Casa da Música ("House of Music")

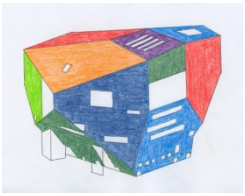
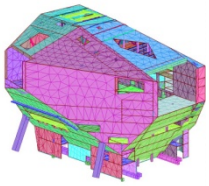
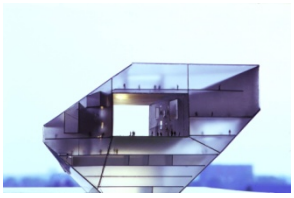
Architecture: Rem Koolhaas & Ellen van Loon - Office for Metropolitan Architecture

Structural design: AFAssociados – Projectos de Engenharia, SA

Casa da Música was conceived to mark 2001, the year in which Porto was Cultural Capital of Europe, and it is the first new building in Portugal to be entirely dedicated to music - to the presentation and public enjoyment of music, to music education and to the creation of music (http://www.casadamusica.com).

The project took shape in 1999 after the Rem Koolhaas & Ellen van Loon - Office for Metropolitan Architecture won the international architectural competition. Work began in 1999 on the site of Porto's former central tram garage on the Rotunda da Boavista, and Casa da Música opened its doors to the public on April 15th, 2005.

In 2007, Casa da Música won the Royal Institute of British Architects' (RIBA) Award, the jury describing the building as "intriguing, disquieting and dynamic".





Images: afaconsult

"Casa da Música" is one of those projects in which architecture and engineering are inseparable and strengthen each other. The challenge was to fit a complex functional programme into an object with an unusual form while also ensuring that the support structure should be an integral part of the architect's spatial concept. For the architect, the elements which engineering needs are opportunities and themes that give form to the space. Making structural sense, columns and sloping walls are formally worked on and integrated into the design, not by disguising them but sometimes by giving them an unexpected leading role. This process creates an initial conceptual freedom which, through strict formal control, leads to the desired result.

In terms of structure, in addition to the need to guarantee the overall stability of the building, the following basic concerns are worthy of mention:

- The need to find a set of structural elements, integrated in the architecture, which ensure that the bearing loads are transmitted to the foundations. The geometrical complexity of the building did not make this an easy task and it was necessary to consider a complex load path, making structural use of most of the concrete walls;

- The need to achieve a strict level of detailing to enable the definition of the building's geometry and structural elements, accurately incorporating all the openings and spaces to be used by the services. Since the building is of exposed white concrete many of the infrastructure elements are embedded in the concrete and the accuracy of detail is thus also applicable to these installations. The reinforced concrete drawings took on the importance of summary drawings and were changed as the result of successive iterations between the architects, structural engineers and services engineers;

- The establishment of a construction scheduling and a support system compatible with the work deadlines and the contractor's preferences;

- The control of surface cracks, due to the importance of this feature for the durability of a white exposed concrete building;

- - The guaranteeing that the work carried out would be of excellent quality by making prototypes to allow the testing of materials and work methodologies and to study alternative processes and materials together with the contractor.

General Description

The building houses a 1300 seat main auditorium, rehearsal space and recording studios for the Porto National Orchestra. The main structural elements of the auditorium building are the shell formed by the outside reinforced concrete wall panels 0,40 m thick, and the two large longitudinal walls bounding the main auditorium 1,0m thick. This major thickness is due to the fact that there are many openings, often large in size, and it is thus important to provide support to perpendicular cantilevering elements.

Considering the shell and its interior, it is found that the centre of gravity is moved to the south of the geometric centre of its base. This fact, and particularly the increase of this eccentricity due to seismic action, led to the use of two inclined columns to give external support at two points located at the intersection of two of its most southern edges with the floor of level O. These columns pass through the three parking levels and are only visible from there. The unit formed by the external shell, the two longitudinal internal walls, the two external columns and the floor slabs which, acting as membranes, work as stiffening vault ribs for the shell, absorbing and transferring the horizontal forces, form the primary structure and stability system of the building.

The external wall panels of the building act as a three dimensional shell with membrane forces and bending moments. The behaviour of each panel, as a plane stressed structure, contributes decisively to the overall stability of the building. The bending moments result from the action of their self weight and from the loads transmitted by the slabs which are supported on the shell. Sometimes these bending effects would be unacceptable if some auxiliary elements, called "interventions", had not been provided. The major "interventions" are the two large inclined columns which cross the South and North sides and give support to the roof panels.
There are also three circular columns coming from the wall-beams of the small auditorium which support the roof above the South foyer.

Due to the slight slope of the roof panels, certain free edges which were to be very slender would have had excessive deformations if the reinforced concrete shell had not been replaced by steel structures composed of open-web girders or beams in a welded, variable cross section construction. The stiffness of these edges is crucial in the situations where they support the large glass panels.

The construction of the "Casa da Música" was a great challenge for the entire team involved in the project. Design architects and engineers worked closely together for 6 years to make the construction of this building possible and to ensure that it will become a landmark of Porto. The success of the project would not have been complete without the great work done by all contractor engineers and site workers.