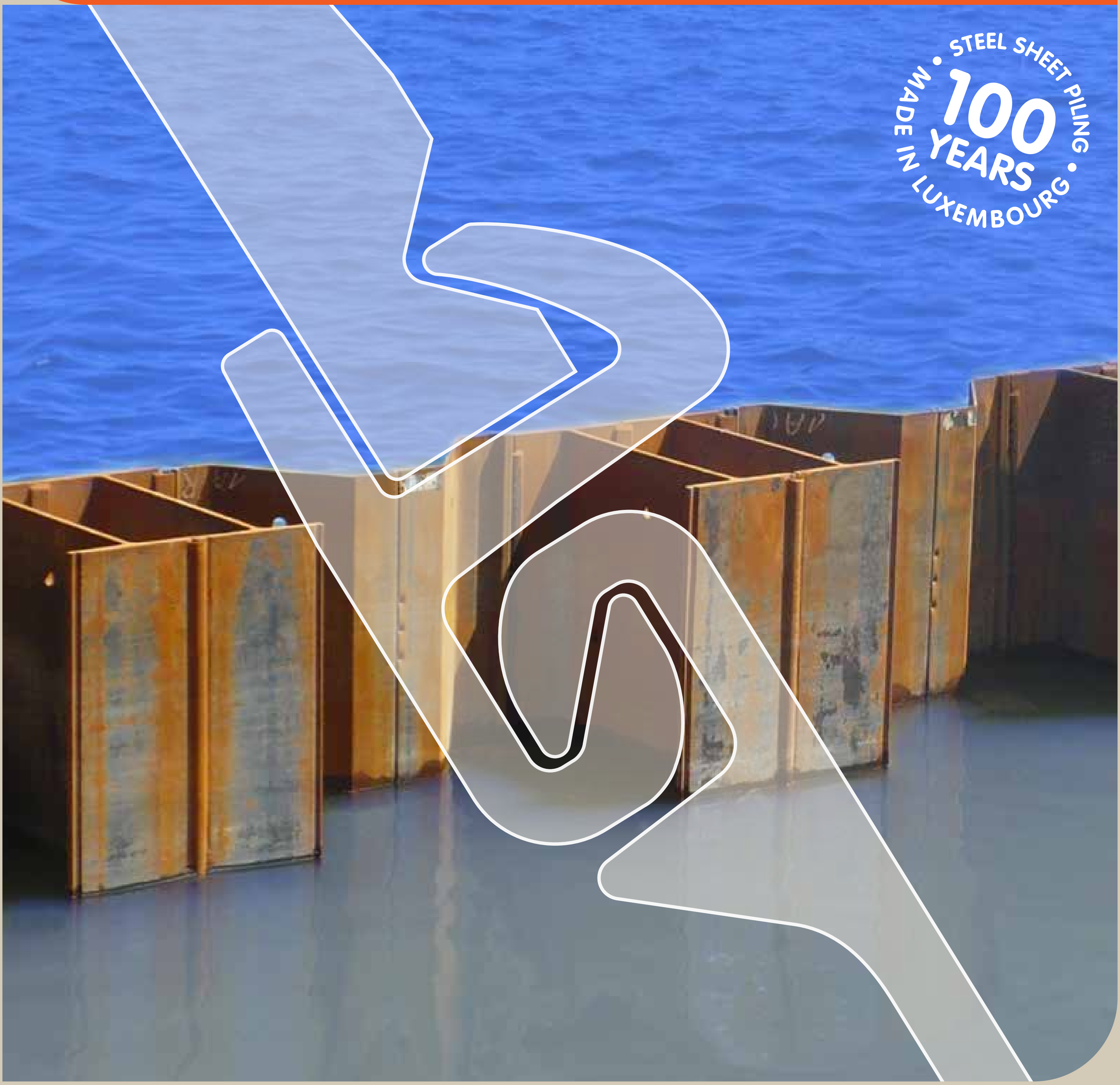
ArcelorMittal Sheet Piling

ArcelorMittal

# The HZ®-M Steel Wall System 2014



# The development of the HZ® / AZ® combined wall system

The race to build larger vessels for the movement of containers and bulk cargo around the world has resulted in an increase of the depth of major ports, and consequently the need for more heavy-load berthing facilities arose. To cope with these deeper structures, conventional steel sheet piles were replaced with 'combined walls' which consist of two complementary elements: a primary element (king pile) and a secondary element (intermediary sheet pile).

Aware of this inescapable evolution in the main application field for the high range of conventional steel sheet piles, 'Arbed' (ArcelorMittal since 2007) in Luxembourg started producing the **HZ-ZH** combined wall system in the 1970's. Quickly this system imposed itself as the first choice for the construction of new quay walls in major ports in Germany, Italy, the USA, and many emerging economies.

Later in the 1990's, the development of the AZ steel sheet piles lead to the improvement of the system: introduction of new HZ king piles that were available in different thicknesses, and the brand new infill sheet, the AZ sheet pile. This **HZ-AZ** system encountered a matchless success and is still being utilized all over the world, in most large ports, in deep excavations, in deep watertight cofferdams, etc. Shipments of the HZ/AZ system during the last years confirmed this evolution.

At the beginning of the 21th century, trends continued evolving towards larger sea-going vessels. Loads on the future berths were expected to continue to increase. Several new mega-ports were on the planning stage, most existing ports were expanding their capacities. Those investments would require the execution of a large amount of new quay walls and deepening of existing ones. New types of applications required larger high-capacity retaining walls.

As a consequence, a shortage of production capacity of the HZ-AZ combined walls was predicted for the long-term. In order to continue to supply state-of-the-art and competitive foundation solutions, the new challenge for our company consisted in developing deeper hot rolled HZ sections, with thicker flanges, and providing a substantial increase in productivity and production capacity. But above all, more cost-effective. An incredible amount of parameters and constraints, in other words, a fascinating challenge for any R&D department.

In 2007, we launched the final research project. Many technical solutions were analysed, then several promising alternatives were investigated in detail in order to retain the one that lead to the best choice: **technically an outstanding and proven solution**, based on existing experience and technology, and **economically, a highly competitive solution** compared to existing systems and alternative construction methods and materials.

The concept consists in **hot rolling a wide flange beam with variable thickness of the flange, and milling a groove into the flanges,** on which a connector will be threaded. The finished product is quite similar to the previous HZ/AZ system.

This innovative solution requires equipment that was specifically engineered and built for this high-precision task, starting from scratch. The best suppliers were challenged to design and fabricate this exclusive milling instrument that will guarantee both a higher production capacity and productivity compared to the existing system.

A supplemental advantage is that due to the very tight milling tolerances achievable it lets us provide a tighter and better mechanical connection between the flange of the king pile and the hot rolled connectors RH/RZ.

Less than one year later, in 2008 ArcelorMittal was proud to supply just on time the first HZ®-M system for a huge project in Northern Germany. A vast challenge mastered through an excellent collaboration between several departments in Luxembourg: R&D, the rolling mill, the technical and the sales department.

We never doubted about the success of this project and are confident that our customers will find within our large range of HZ/AZ combinations the most competitive solution for their project.
In 2012, ArcelorMittal have already delivered thousands of tonnes of the HZ/AZ system around the world: Brazil, Canada, France, Germany, Italy, Mexico, Nigeria, Poland, Russia, South Africa, The Netherlands, UK, USA, just to mention a few ones.

The HZ 680M was introduced in 2013.

# The HZ®-M Steel Wall System

The enhanced 'HZ Steel Wall System' is a combined wall system that comprises two elements:

- **HZ** king pile, a brand new wide flange beam with a specific flange geometry
- **AZ** infill sheet piles

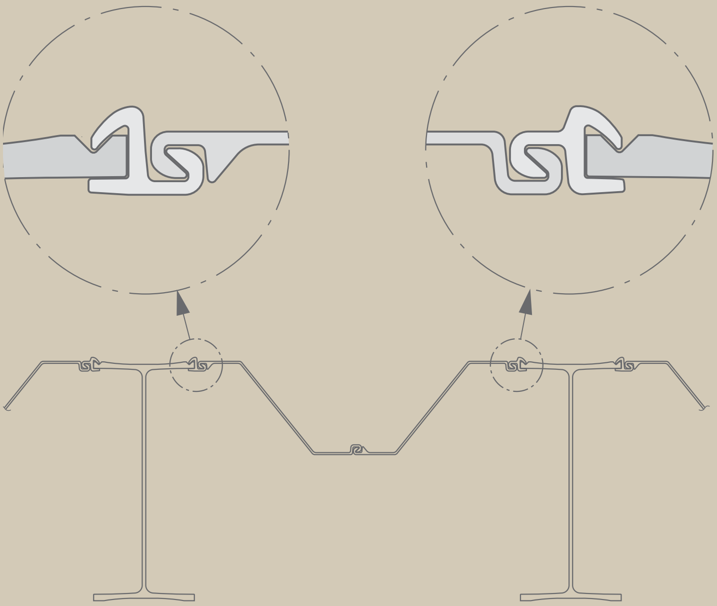
Hot rolled RZD/RZU and RH sections connect infill sheets and HZ king piles to guarantee a continuous wall.

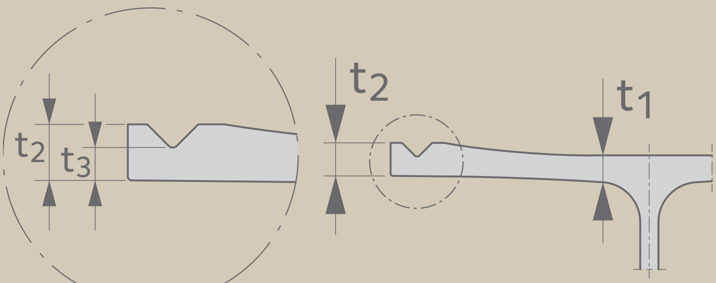
The general concept of the 'HZ steel wall system' bases on a **stiff king pile** with **light intermediary sheet piles** resulting in an overall safe and cost-effective high capacity retaining structure, with a high stiffness and high bending moment capacity.

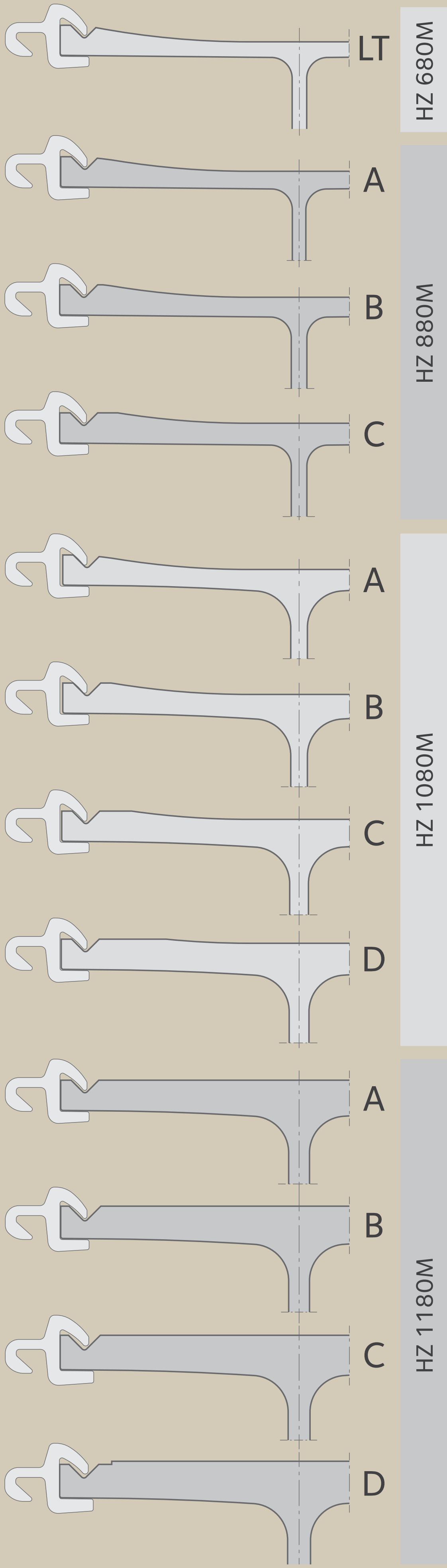
There are four HZ king piles available, and each one can be rolled in different thicknesses. Six different 'solutions' are proposed for each HZ section.

The main improvement of the HZ king piles is the concave geometry of the flanges of the lighter HZ sections, and the unmatched flange thickness of the heavier king pile sections. To thread the RH/RZ connectors, **a groove is milled into the flange**. The milling equipment was designed in order to guarantee very tight tolerances of the groove, which improves the minimum interlock hook connection and ensures a sufficient residual steel thickness $t_3$. The groove will be milled only if required, i.e. sol. 12 and sol. C1 have only grooves on one flange.

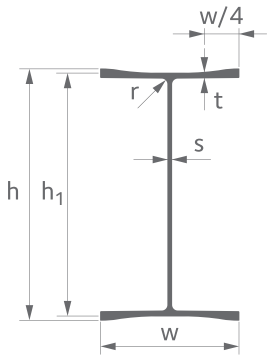
The new HZ/AZ combinations can achieve equivalent elastic section moduli $W_{el,y}$ that are more than 30% higher than with the previous HZ/AZ system.

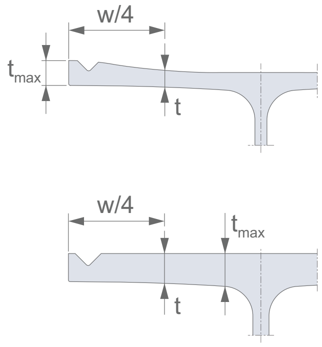




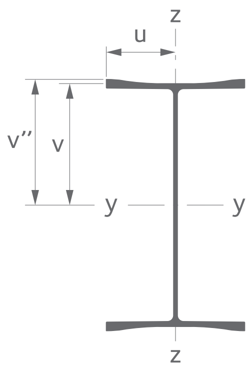
# HZ®-M - King Piles



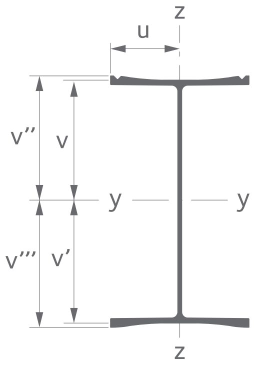

| Section | h<br>mm | h1<br>mm | w<br>mm | tmax<br>mm | t<br>mm | s<br>mm | r<br>mm | Suitable connectors | |
|---|---|---|---|---|---|---|---|---|---|
| HZ 680M LT | 631.8 | 599.9 | 460 | 29.0 | 16.9 | 14.0 | 20 | RZD/RZU 16 | RH 16 |
| HZ 880M A | 831.3 | 803.4 | 458 | 29.0 | 18.9 | 13.0 | 20 | RZD/RZU 16 | RH 16 |
| HZ 880M B | 831.3 | 807.4 | 460 | 29.0 | 20.9 | 15.0 | 20 | RZD/RZU 16 | RH 16 |
| HZ 880M C | 831.3 | 811.4 | 460 | 29.0 | 22.9 | 15.0 | 20 | RZD/RZU 16 | RH 16 |
| HZ 1080M A | 1075.3 | 1047.4 | 454 | 29.0 | 19.6 | 16.0 | 35 | RZD/RZU 16 | RH 16 |
| HZ 1080M B | 1075.3 | 1053.4 | 454 | 29.0 | 22.6 | 16.0 | 35 | RZD/RZU 16 | RH 16 |
| HZ 1080M C | 1075.3 | 1059.4 | 456 | 29.0 | 25.7 | 18.0 | 35 | RZD/RZU 16 | RH 16 |
| HZ 1080M D | 1075.3 | 1067.4 | 457 | 30.7 | 29.7 | 19.0 | 35 | RZD/RZU 16 | RH 16 |
| HZ 1180M A | 1075.4 | - | 458 | 34.7 | 31.0 | 20.0 | 35 | RZD/RZU 16 | RH 16 |
| HZ 1180M B | 1079.4 | - | 458 | 36.7 | 33.0 | 20.0 | 35 | RZD/RZU 16 | RH 16 |
| HZ 1180M C | 1083.4 | - | 459 | 38.7 | 35.0 | 21.0 | 35 | RZD/RZU 18 | RH 20 |
| HZ 1180M D | 1087.4 | - | 460 | 40.7 | 37.0 | 22.0 | 35 | RZD/RZU 18 | RH 20 |

## Solution 100



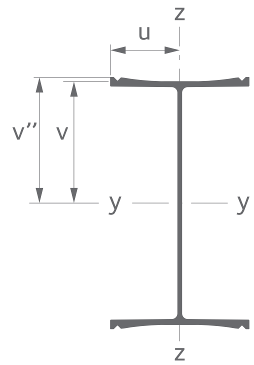

| | Dimensions | | | | | | Properties per solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section | v<br>mm | v'<br>mm | v''<br>mm | v'''<br>mm | u<br>mm | u'<br>mm | A<br>cm² | G<br>kg/m | Iy<br>cm⁴ | Iz<br>cm⁴ | Wel.y*<br>cm³ | Wel.y**<br>cm³ | Wel.z<br>cm³ | ALW<br>m²/m | ALS<br>m²/m |
| HZ 680M LT | 299.9 | - | 315.9 | - | 230.0 | - | 260.9 | **204.8** | 180 430 | 38 620 | **6 015** | - | 1 680 | 0.462 | 2.573 |
| HZ 880M A | 401.7 | - | 415.7 | - | 229.0 | - | 295.6 | **232.0** | 356 770 | 39 990 | **8 880** | - | 1 745 | 0.459 | 2.966 |
| HZ 880M B | 403.7 | - | 415.7 | - | 230.0 | - | 328.2 | **257.6** | 392 750 | 42 770 | **9 730** | - | 1 860 | 0.461 | 2.967 |
| HZ 880M C | 405.7 | - | 415.7 | - | 230.0 | - | 342.7 | **269.0** | 416 760 | 44 350 | **10 275** | - | 1 930 | 0.461 | 2.967 |
| HZ 1080M A | 523.7 | - | 537.7 | - | 227.0 | - | 374.2 | **293.8** | 705 260 | 39 330 | **13 465** | - | 1 735 | 0.455 | 3.396 |
| HZ 1080M B | 526.7 | - | 537.7 | - | 227.0 | - | 397.6 | **312.1** | 770 550 | 42 310 | **14 630** | - | 1 865 | 0.455 | 3.396 |
| HZ 1080M C | 529.7 | - | 537.7 | - | 228.0 | - | 439.6 | **345.1** | 848 970 | 44 960 | **16 025** | - | 1 970 | 0.457 | 3.397 |
| HZ 1080M D | 533.7 | - | 537.7 | - | 228.5 | - | 473.6 | **371.8** | 925 360 | 46 940 | **17 340** | - | 2 055 | 0.457 | 3.398 |
| HZ 1180M A | 537.7 | - | 537.7 | - | 229.0 | - | 500.8 | **393.1** | 983 050 | 47 950 | **18 285** | - | 2 095 | 0.458 | 3.399 |
| HZ 1180M B | 539.7 | - | 539.7 | - | 229.0 | - | 519.1 | **407.5** | 1 036 160 | 51 150 | **19 200** | - | 2 235 | 0.458 | 3.407 |
| HZ 1180M C | 541.7 | - | 541.7 | - | 229.5 | - | 548.3 | **430.4** | 1 100 310 | 54 730 | **20 310** | - | 2 385 | 0.459 | 3.416 |
| HZ 1180M D | 543.7 | - | 543.7 | - | 230.0 | - | 577.5 | **453.3** | 1 165 100 | 58 350 | **21 430** | - | 2 535 | 0.460 | 3.425 |

## Solution 102



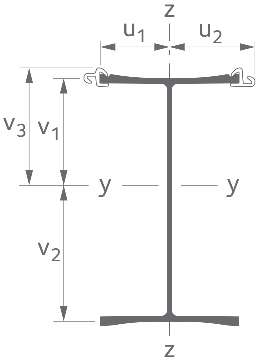

| | Dimensions | | | | | | Properties per solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | v | v′ | v″ | v‴ | u | u′ | A | G | $I_y$ | $I_z$ | $W_{el.y}$ * | $W_{el.y}$ ** | $W_{el.z}$ | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^4$ | $cm^3$ | $cm^3$ | $cm^3$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 303.7 | 296.2 | 319.7 | 312.1 | 230.0 | – | 257.8 | **202.4** | 177 370 | 37 280 | **5 840** | – | 1 620 | 0.479 | 2.573 |
| **HZ 880M A** | 406.2 | 397.2 | 420.1 | 411.2 | 229.0 | – | 292.4 | **229.5** | 351 350 | 38 640 | **8 650** | – | 1 685 | 0.478 | 2.966 |
| **HZ 880M B** | 408.1 | 399.3 | 420.0 | 411.3 | 230.0 | – | 324.7 | **254.9** | 386 810 | 41 280 | **9 480** | – | 1 795 | 0.481 | 2.967 |
| **HZ 880M C** | 409.9 | 401.5 | 419.9 | 411.4 | 230.0 | – | 339.2 | **266.3** | 410 830 | 42 870 | **10 025** | – | 1 865 | 0.480 | 2.967 |
| **HZ 1080M A** | 528.2 | 519.2 | 542.1 | 533.2 | 227.0 | – | 371.1 | **291.3** | 696 340 | 38 030 | **13 185** | – | 1 675 | 0.473 | 3.396 |
| **HZ 1080M B** | 531.4 | 522.0 | 542.3 | 533.0 | 227.0 | – | 394.1 | **309.4** | 760 600 | 40 870 | **14 315** | – | 1 800 | 0.475 | 3.396 |
| **HZ 1080M C** | 533.9 | 525.5 | 541.9 | 533.4 | 228.0 | – | 436.1 | **342.4** | 839 020 | 43 500 | **15 715** | – | 1 910 | 0.476 | 3.397 |
| **HZ 1080M D** | 537.6 | 529.8 | 541.6 | 533.7 | 228.5 | – | 470.1 | **369.0** | 915 420 | 45 480 | **17 025** | – | 1 990 | 0.477 | 3.398 |
| **HZ 1180M A** | 541.4 | 534.0 | 541.4 | 534.0 | 229.0 | – | 497.3 | **390.4** | 973 040 | 46 470 | **17 970** | – | 2 030 | 0.477 | 3.399 |
| **HZ 1180M B** | 544.5 | 534.9 | 544.5 | 534.9 | 229.0 | – | 514.5 | **403.9** | 1 022 780 | 49 180 | **18 785** | – | 2 150 | 0.481 | 3.407 |
| **HZ 1180M C** | 546.3 | 537.1 | 546.3 | 537.1 | 229.5 | – | 543.6 | **426.8** | 1 086 840 | 52 750 | **19 895** | – | 2 300 | 0.482 | 3.416 |
| **HZ 1180M D** | 550.4 | 537.0 | 550.4 | 537.0 | 230.0 | – | 570.5 | **447.8** | 1 144 400 | 55 350 | **20 795** | – | 2 405 | 0.487 | 3.425 |

## Solution 104



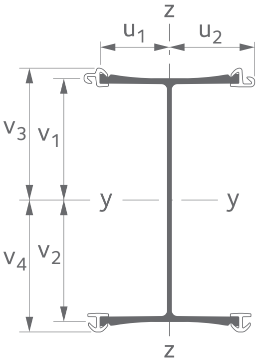

| | Dimensions | | | | | | Properties per solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | v | v′ | v″ | v‴ | u | u′ | A | G | $I_y$ | $I_z$ | $W_{el.y}$ * | $W_{el.y}$ ** | $W_{el.z}$ | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^4$ | $cm^3$ | $cm^3$ | $cm^3$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 299.9 | – | 315.9 | – | 230.0 | – | 254.7 | **199.9** | 174 380 | 35 930 | **5 815** | – | 1 560 | 0.479 | 2.590 |
| **HZ 880M A** | 401.7 | – | 415.7 | – | 229.0 | – | 289.2 | **227.0** | 346 040 | 37 290 | **8 615** | – | 1 630 | 0.478 | 2.984 |
| **HZ 880M B** | 403.7 | – | 415.7 | – | 230.0 | – | 321.3 | **252.2** | 381 010 | 39 800 | **9 440** | – | 1 730 | 0.481 | 2.987 |
| **HZ 880M C** | 405.7 | – | 415.7 | – | 230.0 | – | 335.7 | **263.6** | 405 030 | 41 380 | **9 985** | – | 1 800 | 0.480 | 2.987 |
| **HZ 1080M A** | 523.7 | – | 537.7 | – | 227.0 | – | 368.0 | **288.9** | 687 560 | 36 730 | **13 130** | – | 1 620 | 0.473 | 3.414 |
| **HZ 1080M B** | 526.7 | – | 537.7 | – | 227.0 | – | 390.6 | **306.7** | 750 820 | 39 430 | **14 255** | – | 1 735 | 0.475 | 3.415 |
| **HZ 1080M C** | 529.7 | – | 537.7 | – | 228.0 | – | 432.7 | **339.6** | 829 230 | 42 050 | **15 655** | – | 1 845 | 0.476 | 3.417 |
| **HZ 1080M D** | 533.7 | – | 537.7 | – | 228.5 | – | 466.7 | **366.3** | 905 630 | 44 020 | **16 970** | – | 1 925 | 0.477 | 3.417 |
| **HZ 1180M A** | 537.7 | – | 537.7 | – | 229.0 | – | 493.8 | **387.7** | 963 160 | 44 990 | **17 915** | – | 1 965 | 0.477 | 3.418 |
| **HZ 1180M B** | 539.7 | – | 539.7 | – | 229.0 | – | 509.8 | **400.2** | 1 009 630 | 47 220 | **18 705** | – | 2 060 | 0.481 | 3.430 |
| **HZ 1180M C** | 541.7 | – | 541.7 | – | 229.5 | – | 539.0 | **423.1** | 1 073 590 | 50 780 | **19 820** | – | 2 210 | 0.482 | 3.439 |
| **HZ 1180M D** | 543.7 | – | 543.7 | – | 230.0 | – | 563.4 | **442.3** | 1 124 210 | 52 350 | **20 675** | – | 2 275 | 0.487 | 3.440 |

## Solution 12



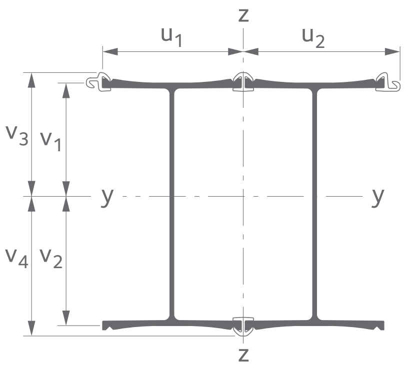

| | Dimensions | | | | | | Properties per solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $u_1$ | $u_2$ | A | G | $I_y$ | $I_z$ | $W_{el.y}$* | $W_{el.y}$** | $W_{el.z}$ | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^4$ | $cm^3$ | $cm^3$ | $cm^3$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 261.7 | 338.1 | 298.1 | - | 229.8 | 282.9 | 298.9 | **234.7** | 210 510 | 61 270 | **6 225** | 7 060 | 2 165 | 0.620 | 2.623 |
| **HZ 880M A** | 356.2 | 447.2 | 390.5 | - | 228.9 | 282.9 | 333.5 | **261.8** | 410 770 | 62 640 | **9 185** | 10 520 | 2 215 | 0.621 | 3.017 |
| **HZ 880M B** | 362.5 | 444.9 | 394.9 | - | 229.9 | 283.9 | 365.8 | **287.2** | 446 960 | 65 480 | **10 045** | 11 320 | 2 305 | 0.624 | 3.019 |
| **HZ 880M C** | 366.1 | 445.3 | 396.4 | - | 229.9 | 283.9 | 380.3 | **298.5** | 471 210 | 67 060 | **10 580** | 11 885 | 2 360 | 0.624 | 3.019 |
| **HZ 1080M A** | 475.6 | 571.8 | 509.9 | - | 226.9 | 280.9 | 412.2 | **323.6** | 799 480 | 61 630 | **13 980** | 15 680 | 2 195 | 0.617 | 3.448 |
| **HZ 1080M B** | 481.5 | 571.9 | 512.9 | - | 226.9 | 280.9 | 435.2 | **341.6** | 864 430 | 64 470 | **15 115** | 16 855 | 2 295 | 0.618 | 3.447 |
| **HZ 1080M C** | 488.5 | 570.9 | 516.8 | - | 227.9 | 281.9 | 477.2 | **374.6** | 943 630 | 67 300 | **16 530** | 18 260 | 2 390 | 0.619 | 3.449 |
| **HZ 1080M D** | 495.3 | 572.1 | 519.6 | - | 228.4 | 282.4 | 511.2 | **401.3** | 1 020 560 | 69 380 | **17 840** | 19 645 | 2 455 | 0.620 | 3.450 |
| **HZ 1180M A** | 501.2 | 574.2 | 521.5 | - | 228.9 | 282.9 | 538.4 | **422.7** | 1 078 560 | 70 470 | **18 785** | 20 680 | 2 490 | 0.621 | 3.450 |
| **HZ 1180M B** | 505.5 | 573.9 | 523.8 | - | 228.9 | 282.9 | 555.6 | **436.1** | 1 129 000 | 73 180 | **19 670** | 21 555 | 2 585 | 0.622 | 3.454 |
| **HZ 1180M C** | 505.5 | 577.9 | 524.8 | - | 229.4 | 283.4 | 589.2 | **462.5** | 1 203 660 | 78 980 | **20 830** | 22 935 | 2 785 | 0.635 | 3.463 |
| **HZ 1180M D** | 511.2 | 576.2 | 528.5 | - | 229.9 | 283.9 | 616.1 | **483.6** | 1 262 570 | 81 690 | **21 915** | 23 890 | 2 875 | 0.641 | 3.468 |

## Solution 14



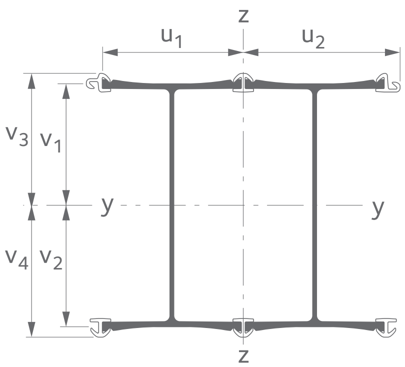

| | Dimensions | | | | | | Properties per solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $u_1$ | $u_2$ | A | G | $I_y$ | $I_z$ | $W_{el.y}$* | $W_{el.y}$** | $W_{el.z}$ | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^4$ | $cm^3$ | $cm^3$ | $cm^3$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 299.5 | 300.4 | 335.8 | 336.9 | 229.8 | 282.9 | 336.0 | **263.8** | 249 190 | 82 640 | **8 295** | 7 400 | 2 920 | 0.620 | 2.853 |
| **HZ 880M A** | 401.1 | 402.4 | 435.4 | 436.8 | 228.9 | 282.9 | 370.6 | **290.9** | 478 080 | 83 810 | **11 880** | 10 945 | 2 965 | 0.621 | 3.253 |
| **HZ 880M B** | 403.1 | 404.3 | 435.4 | 436.8 | 229.9 | 283.9 | 402.6 | **316.1** | 513 050 | 86 710 | **12 690** | 11 745 | 3 055 | 0.624 | 3.256 |
| **HZ 880M C** | 405.1 | 406.3 | 435.5 | 436.7 | 229.9 | 283.9 | 417.1 | **327.4** | 537 070 | 88 290 | **13 220** | 12 300 | 3 110 | 0.624 | 3.255 |
| **HZ 1080M A** | 522.9 | 524.5 | 557.2 | 558.9 | 226.9 | 280.9 | 449.3 | **352.7** | 911 570 | 82 480 | **17 380** | 16 310 | 2 935 | 0.617 | 3.683 |
| **HZ 1080M B** | 526.0 | 527.4 | 557.3 | 558.9 | 226.9 | 280.9 | 472.0 | **370.5** | 974 820 | 85 180 | **18 485** | 17 445 | 3 035 | 0.618 | 3.684 |
| **HZ 1080M C** | 529.0 | 530.4 | 557.3 | 558.8 | 227.9 | 281.9 | 514.0 | **403.5** | 1 053 250 | 88 180 | **19 860** | 18 850 | 3 130 | 0.619 | 3.685 |
| **HZ 1080M D** | 533.1 | 534.3 | 557.4 | 558.8 | 228.4 | 282.4 | 548.0 | **430.2** | 1 129 640 | 90 350 | **21 140** | 20 215 | 3 200 | 0.620 | 3.686 |
| **HZ 1180M A** | 537.1 | 538.3 | 557.4 | 558.7 | 228.9 | 282.9 | 575.2 | **451.5** | 1 187 170 | 91 510 | **22 055** | 21 250 | 3 235 | 0.621 | 3.687 |
| **HZ 1180M B** | 539.1 | 540.3 | 557.4 | 558.7 | 228.9 | 282.8 | 591.2 | **464.1** | 1 233 640 | 93 740 | **22 835** | 22 080 | 3 315 | 0.622 | 3.688 |
| **HZ 1180M C** | 545.9 | 537.5 | 565.2 | 556.8 | 229.4 | 283.4 | 635.1 | **498.5** | 1 336 980 | 105 670 | **24 490** | 23 655 | 3 730 | 0.635 | 3.722 |
| **HZ 1180M D** | 547.8 | 539.6 | 565.1 | 556.9 | 229.9 | 283.9 | 659.5 | **517.7** | 1 387 600 | 107 480 | **25 335** | 24 555 | 3 785 | 0.641 | 3.728 |

