Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959–1969. Installation of glass windows in the main auditorium. © FCG Archive, 1968.

Brutalism and Nature. The Gulbenkian Foundation Buildings (1959–1969)

BY ANA TOSTÕES

The Calouste Gulbenkian Foundation headquarters and museum complex (1959–1969) headed a fundamental role in building science in Portugal, as it contributed to the accomplishment of a Modern Movement design committed with a high level of construction quality, showing that there was more beyond Modern Movement formalism. Inaugurated in 1969, it was designed to create a pleasant environment, providing prospects from inside at various angles to the grove of trees and the surrounding land. As a mega-structure designed under a multi-disciplinary design and construction team it achieved a high level of technical excellence and comfort, whilst beautifully linking the building and garden.
Located in central Lisbon, within a park with an area of 7.5 ha, occupying an area of 25.000 m^2, it was designed by the architects Alberto Pessoa (1919–1985), Pedro Cid (1925–1983) and Ruy Jevis d'Athouguia (1917–2006) with the collaboration of the landscape designers Ribeiro Barreto (1924–2013) and Gonçalo Ribeiro Telles (1922–). The construction gathered an international interdisciplinary team of specialists. The most up-to-date techniques were adopted, including reinforced and pre-stressed concrete in its construction. Some figures illustrate the volume of these buildings: 150,000 m^3 of excavation, 45,000 m^3 of concrete, 3,200 t of steel, 100 km of power cables, 50,000 m of air conditioning pipes and 3,500 kW of installed electrical capacity.
The architectural design expresses the structure. The aim of having a dominant horizontal line that guaranteed the image of a low building hugging the land and the wish to emphasize the long slabs of concrete that constituted the visible image of the built complex called for a very creative structural concept.
The impact that the complex has had and the way in which it has manifested the effectiveness of its qualities, such as formal sobriety and restraint, have confirmed the close relationship between the conception process and the construction site. With its garden it has created the very image of the prestige and innovation of the Foundation itself.

Introduction

The headquarters and museum of the Calouste Gulbenkian Foundation, together with the garden, contributed to the definition of the Foundation's own image of modernity, innovation and prestige. The architecture was instrumental in forming the Foundation's image and in revolutionizing Portugal's cultural panorama thus altering the meaning of monumentality[1] which made the Foundation unique at an international level. For the first time in Portugal, the project brought together an important group of technicians, specialists and consultants. Thanks to the generous legacy of Calouste Sarkis Gulbenkian (1869–1955), the Foundation's financial capacity allowed for a project of unprecedented magnitude.

Indeed, the "amplitude and complexity of the project [...], if not the importance of the Foundation itself, mobilised work methods that were not very common in Portugal"[2], concretised in a work that was noteworthy at all levels — the result of the cohesion and good understanding amongst the team, and most certainly of the personal commitment of the Chairman of the Foundation's Board of Trustees, José de Azevedo Perdigão (1896–1993), who played a decisive role in the diverse phases of the undertaking. .The sequence in which the building project was carried out reveals Perdigão's commitment to a high standard that would guarantee the perfect fulfilment of the objective: "do more, do better and do differently"[3]. The process was exemplary, from the choice of the site to the setting up of the Projects and Works Service (SPO), from the fine tuning of the design to the composition of the teams of consultants, from the choice of the competition (1959–1960) winner, to the conclusion of the building process.

The aim of this paper is to present the research concerning the construction process, considering the relationship between architecture, structure and infrastructure. By describing the building process, it argues that the complexity and multidisciplinary nature of the project embodies a mature modernity confirming the outstanding construction process which leads to its recognition as a national monument in 2011[4].

Methods and program, team composition and organisation

The adopted methodology ensured a diversity of skills among the architects chosen through the competition, the national and international consultants and the technical specialists. Francisco Keil do Amaral (1910–1975) and Carlos Ramos (1897–1969) were the Portuguese architects chosen by the Foundation to work alongside with Franco Albini (1905–1977)[5] and Sir Leslie Martin (1908–2000) from England[6], thus forming the group of permanent consultants. Georges Henry Rivière (1897–1985)[7] and William Allen (1914–1998)[8] were coordinated by Luis Guimarães Lobato (1915–2008), engineer and head of the SPO, which was formed by the architects Sommer Ribeiro and Sotto Mayor.

