Terratest

Terra Precast and Prestressed Piles

ER-0224/2004

TERRATEST

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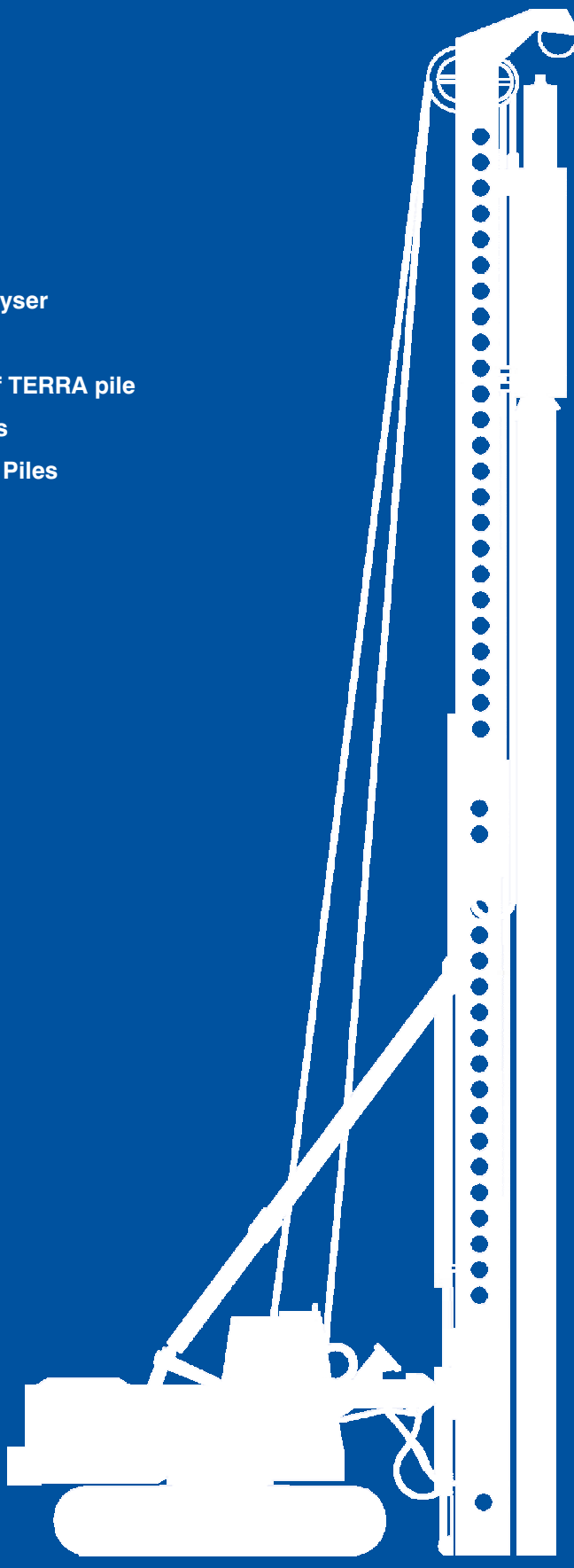
Terminal A Extension
Barcelona Airport



1 PRODUCTION (UNE EN 12794:2006 + A1)

TERRA piles are made in our Cartagena and Seville plants, from where they are shipped to work sites in Spain and overseas. They are made from a minimum length of 5 m, up to 14 m. For longer measures, a joint type ABB is used (Class A, according to UNE-EN 12794:2006 + A1).

Both these facilities are designed to produce Category I piles according to the Technical Building Standard (UNE-EN 12794:2006+A1) CE Marking for precast concrete products - displacement piles (0099/cpd/a87/0037) and have the most modern resources, operated by highly-qualified personnel.

Systematic controls are run on material reception (cement, water, aggregates, reinforcement, joints, shoes and rigs), manufacturing controls (preparation of moulds, automatic plant concrete dosing, concrete and steel strength, and concrete ageing), controls on storage (care and handling of piles) and finally shipping controls to ensure that all piles delivered to work sites fulfill the quality required according to standards (UNE-EN 12794:2006 + A1) and the instruction EHE-08.