## Solution 24



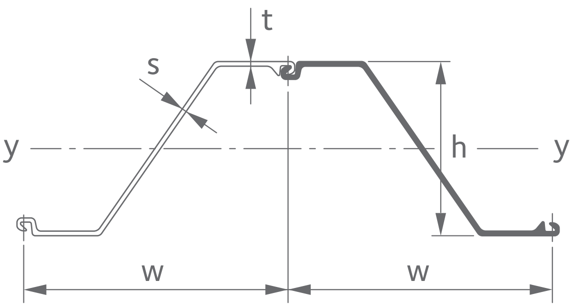

| | Dimensions | | | | | | Properties per solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $u_1$ | $u_2$ | A | G | $I_y$ | $I_z$ | $W_{el.y}$* | $W_{el.y}$** | $W_{el.z}$ | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^4$ | $cm^3$ | $cm^3$ | $cm^3$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 279.0 | 320.9 | 315.3 | 357.4 | 466.8 | 519.9 | 590.7 | **463.7** | 420 940 | 452 060 | **13 120** | 11 780 | 8 695 | 1.144 | 3.163 |
| **HZ 880M A** | 376.7 | 426.7 | 411.2 | 461.2 | 464.8 | 518.9 | 659.8 | **518.0** | 820 000 | 490 460 | **19 220** | 17 780 | 9 450 | 1.144 | 3.559 |
| **HZ 880M B** | 380.9 | 426.5 | 413.4 | 458.9 | 466.9 | 520.9 | 723.9 | **568.3** | 890 310 | 534 990 | **20 875** | 19 400 | 10 270 | 1.150 | 3.565 |
| **HZ 880M C** | 383.8 | 427.6 | 414.3 | 458.1 | 466.9 | 520.9 | 752.8 | **591.0** | 938 480 | 554 410 | **21 950** | 20 490 | 10 645 | 1.150 | 3.565 |
| **HZ 1080M A** | 497.4 | 550.0 | 531.8 | 584.4 | 460.9 | 514.9 | 817.3 | **641.6** | 1 593 470 | 568 570 | **28 970** | 27 265 | 11 045 | 1.136 | 3.985 |
| **HZ 1080M B** | 501.8 | 551.6 | 533.2 | 583.1 | 460.9 | 514.9 | 862.6 | **677.2** | 1 720 280 | 598 790 | **31 185** | 29 505 | 11 630 | 1.138 | 3.987 |
| **HZ 1080M C** | 507.0 | 552.4 | 535.4 | 580.8 | 462.9 | 516.9 | 946.7 | **743.1** | 1 877 600 | 654 870 | **33 990** | 32 325 | 12 670 | 1.141 | 3.990 |
| **HZ 1080M D** | 512.5 | 554.9 | 536.9 | 579.3 | 463.9 | 517.9 | 1014.7 | **796.5** | 2 030 710 | 698 950 | **36 595** | 35 055 | 13 495 | 1.142 | 3.991 |
| **HZ 1180M A** | 517.6 | 557.8 | 538.0 | 578.2 | 464.9 | 518.9 | 1069.0 | **839.2** | 2 146 010 | 733 770 | **38 470** | 37 115 | 14 140 | 1.144 | 3.993 |
| **HZ 1180M B** | 520.2 | 559.2 | 538.6 | 577.7 | 464.9 | 518.9 | 1101.0 | **864.3** | 2 239 080 | 756 060 | **40 040** | 38 760 | 14 570 | 1.147 | 4.002 |
| **HZ 1180M C** | 521.4 | 562.0 | 540.7 | 581.3 | 466.9 | 520.9 | 1174.1 | **921.6** | 2 405 860 | 813 450 | **42 810** | 41 390 | 15 615 | 1.164 | 4.015 |
| **HZ 1180M D** | 524.2 | 563.2 | 541.5 | 580.5 | 467.9 | 521.9 | 1222.9 | **960.0** | 2 507 280 | 847 260 | **44 520** | 43 195 | 16 235 | 1.176 | 4.025 |

## Solution 26




| | Dimensions | | | | | | Properties per solution | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $u_1$ | $u_2$ | A | G | $I_y$ | $I_z$ | $W_{el.y}$* | $W_{el.y}$** | $W_{el.z}$ | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^4$ | $cm^3$ | $cm^3$ | $cm^3$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 299.7 | 300.2 | 336.0 | 336.6 | 466.8 | 519.9 | 631.0 | **495.3** | 460 880 | 542 600 | **15 355** | 13 690 | 10 435 | 1.144 | 3.376 |
| **HZ 880M A** | 401.4 | 402.0 | 435.8 | 436.5 | 464.9 | 518.8 | 700.1 | **549.6** | 889 890 | 580 240 | **22 135** | 20 385 | 11 185 | 1.144 | 3.776 |
| **HZ 880M B** | 403.4 | 404.0 | 435.8 | 436.5 | 467.0 | 520.8 | 764.1 | **599.9** | 959 830 | 625 530 | **23 755** | 21 990 | 12 010 | 1.150 | 3.782 |
| **HZ 880M C** | 405.4 | 406.0 | 435.9 | 436.5 | 467.0 | 520.8 | 793.1 | **622.6** | 1 007 860 | 644 950 | **24 825** | 23 090 | 12 385 | 1.150 | 3.782 |
| **HZ 1080M A** | 523.3 | 524.1 | 557.7 | 558.5 | 460.9 | 514.9 | 857.6 | **673.2** | 1 710 510 | 656 830 | **32 635** | 30 625 | 12 755 | 1.136 | 4.202 |
| **HZ 1080M B** | 526.3 | 527.1 | 557.7 | 558.5 | 460.9 | 514.9 | 902.9 | **708.8** | 1 837 030 | 687 060 | **34 855** | 32 890 | 13 345 | 1.138 | 4.204 |
| **HZ 1080M C** | 529.4 | 530.1 | 557.8 | 558.5 | 462.9 | 516.9 | 986.9 | **774.7** | 1 993 870 | 743 900 | **37 615** | 35 700 | 14 395 | 1.141 | 4.208 |
| **HZ 1080M D** | 533.4 | 534.0 | 557.8 | 558.5 | 463.9 | 517.9 | 1054.9 | **828.1** | 2 146 660 | 788 350 | **40 195** | 38 440 | 15 225 | 1.142 | 4.209 |
| **HZ 1180M A** | 537.4 | 538.0 | 557.8 | 558.4 | 464.9 | 518.9 | 1109.3 | **870.8** | 2 261 730 | 823 550 | **42 040** | 40 500 | 15 875 | 1.144 | 4.210 |
| **HZ 1180M B** | 539.4 | 540.0 | 557.8 | 558.4 | 464.9 | 518.8 | 1141.3 | **895.9** | 2 354 670 | 845 840 | **43 605** | 42 165 | 16 305 | 1.147 | 4.213 |
| **HZ 1180M C** | 543.9 | 539.5 | 563.2 | 558.8 | 466.9 | 520.9 | 1224.5 | **961.3** | 2 549 710 | 927 520 | **46 880** | 45 275 | 17 805 | 1.164 | 4.251 |
| **HZ 1180M D** | 545.8 | 541.6 | 563.1 | 558.9 | 467.9 | 521.9 | 1273.4 | **999.6** | 2 650 950 | 961 810 | **48 570** | 47 080 | 18 430 | 1.176 | 4.264 |

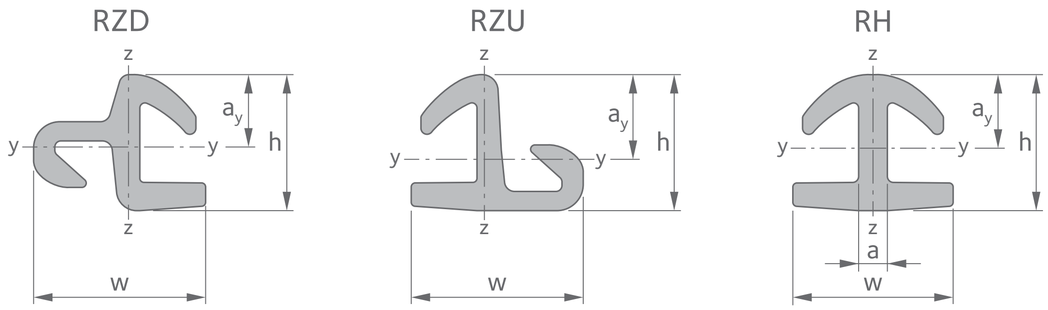
## AZ® - Intermediary Piles




| Section | Dimensions h | w | t | s | Properties Double Piles A | G | $I_y$ | $W_{el.y}$ | $i_y$ | $A_{LW}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^3$ | cm | $m^2/m$ |
| **AZ 13-770** | 344 | 770 | 9.0 | 9.0 | 193.8 | **152.1** | 34 440 | **2 000** | 13.33 | 1.85 |
| **AZ 14-770** | 345 | 770 | 9.5 | 9.5 | 202.6 | **159.0** | 35 890 | **2 085** | 13.31 | 1.85 |
| **AZ 13-700** | 315 | 700 | 9.5 | 9.5 | 188.5 | **148.0** | 28 750 | **1 825** | 12.35 | 1.71 |
| **AZ 13-700-10/10** | 316 | 700 | 10.0 | 10.0 | 196.6 | **154.3** | 29 910 | **1 895** | 12.33 | 1.71 |
| **AZ 18-700** | 420 | 700 | 9.0 | 9.0 | 194.9 | **153.0** | 52 920 | **2 520** | 16.47 | 1.86 |
| **AZ 20-700** | 421 | 700 | 10.0 | 10.0 | 212.8 | **167.0** | 57 340 | **2 725** | 16.42 | 1.86 |
| **AZ 26-700** | 460 | 700 | 12.2 | 12.2 | 262.1 | **205.7** | 83 610 | **3 635** | 17.86 | 1.93 |
| **AZ 26-700N** | 460 | 700 | 13.5 | 10.0 | 247.0 | **193.9** | 83 710 | **3 640** | 18.41 | 1.92 |
| **AZ 18-10/10** | 381 | 630 | 10.0 | 10.0 | 198.1 | **155.5** | 44 790 | **2 355** | 15.04 | 1.71 |
| **AZ 26** | 427 | 630 | 13.0 | 12.2 | 249.2 | **195.6** | 69 940 | **3 280** | 16.75 | 1.78 |

**Note:** Any AZ sheet pile from our production range can be used. Above list shows the most commonly used infill sheet piles.

## Connectors




| Section | Dimensions h | w | a | $a_y$ | Properties A | G | $I_y$ | $I_z$ | $W_{el.y}$ | $W_{el.z}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mm | mm | mm | mm | $cm^2$ | kg/m | $cm^4$ | $cm^4$ | $cm^3$ | $cm^3$ | $m^2/m$ | $m^2/m$ |
| **RZD 16** | 61.8 | 80.5 | - | 31.5 | 20.7 | **16.2** | 57 | 94 | **18** | 22 | 0.12 | 0.06 |
| **RZU 16** | 61.8 | 80.5 | - | 38.3 | 20.4 | **16.0** | 68 | 94 | **18** | 22 | 0.08 | 0.10 |
| **RH 16** | 61.8 | 68.2 | 12.2 | 32.5 | 20.1 | **15.8** | 83 | 54 | **25** | 16 | 0.10 | 0.09 |
| **RZD 18** | 67.3 | 85.0 | - | 35.9 | 23.0 | **18.0** | 78 | 110 | **22** | 25 | 0.12 | 0.07 |
| **RZU 18** | 67.3 | 85.0 | - | 42.1 | 22.6 | **17.8** | 92 | 110 | **22** | 25 | 0.09 | 0.10 |
| **RH 20** | 67.3 | 79.2 | 14.2 | 36.5 | 25.2 | **19.8** | 122 | 88 | **33** | 22 | 0.11 | 0.10 |

# Delivery conditions

## Tolerances

| Standard EN 10248 | HZ | | AZ |
|---|---|---|---|
| Mass [1] | | ± 5 % | |
| Length (L) | | ± 200 mm | |
| Thicknesses (t,s) | t,s > 12.5 mm: + 2.5 mm / -1.5 mm | | t,s > 8.5 mm: ± 6 % |
| Height (h) | h ≥ 500 mm: ± 7.0 mm | | h ≥ 300 mm: ± 7.0 mm |
| Width single pile (w) | | ± 2 % w | |
| Width double piles | | ± 3 % w | |
| Straightness (q) | | ≤ 0.2 % L | |
| Ends out of square | | ± 2 % w | |

[1] from the mass of the total delivery

## Maximum rolling length[1]

| | |
|---|---|
| HZ | 33.0 m |
| AZ | 31.0 m |
| RZD / RZU / RH | 24.0 m |

[1] longer sections may be supplied. Please contact us.

| Section \ Steel Grade | EN 10248 S 240 GP | S 270 GP | S 320 GP | S 355 GP | S 390 GP | S 430 GP | S 460 AP* | ASTM A 572 | A 690 |
|---|---|---|---|---|---|---|---|---|---|
| HZ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| AZ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| RH / RZD / RZU | × | × | × | × | × | ✓ | ✓ | × | ✓ |

✓ available × currently unavailable

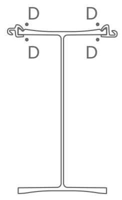
## Steel Grades

| Standard EN 10248 | Min. yield strength $R_{eH}$ MPa | Min. tensile strength $R_m$ MPa | Min. elongation $L_o = 5.65 \sqrt{S_o}$ % |
|---|---|---|---|
| **S 240 GP** | **240** | 340 | 26 |
| **S 270 GP** | **270** | 410 | 24 |
| **S 320 GP** | **320** | 440 | 23 |
| **S 355 GP** | **355** | 480 | 22 |
| **S 390 GP** | **390** | 490 | 20 |
| **S 430 GP** | **430** | 510 | 19 |
| **ArcelorMittal mill specification** | | | |
| **S 460 AP** | **460** | 550 | 17 |

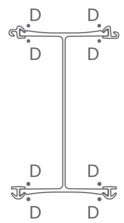
All the components of the HZ Steel Wall System are available in **ASTM A 690** steel grade. **ASTM A 690** with higher yield strength on request.

# Standard Welding Configuration

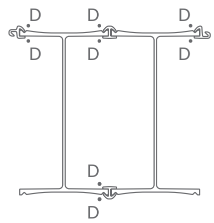
Sol 12



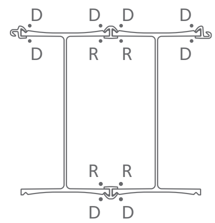

Sol 14



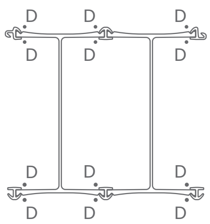

Sol 24 - Form 'a'



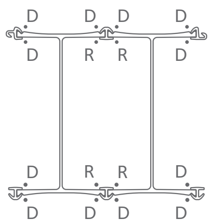

Sol 24 - Form 'b'



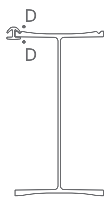

Sol 26 - Form 'a'



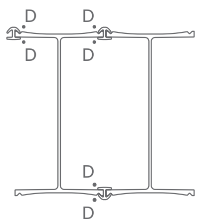

Sol 26 - Form 'b'



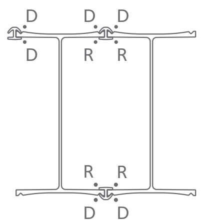

Sol C1




Sol C23 - Form 'a'




Sol C23 - Form 'b'




**D** discontinuous weld, a = 6 mm: 10% of length (100 mm/m) over whole connector length & 500 mm continuous weld at top and toe of connector
**R** continuous weld, a = 6 mm: 500 mm at top and toe of connector

In **Form 'a'** the HZ king piles can be driven separately if necessary (for instance, in hard driving conditions).
**Form 'b' is the standard delivery form:** the HZ king piles are welded together and can only be driven in one piece as a box pile.
If hard driving conditions are predicted, the length of the discontinuous weld 'D' should be increased. Please contact our technical department for more details.

## Combination HZ ... M - 12 / AZ 13-770 ($b_{sys}$= 2.067 m)

| | Properties per meter of wall | | | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|
| | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
| Section | $cm^2/m$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $kg/m^2$ | $kg/m^2$ | $kg/m^2$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 238.0 | 118 330 | **3 500** | 3 970 | 151 | 169 | **187** | 2.465 | 4.468 |
| **HZ 880M A** | 255.0 | 215 290 | **4 815** | 5 515 | 164 | 182 | **200** | 2.466 | 4.862 |
| **HZ 880M B** | 270.4 | 232 560 | **5 230** | 5 890 | 177 | 194 | **212** | 2.469 | 4.864 |
| **HZ 880M C** | 277.4 | 244 270 | **5 485** | 6 160 | 182 | 200 | **218** | 2.469 | 4.864 |
| **HZ 1080M A** | 293.6 | 404 030 | **7 065** | 7 925 | 195 | 213 | **230** | 2.462 | 5.293 |
| **HZ 1080M B** | 304.8 | 435 500 | **7 615** | 8 490 | 203 | 221 | **239** | 2.463 | 5.293 |
| **HZ 1080M C** | 324.8 | 473 410 | **8 295** | 9 160 | 219 | 237 | **255** | 2.464 | 5.294 |
| **HZ 1080M D** | 341.1 | 510 400 | **8 920** | 9 825 | 232 | 250 | **268** | 2.465 | 5.295 |
| **HZ 1180M A** | 354.1 | 538 200 | **9 375** | 10 320 | 242 | 260 | **278** | 2.466 | 5.295 |
| **HZ 1180M B** | 362.4 | 562 590 | **9 800** | 10 740 | 249 | 267 | **284** | 2.467 | 5.299 |
| **HZ 1180M C** | 378.5 | 598 400 | **10 355** | 11 400 | 261 | 279 | **297** | 2.480 | 5.308 |
| **HZ 1180M D** | 391.2 | 626 580 | **10 875** | 11 855 | 271 | 289 | **307** | 2.486 | 5.313 |

## Combination HZ ... M - 14 / AZ 13-770 ($b_{sys}$= 2.067 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 256.0 | 137 020 | **4 560** | 4 070 | 159 | 180 | **201** | 2.465 | 4.698 |
| **HZ 880M A** | 272.9 | 247 840 | **6 160** | 5 675 | 172 | 193 | **214** | 2.466 | 5.098 |
| **HZ 880M B** | 288.1 | 264 490 | **6 540** | 6 055 | 184 | 205 | **226** | 2.469 | 5.101 |
| **HZ 880M C** | 295.1 | 276 090 | **6 795** | 6 320 | 190 | 211 | **232** | 2.469 | 5.100 |
| **HZ 1080M A** | 311.6 | 458 340 | **8 740** | 8 200 | 203 | 224 | **245** | 2.462 | 5.528 |
| **HZ 1080M B** | 322.6 | 488 980 | **9 270** | 8 750 | 211 | 232 | **253** | 2.463 | 5.529 |
| **HZ 1080M C** | 342.6 | 526 470 | **9 925** | 9 420 | 227 | 248 | **269** | 2.464 | 5.530 |
| **HZ 1080M D** | 358.9 | 563 170 | **10 540** | 10 080 | 240 | 261 | **282** | 2.465 | 5.531 |
| **HZ 1180M A** | 371.9 | 590 720 | **10 975** | 10 575 | 250 | 271 | **292** | 2.466 | 5.532 |
| **HZ 1180M B** | 379.6 | 613 190 | **11 350** | 10 975 | 256 | 277 | **298** | 2.467 | 5.533 |
| **HZ 1180M C** | 400.6 | 662 840 | **12 140** | 11 725 | 270 | 292 | **314** | 2.480 | 5.567 |
| **HZ 1180M D** | 412.2 | 686 980 | **12 540** | 12 160 | 280 | 302 | **324** | 2.486 | 5.573 |

## Combination HZ ... M - 24 / AZ 13-770 ($b_{sys}$= 2.538 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 308.4 | 179 000 | **5 580** | 5 010 | 213 | 228 | **242** | 2.989 | 5.008 |
| **HZ 880M A** | 336.1 | 336 390 | **7 885** | 7 295 | 235 | 249 | **264** | 2.989 | 5.404 |
| **HZ 880M B** | 360.7 | 363 500 | **8 525** | 7 920 | 254 | 269 | **283** | 2.995 | 5.410 |
| **HZ 880M C** | 372.1 | 382 440 | **8 945** | 8 350 | 263 | 278 | **292** | 2.995 | 5.410 |
| **HZ 1080M A** | 399.3 | 642 930 | **11 690** | 11 000 | 284 | 299 | **313** | 2.981 | 5.830 |
| **HZ 1080M B** | 417.2 | 693 020 | **12 565** | 11 885 | 298 | 313 | **328** | 2.983 | 5.832 |
| **HZ 1080M C** | 449.7 | 753 960 | **13 650** | 12 980 | 324 | 338 | **353** | 2.986 | 5.835 |
| **HZ 1080M D** | 476.1 | 813 690 | **14 665** | 14 045 | 345 | 359 | **374** | 2.987 | 5.836 |
| **HZ 1180M A** | 497.2 | 858 450 | **15 390** | 14 845 | 361 | 376 | **390** | 2.989 | 5.838 |
| **HZ 1180M B** | 509.8 | 895 090 | **16 005** | 15 495 | 371 | 386 | **400** | 2.992 | 5.847 |
| **HZ 1180M C** | 537.7 | 959 240 | **17 070** | 16 500 | 393 | 407 | **422** | 3.009 | 5.860 |
| **HZ 1180M D** | 556.4 | 998 320 | **17 725** | 17 200 | 407 | 422 | **437** | 3.021 | 5.870 |

## Combination HZ ... M - 26 / AZ 13-770 ($b_{sys}$= 2.538 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 324.2 | 194 700 | **6 485** | 5 785 | 221 | 238 | **254** | 2.989 | 5.221 |
| **HZ 880M A** | 351.9 | 363 910 | **9 050** | 8 335 | 242 | 259 | **276** | 2.989 | 5.621 |
| **HZ 880M B** | 376.5 | 390 830 | **9 675** | 8 955 | 262 | 279 | **296** | 2.995 | 5.627 |
| **HZ 880M C** | 387.9 | 409 710 | **10 090** | 9 385 | 271 | 288 | **305** | 2.995 | 5.627 |
| **HZ 1080M A** | 415.2 | 689 160 | **13 150** | 12 340 | 292 | 309 | **326** | 2.981 | 6.047 |
| **HZ 1080M B** | 433.1 | 739 130 | **14 025** | 13 235 | 306 | 323 | **340** | 2.983 | 6.049 |
| **HZ 1080M C** | 465.6 | 799 810 | **15 090** | 14 320 | 331 | 348 | **365** | 2.986 | 6.053 |
| **HZ 1080M D** | 492.0 | 859 380 | **16 090** | 15 390 | 352 | 369 | **386** | 2.987 | 6.054 |
| **HZ 1180M A** | 513.0 | 904 000 | **16 805** | 16 190 | 369 | 386 | **403** | 2.989 | 6.055 |
| **HZ 1180M B** | 525.6 | 940 590 | **17 420** | 16 845 | 379 | 396 | **413** | 2.992 | 6.058 |
| **HZ 1180M C** | 557.5 | 1 015 780 | **18 675** | 18 035 | 402 | 420 | **438** | 3.009 | 6.096 |
| **HZ 1180M D** | 576.3 | 1 054 750 | **19 325** | 18 730 | 417 | 434 | **452** | 3.021 | 6.109 |

## Combination HZ ... M - 12 / AZ 14-770 ($b_{sys}$= 2.067 m)

| Section | Properties per meter of wall | | | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|
| | A | $I_y$ | $W_{ely}$* | $W_{ely}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
| | $cm^2/m$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $kg/m^2$ | $kg/m^2$ | $kg/m^2$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 242.3 | 119 030 | **3 520** | 3 995 | 153 | 172 | **190** | 2.465 | 4.468 |
| **HZ 880M A** | 259.2 | 215 990 | **4 830** | 5 530 | 167 | 185 | **204** | 2.466 | 4.862 |
| **HZ 880M B** | 274.6 | 233 260 | **5 245** | 5 905 | 179 | 197 | **216** | 2.469 | 4.864 |
| **HZ 880M C** | 281.6 | 244 980 | **5 500** | 6 180 | 184 | 203 | **221** | 2.469 | 4.864 |
| **HZ 1080M A** | 297.9 | 404 730 | **7 080** | 7 940 | 197 | 215 | **234** | 2.462 | 5.293 |
| **HZ 1080M B** | 309.0 | 436 200 | **7 630** | 8 505 | 206 | 224 | **243** | 2.463 | 5.293 |
| **HZ 1080M C** | 329.1 | 474 110 | **8 305** | 9 175 | 221 | 240 | **258** | 2.464 | 5.294 |
| **HZ 1080M D** | 345.3 | 511 100 | **8 935** | 9 835 | 234 | 253 | **271** | 2.465 | 5.295 |
| **HZ 1180M A** | 358.3 | 538 900 | **9 385** | 10 335 | 244 | 263 | **281** | 2.466 | 5.295 |
| **HZ 1180M B** | 366.6 | 563 290 | **9 815** | 10 755 | 251 | 269 | **288** | 2.467 | 5.299 |
| **HZ 1180M C** | 382.7 | 599 100 | **10 370** | 11 415 | 263 | 282 | **300** | 2.480 | 5.308 |
| **HZ 1180M D** | 395.5 | 627 280 | **10 885** | 11 870 | 273 | 292 | **310** | 2.486 | 5.313 |

## Combination HZ ... M - 14 / AZ 14-770 ($b_{sys}$= 2.067 m)

| Section | A | $I_y$ | $W_{ely}$* | $W_{ely}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 260.2 | 137 720 | **4 585** | 4 090 | 161 | 183 | **204** | 2.465 | 4.698 |
| **HZ 880M A** | 277.2 | 248 540 | **6 175** | 5 690 | 174 | 196 | **218** | 2.466 | 5.098 |
| **HZ 880M B** | 292.4 | 265 190 | **6 560** | 6 070 | 186 | 208 | **230** | 2.469 | 5.101 |
| **HZ 880M C** | 299.4 | 276 790 | **6 815** | 6 340 | 192 | 213 | **235** | 2.469 | 5.100 |
| **HZ 1080M A** | 315.9 | 459 040 | **8 750** | 8 215 | 205 | 226 | **248** | 2.462 | 5.528 |
| **HZ 1080M B** | 326.8 | 489 690 | **9 285** | 8 760 | 213 | 235 | **257** | 2.463 | 5.529 |
| **HZ 1080M C** | 346.9 | 527 170 | **9 940** | 9 435 | 229 | 251 | **272** | 2.464 | 5.530 |
| **HZ 1080M D** | 363.1 | 563 870 | **10 555** | 10 090 | 242 | 263 | **285** | 2.465 | 5.531 |
| **HZ 1180M A** | 376.1 | 591 420 | **10 985** | 10 585 | 252 | 274 | **295** | 2.466 | 5.532 |
| **HZ 1180M B** | 383.9 | 613 890 | **11 360** | 10 990 | 258 | 280 | **301** | 2.467 | 5.533 |
| **HZ 1180M C** | 404.9 | 663 540 | **12 155** | 11 740 | 272 | 295 | **318** | 2.480 | 5.567 |
| **HZ 1180M D** | 416.5 | 687 680 | **12 555** | 12 170 | 282 | 304 | **327** | 2.486 | 5.573 |

## Combination HZ ... M - 24 / AZ 14-770 ($b_{sys}$= 2.538 m)

| Section | A | $I_y$ | $W_{ely}$* | $W_{ely}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 311.8 | 179 570 | **5 595** | 5 025 | 215 | 230 | **245** | 2.989 | 5.008 |
| **HZ 880M A** | 339.5 | 336 970 | **7 895** | 7 305 | 236 | 251 | **267** | 2.989 | 5.404 |
| **HZ 880M B** | 364.2 | 364 070 | **8 535** | 7 935 | 256 | 271 | **286** | 2.995 | 5.410 |
| **HZ 880M C** | 375.6 | 383 010 | **8 955** | 8 360 | 265 | 280 | **295** | 2.995 | 5.410 |
| **HZ 1080M A** | 402.8 | 643 510 | **11 700** | 11 010 | 286 | 301 | **316** | 2.981 | 5.830 |
| **HZ 1080M B** | 420.7 | 693 590 | **12 575** | 11 895 | 300 | 315 | **330** | 2.983 | 5.832 |
| **HZ 1080M C** | 453.2 | 754 530 | **13 660** | 12 990 | 326 | 341 | **356** | 2.986 | 5.835 |
| **HZ 1080M D** | 479.6 | 814 260 | **14 675** | 14 055 | 346 | 361 | **376** | 2.987 | 5.836 |
| **HZ 1180M A** | 500.6 | 859 020 | **15 400** | 14 855 | 363 | 378 | **393** | 2.989 | 5.838 |
| **HZ 1180M B** | 513.2 | 895 660 | **16 015** | 15 505 | 373 | 388 | **403** | 2.992 | 5.847 |
| **HZ 1180M C** | 541.1 | 959 810 | **17 080** | 16 510 | 394 | 409 | **425** | 3.009 | 5.860 |
| **HZ 1180M D** | 559.9 | 998 890 | **17 735** | 17 210 | 409 | 424 | **440** | 3.021 | 5.870 |

## Combination HZ ... M - 26 / AZ 14-770 ($b_{sys}$= 2.538 m)

| Section | A | $I_y$ | $W_{ely}$* | $W_{ely}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 327.7 | 195 270 | **6 505** | 5 800 | 222 | 240 | **257** | 2.989 | 5.221 |
| **HZ 880M A** | 355.4 | 364 480 | **9 065** | 8 350 | 244 | 261 | **279** | 2.989 | 5.621 |
| **HZ 880M B** | 380.0 | 391 400 | **9 690** | 8 965 | 263 | 281 | **298** | 2.995 | 5.627 |
| **HZ 880M C** | 391.4 | 410 280 | **10 105** | 9 400 | 272 | 290 | **307** | 2.995 | 5.627 |
| **HZ 1080M A** | 418.7 | 689 730 | **13 160** | 12 350 | 293 | 311 | **329** | 2.981 | 6.047 |
| **HZ 1080M B** | 436.6 | 739 700 | **14 035** | 13 245 | 308 | 325 | **343** | 2.983 | 6.049 |
| **HZ 1080M C** | 469.1 | 800 380 | **15 100** | 14 330 | 333 | 351 | **368** | 2.986 | 6.053 |
| **HZ 1080M D** | 495.5 | 859 950 | **16 105** | 15 400 | 354 | 371 | **389** | 2.987 | 6.054 |
| **HZ 1180M A** | 516.5 | 904 570 | **16 815** | 16 200 | 370 | 388 | **405** | 2.989 | 6.055 |
| **HZ 1180M B** | 529.1 | 941 160 | **17 430** | 16 855 | 380 | 398 | **415** | 2.992 | 6.058 |
| **HZ 1180M C** | 561.0 | 1 016 350 | **18 685** | 18 045 | 404 | 422 | **440** | 3.009 | 6.096 |
| **HZ 1180M D** | 579.7 | 1 055 320 | **19 335** | 18 740 | 418 | 437 | **455** | 3.021 | 6.109 |

