.830	168	192	305 416	6 440	5 007	1421 [1777]	1721 [2203]	1789 [2303]	2078 [2754]
		14.2	2.830	186	210	345 500	7 296	5 664	1630 [2011]	1987 [2492]	2068 [2605]	2421 [3115]
		16	2.830	204	229	387 569	8 196	6 354	1846 [2256]	2260 [2796]	2356 [2923]	2772 [3494]
		18	2.830	225	249	433 867	9 190	7 113	2080 [2525]	2556 [3130]	2666 [3272]	3151 [3912]
		20	2.830	246	270	479 698	10 178	7 864	2309 [2792]	2844 [3460]	2969 [3617]	
		21 ***	2.830	256	280	502 439	10 669	8 237	2 924	2986 [3624]	3117 [3789]	
		22 ***	2.830	266	290	525 065	11 158	8 608	3 056	3127 [3787]	3265 [3960]	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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}: 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}: Moment of inertia of combined wall
$W_{sys,pl}$: Plastic section modulus of combined wall
$W_{sys,el}$: Elastic section modulus of combined wall
M_{Rd}: Design value of bending moment resistance with specified steel grade

Primary elements			Secondary elements = Double AZ18-800									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
		8	2.076	88	122	9 571	612	471	167	172 [207]	179 [217]	213 [259]
RR400	406.4	10	2.076	97	131	11 788	757	580	269	255	267	265 [319]
		12.5	2.076	109	142	14 463	934	712	332	411	430	391
		8	2.127	91	123	13 374	758	585	208	212 [258]	222 [269]	263 [322]
RR450	457.0	10	2.127	101	134	16 498	940	722	334	318	332	328 [397]
		12.5	2.127	114	146	20 284	1 161	888	412	511	408	488
		8	2.178	93	125	18 035	918	710	208 [252]	256 [312]	267 [327]	317 [391]
		10	2.178	104	136	22 277	1 139	877	311	320 [386]	334 [403]	397 [482]
RR500	508.0	12.5	2.178	118	150	27 436	1 409	1 080	500	475	497	493 [594]
		14.2	2.178	127	159	30 853	1 590	1 215	565	700	559	668
		16 **	2.178	137	169	34 393	1 779	1 354	632	783	818	
		8	2.229	96	127	23 582	1 090	844	246 [300]	302 [371]	315 [388]	372 [464]
		10	2.229	108	139	29 162	1 352	1 043	370	379 [459]	396 [480]	470 [574]
RR550	559.0	12.5	2.229	122	154	35 963	1 675	1 287	595	566	592	585 [708]
		14.2	2.229	132	164	40 480	1 891	1 448	671	637	666	661 [797]
		16 **	2.229	143	174	45 170	2 117	1 616	752	932	974	
		8	2.280	98	128	30 066	1 272	986	286 [350]	351 [434]	365 [453]	430 [542]
		10	2.280	111	141	37 213	1 579	1 220	358 [433]	441 [537]	461 [561]	546 [671]
		12.5	2.280	127	157	45 945	1 958	1 506	535	549 [663]	574 [693]	683 [829]
RR600	610.0	14.2	2.280	137	168	51 756	2 211	1 697	785	747	781	773 [933]
		16	2.280	149	179	57 799	2 477	1 895	879	834	872	1 042
		18	2.280	161	192	64 382	2 768	2 111	983	1 218	1 273	1 161
		8	2.330	100	130	37 377	1 460	1 133	327 [402]	399 [498]	416 [521]	488 [623]
		10	2.330	114	143	46 296	1 813	1 403	411 [498]	505 [617]	527 [645]	623 [772]
		12.5	2.330	130	160	57 213	2 250	1 734	615	631 [763]	659 [798]	783 [954]
RR650	660.0	14.2	2.330	142	172	64 491	2 542	1 954	694	860	745 [899]	888 [1075]
		16	2.330	154	184	72 069	2 849	2 184	1 011	961	1 005	996 [1201]
		18	2.330	167	197	80 338	3 185	2 434	1 131	1 401	1 120	1 339
		8	2.381	102	131	45 847	1 661	1 290	370 [458]	450 [567]	469 [593]	547 [709]
		10	2.381	116	146	56 825	2 064	1 598	466 [567]	572 [703]	597 [735]	704 [879]
		12.5	2.381	134	164	70 283	2 562	1 977	702	717 [870]	749 [909]	889 [1087]
RR700	711.0	14.2	2.381	146	176	79 267	2 896	2 230	792	813 [981]	849 [1026]	1010 [1226]
		16	2.381	159	188	88 635	3 246	2 493	1 152	1 097	1 147	1135 [1371]
		18	2.381	173	202	98 870	3 631	2 781	1 289	1 224	1 279	1269 [1530]
		20	2.381	187	216	108 925	4 012	3 064	1 424	1 765	1 845	

