

# SPECIAL PROJECTS



PACADAR, S.A.U.

"TORRE ESPACIO" Paseo de la Castellana, 259 D 28046 MADRID  
Tel.: 91 529 79 00 · Fax: 91 529 79 09 · email: [pacadar@pacadar.es](mailto:pacadar@pacadar.es)

## SPECIAL PROJECTS IN PRECAST CONCRETE

### INTRODUCTION

In the last decade of the twentieth century, PACADAR took on the challenge of introducing precast concrete structures to Heavy Industry, thus applying the undoubted benefits of such products in works such as:

- Nuclear power plants
- Thermal power plants
- Refineries

In these facilities, the structures that best adapt to the use of precast concrete are:

- Racks
- Cooling towers
- Electrical substations

The technical specifications required in this type of project in relation to tolerance, implementation quality and speed in assembly can be met through the use of precast concrete to a greater degree than with traditional on-site construction.



PACADAR, a long-standing precast concrete company and always at the forefront of technological development in precast structures, has been driving improvements both with regards to technical aspects and the implementation of the works when compared to the more traditional implementation of this kind of structure, and is currently the most highly reputable company in industrial precast engineering in the domestic market.



PACADAR has collaborated -and continues to be in contact with - large engineering and energy sector companies to ensure that the heavy industry precast projects being implemented are sustainable in terms of economic and implementation factors.



## PIPE RACKS

Such structures are used in refineries and nuclear power plants as support racks for the pipes carrying various gases and liquids.

Those built for the petrochemical industry (oil refineries and processing of oil derivatives) are particularly significant.

Also frequent are those found in nuclear and thermal power plants for the production of electrical energy from steam and in the chemical industry (manufacture of plastics, tyres, food, pharmaceutical products, etc.).

They are used in industries in general to have air, water, steam, fuel, and all manner of liquids and even meltable solids transported and pumped.



These are rather slender structures made up of column and girder grids at different heights and arranged in columns and rows of cross bracing, due to the heavy loads they bear (gravity, wind and seismic forces).

### COOLING TOWERS

Cooling towers are structures used for cooling water and other elements at temperatures as close to ambient temperature as possible. The main use of these large industrial cooling towers is to lower the temperature of cooling water used in power plants, oil refineries, petrochemical plants, natural gas processing plants as well as other industrial facilities.



These structures are made up of column and girder grids at different heights and arranged in columns and rows of cross bracing.

Cross bracing of the different portals is paramount for the design and calculations of this kind of structure, since air circulation is driven by fans located on the roof, which generate intense vibration that must be absorbed.



#### ELECTRICAL SUBSTATIONS

Electrical Substations are used to increase the voltage of electrical power produced in the generators of any power plant, whatever their type.

These are industrial buildings that have vulnerable areas that must be protected and that require a certain monolithic image reached through precast structures.