## Combination HZ ... M - 12 / AZ 13-700 ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| | Properties per meter of wall | | | | | | | Per system | |
| | $cm^2/m$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $kg/m^2$ | $kg/m^2$ | $kg/m^2$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 252.6 | 123 970 | **3 665** | 4 160 | 161 | 180 | **198** | 2.331 | 4.334 |
| **HZ 880M A** | 270.8 | 227 970 | **5 095** | 5 840 | 175 | 194 | **213** | 2.332 | 4.728 |
| **HZ 880M B** | 287.2 | 246 480 | **5 540** | 6 240 | 188 | 207 | **225** | 2.335 | 4.730 |
| **HZ 880M C** | 294.7 | 259 050 | **5 815** | 6 535 | 194 | 213 | **231** | 2.335 | 4.730 |
| **HZ 1080M A** | 312.2 | 430 470 | **7 530** | 8 445 | 208 | 226 | **245** | 2.328 | 5.159 |
| **HZ 1080M B** | 324.2 | 464 230 | **8 120** | 9 050 | 217 | 236 | **254** | 2.329 | 5.158 |
| **HZ 1080M C** | 345.7 | 504 870 | **8 845** | 9 770 | 234 | 253 | **271** | 2.330 | 5.160 |
| **HZ 1080M D** | 363.1 | 544 530 | **9 515** | 10 480 | 248 | 266 | **285** | 2.331 | 5.161 |
| **HZ 1180M A** | 377.0 | 574 330 | **10 005** | 11 010 | 259 | 277 | **296** | 2.332 | 5.161 |
| **HZ 1180M B** | 385.9 | 600 490 | **10 465** | 11 465 | 266 | 284 | **303** | 2.333 | 5.165 |
| **HZ 1180M C** | 403.2 | 638 880 | **11 055** | 12 175 | 278 | 297 | **316** | 2.346 | 5.174 |
| **HZ 1180M D** | 416.9 | 669 080 | **11 615** | 12 660 | 289 | 308 | **327** | 2.352 | 5.179 |

## Combination HZ ... M - 14 / AZ 13-700 ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 271.8 | 144 010 | **4 795** | 4 275 | 169 | 191 | **213** | 2.331 | 4.564 |
| **HZ 880M A** | 290.0 | 262 880 | **6 535** | 6 020 | 184 | 206 | **228** | 2.332 | 4.964 |
| **HZ 880M B** | 306.3 | 280 730 | **6 945** | 6 430 | 197 | 218 | **240** | 2.335 | 4.967 |
| **HZ 880M C** | 313.8 | 293 170 | **7 215** | 6 715 | 202 | 224 | **246** | 2.335 | 4.966 |
| **HZ 1080M A** | 331.5 | 488 730 | **9 320** | 8 745 | 216 | 238 | **260** | 2.328 | 5.394 |
| **HZ 1080M B** | 343.3 | 521 610 | **9 890** | 9 335 | 225 | 247 | **269** | 2.329 | 5.395 |
| **HZ 1080M C** | 364.8 | 561 780 | **10 590** | 10 055 | 242 | 264 | **286** | 2.330 | 5.396 |
| **HZ 1080M D** | 382.2 | 601 140 | **11 250** | 10 760 | 256 | 278 | **300** | 2.331 | 5.397 |
| **HZ 1180M A** | 396.1 | 630 660 | **11 715** | 11 290 | 267 | 289 | **311** | 2.332 | 5.398 |
| **HZ 1180M B** | 404.4 | 654 770 | **12 120** | 11 720 | 274 | 295 | **317** | 2.333 | 5.399 |
| **HZ 1180M C** | 426.9 | 708 000 | **12 970** | 12 525 | 289 | 312 | **335** | 2.346 | 5.433 |
| **HZ 1180M D** | 439.4 | 733 860 | **13 400** | 12 985 | 299 | 322 | **345** | 2.352 | 5.439 |

## Combination HZ ... M - 24 / AZ 13-700 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 324.1 | 187 060 | **5 830** | 5 235 | 224 | 239 | **254** | 2.855 | 4.874 |
| **HZ 880M A** | 353.5 | 353 650 | **8 290** | 7 670 | 247 | 262 | **277** | 2.855 | 5.270 |
| **HZ 880M B** | 379.5 | 382 300 | **8 965** | 8 330 | 268 | 283 | **298** | 2.861 | 5.276 |
| **HZ 880M C** | 391.6 | 402 340 | **9 410** | 8 785 | 277 | 292 | **307** | 2.861 | 5.276 |
| **HZ 1080M A** | 420.5 | 678 180 | **12 330** | 11 605 | 300 | 315 | **330** | 2.847 | 5.696 |
| **HZ 1080M B** | 439.4 | 731 200 | **13 255** | 12 540 | 315 | 330 | **345** | 2.849 | 5.698 |
| **HZ 1080M C** | 473.8 | 795 640 | **14 405** | 13 700 | 342 | 357 | **372** | 2.852 | 5.701 |
| **HZ 1080M D** | 501.7 | 858 830 | **15 475** | 14 825 | 364 | 379 | **394** | 2.853 | 5.702 |
| **HZ 1180M A** | 524.0 | 906 150 | **16 245** | 15 670 | 381 | 396 | **411** | 2.855 | 5.704 |
| **HZ 1180M B** | 537.3 | 944 930 | **16 895** | 16 360 | 392 | 407 | **422** | 2.858 | 5.713 |
| **HZ 1180M C** | 566.8 | 1 012 730 | **18 020** | 17 425 | 414 | 430 | **445** | 2.875 | 5.726 |
| **HZ 1180M D** | 586.6 | 1 054 050 | **18 715** | 18 160 | 430 | 445 | **460** | 2.887 | 5.736 |

## Combination HZ ... M - 26 / AZ 13-700 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 340.9 | 203 670 | **6 785** | 6 050 | 232 | 250 | **268** | 2.855 | 5.087 |
| **HZ 880M A** | 370.3 | 382 770 | **9 520** | 8 770 | 255 | 273 | **291** | 2.855 | 5.487 |
| **HZ 880M B** | 396.3 | 411 220 | **10 180** | 9 420 | 276 | 293 | **311** | 2.861 | 5.493 |
| **HZ 880M C** | 408.3 | 431 200 | **10 620** | 9 880 | 285 | 303 | **321** | 2.861 | 5.493 |
| **HZ 1080M A** | 437.3 | 727 120 | **13 875** | 13 020 | 308 | 326 | **343** | 2.847 | 5.913 |
| **HZ 1080M B** | 456.3 | 780 010 | **14 800** | 13 965 | 323 | 340 | **358** | 2.849 | 5.915 |
| **HZ 1080M C** | 490.6 | 844 170 | **15 925** | 15 115 | 350 | 367 | **385** | 2.852 | 5.919 |
| **HZ 1080M D** | 518.5 | 907 180 | **16 985** | 16 245 | 372 | 389 | **407** | 2.853 | 5.920 |
| **HZ 1180M A** | 540.7 | 954 360 | **17 740** | 17 090 | 389 | 407 | **424** | 2.855 | 5.921 |
| **HZ 1180M B** | 554.1 | 993 090 | **18 390** | 17 785 | 400 | 417 | **435** | 2.858 | 5.924 |
| **HZ 1180M C** | 587.8 | 1 072 570 | **19 720** | 19 045 | 424 | 443 | **461** | 2.875 | 5.962 |
| **HZ 1180M D** | 607.6 | 1 113 760 | **20 405** | 19 780 | 440 | 458 | **477** | 2.887 | 5.975 |

## Combination HZ ... M - 12 / AZ 13-700-10/10 ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| | Properties per meter of wall | | | | | | | Per system | |
| | $cm^2/m$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $kg/m^2$ | $kg/m^2$ | $kg/m^2$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 256.7 | 124 570 | **3 685** | 4 180 | 163 | 182 | **202** | 2.331 | 4.334 |
| **HZ 880M A** | 275.0 | 228 570 | **5 110** | 5 855 | 177 | 196 | **216** | 2.332 | 4.728 |
| **HZ 880M B** | 291.4 | 247 080 | **5 555** | 6 255 | 190 | 209 | **229** | 2.335 | 4.730 |
| **HZ 880M C** | 298.9 | 259 650 | **5 830** | 6 550 | 196 | 215 | **235** | 2.335 | 4.730 |
| **HZ 1080M A** | 316.4 | 431 080 | **7 540** | 8 455 | 210 | 229 | **248** | 2.328 | 5.159 |
| **HZ 1080M B** | 328.4 | 464 830 | **8 130** | 9 065 | 219 | 238 | **258** | 2.329 | 5.158 |
| **HZ 1080M C** | 349.9 | 505 470 | **8 855** | 9 780 | 236 | 255 | **275** | 2.330 | 5.160 |
| **HZ 1080M D** | 367.3 | 545 130 | **9 530** | 10 490 | 250 | 269 | **288** | 2.331 | 5.161 |
| **HZ 1180M A** | 381.2 | 574 940 | **10 015** | 11 025 | 261 | 280 | **299** | 2.332 | 5.161 |
| **HZ 1180M B** | 390.1 | 601 100 | **10 475** | 11 475 | 268 | 287 | **306** | 2.333 | 5.165 |
| **HZ 1180M C** | 407.4 | 639 490 | **11 065** | 12 185 | 280 | 300 | **320** | 2.346 | 5.174 |
| **HZ 1180M D** | 421.1 | 669 680 | **11 625** | 12 670 | 291 | 311 | **331** | 2.352 | 5.179 |

## Combination HZ ... M - 14 / AZ 13-700-10/10 ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 276.0 | 144 610 | **4 815** | 4 295 | 171 | 194 | **217** | 2.331 | 4.564 |
| **HZ 880M A** | 294.2 | 263 480 | **6 550** | 6 030 | 186 | 208 | **231** | 2.332 | 4.964 |
| **HZ 880M B** | 310.5 | 281 330 | **6 960** | 6 440 | 199 | 221 | **244** | 2.335 | 4.967 |
| **HZ 880M C** | 318.0 | 293 770 | **7 230** | 6 725 | 204 | 227 | **250** | 2.335 | 4.966 |
| **HZ 1080M A** | 335.7 | 489 330 | **9 330** | 8 755 | 218 | 241 | **264** | 2.328 | 5.394 |
| **HZ 1080M B** | 347.5 | 522 210 | **9 900** | 9 345 | 227 | 250 | **273** | 2.329 | 5.395 |
| **HZ 1080M C** | 369.0 | 562 390 | **10 605** | 10 065 | 244 | 267 | **290** | 2.330 | 5.396 |
| **HZ 1080M D** | 386.4 | 601 740 | **11 260** | 10 770 | 258 | 281 | **303** | 2.331 | 5.397 |
| **HZ 1180M A** | 400.3 | 631 270 | **11 725** | 11 300 | 269 | 292 | **314** | 2.332 | 5.398 |
| **HZ 1180M B** | 408.6 | 655 370 | **12 130** | 11 730 | 275 | 298 | **321** | 2.333 | 5.399 |
| **HZ 1180M C** | 431.1 | 708 600 | **12 980** | 12 535 | 291 | 315 | **338** | 2.346 | 5.433 |
| **HZ 1180M D** | 443.6 | 734 460 | **13 410** | 13 000 | 301 | 324 | **348** | 2.352 | 5.439 |

## Combination HZ ... M - 24 / AZ 13-700-10/10 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 327.5 | 187 540 | **5 845** | 5 250 | 226 | 242 | **257** | 2.855 | 4.874 |
| **HZ 880M A** | 356.8 | 354 130 | **8 300** | 7 680 | 249 | 265 | **280** | 2.855 | 5.270 |
| **HZ 880M B** | 382.9 | 382 790 | **8 975** | 8 340 | 270 | 285 | **301** | 2.861 | 5.276 |
| **HZ 880M C** | 394.9 | 402 830 | **9 420** | 8 795 | 279 | 295 | **310** | 2.861 | 5.276 |
| **HZ 1080M A** | 423.9 | 678 670 | **12 340** | 11 615 | 302 | 317 | **333** | 2.847 | 5.696 |
| **HZ 1080M B** | 442.8 | 731 690 | **13 265** | 12 550 | 316 | 332 | **348** | 2.849 | 5.698 |
| **HZ 1080M C** | 477.2 | 796 120 | **14 410** | 13 705 | 343 | 359 | **375** | 2.852 | 5.701 |
| **HZ 1080M D** | 505.1 | 859 310 | **15 485** | 14 835 | 365 | 381 | **397** | 2.853 | 5.702 |
| **HZ 1180M A** | 527.3 | 906 640 | **16 255** | 15 680 | 383 | 398 | **414** | 2.855 | 5.704 |
| **HZ 1180M B** | 540.7 | 945 410 | **16 905** | 16 365 | 393 | 409 | **424** | 2.858 | 5.713 |
| **HZ 1180M C** | 570.2 | 1 013 220 | **18 030** | 17 430 | 416 | 432 | **448** | 2.875 | 5.726 |
| **HZ 1180M D** | 590.0 | 1 054 530 | **18 725** | 18 165 | 432 | 447 | **463** | 2.887 | 5.736 |

## Combination HZ ... M - 26 / AZ 13-700-10/10 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 344.3 | 204 160 | **6 800** | 6 065 | 234 | 252 | **270** | 2.855 | 5.087 |
| **HZ 880M A** | 373.6 | 383 250 | **9 535** | 8 780 | 257 | 275 | **293** | 2.855 | 5.487 |
| **HZ 880M B** | 399.6 | 411 700 | **10 190** | 9 430 | 277 | 296 | **314** | 2.861 | 5.493 |
| **HZ 880M C** | 411.7 | 431 690 | **10 635** | 9 890 | 287 | 305 | **323** | 2.861 | 5.493 |
| **HZ 1080M A** | 440.7 | 727 600 | **13 885** | 13 025 | 309 | 328 | **346** | 2.847 | 5.913 |
| **HZ 1080M B** | 459.7 | 780 500 | **14 810** | 13 975 | 324 | 343 | **361** | 2.849 | 5.915 |
| **HZ 1080M C** | 494.0 | 844 650 | **15 935** | 15 125 | 351 | 370 | **388** | 2.852 | 5.919 |
| **HZ 1080M D** | 521.9 | 907 660 | **16 995** | 16 255 | 373 | 391 | **410** | 2.853 | 5.920 |
| **HZ 1180M A** | 544.1 | 954 850 | **17 750** | 17 100 | 391 | 409 | **427** | 2.855 | 5.921 |
| **HZ 1180M B** | 557.5 | 993 580 | **18 400** | 17 795 | 401 | 419 | **438** | 2.858 | 5.924 |
| **HZ 1180M C** | 591.2 | 1 073 050 | **19 730** | 19 055 | 426 | 445 | **464** | 2.875 | 5.962 |
| **HZ 1180M D** | 611.0 | 1 114 240 | **20 415** | 19 790 | 441 | 461 | **480** | 2.887 | 5.975 |

## Combination HZ ... M - 12 / AZ 18-700 ($b_{sys}$= 1.927m)

| | Properties per meter of wall | | | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|
| | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
| Section | $cm^2/m$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $kg/m^2$ | $kg/m^2$ | $kg/m^2$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 255.9 | 136 490 | **4 035** | 4 580 | 162 | 182 | **201** | 2.476 | 4.479 |
| **HZ 880M A** | 274.1 | 240 500 | **5 380** | 6 160 | 177 | 196 | **215** | 2.477 | 4.873 |
| **HZ 880M B** | 290.5 | 259 000 | **5 820** | 6 560 | 190 | 209 | **228** | 2.480 | 4.875 |
| **HZ 880M C** | 298.0 | 271 570 | **6 100** | 6 850 | 196 | 215 | **234** | 2.479 | 4.875 |
| **HZ 1080M A** | 315.5 | 443 030 | **7 745** | 8 690 | 209 | 228 | **248** | 2.472 | 5.304 |
| **HZ 1080M B** | 327.5 | 476 790 | **8 340** | 9 295 | 219 | 238 | **257** | 2.474 | 5.303 |
| **HZ 1080M C** | 349.0 | 517 420 | **9 065** | 10 010 | 235 | 255 | **274** | 2.475 | 5.305 |
| **HZ 1080M D** | 366.4 | 557 070 | **9 735** | 10 720 | 249 | 268 | **288** | 2.476 | 5.305 |
| **HZ 1180M A** | 380.4 | 586 870 | **10 220** | 11 255 | 260 | 279 | **299** | 2.476 | 5.306 |
| **HZ 1180M B** | 389.3 | 613 030 | **10 680** | 11 705 | 267 | 286 | **306** | 2.478 | 5.310 |
| **HZ 1180M C** | 406.5 | 651 410 | **11 275** | 12 410 | 280 | 300 | **319** | 2.491 | 5.319 |
| **HZ 1180M D** | 420.2 | 681 600 | **11 830** | 12 895 | 291 | 310 | **330** | 2.497 | 5.324 |

## Combination HZ ... M - 14 / AZ 18-700 ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 275.2 | 156 530 | **5 210** | 4 645 | 171 | 194 | **216** | 2.476 | 4.709 |
| **HZ 880M A** | 293.3 | 275 420 | **6 845** | 6 305 | 185 | 208 | **230** | 2.477 | 5.108 |
| **HZ 880M B** | 309.6 | 293 250 | **7 255** | 6 715 | 198 | 221 | **243** | 2.480 | 5.112 |
| **HZ 880M C** | 317.1 | 305 690 | **7 525** | 7 000 | 204 | 226 | **249** | 2.479 | 5.111 |
| **HZ 1080M A** | 334.8 | 501 290 | **9 560** | 8 970 | 218 | 240 | **263** | 2.472 | 5.539 |
| **HZ 1080M B** | 346.6 | 534 170 | **10 130** | 9 560 | 227 | 250 | **272** | 2.474 | 5.540 |
| **HZ 1080M C** | 368.1 | 574 330 | **10 830** | 10 280 | 244 | 266 | **289** | 2.475 | 5.541 |
| **HZ 1080M D** | 385.5 | 613 680 | **11 485** | 10 985 | 258 | 280 | **303** | 2.476 | 5.542 |
| **HZ 1180M A** | 399.4 | 643 200 | **11 950** | 11 510 | 269 | 291 | **314** | 2.476 | 5.543 |
| **HZ 1180M B** | 407.7 | 667 300 | **12 350** | 11 945 | 275 | 298 | **320** | 2.478 | 5.544 |
| **HZ 1180M C** | 430.3 | 720 530 | **13 200** | 12 750 | 290 | 314 | **338** | 2.491 | 5.578 |
| **HZ 1180M D** | 442.7 | 746 380 | **13 625** | 13 210 | 300 | 324 | **348** | 2.497 | 5.584 |

## Combination HZ ... M - 24 / AZ 18-700 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 326.8 | 197 110 | **6 145** | 5 515 | 226 | 241 | **257** | 2.999 | 5.019 |
| **HZ 880M A** | 356.1 | 363 720 | **8 525** | 7 885 | 249 | 264 | **280** | 3.000 | 5.415 |
| **HZ 880M B** | 382.2 | 392 360 | **9 200** | 8 550 | 269 | 285 | **300** | 3.006 | 5.421 |
| **HZ 880M C** | 394.2 | 412 400 | **9 645** | 9 005 | 279 | 294 | **309** | 3.006 | 5.420 |
| **HZ 1080M A** | 423.2 | 688 290 | **12 515** | 11 775 | 301 | 317 | **332** | 2.992 | 5.841 |
| **HZ 1080M B** | 442.1 | 741 310 | **13 440** | 12 715 | 316 | 332 | **347** | 2.994 | 5.843 |
| **HZ 1080M C** | 476.4 | 805 720 | **14 585** | 13 870 | 343 | 359 | **374** | 2.997 | 5.846 |
| **HZ 1080M D** | 504.4 | 868 900 | **15 660** | 15 000 | 365 | 381 | **396** | 2.998 | 5.847 |
| **HZ 1180M A** | 526.6 | 916 220 | **16 425** | 15 845 | 383 | 398 | **413** | 3.000 | 5.849 |
| **HZ 1180M B** | 540.0 | 955 000 | **17 075** | 16 535 | 393 | 408 | **424** | 3.003 | 5.858 |
| **HZ 1180M C** | 569.5 | 1 022 790 | **18 200** | 17 595 | 416 | 431 | **447** | 3.020 | 5.871 |
| **HZ 1180M D** | 589.3 | 1 064 090 | **18 895** | 18 330 | 431 | 447 | **463** | 3.032 | 5.881 |

## Combination HZ ... M - 26 / AZ 18-700 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 343.6 | 213 730 | **7 120** | 6 350 | 234 | 252 | **270** | 2.999 | 5.232 |
| **HZ 880M A** | 372.9 | 392 840 | **9 770** | 9 000 | 257 | 275 | **293** | 3.000 | 5.632 |
| **HZ 880M B** | 398.9 | 421 280 | **10 425** | 9 650 | 277 | 295 | **313** | 3.006 | 5.638 |
| **HZ 880M C** | 411.0 | 441 260 | **10 870** | 10 110 | 287 | 305 | **323** | 3.006 | 5.638 |
| **HZ 1080M A** | 440.0 | 737 220 | **14 065** | 13 200 | 309 | 327 | **345** | 2.992 | 6.058 |
| **HZ 1080M B** | 458.9 | 790 110 | **14 990** | 14 145 | 324 | 342 | **360** | 2.994 | 6.060 |
| **HZ 1080M C** | 493.2 | 854 250 | **16 115** | 15 295 | 351 | 369 | **387** | 2.997 | 6.063 |
| **HZ 1080M D** | 521.2 | 917 260 | **17 175** | 16 425 | 373 | 391 | **409** | 2.998 | 6.064 |
| **HZ 1180M A** | 543.4 | 964 440 | **17 925** | 17 270 | 390 | 409 | **427** | 3.000 | 6.066 |
| **HZ 1180M B** | 556.7 | 1 003 160 | **18 575** | 17 965 | 401 | 419 | **437** | 3.003 | 6.069 |
| **HZ 1180M C** | 590.5 | 1 082 630 | **19 905** | 19 225 | 425 | 445 | **464** | 3.020 | 6.107 |
| **HZ 1180M D** | 610.3 | 1 123 800 | **20 590** | 19 955 | 441 | 460 | **479** | 3.032 | 6.120 |

## Combination HZ ... M - 12 / AZ 20-700 ($b_{sys}$= 1.927 m)

| | Properties per meter of wall | | | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|
| | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
| Section | $cm^2/m$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $kg/m^2$ | $kg/m^2$ | $kg/m^2$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 265.1 | 138 780 | **4 105** | 4 655 | 167 | 187 | **208** | 2.476 | 4.479 |
| **HZ 880M A** | 283.4 | 242 800 | **5 430** | 6 220 | 181 | 202 | **222** | 2.477 | 4.873 |
| **HZ 880M B** | 299.8 | 261 290 | **5 875** | 6 615 | 194 | 215 | **235** | 2.480 | 4.875 |
| **HZ 880M C** | 307.3 | 273 860 | **6 150** | 6 910 | 200 | 221 | **241** | 2.479 | 4.875 |
| **HZ 1080M A** | 324.8 | 445 330 | **7 790** | 8 735 | 214 | 234 | **255** | 2.472 | 5.304 |
| **HZ 1080M B** | 336.8 | 479 090 | **8 380** | 9 340 | 223 | 244 | **264** | 2.474 | 5.303 |
| **HZ 1080M C** | 358.3 | 519 710 | **9 105** | 10 055 | 240 | 261 | **281** | 2.475 | 5.305 |
| **HZ 1080M D** | 375.7 | 559 370 | **9 775** | 10 765 | 254 | 274 | **295** | 2.476 | 5.305 |
| **HZ 1180M A** | 389.6 | 589 160 | **10 260** | 11 295 | 265 | 285 | **306** | 2.476 | 5.306 |
| **HZ 1180M B** | 398.5 | 615 320 | **10 720** | 11 750 | 272 | 292 | **313** | 2.478 | 5.310 |
| **HZ 1180M C** | 415.8 | 653 710 | **11 315** | 12 455 | 284 | 305 | **326** | 2.491 | 5.319 |
| **HZ 1180M D** | 429.5 | 683 890 | **11 870** | 12 940 | 295 | 316 | **337** | 2.497 | 5.324 |

## Combination HZ ... M - 14 / AZ 20-700 ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 284.4 | 158 820 | **5 285** | 4 715 | 175 | 199 | **223** | 2.476 | 4.709 |
| **HZ 880M A** | 302.6 | 277 710 | **6 900** | 6 360 | 190 | 214 | **238** | 2.477 | 5.108 |
| **HZ 880M B** | 318.9 | 295 540 | **7 310** | 6 765 | 202 | 226 | **250** | 2.480 | 5.112 |
| **HZ 880M C** | 326.4 | 307 980 | **7 580** | 7 050 | 208 | 232 | **256** | 2.479 | 5.111 |
| **HZ 1080M A** | 344.1 | 503 590 | **9 600** | 9 010 | 222 | 246 | **270** | 2.472 | 5.539 |
| **HZ 1080M B** | 355.9 | 536 470 | **10 170** | 9 600 | 231 | 255 | **279** | 2.474 | 5.540 |
| **HZ 1080M C** | 377.4 | 576 630 | **10 870** | 10 320 | 248 | 272 | **296** | 2.475 | 5.541 |
| **HZ 1080M D** | 394.8 | 615 970 | **11 530** | 11 025 | 262 | 286 | **310** | 2.476 | 5.542 |
| **HZ 1180M A** | 408.7 | 645 490 | **11 990** | 11 555 | 273 | 297 | **321** | 2.476 | 5.543 |
| **HZ 1180M B** | 417.0 | 669 600 | **12 395** | 11 985 | 279 | 303 | **327** | 2.478 | 5.544 |
| **HZ 1180M C** | 439.5 | 722 820 | **13 240** | 12 790 | 295 | 320 | **345** | 2.491 | 5.578 |
| **HZ 1180M D** | 452.0 | 748 670 | **13 670** | 13 250 | 305 | 330 | **355** | 2.497 | 5.584 |

## Combination HZ ... M - 24 / AZ 20-700 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 334.2 | 198 950 | **6 200** | 5 565 | 229 | 246 | **262** | 2.999 | 5.019 |
| **HZ 880M A** | 363.6 | 365 560 | **8 565** | 7 925 | 252 | 269 | **285** | 3.000 | 5.415 |
| **HZ 880M B** | 389.6 | 394 200 | **9 245** | 8 590 | 273 | 289 | **306** | 3.006 | 5.421 |
| **HZ 880M C** | 401.7 | 414 240 | **9 690** | 9 045 | 282 | 299 | **315** | 3.006 | 5.420 |
| **HZ 1080M A** | 430.6 | 690 140 | **12 550** | 11 810 | 305 | 321 | **338** | 2.992 | 5.841 |
| **HZ 1080M B** | 449.6 | 743 150 | **13 470** | 12 745 | 320 | 336 | **353** | 2.994 | 5.843 |
| **HZ 1080M C** | 483.9 | 807 570 | **14 620** | 13 905 | 347 | 363 | **380** | 2.997 | 5.846 |
| **HZ 1080M D** | 511.9 | 870 750 | **15 690** | 15 030 | 369 | 385 | **402** | 2.998 | 5.847 |
| **HZ 1180M A** | 534.1 | 918 060 | **16 460** | 15 875 | 386 | 403 | **419** | 3.000 | 5.849 |
| **HZ 1180M B** | 547.4 | 956 840 | **17 110** | 16 565 | 397 | 413 | **430** | 3.003 | 5.858 |
| **HZ 1180M C** | 576.9 | 1 024 620 | **18 235** | 17 625 | 419 | 436 | **453** | 3.020 | 5.871 |
| **HZ 1180M D** | 596.7 | 1 065 930 | **18 930** | 18 365 | 435 | 452 | **468** | 3.032 | 5.881 |

## Combination HZ ... M - 26 / AZ 20-700 ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el,y}$* | $W_{el,y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 351.0 | 215 570 | **7 180** | 6 405 | 237 | 256 | **276** | 2.999 | 5.232 |
| **HZ 880M A** | 380.4 | 394 680 | **9 815** | 9 040 | 260 | 279 | **299** | 3.000 | 5.632 |
| **HZ 880M B** | 406.4 | 423 110 | **10 475** | 9 695 | 281 | 300 | **319** | 3.006 | 5.638 |
| **HZ 880M C** | 418.4 | 443 090 | **10 915** | 10 150 | 290 | 309 | **328** | 3.006 | 5.638 |
| **HZ 1080M A** | 447.5 | 739 070 | **14 100** | 13 235 | 313 | 332 | **351** | 2.992 | 6.058 |
| **HZ 1080M B** | 466.4 | 791 960 | **15 025** | 14 180 | 328 | 347 | **366** | 2.994 | 6.060 |
| **HZ 1080M C** | 500.7 | 856 100 | **16 150** | 15 330 | 355 | 374 | **393** | 2.997 | 6.063 |
| **HZ 1080M D** | 528.7 | 919 100 | **17 210** | 16 460 | 376 | 396 | **415** | 2.998 | 6.064 |
| **HZ 1180M A** | 550.9 | 966 280 | **17 960** | 17 305 | 394 | 413 | **432** | 3.000 | 6.066 |
| **HZ 1180M B** | 564.2 | 1 005 000 | **18 610** | 17 995 | 404 | 424 | **443** | 3.003 | 6.069 |
| **HZ 1180M C** | 597.9 | 1 084 460 | **19 940** | 19 255 | 429 | 449 | **469** | 3.020 | 6.107 |
| **HZ 1180M D** | 617.7 | 1 125 640 | **20 625** | 19 990 | 445 | 465 | **485** | 3.032 | 6.120 |

## Combination HZ ... M - 12 / AZ 26-700 ($b_{sys}$= 1.927 m)

| Section | Properties per meter of wall | | | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|
| | A $cm^2/m$ | $I_y$ $cm^4/m$ | $W_{el.y}$* $cm^3/m$ | $W_{el.y}$** $cm^3/m$ | $G_{60\%}$ $kg/m^2$ | $G_{80\%}$ $kg/m^2$ | $G_{100\%}$ $kg/m^2$ | $A_{LW}$ $m^2/m$ | $A_{LS}$ $m^2/m$ |
| **HZ 680M LT** | 290.7 | 152 390 | **4 505** | 5 110 | 179 | 204 | **228** | 2.551 | 4.553 |
| **HZ 880M A** | 308.9 | 256 420 | **5 735** | 6 565 | 193 | 218 | **243** | 2.551 | 4.948 |
| **HZ 880M B** | 325.4 | 274 900 | **6 180** | 6 960 | 206 | 231 | **255** | 2.554 | 4.949 |
| **HZ 880M C** | 332.9 | 287 470 | **6 455** | 7 250 | 212 | 237 | **261** | 2.554 | 4.949 |
| **HZ 1080M A** | 350.5 | 458 990 | **8 025** | 9 000 | 226 | 250 | **275** | 2.547 | 5.378 |
| **HZ 1080M B** | 362.4 | 492 740 | **8 615** | 9 610 | 235 | 260 | **285** | 2.548 | 5.378 |
| **HZ 1080M C** | 383.9 | 533 350 | **9 345** | 10 320 | 252 | 277 | **301** | 2.549 | 5.379 |
| **HZ 1080M D** | 401.3 | 573 000 | **10 015** | 11 030 | 266 | 290 | **315** | 2.550 | 5.380 |
| **HZ 1180M A** | 415.2 | 602 790 | **10 500** | 11 560 | 277 | 301 | **326** | 2.551 | 5.381 |
| **HZ 1180M B** | 424.1 | 628 950 | **10 960** | 12 010 | 284 | 308 | **333** | 2.552 | 5.385 |
| **HZ 1180M C** | 441.3 | 667 320 | **11 550** | 12 715 | 296 | 321 | **346** | 2.565 | 5.394 |
| **HZ 1180M D** | 455.0 | 697 500 | **12 105** | 13 195 | 307 | 332 | **357** | 2.571 | 5.399 |

