Marine Tie Bar Systems

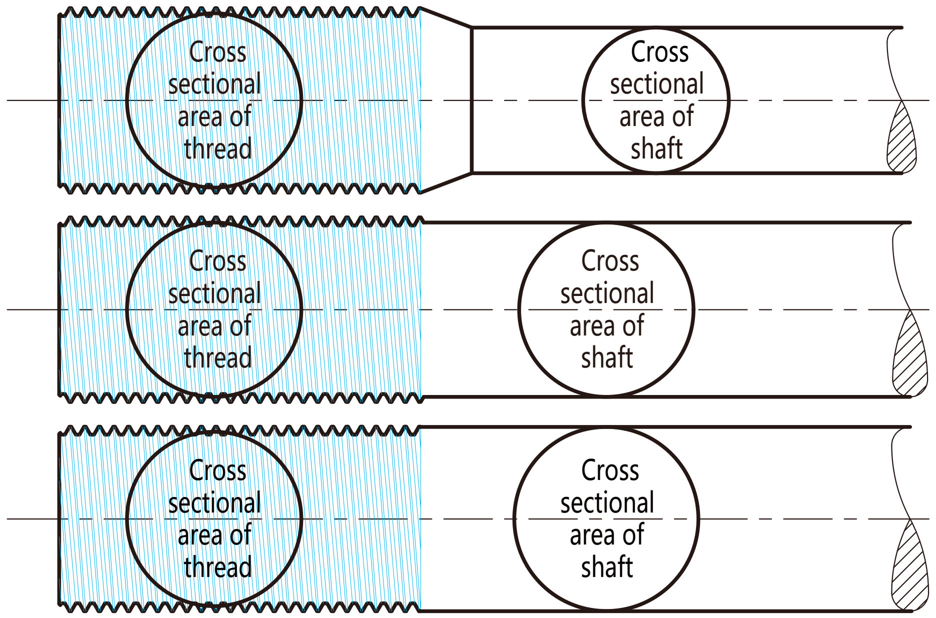
Macalloy

100 years 1921-2021

MACALLOY INTRODUCTION

Macalloy manufactures various types of anchor products for sheet pile structures, widely used in structures such as docks, shipyards, berths, and cofferdams. Our anchor rods range in diameter from M56 to M200 and offer products in grades 355, 460, 500, and 700. Anchors are forged or threaded ends made of round steel bars, allowing for various connections to steel sheet piles, steel pipes, H-piles, and diaphragm walls. A large amount of low alloy steel and medium carbon alloy quenched and tempered steel materials, such as 40Cr, 42CrMo4, 34CrNiMo6, 40Crnimo, ensure a shorter delivery time, and the forged parts from M56 to M200 for our product area. We can also perform drilling, pre-assembly, milling, turning, and welding work, including complete anchor and waling system.

All threads, including upset threads, are rolled and processed by us in our factory. Rolling processing causes additional work hardening on the surface, thereby improving the mechanical strength of the thread surface. For simple rolling threads, any length of thread is possible, and we can even provide fully threaded anchor rods. We guarantee high-quality threads and fast manufacturing. The nuts, connectors, and components required for matching round steel tie rods with rolled threads may not necessarily be the same as the rolled threads, as internal threads always experience lower stress than external threads. Therefore, combining the rolled external thread on the anchor with the machined internal thread in the nut and turnbuckle is not a problem.



Forged upset thread advantage:cross-sectional of thread> cross-sectional of shaft,the anchor is the weakest position in the whole anchor system

Unlike traditional forging, the process of heating and forging hot-rolled round steel into larger end sizes is a process of increasing the cross-sectional area of the parent metal, which allows the cross-sectional area of both ends of the round steel to increase, and then rolling or cutting threads onto the forged cylinder after increasing the cross-sectional area. The same process can also be used to form joint ends, such as eyes or hemispherical swivel ends. The advantage of forging end joints is to avoid welding, ensuring that the end joint and anchor rod spindle have the same quality and mechanical properties after heat treatment process. Circular threads on round steel can be directly processed by cutting or rolling, so that the smallest thread will appear in the threaded part of the steel bar. Forge the end of the round steel to produce a larger diameter on the threaded part, and the minimum tensile area is now on the anchor shaft, which can achieve the goal of saving materials and reducing engineering costs.

To ensure the safety of the anchor, we have established a complete laboratory for testing performance, including chemical analysis testers, universal tensile testing machines, impact testing machines and cooling equipment up to -60 degrees, ultrasonic flaw detectors, and magnetic particle flaw detectors.

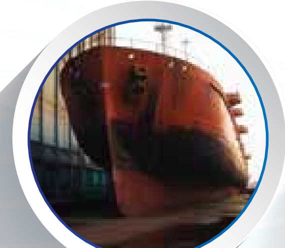
We have also developed a thousand ton level horizontal tensile testing machine, with a test length exceeding 10 meters, for conducting full-scale anchor breaking tests, including all connecting components, so that the strength of the connecting components can be verified simultaneously.

MACALLOY ANCHORS

OVERVIEW OF STEEL GRADES

Macalloy offers 4 standard steel grades for anchors:

SteelGrade (Mpa)	Diameter (mm)	Fy (Mpa)	Fua (Mpa)	Impact (J at 0°C)	Elogation (%)
355	D40-D200	355	510	27	18
460	D40-D200	460	610	27	17
500	D40-D200	500	660	27	17
700	D40-D200	700	900	27	15



1 / GRADE 355

- Mechanical properties: 355/510
- Classic quality structural steel proved over many years which has good plasticity、impact performance and good elongation，regulated in GB/T 1591-2018 or DIN EN 10025-1
- Designed to EN 1993-5 with factors 1.0/1.25
- length of forged end anchors available in 12 metres

2 / GRADE 460

- Mechanical properties: 460/610
- Classic QT steel regulated in GB/T 3077-2015 or DIN EN 10083-1
- Designed to EN 1993-5 with factors 1.0/1.25
- length of forged end anchors available in 12 metres

3 / GRADE 500

- Mechanical properties: 500/660
- Classic QT steel regulated in GB/T 3077-2015 or DIN EN 10083-1
- Designed to EN 1993-5 with factors 1.0/1.25
- length of forged end anchors available in 12 metres

4 / GRADE 700

- Mechanical properties: 700/900
- Classic QT steel regulated in GB/T 3077-2015 or DIN EN 10083-1
- Designed to EN 1993-5 with factors 1.0/1.25
- length of forged end anchors available in 12 metres

The choice of strength grade for steel tie rods depends on many factors, including the distance between the main wall and the anchored wall, the spacing setting of the tie rods, elongation requirements, and impact requirements at different temperatures. It is obvious that high-strength steel always produces the lightest weight anchor and the lowest cost. However, this may not be suitable for design requirements such as elongation, impact requirements, on-site welding, or delivery times.

Based on the required diameter and length, we will flexibly choose high-strength low alloy steel or quenched and tempered steel for manufacturing according to specific strength grades. All steel is produced by continuous casting method with fine grain steel and rolled according to traditional methods. The advantage of continuous casting is that the material properties of the entire anchor rod section are uniform.

We do not use any temptation core steel because it often retains a soft core, especially for larger diameter hot-rolled round steel. Regardless of the choice, the minimum performance required for the project will be met. All pull rods and components are manufactured according to a quality system certified by ISO 9001.

TENSILE RESISTANCE OF TIE BARS
According to DIN EN 1993-5, the calculation format for the ultimate limit state of anchors is:

$$F_{t,Rd} = \min F_{tt,Rd} \text{ vs } F_{tg,Rd}$$

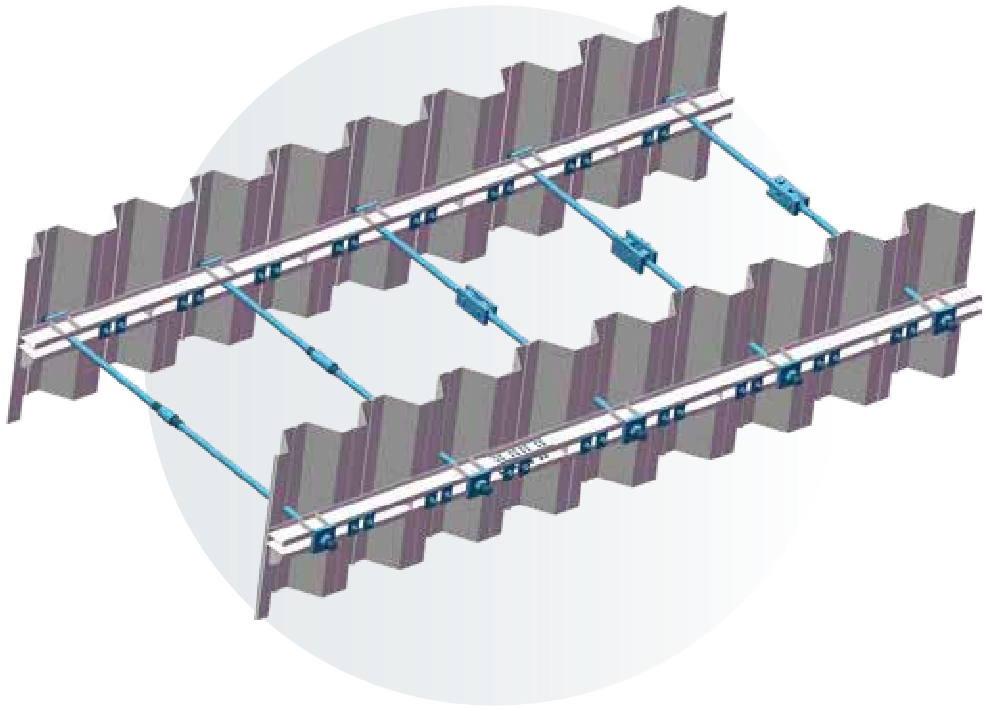
$$F_{tt,Rd} = k_t * F_{ua} * A_s / \gamma_{M2}$$

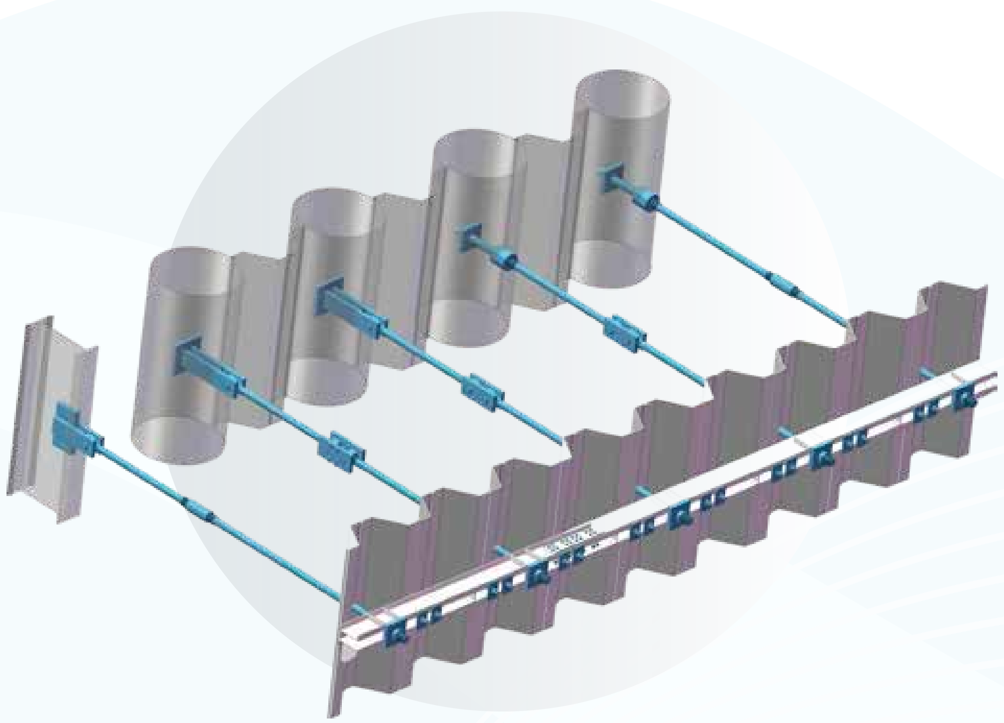
$$F_{tg,Rd} = A_g * F_y / \gamma_{M0}$$

- $F_{t,Rd}$ = Design tensile resistance of anchor
- $F_{tt,Rd}$ = Design tensile resistance of anchor thread
- $F_{tg,Rd}$ = Design tensile resistance of anchor shaft
- K_t = Notch factor
- F_{ua} = Tensile strength of anchor
- F_y = Yield stress of anchor
- A_s = Stressed cross-sectional area, thread
- A_g = Gross cross-sectional area, shaft
- γ_{M2} = Partial safety factor for anchor shaft stressed up to failure
- γ_{M0} = Partial safety factor for anchor shaft

NOTED γ_{M0} & γ_{M2} = partial factors according to EN1993-5 typically 1.0 & 1.25 respectively

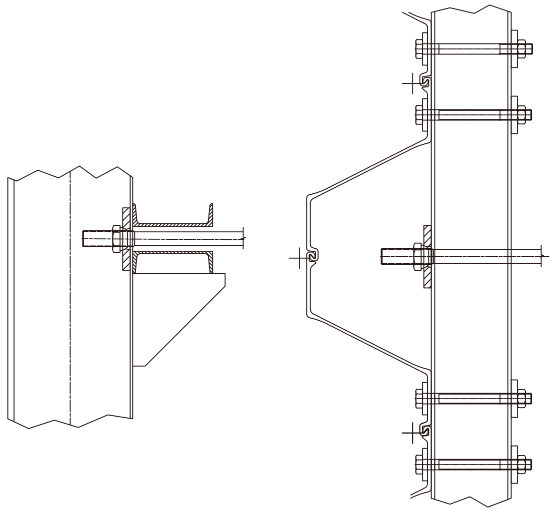
MACALLOY
COMMON STRUCTURES OF PULL RODS

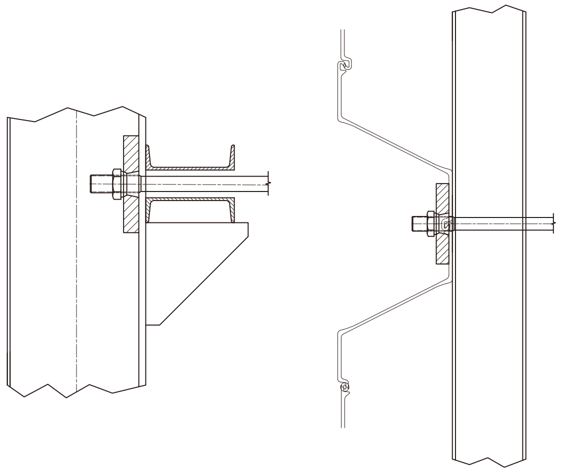




TYPICAL CONNECTION BETWEEN ANCHOR AND Z-PILE SHEET PILE

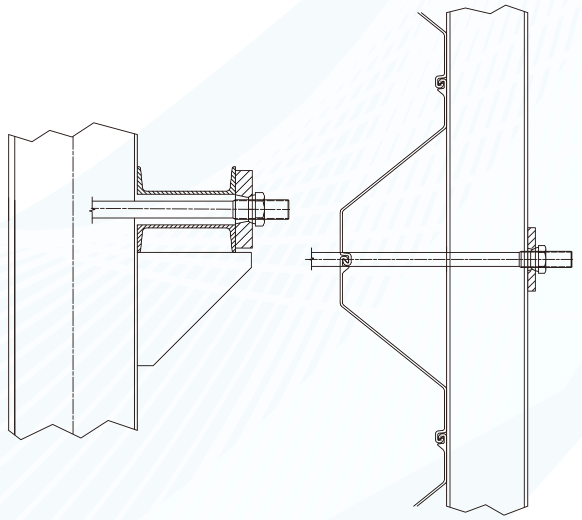
The connection method between the anchor and the main wall, which is always strongly recommended, has obvious advantages. Anchoring behind the wall can greatly reduce the corrosion rate. The load on sheet piles is transferred to the wall through wall bolts, and then to the anchor through bearing plates and spherical nuts.



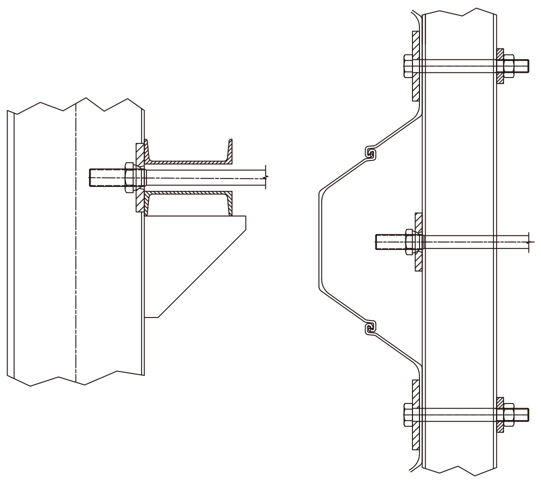


The connection method between the anchor and the main wall is not recommended. The load on the sheet pile is directly transferred to the anchor rod. The advantage is obvious, which can save waling bolts, but the disadvantage is that the threaded end of the anchor is placed in front of the wall, facing a severe corrosive environment and increasing the corrosion rate.

Recommended connection method for anchor walls. The anchor force is directly transmitted to the anchor wall through waling. Generally, it is not necessary to install waling bolts.

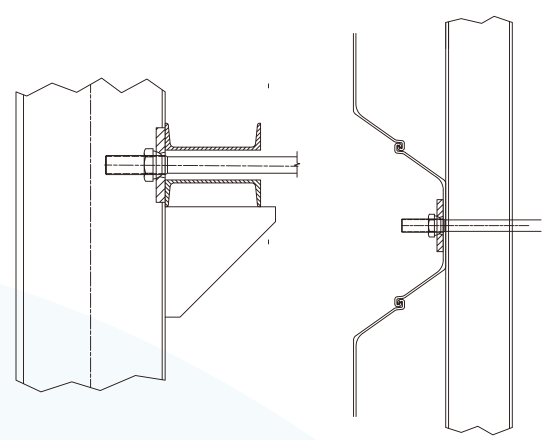


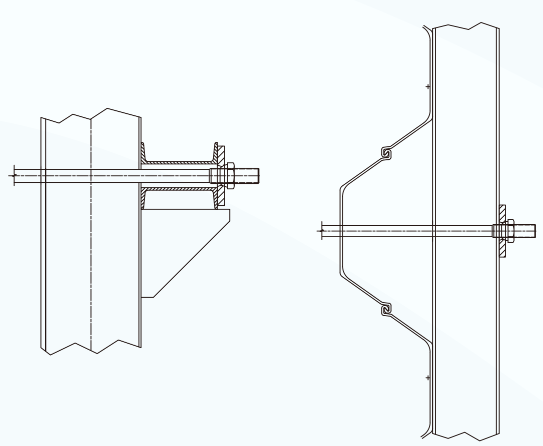
TYPICAL CONNECTION BETWEEN ANCHOR AND U-PILE SHEET PILE



The connection method between the anchor and the main wall, which is always strongly recommended, has obvious advantages.
Anchoring behind the wall can greatly reduce the corrosion rate. The load on sheet piles is transferred to the wall through wall bolts, and then to the anchor through bearing plates and spherical nuts.

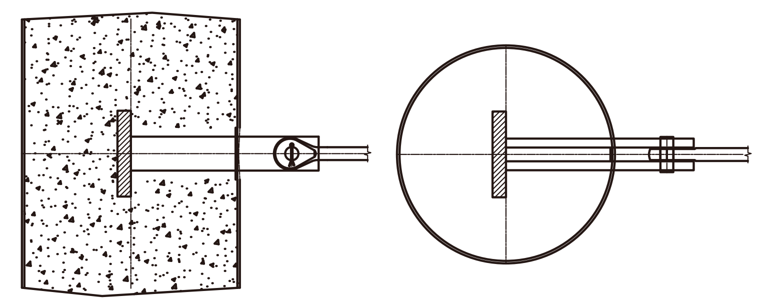
The connection method between the anchor and the main wall is not recommended. The load on the sheet pile is directly transferred to the anchor rod. The advantage is obvious, which can save waling bolts, but the disadvantage is that the threaded end of the anchor is placed in front of the wall, facing a severe corrosive environment and increasing the corrosion rate.



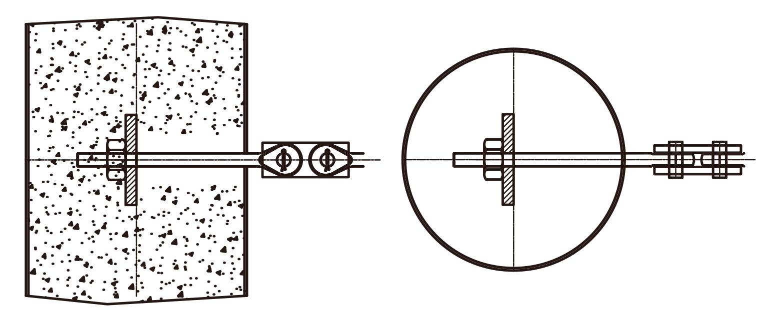


Recommended connection method for anchor walls. The anchor force is directly transmitted to the anchor wall through waling.Generally, it is not necessary to install waling bolts.