## OVERALL ASPECTS OF DESIGN

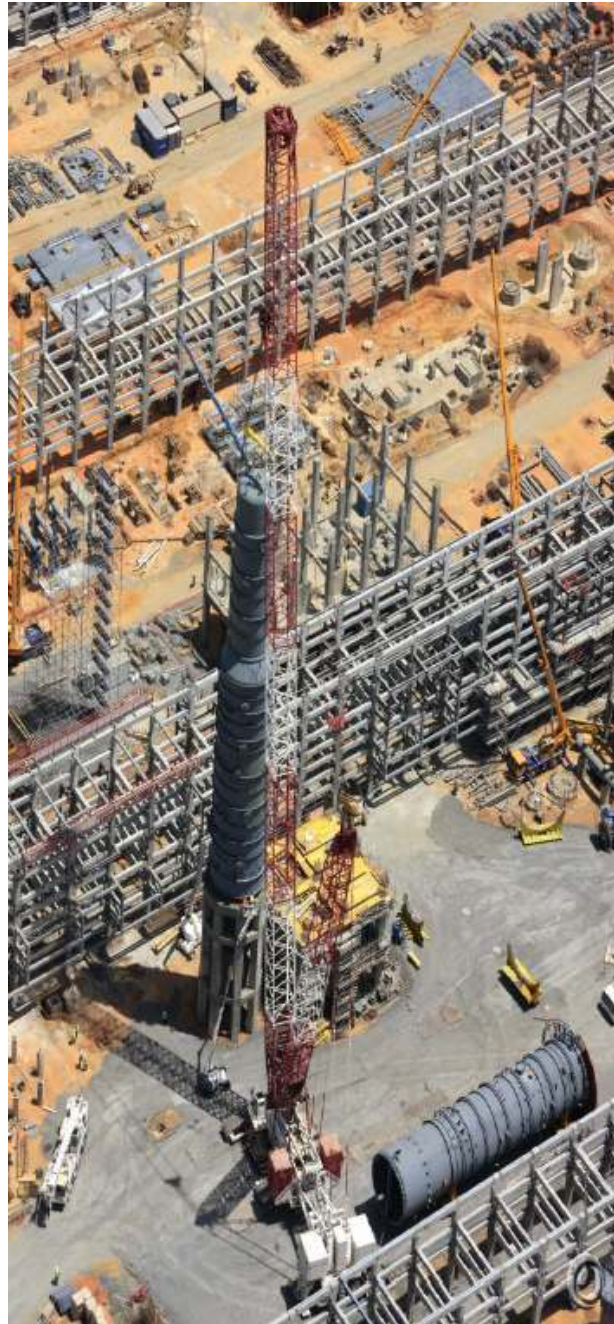
### Environmental factors and Covering

Given that this type of structure tends to be exposed to chemically aggressive environments, it must meet special requirements that restrict the materials used in their manufacturing.

Many of the special projects we refer to are close to the coast, and therefore, the most common type of exposure is IIIa + Qa.

Equally, with regards to Cooling Towers, if the cooling is carried out with sea water, the requirements are quite different than if fresh water is planned to be used, and therefore the corrosion of the precast structure always requires a special study in these cases.

To guarantee adequate protection of the reinforcements when combating aggressive environmental activity, the designer will attach a covering greater than 35 mm on all the precast elements.