The TERRA Pile Production Technical Procedure included in the TERRATEST Quality Assurance Manual means the supply can be guaranteed of very high-technology piles (50 and 55 MPa Concrete, large capacity of resistance to chemical agents, both sulfates and sea water (made with cement I 52.5 R/SR or N/SR (RC-08)), and highly compaction (due to the automatic placing over the molded, and concrete vibration).

TERRATEST has its own R+D+I management certificated according to UNE-166002:2006, development and technological innovation in pile driving works (IDI-0045/06), working in the continuous searching of new applications and products to provide a better service to our customers. Result of our R+D+I Department is the development of new products (Prestressed Piles, Hydraulic Head Trimmers, Continuous Parameter Measurement Equipment, LT3, etc.), and patents (Prestressed Pile Connecting Joints).

Cartagena Plant

Seville Plant

2 DRIVING (UNE EN 12699:2011, ER-0816-2003)

The piles are driving with modern free-fall equipment, using a hammer of between 7 and 11 tons raised either by the most advanced hydraulic drive methods with high performance and controls.

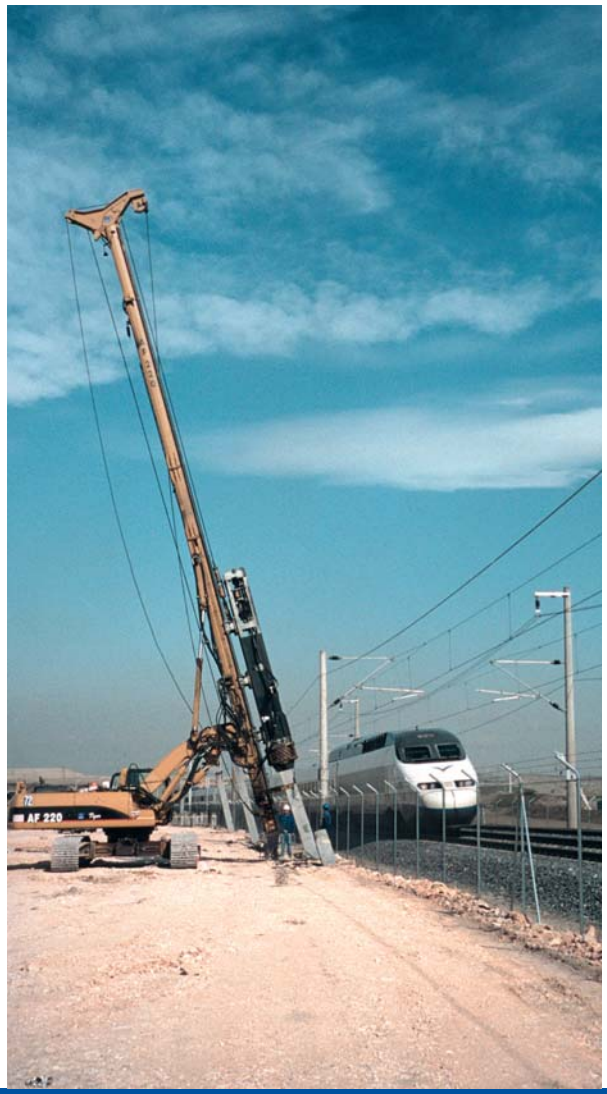
This equipment is completely autonomous (requiring no auxiliary components) and mounted on crawler-cranes for easy movement.

The work is planned in advance, with analysis of the test-pile driving sequence, stacking zone, etc.

The test piles (piles-penetrometers) provide the reference for definition of optimum pile depth, as confirmation of that planned.

Both the production of the piles and their shipment to the site are independently certified by Aenor (UNE-EN ISO 9001:2008, ER 1477/2000 and ER 0816/2003), confirming TERRATEST as the leading company in the sector.

