BRIDGE FOR THE AIRBUS A-380 IN BARAJAS AIRPORT MADRID (SPAIN)

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ABSTRACT

During the years 2004 and 2005 it has been constructed in Barajas airport of Madrid a special bridge for the new airplane AIRBUS A380. This new airplane has a weight of 1,500,000 pounds and 18 wheels with a reaction of 39.2 tonnes per each one and the braking force is about 600 tonnes. The enormous loads transmitted for the airplane made this bridge a special structure. The present article exposes the most important characteristics of project and construction, of one of the special bridges in the airport Barajas of Madrid. This bridge was constructed for the access to the hangar of airplanes in Barajas, known “La Muñoza”. The structure has a width of 48 m, two spans of 13 m each one and a vertical clearance of 5.50 m to allow passing vehicles under it, along the new motorway in Barajas (Madrid).

KEYWORDS: Aileron, Soil boring, Deck, Abutment, Sheet-pile, Pier-pile.

1 THE ENLARGEMENT OF THE AIRPORT OF BARAJAS

During the first decade on 21th century it has been made the enlargement of Barajas airport. The construction of four new airplane lanes will allow to reach a capacity of 120 movements per hour and to give service to 70 million passengers per year. The cost of this enlargement has reached more than 5 million Euros.

This includes the construction of two new airplane lanes, totaling four with the two existing ones, which will be parallel two by two. Also it has been planned to construct a new Terminal Area and his satellites buildings, which will be connected with the principal building by means of a rapid electric subterranean train or “people to move" (Fig. 1).

Besides the extension of air traffic in Barajas, for the construction and maintenance of airports the Airport National Agency (AENA) has considered necessary to enlarge the area of maintenance and repairing services known the hangar of “La Muñoza” one of the largest in the world.

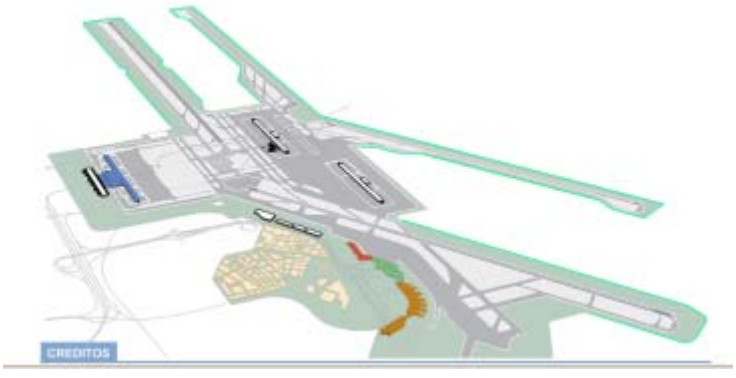

Fig. nº 1 Enlargement of Barajas airport

The hangar of “La Muñoza” is located in the southeast of Barajas airport (figures 2 and 3)

Fig. nº 2 Aerial view of Barajas airport

In the hangar “La Muñoza” takes places for the planes, every five years the review D, known popularly as the Great Stop. A program of 100 % structural inspection for the airplane, which involves the total disassembly of it, the complete review, the repairing or the change of all the interior and exterior elements of the plane. For some 70 days, engines, landing gears, controls of flight, helms, ailerons, etc., that is, all the components of the airplane go out from his place, to be turning them to his place in perfect condition being this operation certified. The results of the maintenance are verified in land and even with a flight of test (Fig. 3).

Fig. nº 3 Hanga “La Muñoza” and the bridge of access to it.

2 THE NEW BRIDGE FOR THE AIRBUS A-380

The enlargement of Barajas airport includes the construction of an internal road highway of services and also the enlargement and amelioration of the hangar of “La Muñoza”. The highway for services in this area of Barajas airport is located between the runway 18-36 and the hangar of “La Muñoza”, so it has been necessary to construct a new bridge (Fig. 3) in order to locate the plane traffic above and the car traffic below.

Due to the prospective airplanes until the year 2020 it was decided by the Airport National Agency AENA to project the new bridge in order to resist the important loads transmitted by the new huge airplane A380 which will operate in the future (Fig. 4).

This new airplane A380 transmit to the soil enormous loads which must be considered in the project of the new bridge for the access of the hangar of "La Muñoza". Its weight in movement is 1.600.000 pounds, the load transmitted by every wheel including impact coefficient is 49 Tonnes and the number of wheels is eighteen (Fig. 4)

Fig. nº 4 The new airplane AIRBUS A231

The airplane will has sixteen of the wheels over the bridge when it is over it, so the deck and the structure of the bridge must resist 2,352 Tonnes in this moment.

The horizontal breaking force of this huge airplane is about 600 Tonnes and the abutments of the new bridge projected must resist this load without any deterioration of the embankments near to the bridge. Also the area occupied by the wheels forces to construct a very broad bridge.

This lead to a bridge with a length of 28.75 m, with two spans of 15.375 m and 13.375 m. The deck has 47 m width and must have a vertical clearance over the motorway under it, at least of 5.50 m to allow the traffic of heavy lorries under the bridge.

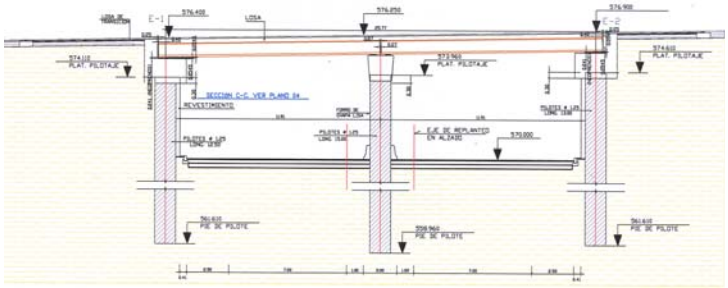

Fig. nº 5 Longitudinal section of the bridge for the new airbus A380

For the characterization of the soil it has been made three soil borings each one on any support of the bridge with a length of 17 meters, giving the next results.