* = Design value of bending moment resistance (M_{pl} for cross-section classes 1 and 2, M_{el} for cross-section class 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 elements			Secondary elements = Double ZZ14-770									
Pile	d	t	b_{sys}	$G_{60\%}$	$G_{100\%}$	I_{sys}	$W_{sys,pl}$	$W_{sys,el}$	$M_{Rd,S355}$	$M_{Rd,S440}$	$M_{Rd,S460}$	$M_{Rd,S550}$
	[mm]	[mm]	[m]	[kg/m²]	[kg/m²]	[cm⁴/m]	[cm³/m]	[cm³/m]	[kNm/m] *	[kNm/m] *	[kNm/m] *	[kNm/m] *
RR750	762.0	8	2.432	104	133	55 380	1 870	1 454	414 [516]	502 [640]	522 [669]	607 [799]
		10	2.432	119	148	68 679	2 325	1 803	524 [640]	641 [793]	668 [829]	787 [991]
		12.5	2.432	138	167	85 005	2 888	2 231	655 [792]	807 [982]	842 [1026]	999 [1227]
		14.2	2.432	151	179	95 917	3 265	2 518	894	916 [1108]	956 [1158]	1137 [1385]
		16	2.432	164	193	107 308	3 662	2 816	1 000	1 239	1074 [1296]	1279 [1549]
		18	2.432	179	207	119 768	4 098	3 144	1 455	1 383	1 446	1433 [1729]
		20	2.432	193	222	132 024	4 529	3 465	1 608	1 525	1 594	
RR800	813.0	8	2.483	106	134	66 009	2 088	1 624	458 [576]	554 [714]	575 [747]	667 [893]
		10	2.483	122	150	81 902	2 597	2 015	583 [715]	712 [887]	741 [927]	870 [1108]
		12.5	2.483	141	169	101 434	3 226	2 495	731 [886]	899 [1098]	938 [1148]	1110 [1372]
		14.2	2.483	155	183	114 505	3 650	2 817	1 000	1022 [1239]	1067 [1296]	1267 [1549]
		16	2.483	169	197	128 160	4 094	3 153	1 119	1149 [1387]	1200 [1450]	1428 [1734]
		18	2.483	184	212	143 113	4 583	3 521	1 627	1 549	1 619	1601 [1936]
		20	2.483	200	228	157 837	5 066	3 883	1 799	1 708	1 786	
		21 ***	2.483	207	235	165 114	5 306	4 062	1 884	1 787	1 868	
		22 ***	2.483	215	243	172 334	5 545	4 239	1 969	2 440	1 950	
RR900	914.0	10	2.584	127	154	112 286	3 163	2 457	703 [872]	854 [1081]	888 [1130]	1036 [1351]
		12.5	2.584	148	175	139 206	3 932	3 046	887 [1081]	1088 [1340]	1134 [1401]	1337 [1675]
		14.2	2.584	162	189	157 254	4 450	3 441	1008 [1222]	1241 [1514]	1295 [1583]	1533 [1893]
		16	2.584	178	204	176 138	4 994	3 854	1 368	1398 [1696]	1460 [1773]	1733 [2120]
		18	2.584	194	221	196 852	5 593	4 307	1 529	1569 [1895]	1639 [1981]	1950 [2369]
		20	2.584	211	238	217 284	6 187	4 755	2 196	2 092	2 187	
		21 ***	2.584	219	246	227 395	6 482	4 976	2 301	2 189	2 289	
		22 ***	2.584	228	255	237 437	6 776	5 196	2 405	2 286	2 390	
RR1000	1016.0	10	2.686	131	157	148 864	3 768	2 930	827 [1040]	1000 [1289]	1038 [1348]	1203 [1612]
		12.5	2.686	154	180	184 707	4 687	3 636	1051 [1291]	1285 [1600]	1338 [1673]	1570 [2000]
		14.2	2.686	169	195	208 772	5 306	4 110	1198 [1459]	1471 [1808]	1533 [1890]	1809 [2260]
		16	2.686	186	212	233 983	5 957	4 606	1350 [1635]	1662 [2027]	1734 [2119]	2054 [2533]
		18	2.686	204	230	261 673	6 675	5 151	1 829	1870 [2266]	1952 [2369]	2319 [2833]
		20	2.686	222	248	289 026	7 388	5 689	2 020	2073 [2503]	2165 [2617]	
		21 ***	2.686	231	257	302 577	7 741	5 956	2 114	2173 [2621]	2270 [2740]	
		22 ***	2.686	240	266	316 045	8 094	6 221	2 873	2 737	2373 [2862]	
RR1200	1220.0	10	2.890	139	163	240 740	5 066	3 947	1078 [1401]	1287 [1736]	1332 [1815]	1520 [2171]
		12.5	2.890	165	189	299 075	6 307	4 903	1391 [1741]	1685 [2157]	1752 [2255]	2035 [2697]
		14.2	2.890	182	206	338 327	7 144	5 546	1596 [1969]	1946 [2440]	2025 [2551]	2371 [3050]
		16	2.890	201	225	379 523	8 026	6 222	1807 [2209]	2213 [2738]	2307 [2862]	2715 [3422]
		18	2.890	221	245	424 859	8 999	6 965	2037 [2473]	2503 [3065]	2611 [3204]	3086 [3831]
		20	2.890	241	265	469 739	9 966	7 701	2261 [2734]	2785 [3388]	2907 [3542]	
		21 ***	2.890	251	275	492 008	10 447	8 066	2 863	2924 [3549]	3053 [3710]	
		22 ***	2.890	261	285	514 164	10 927	8 429	2 992	3062 [3709]	3197 [3877]	

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