## Combination HZ ... M - 14 / AZ 26-700 ($b_{sys}$= 1.927 m)

| Section | A $cm^2/m$ | $I_y$ $cm^4/m$ | $W_{el.y}$* $cm^3/m$ | $W_{el.y}$** $cm^3/m$ | $G_{60\%}$ $kg/m^2$ | $G_{80\%}$ $kg/m^2$ | $G_{100\%}$ $kg/m^2$ | $A_{LW}$ $m^2/m$ | $A_{LS}$ $m^2/m$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 309.9 | 172 430 | **5 740** | 5 120 | 187 | 215 | **243** | 2.551 | 4.783 |
| **HZ 880M A** | 328.2 | 291 340 | **7 240** | 6 670 | 202 | 230 | **258** | 2.551 | 5.183 |
| **HZ 880M B** | 344.4 | 309 150 | **7 645** | 7 080 | 214 | 242 | **270** | 2.554 | 5.186 |
| **HZ 880M C** | 351.9 | 321 590 | **7 915** | 7 365 | 220 | 248 | **276** | 2.554 | 5.186 |
| **HZ 1080M A** | 369.8 | 517 240 | **9 860** | 9 255 | 234 | 262 | **290** | 2.547 | 5.613 |
| **HZ 1080M B** | 381.5 | 550 120 | **10 430** | 9 845 | 243 | 271 | **300** | 2.548 | 5.614 |
| **HZ 1080M C** | 403.0 | 590 270 | **11 130** | 10 565 | 260 | 288 | **316** | 2.549 | 5.616 |
| **HZ 1080M D** | 420.4 | 629 600 | **11 785** | 11 270 | 274 | 302 | **330** | 2.550 | 5.616 |
| **HZ 1180M A** | 434.3 | 659 120 | **12 245** | 11 795 | 285 | 313 | **341** | 2.551 | 5.617 |
| **HZ 1180M B** | 442.6 | 683 220 | **12 645** | 12 230 | 291 | 319 | **347** | 2.552 | 5.619 |
| **HZ 1180M C** | 465.1 | 736 440 | **13 490** | 13 030 | 307 | 336 | **365** | 2.565 | 5.652 |
| **HZ 1180M D** | 477.5 | 762 280 | **13 915** | 13 490 | 317 | 346 | **375** | 2.571 | 5.659 |

## Combination HZ ... M - 24 / AZ 26-700 ($b_{sys}$= 2.398 m)

| Section | A $cm^2/m$ | $I_y$ $cm^4/m$ | $W_{el.y}$* $cm^3/m$ | $W_{el.y}$** $cm^3/m$ | $G_{60\%}$ $kg/m^2$ | $G_{80\%}$ $kg/m^2$ | $G_{100\%}$ $kg/m^2$ | $A_{LW}$ $m^2/m$ | $A_{LS}$ $m^2/m$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 354.7 | 209 880 | **6 540** | 5 875 | 239 | 259 | **278** | 3.074 | 5.093 |
| **HZ 880M A** | 384.1 | 376 510 | **8 825** | 8 165 | 262 | 282 | **302** | 3.074 | 5.489 |
| **HZ 880M B** | 410.1 | 405 120 | **9 500** | 8 825 | 282 | 302 | **322** | 3.081 | 5.495 |
| **HZ 880M C** | 422.2 | 425 160 | **9 945** | 9 280 | 292 | 312 | **331** | 3.080 | 5.495 |
| **HZ 1080M A** | 451.3 | 701 120 | **12 745** | 11 995 | 314 | 334 | **354** | 3.066 | 5.915 |
| **HZ 1080M B** | 470.2 | 754 140 | **13 670** | 12 935 | 329 | 349 | **369** | 3.068 | 5.918 |
| **HZ 1080M C** | 504.5 | 818 530 | **14 815** | 14 090 | 356 | 376 | **396** | 3.072 | 5.921 |
| **HZ 1080M D** | 532.4 | 881 700 | **15 890** | 15 220 | 378 | 398 | **418** | 3.073 | 5.922 |
| **HZ 1180M A** | 554.6 | 929 010 | **16 655** | 16 065 | 396 | 416 | **435** | 3.074 | 5.923 |
| **HZ 1180M B** | 568.0 | 967 790 | **17 305** | 16 755 | 406 | 426 | **446** | 3.077 | 5.932 |
| **HZ 1180M C** | 597.4 | 1 035 550 | **18 425** | 17 815 | 429 | 449 | **469** | 3.094 | 5.945 |
| **HZ 1180M D** | 617.2 | 1 076 850 | **19 120** | 18 550 | 444 | 464 | **484** | 3.107 | 5.955 |

## Combination HZ ... M - 26 / AZ 26-700 ($b_{sys}$= 2.398 m)

| Section | A $cm^2/m$ | $I_y$ $cm^4/m$ | $W_{el.y}$* $cm^3/m$ | $W_{el.y}$** $cm^3/m$ | $G_{60\%}$ $kg/m^2$ | $G_{80\%}$ $kg/m^2$ | $G_{100\%}$ $kg/m^2$ | $A_{LW}$ $m^2/m$ | $A_{LS}$ $m^2/m$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 371.5 | 226 490 | **7 545** | 6 730 | 247 | 269 | **292** | 3.074 | 5.307 |
| **HZ 880M A** | 400.9 | 405 620 | **10 090** | 9 295 | 270 | 292 | **315** | 3.074 | 5.706 |
| **HZ 880M B** | 426.9 | 434 040 | **10 745** | 9 945 | 290 | 313 | **335** | 3.081 | 5.713 |
| **HZ 880M C** | 438.9 | 454 020 | **11 185** | 10 400 | 300 | 322 | **345** | 3.080 | 5.712 |
| **HZ 1080M A** | 468.1 | 750 050 | **14 310** | 13 430 | 322 | 345 | **367** | 3.066 | 6.132 |
| **HZ 1080M B** | 487.0 | 802 940 | **15 235** | 14 375 | 337 | 360 | **382** | 3.068 | 6.135 |
| **HZ 1080M C** | 521.3 | 867 060 | **16 360** | 15 525 | 364 | 387 | **409** | 3.072 | 6.138 |
| **HZ 1080M D** | 549.2 | 930 050 | **17 415** | 16 655 | 386 | 409 | **431** | 3.073 | 6.139 |
| **HZ 1180M A** | 571.4 | 977 220 | **18 165** | 17 500 | 404 | 426 | **449** | 3.074 | 6.140 |
| **HZ 1180M B** | 584.7 | 1 015 950 | **18 815** | 18 195 | 414 | 437 | **459** | 3.077 | 6.144 |
| **HZ 1180M C** | 618.4 | 1 095 390 | **20 140** | 19 450 | 439 | 462 | **485** | 3.094 | 6.181 |
| **HZ 1180M D** | 638.2 | 1 136 560 | **20 825** | 20 185 | 454 | 478 | **501** | 3.107 | 6.194 |

## Combination HZ ... M - 12 / AZ 26-700N ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el.y}$ * | $W_{el.y}$ ** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| | Properties per meter of wall | | | | | | | Per system | |
| | cm²/m | cm⁴/m | cm³/m | cm³/m | kg/m² | kg/m² | kg/m² | m²/m | m²/m |
| **HZ 680M LT** | 282.8 | 152 440 | **4 510** | 5 115 | 175 | 199 | **222** | 2.538 | 4.540 |
| **HZ 880M A** | 301.1 | 256 470 | **5 735** | 6 570 | 189 | 213 | **236** | 2.539 | 4.935 |
| **HZ 880M B** | 317.5 | 274 950 | **6 180** | 6 965 | 202 | 226 | **249** | 2.542 | 4.937 |
| **HZ 880M C** | 325.0 | 287 520 | **6 455** | 7 255 | 208 | 232 | **255** | 2.541 | 4.937 |
| **HZ 1080M A** | 342.6 | 459 040 | **8 025** | 9 005 | 222 | 245 | **269** | 2.534 | 5.366 |
| **HZ 1080M B** | 354.6 | 492 790 | **8 615** | 9 610 | 231 | 255 | **278** | 2.535 | 5.365 |
| **HZ 1080M C** | 376.0 | 533 400 | **9 345** | 10 320 | 248 | 272 | **295** | 2.537 | 5.367 |
| **HZ 1080M D** | 393.5 | 573 050 | **10 015** | 11 030 | 262 | 285 | **309** | 2.538 | 5.367 |
| **HZ 1180M A** | 407.4 | 602 840 | **10 500** | 11 560 | 273 | 296 | **320** | 2.538 | 5.368 |
| **HZ 1180M B** | 416.3 | 629 000 | **10 960** | 12 010 | 280 | 303 | **327** | 2.540 | 5.372 |
| **HZ 1180M C** | 433.5 | 667 370 | **11 550** | 12 715 | 293 | 316 | **340** | 2.553 | 5.381 |
| **HZ 1180M D** | 447.2 | 697 550 | **12 105** | 13 200 | 303 | 327 | **351** | 2.559 | 5.386 |

## Combination HZ ... M - 14 / AZ 26-700N ($b_{sys}$= 1.927 m)

| Section | A | $I_y$ | $W_{el.y}$ * | $W_{el.y}$ ** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 302.1 | 172 480 | **5 740** | 5 120 | 184 | 210 | **237** | 2.538 | 4.771 |
| **HZ 880M A** | 320.3 | 291 390 | **7 240** | 6 670 | 198 | 225 | **251** | 2.539 | 5.170 |
| **HZ 880M B** | 336.6 | 309 200 | **7 650** | 7 080 | 211 | 237 | **264** | 2.542 | 5.173 |
| **HZ 880M C** | 344.1 | 321 640 | **7 915** | 7 365 | 217 | 243 | **270** | 2.541 | 5.173 |
| **HZ 1080M A** | 361.9 | 517 290 | **9 865** | 9 255 | 231 | 257 | **284** | 2.534 | 5.601 |
| **HZ 1080M B** | 373.7 | 550 170 | **10 430** | 9 845 | 240 | 267 | **293** | 2.535 | 5.602 |
| **HZ 1080M C** | 395.1 | 590 320 | **11 130** | 10 565 | 257 | 283 | **310** | 2.537 | 5.603 |
| **HZ 1080M D** | 412.5 | 629 650 | **11 785** | 11 270 | 270 | 297 | **324** | 2.538 | 5.604 |
| **HZ 1180M A** | 426.4 | 659 170 | **12 245** | 11 800 | 281 | 308 | **335** | 2.538 | 5.605 |
| **HZ 1180M B** | 434.7 | 683 270 | **12 645** | 12 230 | 288 | 315 | **341** | 2.540 | 5.606 |
| **HZ 1180M C** | 457.2 | 736 490 | **13 490** | 13 030 | 303 | 331 | **359** | 2.553 | 5.640 |
| **HZ 1180M D** | 469.7 | 762 340 | **13 920** | 13 490 | 313 | 341 | **369** | 2.559 | 5.646 |

## Combination HZ ... M - 24 / AZ 26-700N ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el.y}$ * | $W_{el.y}$ ** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 348.4 | 209 920 | **6 540** | 5 875 | 236 | 255 | **274** | 3.061 | 5.081 |
| **HZ 880M A** | 377.8 | 376 550 | **8 825** | 8 165 | 259 | 278 | **297** | 3.062 | 5.477 |
| **HZ 880M B** | 403.8 | 405 160 | **9 500** | 8 830 | 279 | 298 | **317** | 3.068 | 5.483 |
| **HZ 880M C** | 415.9 | 425 200 | **9 945** | 9 285 | 289 | 308 | **326** | 3.068 | 5.482 |
| **HZ 1080M A** | 444.9 | 701 160 | **12 750** | 11 995 | 311 | 330 | **349** | 3.054 | 5.903 |
| **HZ 1080M B** | 463.9 | 754 180 | **13 670** | 12 935 | 326 | 345 | **364** | 3.056 | 5.905 |
| **HZ 1080M C** | 498.2 | 818 570 | **14 820** | 14 095 | 353 | 372 | **391** | 3.059 | 5.908 |
| **HZ 1080M D** | 526.1 | 881 740 | **15 890** | 15 220 | 375 | 394 | **413** | 3.060 | 5.909 |
| **HZ 1180M A** | 548.3 | 929 050 | **16 655** | 16 065 | 393 | 412 | **430** | 3.062 | 5.911 |
| **HZ 1180M B** | 561.7 | 967 830 | **17 305** | 16 755 | 403 | 422 | **441** | 3.065 | 5.920 |
| **HZ 1180M C** | 591.1 | 1 035 590 | **18 430** | 17 815 | 426 | 445 | **464** | 3.082 | 5.933 |
| **HZ 1180M D** | 610.9 | 1 076 890 | **19 120** | 18 550 | 441 | 460 | **480** | 3.094 | 5.942 |

## Combination HZ ... M - 26 / AZ 26-700N ($b_{sys}$= 2.398 m)

| Section | A | $I_y$ | $W_{el.y}$ * | $W_{el.y}$ ** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 365.2 | 226 530 | **7 545** | 6 730 | 244 | 265 | **287** | 3.061 | 5.294 |
| **HZ 880M A** | 394.6 | 405 660 | **10 090** | 9 295 | 267 | 288 | **310** | 3.062 | 5.694 |
| **HZ 880M B** | 420.6 | 434 080 | **10 745** | 9 945 | 287 | 309 | **330** | 3.068 | 5.700 |
| **HZ 880M C** | 432.6 | 454 060 | **11 185** | 10 405 | 297 | 318 | **340** | 3.068 | 5.700 |
| **HZ 1080M A** | 461.8 | 750 090 | **14 310** | 13 430 | 319 | 341 | **362** | 3.054 | 6.120 |
| **HZ 1080M B** | 480.7 | 802 980 | **15 235** | 14 375 | 334 | 356 | **377** | 3.056 | 6.122 |
| **HZ 1080M C** | 515.0 | 867 100 | **16 360** | 15 525 | 361 | 383 | **404** | 3.059 | 6.125 |
| **HZ 1080M D** | 542.9 | 930 090 | **17 415** | 16 655 | 383 | 405 | **426** | 3.060 | 6.126 |
| **HZ 1180M A** | 565.1 | 977 260 | **18 165** | 17 500 | 401 | 422 | **444** | 3.062 | 6.128 |
| **HZ 1180M B** | 578.4 | 1 015 990 | **18 815** | 18 195 | 411 | 433 | **454** | 3.065 | 6.131 |
| **HZ 1180M C** | 612.1 | 1 095 430 | **20 140** | 19 450 | 436 | 458 | **481** | 3.082 | 6.169 |
| **HZ 1180M D** | 631.9 | 1 136 600 | **20 825** | 20 185 | 451 | 474 | **496** | 3.094 | 6.181 |

## Combination HZ ... M - 12 / AZ 18-10/10 ($b_{sys}$= 1.787 m)

| Section | Properties per meter of wall | | | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|
| | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
| | $cm^2/m$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $kg/m^2$ | $kg/m^2$ | $kg/m^2$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 277.7 | 142 630 | **4 220** | 4 785 | 176 | 197 | **218** | 2.329 | 4.332 |
| **HZ 880M A** | 297.4 | 254 790 | **5 695** | 6 525 | 191 | 212 | **233** | 2.330 | 4.726 |
| **HZ 880M B** | 315.1 | 274 720 | **6 175** | 6 955 | 205 | 226 | **247** | 2.333 | 4.728 |
| **HZ 880M C** | 323.2 | 288 270 | **6 475** | 7 270 | 212 | 233 | **254** | 2.333 | 4.728 |
| **HZ 1080M A** | 342.2 | 473 240 | **8 275** | 9 280 | 226 | 248 | **269** | 2.326 | 5.157 |
| **HZ 1080M B** | 355.1 | 509 650 | **8 910** | 9 940 | 237 | 258 | **279** | 2.327 | 5.157 |
| **HZ 1080M C** | 378.2 | 553 430 | **9 695** | 10 710 | 255 | 276 | **297** | 2.328 | 5.158 |
| **HZ 1080M D** | 397.0 | 596 170 | **10 420** | 11 475 | 270 | 291 | **312** | 2.329 | 5.159 |
| **HZ 1180M A** | 412.0 | 628 270 | **10 940** | 12 045 | 281 | 302 | **323** | 2.330 | 5.159 |
| **HZ 1180M B** | 421.6 | 656 480 | **11 440** | 12 535 | 289 | 310 | **331** | 2.331 | 5.163 |
| **HZ 1180M C** | 440.1 | 697 850 | **12 075** | 13 295 | 303 | 324 | **346** | 2.344 | 5.172 |
| **HZ 1180M D** | 454.9 | 730 370 | **12 675** | 13 820 | 314 | 336 | **357** | 2.350 | 5.177 |

## Combination HZ ... M - 14 / AZ 18-10/10 ($b_{sys}$= 1.787 m)

| Section | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 298.5 | 164 230 | **5 465** | 4 875 | 185 | 210 | **234** | 2.329 | 4.562 |
| **HZ 880M A** | 318.1 | 292 440 | **7 270** | 6 695 | 201 | 225 | **250** | 2.330 | 4.962 |
| **HZ 880M B** | 335.7 | 311 640 | **7 710** | 7 135 | 214 | 239 | **263** | 2.333 | 4.965 |
| **HZ 880M C** | 343.7 | 325 060 | **8 000** | 7 445 | 221 | 245 | **270** | 2.333 | 4.964 |
| **HZ 1080M A** | 363.0 | 536 070 | **10 220** | 9 590 | 236 | 260 | **285** | 2.326 | 5.392 |
| **HZ 1080M B** | 375.7 | 571 530 | **10 835** | 10 225 | 246 | 270 | **295** | 2.327 | 5.393 |
| **HZ 1080M C** | 398.8 | 614 800 | **11 590** | 11 000 | 264 | 288 | **313** | 2.328 | 5.395 |
| **HZ 1080M D** | 417.6 | 657 210 | **12 300** | 11 760 | 279 | 303 | **328** | 2.329 | 5.395 |
| **HZ 1180M A** | 432.5 | 689 020 | **12 800** | 12 330 | 290 | 315 | **340** | 2.330 | 5.396 |
| **HZ 1180M B** | 441.5 | 715 010 | **13 235** | 12 800 | 297 | 322 | **347** | 2.331 | 5.398 |
| **HZ 1180M C** | 465.8 | 772 370 | **14 150** | 13 665 | 314 | 340 | **366** | 2.344 | 5.431 |
| **HZ 1180M D** | 479.2 | 800 220 | **14 610** | 14 160 | 325 | 350 | **376** | 2.350 | 5.437 |

## Combination HZ ... M - 24 / AZ 18-10/10 ($b_{sys}$= 2.258 m)

| Section | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 348.5 | 205 710 | **6 410** | 5 755 | 240 | 257 | **274** | 2.853 | 4.872 |
| **HZ 880M A** | 379.7 | 382 650 | **8 970** | 8 300 | 265 | 281 | **298** | 2.853 | 5.268 |
| **HZ 880M B** | 407.3 | 413 030 | **9 685** | 9 000 | 287 | 303 | **320** | 2.860 | 5.274 |
| **HZ 880M C** | 420.1 | 434 310 | **10 155** | 9 480 | 297 | 313 | **330** | 2.859 | 5.274 |
| **HZ 1080M A** | 450.9 | 727 470 | **13 225** | 12 450 | 321 | 337 | **354** | 2.845 | 5.694 |
| **HZ 1080M B** | 471.1 | 783 780 | **14 210** | 13 445 | 336 | 353 | **370** | 2.847 | 5.696 |
| **HZ 1080M C** | 507.5 | 852 120 | **15 425** | 14 670 | 365 | 382 | **398** | 2.850 | 5.700 |
| **HZ 1080M D** | 537.1 | 919 180 | **16 565** | 15 865 | 388 | 405 | **422** | 2.851 | 5.701 |
| **HZ 1180M A** | 560.7 | 969 380 | **17 380** | 16 765 | 407 | 424 | **440** | 2.853 | 5.702 |
| **HZ 1180M B** | 574.9 | 1 010 560 | **18 070** | 17 495 | 418 | 435 | **451** | 2.856 | 5.711 |
| **HZ 1180M C** | 606.1 | 1 082 440 | **19 260** | 18 620 | 442 | 459 | **476** | 2.873 | 5.724 |
| **HZ 1180M D** | 627.1 | 1 126 250 | **20 000** | 19 405 | 459 | 475 | **492** | 2.885 | 5.734 |

## Combination HZ ... M - 26 / AZ 18-10/10 ($b_{sys}$= 2.258 m)

| Section | A | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $G_{60\%}$ | $G_{80\%}$ | $G_{100\%}$ | $A_{LW}$ | $A_{LS}$ |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 366.2 | 223 350 | **7 440** | 6 635 | 249 | 268 | **288** | 2.853 | 5.085 |
| **HZ 880M A** | 397.5 | 413 570 | **10 285** | 9 475 | 273 | 293 | **312** | 2.853 | 5.485 |
| **HZ 880M B** | 425.1 | 443 730 | **10 985** | 10 165 | 295 | 314 | **334** | 2.860 | 5.491 |
| **HZ 880M C** | 437.8 | 464 950 | **11 450** | 10 655 | 305 | 324 | **344** | 2.859 | 5.491 |
| **HZ 1080M A** | 468.8 | 779 440 | **14 870** | 13 955 | 329 | 349 | **368** | 2.845 | 5.911 |
| **HZ 1080M B** | 488.9 | 835 620 | **15 855** | 14 960 | 345 | 364 | **384** | 2.847 | 5.914 |
| **HZ 1080M C** | 525.3 | 903 660 | **17 050** | 16 180 | 373 | 393 | **412** | 2.850 | 5.917 |
| **HZ 1080M D** | 555.0 | 970 530 | **18 175** | 17 380 | 397 | 416 | **436** | 2.851 | 5.918 |
| **HZ 1180M A** | 578.5 | 1 020 580 | **18 970** | 18 275 | 415 | 435 | **454** | 2.853 | 5.919 |
| **HZ 1180M B** | 592.7 | 1 061 710 | **19 660** | 19 015 | 426 | 446 | **465** | 2.856 | 5.923 |
| **HZ 1180M C** | 628.4 | 1 145 980 | **21 070** | 20 350 | 452 | 473 | **493** | 2.873 | 5.960 |
| **HZ 1180M D** | 649.4 | 1 189 650 | **21 795** | 21 125 | 469 | 489 | **510** | 2.885 | 5.973 |

## Combination HZ ... M - 12 / AZ 26 ($b_{sys}$= 1.787 m)

| Section | A cm²/m | $I_y$ cm⁴/m | $W_{el.y}$* cm³/m | $W_{el.y}$** cm³/m | $G_{60\%}$ kg/m² | $G_{80\%}$ kg/m² | $G_{100\%}$ kg/m² | $A_{LW}$ m²/m | $A_{LS}$ m²/m |
|---|---|---|---|---|---|---|---|---|---|
| | Properties per meter of wall | | | | | | | Per system | |
| **HZ 680M LT** | 306.2 | 156 680 | **4 635** | 5 255 | 189 | 215 | **240** | 2.403 | 4.405 |
| **HZ 880M A** | 325.9 | 268 850 | **6 010** | 6 885 | 205 | 230 | **256** | 2.403 | 4.800 |
| **HZ 880M B** | 343.6 | 288 770 | **6 490** | 7 315 | 219 | 244 | **270** | 2.406 | 4.802 |
| **HZ 880M C** | 351.7 | 302 320 | **6 790** | 7 625 | 225 | 251 | **276** | 2.406 | 4.801 |
| **HZ 1080M A** | 370.7 | 487 340 | **8 520** | 9 560 | 240 | 265 | **291** | 2.399 | 5.230 |
| **HZ 1080M B** | 383.6 | 523 750 | **9 160** | 10 215 | 250 | 276 | **301** | 2.400 | 5.230 |
| **HZ 1080M C** | 406.7 | 567 510 | **9 940** | 10 980 | 268 | 294 | **319** | 2.402 | 5.232 |
| **HZ 1080M D** | 425.5 | 610 240 | **10 665** | 11 745 | 283 | 309 | **334** | 2.402 | 5.232 |
| **HZ 1180M A** | 440.5 | 642 340 | **11 185** | 12 315 | 295 | 320 | **346** | 2.403 | 5.233 |
| **HZ 1180M B** | 450.1 | 670 550 | **11 685** | 12 800 | 302 | 328 | **353** | 2.405 | 5.237 |
| **HZ 1180M C** | 468.7 | 711 900 | **12 320** | 13 565 | 316 | 342 | **368** | 2.418 | 5.246 |
| **HZ 1180M D** | 483.4 | 744 420 | **12 920** | 14 085 | 328 | 354 | **379** | 2.424 | 5.251 |

## Combination HZ ... M - 14 / AZ 26 ($b_{sys}$= 1.787 m)

| Section | A cm²/m | $I_y$ cm⁴/m | $W_{el.y}$* cm³/m | $W_{el.y}$** cm³/m | $G_{60\%}$ kg/m² | $G_{80\%}$ kg/m² | $G_{100\%}$ kg/m² | $A_{LW}$ m²/m | $A_{LS}$ m²/m |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 327.0 | 178 280 | **5 935** | 5 295 | 199 | 228 | **257** | 2.403 | 4.636 |
| **HZ 880M A** | 346.6 | 306 500 | **7 620** | 7 015 | 214 | 243 | **272** | 2.403 | 5.035 |
| **HZ 880M B** | 364.1 | 325 690 | **8 055** | 7 455 | 228 | 257 | **286** | 2.406 | 5.038 |
| **HZ 880M C** | 372.2 | 339 110 | **8 345** | 7 765 | 234 | 263 | **292** | 2.406 | 5.038 |
| **HZ 1080M A** | 391.6 | 550 170 | **10 490** | 9 845 | 249 | 278 | **307** | 2.399 | 5.465 |
| **HZ 1080M B** | 404.3 | 585 630 | **11 105** | 10 480 | 259 | 288 | **317** | 2.400 | 5.467 |
| **HZ 1080M C** | 427.3 | 628 880 | **11 855** | 11 255 | 277 | 306 | **335** | 2.402 | 5.468 |
| **HZ 1080M D** | 446.1 | 671 280 | **12 565** | 12 015 | 292 | 321 | **350** | 2.402 | 5.469 |
| **HZ 1180M A** | 461.1 | 703 080 | **13 060** | 12 585 | 304 | 333 | **362** | 2.403 | 5.469 |
| **HZ 1180M B** | 470.0 | 729 070 | **13 495** | 13 050 | 311 | 340 | **369** | 2.405 | 5.471 |
| **HZ 1180M C** | 494.3 | 786 430 | **14 405** | 13 915 | 327 | 358 | **388** | 2.418 | 5.505 |
| **HZ 1180M D** | 507.6 | 814 270 | **14 865** | 14 410 | 338 | 368 | **399** | 2.424 | 5.511 |

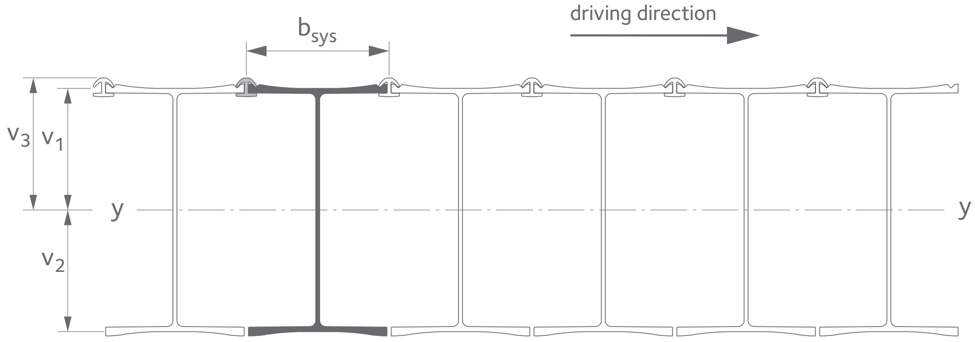
## Combination HZ ... M - 24 / AZ 26 ($b_{sys}$= 2.258 m)

| Section | A cm²/m | $I_y$ cm⁴/m | $W_{el.y}$* cm³/m | $W_{el.y}$** cm³/m | $G_{60\%}$ kg/m² | $G_{80\%}$ kg/m² | $G_{100\%}$ kg/m² | $A_{LW}$ m²/m | $A_{LS}$ m²/m |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 371.0 | 216 820 | **6 755** | 6 065 | 251 | 271 | **291** | 2.926 | 4.946 |
| **HZ 880M A** | 402.2 | 393 780 | **9 230** | 8 540 | 275 | 296 | **316** | 2.927 | 5.342 |
| **HZ 880M B** | 429.8 | 424 140 | **9 945** | 9 240 | 297 | 317 | **337** | 2.933 | 5.348 |
| **HZ 880M C** | 442.6 | 445 420 | **10 415** | 9 725 | 307 | 327 | **347** | 2.932 | 5.347 |
| **HZ 1080M A** | 473.6 | 738 630 | **13 430** | 12 640 | 331 | 352 | **372** | 2.919 | 5.768 |
| **HZ 1080M B** | 493.7 | 794 950 | **14 410** | 13 635 | 347 | 367 | **388** | 2.921 | 5.770 |
| **HZ 1080M C** | 530.1 | 863 270 | **15 625** | 14 860 | 376 | 396 | **416** | 2.924 | 5.773 |
| **HZ 1080M D** | 559.7 | 930 320 | **16 765** | 16 060 | 399 | 419 | **439** | 2.925 | 5.774 |
| **HZ 1180M A** | 583.3 | 980 510 | **17 580** | 16 955 | 418 | 438 | **458** | 2.926 | 5.776 |
| **HZ 1180M B** | 597.5 | 1 021 690 | **18 270** | 17 685 | 429 | 449 | **469** | 2.930 | 5.785 |
| **HZ 1180M C** | 628.6 | 1 093 550 | **19 460** | 18 815 | 453 | 473 | **493** | 2.947 | 5.798 |
| **HZ 1180M D** | 649.6 | 1 137 340 | **20 195** | 19 595 | 469 | 490 | **510** | 2.959 | 5.807 |

## Combination HZ ... M - 26 / AZ 26 ($b_{sys}$= 2.258 m)

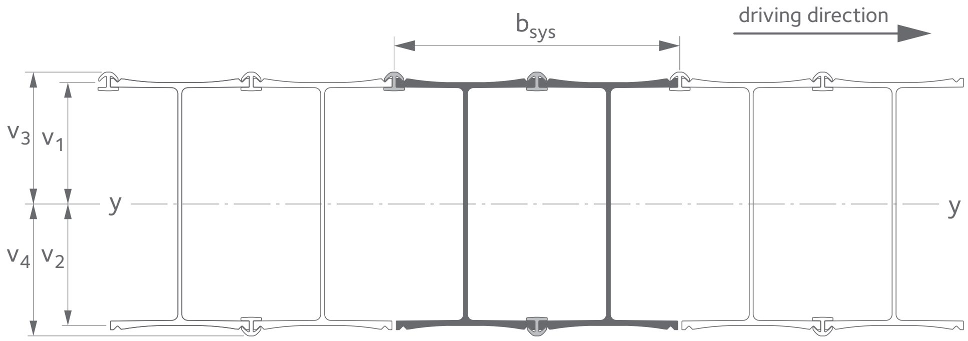
| Section | A cm²/m | $I_y$ cm⁴/m | $W_{el.y}$* cm³/m | $W_{el.y}$** cm³/m | $G_{60\%}$ kg/m² | $G_{80\%}$ kg/m² | $G_{100\%}$ kg/m² | $A_{LW}$ m²/m | $A_{LS}$ m²/m |
|---|---|---|---|---|---|---|---|---|---|
| **HZ 680M LT** | 388.8 | 234 460 | **7 810** | 6 965 | 259 | 282 | **305** | 2.926 | 5.159 |
| **HZ 880M A** | 420.0 | 424 700 | **10 565** | 9 730 | 284 | 307 | **330** | 2.927 | 5.559 |
| **HZ 880M B** | 447.6 | 454 840 | **11 260** | 10 420 | 306 | 328 | **351** | 2.933 | 5.565 |
| **HZ 880M C** | 460.4 | 476 060 | **11 725** | 10 905 | 316 | 338 | **361** | 2.932 | 5.564 |
| **HZ 1080M A** | 491.5 | 790 610 | **15 085** | 14 155 | 340 | 363 | **386** | 2.919 | 5.985 |
| **HZ 1080M B** | 511.6 | 846 790 | **16 065** | 15 160 | 356 | 379 | **402** | 2.921 | 5.987 |
| **HZ 1080M C** | 547.9 | 914 810 | **17 260** | 16 380 | 384 | 407 | **430** | 2.924 | 5.990 |
| **HZ 1080M D** | 577.6 | 981 660 | **18 380** | 17 580 | 407 | 430 | **453** | 2.925 | 5.991 |
| **HZ 1180M A** | 601.1 | 1 031 710 | **19 175** | 18 475 | 426 | 449 | **472** | 2.926 | 5.993 |
| **HZ 1180M B** | 615.3 | 1 072 840 | **19 865** | 19 210 | 437 | 460 | **483** | 2.930 | 5.996 |
| **HZ 1180M C** | 650.9 | 1 157 090 | **21 275** | 20 545 | 463 | 487 | **511** | 2.947 | 6.034 |
| **HZ 1180M D** | 671.9 | 1 200 740 | **22 000** | 21 325 | 480 | 504 | **527** | 2.959 | 6.046 |

