



# Extension of the South Quay

Port of Huelva | Spain



Extension of the South Quay | Installation of the combined wall system HZ<sup>®</sup>-M/AZ<sup>®</sup>.

The port of Huelva is in the southwest, Atlantic side of the Iberian Peninsula. The area has been visited by sea bearing Phoenicians since 1250BC and by Roman times it was one of Europe's main gateways for maritime trade. Huelva Port maintains this legacy acting as a major hub of the European trade network linking to the African and American continents.

With the need to cater to growing demands while keeping the Port's high quality of service, the Port Authority of Huelva decided to welcome the future with the extension of its south quay for increased container handling capacity.

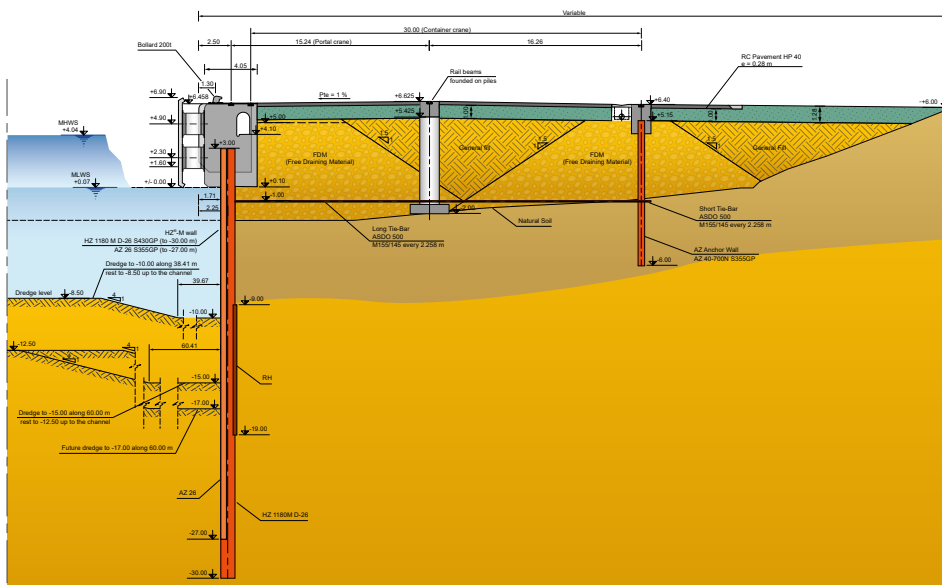
In September 2016 the Port of Huelva awards INCREA the design project. The environmental impact assessment followed with approval in December 2016. The final design and tender specification by INCREA were completed in May 2018. Steel Sheet Piles (SSP) were the solution of choice on the basis of quality assurance and project specific environmental considerations. By May 2019 the project tender had been awarded to Ferrovial as main contractor and was well under way.

The South Quay extension project consists of a 525 m long quay with a tapered end wall. The quay is designed for 23.5 m maximum retaining height with mean tidal variation of 4 m.

Due to significant variation in stratigraphy along the wall's alignment two main design sections and a tapered wing wall were created to optimize the project. The sections follow a typical configuration with a front HZ<sup>®</sup>-M combi wall tied to a rear anchor wall.

Main Section 1 extends 237 m through a zone of soft materials corresponding to a Quaternary fluvial paleochannel bed, hence the pile toe had to penetrate in the underlying dense to very dense partially cemented Tertiary silty sands. This demanded 33 m long double section HZ 1180M D-26 combined with 30 m long AZ 26 intermediary piles and ASDO 500 M155/145 tie bars (world's largest at the time) from Anker Schroeder. The high anchor loads required a custom connection design for adequate transfer into the piles. This design benefited from close collaboration of INCREA and the ArcelorMittal and ASDO engineering teams.

## Cross section type 1 | HZ 1180M-26 / AZ 26



Main Section 2 extending 287 m is characterized by the presence of a layer of Quaternary gravels and sands underlain by the same Tertiary material of the previous section at a shallower depth. The comparatively better soil characteristics allowed for a lighter system combi wall solution comprised of 29 m long single section HZ 1180M D-14 with 23 m long AZ 28-700 intermediary piles.

Profiles AZ 40-700N & AZ 28-700 are used for anchor-walls in lengths of 11.15 & 9.15 m. Distance to front varies slightly in the range of 31-32 m with anchors connected at every main HZ<sup>®</sup>-M pile.