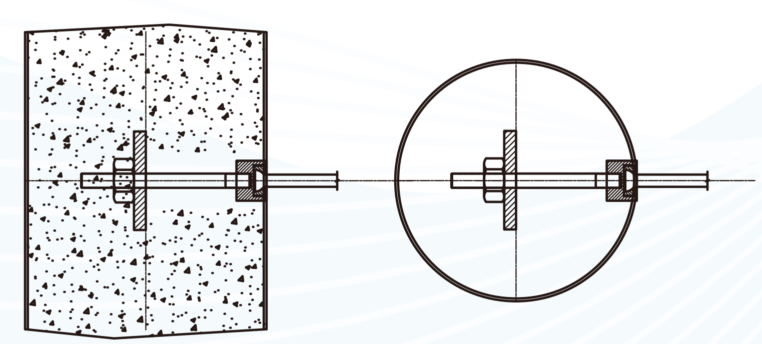
DOUBLE T-PLATE CONNECTION BETWEEN ANCHOR AND STEEL PILE PIPE



Strongly recommended connection method. A double T-plate is cast into the tube, transmitting force to the center of the tube. The forged eye anchor rod is connected to the T-connector through a pin, allowing for vertical movement.

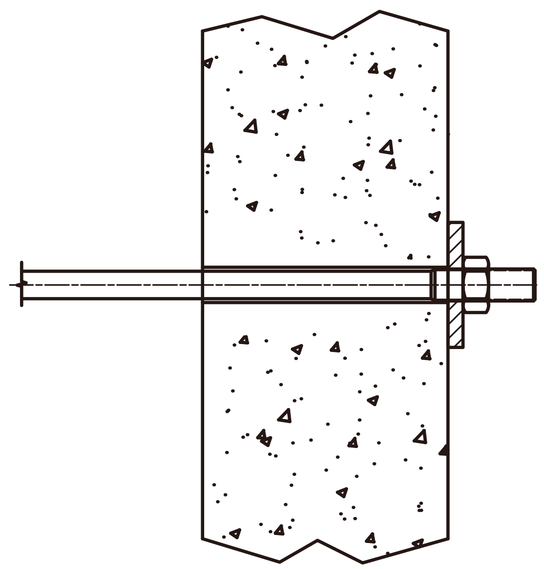


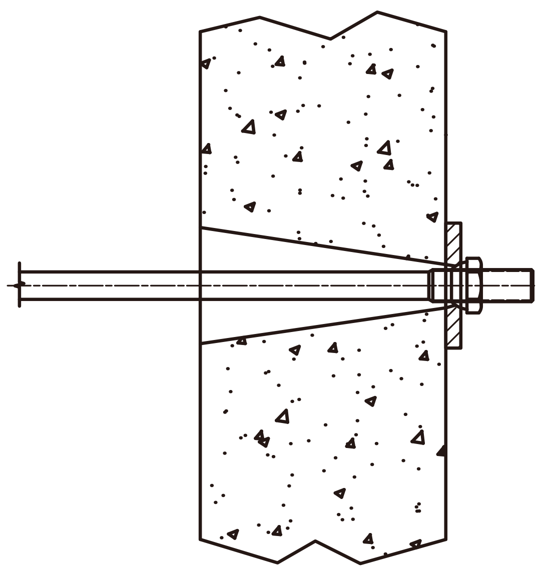
A shorter eye rod is cast into the pipe, connecting the nut and anchor plate, transmitting force to the center of the pipe, and connecting the entire set of anchors through vertical hinges, allowing for vertical movement.



A shorter threaded rod and spherical universal joint are cast into the pipe, and force is transmitted to the center of the pipe through nuts and anchor plates. An anchor rod with a forged spherical end is connected to the universal joint, allowing for movement in any direction.

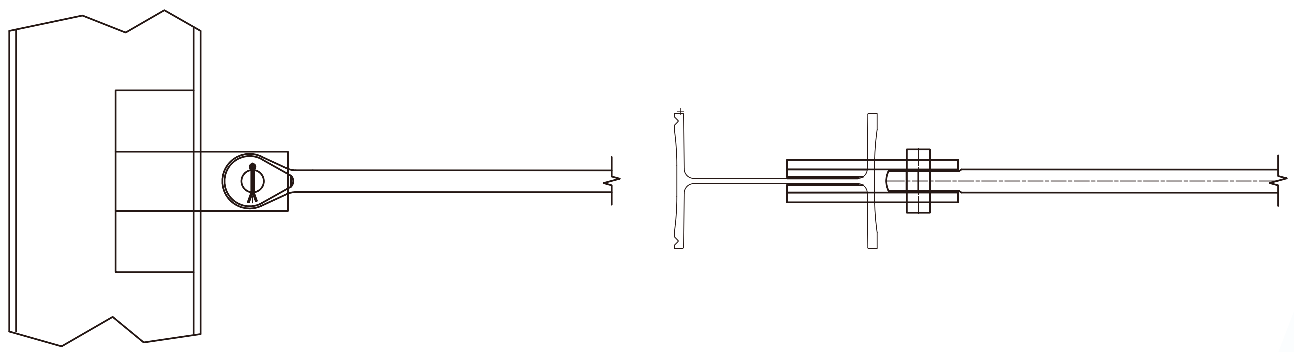
TYPICAL CONNECTION BETWEEN ANCHOR AND CONCRETE WALL



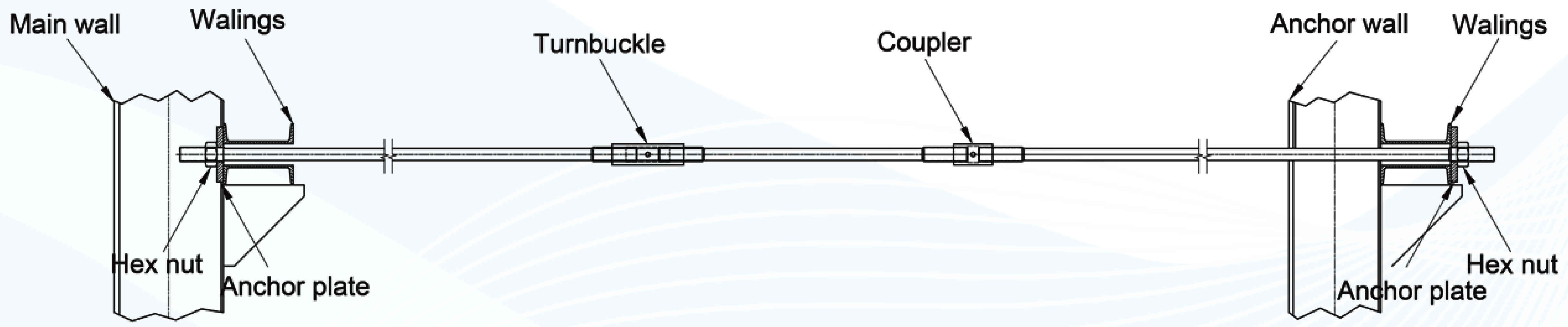


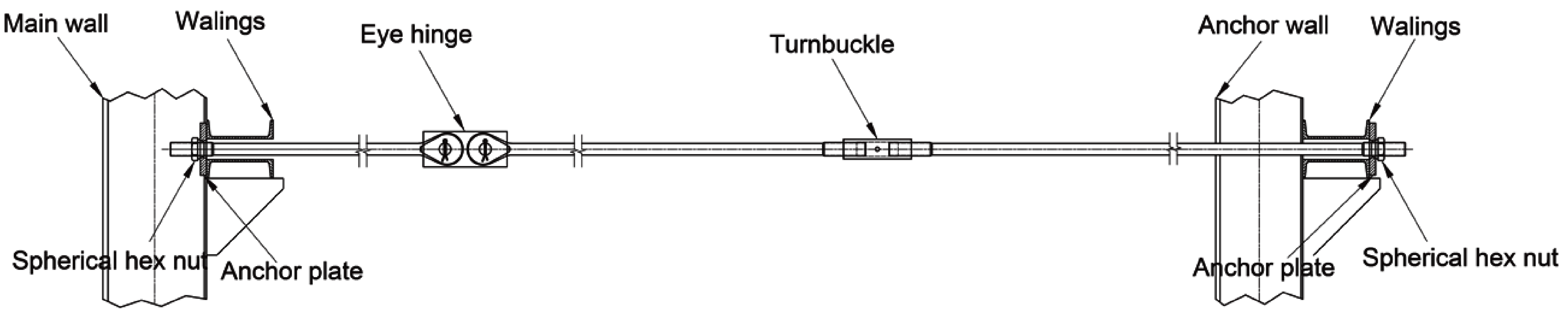
T-PLATE CONNECTION BETWEEN ANCHOR AND HZ-M-PILE

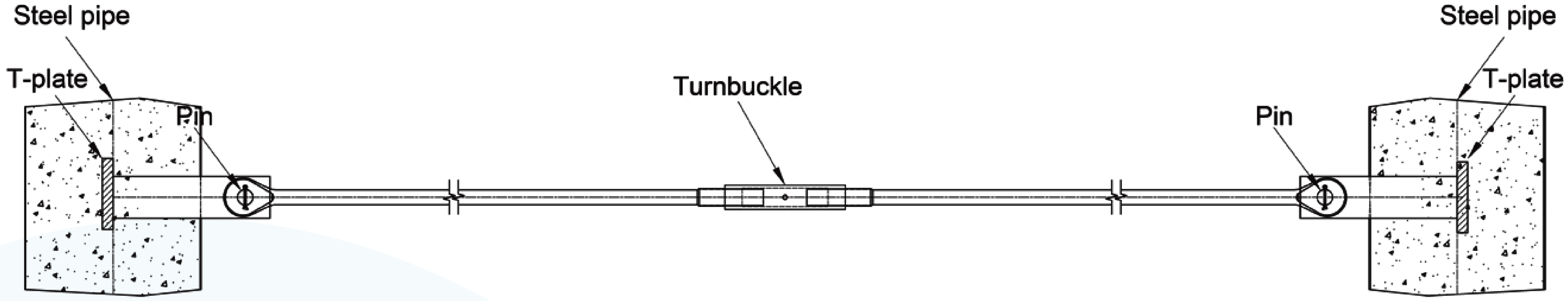
Two T-plates are welded on both sides of HZ-M and pass through the holes on the flange. The eye anchor rod is connected to the T-plate through a pin to transmit force. Eye anchors allow for vertical movement.

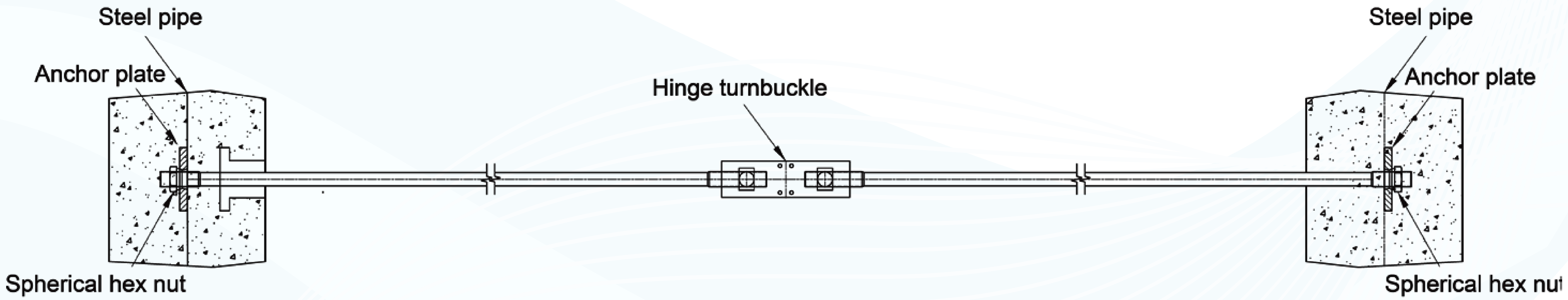


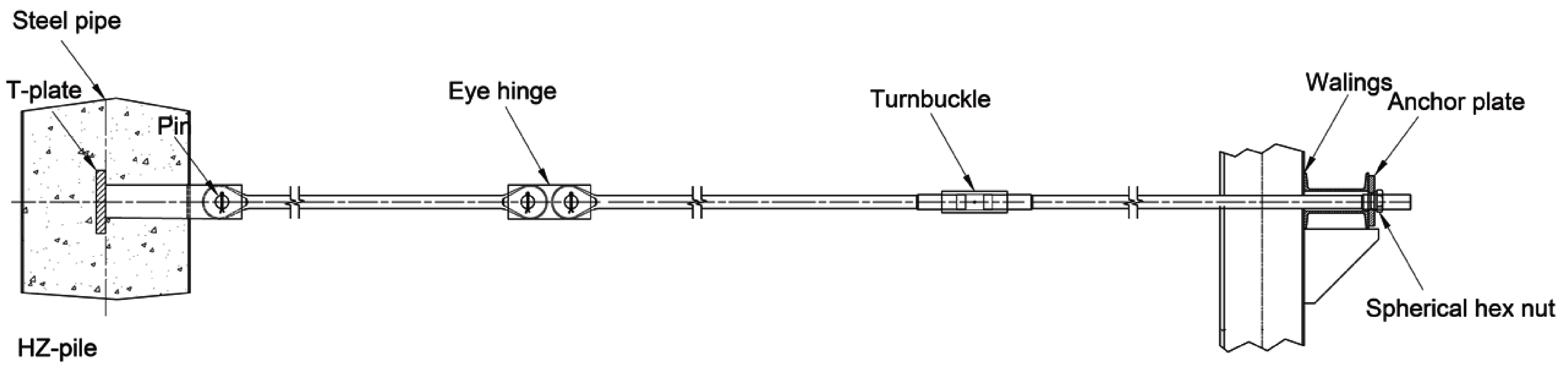
TYPICAL COMPLETE SYSTEM OF ANCHORS AND WALLS

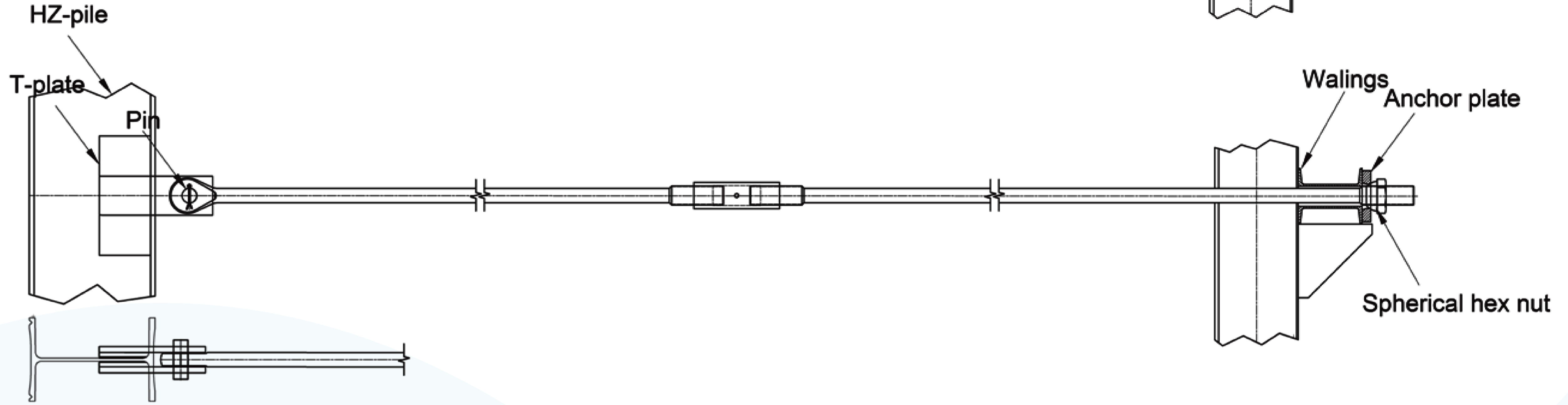



Main wall
Walings
Eye hinge
Turnbuckle
Anchor wall
Walings
Spherical hex nut
Anchor plate
Anchor plate
Spherical hex nut

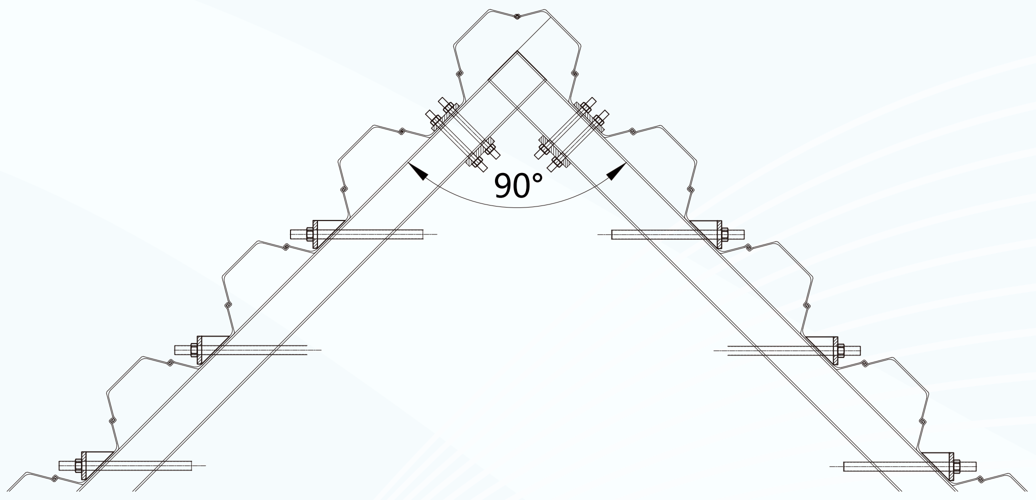

Steel pipe
T-plate
Pin
Turnbuckle
Steel pipe
T-plate
Pin

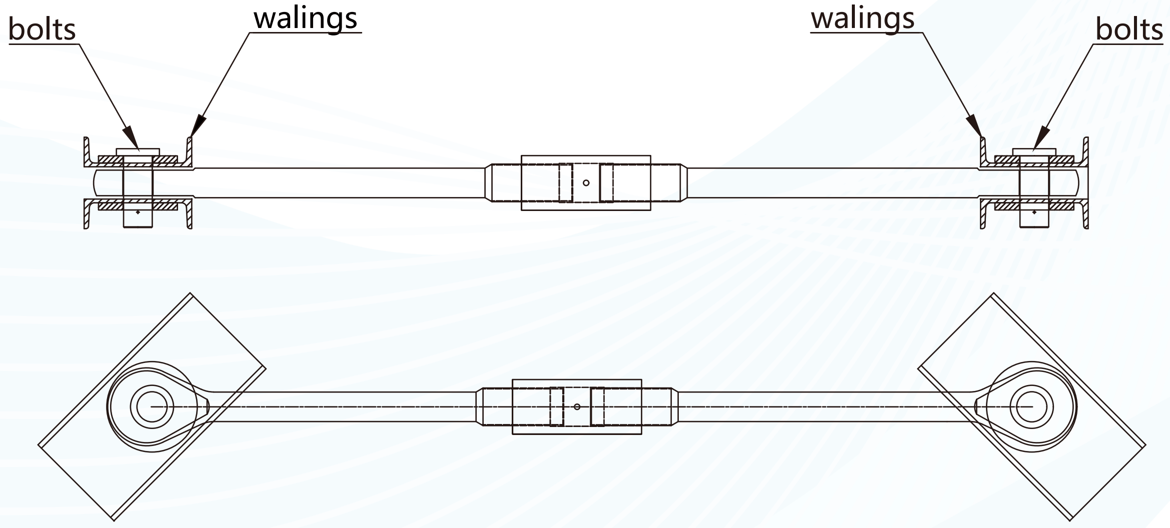

Steel pipe
Anchor plate
Hinge turnbuckle
Steel pipe
Anchor plate
Spherical hex nut
Spherical hex nut





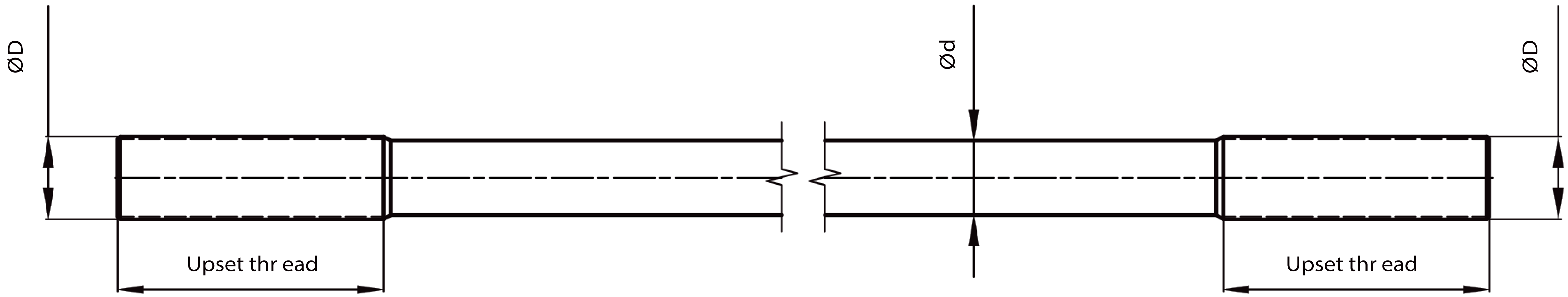
TYPICAL CONNECTION BETWEEN ANCHORS、WALINGS AND SHEET PILE IN CORNER





THE DESIGN RESISTANCES ANCHORS WITH UPSET AND ROLLED THREADS ROUND STEEL TIE RODS TO DIN EN 1993-5

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Stressed area, thread	As	mm²	976	1121	1306	1473	1758	2030	2362	2676	3005	3460	3889	4344	4948	5591	6273	6995	7755	8556	9395	10274	11191	12149	13145	14181	15256	16370	17524	18716



