Introducción del IETcc

• The Eduardo Torroja Institute for Construction Sciences (IETcc) has been staying since 1953 in the building located in the Costillares neighborhood, next to Arturo Soria Street in the north of Madrid.

• This institution, belonging to the Higher Council of Scientific Research (CSIC), is dedicated to research in the field of construction and its materials.
The current headquarters of the IETcc, conceived by Eduardo Torroja, consists of a central building formed by several bodies that extend through the plot forming various patios and attractive outdoor spaces, designed to be the scenarios of recreation and meeting of workers and visitors.

Over the years, the volumes that shape this Institution were expanded based on the needs that were emerging in the activities developed. This work stands out both for the interesting spatial organization of the whole and for the many singular contributions that were made in its creation, turning the design and construction of the building into a real experimental workshop.

As a result, an original compendium of innovative architectural spaces and structural designs was obtained, forming the most singular elements of this venue. These elements include the circular dining room, the laminar triangular roof of workshops and warehouses, the support by cables of the mezzanine of the entrance hall to the assembly hall, as well as other structural and architectural details of the Center.
Introducción Costilla Laminar

• Durante las primeras dos décadas de funcionamiento de la sede única del IETcc, el personal se multipliò considerablemente, de manera que la capilla que estaba disponible, construida alrededor de 1956, fue insuficiente. La construcción de una capilla externa alrededor de la cual se pudiera concentrar a todos los miembros del Instituto fue considerada la solución óptima.

• El lugar elegido para ubicar la estructura fue el denominado patio de los “Alarifes”, espacio paisajístico que está delimitado por la ampliación de talleres, la nave de hormigones y el nuevo salón de ensayos, que fue inaugurado un año antes de la construcción de la plate. En ese tiempo contenía una escultura consistente en un juego espacial atractivo con varios perfiles de acero enrollados que representaban la importancia de estos elementos en la construcción y, por lo tanto, en las actividades del Instituto.

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The aim was to create a monument to the three great building materials of the time: concrete, steel and ceramics.

As the place chosen, the patio of the alarifes, already had a monument to the metal profiles, it was decided that the monument would be composed of concrete and ceramics.

- And since in the year of construction the Congress of the International Association of Laminar Structures was held in Madrid, it was decided to make a laminar structure.
The importance of the roof goes to the foreground, relegating to a second plane the rest of the elements -platform and accesses-, to which a treatment of maximum simplicity would have to be given, both formal and structural.

The main longitudinal bending was studied by assimilating the sheet to a parabolic variable cross-section bracket.

As for the secondary bends in the wall of the sheet, it was calculated according to the beam theory, assimilating the real shape to a cantilevered cylindrical sheet.
• The directrix, curve intersection of the intrados of the sheet with the vertical plane of symmetry of the same, is, between B and C, a lemniscate of BERNOUILLI.

• The generatrices, intersections of the intrados of the sheet with planes normal to the directrix, are parabolas of 2 ° degree whose vertex is on the directrix.

• Defining the surface of the intrados of the sheet, the variation of the thicknesses along the guideline and along the longitudinal edge of the same is now fixed.

• The boards of the formwork, placed parallel to the generatrices both in the backbone and in the intrados, can not be rectangular, but, as with the casks, have to have greater width at the center to be able to assemble perfectly among themselves.
The main obstacle that had to be fought was the strict deadline for construction: less than 15 days.

The formwork was composed, fundamentally, of a central spine that defined the guideline, on which the 29 trucks were attached, 60 cm apart, which defined the interior surface. A series of ribbons were nailed between the trucks to receive the boards that completed the formwork.

The placement of the armor required a great effort, because, being each bar of different length and curvature, did not give time to prepare them in the workshop and had to be adapted to the layout "in situ".

A concrete made of white cement was used.
The resulting sheet has a length in plan higher than 10 m, with 17 m of curved travel, more than 7 m width in plan and a height of 6.5 m.

Due to the complexity of the geometry, it has been chosen to lift this structure with a laser-scanner equipment.

Shots were taken from multiple places due to the obstacles present. Point clouds were obtained with color data.
• The project geometry of the sheet has been compared with the geometry actually measured. Fixing the embedment as a common position, it is possible to avoid taking into account the turns of the structure.

• Under this premise the maximum arrow has been measured at the end of the cantilever, with 383 mm of arrow. This arrow is approximately 3 times the measured instantaneous arrow (120 mm to 3 days)

• The section between the base and section S1080, the sheet moves to the outside.
Estado actual: Inspección

• The structure consists of a sheet of reinforced concrete of small thickness that is outdoors in a cold climate zone in winter, so it can be determined that the most important attack is that of water.

• The measured coating is 4 cm. Despite this coating, there is a slight oxidation in the horizontal section.

• It has also been observed that, due to the complicated execution, coke and coatings inferior to those stipulated have been produced.

• Despite this, integrity is guaranteed.
In order to carry out the recalculation, the loads of the structure have been calculated by means of the guidelines of the Instruction for the Concrete Works Project of 1944.

Based on these indications, a calculation using finite elements has been carried out.

The results obtained show that the resistant sections are sufficient, although the arrows obtained are lower than the measurements.

The differences of arrows measured with those calculated are due to the cracking of the structure in the horizontal section, which is the section with the greatest bending stresses.