- Vegetable Level and / or weak fillings constituted by clayey sands with a thickness of 1.00 m.
- Quaternary: Deposits of alluvial terrace of the river Jarama: (thickness: 2.50 m).
- Miocene Substratum, known locally as "peñuelas" and coarse clayey with a thickness of 13.5 m., at least up to 17 recognized meters.

Due to the loads the bridge must resist and the type of the soil under it, the foundation must be deep with piles and the most economical solution was to use pier-piles of 1.25 m of diameter, which must be constructed into the soil 13.00 m on the abutments and 15.00 m in the central support (Fig. 5).

3 THE BREAKING FORCES OF THE AIRBUS A380

According with the constructor of the airplane, the horizontal breaking force is 31.4 Tones per wheel, acting on the surface of the road. This obliges to resist 31.4 x 18 = 565.60 Tones for every abutment. This enormous horizontal force acting from the back to the front of the abutment must be resisted by passive or active anchors.

It was decided to use passive anchors, in order not to lay into the soil cables with very big tensions. So it was projected on the rear part of every abutment one inclined anchor slab which mobilizes the rubbing force of Coulomb. The slab is 2.87 m x 45.00 m and the resisting force of every anchor slab is more than 600 Tones greater than the 565.60 Tones transmitted by the plane.

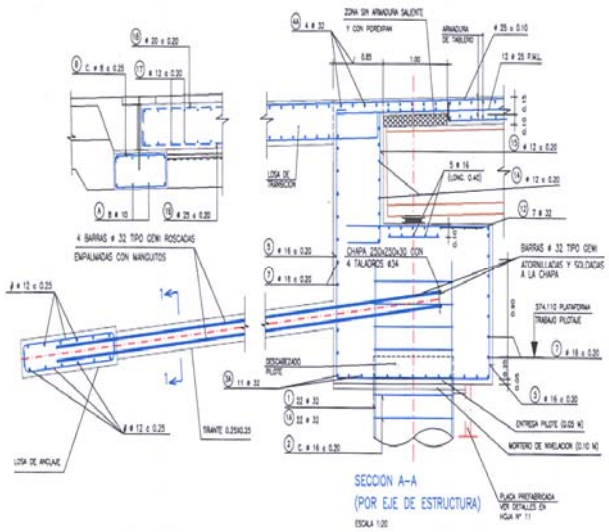

Fig. nº 6 The anchor slabs on the abutments

4 THE PROJECT OF THE BRIDGE

The project of the bridge was made according with the Spanish regulations IAP-98 and it was considered the huge loads transmitted for the plane and the rest of the actions considered in the IAP-98.

The complete model of the bride was made with the SAP2000N program and the considerations of loads were static and dynamic. The piles on the abutments must resist also de pushing forces of the soil against them, when the soil under the bridge is excavated to form the platform of the motorway. This forces to consider 60 hypotheses of load combinations (Fig. 7).

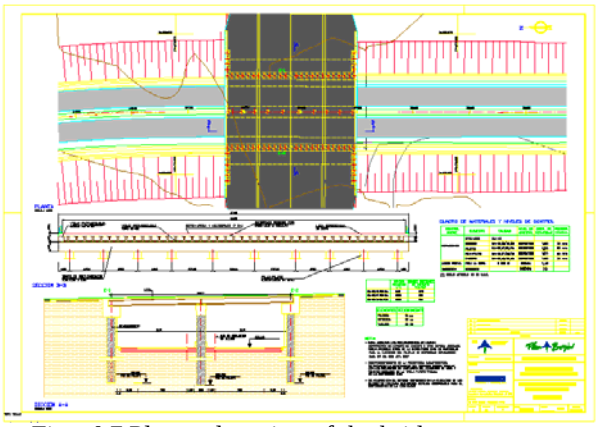

Fig. nº 7 Plan and section of the bridge

5 THE CONSTRUCTION OF THE BRIDGE

The construction of the bridge must follow the next process (Fig. 8 and 9):

- First it must be prepared the soil to form an horizontal platform for the construction of piles
- Next it must construct the concrete piles of 1.25 m of diameter, separated 1.90 m from the centres.
- After, it must be constructed the beam to tie the heads of piles with b=2.10 m and h = 1.60 m on the abutments and the beam with trapezoidal transversal section on the central support.
- Once the sheet pile of abutments and the central piles has been constructed, it must be excavated the soil under the deck, for the motorway below the bridge.
- The next phase is to place the presstresed beams of 0.82 m height.
- After the beams have been put in place, the next phase is to spill the concrete to construct the compression slab over the prestressed beams.
- Finally it must construct the rest of the bridge.

Fig. nº 8 Construction of the bridge for the access to the hangar of “La Muñoza”

Fig. nº 9 Finished bridge

6 CONCLUSIONS

Finally it was constructed a new bridge with a width of 48 m and two spans of 15.375 and 13.375 m, and a vertical clearance of 5.50 m to allow passing vehicles under it, along the new motorway for the service of the airport of Barajas in Madrid and big airplanes over it.

The bridge now it is in service with satisfactory results. All types of airplanes have passed over it to the hangar of “La Muñoza”, but no one airplane was the Airbus A380, waiting for the decision to permit the landing of it.

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