S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	30	32	36	36	38	40	45	50	50	55	55	60	65	70	72	75	80	85	90	90	95	100	105	110	115	115	120	125
Area, shaft	A_g	mm²	707	804	1018	1018	1134	1257	1590	1963	1963	2376	2376	2827	3318	3848	4071	4418	5026	5674	6362	6362	7088	7854	8659	9503	10387	10387	11309	12271
Shaft yield capacity	F_y	KN	251	285	361	361	403	446	565	697	697	843	843	1004	1178	1366	1445	1568	1784	2014	2258	2258	2516	2788	3074	3374	3687	3687	4015	4356
Shaft ultimate capacity	F_{ua}	KN	360	410	519	519	578	641	811	1001	1001	1212	1212	1442	1692	1963	2076	2253	2563	2894	3244	3244	3615	4005	4416	4847	5297	5297	5768	6258
Design resistance, shaft	$F_{tg,Rd}$	KN	251	285	361	361	403	446	565	697	697	843	843	1004	1178	1366	1445	1568	1784	2014	2258	2258	2516	2788	3074	3374	3687	3687	4015	4356
Design resistance, thread	$F_{tt,Rd}$	KN	239	274	320	361	430	497	578	655	736	847	952	1063	1211	1369	1536	1712	1898	2095	2300	2515	2740	2974	3218	3472	3735	4007	4290	4582
Design tensile resistance	$F_{t,Rd}$	KN	239	274	320	361	403	446	565	655	697	843	843	1004	1178	1366	1445	1568	1784	2014	2258	2258	2516	2788	3074	3374	3687	3687	4015	4356

S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	36	38	40	42	45	48	50	55	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
Area, shaft	A_g	mm²	1018	1134	1257	1385	1590	1810	1963	2376	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671
Shaft yield capacity	F_y	KN	361	403	446	492	565	642	697	843	1004	1178	1289	1445	1568	1784	2014	2258	2516	2788	3074	3374	3687	4015	4356	4712	5081	5465	5862	6273
Shaft ultimate capacity	F_{ua}	KN	519	578	641	707	811	923	1001	1212	1442	1692	1852	2076	2253	2563	2894	3244	3615	4005	4416	4847	5297	5768	6258	6769	7300	7851	8421	9012
Design resistance, shaft	$F_{tg,Rd}$	KN	361	403	446	492	565	642	697	843	1004	1178	1289	1445	1568	1784	2014	2258	2516	2788	3074	3374	3687	4015	4357	4712	5081	5465	5862	6273
Design resistance, thread	$F_{tt,Rd}$	KN	358	412	480	541	646	745	867	983	1103	1271	1428	1595	1817	2053	2303	2569	2848	3142	3450	3773	4109	4461	4827	5207	5602	6011	6435	6873
Design tensile resistance	$F_{t,Rd}$	KN	358	403	446	492	565	642	697	843	1004	1178	1289	1445	1568	1784	2014	2258	2516	2788	3074	3374	3687	4015	4357	4712	5081	5465	5862	6273

S460 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN QT STEEL

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	30	32	36	36	38	40	45	50	50	55	55	60	65	70	72	75	80	85	90	90	95	100	105	110	115	115	120	125
Area, shaft	A_g	mm²	707	804	1018	1018	1134	1257	1590	1963	1963	2376	2376	2827	3318	3848	4071	4418	5026	5674	6362	6362	7088	7854	8659	9503	10387	10387	11309	12271
Shaft yield capacity	F_y	KN	325	370	468	468	522	578	732	903	903	1093	1093	1301	1526	1770	1873	2032	2312	2610	2926	2926	3260	3613	3983	4371	4778	4778	5202	5645
Shaft ultimate capacity	F_{ua}	KN	431	491	621	621	692	767	970	1198	1198	1449	1449	1725	2024	2347	2484	2695	3066	3461	3881	3881	4324	4791	5282	5797	6336	6336	6899	7486
Design resistance, shaft	$F_{tg,Rd}$	KN	325	370	468	468	522	578	732	903	903	1093	1093	1301	1526	1770	1873	2032	2312	2610	2926	2926	3260	3613	3983	4371	4778	4778	5202	5645
Design resistance, thread	$F_{tt,Rd}$	KN	286	328	382	431	515	594	692	784	880	1013	1139	1272	1449	1637	1837	2048	2271	2505	2751	3008	3277	3557	3849	4152	4467	4793	5131	5480
Design tensile resistance	$F_{t,Rd}$	KN	286	328	382	431	515	578	692	784	880	1013	1093	1272	1449	1637	1837	2032	2271	2505	2751	2926	3260	3983	3849	4152	4467	4778	5131	5480

S460 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN QT STEEL

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	36	38	40	42	45	48	50	55	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
Area, shaft	A_g	mm²	1018	1134	1257	1385	1590	1810	1963	2376	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671
Shaft yield capacity	F_y	KN	468	522	578	637	732	832	903	1093	1301	1526	1671	1873	2032	2312	2610	2926	3260	3613	3983	4371	4778	5202	5645	6106	6584	7081	7596	8129
Shaft ultimate capacity	F_{ua}	KN	621	692	767	845	970	1104	1198	1449	1725	2024	2215	2484	2695	3066	3461	3881	4324	4791	5282	5797	6336	6899	7486	8096	8731	9390	10073	10779
Design resistance, shaft	$F_{tg,Rd}$	KN	468	522	578	637	732	832	903	1093	1301	1526	1671	1873	2032	2312	2610	2926	3260	3613	3983	4371	4778	5202	5645	6106	6584	7081	7596	8129
Design resistance, thread	$F_{tt,Rd}$	KN	429	492	574	647	772	892	1037	1175	1320	1520	1708	1908	2173	2456	2755	3072	3406	3758	4126	4512	4915	5336	5773	6228	6700	7190	7697	8220
Design tensile resistance	$F_{t,Rd}$	KN	429	492	574	637	732	832	903	1093	1301	1520	1671	1873	2032	2312	2610	2926	3260	3613	3983	4371	4778	5202	5645	6106	6584	7081	7596	8129

S500 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN QT STEEL

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	30	32	36	36	38	40	45	50	50	55	55	60	65	70	72	75	80	85	90	90	95	100	105	110	115	115	120	125
Area, shaft	A_g	mm²	707	804	1018	1018	1134	1257	1590	1963	1963	2376	2376	2827	3318	3848	4071	4418	5026	5674	6362	6362	7088	7854	8659	9503	10387	10387	11309	12271
Shaft yield capacity	F_y	KN	353	402	509	509	567	628	795	982	982	1188	1188	1414	1659	1924	2036	2209	2513	2837	3181	3181	3544	3927	4329	4752	5193	5193	5655	6136
Shaft ultimate capacity	F_{ua}	KN	467	531	672	672	748	829	1050	1296	1296	1568	1568	1866	2190	2540	2687	2916	3317	3745	4199	4199	4678	5183	5715	6272	6855	6855	7464	8099
Design resistance, shaft	$F_{tg,Rd}$	KN	353	402	509	509	567	628	795	982	982	1188	1188	1414	1659	1924	2036	2209	2513	2837	3181	3181	3544	3927	4329	4752	5193	5193	5655	6136
Design resistance, thread	$F_{tt,Rd}$	KN	309	355	414	467	557	643	748	848	952	1096	1232	1376	1568	1771	1987	2216	2457	2711	2976	3255	3545	3849	4164	4493	4833	5186	5552	5929
Design tensile resistance	$F_{t,Rd}$	KN	309	355	414	467	557	628	748	848	952	1096	1188	1376	1568	1771	1987	2209	2457	2711	2976	3181	3544	3849	4164	4493	4833	5186	5552	5929

S500 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN QT STEEL

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	36	38	40	42	45	48	50	55	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
Area, shaft	A_g	mm²	1018	1134	1257	1385	1590	1810	1963	2376	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671
Shaft yield capacity	F_y	KN	509	567	628	693	795	905	982	1188	1414	1659	1816	2036	2209	2513	2837	3181	3544	3927	4329	4752	5193	5655	6136	6636	7157	7697	8256	8835
Shaft ultimate capacity	F_{ua}	KN	672	748	829	914	1050	1194	1296	1568	1866	2190	2397	2687	2916	3317	3745	4199	4678	5183	5715	6272	6855	7464	8099	8760	9447	10160	10898	11663
Design resistance, shaft	$F_{tg,Rd}$	KN	509	567	628	693	795	905	982	1188	1414	1659	1816	2036	2209	2513	2837	3181	3544	3927	4329	4752	5193	5655	6136	6636	7157	7697	8256	8835
Design resistance, thread	$F_{tt,Rd}$	KN	464	533	621	700	835	965	1122	1272	1428	1644	1848	2064	2351	2657	2981	3324	3685	4066	4465	4882	5318	5773	6247	6739	7250	7779	8327	8894
Design tensile resistance	$F_{t,Rd}$	KN	464	533	621	693	795	905	982	1188	1414	1644	1816	2036	2209	2513	2837	3181	3544	3927	4329	4752	5193	5655	6136	6636	7157	7697	8257	8835

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN QT STEEL

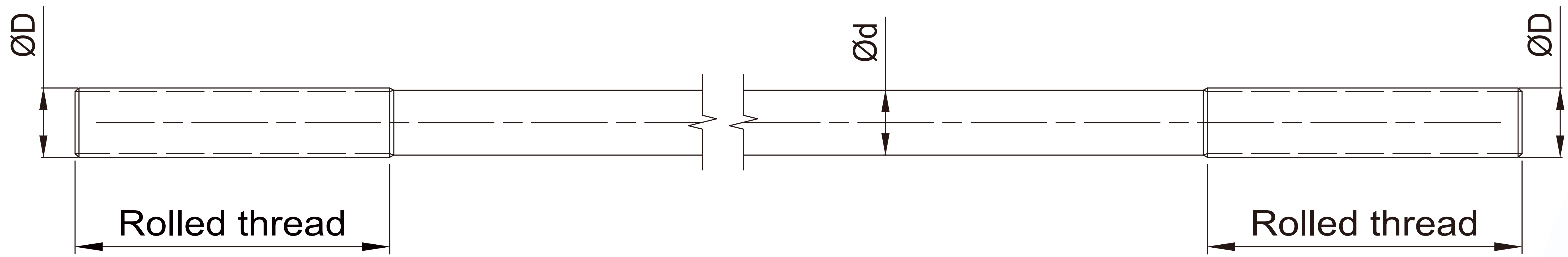
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	30	32	36	36	38	40	45	50	50	55	55	60	65	70	72	75	80	85	90	90	95	100	105	110	115	115	120	125
Area, shaft	A_g	mm²	707	804	1018	1018	1134	1257	1590	1963	1963	2376	2376	2827	3318	3848	4071	4418	5026	5674	6362	6362	7088	7854	8659	9503	10387	10387	11309	12271
Shaft yield capacity	F_y	KN	495	563	712	712	794	880	1113	1374	1374	1663	1663	1979	2323	2694	2850	3092	3518	3972	4453	4453	4962	5498	6061	6652	7271	7271	7917	8590
Shaft ultimate capacity	F_{ua}	KN	636	724	916	916	1021	1131	1431	1767	1767	2138	2138	2545	2986	3464	3664	3976	4524	5107	5725	5725	6379	7068	7793	8553	9348	9348	10178	11044
Design resistance, shaft	$F_{tg,Rd}$	KN	495	563	712	712	794	880	1113	1374	1374	1663	1663	1979	2323	2694	2850	3092	3518	3972	4453	4453	4962	5498	6061	6652	7271	7271	7917	8590
Design resistance, thread	$F_{tt,Rd}$	KN	422	484	564	636	759	877	1020	1156	1298	1495	1680	1877	2138	2415	2710	3022	3350	3696	4059	4438	4835	5248	5679	6126	6591	7072	7570	8085
Design tensile resistance	$F_{t,Rd}$	KN	422	484	564	636	759	877	1020	1156	1298	1495	1663	1877	2138	2415	2710	3022	3350	3696	4059	4438	4835	5248	5679	6126	6591	7072	7570	8085

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN QT STEEL

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Shaft diameter	Ød	mm	36	38	40	42	45	48	50	55	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
Area, shaft	A_g	mm²	1018	1134	1257	1385	1590	1810	1963	2376	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671
Shaft yield capacity	F_y	KN	712	794	880	970	1113	1267	1374	1663	1979	2323	2542	2850	3092	3518	3972	4453	4962	5498	6061	6652	7271	7917	8590	9291	10019	10775	11559	12370
Shaft ultimate capacity	F_y	KN	916	1021	1131	1247	1431	1629	1767	2138	2545	2986	3268	3664	3976	4524	5107	5725	6379	7068	7793	8553	9348	10178	11044	11946	12882	13854	14861	15904
Design resistance, shaft	$F_{tg,Rd}$	KN	712	794	880	970	1113	1267	1374	1663	1979	2323	2542	2850	3092	3518	3972	4453	4962	5498	6061	6652	7271	7917	8590	9291	10019	10775	11559	12370
Design resistance, thread	$F_{tt,Rd}$	KN	632	726	846	955	1139	1315	1531	1734	1947	2242	2520	2815	3206	3623	4065	4533	5025	5544	6088	6658	7252	7873	8518	9189	9886	10608	11356	12128
Design tensile resistance	$F_{t,Rd}$	KN	632	726	846	955	1113	1267	1374	1663	1947	2242	2520	2815	3092	3518	3972	4453	4962	5498	6061	6652	7252	7873	8518	9189	9886	10608	11356	12128

THE DESIGN RESISTANCES ANCHORS WITH ROLLED THREADS ROUND STEEL TIE RODS TO DIN EN 1993-5

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M78	M83	M88	M93	M98	M103	M108	M113	M118	M123	M128	M133	M138	M143	M148	M153	M158
Stressed area, thread	As	mm²	976	1121	1306	1473	1758	2030	2362	2676	3005	3460	3889	4114	4702	5329	5995	6701	7446	8231	9054	9917	10820	11761	12742	13762	14821	15920	17057	18235



S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M78	M83	M88	M93	M98	M103	M108	M113	M118	M123	M128	M133	M138	M143	M148	M153	M158
Shaft diameter	Ød	mm	36	40	42	45	50	52	56	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
Area, shaft	A_g	mm²	1018	1257	1385	1590	1963	2124	2463	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671	18869
Design resistance, shaft	$F_{tg,Rd}$	KN	361	446	492	565	697	754	874	1004	1178	1289	1445	1568	1784	2014	2258	2516	2788	3074	3374	3687	4015	4356	4712	5081	5465	5862	6273	6698
Design resistance, thread	$F_{tt,Rd}$	KN	358	412	480	541	646	745	867	983	1103	1271	1428	1511	1727	1957	2201	2461	2734	3022	3325	3642	3973	4319	4679	5053	5442	5846	6263	6696
Design tensile resistance	$F_{t,Rd}$	KN	358	412	480	541	646	745	867	983	1103	1271	1428	1511	1727	1957	2201	2461	2734	3022	3325	3642	3973	4319	4679	5053	5442	5846	6263	6696

S460 ANCHORS TO DIN EN 1993-5 WITH KT=0.9

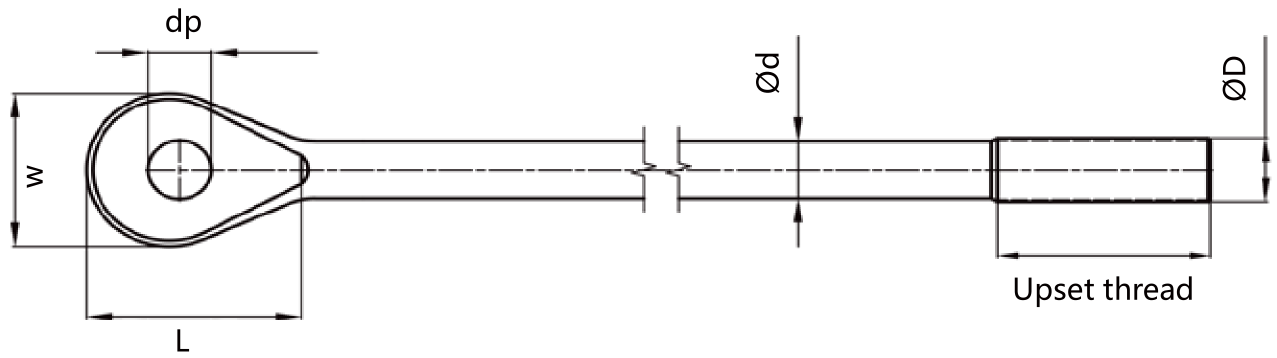
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M78	M83	M88	M93	M98	M103	M108	M113	M118	M123	M128	M133	M138	M143	M148	M153	M158
Shaft diameter	Ød	mm	36	40	42	45	50	52	56	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
Area, shaft	A_g	mm^2	1018	1257	1385	1590	1963	2124	2463	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671	18869
Design resistance, shaft	$F_{tg,Rd}$	KN	468	578	637	732	903	977	1133	1301	1526	1671	1873	2032	2312	2610	2926	3260	3613	3983	4371	4778	5202	5645	6106	6584	7081	7596	8129	8680
Design resistance, thread	$F_{tt,Rd}$	KN	429	492	574	647	772	892	1037	1175	1320	1520	1708	1807	2065	2340	2633	2943	3270	3615	3977	4356	4752	5165	5596	6044	6509	6992	7491	8009
Design tensile resistance	$F_{t,Rd}$	KN	429	492	574	647	772	892	1037	1175	1320	1520	1708	1807	2065	2340	2633	2943	3270	3615	3977	4356	4752	5165	5596	6044	6509	6992	7491	8009

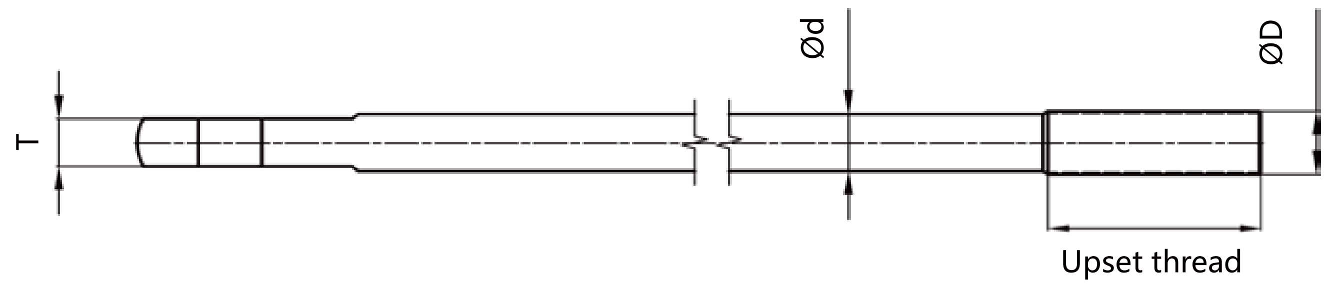
S500 ANCHORS TO DIN EN 1993-5 WITH KT=0.9

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M78	M83	M88	M93	M98	M103	M108	M113	M118	M123	M128	M133	M138	M143	M148	M153	M158
Shaft diameter	Ød	mm	36	40	42	45	50	52	56	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
Area, shaft	A_g	mm^2	1018	1257	1385	1590	1963	2124	2463	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671	18869
Design resistance, shaft	$F_{tg,Rd}$	KN	509	628	693	795	982	1062	1231	1414	1659	1816	2036	2209	2513	2837	3181	3544	3927	4329	4752	5193	5655	6136	6636	7157	7697	8256	8835	9434
Design resistance, thread	$F_{tt,Rd}$	KN	464	533	621	700	835	965	1122	1272	1428	1644	1848	1955	2234	2532	2849	3184	3538	3911	4302	4713	5142	5589	6055	6540	7043	7565	8105	8665
Design tensile resistance	$F_{t,Rd}$	KN	464	533	621	700	835	965	1122	1272	1428	1644	1848	1955	2234	2532	2849	3184	3538	3911	4302	4713	5142	5589	6055	6540	7043	7565	8105	8665

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M78	M83	M88	M93	M98	M103	M108	M113	M118	M123	M128	M133	M138	M143	M148	M153	M158
Shaft diameter	Ød	mm	36	40	42	45	50	52	56	60	65	68	72	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
Area, shaft	A_g	mm^2	1018	1257	1385	1590	1963	2124	2463	2827	3318	3632	4071	4418	5026	5674	6362	7088	7854	8659	9503	10387	11309	12271	13273	14313	15393	16513	17671	18869
Design resistance, shaft	$F_{tg,Rd}$	KN	712	880	970	1113	1374	1487	1724	1979	2323	2542	2850	3092	3518	3972	4453	4962	5498	6061	6652	7271	7917	8590	9291	10019	10775	11559	12370	13208
Design resistance, thread	$F_{tt,Rd}$	KN	632	726	846	955	1139	1315	1531	1734	1947	2242	2520	2666	3047	3453	3885	4342	4825	5334	5867	6426	7011	7621	8257	8918	9604	10316	11053	11816
Design tensile resistance	$F_{t,Rd}$	KN	632	726	846	955	1139	1315	1531	1734	1947	2242	2520	2666	3047	3453	3885	4342	4825	5334	5867	6426	7011	7621	8257	8918	9604	10316	11053	11816

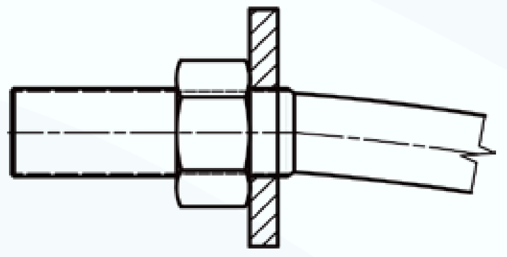




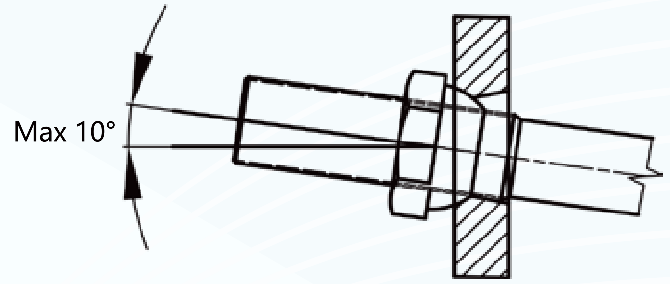
S355 TO S700 ANCHORS TO DIN EN 1993-5 WITH KT 0.6

Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Eye thickness	**T**	mm	35	40	42	42	45	50	56	60	60	62	65	70	75	75	80	85	90	95	95	100	105	110
Eye length	**L**	mm	120	135	160	170	200	205	215	225	225	225	250	260	290	310	330	340	360	370	380	410	440	460
Eye width	**W**	mm	95	110	125	130	155	155	166	180	180	180	190	210	230	240	255	270	275	290	300	310	330	340
Pin diameter	**dp**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

It should be noted that the thread capacity of the anchor reduces the coefficient kt factor. According to EN1993-5, this is to take into account the additional stresses that may be introduced under non ideal conditions due to the self weight of the anchor, backfill, or settlement caused by installation.