## Combination C 1 ($b_{sys}$ = 0.475 / 0.470 / 0.475 m)




| | Dimensions | | | | Properties per meter of wall | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v_1$ | $v_2$ | $v_3$ | $v_4$ | A | G | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | $cm^2/m$ | $kg/m^2$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 281.4 | 318.4 | 317.6 | - | 586.4 | **460.3** | 411 590 | **12 925** | 12 960 | 0.552 | 2.594 |
| **HZ 880M A** | 379.9 | 423.5 | 414.3 | - | 662.1 | **519.8** | 811 010 | **19 150** | 19 575 | 0.551 | 3.001 |
| **HZ 880M B** | 384.3 | 423.1 | 416.7 | - | 727.6 | **571.1** | 882 820 | **20 865** | 21 185 | 0.554 | 3.003 |
| **HZ 880M C** | 387.1 | 424.3 | 417.5 | - | 758.1 | **595.1** | 933 600 | **22 000** | 22 360 | 0.554 | 3.002 |
| **HZ 1080M A** | 500.9 | 546.5 | 535.3 | - | 835.9 | **656.2** | 1 602 720 | **29 330** | 29 940 | 0.547 | 3.431 |
| **HZ 1080M B** | 505.6 | 547.8 | 537.1 | - | 885.1 | **694.8** | 1 740 470 | **31 775** | 32 410 | 0.548 | 3.431 |
| **HZ 1080M C** | 510.6 | 548.8 | 539.0 | - | 970.7 | **762.0** | 1 900 270 | **34 625** | 35 255 | 0.549 | 3.433 |
| **HZ 1080M D** | 515.9 | 551.5 | 540.3 | - | 1 040.9 | **817.1** | 2 058 680 | **37 330** | 38 100 | 0.550 | 3.433 |
| **HZ 1180M A** | 520.9 | 554.5 | 541.3 | - | 1 096.3 | **860.6** | 2 176 560 | **39 250** | 40 210 | 0.551 | 3.434 |
| **HZ 1180M B** | 524.5 | 554.9 | 543.0 | - | 1 132.6 | **889.1** | 2 282 550 | **41 140** | 42 040 | 0.553 | 3.440 |
| **HZ 1180M C** | 522.8 | 560.6 | 542.1 | - | 1 197.6 | **940.1** | 2 430 450 | **43 355** | 44 835 | 0.558 | 3.457 |
| **HZ 1180M D** | 527.9 | 559.5 | 545.2 | - | 1 251.5 | **982.4** | 2 547 690 | **45 530** | 46 735 | 0.564 | 3.464 |

## Combination C 23 ($b_{sys}$ = 0.950 / 0.940 / 0.950 m)



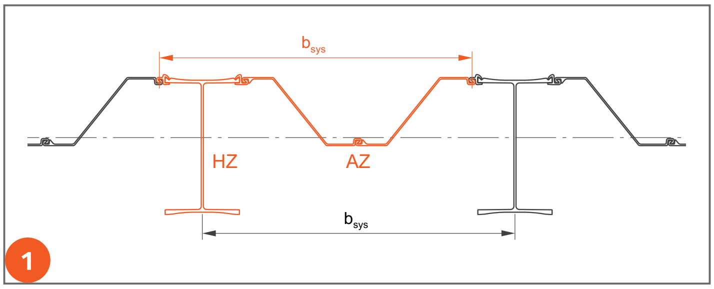

| | Dimensions | | | | Properties per meter of wall | | | | | Per system | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v_1$ | $v_2$ | $v_3$ | $v_4$ | A | G | $I_y$ | $W_{el.y}$* | $W_{el.y}$** | $A_{LW}$ | $A_{LS}$ |
| Section | mm | mm | mm | mm | $cm^2/m$ | $kg/m^2$ | $cm^4/m$ | $cm^3/m$ | $cm^3/m$ | $m^2/m$ | $m^2/m$ |
| **HZ 680M LT** | 289.2 | 310.7 | 325.4 | 347.1 | 601.0 | **471.8** | 426 220 | **13 720** | 12 280 | 1.075 | 3.117 |
| **HZ 880M A** | 389.0 | 414.4 | 423.4 | 448.9 | 676.7 | **531.2** | 836 540 | **20 185** | 18 635 | 1.074 | 3.542 |
| **HZ 880M B** | 392.1 | 415.3 | 424.6 | 447.7 | 741.5 | **582.0** | 906 880 | **21 840** | 20 255 | 1.081 | 3.549 |
| **HZ 880M C** | 394.6 | 416.8 | 425.1 | 447.3 | 772.0 | **606.0** | 957 590 | **22 975** | 21 410 | 1.080 | 3.548 |
| **HZ 1080M A** | 510.4 | 537.0 | 544.8 | 571.4 | 850.8 | **667.9** | 1 646 140 | **30 655** | 28 810 | 1.066 | 3.969 |
| **HZ 1080M B** | 514.1 | 539.3 | 545.5 | 570.7 | 899.2 | **705.9** | 1 781 400 | **33 035** | 31 215 | 1.068 | 3.971 |
| **HZ 1080M C** | 518.3 | 541.1 | 546.7 | 569.6 | 984.8 | **773.0** | 1 940 790 | **35 865** | 34 075 | 1.072 | 3.974 |
| **HZ 1080M D** | 523.1 | 544.3 | 547.5 | 568.8 | 1 054.9 | **828.1** | 2 098 950 | **38 560** | 36 905 | 1.073 | 3.975 |
| **HZ 1180M A** | 527.6 | 547.8 | 548.0 | 568.2 | 1 110.2 | **871.5** | 2 216 470 | **40 460** | 39 010 | 1.074 | 3.977 |
| **HZ 1180M B** | 529.9 | 549.5 | 548.3 | 567.9 | 1 144.1 | **898.1** | 2 314 950 | **42 130** | 40 765 | 1.078 | 3.988 |
| **HZ 1180M C** | 530.2 | 553.2 | 549.5 | 572.5 | 1 214.4 | **953.3** | 2 478 200 | **44 800** | 43 290 | 1.087 | 4.009 |
| **HZ 1180M D** | 532.7 | 554.7 | 550.0 | 572.0 | 1 263.2 | **991.6** | 2 579 400 | **46 500** | 45 095 | 1.099 | 4.018 |

# Definition of the HZ® / AZ® combi-wall

The HZ/AZ wall is an economical combined wall system which consists of:

HZ king piles,

- a pair of AZ sheet piles as intermediary element,
- special hot rolled connectors (RH, RZD, RZU).




The **HZ king piles**, with milled grooves on the flanges and thicknesses up to 40 mm, fulfill two different structural functions:

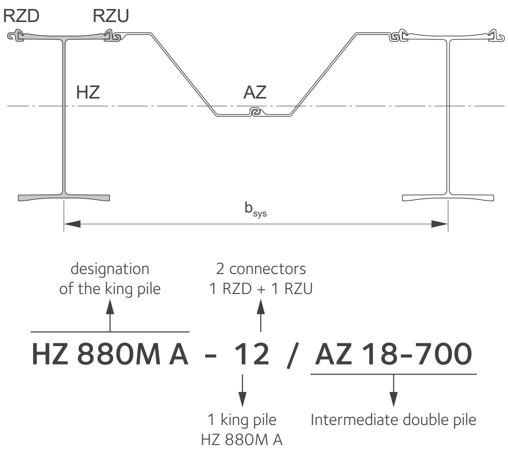
retaining members for soil and hydrostatic pressures,

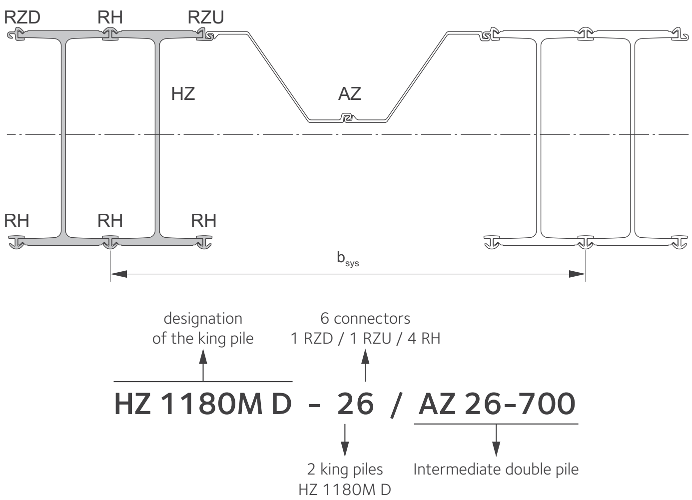
bearing piles for vertical loads.

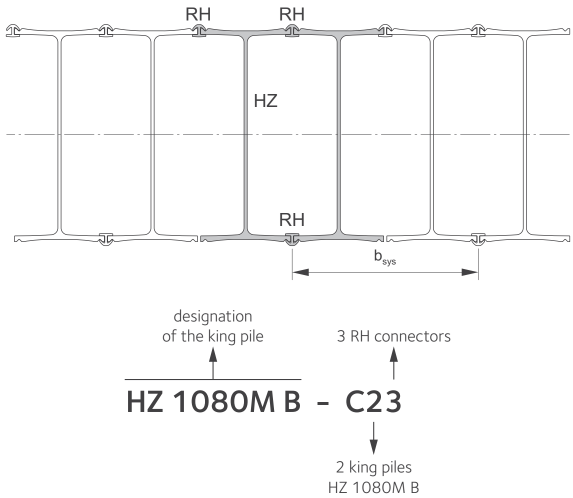
The **AZ intermediary sheet piles** have a soil-retaining and load-transferring function and are generally shorter than the HZ king piles.

The combinations are based on the same principle: structural supports comprising 1 or 2 HZ king pile sections alternating with intermediary double AZ sheet pile sections, or alternatively without any infill sheet piles.

Denomination of the HZ/AZ system:




The connectors are partially welded to the HZ king pile, increasing the stiffness and the section modulus of the whole wall. Unlike other combined wall systems, the geometry of the connectors ensure a **'mechanical connection'** between the two elements of the HZ/AZ system and guarantee the continuity of the wall without relying on the welding of the connectors.

The outstanding feature of the HZ/AZ combined wall system is the extensive collection of possible combinations using the entire AZ sheet pile range, including the latest wide AZ-700 sections, as well as all rolled-up and rolled-down AZ sections. In this brochure, to limit the number of pages, the tables are restricted to the main infill sheets from our AZ rolling program, but you can contact our technical department to obtain the data for other combinations.

Additionally, the HZ/AZ system has some advantages compared to equivalent tube-combiwall:

- it forms nearly a straight wall on the water side / excavation side,
- the depth of the combi-wall is shallower, which is an advantage in tight situations (for instance, when installing a wall in front of an existing berthing facility),
- the capping beam is also easier to construct and requires less concrete,
- anchoring of the HZ is quite simple (see specific paragraph).

## Designing an HZ® / AZ® system

The design of a combined wall is similar to that of all standard sheet pile walls, but calculating the section properties of a combined HZ/AZ system is undertaken differently to conventional sheet piling.

The combined wall is a combination of different elements with the basic assumption that the bending moments along the wall are distributed to the different elements proportionally to their stiffness.

Consequently:

- moment of inertia of one HZ/AZ system (one HZ and one pair of AZ):

$$I_{sys} = I_{HZ} + I_{AZ} \qquad [m^4]$$

- moment of inertia of the HZ/AZ system per meter of wall:

$$I_{sys/m} = \frac{I_{HZ} + I_{AZ}}{b_{sys}} \qquad [m^4/m]$$

Hence, following formulas allow calculating the bending moment distribution to each single component.

Assuming that $M_{sys}$ is the bending moment per meter of wall based on the geotechnical design:

- bending moment transmitted to the HZ king pile (including the connectors):

$$M_{HZ} = \left(\frac{I_{HZ}}{I_{sys}} M_{sys}\right) b_{sys} \qquad [Nm]$$

- bending moment transmitted to the intermediate AZ sheet pile:

$$M_{AZ} = \left(\frac{I_{AZ}}{I_{sys}} M_{sys}\right) b_{sys} \qquad [Nm]$$

### Steel Stress Verification – Global Safety Approach

If one considers only the effect of bending moments, steel stresses can be determined with the basic formula:

$$\sigma = \frac{M}{W}$$

For the king piles HZ:

$$\sigma_{HZ} = \frac{M_{HZ}}{W_{HZ}} = \left(\frac{1}{W_{HZ}}\right)\left(\frac{I_{HZ}}{I_{sys}} M_{sys}\right) b_{sys}$$

$$= \frac{1}{W_{HZ,\,eq}} M_{sys} \qquad [Pa]$$

where $$W_{HZ,\,eq} = \frac{I_{sys}}{b_{sys}\, Max(v_1, v_2)} \qquad [m^3/m]$$

is the 'equivalent section modulus' of the HZ king pile. This approach simplifies the task of the designer by using exclusively $M_{sys}$ (no need to decompose $M_{sys}$).

Note: "$W_{HZ,eq}$" is labelled in the tables of this brochure as $W_{el,y}$*.

For the connectors RH / RZD / RZU:

$$\sigma_{RH/RZ} = \frac{M_{HZ}}{W_{RH/RZ}} = \left(\frac{1}{W_{RH/RZ}}\right)\left(\frac{I_{HZ}}{I_{sys}} M_{sys}\right) b_{sys}$$

$$= \frac{1}{W_{RH/RZ,\,eq}} M_{sys} \qquad [Pa]$$

where $$W_{RH/RZ,\,eq} = \frac{I_{sys}}{b_{sys}\, Max(v_3, v_4)} \qquad [m^3/m]$$

Note: "$W_{RH/RZ,eq}$" is labelled in the tables of this brochure as $W_{el,y}$**.

For the AZ infill sheet piles:

$$\sigma_{AZ} = \frac{M_{AZ}}{W_{AZ}} = \frac{\frac{I_{AZ}}{I_{sys}} M_{sys}\, b_{sys}}{W_{AZ}} \qquad [Pa]$$

Based on above formulas, the verification of the allowable stresses is straightforward:

$$\sigma_{allowable} = \frac{f_y}{S_F}$$

The steel stresses of each component must be checked individually:

$$\sigma_{HZ} \leq \sigma_{allowable,\,HZ}$$

$$\sigma_{RH/RZ} \leq \sigma_{allowable,\,RH/RZ}$$

$$\sigma_{AZ} \leq \sigma_{allowable,\,AZ}$$

Notes:

- the yield stress of each individual component may be different. As a rule of thumb, stresses within the infill sheet piles are most often relatively small allowing the use of a low steel grade for the AZ. This improves the cost efficiency of the solution. However, driveability issues may trigger the choice of a higher steel grade than required by the design calculations.
- the yield stress of the connectors must be higher than the one of the HZ, except for the combination 12. Hence, connectors are available exclusively with a yield point of 460 MPa.
- the full range of HZ/AZ systems are also available in ASTM A 690, with yield stresses of 345 MPa and above.

The HZ king piles are capable of transferring high vertical loads to the subsoil. In such cases, stress analysis should include vertical loads and additional bending moments induced by deflection. Vertical loads can also originate from battered anchors, struts, etc.

The basic formula changes to:

$$\sigma = \frac{M}{W_x} + \frac{N \cdot e}{W_x} + \frac{N}{A_{HZ}}$$

To summarize, the designer can calculate in an easy way the stresses in the different components of the HZ by using the bending moment $M_{sys}$ of the combi-wall and the two 'equivalent' section moduli' $W_{el,y}$* and $W_{el,y}$** which are shown in the tables of this brochure.

## Steel Stress Verification – Partial Safety Approach

In Europe, the design of steel sheet pile walls has to be done according to the Eurocodes. Please refer to EN 1993 - Part 5 [1] for the complete design method. Eurocodes are based on 'partial safety factors' that are applied to the resistances (EN 1993-5) and to the actions (geotechnical design based on EN 1997- Part1 [2]).

## Practical aspects

The contribution of the infill sheets is relatively small for certain combinations, so that sometimes the designer neglects the contribution of the moment of inertia of the infill sheets. This is a safe-sided approach but might be quite penalizing in some cases.

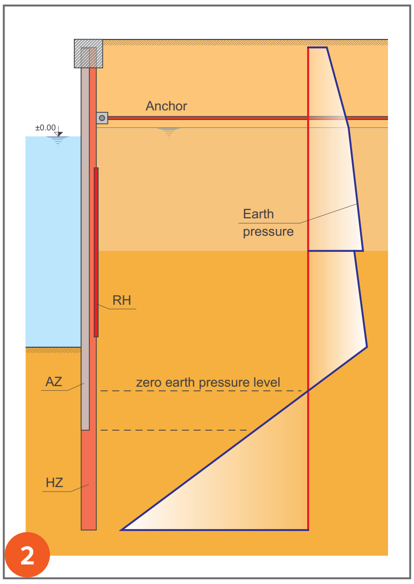
Savings can be achieved by shortening the length of the intermediate sheet piles. In the ground, where there is earth support and embedment, the length of the intermediate sheet piles can be considerably curtailed. In the infill role the intermediate sheet piling is only required to resist active earth pressures down to the zero earth pressure level. For safety reasons, its length is extended below this level by at least 1 - 2 m (Figure 2). If the embedment of the infill sheets is quite small, special care must be taken during construction in order to make sure that the piles are driven to the design level. For cantilever walls, the maximum bending moment occurs in the embedded portion so that the length of the infill sheet piles must be checked. Furthermore, if groundwater pressures are high, the risk of seepage beneath the toe should be analysed when curtailing the length of the intermediate sheet piles.

The HZ king pile spacing should be limited so that full continuous earth resistance is safeguarded. When determining pile spacing, arching effects of the soils may be considered. If these properties are negligible (eg. in soft mud or where groundwater pressure is high), the transverse load capacity of the intermediate sheet piles needs to be checked. Additionally, the development of the earth resistance in front of the wall may have to be checked. Experience shows that for the standard HZ/AZ combinations, this 3D effect on the passive resistance can be taken into account and the design of the combined wall can be done as a continuous retaining wall. More detailed information can be found in Chapter 8.1.4 of the 'EAU 2004' [3]. The section modulus of the HZ king piles can be adapted to the resultant bending moment by adding RH connectors to the rear flanges. As a result, a lighter section can be selected and simply strengthened locally where maximum bending occurs (Figure 3).

The HZ combined wall system, in which the full range of AZ sections can be used as intermediate sheet piles, offers maximum flexibility in terms of design. Heavier AZ sections can also be selected to enhance corrosion resistance or enhance driving behaviour. Generally speaking, the range of suitable sheet piles varies from 1 200 $cm^3$/m to 3 000 $cm^3$/m.

Driveability is a supplementary key factor that should be analysed when choosing the infill sheets. In normal driving conditions, infill sheet piles above 20 m should have a section modulus above 2 000 $cm^3$/m.

Local standards or regulations may call for specific features of the infill sheets. For instance, in some countries infill sheet piles used in marine structures shall have a minimum thickness of 10 - 12 mm.

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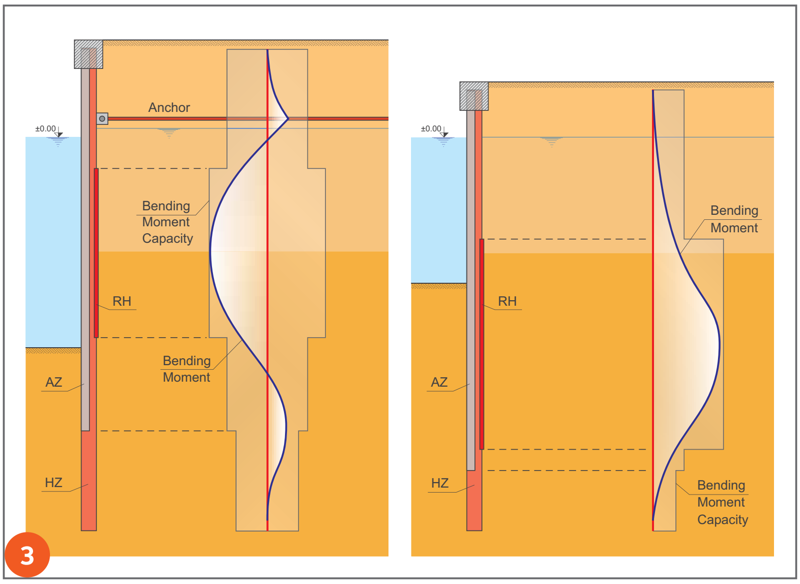


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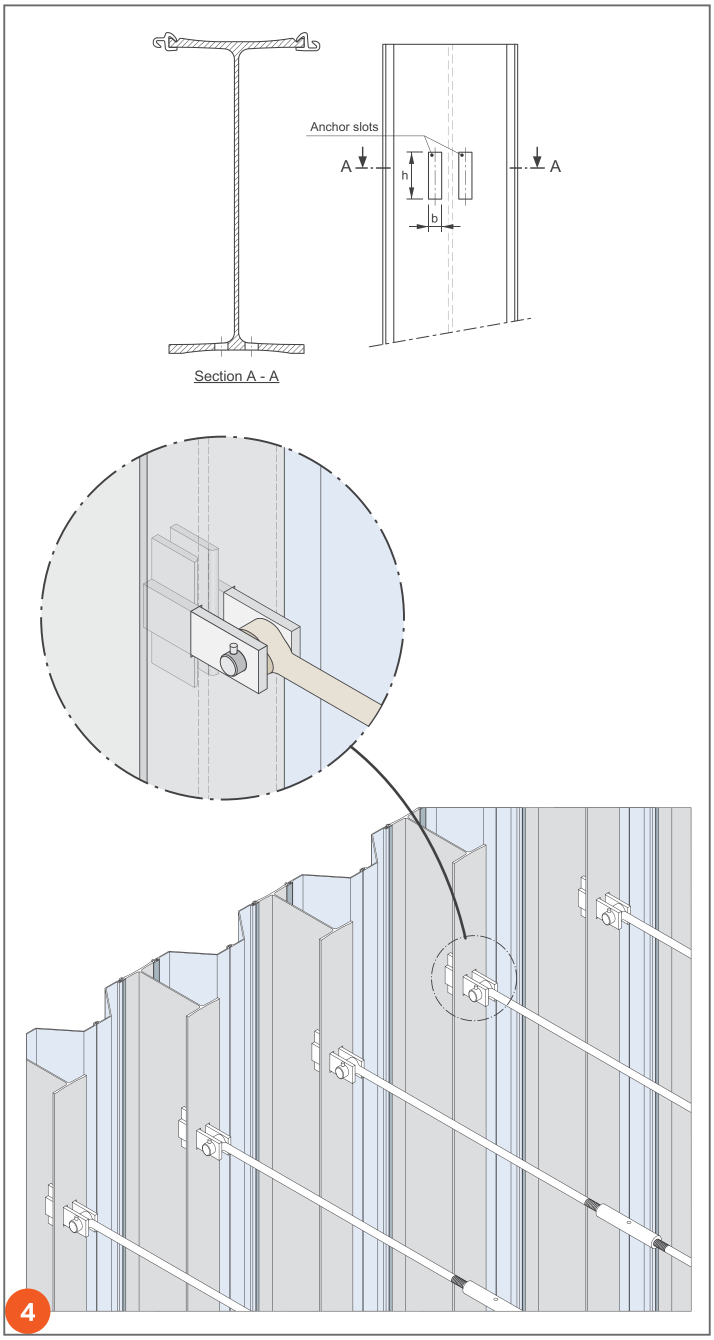
## HZ®-M specific tie-back system

Anchoring an HZ wall can be quite simple and efficient: a tie-rod links each HZ king pile or HZ box pile to a steel sheet pile anchor wall or to isolated sheet pile panels - a particularly economic solution.

Because each king pile is anchored, a traditional waler system can be avoided. The tie-rod is simply linked to the HZ-pile by two T-connectors and a pin. T-connectors are threaded through jobsite cut slots in the rear flange of the HZ-pile after driving. Loads are thereby applied close to the web.

HZ sections can be delivered with precut anchor slots on request, although this is not best practice as it is difficult to achieve the exact elevation of the slots due to driving tolerances. The sketch below shows the slots cut in the HZ king pile. The dimensions "h" and "b" vary with the tie rod diameter.

Conventional anchoring, incorporating a waler system, is an alternative. The HZ system can also be anchored with battered steel HP-piles or with grout anchors.

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5a

5b

5c

5d

6

## Installation procedure

The combined wall system HZ/AZ can be installed on land and on water in a similar way. The key element for a state-of-the-art installation is the template. The quality of the installation can be quite poor if the template is not adequate.

First the template is placed and secured to avoid any shifting during driving. Then a number of HZ king piles are pitched in the template. Afterwards the king piles are driven into the ground (Figure 7 – Step 1), starting preferably with a vibratory hammer, adopting the "Pilgrim's step" driving sequence.

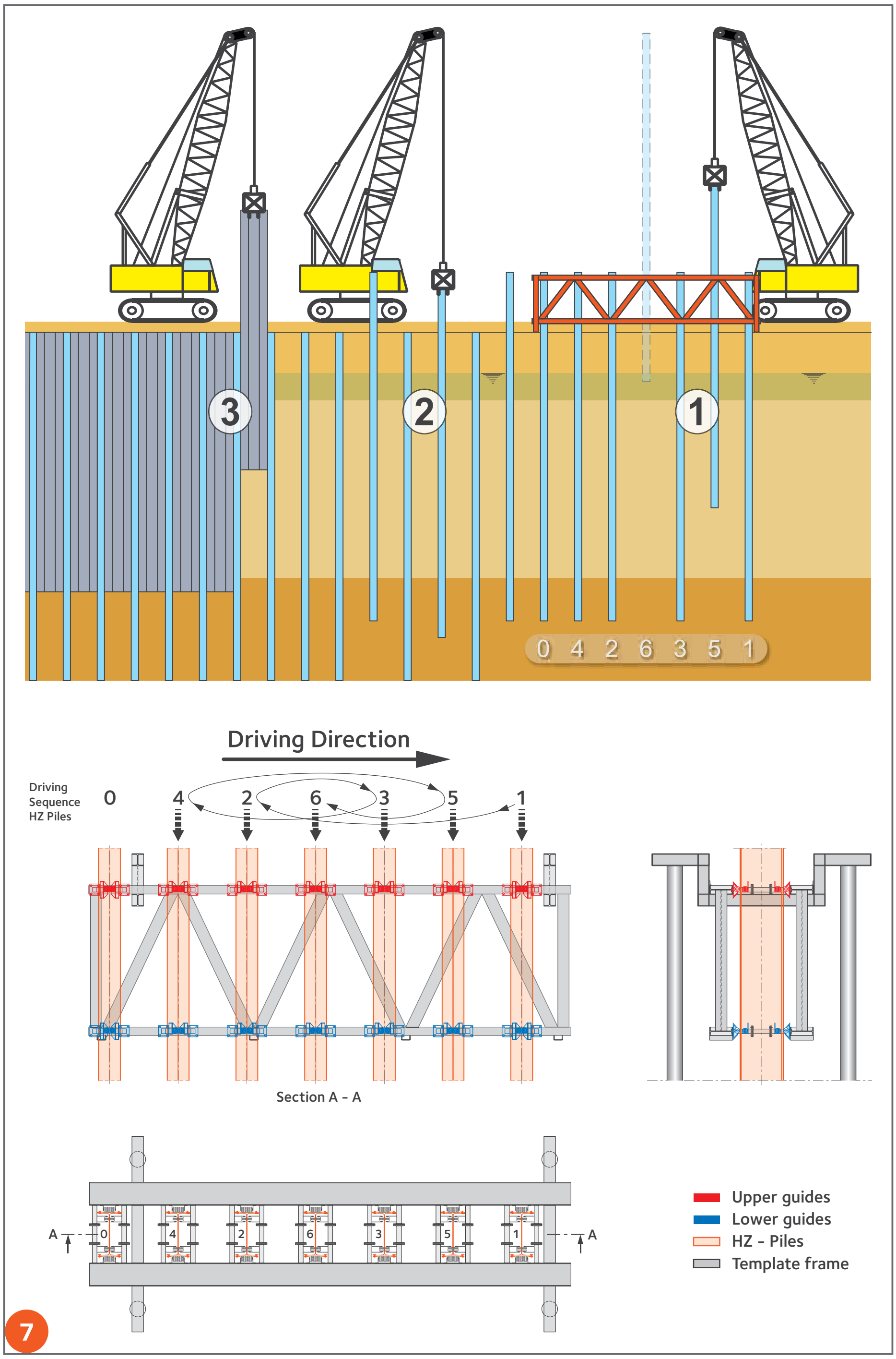
Depending on soil conditions and on the geometry of the final structure, a second driving phase with an impact hammer may be indispensable (Figure 7 – Step 2): driving to final grade resumes after removal of the driving template.

Generally the intermediate sheet piles are only pitched and driven after the driving of the HZ piles is completed (Figure 7 – Step 3).

However, in case of difficult geotechnical conditions, it may be necessary to carry out the whole driving operation in two stages:

- first stage: drive the king piles as deep as possible into the ground, or to a predetermined intermediate depth. The intermediate sheet piles are then threaded and driven to the same depth as the king piles, or to a shallower depth,
- second stage: drive the king piles and then the infill sheets down to the design depth or to refusal.

It is recommended to use partially crimped pairs of AZ sheet piles: the specific crimping of the interlocks increases the stiffness of the sheet pile at the top, and facilitates the installation process (Figure 8). At the bottom, the AZ sheets are still 'flexible' enough in order to accommodate driving tolerances of the king piles.