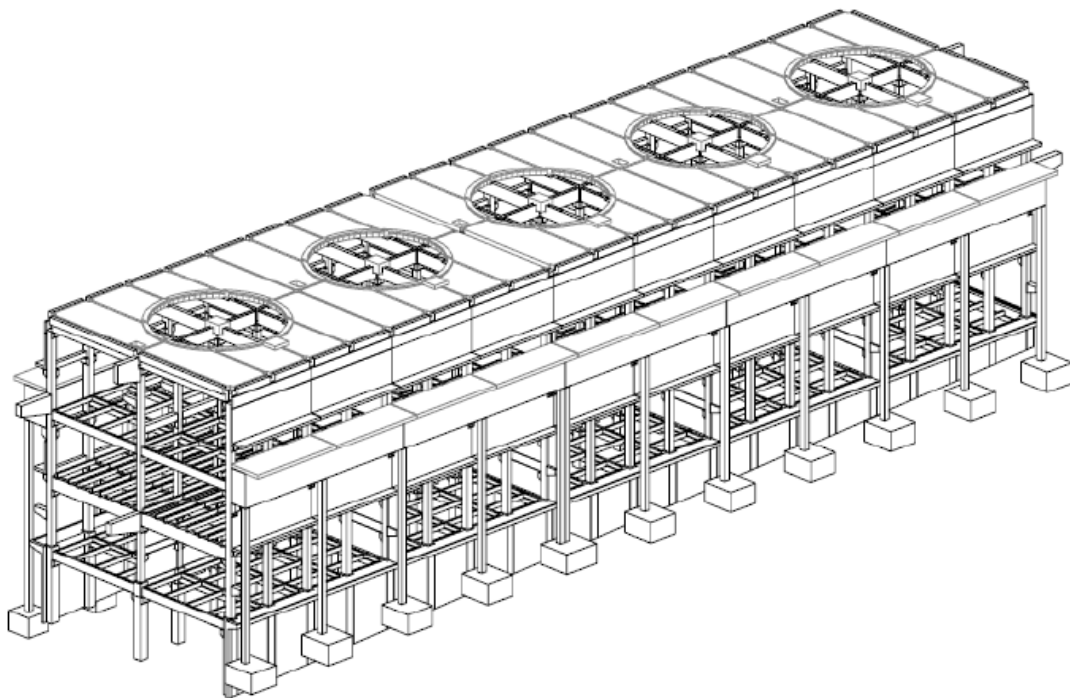


Aerial image of the Pipe Rack in La Rábida (Huelva)

## **Types of Cement**

As these structures are generally located in coastal areas and, furthermore, in the case of cooling towers, the extreme activity which they are submitted to by external factors, the cements used tend to be CEM I and CEM II/AD, with additional resistance to sulphate (SR) or to seawater (MR).

In the event that the environment where the structure is located is of type III b or III c, the cement must be of MR type, and in the case of special class type QB or Qc it must be type SR. If the environment is type III a + Qa, the use of cement type MR or SR is not obligatory.



## **Joints between precast elements**

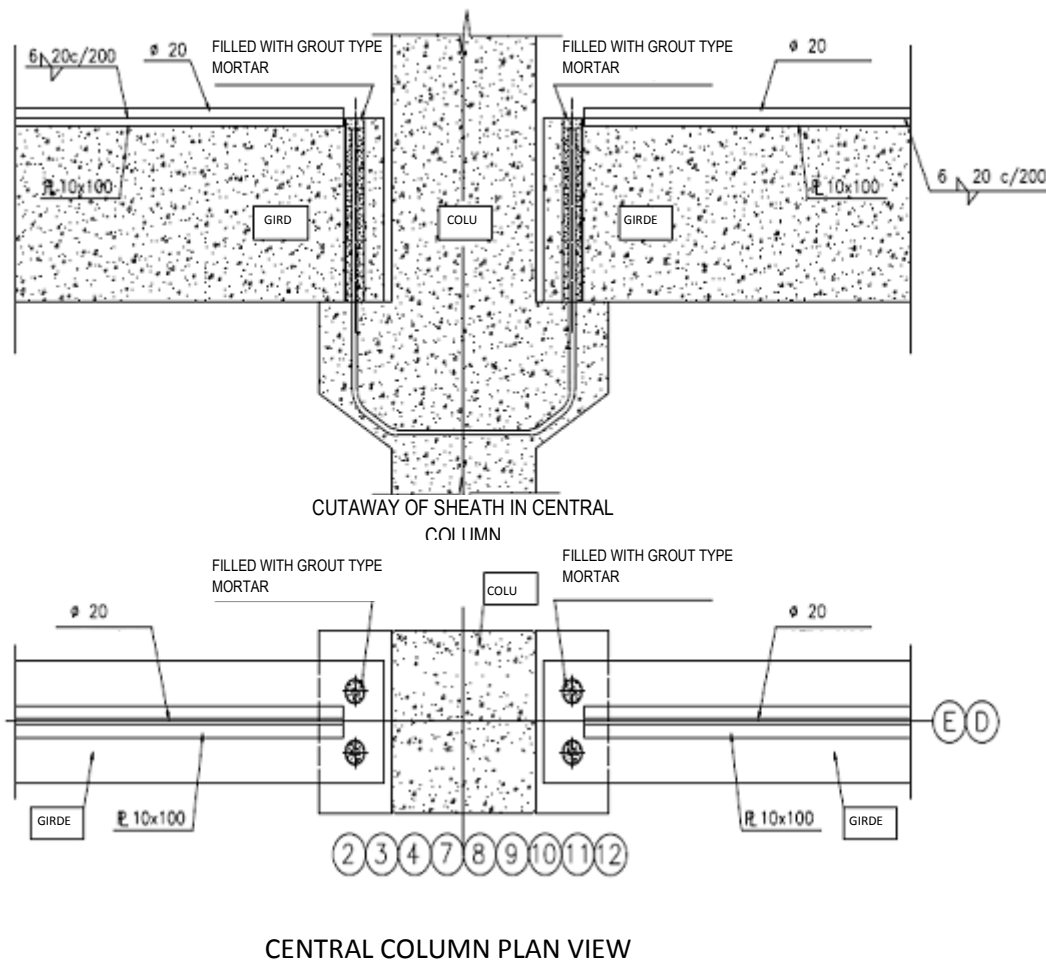
This type of structure is characterised by being submitted to three different types of loads:

- The weight of the structure itself.
- Significant gravitational loads in the roof area, coming from the equipment installed on the roof.
- Horizontal loads due to the wind and seismic activity.

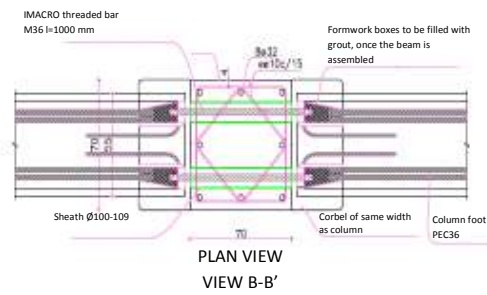
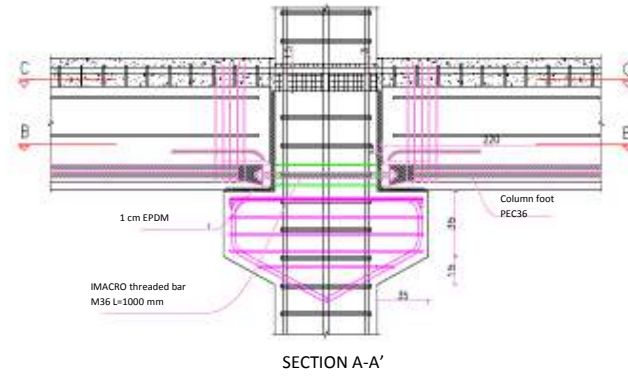
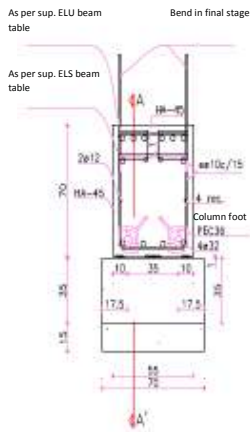
We can differentiate between two types of joints within the Special Precast Concrete Structures Project.

1.– Joints between columns and beams. Isostatic or statically indeterminate joints can be designed.