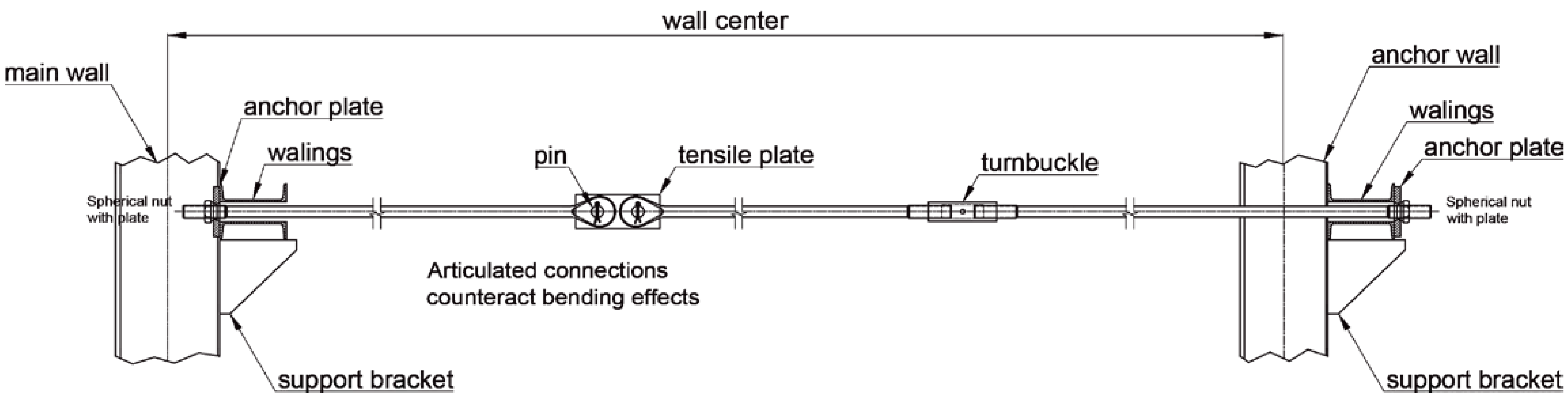


Bending stress loss installation and self weight



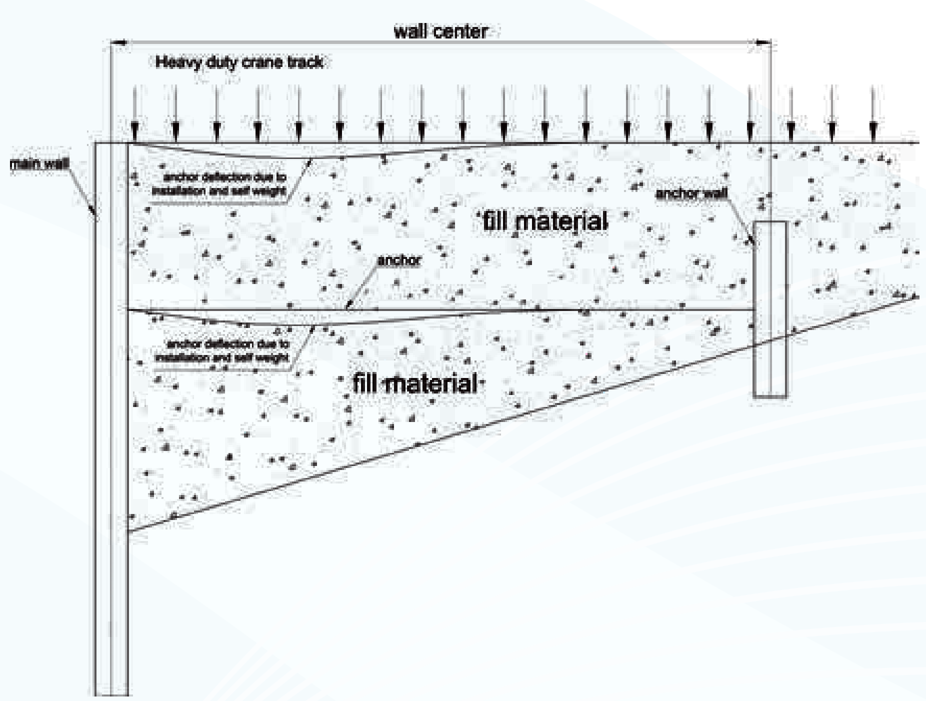
Spherical nut with plate counteract bending effects

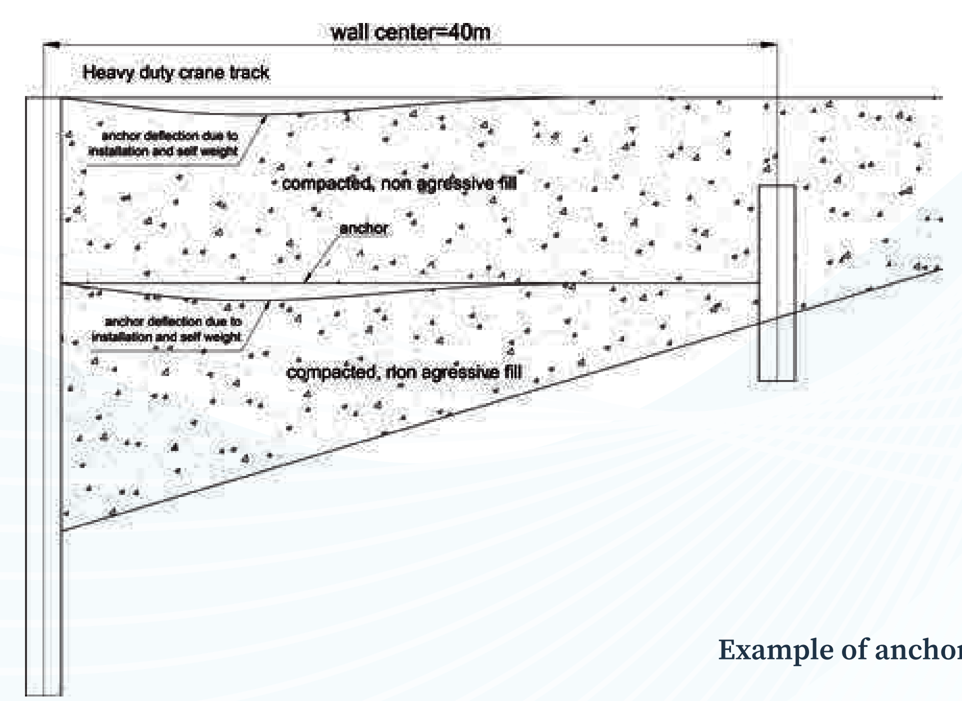
According to many EN1993-5 country attachments, when 0.9 can be used, a conservative kt factor of 0.6 should be used unless any possible bending is eliminated. Whether using plastic pipes or other methods, completely eliminating bending is difficult, and anchor alignment, especially diaphragm walls, is also difficult to accurately predict settlement. Therefore, we suggest combining the kt factor of 0.6 with hinged connections, which may also be beneficial for corrosion resistance. Our anchor system allows for thread size increase through forging, which only adds a small amount of extra weight. By increasing the thread diameter, bending stress can be minimized, and sacrificial steel can be easily added to the threaded portion, which is usually the most vulnerable part of the anchor. This is obviously beneficial, as in the event of unfortunate structural failure, the anchor will fully utilize its own extension ability, providing greater warning for the usability failure of pile walls.



The design of anchors should provide sufficient design resistance to meet the required minimum design load requirements (note that the calculation method and final value of design resistance may vary depending on the design standards). Round steel anchor and waling bolts are usually mainly subjected to static loads (dynamic loads are rarely generated, but are usually ignored). Round steel anchors are the most cost-effective way to sheet pile walls. Usually, these forces are transferred to the anchor plate. When using concrete anchor plates, it is necessary to excavate the bottom of the concrete component in order to install the anchor plates. When using steel sheet piles or steel sheet pile composite walls, excavation only needs to reach the depth of the anchor itself.

It is particularly important to note that the elongation of the anchor under working load may be a more important limiting factor rather than design resistance, especially when it is necessary to accommodate large crane passages. The higher the strength of the anchor, the generally higher the elongation, so higher grade tie rods with the lowest cost (such as Grade 700) may not be the most suitable. If the elongation exceeds the design requirements, while maintaining the same design resistance, the elongation of the anchor can be reduced by reducing its strength level and increasing its diameter. The method of pre-stressing the anchor and adding a certain amount of pre-stress can reduce the elongation under working load, thereby increasing the stability of the structure.
Through hydraulic jacks, the pre-stressing of the anchor is most easily achieved at the threaded end of the anchor, and the pre-stressing of the anchor should be considered during the design phase. If pre-stressing cannot be achieved at the threaded end due to the installation sequence or conditions on site, it can also be achieved through a turnbuckle, but it will require a relatively longer time. It can be applied in two stages to the final design pre-stressing, making the application of prestress more uniform.





Example of anchor design

Design requirements

- Steel Grade 500
- Design ultimate load for anchor, F_{Ed} = 2,750 kN
- Anchor length = 40m (wall center to center)
- Serviceability characteristic load, $F_{t,ser}$ = 2000 kN
- Anchor elongation limit = 100 mm
- Design life structure = 50 years
- Thread notch factor k_t= 0.6 (According to DIN EN 1993-5)

First step

Anchor diameter selection:
Minimum Anchor diameter required –
The selection can be obtained from the loading capacity table:

- Grade 500, k_t= 0.6 select D85/M110 anchor
- Design tensile resistance $F_{t,Rd}$ = 2837 k_N > F_{Ed}
- Thread = M110 (stress area, A_s = 8556 mm^2)
- Shaft =85 mm diameter (stress area A_g = 5671 mm2)
- f_y = 500 N/mm^2, f_{ua} = 660 N/mm^2

Serviceability check

Elongation under axial characteristic loading
$F_{t,ser}$ = 2000 kN

Stress in shaft =2000*10^3/5671=352N/mm^2, ok
Elongation =352*40000/210/10^3=67mm<100mm, ok
Where elastic modulus = 210 kN/m^2

NOTED:
IF THE ELONGATION EXCEEDS THE DESIGN REQUIREMENTS, WHILE MAINTAINING THE SAME DESIGN RESISTANCE, THE ELONGATION OF THE ANCHOR CAN BE REDUCED BY REDUCING ITS STRENGTH LEVEL AND INCREASING ITS DIAMETER.

Serviceability limit state (According to DIN EN 1993-5)
$F_{t,ser} \leq F_y{*}A_s/\gamma_{Mt,ser}/10^3$
Where A_s is the lesser of shaft area or thread area
$\gamma_{Mt,ser}$=1.10(According to DIN EN 1993-5)

$F_{t,ser}$ = 2000 kN
$F_y{*}A_s/\gamma_{Mt,ser}$= 500*5671/1.1/10^3=2577kN
So $F_{t,ser} \leq F_y{*}A_s/\gamma_{Mt,ser}/10^3$, ok

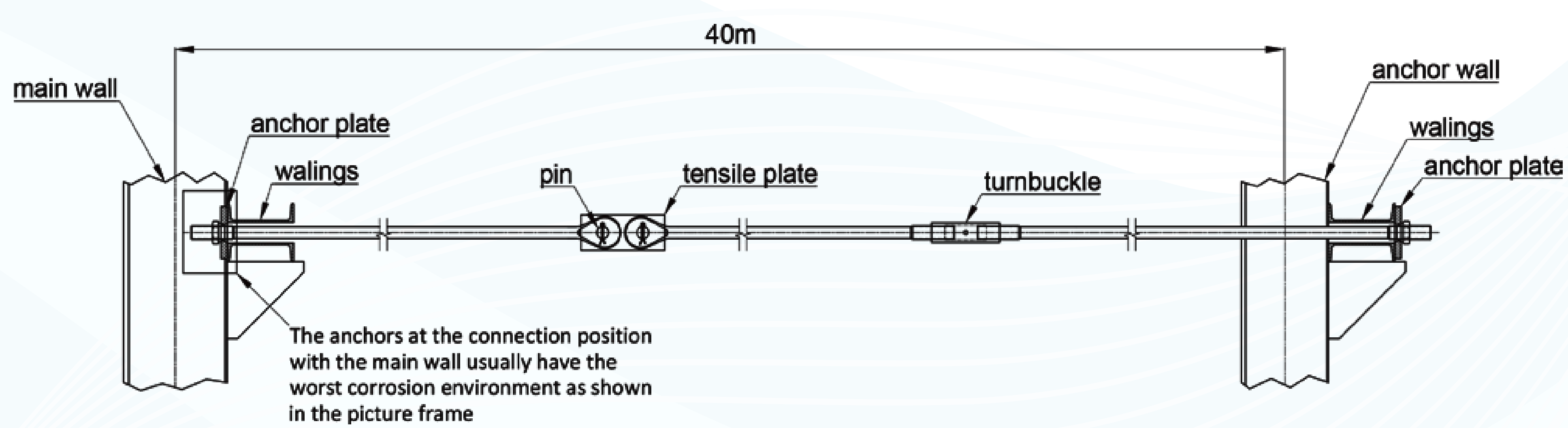
When considering corrosion resistance, the corrosion environment of anchors in different areas varies, especially the anchors at the connection position with the main wall usually have the worst corrosion environment. Therefore, considering that the reserved corrosion amount is usually based on this position. Note that placing the anchor connector behind the sheet pile plate can greatly reduce the corrosion rate in this area.The selection of anchors considering corrosion resistance is as follows for reference:

Anchor position	Corrosion Environment	Corrosion allowance	Min. size in thread including corrosion allowance	Min. size in thread including Corrosion allowance
Near main wall	low water and splash zones	3.75mm for 50 years (from table 4.2 EN1993-5)	117.5mm	92.5mm

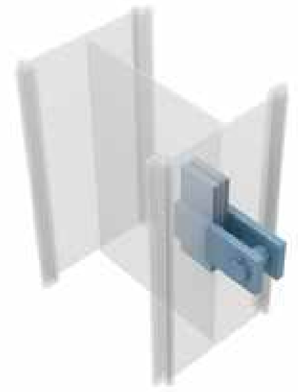
According to the table above, the closest standard thread size is M120, and the closest standard rod size is 95mm.

Because M120/95 is not our company's standard specification, the final design selection for the anchor should be as follows:

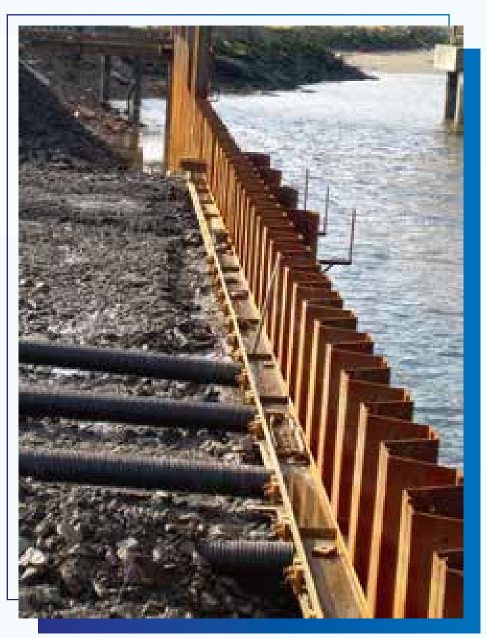
Grade500,M125/95,with hinged connections, turnbuckles, and lengths as shown on the drawings
Design ultimate load for anchor, F_{Ed} = 2,750 kN (after corrosion loss)
k_t=0.6 (according to EN1993-5)
f_y=500 N/mm^2
f_{ua}=660 N/mm^2



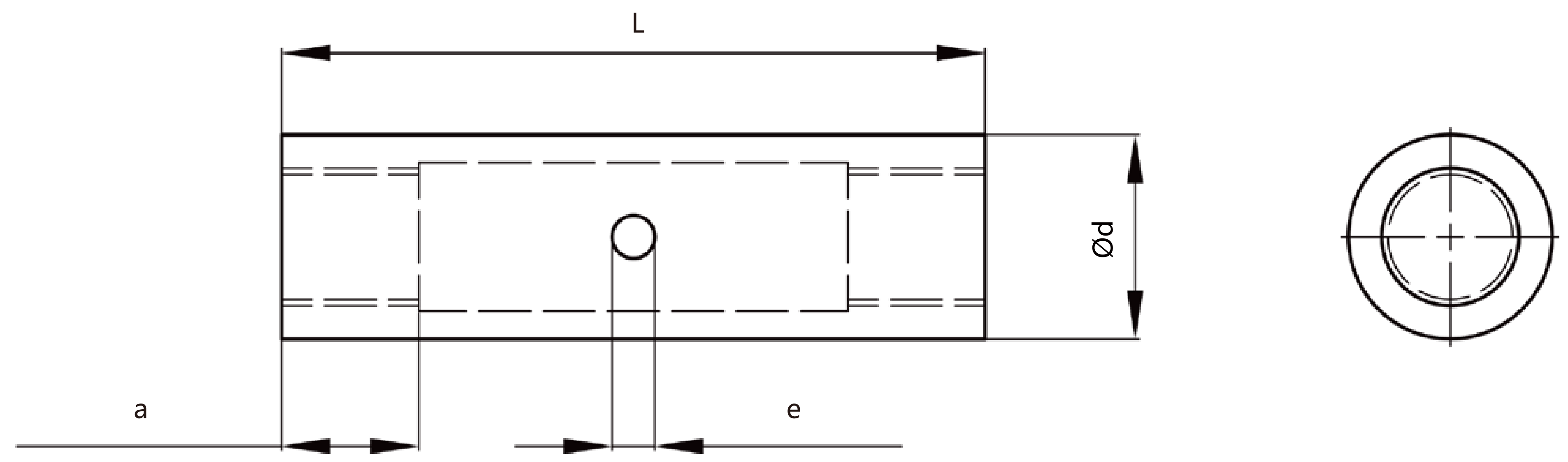
When designing the structure of steel tie rods, special attention should be paid to the settlement effect - the self weight of the anchor itself and the settlement caused by backfill materials. The bending of the anchor caused by settlement may cause significant bending stress at the fixed anchorage and increase the tensile stress of the local anchor. If the tension rod is displaced during the settlement of backfill material, it may also generate shear stress, which can generally be overcome by providing vertical hinged joints, cardan hinged joints, and universal spherical joints at the connection with the wall. Hinges should allow movement in the vertical or horizontal direction to avoid related bending stresses at threaded joints. The connection between steel sheet piles and H-piles or pipe piles is usually achieved through a T-shaped connection on the pile wall. There are two common types of T-shaped connections. When installing this type of T-shaped connection, it is necessary to cut corresponding grooves on the flange surface of the steel pipe wall and H-pile, and then insert them into the steel pipe and H-pile. The T-shaped connection of steel pipes does not require additional on-site welding, while the T-shaped connection of H-piles requires on-site welding.



The use of plastic pipes with anchor installation can also reduce bending at the connection points, but pipeline installation may be difficult and expensive. If the installation angle cannot be correctly aligned, it will not effectively prevent the settlement and bending of the anchor. If using settlement pipes, it is recommended to set hinge joints at the wall connections to prevent greater bending effects due to increased anchor weight during pipe movement. In this case, a complete anti-corrosion system (such as wrapping) is still necessary, especially when seawater may accumulate inside the pipeline.



The components of the anchor are usually connected by a series of round steel anchors with external threads or eye shaped forged joints and turnbuckle or coupler with left and right internal threads, or various types of hinges to achieve adjustable total length and direction of the anchor. All components of the anchor should exceed the designed tensile resistance (Ft,Rd) of the anchors itself, therefore the threaded part of the anchor determines the overall tensile resistance of the anchor. If the force axis of the anchor is not perpendicular to the structure, or it is difficult to accurately achieve this during construction (in fact, it is indeed difficult to achieve complete verticality to the direction of the structure), then setting a vertical connection is the least.Vertical hinge is the most commonly used and easiest to install hinge method. Turnbuckles are the most commonly used connections for applying pre-stress, adjusting length, and increasing the overall length of anchors. The turnbuckle has left and right threads. In contrast, couplers only serve as connections and therefore cannot be used for pre-stressing. The hinge turnbuckle has both the functions of a turnbuckle and a vertical hinge, allowing for both vertical and length adjustment. When both vertical and horizontal movements are required simultaneously, universal joints should be provided, including ball joint,universal joints, spherical nuts, and spherical anchor plates with machined curved surfaces.