Foundations for the España Esplabade in Alicante



Foundations for the estructure “OF 37” on the hig speed railway at Perales del Río (Madrid)

3 JOINT TYPE ABB (CLASS A, UNE EN 12794:2006 + A1)

The joint type ABB is the element allowing the union of different pile sections, to reach the necessary depth.

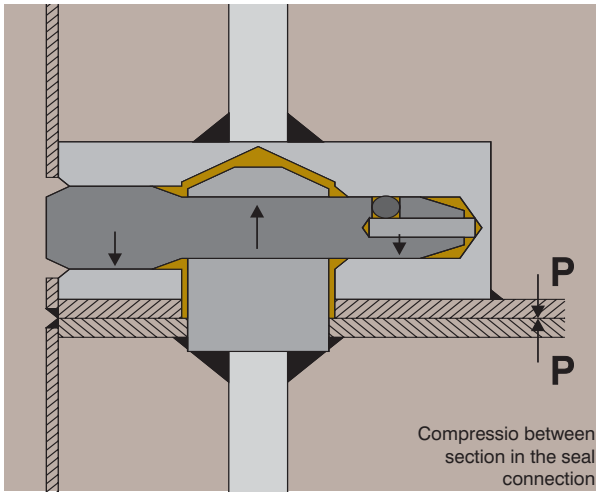
These joints are made with high-quality materials, and calculated to bear greater stresses even that the pile's standard section, as demonstrated in bending, compression and traction trials.

All components are completely covered in concrete and protected from the surroundings, except for the outer plate which, once the pile is concreted, has no structural function.

In addition, all the connection elements are embedded in grease to protect them from corrosion (certified by the Aerospace Technical Institute), and their component parts adjusted so that, once the various parts are joined, prestress is generated which guarantees that forces are perfectly transmitted.

These qualities, along with ease of shipment to the site and strict production controls, make this constructive element (patented in numerous countries) a quality guarantee in line with that of the pile itself, certified according to Class A type according to UNE EN 12724:2006 + A1 and UNE EN ISO 9001: 2008 certificated of quality management.

T-400 Seal Quality Control



Compressio between section in the seal connection

Phase 1: Placing the pile for joining

Phase 2: Introduction of pins

4 CONTROL

TERRA precast piles are systematically controlled during both production and installation on site.

In-Plant Control (UNE EN 12794:2006+A1, UNE-EN ISO 9001:2008 and EHE-08)

Material reception:

Water, cement, aggregates, reinforcing and additives, with the test prescribed in the EHE-08 Standard.

Strength and geometry:

Piles, shoes, rigs and joints

Production:

- Preparation of moulds.
-Correct installation of active and passive reinforcement.
-Correct dosing and placement of the concrete.
-Cable tension (Prestressed Piles).
- Vibrating.
-Handling.
- Ageing.

Concrete strength and consistency:

TERRA precast piles are manufactured with characteristic strength concrete at 28 days of not less than 50 MPa (Precast Piles) and 55 MPa (Prestressed Piles), with a minimum cement content higher than 390 Kg/m3, a water - cement ratio less than 0,45 and penetration of water under a maximum pressure less than 50 mm and average less than 30 mm (Concrete suitable for use in exposure classes IV + Qc or below).

Static load test on a prestressed pile

Trial for compression shear on concrete specimens

Site Controls

All over and every one TERRA piles is measured refuse (penetration every 10 impacts), to ensure that the pile's load capacity has been reached.

Static load tests (ASTM D 1143):

In this type of test, aided by other piles or anchors as reaction, a pile is subjected to loads above the maximum service levels, to note its performance and to obtain the load-seating curve.

Pile Drive Analyzer (AHP) (ASTM D 4945):

Dynamic load test. This is a fast, non-destructive test to analyse both the land conditions and the driving, controlling the pile's integrity and its load capacity, differentiated for shaft and tip. This is currently contained in a number of Spanish standards (ROM-05-94, UNE - EN 12699, Technical Building Code, Basic Document SE-C 2006, Ministry Building Foundations Guide, etc…) and international standards (ASTMD-4945, Eurocodes, etc...).