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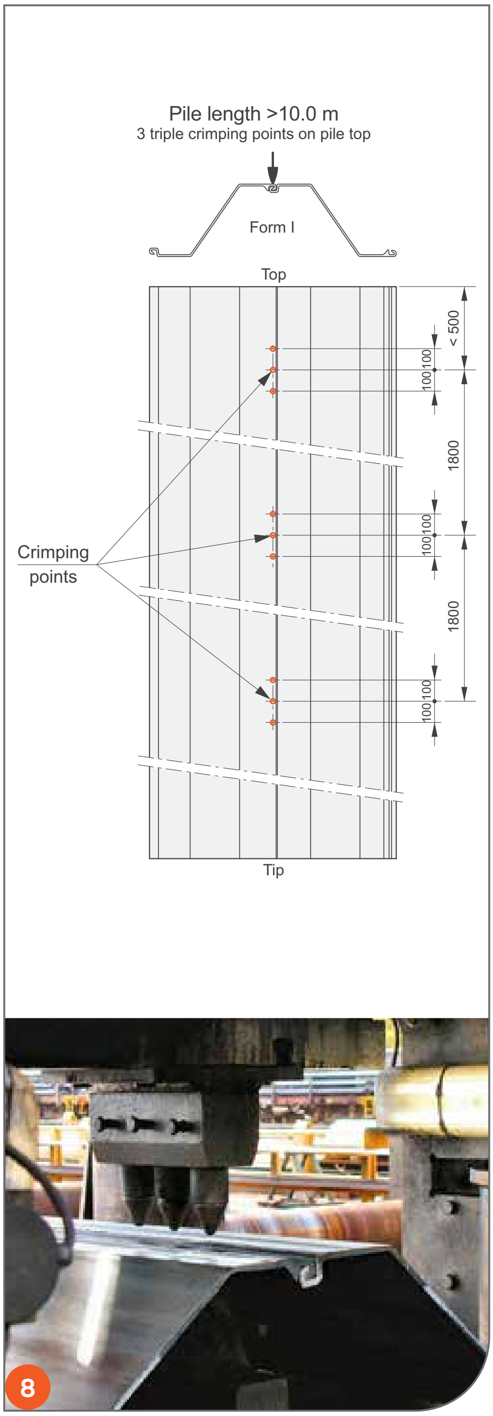

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## Installation Methods

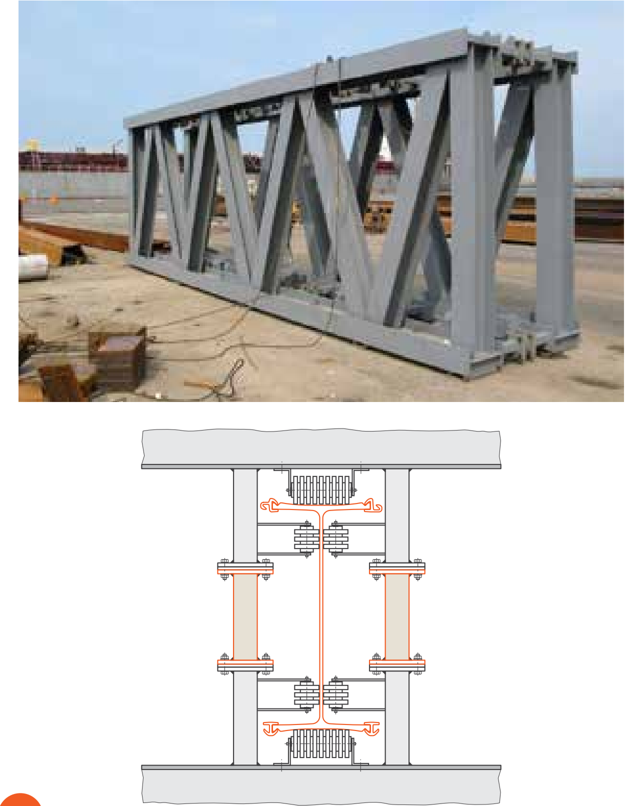
It is essential that the king piles are driven in the correct position and vertically, or at the prescribed batter. Two different methods can be used.

### Method 1: Template with two guide levels

This is the recommended method and utilizes a rigid template with two guide levels on which the theoretical position of the king piles are set (Figure 9). The vertical distance between the two levels should be at least 3 m.

The template should be placed as close to the ground as possible. On land the template can rest on the ground but it should be secured firmly against any shifting. However, it is advisable to support the template on piles. When driving in water the template is supported on auxiliary piles just above the water level.

Depending on the design, such templates usually have space for 5 to 9 king piles (Figure 7). These primary piles are driven using a free-hanging vibrator or an impact hammer, the vibrator being the most commonly used equipment. Inside the template the proper HZ guiding system (Figure 10) should be designed to avoid damage to the coating on the sheet piles if applicable (for example by using guide rolls).



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After all the piles of one template are driven, the template is removed and repositioned. The last driven pile will serve as a guide for the new position of the template in order to ensure a proper alignment and distance between the king piles. Actually, it could also serve as a support pile, but from a practical point of view, it is best to separate the two functions.

Later on, the intermediate sheet piles can then be installed with the same driving equipment, or by a second pile driving team.

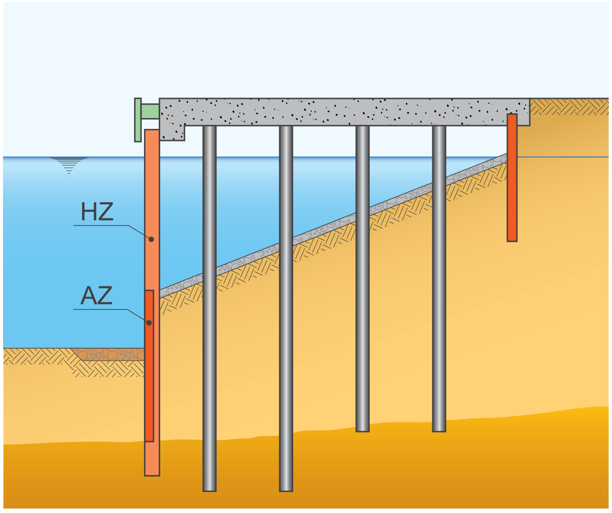
### Method 2: Piling equipment guided by a fixed leader

The king piles are driven using piling equipment guided by a fixed leader (Figure 11). The correct driving angle, in the direction of the pile axis, must be achieved by the leader, and the correct positioning through a simple horizontal driving guide. When piling in water the latter is secured above the water level on auxiliary piles, in all other cases it is set down on the driving platform and secured.

11

### Installation below water level

The rehabilitation of an existing deck on piles (Figure 12) or a gravity structure may be solved with an underwater cantilever or anchored sheet pile wall installed in front of the existing wall. The installation of such a wall is more complex, but the procedure is similar to above water driving. There is a need for a template and the driving sequence follows the same principles, but the different phases have to be adapted to the local environment and tidal fluctuations. The driving equipment should be able to work under water, otherwise a vibratory hammer fitted with a 'follower' (extension) can be used (Figure 12).

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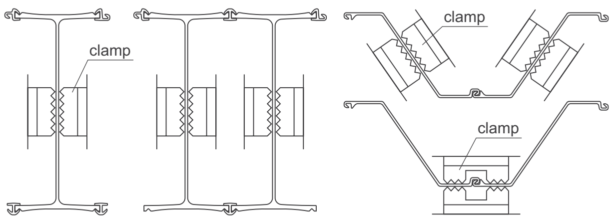
### Comments

It is important to constantly check the position of the king piles and the verticality. It should be as close as possible to the theoretical position. This is essential to ensure unproblematic installation of the intermediate sheet piles.

At the depth of the toe of the AZ infill sheets, the distance between two adjacent king piles should not be more than 200 mm off the theoretical distance, otherwise the king piles should be extracted and re-driven, or the contractor must fabricate a special pile which takes into account the excessive driving tolerances.

## Driving Equipment

Current driving technology allows the use of impact or vibratory equipment to drive king piles and intermediate sheet piles. Vibratory equipment should be preferred whenever possible. A combination of the two techniques can be used for the driving of the king piles: the king piles are first driven using vibration as described above, then the final depth is reached with an impact hammer.





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Intermediate sheet piles are generally installed with vibratory hammers.

Vibratory hammers should be fitted with adequate clamps to ensure a correct load transfer to the pile. It is recommended to use double clamps for HZ box piles. For intermediate AZ sheet piles single or double clamps can be used (Figure 13). It is advisable to choose a vibrator with sufficient power reserve to allow good driving speed and penetration to prevent damaging the interlocks through over-heating. Vibratory hammers with variable impact energy are preferable.

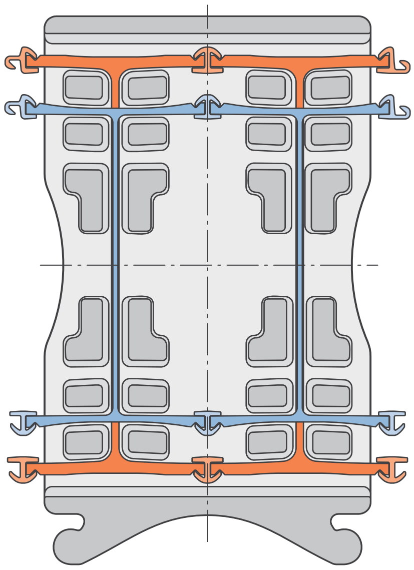
Types of hammers are free-fall hammers, diesel hammers and hydraulic hammers. A driving cap must be used with free-fall or diesel hammers (Figure 14). In the case of an hydraulic hammer the manufacturer can provide special driving plates which fit the geometry of the pile head. Note that impact hammers should also be powerful enough so as to avoid local deformation of the pile heads.

If driving of the intermediate sheet piles shows no progress, is impossible or can only be achieved through excessive driving energy, do the following:

- check for obstructions in the soil. This can be done, for example, by extracting the intermediate sheet pile and re-driving it outside the interlocks.
- verify that the spacing and the positioning of the king piles is correct. This can be done, for example, by means of an inclinometer. A tube of the same diameter as the inclinometer is fitted with a corresponding connector and jetted down on the interlocks at the back flange of the king pile. The measurements taken by the inclinometer will give information on the actual position of the king pile at the relevant depths. In case the spacing between the king piles does not comply with the driving tolerances requirements, the king piles must be extracted and re-driven.

It is strongly advised to avoid forcing the driving of an intermediate sheet pile as this might lead to declutching.

Position of section HZ 880M / 1080M / 1180M as box pile



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## Driving Aids

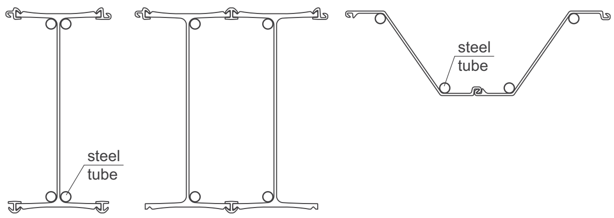
Whenever difficult driving is expected due to unfavourable geotechnical conditions, auxiliary techniques can help smooth the progress of driving:

- water jetting: low-pressure or high-pressure, mainly in granular or soft cohesive soils
- pre-drilling
- reinforcing the toe of the piles
- blasting (quite rare nowadays)

### Low-pressure or high-pressure jetting in granular or soft cohesive soil

Jetting tubes attached to the intermediate sheet piles, close to the free threading interlocks might facilitate driving. Low pressure water jetting with around 10 - 20 bars yields good results in granular soils (mainly in sands) through reduction of the friction along the sheet pile surface and toe resistance. Installation time, driving energy and vibrations are drastically reduced.

For high-pressure jetting it is recommended to use an appropriately equipped displacement pile. This displacement pile is driven prior to inserting the actual intermediate sheet pile, and then extracted.

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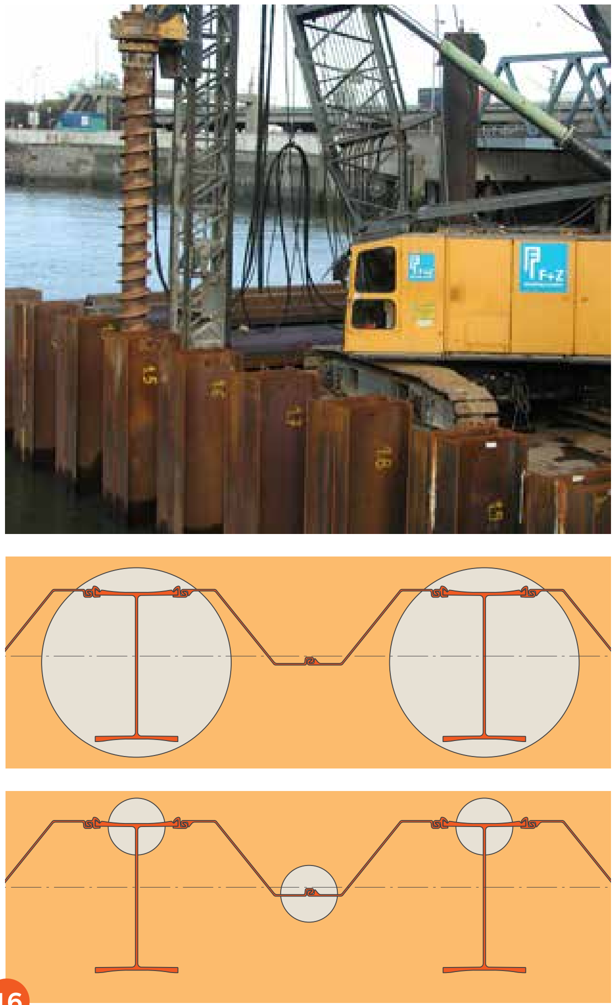
## Pre-drilling / Augering

Pre-drilling or augering is often used when sheet piles are to be driven into compact sands or stiff clays. The method consists in softening the soil so that driving can be performed with standard equipment.

Pre-drilling can also be used when the combi-wall has to penetrate into rock layers. In this case, only the HZ king piles are driven into the drilled space in the soil layer (Figure 16).

The advantage of this solution is that both activities can be done in parallel and that driving of the sheet piles is much faster. The drawback is that the contractor needs two different equipments on the job-site to execute relatively large diameter drills for the HZ or smaller drills for the AZ.

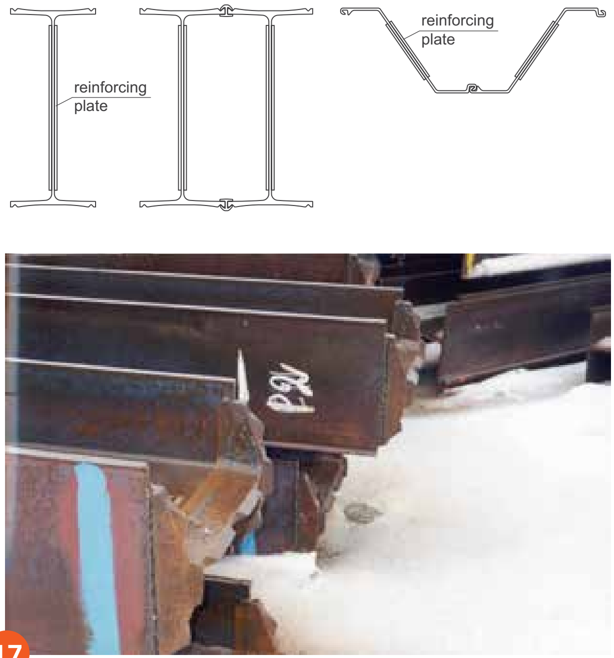


16

## Reinforcing of the cross section at the pile toe

This method consists of welding steel plates at the tip of the pile. It is used predominantly in cohesive soils, and the aim is to reduce skin friction (Figure 17).

Alternatively the whole toe of the pile can be equipped with special cast elements also called 'tip points' or 'pile shoes'. This allows the pile to penetrate into rock, up to a few meters (for instance in sandstone or mudstone), without damage.

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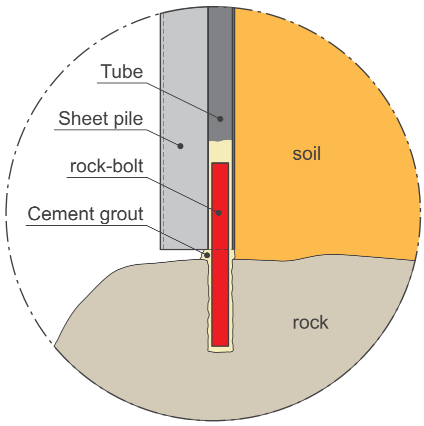
## Rock bolting / Toe pinning into a rock layer

If the rock horizon is higher than the required embedment depth of the combined wall, then the bottom of the wall can be secured by dowelling the king pile to the underlying rock (toe-pin). Please consult the specific brochure for more information.

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## Durability

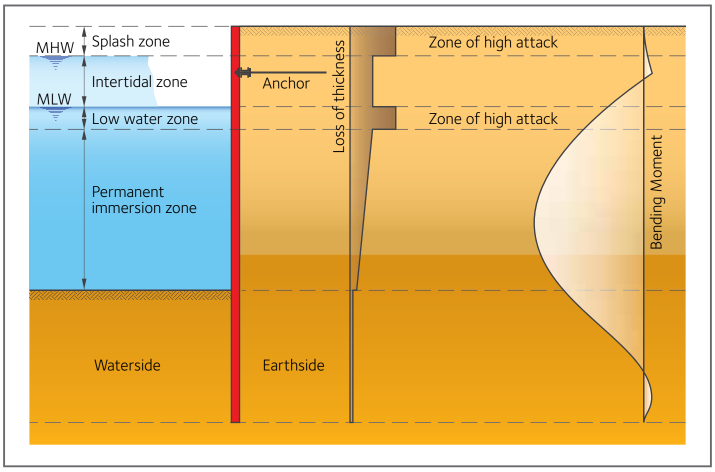
Temporary structures are not endangered by corrosion, but the service life of a permanent structure has to be analysed in different situations. The loss of steel is to be taken into account for structures executed in marine environments. Atmospheric corrosion is quite small, and in most natural soils, steel resists quite well to the natural phenomenon of corrosion.

The determination of the residual section properties after corrosion of an HZ system is more complex than for standard sheet piles, because the corrosion is higher on the water side of the wall. Assumptions like proportionality to the initial thickness of the flange are too safe-sided and may lead to uneconomic solutions. Please contact our technical department if you need an assessment of the residual section properties.

Additional protection methods of the steel include surface coatings, cathodic protection (only in the zone which is permanently in contact with water), concrete capping beams, etc.

ArcelorMittal has developed a new steel grade **AMLoCor** that is more resistant to corrosion in the 'Permanent Immersion Zone' and in the 'Low Water Zone'. In the near future all the elements of the HZ system will be available in steel grade AMLoCor with different yield strength.

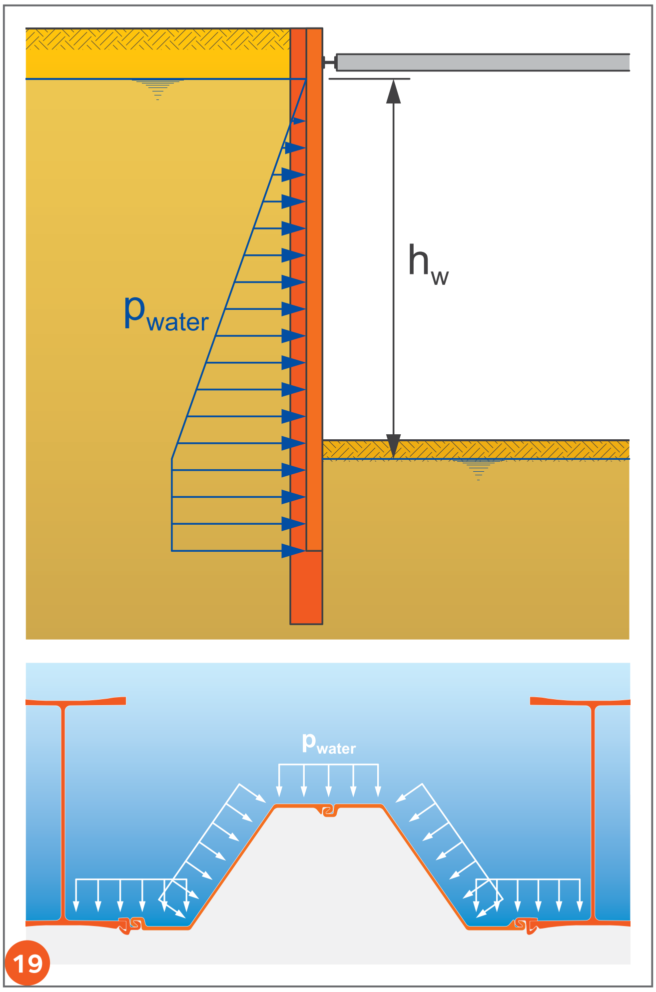
Typical loss of thickness due to corrosion and moment distribution for anchored sheet pile wall in marine environment:




ArcelorMittal's technical department can assist with any queries.

## Resistance to water pressure

The HZ system can be submitted to large hydraulic pressures, for instance when used to build a cofferdam in the middle of a river. The performance of the system under water pressure depends on the chosen combination HZ king pile and AZ infill sheet and their respective steel grades. This chapter aims to provide sufficient information to choose the most adapted HZ/AZ combination for this particular loading case.



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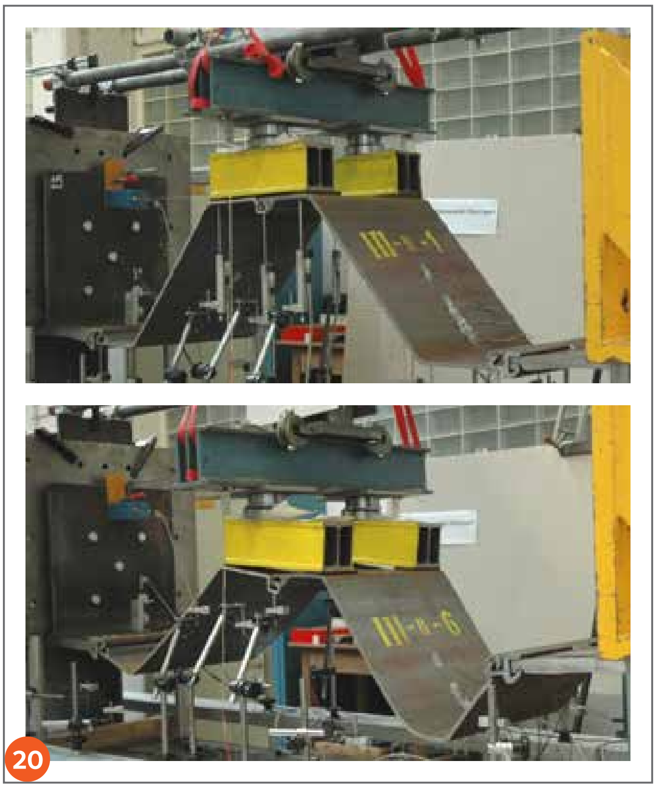
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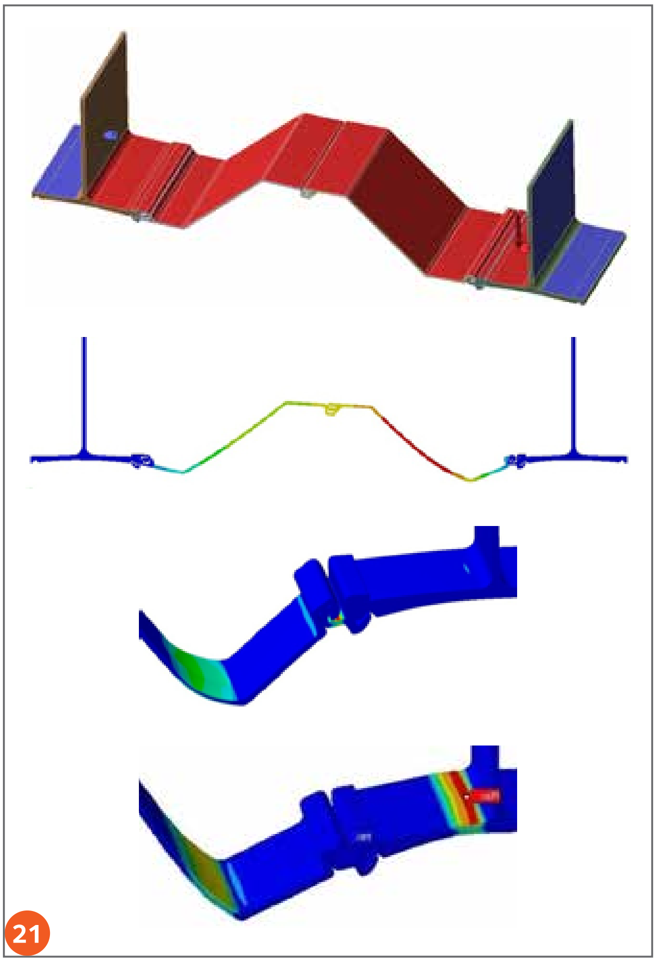
A large number of mechanical testing in the laboratory and finite element simulations were performed at the Institute of Structural Design of the University of Stuttgart, Germany, in order to determine the resistance of the HZ/AZ system to hydraulic pressure. The mechanical tests used several hydraulic jacks applying progressive loads on the upper corners of the AZ piles. Back-calculation of these tests allowed for calibration of FE models with subsequent consideration of distributed water pressure perpendicular to the contact surface.

The results confirm the excellent behaviour of the HZ/AZ combined wall system which can resist to water head differences of up to 14 m. Declutching of the interlocks did not occur in any test, which confirms the outstanding reliability of the connectors and of the 'Larssen' interlocks of the AZ sheet piles.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**Characteristic values** for the maximum water pressures $p_{max,k}$ have been determined with a careful statistical evaluation and can be taken from the table below. These values are based on following assumptions:

- steel grades
  - ➢ HZ S 430 GP & above $f_y \geq 430$ MPa
  - ➢ RZD/RZU S 460 GP [1] $f_y \geq 460$ MPa
  - ➢ AZ S 240 GP, S 355 GP & S 430 GP
- the structure is submitted to pure water pressure. Eventual additional earth pressures are not considered.

The table is subdivided in three combinations of HZ king piles:

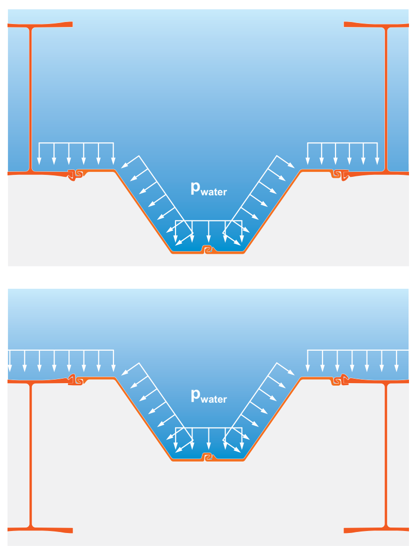
- HZ 880M A & HZ 880M B, S 430 GP
- HZ 880M A & HZ 880M B, S 460 GP
- HZ 880M C, HZ 1080M & HZ 1180M, S 430 GP and above

**Design values** [2] can be obtained by applying the partial safety factor $\gamma_{M1}$. Please refer to EN 1993 – Part 5 and the relevant National Annex for $\gamma_{M1}$ (EN 1993 – Part 5 recommends a value of $\gamma_{M1}$ = 1.10).

| | HZ king pile | HZ 880M A<br>HZ 880M B | | | HZ 880M A<br>HZ 880M B | | | HZ 880M C<br>HZ 1080M<br>HZ 1180M | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | HZ steel grade | S 430 GP | | | S 460 GP [1] | | | S 430 GP & S 460 GP [1] | | |
| | AZ steel grade | S 240 GP | S 355 GP | S 430 GP | S 240 GP | S 355 GP | S 430 GP | S 240 GP | S 355 GP | S 430 GP |
| AZ infill sheet | t (mm) | Characteristic values of water pressure $p_{max.k}$ (kPa) | | | | | | | | |
| **AZ 12-770** | 8.5 | 35.1 | 51.9 | 57.6 | 35.1 | 51.9 | 57.6 | 35.1 | 51.9 | 57.6 |
| **AZ 13-770** | 9.0 | 38.5 | 57.0 | 63.0 | 38.5 | 57.0 | 63.0 | 38.5 | 57.0 | 63.0 |
| **AZ 14-770** | 9.5 | 42.0 | 62.1 | 68.3 | 42.0 | 62.1 | 68.3 | 42.0 | 62.1 | 68.3 |
| **AZ 14-770-10/10** | 10.0 | 45.4 | 67.1 | 73.6 | 45.4 | 67.1 | 73.6 | 45.4 | 67.1 | 73.6 |
| **AZ 12-700** | 8.5 | 46.5 | 68.8 | 77.4 | 46.5 | 68.8 | 77.4 | 46.5 | 68.8 | 77.4 |
| **AZ 13-700** | 9.5 | 52.7 | 77.9 | 78.8 | 52.7 | 77.9 | 83.8 | 52.7 | 77.9 | 88.2 |
| **AZ 13-700-10/10** | 10.0 | 55.7 | 78.8 | 78.8 | 55.7 | 82.4 | 83.8 | 55.7 | 82.4 | 93.5 |
| **AZ 14-700** | 10.5 | 58.8 | 78.8 | 78.8 | 58.8 | 83.8 | 83.8 | 58.8 | 87.0 | 98.9 |
| **AZ 17-700** | 8.5 | 41.3 | 61.1 | 67.4 | 41.3 | 61.1 | 67.4 | 41.3 | 61.1 | 67.4 |
| **AZ 18-700** | 9.0 | 45.0 | 66.6 | 73.7 | 45.0 | 66.6 | 73.7 | 45.0 | 66.6 | 73.7 |
| **AZ 19-700** | 9.5 | 48.7 | 72.1 | **78.8** | 48.7 | 72.1 | 79.9 | 48.7 | 72.1 | 79.9 |
| **AZ 20-700** | 10.0 | 52.5 | 77.6 | **78.8** | 52.5 | 77.6 | **83.8** | 52.5 | 77.6 | 86.2 |
| **AZ 24-700** | 11.2 | 68.6 | **78.8** | **78.8** | 68.6 | **83.8** | **83.8** | 68.6 | 101.5 | 113.8 |
| **AZ 26-700** | 12.2 | 76.8 | **78.8** | **78.8** | 76.8 | **83.8** | **83.8** | 76.8 | 113.6 | 127.9 |
| **AZ 28-700** | 13.2 | **78.8** | **78.8** | **78.8** | **83.8** | **83.8** | **83.8** | 85.0 | 125.8 | 142.0 |

Notes

- as a rule of thumb, the resistance of AZ infill sheets increases with the yield strength,
- failure can occur in the AZ infill sheets or in the flange of the HZ king pile, and consequently the minimum value of both resistances is chosen. Failure of the flange of the lighter HZ 880M series under high pressure governs the resistance in a few cases,
- AZ infill sheets that have to resist higher water pressures can be placed such that they work in tension (Figure 22),
- contact the technical department for the HZ 680M.

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[1] S 460 GP according to prEN 10248: 2006 [4]

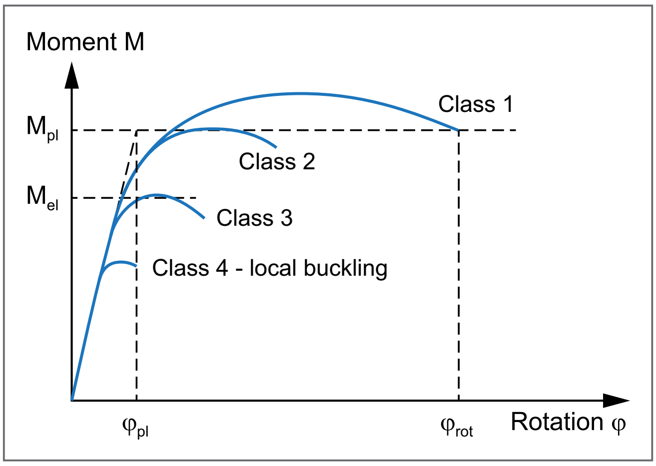
[2] This procedure is only valid for a **'Limit State'** design approach like the European Eurocodes. If the design of the sheet pile structure is still based on an 'Allowable Strength Design' (ASD) approach, the characteristic values of the table must be divided by an appropriate global safety factor based on local standards and design rules.

# Cross-sectional classification of HZ®-M

## Standard case in pure bending [1)]

The design of steel sheet piles according to the European standard Eurocode 3 requires the cross-sectional classification of the profiles. This standard provides tables for the classification of most common sections, as tubes, angles, H-beams, but does not deal with special sections like HZ with welded connectors in the extremities of the flanges, or sections with specific geometries as curved flanges with increasing thickness towards its 'free' ends. That is why a realistic classification was prepared taking into account the real geometry and the bending moment distribution for the HZ solutions.