S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	300	300	310	315	325	350	360	370	375	385	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560
Diameter	Ød	mm	64	70	73	76	83	83	89	102	102	108	114	114	121	127	133	140	152	152	159	168	180	180	194	194	203	219	219	219
Thread Length	a	mm	40	45	45	50	55	60	60	65	70	75	80	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	300	300	310	315	325	350	360	370	375	385	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560
Diameter	Ød	mm	73	76	83	83	89	102	102	108	114	121	127	133	140	140	152	159	168	180	194	194	203	219	219	219	245	245	245	245
Thread Length	a	mm	40	45	45	50	55	60	60	65	70	75	80	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

S460/S500 FOR ANCHORS TO DIN EN 1993-5 WITH KT 0.6/0.9 IN CLASS 8

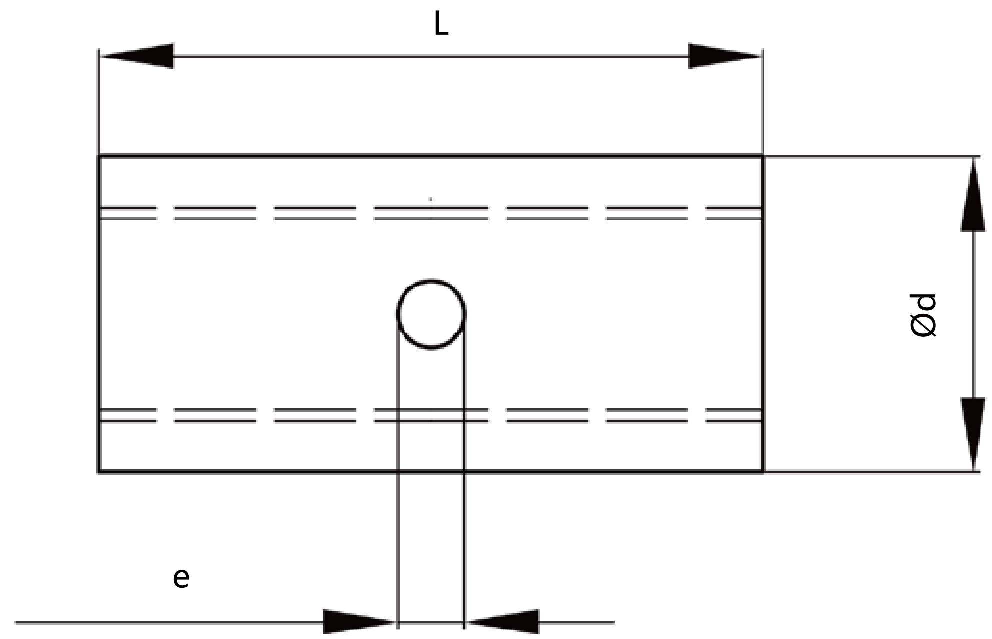
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	300	300	310	315	325	350	360	370	375	385	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560
Diameter	Ød	mm	73	76	83	83	89	102	102	108	114	121	127	133	140	140	152	159	168	180	194	194	203	203	219	219	245	245	245	245
Thread Length	a	mm	40	45	45	50	55	60	60	65	70	75	80	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

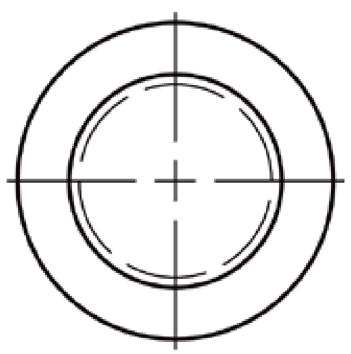
S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN CLASS 10

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	300	300	310	315	325	350	360	370	375	385	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560
Diameter	Ød	mm	70	73	76	83	89	102	102	108	114	121	127	133	140	140	152	159	168	180	194	194	203	203	219	219	245	245	245	245
Thread Length	a	mm	40	45	45	50	55	60	60	65	70	75	80	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN CLASS 10

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	300	300	310	315	325	350	360	370	375	385	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560
Diameter	Ød	mm	83	83	89	89	102	102	108	114	121	127	133	140	152	159	168	168	180	194	194	203	219	219	245	245	245	273	273	273
Thread Length	a	mm	40	45	45	50	55	60	60	65	70	75	80	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100





S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	120	130	140	150	150	170	180	180	190	200	210	225	240	250	260	260	260	260	260	260	260	260	270	280	290	300	310	320
Diameter	Ød	mm	64	70	73	76	83	83	89	102	102	108	114	114	121	127	133	140	152	152	159	168	180	180	194	194	203	219	219	219
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	120	130	140	150	150	170	180	180	190	200	210	225	240	250	260	275	285	295	305	320	330	340	350	360	370	380	390	400
Diameter	Ød	mm	73	76	83	83	89	102	102	108	114	121	127	133	140	140	152	159	168	180	194	194	203	219	219	219	245	245	245	245
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

S460/S500 FOR ANCHORS TO DIN EN 1993-5 WITH KT 0.6/0.9 IN CLASS 8

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	120	130	140	150	150	170	180	180	190	200	210	225	240	250	260	275	285	295	305	320	330	340	350	360	370	380	390	400
Diameter	Ød	mm	73	76	83	83	89	102	102	108	114	121	127	133	140	140	152	159	168	180	194	194	203	203	219	219	245	245	245	245
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

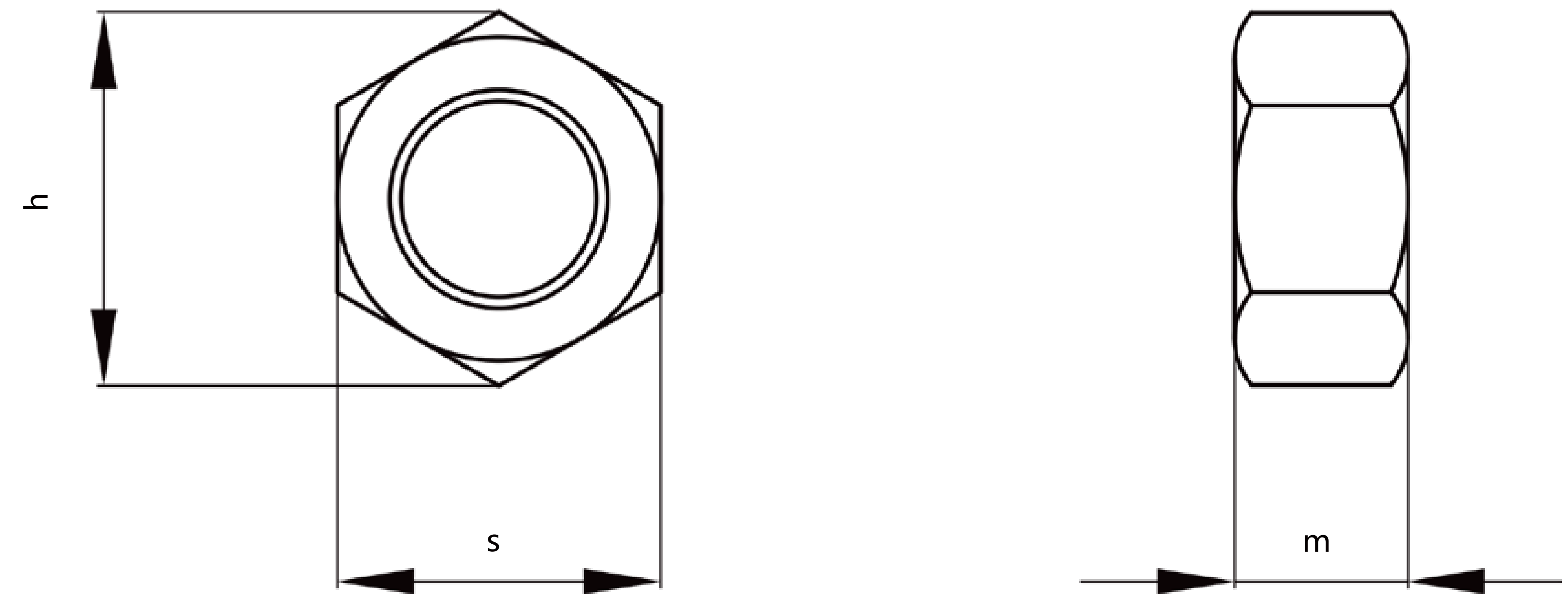
S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN CLASS 10

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	120	130	140	150	150	170	180	180	190	200	210	225	240	250	260	275	285	295	305	320	330	340	350	360	370	380	390	400
Diameter	Ød	mm	70	73	76	83	89	102	102	108	114	121	127	133	140	140	152	159	168	180	194	194	203	203	219	219	245	245	245	245
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN CLASS 10

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Length	L	mm	120	130	140	150	150	170	180	180	190	200	210	225	240	250	260	275	285	295	305	320	330	340	350	360	370	380	390	400
Diameter	Ød	mm	83	83	89	89	102	102	108	114	121	127	133	140	152	159	168	168	180	194	194	203	219	219	245	245	245	273	273	273
Hole diameter	e	mm	10	10	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

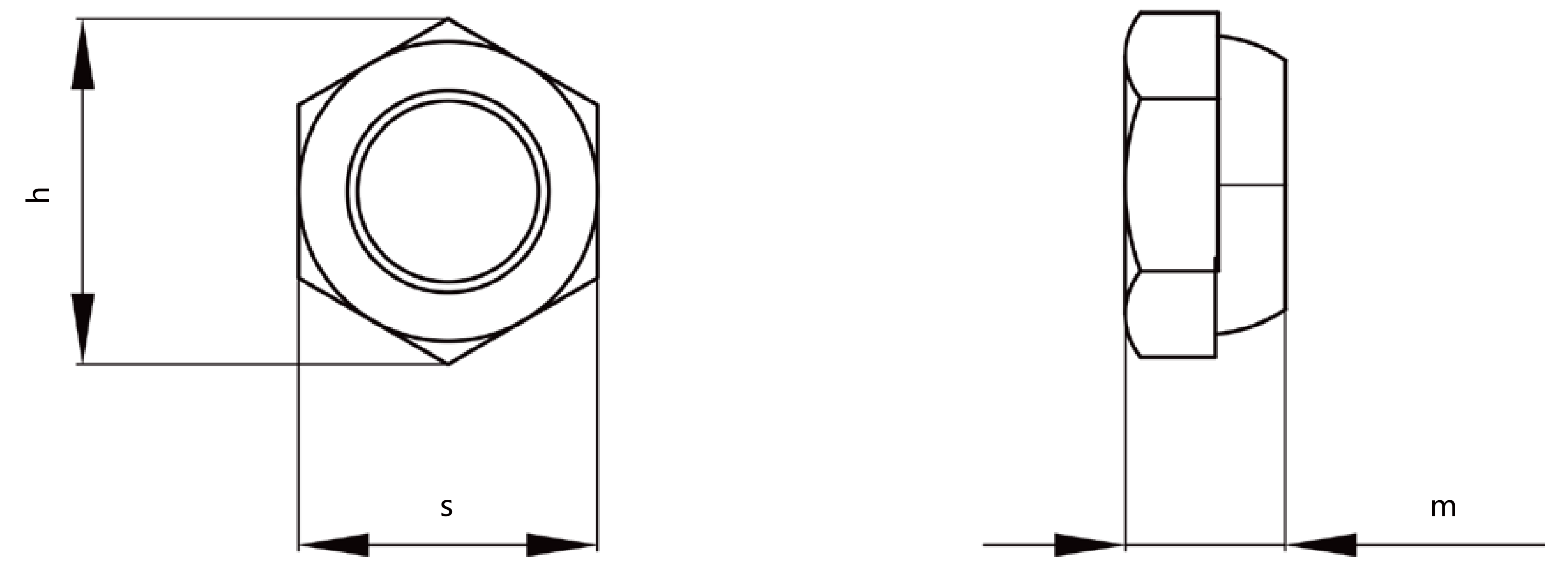
HEXAGONAL NUTS



S355 TO S700 FOR ANCHORS IN CLASS 8/CLASS 10

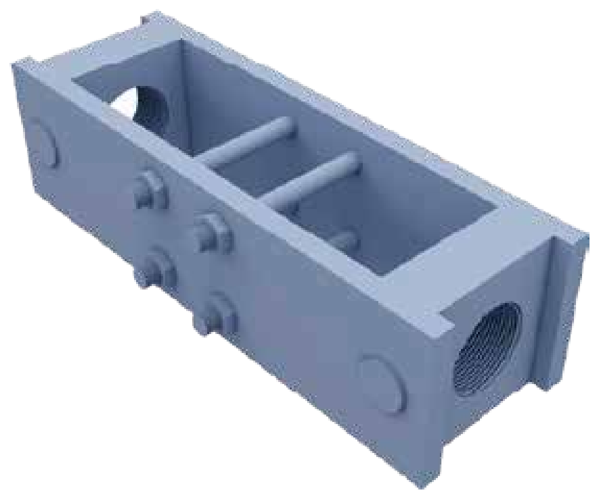
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Width across flats	s	mm	60	65	70	75	80	85	90	95	100	105	110	115	120	130	135	145	150	155	165	170	180	185	190	200	210	210	220	230
Width across corners	h	mm	66	72	78	83	89	94	100	106	112	117	123	128	134	145	151	162	168	173	185	190	202	207	212	224	234	234	245	255
Height	m	mm	31	34	36	38	42	45	48	51	54	58	61	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	128

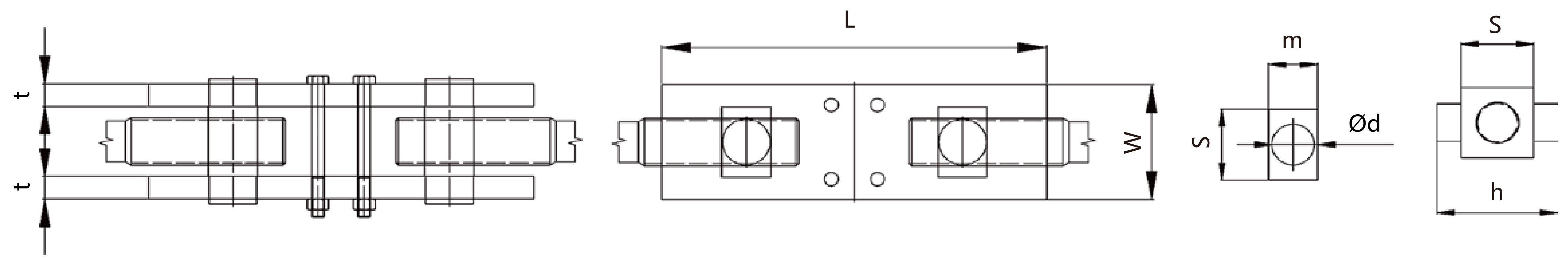
SPHERICAL HEXAGONAL NUTS



S355 TO S700 FOR ANCHORS IN CLASS 8/CLASS 10

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Width across flats	s	mm	60	65	70	75	80	85	90	95	100	105	110	115	120	130	135	145	150	155	165	170	180	185	190	200	210	210	220	230
Width across corners	h	mm	66	72	78	83	89	94	100	106	112	117	123	128	134	145	151	162	168	173	185	190	202	207	212	224	234	234	245	255
Height	m	mm	31	34	36	38	42	45	48	51	54	58	61	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	128





S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate length	L	mm	430	440	450	460	470	480	490	500	510	540	650	670	680	690	720	760	790	810	850	870	910	930	940	940	970	970	1010	1030
Plate width	w	mm	100	110	120	130	130	150	150	160	170	180	190	210	220	230	240	260	270	280	300	310	320	340	350	360	380	390	410	420
Plate thickness	t	mm	15	15	20	20	20	20	25	25	25	25	30	30	30	35	35	40	40	40	40	45	45	50	50	50	55	55	60	60
Nut thickness	m	mm	40	45	45	50	55	60	60	65	70	75	80	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Width across flats	s	mm	60	65	70	75	80	85	90	95	100	105	110	115	120	130	135	145	150	155	165	170	180	185	190	200	210	210	220	230
Width total	h	mm	100	110	120	130	130	140	150	160	160	170	180	190	190	210	220	240	140	250	260	270	280	300	300	310	330	330	350	360
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate length	L	mm	430	440	450	460	470	480	490	500	510	540	650	670	680	690	720	760	790	810	850	870	910	930	940	940	970	970	1010	1030
Plate width	w	mm	100	110	120	130	130	150	150	160	170	180	190	210	220	230	240	260	270	280	300	310	320	340	350	360	380	390	410	420
Plate thickness	t	mm	20	20	25	25	25	30	30	35	35	35	40	40	45	45	50	55	55	60	60	65	65	70	70	75	75	80	80	85
Nut thickness	m	mm	40	45	45	50	55	60	60	65	70	75	80	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Width across flats	s	mm	60	65	70	75	80	85	90	95	100	105	110	115	120	130	135	145	150	155	165	170	180	185	190	200	210	210	220	230
Width total	h	mm	110	120	130	140	140	160	160	180	180	190	200	210	220	230	250	270	270	290	300	310	320	340	340	360	370	380	390	410
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

S460/S500 FOR ANCHORS TO DIN EN 1993-5 WITH KT 0.6/0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate length	L	mm	430	440	450	460	470	480	490	500	510	540	650	670	680	690	720	760	790	810	850	870	910	930	940	940	970	970	1010	1030
Plate width	w	mm	100	110	120	130	130	150	150	160	170	180	190	210	220	230	240	260	270	280	300	310	320	340	350	360	380	390	410	420
Plate thickness	t	mm	20	20	25	25	25	30	30	35	35	35	40	40	45	45	50	55	55	60	60	65	65	70	70	75	75	80	80	85
Nut thickness	m	mm	40	45	45	50	55	56	60	64	68	72	76	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Width across flats	s	mm	60	65	70	75	80	85	90	95	100	105	110	115	120	130	135	145	150	155	165	170	180	185	190	200	210	210	220	230
Width total	h	mm	110	120	130	140	140	160	160	180	180	190	200	210	220	230	250	270	270	290	300	310	320	340	340	360	370	380	390	410
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

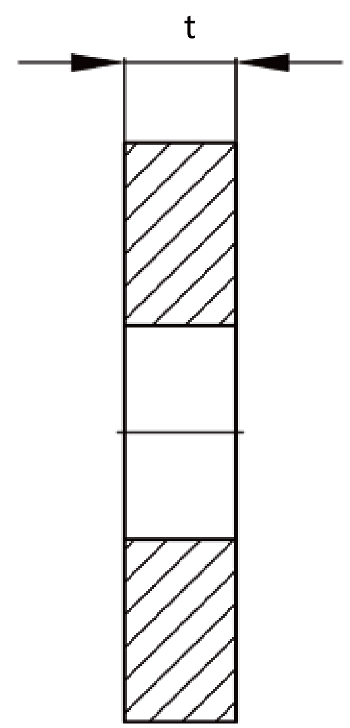
S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.6 IN Q355

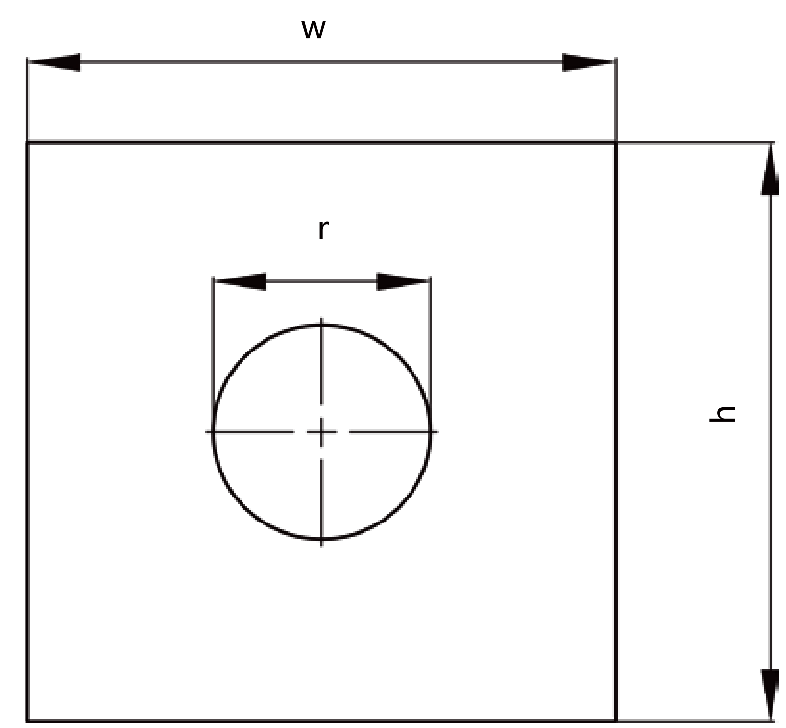
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate length	L	mm	430	440	450	460	470	480	490	500	510	540	650	670	680	690	720	760	790	810	850	870	910	930	940	940	970	970	1010	1030
Plate width	w	mm	100	110	120	130	130	150	150	160	170	180	190	210	220	230	240	260	270	280	300	310	320	340	350	360	380	390	410	420
Plate thickness	t	mm	20	20	20	25	25	25	30	30	35	35	35	40	40	45	45	50	50	55	55	60	60	65	65	70	70	75	75	80
Nut thickness	m	mm	40	45	45	50	55	56	60	64	68	72	76	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Width across flats	s	mm	110	120	130	140	140	85	90	95	100	105	110	115	120	130	135	145	150	155	165	170	180	185	190	200	210	210	220	230
Width total	h	mm	110	120	120	140	140	150	1160	170	180	190	190	210	210	230	240	260	260	280	290	300	310	330	330	350	360	370	380	400
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate length	L	mm	430	440	450	460	470	480	490	500	510	540	650	670	680	690	720	760	790	810	850	870	910	930	940	940	970	970	1010	1030
Plate width	w	mm	430	440	450	460	470	150	150	160	170	180	190	210	220	230	240	260	270	280	300	310	320	340	350	360	380	390	410	420
Plate thickness	t	mm	25	25	25	30	30	35	35	35	40	40	45	50	50	55	55	60	65	65	70	70	75	80	80	85	90	95	95	100
Nut thickness	m	mm	40	45	45	50	55	56	60	64	68	72	76	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
Width across flats	s	mm	110	120	130	140	140	85	90	95	100	105	110	115	120	130	135	145	150	155	165	170	180	185	190	200	210	210	220	230
Width total	h	mm	120	130	130	150	150	170	170	180	190	200	210	230	230	250	260	280	290	300	320	320	340	360	360	380	400	410	420	440
Adjustment	±	mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