Pile Integrity Analyser (AIP):

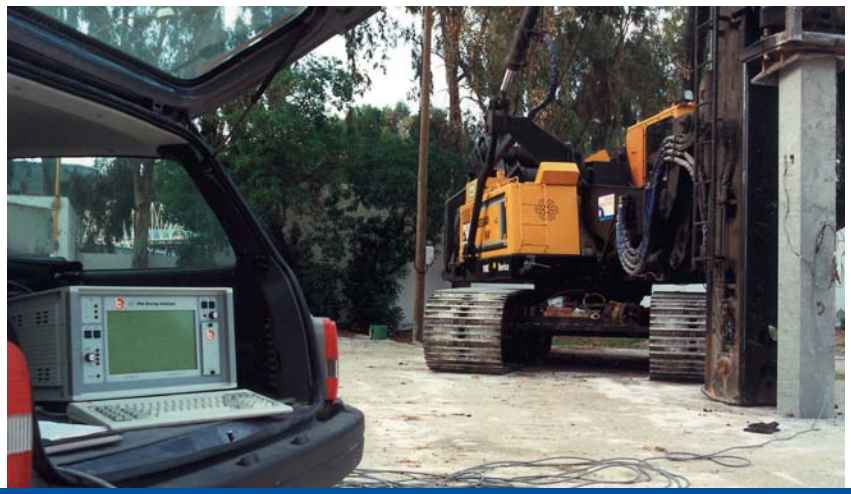
This is used specifically to monitor pile integrity. It is also based on the theory of shockwave propagation through the piles. In a simple way, and with handheld equipment, it is possible to check a large number of piles in one day, measuring reductions or increases in pile section.

Vibration Control:

When site conditions demand, it is possible to control the transmission of vibrations and the aerial shockwave caused by installation of the piles. Their calculation enables driving criteria to be confirmed and to be adjusted to the situation.

Driving Parameter Control:

It is possible, on a statistical number of piles on the site (preferably test piles) to use fully automated equipment to monitor the pile drive parameters, such as height of hammer fall, the number of impacts (advance) every 20 cm, the energy transmission, driving time, etc



Trial with the pile drive analyser

PIT Integrity trial

5 PILE DRIVE ANALYSER

The pile drive analyser allows the following:

1. To obtain data on:

- Pile load capacity (strength mobilised at shaft and tip).
- Structural integrity.
- Soil performance and characteristics.
- Driving equipment efficiency.

2. To decide on:

- The best foundation design, optimising safety coefficients.
- The most appropriate section.
- Pile depths for the planned working loads.

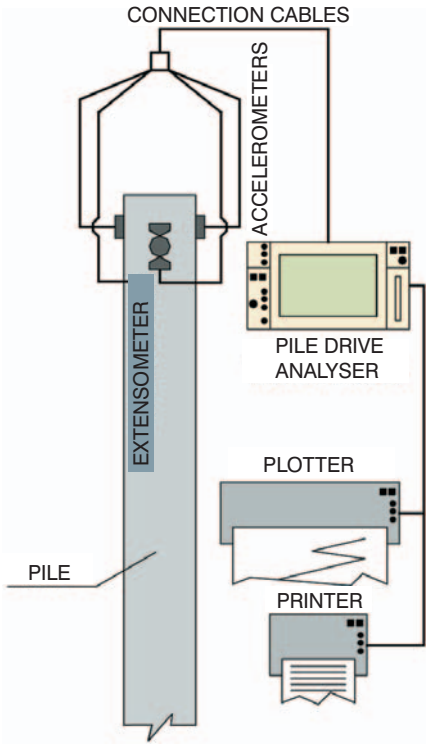
3. Supply of bases for:

- Control and monitoring.
- Economy.