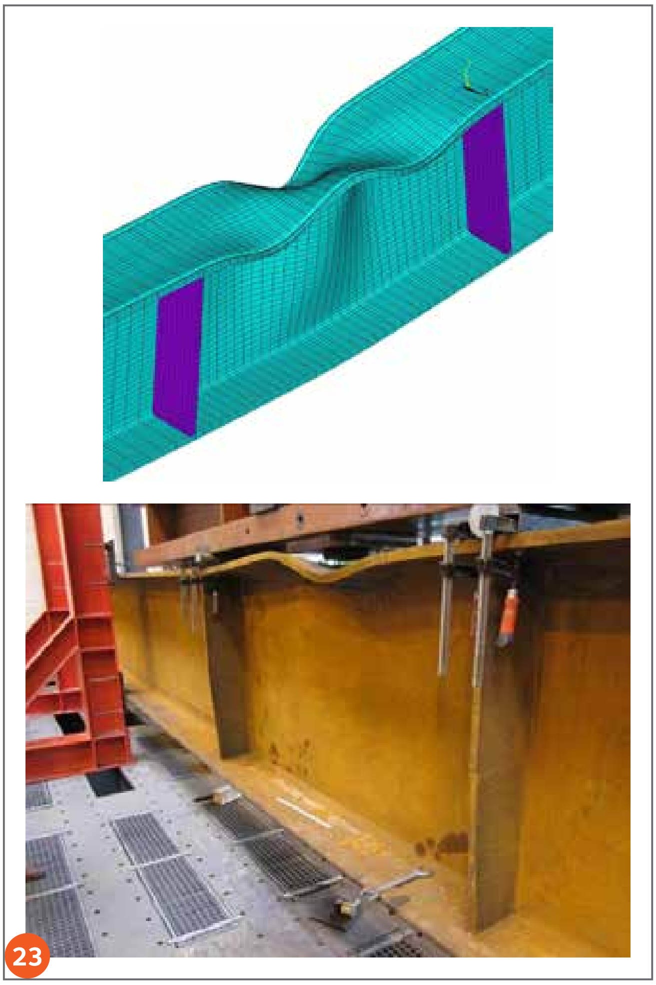
**A class 2 section can be designed using the plastic section modulus** $W_{pl}$ whereas for a class 3 section the designer can only use the elastic section modulus $W_{el}$. For a class 4 section, local buckling occurs before reaching the elastic bending moment capacity $M_{el}$.




ArcelorMittal R&D Esch, Piling products department, in collaboration with the Rhine-Westphalia University of Technology in Aachen (RWTH Aachen), more precisely the "Institut und Lehrstuhl für Stahlbau und Leichtmetallbau" from Professor Feldmann, lead an experimental campaign on "4 points bending tests" backed by numerical simulation (Figure 23) from a finite element model developed by RWTH for this project [2)].

The cross section's classes of HZ resulting from this campaign are summarized in Figure 24 hereafter and are valid for the whole HZ range and for steel grades from S 240 GP to S 460 AP [3)].

From a safe-sided approach, all sections can be classified as cross-section class 2, for steel grades ranging from S 240 GP to S 460 AP, except for the solutions 12 and 24 (with connectors on the tensile flange or on the compression flange) which can be classified as class 3.



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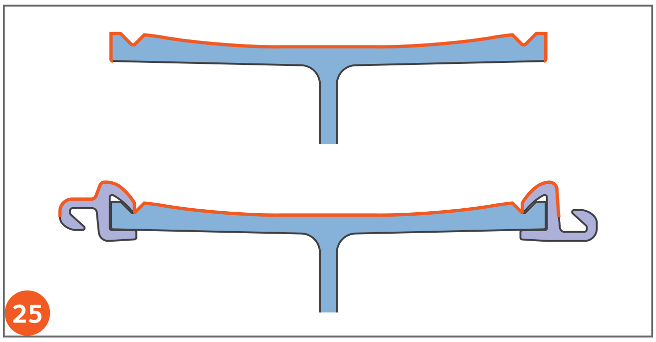
## Influence of the loss of steel thickness of the flange

An additional research project [4)] took into account the corrosion phenomenon and its influence on the cross sectional classification. This parametric study was also carried out with a finite element model developed by RWTH considering a loss of steel thickness on one flange (outer face) up to 8 mm (Figure 25).



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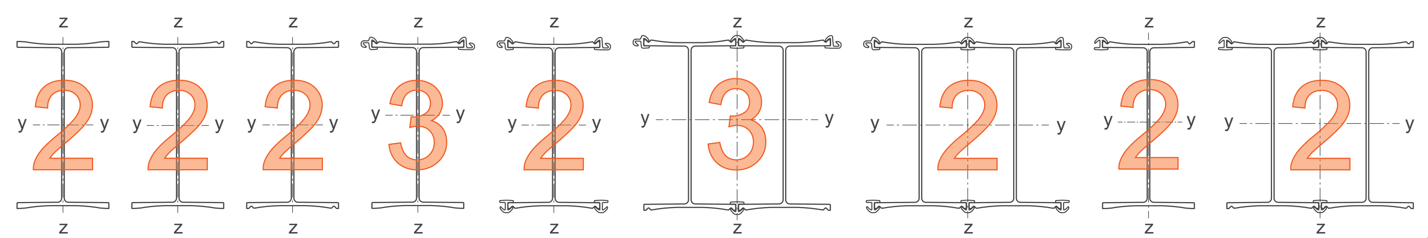


24 *Cross section classes of HZ solutions, valid for the whole HZ range with nominal geometries and for steel grades from S 240 GP to S 460 AP*

In this numerical study the worst case was considered: the connectors are on the tension flange and the flange thickness reduction is at the compression flange[5)].

In general connectors and corrosion are on the tension flange, and the cross section class can be chosen to the class shown in the table below.

| Section | Classification for loss of steel thickness 0 - 8 mm |
|---|---|
| HZ 880M A | 3 |
| HZ 880M B | 3 |
| HZ 880M C | 3 |
| HZ 1080M A | 3 |
| HZ 1080M B | 3 |
| HZ 1080M C | 2 |
| HZ 1080M D | 2 |
| HZ 1180M A | 2 |
| HZ 1180M B | 2 |
| HZ 1180M C | 2 |
| HZ 1180M D | 2 |

*Cross section classes with connectors on the tension flange and corrosion on the tension flange, valid for all HZ solutions, up to S 460 AP steel grade.*

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## General conclusions

Combining the results from both research projects, the classification of the cross sections for the HZ solutions in pure bending can be summarized as follows:

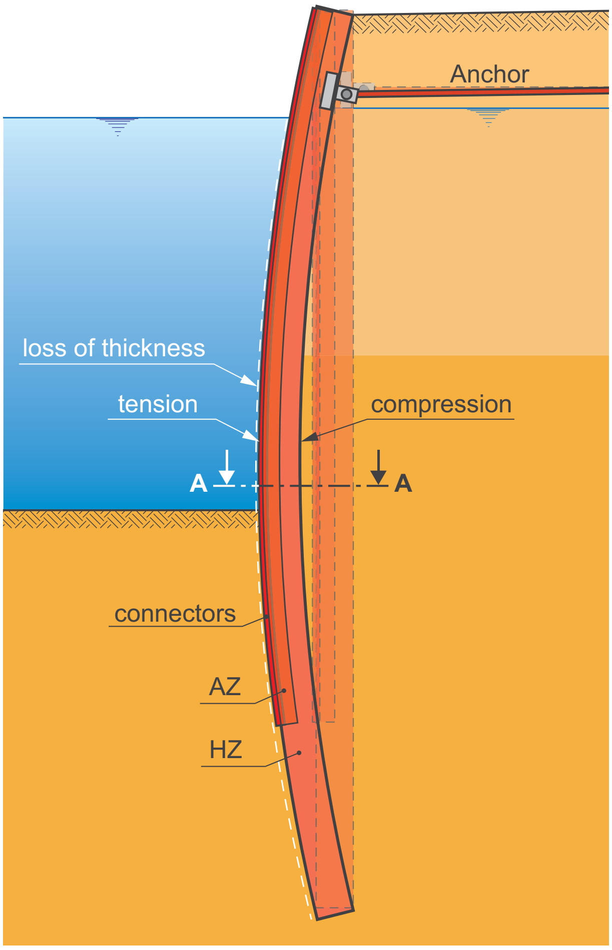
- **Without corrosion**

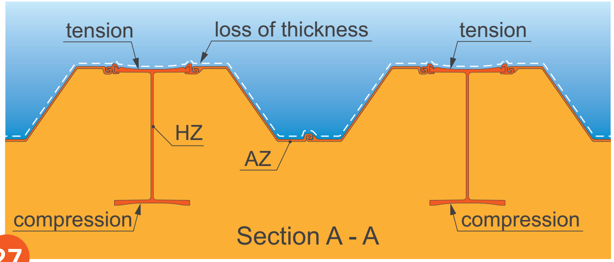
  all the HZ solutions can be calculated as class 2 (except solutions 12 and 24: class 3)

- **With corrosion**

  for the most common configurations[6)], the effect of the corrosion on the HZ classification is very limited.
  **All the HZ solutions can be calculated in class 2 or 3 for up to 8 mm of loss of steel** according to the table and the sketch above (Figure 26 & 27).

Above conclusions are valid for the whole HZ range from HZ 880M A to HZ 1180M D, and for steel grades S 240 GP up to S 460 AP. Please contact the technical department for the HZ 680M.

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1) In case of a combination of bending moments and significant compression loads, the design of the HZ section will generally be governed by the web slenderness (see formulas in EN 1993), except in the case of corrosion of flanges and web
2) Cross sectional classification of ArcelorMittal HZ range. RWTH Aachen. 2012
3) In fact all the HZ 1180M can be classified in class 1, but for steel sheet piling applications, the rotation capacity has to be checked by dedicated calculations, otherwise the HZ 1180M are classified as class 2
4) Cross sectional classification taking into account corrosion of ArcelorMittal HZ range. RWTH Aachen. 2012
5) 'Solution 12' was chosen for all investigations as it is the most critical configuration (safe sided approach).
6) Please contact our technical department in case the connectors are on the tension flange and corrosion occurs on the compression flange

## Conventions and symbols

| | |
|---|---|
| $b_{sys}$ | width of one system (HZ/AZ combination) [m] |
| $e$ | eccentricity [m] |
| $f_y$ | yield strength of the steel [Pa] |
| $h_i$ | height (depth) of the section [m] |
| $i_y$ | radius of gyration about the y-y axis [m]. $i_y = \sqrt{I_y / A}$ |
| $r$ | inner radius of the HZ profile, between web and flange [m] |
| $s$ | thickness of the web [m] |
| $t$ | thickness of the flange / thickness of the HZ flange at a distance w/4 from the edge [m] |
| $t_{max}$ | maximum thickness of the HZ flange [m] |
| $v_1$, $v_2$, $u_1$ | distance of the neutral axis to the extreme fibre of the HZ flanges [m] |
| $v_3$, $v_4$, $u_2$ | distance of the neutral axis to the extreme fibre of the connector RH/RZ [m] |
| $w$ | nominal width of the element [m] |
| $A$ | cross sectional steel area [$m^2$], [$m^2$/m] |
| $A_{HZ}$ | cross sectional steel area of the HZ king pile [$m^2$], [$m^2$/m] |
| $A_{LS}$ | coating area on the soil side (back), excluding the inside of the interlocks, per element or system width, per unit length [$m^2$/m] |
| $A_{LW}$ | coating area on the water side (front), excluding the inside of the interlocks, per element or system width, per unit length [$m^2$/m] |
| $G$ | mass of the element / solution (with length RH/RZ = length HZ) per unit length [kg/m], [kg/$m^2$] |
| $G_{60\%}$ | mass of the combination with length of the infill sheets AZ = 60% of length of the HZ king piles [kg/$m^2$] |
| $G_{80\%}$ | mass of the combination with length of the infill sheets AZ = 80% of length of the HZ king piles [kg/$m^2$] |
| $G_{100\%}$ | mass of the combination with length of the infill sheets AZ = 100% of length of the HZ king piles [kg/$m^2$] |
| $I_{AZ}$ | moment of inertia of one pair of AZ sheet pile [$m^4$] |
| $I_{HZ}$ | moment of inertia of one HZ solution [$m^4$] |
| $I_{sys}$ | moment of inertia of one system (HZ/AZ combination) [$m^4$] |
| $I_{sys/m}$ | moment of inertia of the wall per m of wall [$m^4$/m] |
| $I_y$ | moment of inertia about the main neutral axis y-y [$m^4$], [$m^4$/m] |
| $I_z$ | moment of inertia about the neutral axis z-z (weak axis) [$m^4$] |
| $M_{AZ}$ | bending moment transmitted to the intermediate AZ sheet pile [Nm/m] |
| $M_{HZ}$ | bending moment transmitted to the HZ king pile [Nm/m] |
| $M_{sys}$ | maximum bending moment per m of wall based on a design [Nm/m] |
| $N$ | vertical load [N/m] |
| $S_F$ | global safety factor applicable to steel |
| $S_y$ | static moment of the HZ [$m^3$] |
| $W_{AZ}$ | section modulus of a pair of AZ [$m^3$] |
| $W_{el,y}$* | equivalent elastic section modulus of the combination related to the extreme fiber of the flange of the HZ [$m^3$/m] |
| $W_{el,y}$** | equivalent elastic section modulus of the combination related to the extreme fiber of the connector RH/RZ [$m^3$/m] |
| $W_{el,z}$ | elastic section modulus of the element related to neutral axis z-z (weak axis) [$m^3$] |
| $W_{HZ, eq.}$ | = $W_{el,y}$* |
| $W_{pl,y}$ | plastic section modulus of the HZ [$m^3$] |
| $W_{RH, RZ}$ | = $W_{el,y}$** |
| $W_{sys}$ | section modulus of the system (HZ/AZ combination) [$m^3$] |
| $\sigma_{AZ}$ | steel stresses in the intermediate AZ sheet pile [Pa] |
| $\sigma_{HZ}$ | steel stresses in the HZ king pile [Pa] |

## Notes

- The nominal width of a combination $b_{sys}$ has been rounded to a mean value valid for the whole range of a combination. However, the nominal width 'w' of the 'solutions' has been taken into account for the determination of the section properties. For installation purposes, the nominal system width of the combination '$b_{sys}$' should be used.
- All the data in the tables in this flyer has been determined with a CAD software. The main section properties have been rounded. Section properties determined in a different way may differ slightly.
- Mass of HZ/AZ combinations: $G_{60\%}$, $G_{80\%}$ & $G_{100\%}$ assume that the length of the connectors RZD/RZU and the RH on the back flange (Sol. 14 and Sol. 26) are the same as the length of the infill sheets AZ. The RH connecting two HZ king piles (Sol. 24 and Sol. 26) have the same length as the HZ king piles.
- Rounding of the mass of single elements of the combined system leads in some cases to slight discrepancies in the mass of the combinations / solutions.

## Figures



## References

[1] EN 1993 - 5: 2007. Eurocode 3. Design of steel structures - Part 5: Piling. CEN
[2] EN 1997 - 1: 2004. Eurocode 7. Geotechnical design - Part 1: General rules. CEN
[3] EAU 2004. Recommendations of the Committee for Waterfront Structures Harbours and Waterways. Ernst und Sohn. 2006
[4] prEN 10248 - 1: 2006. Hot-rolled steel sheet piling - Part 1: Technical delivery conditions. CEN

## HZ | Static moment & Plastic section modulus

| Section | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ |
|---|---|---|---|---|---|---|---|---|---|
| | Sol. 100 | | | Sol. 12 | | | Sol. 26 | | |
| HZ 680M LT | 6 015 | 3 250 | **6 500** | 6 225 | 3 760 | **7 385** | 15 355 | 8 145 | **16 295** |
| HZ 880M A | 8 880 | 4 840 | **9 675** | 9 185 | 5 525 | **10 920** | 22 135 | 11 865 | **23 730** |
| HZ 880M B | 9 730 | 5 335 | **10 670** | 10 045 | 6 025 | **11 940** | 23 755 | 12 835 | **25 670** |
| HZ 880M C | 10 275 | 5 630 | **11 260** | 10 580 | 6 320 | **12 530** | 24 825 | 13 425 | **26 850** |
| HZ 1080M A | 13 465 | 7 535 | **15 065** | 13 980 | 8 455 | **16 825** | 32 635 | 17 925 | **35 850** |
| HZ 1080M B | 14 630 | 8 150 | **16 300** | 15 115 | 9 065 | **18 045** | 34 855 | 19 125 | **38 245** |
| HZ 1080M C | 16 025 | 8 985 | **17 970** | 16 530 | 9 905 | **19 735** | 37 615 | 20 790 | **41 580** |
| HZ 1080M D | 17 340 | 9 750 | **19 495** | 17 840 | 10 670 | **21 275** | 40 195 | 22 315 | **44 635** |
| HZ 1180M A | 18 285 | 10 335 | **20 670** | 18 785 | 11 260 | **22 455** | 42 040 | 23 485 | **46 970** |
| HZ 1180M B | 19 200 | 10 825 | **21 655** | 19 670 | 11 725 | **23 390** | 43 605 | 24 350 | **48 700** |
| HZ 1180M C | 20 310 | 11 470 | **22 940** | 20 830 | 12 475 | **24 870** | 46 880 | 26 275 | **52 555** |
| HZ 1180M D | 21 430 | 12 115 | **24 230** | 21 915 | 13 065 | **26 060** | 48 570 | 27 310 | **54 615** |

| Section | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ |
|---|---|---|---|---|---|---|---|---|---|
| | Sol. 102 | | | Sol. 14 | | | Sol. C1 | | |
| HZ 680M LT | 5 840 | 3 200 | **6 400** | 8 295 | 4 385 | **8 765** | 6 125 | 3 495 | **6 960** |
| HZ 880M A | 8 650 | 4 770 | **9 545** | 11 880 | 6 345 | **12 690** | 9 040 | 5 165 | **10 305** |
| HZ 880M B | 9 480 | 5 265 | **10 525** | 12 690 | 6 830 | **13 660** | 9 890 | 5 655 | **11 295** |
| HZ 880M C | 10 025 | 5 560 | **11 115** | 13 220 | 7 125 | **14 250** | 10 430 | 5 955 | **11 885** |
| HZ 1080M A | 13 185 | 7 450 | **14 900** | 17 380 | 9 500 | **19 000** | 13 725 | 7 965 | **15 915** |
| HZ 1080M B | 14 315 | 8 060 | **16 115** | 18 485 | 10 100 | **20 200** | 14 870 | 8 575 | **17 130** |
| HZ 1080M C | 15 715 | 8 890 | **17 780** | 19 860 | 10 930 | **21 865** | 16 275 | 9 410 | **18 800** |
| HZ 1080M D | 17 025 | 9 655 | **19 310** | 21 140 | 11 695 | **23 390** | 17 580 | 10 175 | **20 330** |
| HZ 1180M A | 17 970 | 10 240 | **20 480** | 22 055 | 12 280 | **24 560** | 18 525 | 10 760 | **21 505** |
| HZ 1180M B | 18 785 | 10 700 | **21 405** | 22 835 | 12 710 | **25 425** | 19 415 | 11 220 | **22 435** |
| HZ 1180M C | 19 895 | 11 345 | **22 685** | 24 490 | 13 735 | **27 465** | 20 595 | 11 990 | **23 960** |
| HZ 1180M D | 20 795 | 11 925 | **23 845** | 25 335 | 14 250 | **28 495** | 21 675 | 12 575 | **25 135** |

| Section | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ | $W_{el.y}$ cm³ | $S_y$ cm³ | $W_{pl.y}$ cm³ |
|---|---|---|---|---|---|---|---|---|---|
| | Sol. 104 | | | Sol. 24 | | | Sol. C23 | | |
| HZ 680M LT | 5 815 | 3 150 | **6 305** | 13 120 | 7 500 | **14 920** | 13 005 | 7 210 | **14 405** |
| HZ 880M A | 8 615 | 4 710 | **9 415** | 19 220 | 11 010 | **21 940** | 19 055 | 10 625 | **21 230** |
| HZ 880M B | 9 440 | 5 195 | **10 385** | 20 875 | 11 985 | **23 905** | 20 705 | 11 595 | **23 175** |
| HZ 880M C | 9 985 | 5 490 | **10 975** | 21 950 | 12 575 | **25 085** | 21 780 | 12 185 | **24 355** |
| HZ 1080M A | 13 130 | 7 365 | **14 735** | 28 970 | 16 825 | **33 605** | 28 695 | 16 310 | **32 610** |
| HZ 1080M B | 14 255 | 7 965 | **15 930** | 31 185 | 18 025 | **36 000** | 30 920 | 17 510 | **35 005** |
| HZ 1080M C | 15 655 | 8 800 | **17 600** | 33 990 | 19 695 | **39 345** | 33 715 | 19 175 | **38 340** |
| HZ 1080M D | 16 970 | 9 565 | **19 125** | 36 595 | 21 225 | **42 405** | 36 325 | 20 705 | **41 400** |
| HZ 1180M A | 17 915 | 10 150 | **20 295** | 38 470 | 22 395 | **44 750** | 38 195 | 21 875 | **43 740** |
| HZ 1180M B | 18 705 | 10 580 | **21 160** | 40 040 | 23 260 | **46 475** | 39 770 | 22 735 | **45 465** |
| HZ 1180M C | 19 820 | 11 220 | **22 440** | 42 810 | 24 915 | **49 785** | 42 560 | 24 415 | **48 815** |
| HZ 1180M D | 20 675 | 11 735 | **23 470** | 44 520 | 25 950 | **51 850** | 44 270 | 25 445 | **50 875** |

The plastic section modulus $W_{pl,y}$ is only relevant for ‘class 1’ and ‘class 2’ sections according to EN 1993.

## Table of combinations sorted by ascending Elastic section modulus

| $W_{el.y}$* cm³/m | $G_{100\%}$ kg/m² | Section | Combination |
|---|---|---|---|
| 3 500 | 187 | HZ 680M LT | 12 / AZ 13-770 |
| 3 520 | 190 | HZ 680M LT | 12 / AZ 14-770 |
| 3 665 | 198 | HZ 680M LT | 12 / AZ 13-700 |
| 3 685 | 202 | HZ 680M LT | 12 / AZ 13-700-10 / 10 |
| 4 035 | 201 | HZ 680M LT | 12 / AZ 18-700 |
| 4 105 | 208 | HZ 680M LT | 12 / AZ 20-700 |
| 4 220 | 218 | HZ 680M LT | 12 / AZ 18-10 / 10 |
| 4 505 | 228 | HZ 680M LT | 12 / AZ 26-700 |
| 4 510 | 222 | HZ 680M LT | 12 / AZ 26-700N |
| 4 560 | 201 | HZ 680M LT | 14 / AZ 13-770 |
| 4 585 | 204 | HZ 680M LT | 14 / AZ 14-770 |
| 4 635 | 240 | HZ 680M LT | 12 / AZ 26 |
| 4 795 | 213 | HZ 680M LT | 14 / AZ 13-700 |
| 4 815 | 200 | HZ 880M A | 12 / AZ 13-770 |
| 4 815 | 217 | HZ 680M LT | 14 / AZ 13-700-10 / 10 |
| 4 830 | 204 | HZ 880M A | 12 / AZ 14-770 |
| 5 095 | 213 | HZ 880M A | 12 / AZ 13-700 |
| 5 110 | 216 | HZ 880M A | 12 / AZ 13-700-10 / 10 |
| 5 210 | 216 | HZ 680M LT | 14 / AZ 18-700 |
| 5 230 | 212 | HZ 880M B | 12 / AZ 13-770 |
| 5 245 | 216 | HZ 880M B | 12 / AZ 14-770 |
| 5 285 | 223 | HZ 680M LT | 14 / AZ 20-700 |
| 5 380 | 215 | HZ 880M A | 12 / AZ 18-700 |
| 5 430 | 222 | HZ 880M A | 12 / AZ 20-700 |
| 5 465 | 234 | HZ 680M LT | 14 / AZ 18-10 / 10 |
| 5 485 | 218 | HZ 880M C | 12 / AZ 13-770 |
| 5 500 | 221 | HZ 880M C | 12 / AZ 14-770 |
| 5 540 | 225 | HZ 880M B | 12 / AZ 13-700 |
| 5 555 | 229 | HZ 880M B | 12 / AZ 13-700-10 / 10 |
| 5 580 | 242 | HZ 680M LT | 24 / AZ 13-770 |
| 5 595 | 245 | HZ 680M LT | 24 / AZ 14-770 |
| 5 695 | 233 | HZ 880M A | 12 / AZ 18-10 / 10 |
| 5 735 | 243 | HZ 880M A | 12 / AZ 26-700 |
| 5 735 | 236 | HZ 880M A | 12 / AZ 26-700N |
| 5 740 | 243 | HZ 680M LT | 14 / AZ 26-700 |
| 5 740 | 237 | HZ 680M LT | 14 / AZ 26-700N |
| 5 815 | 231 | HZ 880M C | 12 / AZ 13-700 |
| 5 820 | 228 | HZ 880M B | 12 / AZ 18-700 |
| 5 830 | 254 | HZ 680M LT | 24 / AZ 13-700 |
| 5 830 | 235 | HZ 880M C | 12 / AZ 13-700-10 / 10 |
| 5 845 | 257 | HZ 680M LT | 24 / AZ 13-700-10 / 10 |
| 5 875 | 235 | HZ 880M B | 12 / AZ 20-700 |
| 5 935 | 257 | HZ 680M LT | 14 / AZ 26 |
| 6 010 | 256 | HZ 880M A | 12 / AZ 26 |
| 6 100 | 234 | HZ 880M C | 12 / AZ 18-700 |
| 6 145 | 257 | HZ 680M LT | 24 / AZ 18-700 |
| 6 150 | 241 | HZ 880M C | 12 / AZ 20-700 |
| 6 160 | 214 | HZ 880M A | 14 / AZ 13-770 |
| 6 175 | 218 | HZ 880M A | 14 / AZ 14-770 |
| 6 175 | 247 | HZ 880M B | 12 / AZ 18-10 / 10 |
| 6 180 | 255 | HZ 880M B | 12 / AZ 26-700 |
| 6 180 | 249 | HZ 880M B | 12 / AZ 26-700N |
| 6 200 | 262 | HZ 680M LT | 24 / AZ 20-700 |
| 6 410 | 274 | HZ 680M LT | 24 / AZ 18-10 / 10 |
| 6 455 | 261 | HZ 880M C | 12 / AZ 26-700 |
| 6 455 | 255 | HZ 880M C | 12 / AZ 26-700N |
| 6 475 | 254 | HZ 880M C | 12 / AZ 18-10 / 10 |
| 6 485 | 255 | HZ 680M LT | 26 / AZ 13-770 |
| 6 490 | 270 | HZ 880M B | 12 / AZ 26 |
| 6 505 | 257 | HZ 680M LT | 26 / AZ 14-770 |
| 6 535 | 228 | HZ 880M A | 14 / AZ 13-700 |
| 6 540 | 226 | HZ 880M B | 14 / AZ 13-770 |
| 6 540 | 278 | HZ 680M LT | 24 / AZ 26-700 |
| 6 540 | 274 | HZ 680M LT | 24 / AZ 26-700N |
| 6 550 | 231 | HZ 880M A | 14 / AZ 13-700-10 / 10 |
| 6 560 | 230 | HZ 880M B | 14 / AZ 14-770 |
| 6 755 | 291 | HZ 680M LT | 24 / AZ 26 |
| 6 785 | 268 | HZ 680M LT | 26 / AZ 13-700 |
| 6 790 | 276 | HZ 880M C | 12 / AZ 26 |
| 6 795 | 232 | HZ 880M C | 14 / AZ 13-770 |
| 6 800 | 270 | HZ 680M LT | 26 / AZ 13-700-10 / 10 |
| 6 815 | 235 | HZ 880M C | 14 / AZ 14-770 |
| 6 845 | 230 | HZ 880M A | 14 / AZ 18-700 |
| 6 900 | 238 | HZ 880M A | 14 / AZ 20-700 |
| 6 945 | 240 | HZ 880M B | 14 / AZ 13-700 |
| 6 960 | 244 | HZ 880M B | 14 / AZ 13-700-10 / 10 |
| 7 065 | 230 | HZ 1080M A | 12 / AZ 13-770 |
| 7 080 | 234 | HZ 1080M A | 12 / AZ 14-770 |
| 7 120 | 270 | HZ 680M LT | 26 / AZ 18-700 |
| 7 180 | 276 | HZ 680M LT | 26 / AZ 20-700 |
| 7 215 | 246 | HZ 880M C | 14 / AZ 13-700 |
| 7 230 | 250 | HZ 880M C | 14 / AZ 13-700-10 / 10 |
| 7 240 | 258 | HZ 880M A | 14 / AZ 26-700 |
| 7 240 | 251 | HZ 880M A | 14 / AZ 26-700N |
| 7 255 | 243 | HZ 880M B | 14 / AZ 18-700 |
| 7 270 | 250 | HZ 880M A | 14 / AZ 18-10 / 10 |
| 7 310 | 250 | HZ 880M B | 14 / AZ 20-700 |
| 7 440 | 288 | HZ 680M LT | 26 / AZ 18-10 / 10 |
| 7 525 | 249 | HZ 880M C | 14 / AZ 18-700 |
| 7 530 | 245 | HZ 1080M A | 12 / AZ 13-700 |
| 7 540 | 248 | HZ 1080M A | 12 / AZ 13-700-10 / 10 |
| 7 545 | 292 | HZ 680M LT | 26 / AZ 26-700 |
| 7 545 | 287 | HZ 680M LT | 26 / AZ 26-700N |
| 7 580 | 256 | HZ 880M C | 14 / AZ 20-700 |
| 7 615 | 239 | HZ 1080M B | 12 / AZ 13-770 |
| 7 620 | 272 | HZ 880M A | 14 / AZ 26 |
| 7 630 | 243 | HZ 1080M B | 12 / AZ 14-770 |
| 7 645 | 270 | HZ 880M B | 14 / AZ 26-700 |
| 7 650 | 264 | HZ 880M B | 14 / AZ 26-700N |
| 7 710 | 263 | HZ 880M B | 14 / AZ 18-10 / 10 |
| 7 745 | 248 | HZ 1080M A | 12 / AZ 18-700 |
| 7 790 | 255 | HZ 1080M A | 12 / AZ 20-700 |
| 7 810 | 305 | HZ 680M LT | 26 / AZ 26 |
| 7 885 | 264 | HZ 880M A | 24 / AZ 13-770 |
| 7 895 | 267 | HZ 880M A | 24 / AZ 14-770 |
| 7 915 | 276 | HZ 880M C | 14 / AZ 26-700 |
| 7 915 | 270 | HZ 880M C | 14 / AZ 26-700N |
| 8 000 | 270 | HZ 880M C | 14 / AZ 18-10 / 10 |
| 8 025 | 275 | HZ 1080M A | 12 / AZ 26-700 |
| 8 025 | 269 | HZ 1080M A | 12 / AZ 26-700N |
| 8 055 | 286 | HZ 880M B | 14 / AZ 26 |
| 8 120 | 254 | HZ 1080M B | 12 / AZ 13-700 |
| 8 130 | 258 | HZ 1080M B | 12 / AZ 13-700-10 / 10 |
| 8 275 | 269 | HZ 1080M A | 12 / AZ 18-10 / 10 |
| 8 290 | 277 | HZ 880M A | 24 / AZ 13-700 |
| 8 295 | 255 | HZ 1080M C | 12 / AZ 13-770 |
| 8 300 | 280 | HZ 880M A | 24 / AZ 13-700-10 / 10 |
| 8 305 | 258 | HZ 1080M C | 12 / AZ 14-770 |
| 8 340 | 257 | HZ 1080M B | 12 / AZ 18-700 |
| 8 345 | 292 | HZ 880M C | 14 / AZ 26 |
| 8 380 | 264 | HZ 1080M B | 12 / AZ 20-700 |
| 8 520 | 291 | HZ 1080M A | 12 / AZ 26 |
| 8 525 | 283 | HZ 880M B | 24 / AZ 13-770 |
| 8 525 | 280 | HZ 880M A | 24 / AZ 18-700 |
| 8 535 | 286 | HZ 880M B | 24 / AZ 14-770 |
| 8 565 | 285 | HZ 880M A | 24 / AZ 20-700 |
| 8 615 | 285 | HZ 1080M B | 12 / AZ 26-700 |
| 8 615 | 278 | HZ 1080M B | 12 / AZ 26-700N |
| 8 740 | 245 | HZ 1080M A | 14 / AZ 13-770 |
| 8 750 | 248 | HZ 1080M A | 14 / AZ 14-770 |
| 8 825 | 302 | HZ 880M A | 24 / AZ 26-700 |
| 8 825 | 297 | HZ 880M A | 24 / AZ 26-700N |
| 8 845 | 271 | HZ 1080M C | 12 / AZ 13-700 |
| 8 855 | 275 | HZ 1080M C | 12 / AZ 13-700-10 / 10 |
| 8 910 | 279 | HZ 1080M B | 12 / AZ 18-10 / 10 |
| 8 920 | 268 | HZ 1080M D | 12 / AZ 13-770 |
| 8 935 | 271 | HZ 1080M D | 12 / AZ 14-770 |
| 8 945 | 292 | HZ 880M C | 24 / AZ 13-770 |
| 8 955 | 295 | HZ 880M C | 24 / AZ 14-770 |
| 8 965 | 298 | HZ 880M B | 24 / AZ 13-700 |
| 8 970 | 298 | HZ 880M A | 24 / AZ 18-10 / 10 |
| 8 975 | 301 | HZ 880M B | 24 / AZ 13-700-10 / 10 |
| 9 050 | 276 | HZ 880M A | 26 / AZ 13-770 |
| 9 065 | 279 | HZ 880M A | 26 / AZ 14-770 |
| 9 065 | 274 | HZ 1080M C | 12 / AZ 18-700 |
| 9 105 | 281 | HZ 1080M C | 12 / AZ 20-700 |
| 9 160 | 301 | HZ 1080M B | 12 / AZ 26 |
| 9 200 | 300 | HZ 880M B | 24 / AZ 18-700 |
| 9 230 | 316 | HZ 880M A | 24 / AZ 26 |
| 9 245 | 306 | HZ 880M B | 24 / AZ 20-700 |
| 9 270 | 253 | HZ 1080M B | 14 / AZ 13-770 |
| 9 285 | 257 | HZ 1080M B | 14 / AZ 14-770 |
| 9 320 | 260 | HZ 1080M A | 14 / AZ 13-700 |
| 9 330 | 264 | HZ 1080M A | 14 / AZ 13-700-10 / 10 |
| 9 345 | 301 | HZ 1080M C | 12 / AZ 26-700 |
| 9 345 | 295 | HZ 1080M C | 12 / AZ 26-700N |