STANDARD ANCHOR PLATE AGAINST WALINGS





S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Waling spacing		mm	80	80	80	80	80	80	100	100	100	100	100	100	120	120	120	140	140	140	140	140	160	160	160	160	180	180	180	180
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate thickness	t	mm	20	25	25	25	25	30	30	30	30	30	30	35	40	40	45	45	45	45	45	50	50	55	55	55	60	60	65	65

S460 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

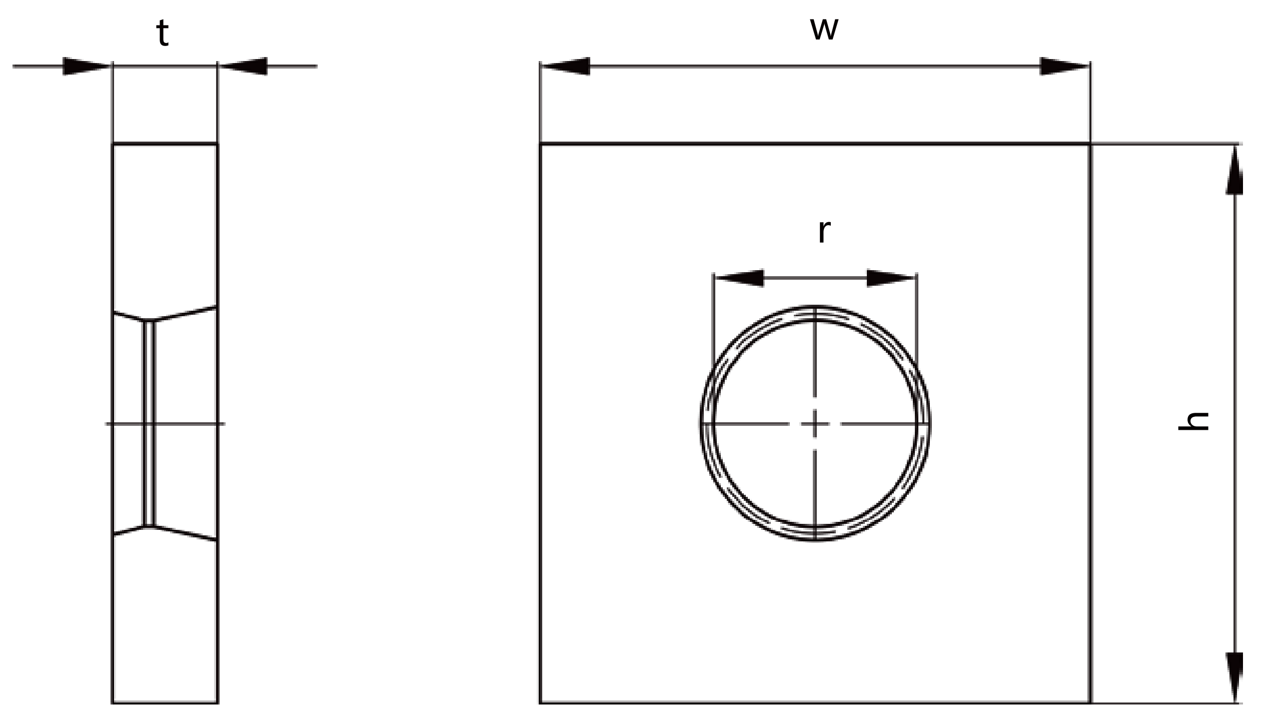
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Waling spacing		mm	80	80	80	80	80	80	100	100	100	100	100	100	120	120	120	140	140	140	140	140	160	160	160	160	180	180	180	180
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate thickness	t	mm	25	30	35	35	35	40	40	40	40	40	40	45	50	50	60	60	65	65	65	70	70	75	75	75	80	80	85	85

S500 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Waling spacing		mm	80	80	80	80	80	80	100	100	100	100	100	100	120	120	120	140	140	140	140	140	160	160	160	160	180	180	180	180
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	220	220	220	230	250	250	300	300	320	320	350	350	360	360	380	380	380	400	400	420	420	450	450
Plate thickness	t	mm	25	30	35	35	35	40	40	40	40	40	40	45	50	50	60	60	65	65	65	70	70	75	75	75	80	80	85	85

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Waling spacing		mm	80	80	80	80	80	80	100	100	100	100	100	100	120	120	120	140	140	140	140	140	160	160	160	160	180	180	180	180
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	220	220	220	230	250	250	300	300	320	320	350	350	360	360	380	380	380	400	400	420	420	450	450
Plate thickness	t	mm	35	40	40	45	45	50	50	50	55	55	55	60	70	70	75	80	80	85	85	90	90	95	95	100	105	110	110	115



S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	200	220	240	240	240	260	280	280	280	300	320	330	340	360	370	390	400	420	440	460	480
Plate thickness	t	mm	20	20	25	25	25	30	35	35	40	40	45	45	50	50	55	60	65	65	70	75	80	85	90	95	95	100	105	110

S460 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate thickness	t	mm	25	30	35	35	35	40	45	45	50	50	55	60	65	65	70	75	85	85	90	95	100	110	115	120	120	125	135	140

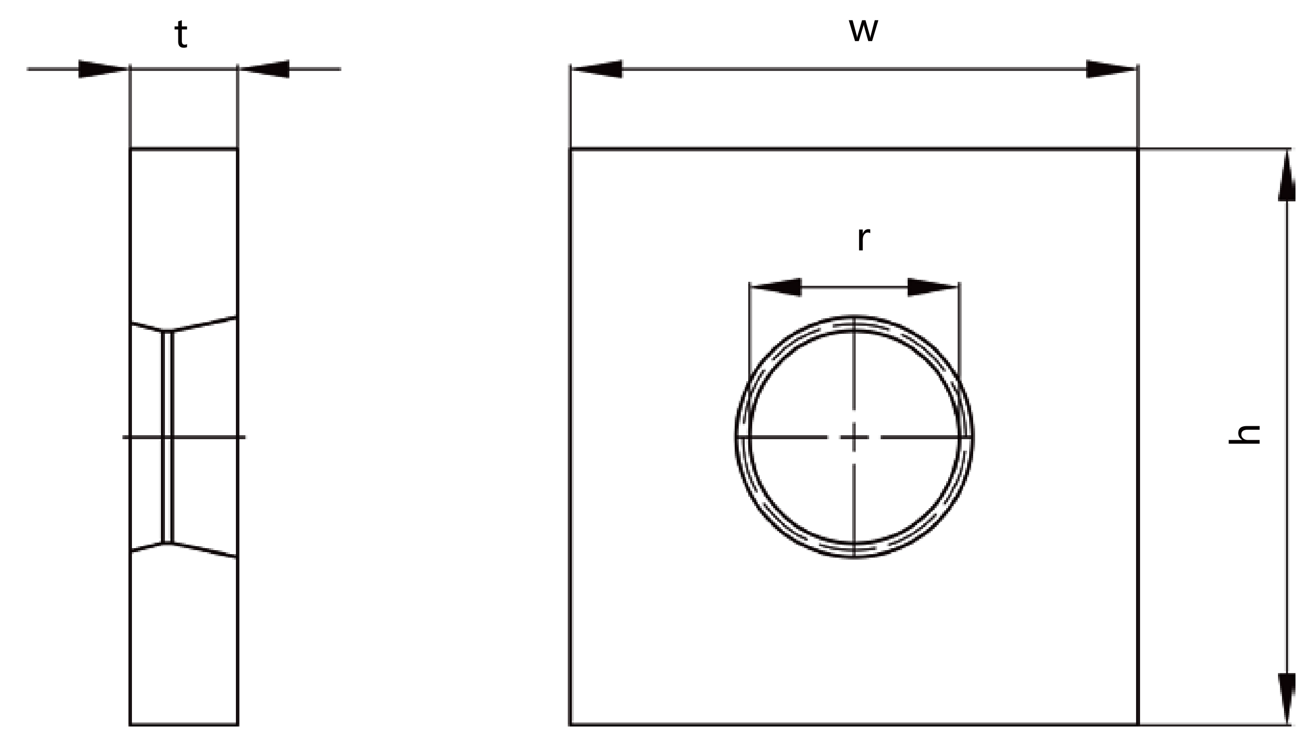
S500 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate thickness	t	mm	25	30	35	35	35	40	45	45	50	50	55	60	65	65	70	75	85	85	90	95	100	110	115	120	120	125	135	140

S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate thickness	t	mm	35	40	40	45	45	50	60	60	65	65	70	70	75	80	90	95	100	100	110	120	125	130	140	150	150	155	165	175

SPHERICAL ANCHOR PLATE AGAINST WALINGS WITH ANGLE 10°



S355 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	200	220	240	240	240	260	280	280	280	300	320	330	340	360	370	390	400	420	440	460	480
Plate thickness	t	mm	20	25	25	25	25	30	35	35	40	40	45	45	50	50	55	60	65	65	70	75	80	85	90	95	95	100	105	110

S460 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	220	220	240	240	240	260	280	280	280	300	320	330	340	360	370	390	400	420	440	460	480
Plate thickness	t	mm	25	30	35	35	35	40	45	50	50	55	55	60	70	70	70	75	90	95	95	100	105	115	125	130	130	135	150	155

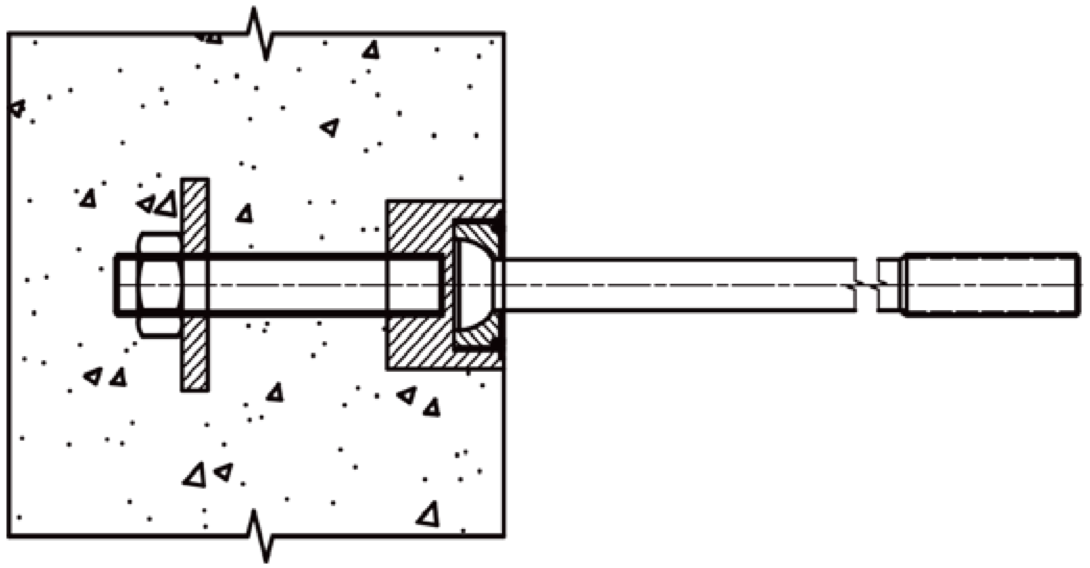
S500 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

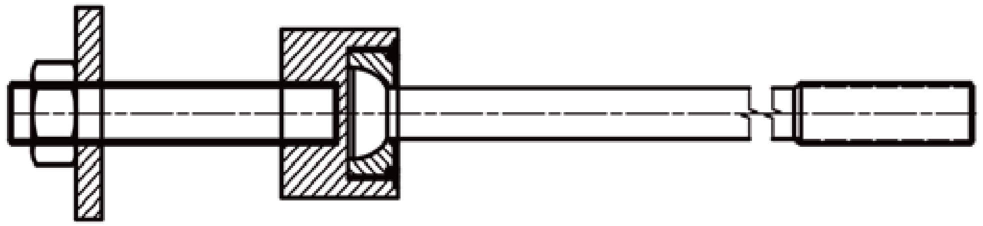
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	200	200	220	220	240	240	240	260	280	280	280	300	320	330	340	360	370	390	400	420	440	460	480
Plate thickness	t	mm	25	30	35	35	35	40	45	50	50	55	55	60	70	70	70	75	90	95	95	100	105	115	125	130	130	135	150	155

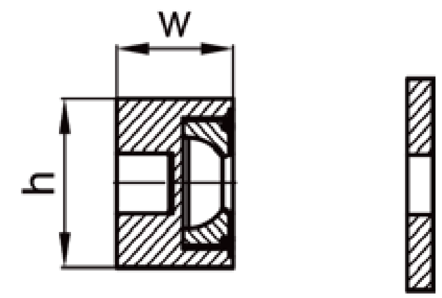
S700 ANCHORS TO DIN EN 1993-5 WITH KT=0.9 IN Q355

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Plate Width	w	mm	160	160	180	180	180	200	200	200	220	220	240	240	240	260	280	280	280	280	300	320	340	340	340	360	360	380	380	400
Plate height	h	mm	160	160	180	180	180	220	220	220	230	250	250	300	300	320	320	350	350	360	360	380	380	380	400	400	420	420	450	450
Plate thickness	t	mm	35	40	40	40	45	50	60	60	65	65	70	75	75	80	90	95	105	110	120	125	130	135	155	160	165	170	185	190

BALL JOINT





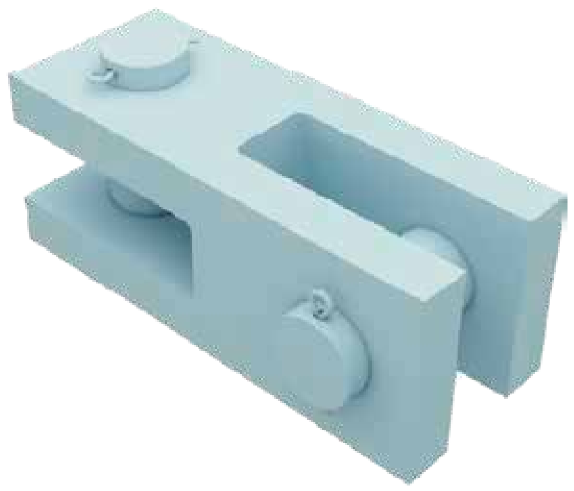


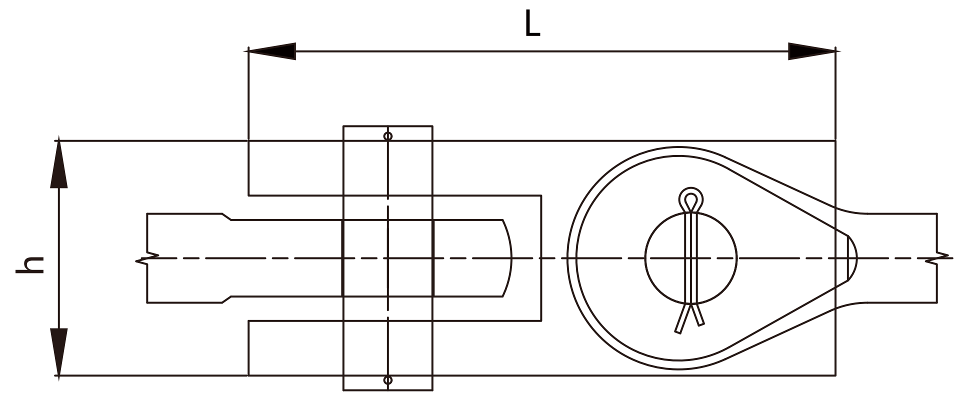
S355 TO S500 ANCHORS TO DIN EN 1993-5 WITH KT 0.9

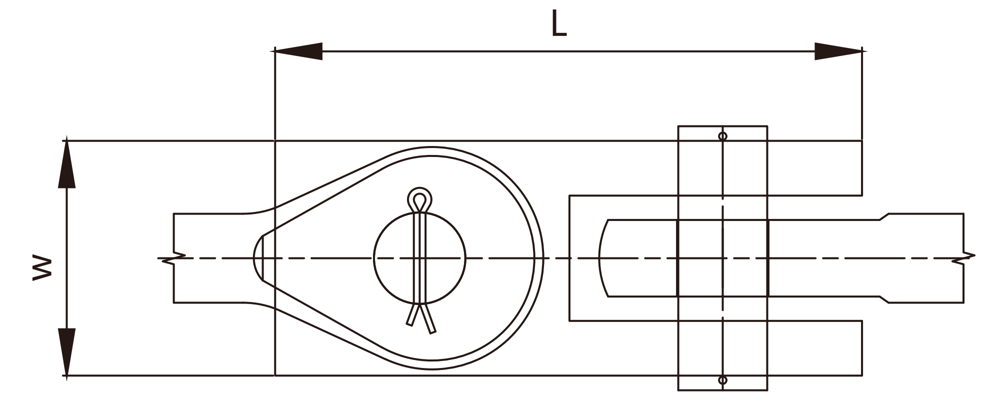
Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Height	h	mm	110	120	125	135	145	155	170	180	190	205	210	225	240	250	265	280	295	310	320	335	350	365	380	390	405	420	435	450
Width	w	mm	75	80	80	85	95	110	120	130	135	145	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320

S355 TO S500 ANCHORS TO DIN EN 1993-5 WITH KT 0.9

Nominal diameter	ØD	Metric	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90	M95	M100	M105	M110	M115	M120	M125	M130	M135	M140	M145	M150	M155	M160
Height	h	mm	110	120	125	135	145	155	170	180	190	205	210	225	240	250	265	280	295	310	320	335	350	365	380	390	405	420	435	450
Width	w	mm	80	85	90	95	105	110	120	130	135	145	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320

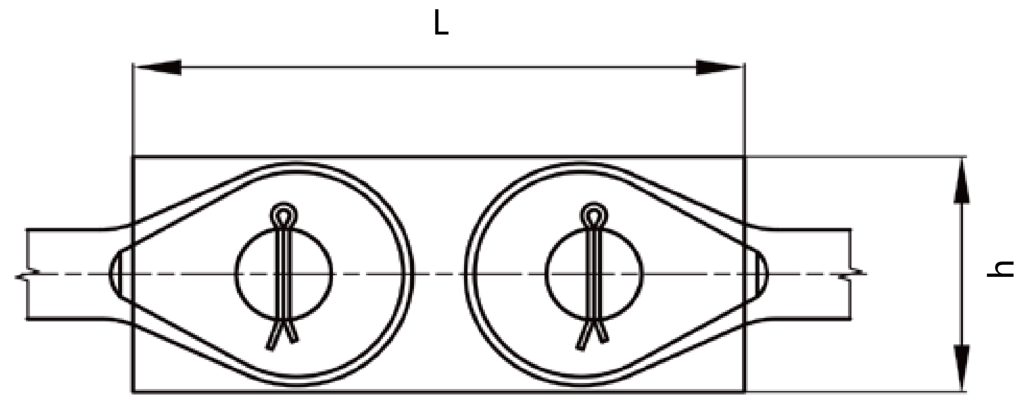


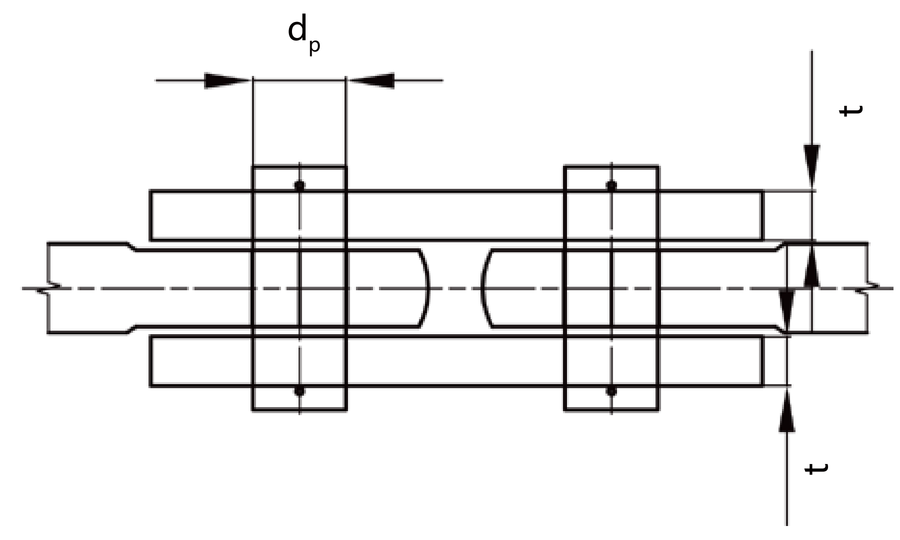




S355 TO S700 ANCHORS TO DIN EN 1993-5 WITH KT 0.6

Shaft diameter	Ød	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Width(W)	l	mm	90	100	120	120	140	140	150	170	170	170	180	190	200	210	220	240	250	260	270	280	290	300
Thickness(T)	h	mm	90	100	120	120	140	140	150	170	170	170	180	190	200	210	220	240	250	260	270	280	290	300
Length(L)	w	mm	265	325	330	360	390	430	480	480	500	500	535	560	585	620	645	670	705	730	765	810	870	910
Pin diameter	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130





S355 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Length	**l**	mm	250	270	300	350	380	390	450	450	475	475	520	530	570	625	660	675	705	730	750	795	840	860
Height	**h**	mm	100	110	130	145	160	170	170	180	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Thickness	**t**	mm	20	20	25	25	25	25	30	30	30	30	30	30	30	30	35	40	40	45	50	50	50	50
Pin diameter in Q355	**d_p**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