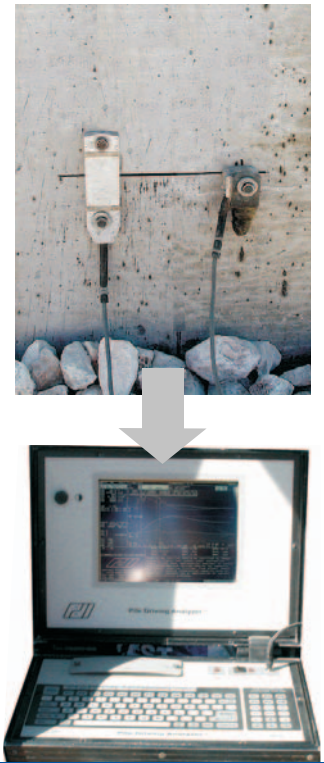
Register and results

The dynamic signals can be displayed on a computer and registered for subsequent analysis using the CAPWAPC Wave Analysis Programme which makes it possible to discretize between shaft strength and the pile tip, and to obtain the load-seating curve.

This provides valuable information quickly and cheaply, using the final work piles, because this trial is non-destructive.



Equipment layout chart



Pile Drive Analyser (AHP)

6 PILE CUT OFF

To facilitate the work following driving of TERRA TYPE precast piles, hydraulic pile cut off are used to simply, rapidly and economically speed the work to demolish the length of the pile as needed to connect them to the caps, so completing the foundation system.

The available types of hydraulic cut off, technically designed not to damage the pile structure, are of two types:

- D-300, with capacity to trim the heads of piles of sections T-235, T-270, T-300 and PT-300.

- D-400, with capacity to trim the heads of piles of sections T-350, T-400, PT-350 and PT-400.

The cut off are operated with a hydraulic rotary back digger with oil supply pressure not less than 300 bar, 24 l/min. flow, and elevation capacity of between 7 and 12 tons (generally a back digger weighing about 25 tons).

To perform the cut off, in the particular case that the capping is to be done under the work platform, the land must be prepared.

Yields are high (including more than 100Units/day) to ensure efficient work progress.

Pile trimming sequence

7 SPECIFICATIONS OF TERRA PILES

1 Precast Piles (TYPE CLASS 1, UNE-EN-A2794:2006+A1)

General Specifications

TERRA precast piles are able to absorb vertical compression forces (structural limit) up to 15N/mm2=0.3 * fck (Technical Building Code, Basic Document SE-C2006, Ministry Building road works Guide 2002), being piles Type Class 1, according UNE-EN-12794:2006, prefabricated with all controls in fixed installations.

All piles are manufactured with concretes of minimum specification strength of 50 N/mm2, (HA-50, suitable for use in exposition classes IV+Qc, according to EHE-08 standard).

The Certificate of Production Control of Concrete in our factories for the manufacture of Precast Piles TERRA is made accord to the Article 86.9 (Certificate of conformity EHE-08, a87/000392).

Also, is always used cement I 52,5 R/SR or N/SR (RC-08), making piles resistant to sulphates and seawater.

They are reinforced throughout, and at corners, with four or eight bars of corrugated steel, of minimum grade B 500 SD (510 N/mm2 elastic limit) for all sections.

They are also ringed throughout their length using transversal B 500 SD steel reinforcement (510 N/mm2 elastic limit) 6 mm in diameter. The step is variable according to the sections (see table below), decreasing in the 50 cm next to the ends accord to Article B.9.5.3. of the UNE-EN-12794: 2006 + A1de CE for precast concrete products - displacement piles.

Technical Specifications

	T-200	T-235	T-270	T-300	T-350	T-400
Theoretical Section cm2	400	552	729	900	1225	1600
Longitudinal Reinforcement (B 500 SD)	4 Ø 12	4 Ø 16	4 Ø 16	4 Ø 20	4 Ø 20	8 Ø 16/20
Transversal Reinforcement (B 500 SD)	19,6 cm.	17,2 cm.	15,2 cm.	13,7 cm.	11,8 cm.	10 cm.
Structural limit (Tn.) (CTE-2006, GC-2002)	61,7 Tn.	84,8 Tn.	112 Tn.	137,9 Tn.	187,7 Tn.	244,8 Tn.