### ISOSTATIC JOINT



### STATICALLY INDETERMINATE JOINT

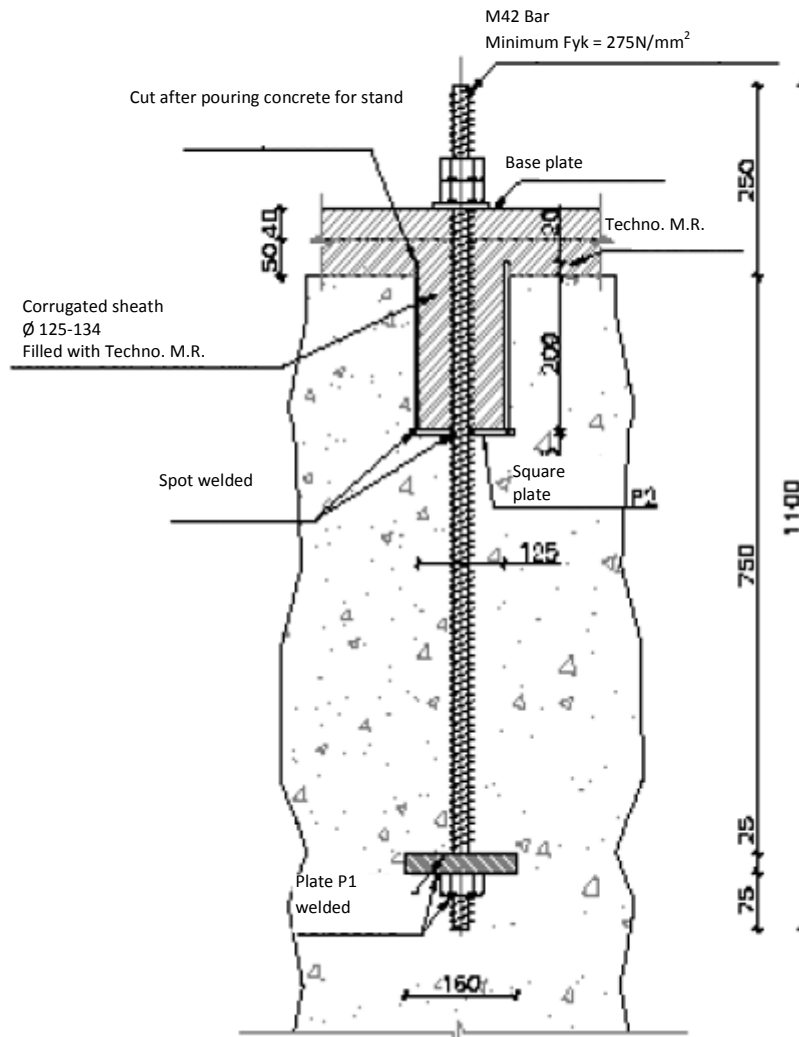


2.– Joints between columns and foundations: There are many systems that can be used, from a simple joint of sheaths filled with non-shrink mortar to screwed joints with base sheets.

### FOUNDATION BAR DETAILS

Dimensions in millimetres

S=1/20



## MANUFACTURING

### Industrial process

Prefabrication is an industrial process which provides quality assurance and optimisation of the materials used, enabling the use of new technologies.

The industrial process consists fundamentally in building the different structural elements at a factory, to subsequently transport them to the work site, where the different elements that will make up the project are assembled.



### Materials used

To make the precast elements, the basic materials that are used are cement and normal and prestressed steel.

Evidently, to comply with our quality standards the raw materials that we use must be completely traceable and have the strictest quality certificates.

The steel used must have a high carbon content and must be mechanically and thermally treated.

The concrete is appropriately treated with additives to achieve a high initial resistance that will allow mass production of all the elements.

## Industrial process

The industrialisation of prefabrication involves the streamlining of all the processes and the optimisation of the resources at our disposal to manufacture an economically competitive product.

Initially we must cut and shape the steel which forms the reinforcement, a process known as steel working.

When this step has been completed, we position this steel framework and the incorporated material (sheets, joining and fixing units) in a mould, with the separators which ensure the reinforcement is covered. Immediately afterwards, if applicable, we place the prestressed reinforcement, close the mould and proceed to the tensioning of the piece, to then carry out the concrete pouring process. When the piece reaches the Characteristic Resistance which the calculation indicates, the prestressed cables are cut, the piece is extracted from the mould and is moved to the stock.



## Quality

As with all automated industrial processes there is a quality and acceptance control process that is followed before starting the next element. The quality control check is carried out by the same member of staff that performed the activity. This control is performed internally by qualified personnel and externally by certified companies equipped to conduct the necessary audits to ensure the products comply with the most demanding standards.