S460 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

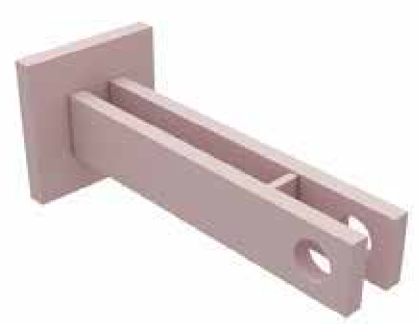
Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Length	**l**	mm	250	270	300	350	380	390	450	450	475	475	520	530	570	625	660	675	705	730	750	795	840	860
Height	**h**	mm	100	110	130	145	160	170	170	180	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Thickness	**t**	mm	25	25	30	30	30	30	35	40	40	40	40	40	40	40	45	50	50	55	60	60	60	65
Pin diameter in Q355	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

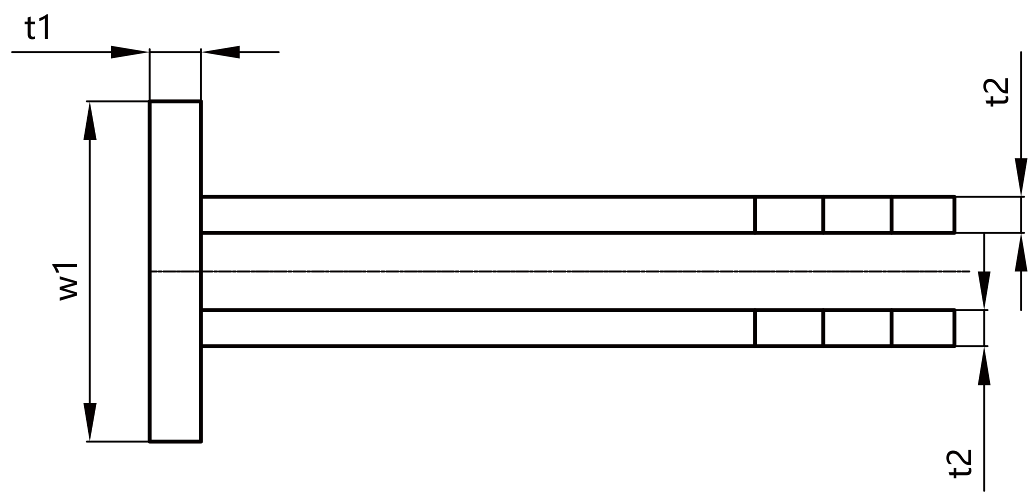
S500 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

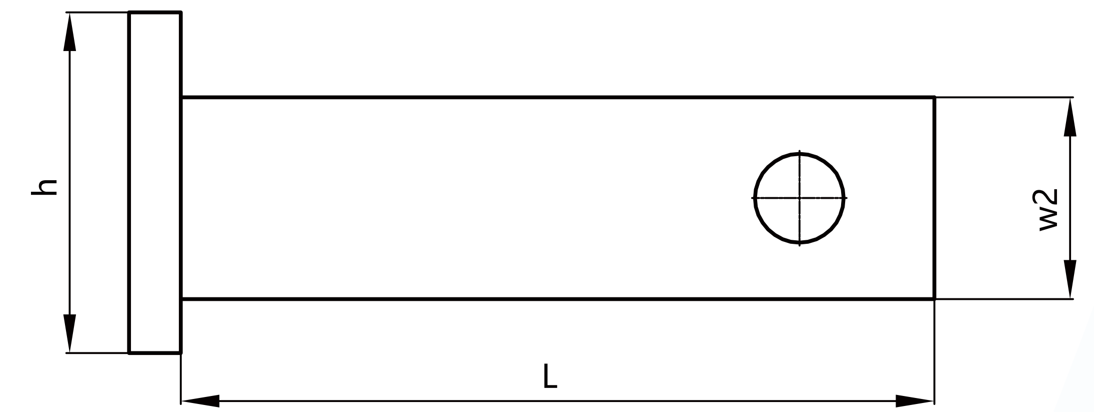
Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Length	**l**	mm	250	270	300	350	380	390	450	450	475	475	520	530	570	625	660	675	705	730	750	795	840	860
Height	**h**	mm	100	110	130	145	160	170	170	180	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Thickness	**t**	mm	25	25	30	30	30	30	35	40	40	40	40	40	40	40	45	50	50	55	60	60	60	65
Pin diameter in Q355	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

S700 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Length	**l**	mm	250	270	300	350	380	390	450	450	475	475	520	530	570	625	660	675	705	730	750	795	840	860
Height	**h**	mm	100	110	130	145	160	170	170	180	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Thickness	**t**	mm	35	35	40	40	45	45	50	55	55	55	55	55	55	55	65	70	70	80	85	85	85	90
Pin diameter in Q355	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130







S355 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Top plate width	**w1**	mm	200	210	230	250	270	300	310	330	340	340	360	380	400	430	460	470	480	520	540	560	580	600
Top plate height	**h**	mm	200	210	230	250	270	300	310	330	340	340	360	380	400	430	460	470	480	520	540	560	580	600
Top plate thickness	**t1**	mm	20	25	30	35	40	40	45	45	50	50	50	55	60	65	60	65	65	70	80	80	85	85
Tensile plate width	**w2**	mm	100	110	130	145	160	170	170	190	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	**t2**	mm	20	20	25	25	25	25	30	30	30	30	30	30	30	30	35	40	40	45	50	50	50	50
Pin diameter in Q355	**d_p**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

S460 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Top plate width	**w1**	mm	200	210	230	250	270	300	310	330	340	340	360	380	400	430	460	480	490	530	550	570	590	610
Top plate height	**h**	mm	200	210	230	250	270	300	310	330	340	340	360	380	400	430	460	480	490	530	550	570	590	610
Top plate thickness	**t1**	mm	30	30	35	40	45	45	50	50	55	55	55	60	65	70	70	75	75	80	90	90	95	95
Tensile plate width	**w2**	mm	100	110	130	145	160	170	170	190	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	**t2**	mm	25	25	30	30	30	30	35	40	40	40	40	40	40	40	45	50	50	55	60	60	60	65
Pin diameter in Q355	**d_p**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

S500 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Top plate width	**w1**	mm	200	210	230	250	270	300	310	330	340	340	360	380	400	430	460	480	490	530	550	570	590	610
Top plate height	**h**	mm	200	210	230	250	270	300	310	330	340	340	360	380	400	430	460	480	490	530	550	570	590	610
Top plate thickness	**t1**	mm	30	30	35	40	45	45	50	50	55	55	55	60	65	70	70	75	75	80	90	90	95	95
Tensile plate width	**w2**	mm	100	110	130	145	160	170	170	190	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	**t2**	mm	25	25	30	30	30	30	35	40	40	40	40	40	40	40	45	50	50	55	60	60	60	65
Pin diameter in Q355	**d_p**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

S700 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	**Ød**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Top plate width	**w1**	mm	230	250	260	280	300	320	330	350	380	400	420	450	480	480	500	530	550	560	600	620	650	680
Top plate height	**h**	mm	230	250	260	280	300	320	330	350	380	400	420	450	480	480	500	530	550	560	600	620	650	680
Top plate thickness	**t1**	mm	30	30	35	35	40	45	50	50	55	55	60	65	65	70	75	80	80	85	85	90	95	100
Tensile plate width	**w2**	mm	100	110	130	145	160	170	170	190	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	**t2**	mm	35	35	40	40	45	45	50	55	55	55	55	55	55	55	65	70	70	80	85	85	85	90
Pin diameter in Q355	**d_p**	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

T-CONNECTION FOR HZ-M PILES

S355 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	Ød	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Bearing plate width	w1	mm	100	105	110	115	140	140	150	170	170	170	190	190	205	240	250	265	265	290	310	330	350	370
Bearing plate height	h	mm	350	360	380	380	420	420	460	530	540	550	560	590	650	680	740	790	840	860	920	970	1040	1090
Bearing plate thickness	t1	mm	15	15	15	15	20	20	20	20	20	20	25	25	25	30	30	30	30	35	35	35	35	35
Tensile plate width	w2	mm	100	110	130	145	160	170	170	0	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	t2	mm	20	20	25	25	25	25	30	30	30	30	30	30	30	30	35	40	40	45	50	50	50	50
Pin diameter in Q355	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

S460 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

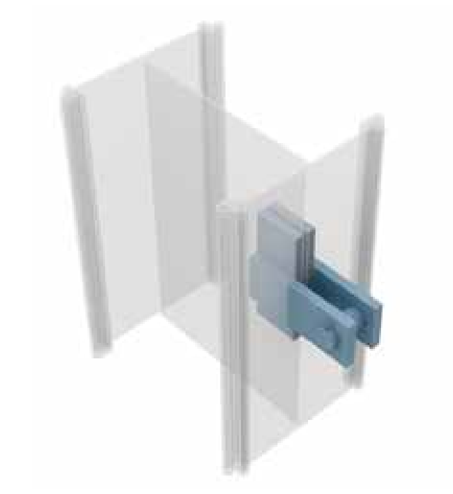
Shaft diameter	Ød	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Bearing plate width	w1	mm	100	105	110	115	140	140	150	170	170	170	190	190	205	240	250	265	265	290	310	330	350	370
Bearing plate height	h	mm	350	380	400	400	440	440	480	550	560	570	580	610	670	700	760	810	860	880	940	990	1060	1110
Bearing plate thickness	t1	mm	15	15	15	20	25	25	25	25	25	25	30	30	30	35	35	35	35	40	40	40	40	40
Tensile plate width	w2	mm	100	110	130	145	160	170	170	68	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	t2	mm	25	25	30	30	30	30	35	40	40	40	40	40	40	40	45	50	50	55	60	60	60	65
Pin diameter in Q355	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

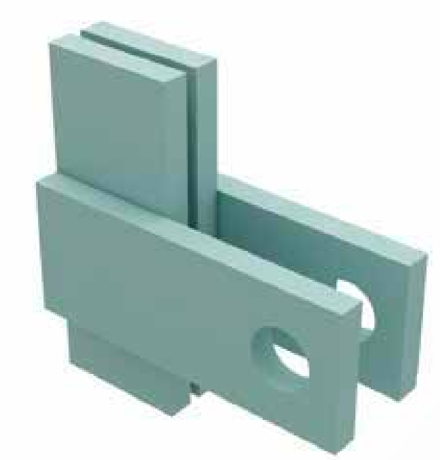
S500 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

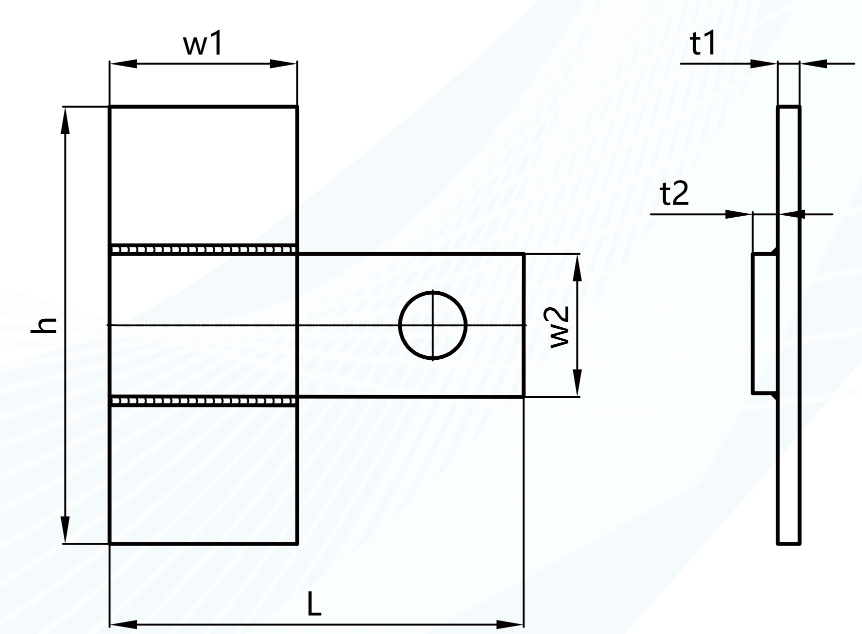
Shaft diameter	Ød	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Bearing plate width	w1	mm	100	105	110	115	140	140	150	170	170	170	190	190	205	240	250	265	265	290	310	330	350	370
Bearing plate height	h	mm	350	380	400	400	440	440	480	550	560	570	580	610	670	700	760	810	860	880	940	990	1060	1110
Bearing plate thickness	t1	mm	15	15	15	20	25	25	25	25	25	25	30	30	30	35	35	35	35	40	40	40	40	40
Tensile plate width	w2	mm	100	110	130	145	160	170	170	68	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	t2	mm	25	25	30	30	30	30	35	40	40	40	40	40	40	40	45	50	50	55	60	60	60	65
Pin diameter in Q355	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130

S700 ANCHORS TO DIN EN 1993-5 WITH KT 0.6 IN Q355

Shaft diameter	Ød	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130
Bearing plate width	w1	mm	100	105	110	115	140	140	150	170	170	170	190	190	205	240	250	265	265	290	310	330	350	370
Bearing plate height	h	mm	350	380	440	440	480	480	520	590	640	650	660	690	750	780	840	890	940	960	1020	1070	1140	1190
Bearing plate thickness	t1	mm	20	20	20	25	30	30	30	30	30	30	35	35	35	40	40	40	40	45	45	45	45	45
Tensile plate width	w2	mm	100	110	130	145	160	170	170	68	190	190	195	225	245	270	285	290	300	320	330	345	365	370
Tensile plate thickness	t2	mm	25	25	30	30	30	30	35	40	40	40	40	40	40	40	45	50	50	55	60	60	60	65
Pin diameter in class 10.9	d_p	mm	40	45	48	50	55	60	65	68	70	72	75	80	85	90	95	100	105	110	115	120	125	130







WAILING BOLTS WITH HEAD AND NUT OR WITH TWO NUTS

S355 TO DIN EN 1993-5 WITH KT=0.6

Nominal diameter	ØD	Metric	M36	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90
Stressed area, thread	As	mm²	817	976	1120	1310	1470	1760	2030	2362	2676	3005	3460	3889	4344	4948	5591
Pitch	P	mm	4	4	5	5	5	5	6	6	6	6	6	6	6	6	6
Yield capacity	F_y	kN	290	346	398	465	522	625	721	839	950	1067	1228	1381	1542	1757	1985
Ultimate capacity	F_{ua}	kN	417	498	571	668	750	898	1035	1205	1365	1533	1765	1983	2215	2523	2851
Tensile Resistance	$F_{t,Rd}$	kN	200	239	274	321	360	431	497	578	655	736	847	952	1063	1211	1369

S500 TO DIN EN 1993-5 WITH KT=0.6

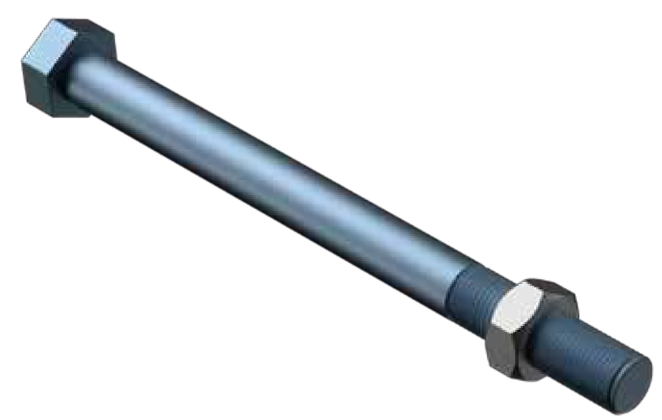
Nominal diameter	ØD	Metric	M36	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90
Stressed area, thread	As	mm²	817	976	1120	1310	1470	1760	2030	2362	2676	3005	3460	3889	4344	4948	5591
Pitch	P	mm	4	4	5	5	5	5	6	6	6	6	6	6	6	6	6
Yield capacity	F_y	kN	409	488	560	655	735	880	1015	1181	1338	1503	1730	1945	2172	2474	2796
Ultimate capacity	F_{ua}	kN	539	644	739	865	970	1162	1340	1559	1766	1983	2284	2567	2867	3266	3690
Tensile Resistance	$F_{t,Rd}$	kN	259	309	355	415	466	558	643	748	848	952	1096	1232	1376	1568	1771

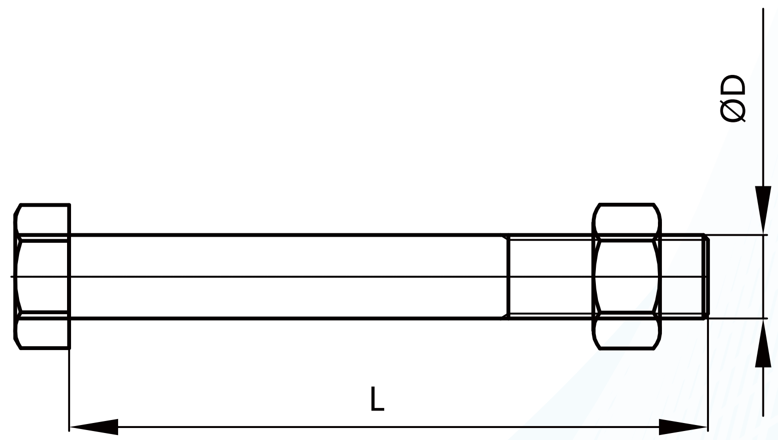
CLASS 8.8 TO DIN EN 1993-5 WITH KT=0.6

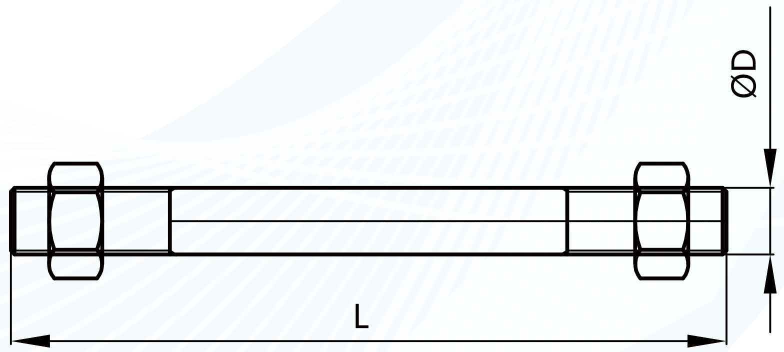
Nominal diameter	ØD	Metric	M36	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90
Stressed area, thread	As	mm²	817	976	1120	1310	1470	1760	2030	2362	2676	3005	3460	3889	4344	4948	5591
Pitch	P	mm	4	4	5	5	5	5	6	6	6	6	6	6	6	6	6
Yield capacity	F_y	kN	523	625	717	838	941	1126	1299	1512	1713	1923	2214	2489	2780	3167	3578
Ultimate capacity	F_{ua}	kN	654	781	896	1048	1176	1408	1624	1890	2141	2404	2768	3111	3475	3958	4473
Tensile Resistance	$F_{t,Rd}$	kN	314	375	430	503	564	676	780	907	1028	1154	1329	1493	1668	1900	2147

CLASS 10.9 TO DIN EN 1993-5 WITH KT=0.6

Nominal diameter	ØD	Metric	M36	M39	M42	M45	M48	M52	M56	M60	M64	M68	M72	M76	M80	M85	M90
Stressed area, thread	As	mm²	817	976	1120	1310	1470	1760	2030	2362	2676	3005	3460	3889	4344	4948	5591
Pitch	P	mm	4	4	5	5	5	5	6	6	6	6	6	6	6	6	6
Yield capacity	F_y	kN	735	878	1008	1179	1323	1584	1827	2126	2408	2705	3114	3500	3910	4453	5032
Ultimate capacity	F_{ua}	kN	817	976	1120	1310	1470	1760	2030	2362	2676	3005	3460	3889	4344	4948	5591
Tensile Resistance	$F_{t,Rd}$	kN	392	468	538	629	706	845	974	1134	1284	1442	1661	1867	2085	2375	2684







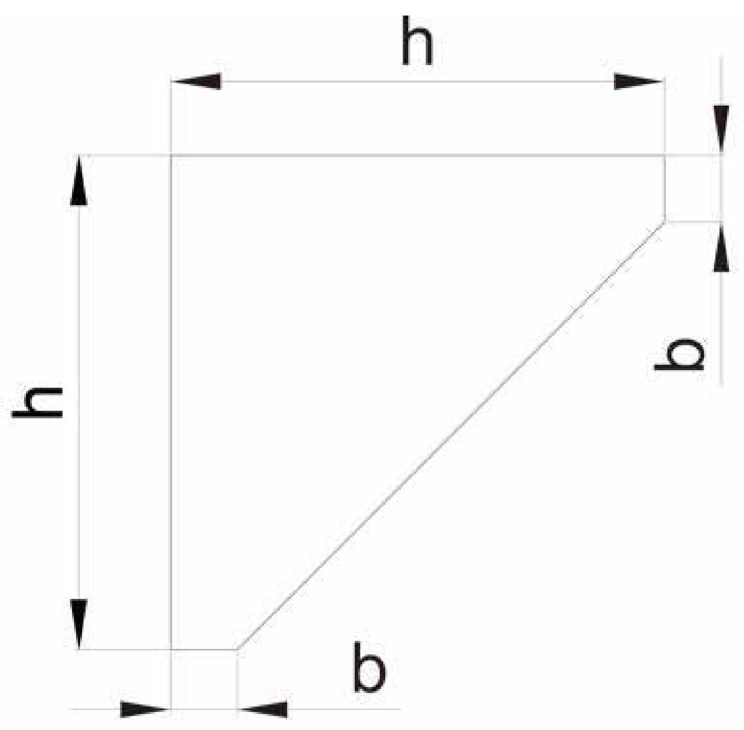
SUPPORT BRACKET OF ANCHOR IN Q355

S355 Anchors		UPN180	UPN200	UPN220	UPN240	UPN260	UPN280	UPN300	UPN320	UPN350	UPN380	UPN400
h	mm	230	250	270	290	310	330	350	370	400	430	450
t	mm	10	10	10	10	10	10	10	10	10	10	10
b	mm	50	50	50	50	50	50	50	50	50	50	50
Weight	kg	2.9	3.3	3.8	4.4	4.9	5.5	6.1	6.7	7.7	8.8	9.6

S460 Anchors		UPN180	UPN200	UPN220	UPN240	UPN260	UPN280	UPN300	UPN320	UPN350	UPN380	UPN400
h	mm	230	250	270	290	310	330	350	370	400	430	450
t	mm	15	15	15	15	15	15	15	15	15	15	15
b	mm	50	50	50	50	50	50	50	50	50	50	50
Weight	kg	4.4	5.0	5.7	6.6	7.4	8.3	9.2	10.1	11.6	13.2	14.4

S500 Anchors		UPN180	UPN200	UPN220	UPN240	UPN260	UPN280	UPN300	UPN320	UPN350	UPN380	UPN400
h	mm	230	250	270	290	310	330	350	370	400	430	450
t	mm	15	15	15	15	15	15	15	15	15	15	15
b	mm	50	50	50	50	50	50	50	50	50	50	50
Weight	kg	6.5	7.4	8.6	9.9	11.0	12.4	13.7	15.1	17.3	19.8	21.6

S700 Anchors		UPN180	UPN200	UPN220	UPN240	UPN260	UPN280	UPN300	UPN320	UPN350	UPN380	UPN400
h	mm	230	250	270	290	310	330	350	370	400	430	450
t	mm	20	20	20	20	20	20	20	20	20	20	20
b	mm	50	50	50	50	50	50	50	50	50	50	50
Weight	kg	5.8	6.6	7.6	8.8	9.8	11.0	12.2	13.4	15.4	17.6	19.2



MACALLOY
CORROSION PROTECTION SYSTEM FOR ANCHORS

Anchors are usually used in different corrosive environments, which have different corrosion rates. Therefore, corrosion protection factors that affect the effective lifespan must be considered.