In special cases, other reinforcements can be used, to order.

Precast pile foundations and pile trimming for a new coolstore for Hero España. Alcantarilla (Murcia)

Terra Precastpile foundations for a new 75,000 ton useful load sugar silo in the Plant at Benavente (Zamora)

7 SPECIFICATIONS OF TERRA PILES

2 Prestressed Piles (TYPE CLASS 1, UNE-EN-A2794:2006+A1)

General Specifications

TERRA's prestressed piles are rectangular, with sides of 300 mm and 350mm, and standard lengths varying between 5 and 14m. For greater lengths, our joint type ABB is used to reach the depths required.

All piles are manufactured with concretes of minimum specification strength of 55 N/mm2, (HP-50, suitable for use in exposition classes IV+Qc, according to EHE-08 standard).

Standard reinforcement is made up of 4/8 prestressed steel cables and a section of 0.5/0.6" as longitudinal reinforcement, and transversal reinforcement formed by hoops of Ø 6 variable according to sections (view technical characteristic table) decreasing in the 50 cm next to the ends pursuant to Article B.9.5.3. of the UNE-EN-12794: 2006 + A1de CE for precast concrete products - displacement piles.

Precast, prestressed piles are particularly indicated for use on very soft land where significant traction stresses may arise during pile-driving, and which are absorbed by the initial pre-compression transmitted by the prestressed cables to the pile, so that the concrete is not subject to traction stresses.

One of the major advantages of this type of pile is that it can be combined with other TERRA type reinforced precast piles on the same job, and even in the same pile, connecting different sections according to requirements.

Technical Specifications

	PT-300	PT-350	PT-400
Section cm	900	1.225	1.600
Longitudinal Reinforcement Y 1860 S7	4/8 Ø 0,5/0,6 "	4/8 Ø 0,5/0,6 "	4/8 Ø 0,6 "
Transversal Reinforcement B 500 SD	Ø 6 a 13,7 cm.	Ø 6 a 11,8 cm.	Ø 6 a 10 cm.
Compression Structural Capacity (ton.) (CTE 2006, GC 2002)	130 ton.	183 ton.	236 ton.
Traction Structural Capacity (ton.), In service	85 ton.	88 ton.	123 ton.
Flexo compression Capacity (mton.) N=100 ton.(ELU)	11,3 mT.	21,0 mT.	32,0 mT.
Flexo compression Capacity (mton.) N=0 ton. (ELU)	12,0 mT.	17,0 mT.	28,0 mT.
Shear Capacity (ton.)N=0 ton.(ELU) (8 Ø 0,6 ")	20,0 ton.	20,0 ton.	32,0 ton.

Pre-tensioned pre-cast piles for the Madrid - Zaragoza - Barcelona - French Frontier High-Speed Rail Line (Barcelona)

2 Prestressed Piles (TYPE CLASS 1, UNE-EN-A2794:2006+A1)

Applications

Because of the initial prestress force, TERRA's precast prestressed piles are particularly indicated for the absorption of traction and bending strains, and horizontal thrust, giving foundations which are more economical than other designs.

The following may be highlighted, among other applications:

Structures (bridges and viaducts). Especially with significant horizontal thrusts from braking stresses, earth thrusts at abutments, long spans, etc., and for significant bending stress transmitted by the structure at the foundation base.

Tall buildings or those situated in earthquake zones, where there are significant bending stresses in foundations (wind, earthquake, etc.), particularly when loads are transmitted by screened pillars, lift screens, etc., with the rest of the foundations designed with precast reinforced concrete piles.

Structures and buildings where the ground floor or basement levels are below the water table, and the piles are subjected to traction stresses from sub-pressure. The initial compression to which the piles are subjected from the prestressing of the cables ensures better performance in case of such traction.

Contention of walls, basements, etc., where the small pile nominal section represents a clear geometric advantage over other, larger, "in-situ" foundation systems,makingmore space available.

Industrial buildings with significant horizontal or bending stresses (travelling cranes, gantries, buildings with large spans, etc.)