## ASSEMBLY

The final phase of the implementation process of a precast structure is its assembly at its permanent location.

### Foundations

In any project of this kind, it is necessary to carry out a review of the foundations before starting to hoist and assemble the structure. We carry out an altimetric and planimetric verification of the elevations to ensure the correct positioning of all the elements.

### Assembly procedure

To proceed to the assembly of the pipe racks, cooling towers and electrical substations, the positioning or location of the cranes is studied, in such a way that there is an appropriate work radius, as well as sufficient height to begin the hoisting and lifting of the structural elements. The lifting systems that are used depend on the type of piece which we have to assemble at a given time.

There are assembly instructions depending on whether the columns are joined to foundations with footings, sheaths or bolt systems.

For each of these cases we use a crane, which is attached to the column with the bolt required for each specific case. We level the footing according to the elevation, and for this we first check the topography, raising the column, positioning it according to the marked axis and we then move on to consolidating the column placing two retracting stanchions. Subsequently the column is aligned and the sheaths are filled with non-shrink mortar, removing the stanchions or winches at least 12 hours after the sheaths were filled.

The beams are assembled by hooking 2 or 4 hoisting points on the beams with a crane, positioning them on the columns or supports, and anchoring the beams to the supports set out in the calculation without the need to reinforce them with external elements.

To assemble roof slabs, we hook the four hoisting points of the slab to the crane, placing the slab on the corresponding supports, detaching it and repeating the process with the remaining slabs.



### **Installation of Hubs**

The greatest difficulty is the installation of statically indeterminate hubs in which, as well as the on-site concrete work, threaded joints of different complexities depending on the demands which they are exposed to are also generally required.

In general, we can distinguish between three separate stages in the installation of hubs.

- A) Reinforcing
- B) Formwork
- C) Concreting

## CONSTRUCTION PROJECTS

PROJECT	CUSTOMER	OWNER	STRUCTURE
La Rábida (H) Refinery	CEPSA	CEPSA	RACKS
La Rábida (H) Refinery	DRAGADOS	CEPSA	ELECTRICAL SUBSTATION
Vandellós (T) Nuclear power plant	T. REUNIDASFERROVIAL	VANDELLOS NUCLEAR POWER STATION	COOLING TOWERS
Vandellós (T) Nuclear power plant	T. REUNIDASFERROVIAL	VANDELLOS NUCLEAR POWER STATION	ELECTRICAL SUBSTATION
Vandellós (T) Nuclear power plant	T. REUNIDASFERROVIAL	VANDELLOS NUCLEAR POWER STATION	PUMPING STATION
Extension of the Cartagena (MU) Refinery	REPSOL YPF	REPSOL YPF	RACKS
Extension of the Cartagena (MU) Refinery	T. REUNIDAS	REPSOL YPF	RACKS
Extension of the Cartagena (MU) Refinery	REPSOL YPF	REPSOL YPF	COOLING TOWERS
Campanillas (MA) CCGT PLANT	ESINDUS	GAS NATURAL	COOLING TOWERS
Cartagena (MU) CCGT PLANT	ESINDUS	GAS NATURAL	COOLING TOWERS
Sagunto (V) CCGT PLANT	SOCOIN	E.U. FENOSA	COOLING TOWERS
Cas Tresorer (PM) CCGT PLANT	DURO FELGUERA	ENDESA	COOLING TOWERS
San Roque (CA) Refinery	CEPSA	CEPSA	RACKS
San Roque (CA) Refinery	DRAGADOS	CEPSA	ELECTRICAL SUBSTATION
Almaraz (CC) Nuclear power plant	ESINDUS	ALMARAZ NUCLEAR POWER STATION	COOLING TOWERS
El Musel (Asturias) Regasification Plant	ENAGAS	ENAGAS	RACKS
El Burgo de Ebro (Z) Energy Recovery Plant	SAICA	SAICA	COOLING TOWERS