## Table of combinations sorted by ascending Elastic section modulus

| $W_{el.y}$* cm³/m | $G_{100\%}$ kg/m² | Section | Combination |
|---|---|---|---|
| 9 375 | 278 | HZ 1180M A | 12 / AZ 13-770 |
| 9 385 | 281 | HZ 1180M A | 12 / AZ 14-770 |
| 9 410 | 307 | HZ 880M C | 24 / AZ 13-700 |
| 9 420 | 310 | HZ 880M C | 24 / AZ 13-700-10 / 10 |
| 9 500 | 322 | HZ 880M B | 24 / AZ 26-700 |
| 9 500 | 317 | HZ 880M B | 24 / AZ 26-700N |
| 9 515 | 285 | HZ 1080M D | 12 / AZ 13-700 |
| 9 520 | 291 | HZ 880M A | 26 / AZ 13-700 |
| 9 530 | 288 | HZ 1080M D | 12 / AZ 13-700-10 / 10 |
| 9 535 | 293 | HZ 880M A | 26 / AZ 13-700-10 / 10 |
| 9 560 | 263 | HZ 1080M A | 14 / AZ 18-700 |
| 9 600 | 270 | HZ 1080M A | 14 / AZ 20-700 |
| 9 645 | 309 | HZ 880M C | 24 / AZ 18-700 |
| 9 675 | 296 | HZ 880M B | 26 / AZ 13-770 |
| 9 685 | 320 | HZ 880M B | 24 / AZ 18-10 / 10 |
| 9 690 | 298 | HZ 880M B | 26 / AZ 14-770 |
| 9 690 | 315 | HZ 880M C | 24 / AZ 20-700 |
| 9 695 | 297 | HZ 1080M C | 12 / AZ 18-10 / 10 |
| 9 735 | 288 | HZ 1080M D | 12 / AZ 18-700 |
| 9 770 | 293 | HZ 880M A | 26 / AZ 18-700 |
| 9 775 | 295 | HZ 1080M D | 12 / AZ 20-700 |
| 9 800 | 284 | HZ 1180M B | 12 / AZ 13-770 |
| 9 815 | 288 | HZ 1180M B | 12 / AZ 14-770 |
| 9 815 | 299 | HZ 880M A | 26 / AZ 20-700 |
| 9 860 | 290 | HZ 1080M A | 14 / AZ 26-700 |
| 9 865 | 284 | HZ 1080M A | 14 / AZ 26-700N |
| 9 890 | 269 | HZ 1080M B | 14 / AZ 13-700 |
| 9 900 | 273 | HZ 1080M B | 14 / AZ 13-700-10 / 10 |
| 9 925 | 269 | HZ 1080M C | 14 / AZ 13-770 |
| 9 940 | 272 | HZ 1080M C | 14 / AZ 14-770 |
| 9 940 | 319 | HZ 1080M C | 12 / AZ 26 |
| 9 945 | 331 | HZ 880M C | 24 / AZ 26-700 |
| 9 945 | 326 | HZ 880M C | 24 / AZ 26-700N |
| 9 945 | 337 | HZ 880M B | 24 / AZ 26 |
| 10 005 | 296 | HZ 1180M A | 12 / AZ 13-700 |
| 10 015 | 299 | HZ 1180M A | 12 / AZ 13-700-10 / 10 |
| 10 015 | 315 | HZ 1080M D | 12 / AZ 26-700 |
| 10 015 | 309 | HZ 1080M D | 12 / AZ 26-700N |
| 10 090 | 305 | HZ 880M C | 26 / AZ 13-770 |
| 10 090 | 315 | HZ 880M A | 26 / AZ 26-700 |
| 10 090 | 310 | HZ 880M A | 26 / AZ 26-700N |
| 10 105 | 307 | HZ 880M C | 26 / AZ 14-770 |
| 10 130 | 272 | HZ 1080M B | 14 / AZ 18-700 |
| 10 155 | 330 | HZ 880M C | 24 / AZ 18-10 / 10 |
| 10 170 | 279 | HZ 1080M B | 14 / AZ 20-700 |
| 10 180 | 311 | HZ 880M B | 26 / AZ 13-700 |
| 10 190 | 314 | HZ 880M B | 26 / AZ 13-700-10 / 10 |
| 10 220 | 299 | HZ 1180M A | 12 / AZ 18-700 |
| 10 220 | 285 | HZ 1080M A | 14 / AZ 18-10 / 10 |
| 10 260 | 306 | HZ 1180M A | 12 / AZ 20-700 |
| 10 285 | 312 | HZ 880M A | 26 / AZ 18-10 / 10 |
| 10 355 | 297 | HZ 1180M C | 12 / AZ 13-770 |
| 10 370 | 300 | HZ 1180M C | 12 / AZ 14-770 |
| 10 415 | 347 | HZ 880M C | 24 / AZ 26 |
| 10 420 | 312 | HZ 1080M D | 12 / AZ 18-10 / 10 |
| 10 425 | 313 | HZ 880M B | 26 / AZ 18-700 |
| 10 430 | 300 | HZ 1080M B | 14 / AZ 26-700 |
| 10 430 | 293 | HZ 1080M B | 14 / AZ 26-700N |
| 10 465 | 303 | HZ 1180M B | 12 / AZ 13-700 |
| 10 475 | 306 | HZ 1180M B | 12 / AZ 13-700-10 / 10 |
| 10 475 | 319 | HZ 880M B | 26 / AZ 20-700 |
| 10 490 | 307 | HZ 1080M A | 14 / AZ 26 |
| 10 500 | 326 | HZ 1180M A | 12 / AZ 26-700 |
| 10 500 | 320 | HZ 1180M A | 12 / AZ 26-700N |
| 10 540 | 282 | HZ 1080M D | 14 / AZ 13-770 |
| 10 555 | 285 | HZ 1080M D | 14 / AZ 14-770 |
| 10 565 | 330 | HZ 880M A | 26 / AZ 26 |
| 10 590 | 286 | HZ 1080M C | 14 / AZ 13-700 |
| 10 605 | 290 | HZ 1080M C | 14 / AZ 13-700-10 / 10 |
| 10 620 | 321 | HZ 880M C | 26 / AZ 13-700 |
| 10 635 | 323 | HZ 880M C | 26 / AZ 13-700-10 / 10 |
| 10 665 | 334 | HZ 1080M D | 12 / AZ 26 |
| 10 680 | 306 | HZ 1180M B | 12 / AZ 18-700 |
| 10 720 | 313 | HZ 1180M B | 12 / AZ 20-700 |
| 10 745 | 335 | HZ 880M B | 26 / AZ 26-700 |
| 10 745 | 330 | HZ 880M B | 26 / AZ 26-700N |
| 10 830 | 289 | HZ 1080M C | 14 / AZ 18-700 |
| 10 835 | 295 | HZ 1080M B | 14 / AZ 18-10 / 10 |
| 10 870 | 323 | HZ 880M C | 26 / AZ 18-700 |
| 10 870 | 296 | HZ 1080M C | 14 / AZ 20-700 |
| 10 875 | 307 | HZ 1180M D | 12 / AZ 13-770 |
| 10 885 | 310 | HZ 1180M D | 12 / AZ 14-770 |
| 10 915 | 328 | HZ 880M C | 26 / AZ 20-700 |
| 10 940 | 323 | HZ 1180M A | 12 / AZ 18-10 / 10 |
| 10 960 | 333 | HZ 1180M B | 12 / AZ 26-700 |
| 10 960 | 327 | HZ 1180M B | 12 / AZ 26-700N |
| 10 975 | 292 | HZ 1180M A | 14 / AZ 13-770 |
| 10 985 | 295 | HZ 1180M A | 14 / AZ 14-770 |
| 10 985 | 334 | HZ 880M B | 26 / AZ 18-10 / 10 |
| 11 055 | 316 | HZ 1180M C | 12 / AZ 13-700 |
| 11 065 | 320 | HZ 1180M C | 12 / AZ 13-700-10 / 10 |
| 11 105 | 317 | HZ 1080M B | 14 / AZ 26 |
| 11 130 | 316 | HZ 1080M C | 14 / AZ 26-700 |
| 11 130 | 310 | HZ 1080M C | 14 / AZ 26-700N |
| 11 185 | 345 | HZ 880M C | 26 / AZ 26-700 |
| 11 185 | 340 | HZ 880M C | 26 / AZ 26-700N |
| 11 185 | 346 | HZ 1180M A | 12 / AZ 26 |
| 11 250 | 300 | HZ 1080M D | 14 / AZ 13-700 |
| 11 260 | 303 | HZ 1080M D | 14 / AZ 13-700-10 / 10 |
| 11 260 | 351 | HZ 880M B | 26 / AZ 26 |
| 11 275 | 319 | HZ 1180M C | 12 / AZ 18-700 |
| 11 315 | 326 | HZ 1180M C | 12 / AZ 20-700 |
| 11 350 | 298 | HZ 1180M B | 14 / AZ 13-770 |
| 11 360 | 301 | HZ 1180M B | 14 / AZ 14-770 |
| 11 440 | 331 | HZ 1180M B | 12 / AZ 18-10 / 10 |
| 11 450 | 344 | HZ 880M C | 26 / AZ 18-10 / 10 |
| 11 485 | 303 | HZ 1080M D | 14 / AZ 18-700 |
| 11 530 | 310 | HZ 1080M D | 14 / AZ 20-700 |
| 11 550 | 346 | HZ 1180M C | 12 / AZ 26-700 |
| 11 550 | 340 | HZ 1180M C | 12 / AZ 26-700N |
| 11 590 | 313 | HZ 1080M C | 14 / AZ 18-10 / 10 |
| 11 615 | 327 | HZ 1180M D | 12 / AZ 13-700 |
| 11 625 | 331 | HZ 1180M D | 12 / AZ 13-700-10 / 10 |
| 11 685 | 353 | HZ 1180M B | 12 / AZ 26 |
| 11 690 | 313 | HZ 1080M A | 24 / AZ 13-770 |
| 11 700 | 316 | HZ 1080M A | 24 / AZ 14-770 |
| 11 715 | 311 | HZ 1180M A | 14 / AZ 13-700 |
| 11 725 | 314 | HZ 1180M A | 14 / AZ 13-700-10 / 10 |
| 11 725 | 361 | HZ 880M C | 26 / AZ 26 |
| 11 785 | 330 | HZ 1080M D | 14 / AZ 26-700 |
| 11 785 | 324 | HZ 1080M D | 14 / AZ 26-700N |
| 11 830 | 330 | HZ 1180M D | 12 / AZ 18-700 |
| 11 855 | 335 | HZ 1080M C | 14 / AZ 26 |
| 11 870 | 337 | HZ 1180M D | 12 / AZ 20-700 |
| 11 950 | 314 | HZ 1180M A | 14 / AZ 18-700 |
| 11 990 | 321 | HZ 1180M A | 14 / AZ 20-700 |
| 12 075 | 346 | HZ 1180M C | 12 / AZ 18-10 / 10 |
| 12 105 | 357 | HZ 1180M D | 12 / AZ 26-700 |
| 12 105 | 351 | HZ 1180M D | 12 / AZ 26-700N |
| 12 120 | 317 | HZ 1180M B | 14 / AZ 13-700 |
| 12 130 | 321 | HZ 1180M B | 14 / AZ 13-700-10 / 10 |
| 12 140 | 314 | HZ 1180M C | 14 / AZ 13-770 |
| 12 155 | 318 | HZ 1180M C | 14 / AZ 14-770 |
| 12 245 | 341 | HZ 1180M A | 14 / AZ 26-700 |
| 12 245 | 335 | HZ 1180M A | 14 / AZ 26-700N |
| 12 300 | 328 | HZ 1080M D | 14 / AZ 18-10 / 10 |
| 12 320 | 368 | HZ 1180M C | 12 / AZ 26 |
| 12 330 | 330 | HZ 1080M A | 24 / AZ 13-700 |
| 12 340 | 333 | HZ 1080M A | 24 / AZ 13-700-10 / 10 |
| 12 350 | 320 | HZ 1180M B | 14 / AZ 18-700 |
| 12 395 | 327 | HZ 1180M B | 14 / AZ 20-700 |
| 12 515 | 332 | HZ 1080M A | 24 / AZ 18-700 |
| 12 540 | 324 | HZ 1180M D | 14 / AZ 13-770 |
| 12 550 | 338 | HZ 1080M A | 24 / AZ 20-700 |
| 12 555 | 327 | HZ 1180M D | 14 / AZ 14-770 |
| 12 565 | 328 | HZ 1080M B | 24 / AZ 13-770 |
| 12 565 | 350 | HZ 1080M D | 14 / AZ 26 |
| 12 575 | 330 | HZ 1080M B | 24 / AZ 14-770 |
| 12 645 | 347 | HZ 1180M B | 14 / AZ 26-700 |
| 12 645 | 341 | HZ 1180M B | 14 / AZ 26-700N |
| 12 675 | 357 | HZ 1180M D | 12 / AZ 18-10 / 10 |
| 12 745 | 354 | HZ 1080M A | 24 / AZ 26-700 |
| 12 750 | 349 | HZ 1080M A | 24 / AZ 26-700N |
| 12 800 | 340 | HZ 1180M A | 14 / AZ 18-10 / 10 |
| 12 920 | 379 | HZ 1180M D | 12 / AZ 26 |
| 12 970 | 335 | HZ 1180M C | 14 / AZ 13-700 |
| 12 980 | 338 | HZ 1180M C | 14 / AZ 13-700-10 / 10 |
| 13 060 | 362 | HZ 1180M A | 14 / AZ 26 |
| 13 150 | 326 | HZ 1080M A | 26 / AZ 13-770 |
| 13 160 | 329 | HZ 1080M A | 26 / AZ 14-770 |
| 13 200 | 338 | HZ 1180M C | 14 / AZ 18-700 |
| 13 225 | 354 | HZ 1080M A | 24 / AZ 18-10 / 10 |

## Table of combinations sorted by ascending Elastic section modulus

| $W_{el,y}$* cm³/m | $G_{100\%}$ kg/m² | Section | Combination |
|---|---|---|---|
| 13 235 | 347 | HZ 1180M B 14 | AZ 18-10/10 |
| 13 240 | 345 | HZ 1180M C 14 | AZ 20-700 |
| 13 255 | 345 | HZ 1080M B 24 | AZ 13-700 |
| 13 265 | 348 | HZ 1080M B 24 | AZ 13-700-10/10 |
| 13 400 | 345 | HZ 1180M D 14 | AZ 13-700 |
| 13 410 | 348 | HZ 1180M D 14 | AZ 13-700-10/10 |
| 13 430 | 372 | HZ 1080M A 24 | AZ 26 |
| 13 440 | 347 | HZ 1080M B 24 | AZ 18-700 |
| 13 470 | 353 | HZ 1080M B 24 | AZ 20-700 |
| 13 490 | 365 | HZ 1180M C 14 | AZ 26-700 |
| 13 490 | 359 | HZ 1180M C 14 | AZ 26-700N |
| 13 495 | 369 | HZ 1180M B 14 | AZ 26 |
| 13 625 | 348 | HZ 1180M D 14 | AZ 18-700 |
| 13 650 | 353 | HZ 1080M C 24 | AZ 13-770 |
| 13 660 | 356 | HZ 1080M C 24 | AZ 14-770 |
| 13 670 | 355 | HZ 1180M D 14 | AZ 20-700 |
| 13 670 | 369 | HZ 1080M B 24 | AZ 26-700 |
| 13 670 | 364 | HZ 1080M B 24 | AZ 26-700N |
| 13 875 | 343 | HZ 1080M A 26 | AZ 13-700 |
| 13 885 | 346 | HZ 1080M A 26 | AZ 13-700-10/10 |
| 13 915 | 375 | HZ 1180M D 14 | AZ 26-700 |
| 13 920 | 369 | HZ 1180M D 14 | AZ 26-700N |
| 14 025 | 340 | HZ 1080M B 26 | AZ 13-770 |
| 14 035 | 343 | HZ 1080M B 26 | AZ 14-770 |
| 14 065 | 345 | HZ 1080M A 26 | AZ 18-700 |
| 14 100 | 351 | HZ 1080M A 26 | AZ 20-700 |
| 14 150 | 366 | HZ 1180M C 14 | AZ 18-10/10 |
| 14 210 | 370 | HZ 1080M B 24 | AZ 18-10/10 |
| 14 310 | 367 | HZ 1080M A 26 | AZ 26-700 |
| 14 310 | 362 | HZ 1080M A 26 | AZ 26-700N |
| 14 405 | 372 | HZ 1080M C 24 | AZ 13-700 |
| 14 405 | 388 | HZ 1180M C 14 | AZ 26 |
| 14 410 | 375 | HZ 1080M C 24 | AZ 13-700-10/10 |
| 14 410 | 388 | HZ 1080M B 24 | AZ 26 |
| 14 585 | 374 | HZ 1080M C 24 | AZ 18-700 |
| 14 610 | 376 | HZ 1180M D 14 | AZ 18-10/10 |
| 14 620 | 380 | HZ 1080M C 24 | AZ 20-700 |
| 14 665 | 374 | HZ 1080M D 24 | AZ 13-770 |
| 14 675 | 376 | HZ 1080M D 24 | AZ 14-770 |
| 14 800 | 358 | HZ 1080M B 26 | AZ 13-700 |
| 14 810 | 361 | HZ 1080M B 26 | AZ 13-700-10/10 |
| 14 815 | 396 | HZ 1080M C 24 | AZ 26-700 |
| 14 820 | 391 | HZ 1080M C 24 | AZ 26-700N |
| 14 865 | 399 | HZ 1180M D 14 | AZ 26 |
| 14 870 | 368 | HZ 1080M A 26 | AZ 18-10/10 |
| 14 990 | 360 | HZ 1080M B 26 | AZ 18-700 |
| 15 025 | 366 | HZ 1080M B 26 | AZ 20-700 |
| 15 085 | 386 | HZ 1080M A 26 | AZ 26 |
| 15 090 | 365 | HZ 1080M C 26 | AZ 13-770 |
| 15 100 | 368 | HZ 1080M C 26 | AZ 14-770 |
| 15 235 | 382 | HZ 1080M B 26 | AZ 26-700 |
| 15 235 | 377 | HZ 1080M B 26 | AZ 26-700N |
| 15 390 | 390 | HZ 1180M A 24 | AZ 13-770 |
| 15 400 | 393 | HZ 1180M A 24 | AZ 14-770 |
| 15 425 | 398 | HZ 1080M C 24 | AZ 18-10/10 |
| 15 475 | 394 | HZ 1080M D 24 | AZ 13-700 |
| 15 485 | 397 | HZ 1080M D 24 | AZ 13-700-10/10 |
| 15 625 | 416 | HZ 1080M C 24 | AZ 26 |
| 15 660 | 396 | HZ 1080M D 24 | AZ 18-700 |
| 15 690 | 402 | HZ 1080M D 24 | AZ 20-700 |
| 15 855 | 384 | HZ 1080M B 26 | AZ 18-10/10 |
| 15 890 | 418 | HZ 1080M D 24 | AZ 26-700 |
| 15 890 | 413 | HZ 1080M D 24 | AZ 26-700N |
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| 15 935 | 388 | HZ 1080M C 26 | AZ 13-700-10/10 |
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| 16 105 | 389 | HZ 1080M D 26 | AZ 14-770 |
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| 16 360 | 404 | HZ 1080M C 26 | AZ 26-700N |
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| 16 460 | 419 | HZ 1180M A 24 | AZ 20-700 |
| 16 565 | 422 | HZ 1080M D 24 | AZ 18-10/10 |
| 16 655 | 435 | HZ 1180M A 24 | AZ 26-700 |
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| 16 765 | 439 | HZ 1080M D 24 | AZ 26 |
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| 16 815 | 405 | HZ 1180M A 26 | AZ 14-770 |
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| 17 075 | 424 | HZ 1180M B 24 | AZ 18-700 |
| 17 080 | 425 | HZ 1180M C 24 | AZ 14-770 |
| 17 110 | 430 | HZ 1180M B 24 | AZ 20-700 |
| 17 175 | 409 | HZ 1080M D 26 | AZ 18-700 |
| 17 210 | 415 | HZ 1080M D 26 | AZ 20-700 |
| 17 260 | 430 | HZ 1080M C 26 | AZ 26 |
| 17 305 | 446 | HZ 1180M B 24 | AZ 26-700 |
| 17 305 | 441 | HZ 1180M B 24 | AZ 26-700N |
| 17 380 | 440 | HZ 1180M A 24 | AZ 18-10/10 |
| 17 415 | 431 | HZ 1080M D 26 | AZ 26-700 |
| 17 415 | 426 | HZ 1080M D 26 | AZ 26-700N |
| 17 420 | 413 | HZ 1180M B 26 | AZ 13-770 |
| 17 430 | 415 | HZ 1180M B 26 | AZ 14-770 |
| 17 580 | 458 | HZ 1180M A 24 | AZ 26 |
| 17 725 | 437 | HZ 1180M D 24 | AZ 13-770 |
| 17 735 | 440 | HZ 1180M D 24 | AZ 14-770 |
| 17 740 | 424 | HZ 1180M A 26 | AZ 13-700 |
| 17 750 | 427 | HZ 1180M A 26 | AZ 13-700-10/10 |
| 17 925 | 427 | HZ 1180M A 26 | AZ 18-700 |
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| 18 020 | 445 | HZ 1180M C 24 | AZ 13-700 |
| 18 030 | 448 | HZ 1180M C 24 | AZ 13-700-10/10 |
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| 18 165 | 444 | HZ 1180M A 26 | AZ 26-700N |
| 18 175 | 436 | HZ 1080M D 26 | AZ 18-10/10 |
| 18 200 | 447 | HZ 1180M C 24 | AZ 18-700 |
| 18 235 | 453 | HZ 1180M C 24 | AZ 20-700 |
| 18 270 | 469 | HZ 1180M B 24 | AZ 26 |
| 18 380 | 453 | HZ 1080M D 26 | AZ 26 |
| 18 390 | 435 | HZ 1180M B 26 | AZ 13-700 |
| 18 400 | 438 | HZ 1180M B 26 | AZ 13-700-10/10 |
| 18 425 | 469 | HZ 1180M C 24 | AZ 26-700 |
| 18 430 | 464 | HZ 1180M C 24 | AZ 26-700N |
| 18 575 | 437 | HZ 1180M B 26 | AZ 18-700 |
| 18 610 | 443 | HZ 1180M B 26 | AZ 20-700 |
| 18 675 | 438 | HZ 1180M C 26 | AZ 13-770 |
| 18 685 | 440 | HZ 1180M C 26 | AZ 14-770 |
| 18 715 | 460 | HZ 1180M D 24 | AZ 13-700 |
| 18 725 | 463 | HZ 1180M D 24 | AZ 13-700-10/10 |
| 18 815 | 459 | HZ 1180M B 26 | AZ 26-700 |
| 18 815 | 454 | HZ 1180M B 26 | AZ 26-700N |
| 18 895 | 463 | HZ 1180M D 24 | AZ 18-700 |
| 18 930 | 468 | HZ 1180M D 24 | AZ 20-700 |
| 18 970 | 454 | HZ 1180M A 26 | AZ 18-10/10 |
| 19 120 | 484 | HZ 1180M D 24 | AZ 26-700 |
| 19 120 | 480 | HZ 1180M D 24 | AZ 26-700N |
| 19 175 | 472 | HZ 1180M A 26 | AZ 26 |
| 19 260 | 476 | HZ 1180M C 24 | AZ 18-10/10 |
| 19 325 | 452 | HZ 1180M D 26 | AZ 13-770 |
| 19 335 | 455 | HZ 1180M D 26 | AZ 14-770 |
| 19 460 | 493 | HZ 1180M C 24 | AZ 26 |
| 19 660 | 465 | HZ 1180M B 26 | AZ 18-10/10 |
| 19 720 | 461 | HZ 1180M C 26 | AZ 13-700 |
| 19 730 | 464 | HZ 1180M C 26 | AZ 13-700-10/10 |
| 19 865 | 483 | HZ 1180M B 26 | AZ 26 |
| 19 905 | 464 | HZ 1180M C 26 | AZ 18-700 |
| 19 940 | 469 | HZ 1180M C 26 | AZ 20-700 |
| 20 000 | 492 | HZ 1180M D 24 | AZ 18-10/10 |
| 20 140 | 485 | HZ 1180M C 26 | AZ 26-700 |
| 20 140 | 481 | HZ 1180M C 26 | AZ 26-700N |
| 20 195 | 510 | HZ 1180M D 24 | AZ 26 |
| 20 405 | 477 | HZ 1180M D 26 | AZ 13-700 |
| 20 415 | 480 | HZ 1180M D 26 | AZ 13-700-10/10 |
| 20 590 | 479 | HZ 1180M D 26 | AZ 18-700 |
| 20 625 | 485 | HZ 1180M D 26 | AZ 20-700 |
| 20 825 | 501 | HZ 1180M D 26 | AZ 26-700 |
| 20 825 | 496 | HZ 1180M D 26 | AZ 26-700N |
| 21 070 | 493 | HZ 1180M C 26 | AZ 18-10/10 |
| 21 275 | 511 | HZ 1180M C 26 | AZ 26 |
| 21 795 | 510 | HZ 1180M D 26 | AZ 18-10/10 |
| 22 000 | 527 | HZ 1180M D 26 | AZ 26 |

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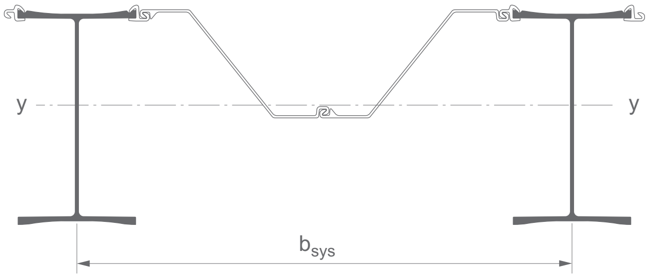
## Combination 12

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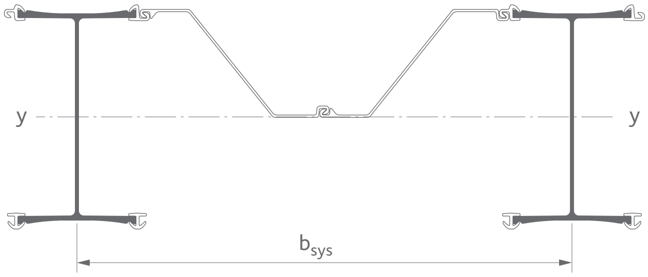
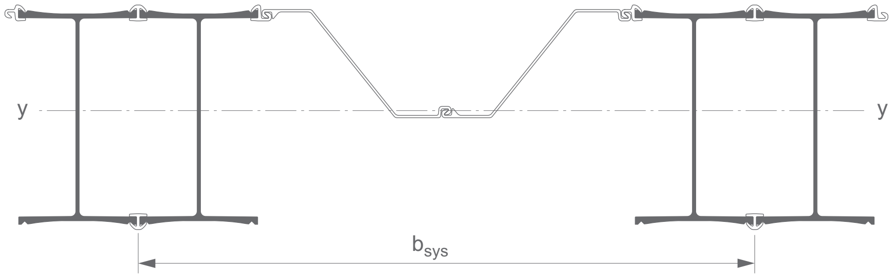



## Combination 24

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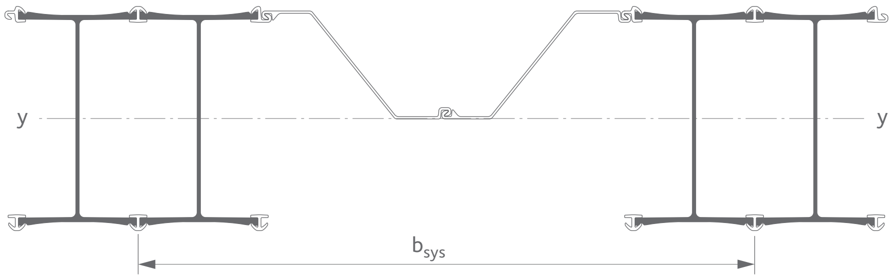

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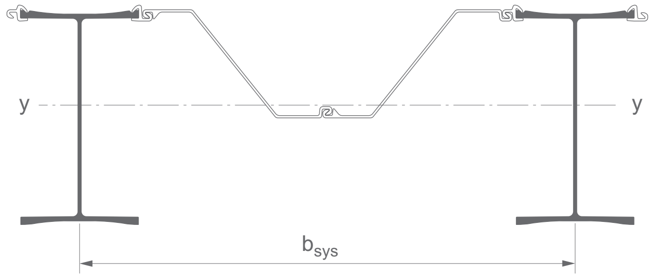


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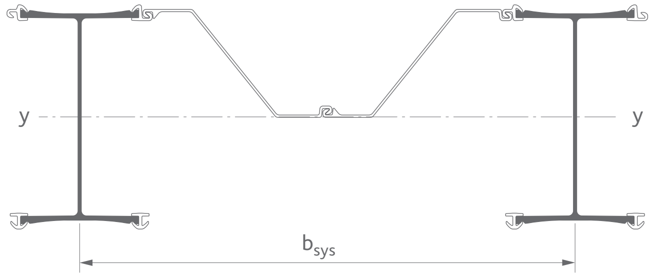
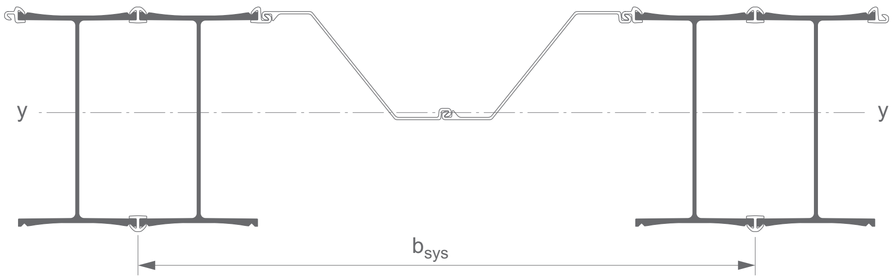



## Combination 24

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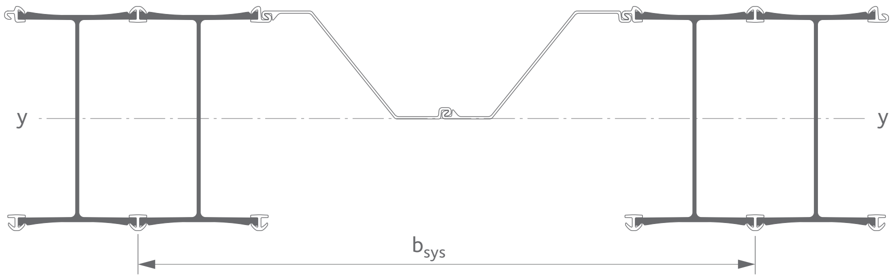

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