Special constructions (pergolas, etc.) and public buildings whose design generates major foundation stresses.

Land with special problems (aggression, traction, etc.)

Carcaixent Shopping Centre Foundations (Valencia)

8 SPECIAL PROJECTS

New Colombino Stadium Foundations
(Huelva)

“HIPERCOR” Shopping Centre Foundations,
La Garena (Madrid)

New Treatment Station Foundations
(Huelva)

8 SPECIAL PROJECTS

Foundations for apartament building, Sotogrande (Cádiz)

Fuengirola Marina Dock Foundations (Málaga)

Aenlargement of structures on the Southem Ring Road (Huelva)

8 SPECIAL PROJECTS

Redevelopment Railway junction for Castelbisbal-Mollet Branch

Fundation by Precast Pile on Crevillente Hig Speed Railway at (Alicante)

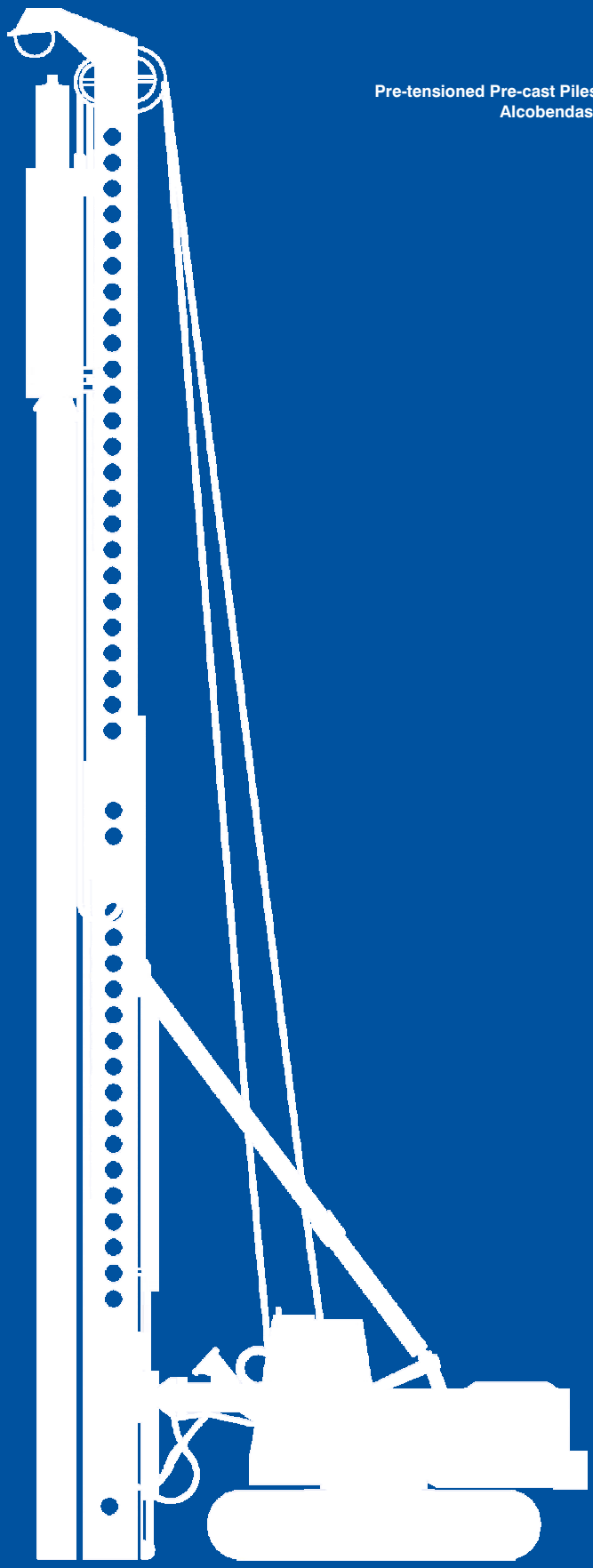
Foundation by Precast Piles for Railway Sevilla-Cadiz. Tranche: Jerez de la Frontera-Cadiz Airport. Subtrante El Portal (Cadiz)