The simplest and cheapest way to achieve effective anti-corrosion protection is to increase the diameter of round steel and end threads. There are several ways to protect anchor rods from corrosion, but we believe that using sacrificial steel is the most practical and robust anti-corrosion method. The diameter of the round steel and thread size has been increased to allow for pre-corrosion losses during the service life of the structure, so no additional coating is required, and the coating system for anchors is often expensive. The use of sacrificial steel does not require special transportation or on-site considerations. Please note that each layer of coating will increase the price per kilogram, increase the manufacturing time of the anchor, and almost always cause damage during transportation and installation. And it will also generate environmental issues It is important to consider the corrosion protection of the anchor during the design phase, especially the connection with the main wall, as the anchor at this location usually has the worst corrosion environment. In most cases, sacrificial steel provides a more economical and robust form of corrosion protection.
However, if you need a coating, any form of coating is possible, and all conventional paint coating systems can be applied to the surface of anchors after thorough sandblasting and rust removal. Surface protection can also be achieved through hot-dip galvanizing. The most commonly used method, apart from paint coating and galvanizing, is to wrap it with DENSO tape. The most commonly used method is to wrap the anchor rod and accessories. Usually, the rod can be packaged in the factory and transported to the site, but various connections can only be wrapped before installation on site. It is important to ensure the correct wrapping of connections such as turnbuckle, coupler, hinge turnbuckle, etc. Any damage or unprotected areas that may occur during the installation process of the pole must be repaired before filling. Any damage or exposure in the wrapping system can lead to severe pitting corrosion, thereby reducing the durability of the anchor. Smaller diameter anchor rods in high-strength grade anchors are particularly dangerous due to their smaller cross-sectional area. The following form will help you choose sacrificial steel or suitable anti-corrosion methods:

EN1993-5, TABLE 4-1:
RECOMMENDED VALUE FOR THE LOSS OF THICKNESS [MM] DUE TO CORROSION FOR PILES AND SHEET PILES IN SOILS, WITH OR WITHOUT GROUNDWATER.

Required design working life	5 years	25 years	50 years	75 years	100 years
Non-compacted and non-aggressive fills (clay, schist, sand, silt)	0.18	0.7	1.2	1.7	2.2

NOTES:

1. Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills the figures in the table should be divided by two.
2. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

EN1993-5, TABLE 4-2:
RECOMMENDED VALUE FOR THE LOSS OF THICKNESS [MM] DUE TO CORROSION FOR PILES AND SHEET PILES IN FRESH WATER OR IN SEA WATER

Required design working life	5 years	25 years	50 years	75 years	100 years
Common fresh water (river, ship canal,...) in the zone of high attack (water line)	0.15	0.55	0.9	1.15	1.4
Very polluted fresh water(sewage,industrial effluent,.)in the zone of high attack (water line)	0.3	1.3	2.3	3.3	4.3
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0.55	1.9	3.75	5.6	7.5
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0.25	0.9	1.75	2.6	3.5

NOTES:

1. The highest corrosion rate is usually found in the splash zone or at the low water level in tidal waters. However, in most cases, the highest bending stresses occur in the permanent immersion zone, see Figure 4-1.
2. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

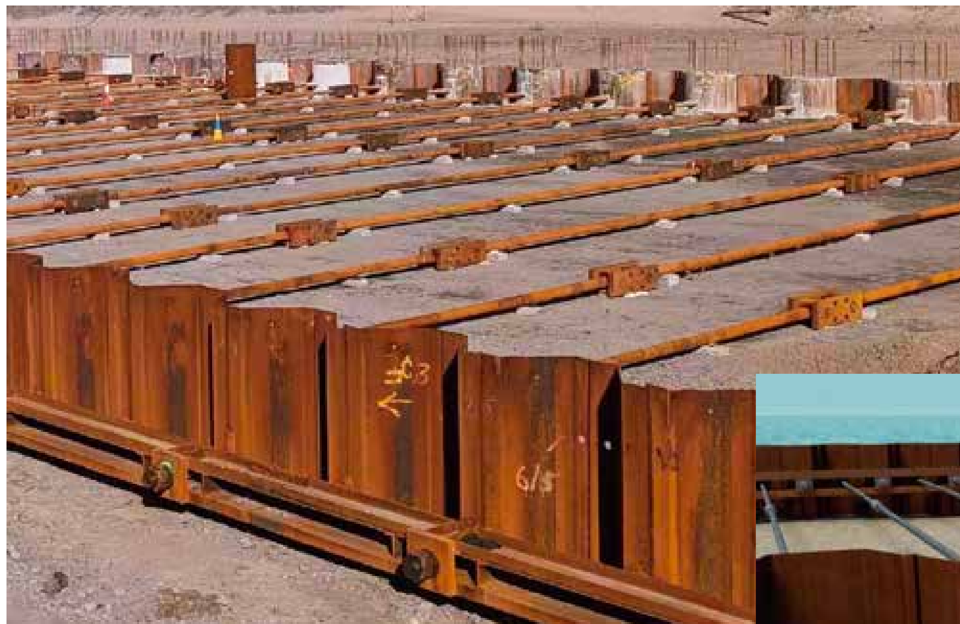
MACALLOY WALING

Normally, the waling beam are arranged in the form of two back-to-back hot-rolled steel channel, with their web plates perpendicular to the sheet pile wall. U-beam or H-beam can be used as needed. The spacing between channels depends on the diameter and angle of the anchor rods, and must be large enough to ensure that the anchor rods do not come into contact with the wall panels. Especially if the anchor needs to be tilted or angled, the wall needs to have sufficient spacing to allow the anchor to tilt smoothly in the vertical plane. For design purposes, walings can be considered continuous,although walls are static and uncertain. The suggestion is to design the wall for the allowable anchoring force of the anchors.

The waling transfers the force from the sheet pile wall to the anchor to hardens and aligns the wall. Anchoring connections to sheet pile walls can be done in two ways - outside or inside the wall, as shown in the diagram. Generally, walings are placed inside the main wall to provide tension, but on the anchor wall, they are usually placed outside the anchored wall to provide pressure. Placed inside the sheet pile wall under tidal or fluctuating water conditions to prevent damage to the waling by the ship. Placing the waling inside the main wall also allows anchor rods to be connected to the sheet piles inside the pan. This greatly improves the anti-corrosion effect on the anchor. When placing the waling behind the main wall, bolts and steel plates must be used at each contact point between the sheet pile and the waling to ensure that the load is completely transferred to the waling. A sturdy bolt (minimum of M39 recommended) is a necessary component for transferring horizontal force to the waling. Similarly, to withstand the forces caused by ship collisions with walls and allow for the risk of corrosion, bolts need to be enlarged in size, requiring at least an additional 25% load pre-loss, and bolts must be sufficiently long.

We can provide a complete range of bolts to suit different project applications. The bolt contains one forged hexagonal head and the other end is threaded. If these forged hexagonal heads are placed on the outside of the wall, they provide greater corrosion protection than exposed threads such as hexagonal nut connections. There are two forms of waling bolts: one end is forged with a hexagonal head, the other end is threaded, and both ends are threaded. Generally, forged hexagonal head bolts have better corrosion resistance. On anchor walls, waling are usually installed on the outside of sheet pile walls to provide pressure, so there is no need to bolt the waling and sheet pile walls in place.

When designing heavy anchors with high stress, it is necessary to strengthen the channels of the walings, usually by welding stiffeners. Weld 2 stiffeners at the position of each anchor plate. Due to the risk of corrosion, structural welds must be at least 2 millimeters thicker than the structural calculation requirements. At the same time, the length of the walings will be limited by the hot rolling of the steel plant, and appropriate connection methods should be used for splicing.

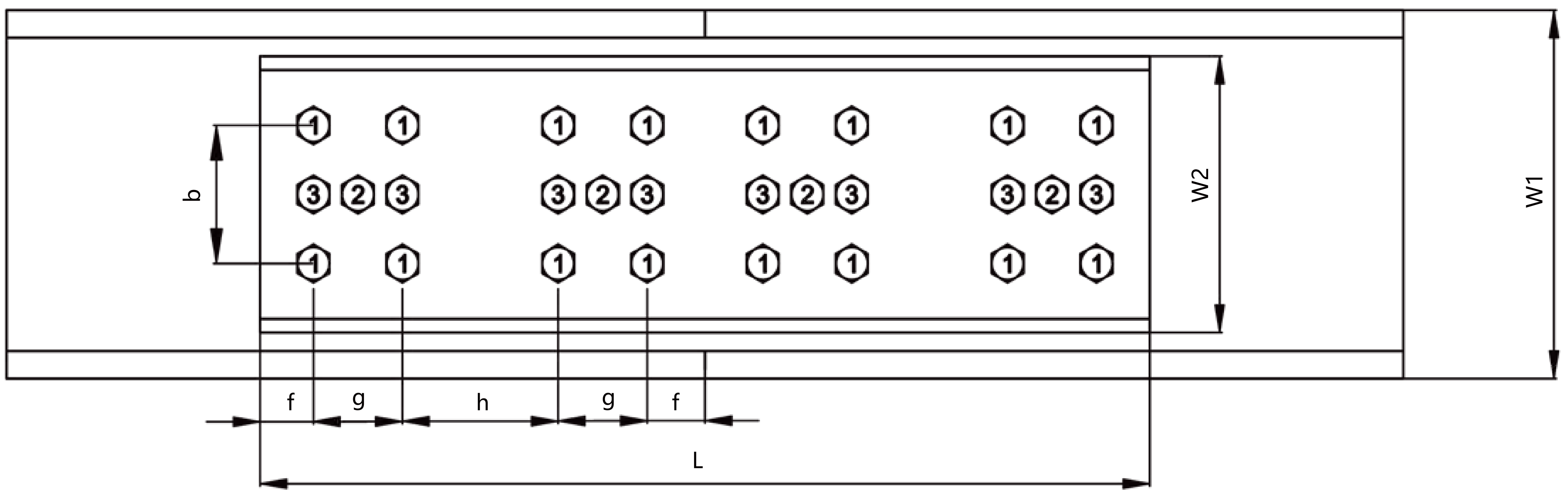


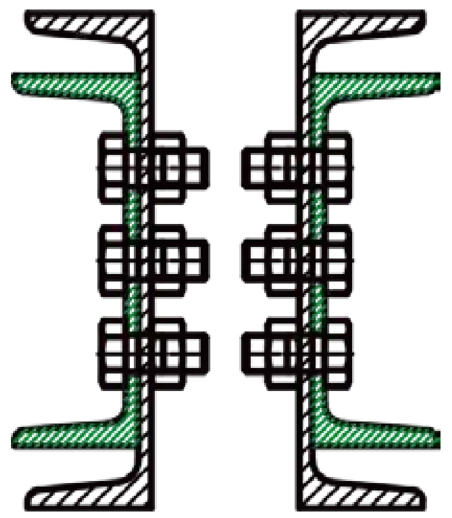
A splice equal to the full cross-section is unnecessary, but the splice must be able to transmit the calculated internal forces. The position of the splice joint should be 0.28 away from the distance between anchors, as this will approach the position of the minimum bending moment. Usually, the form of channel steel connected by bolts is adopted, and necessary bolt holes are pre-drilled for installation. Due to the actual error caused by possible slight deformation during installation, pre-drilling is only carried out on one side.The other side is more suitable for on-site drilling after determining the final length to ensure well splicing. Welding joints do not need to be spliced, as long as they are arranged in a staggered manner and fully connected in a steel structure connection. The waling beam should be 100mm longer than the theoretical size to allow for any discrepancies or creep which may develop in the wall as the piles are installed.

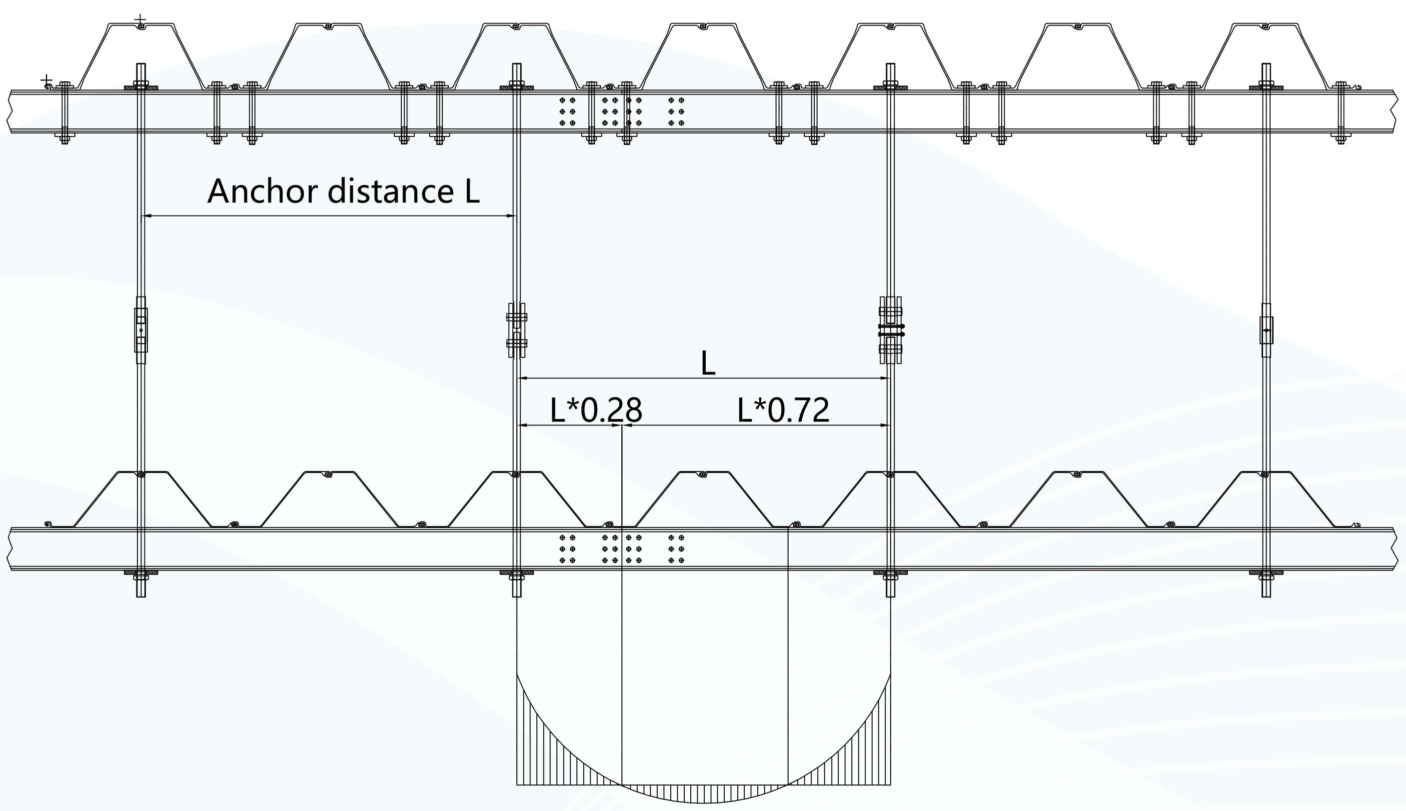
When anchors and waling need to be set at the corners of the wall, diagonal anchors of varying lengths are required, usually with a diagonal angle of 45 degrees. At this point, it is possible to drill holes on the wall and use eye anchors to connect the anchor and wall through the hole of the wall through a pin shaft. At the same time, horizontal rotation adjustment can be achieved

If the walings form part of a permanent structure, they can provide protective coatings or typically sacrifice steel more economically. If coating is provided, it is recommended to further coat on-site after installation.

Each waling must be connected to the main wall to correctly transmit the forces. In order to simplify installation and adapt to vertical forces, the walings are supported by appropriately designed welded brackets. These brackets are usually made of torch cut steel plates. The internal wall (tension wall) must be carefully connected to the sheet pile wall.







Doubule Wailings	Section Modulus cm^3	Weight kg/m	Doubule Splicing	Weight kg/m	Splicing Length L	Hole position	b	f	g	h	Bolts of class 8.8 or 10.9	Quantity of Bolts
UPN180	300	44	UPN120	15	560	1	45	40	60	80	M20*45mm	32
UPN200	382	50.6	UPN140	20.5	640	1	60	40	60	120	M20*45mm	32
UPN220	490	58.8	UPN160	25.6	680	1	80	40	60	140	M20*45mm	32
UPN240	600	66.4	UPN180	32.6	740	1	90	50	75	120	M24*50mm	32
UPN260	742	75.8	UPN200	40.5	800	1	110	50	75	150	M24*50mm	32
UPN280	896	83.6	UPN220	49.4	840	12	120	50	90	140	M24*55mm	40
UPN300	1070	92.4	UPN220	54.1	920	12	120	50	90	180	M24*55mm	40
UPN320	1358	119	UPN240	66.4	1000	12	130	60	110	160	M30*65mm	40
UPN350	1468	121.2	UPN260	75.8	1000	12	140	60	110	160	M30*65mm	40
UPN380	1658	126.2	UPN300	92.4	1000	13	180	60	90	200	M30*65mm	48
UPN400	2040	143.6	UPN300	92.4	1000	13	180	60	90	200	M30*65mm	48

MACALLOY
INSTALLATION OF ANCHORS

Non axial forces such as torque and shear are eliminated, anchors perform best in pure axial forces. Therefore, this can be achieved by designing appropriate accessories and accurate alignment. Good manufacturing processes, experienced on-site installation, inspection supervision, and safety are crucial for the successful deployment of anchoring systems. The final inspection procedure should always be carried out to ensure that any damaged protection is repaired, all component connections are completed, and anchor plate accessories are correctly aligned. Sometimes, the anchor bolt plate is welded to the wall to avoid sliding when the bolts are tightened. The waling should be carefully and firmly fixed to the sheet pile wall. When a load is carried onto a concrete wall, a larger area of anchor plates need to be used to distribute the load onto the concrete.

The installation of anchors should be as close as possible to the force axis of the actual working load. Extra forces introduced through filling should be considered, especially bending at wall connections.The storage and handling of anchors and accessories should avoid excessive deformation, severe corrosion, high temperatures (such as welding, flame cutting, etc.), any bending or damage to the rod body, thread, turnbuckle,coupler or nut. All threaded components must be carefully protected to prevent dust, dirt, bumps, and wear. Before use, all threads should be checked and thoroughly cleaned. It is recommended to install on a clear and sturdy drum bracket. The length of all threaded connections cannot be less than the diameter of the thread

THE FOLLOWING IS THE RECOMMENDED INSTALLATION SEQUENCE TO ENSURE THE CORRECT INSTALLATION AND TENSIONING OF THE ANCHORS:

- Backfill to approximately 150 mm below the level of the anchor rod installation position;
- Place sandbags on both sides of connectors, turnbuckle,coupler or hinged joints every 6m;
- Pre-bend or install plastic pipes on sleepers according to design suggestions;
- Assemble with a turnbuckle to provide the designed gap between the two ends of the anchor rod. The couplers should be fully screwed to the bottom;
- Adapt to applying pre-stress from the threaded end outside the wall using a tensioning jack to compensate for relaxation;
- Tighten the nut at the tensioning thread end;
- Fill the plastic pipes with sand or carefully compact the clean particle filling material around the anchors;
- Backfill to the horizontal position required by the design, and first pay attention to completing the backfilling and compaction before anchoring. These steps are suitable for simple situations and other activities can be considered, such as applying pre-tensioned piles before final backfilling and applying stress after backfilling to prevent subsequent loads from causing future movement;
- Before the anchor rod and anchoring are completed, do not overload the front wall. Cantilevered walls often move beyond prediction, especially when subjected to dynamic loading.

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For further information call +44 (0)1909 519200
email sales@macalloy.com or visit macalloy.com

Caxton Way, Dinnington, Sheffield, S25 3QE, U.K.