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<b>Client</b>	Autoridad Portuaria de Huelva   Huelva   ES			
<b>Designer</b>	INCREA   Madrid   ES			
<b>Contractor</b>	Ferrovia   Madrid   ES			
<b>Installation specialist</b>	Tecnoterra S.A. Suisse - Groupe Piacentini			
<b>Main quay</b>	HZ 1180M D-26	S 430 GP	33 m	3 229 t
	AZ 26	S 355 GP	30 m	596 t
	HZ 1180M D-14	S 430 GP	29 m	2 177 t
	AZ 28-700	S 355 GP	23 m	790 t
	HZ 1180M D-12	S 430 GP	28.4-9.1 m	238 t
<b>Anchor walls</b>	AZ 28-700	S 355 GP	23-3.7 m	77 t
	AZ 40-700N	S 355 GP	11.15 m	494 t
	AZ 28-700	S 355 GP	11.15 m	528 t
<b>Tie bars</b>	ASDO M155/145	ASDO 500	32 m	623 t
	ASDO M120/110	ASDO 500	31-32 m	554 t
	<b>Total</b>			<b>1 177 t</b>
<b>Total</b>				<b>8 186 t</b>

Temporary SSP installed into a temporary berm in front of the main wall enabled dewatering for the installation of tie rods 1 m below low tide.

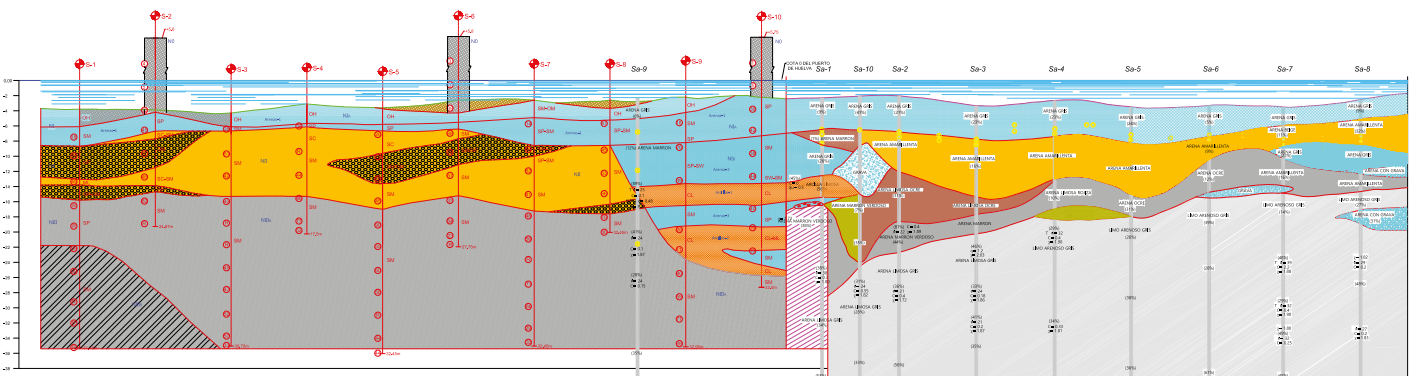
Tecnoterra, a sheet piling contractor, installed the sheet piles. Driving of the main HZ-M piles was done with initial positioning via an MS120 vibro hammer and final drive via an BSP CG240 hydraulic impact hammer with 16 t drop weight delivering 235 kNm of energy per blow with a blow rate of 26/min. Hard driving conditions in Section 2 were little challenge with the equipment and experience of Tecnoterra, whom managed a speedy installation without employing additional hard driving measures. Intermediary and anchor wall piles were driven with the Müller MS 120 HHF and an MS 32 HFV vibratory hammers respectively.

An innovative hydraulic levelling guide frame was designed and patented by Ferrovial specifically for this project.

Installation achieved impressive productivity rates of 7 double HZ-M piles per day and 12 single HZ-M piles per day.

It should be noted that this project has progressed successfully and safely under the shroud of the COVID-19 world pandemic. The inherent installation simplicity of the ArcelorMittal solution and the ASDO anchoring system have been major contributors to making social distancing easily manageable on site. Moreover, trust and cooperation between the port of Huelva, Ferrovial, and all other stakeholders have been at the root of this victory against the difficulties of the times.

The new quay is expected to start operation first quarter 2022.



NIVELES	EDAD	LITOLOGÍA
N0	Relleno	Relleno terraplén. Relleno fondo marino.
NI	NiA NiB	Cuaternario Fango y arenas. Falescosal. Arenas y arcillas.
NIi	PIlocuaternario	Arenas y gravas marrones
NIii	NiiA NiiB NiiC	Terciario Arenas limosas grises (densa a muy densa). Arena fina limosa gris parcialmente llicada (densa a muy densa)
Simbología		Sondaeo a rotación Falta de datos

NOTA:  
 RECHAZO SPT  
 RECHAZO BORRDS  
 ENTRE PARENTESIS ( ) FIGURAN LOS PORCENTAJES DE FINOS DE LAS MUESTRAS