8 SPECIAL PROJECTS

Precast and Prestressed Piling Foundation works for a Combined Cicle Power Plant at Barcelona Seaport

Foundation for a Thermosolar Plant in Palma del Rio (Sevilla)

Precast Piling Foundation for Catalonia Hotel at Europa Square, Hospitalet de Llobregat (Barcelona)

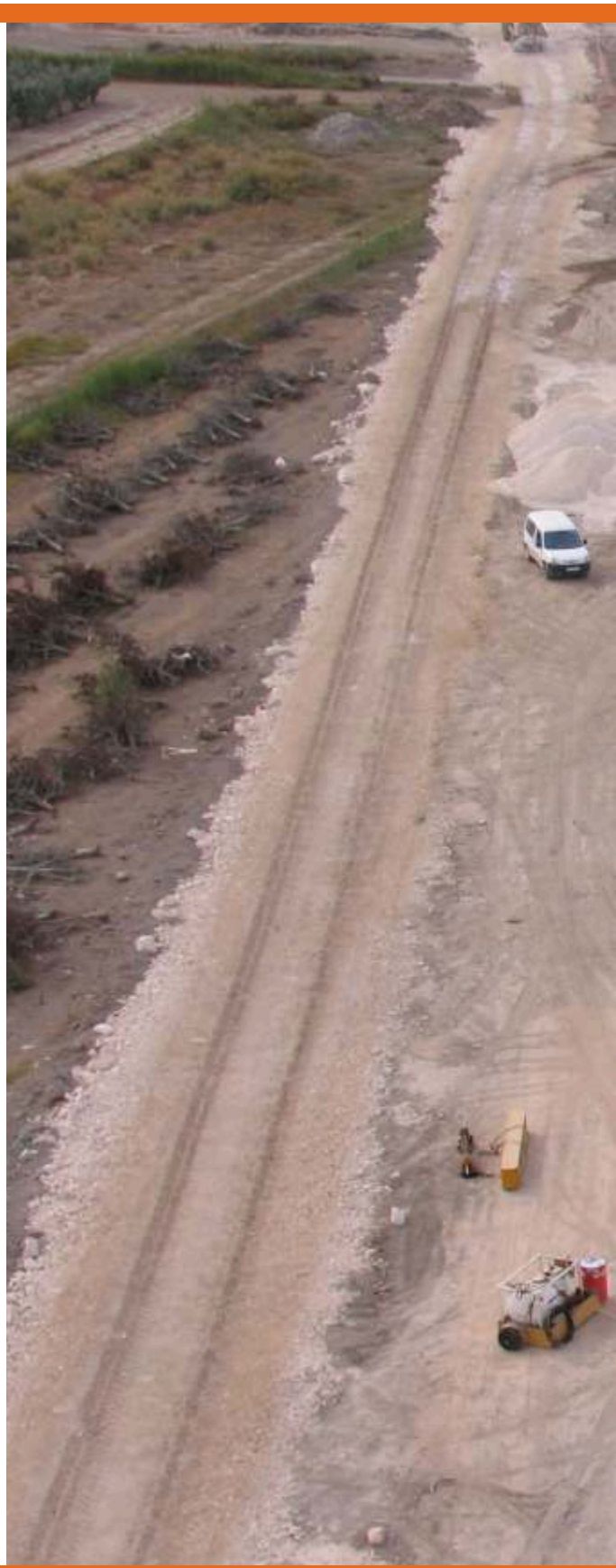


Pre-tensioned Pre-cast Piles Curtain,
Alcobendas (Madrid)

Arrubal Combined Cycle Power Station Foundations
(La Rioja)

TERRATEST

Juan de Arespacochaga y Felipe, 12
E28037 Madrid
Tel.: 914 237 500
Fax: 914 237 501
Web: www.terratest.com
Mail: terratest@terratest.com



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