The consultants and the SPO team unanimously suggested the selection of the solution presented by Alberto Pessoa (1919–1985), Pedro Cid (1925–1983) and Ruy Jervis d'Athouguia (1917–2006) in the competition. In the jury's opinion, it was the best study of the three submitted:

> *It complies with the conditions established in the program and, in general terms, its design efficiently meets the demands of the departments to be installed in the Foundation's Headquarters and Museum building. We are convinced that the study on the basis of this functional starting point, which has already produced a subtle solution with imagination, can now be taken even further.*[9]

The transition from project to construction work became a long and complex investigative process, involving the team of national and international experts, all concentrating on issues of structure and construction. The project for licensing was completed by July of 1961 and reaffirmed the notion of manipulation of nature, since "in the framework of the architectural solution, the landscaping was of great importance in adding value"[10]. The fact that 86.6% of the site area remained free allowed the vegetation to serve as a framework for the building. Construction took place according to a study that took into account some of the pre-existing features of the landscape, such as the location of the more valuable trees, but also made it possible to effect transformations in the morphology of the site. It is in this sense that an unyielding horizontality, when it came to the distribution of the constructed volumes, was appropriate because "it allowed a reading of the buildings, in all directions, as a continuation of green spaces"[11]. The inner spaces also seemed to be organized according to their relation with the outdoor spaces, thus "providing a comprehensive overview of the park"[12]. A further consequence of this approach is that it also promoted the treatment of the lower volumes as a succession of landscaped platforms integrating with the park. Thus, the construction was manipulated as a mega-structure made of garden and inert concrete bodies, which adhered to the terrain subtly through recessing foundations. The furthering of the program allowed the integration of the built-up mass into the surrounding park following a deliberate economy of means and stripped-down formal expression, which led to the most economical proposal, the one involving the least amount of building of only 13% of the Park's area[13].

The very simple solution basically linked two bodies in a T-shaped disposition, with the addition of the independent volume of the auditorium: on the northern side was the solid and extended horizontal volume (125 m by 25 m) of the headquarters building which ran parallel to, and overlooking *Berna* Avenue, and was prolonged by the lower body of the temporary exhibitions gallery; and perpendicular to this, on the eastern side, the body of the museum which measured approximately 90 m by 60 m.

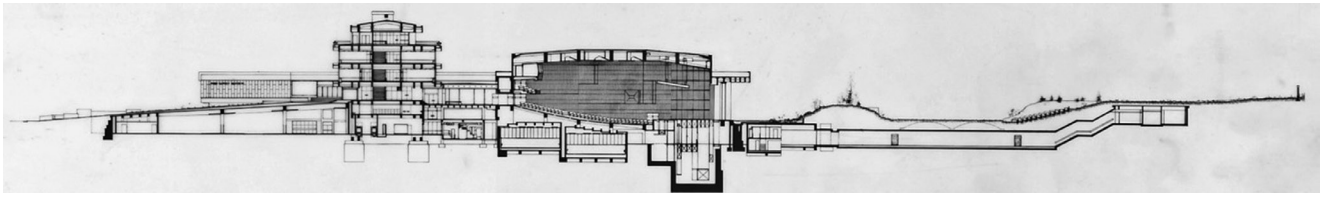
The Headquarters: served and serving spaces, the window frame prototype

In terms of its exterior, the headquarters building is that which most asserts itself in the complex of the three bodies. Treated as the dominant volume, it emerges as the first image of the Foundation. The decision of using exposed concrete as finishing implied that the high quality of the concrete had to be guaranteed through daily tests to its chemical composition conducted by the National Laboratory for Civil Engineering (LNEC). It was important that the architectural design was in line with the structure, making it more expressive. The aim of having a dominant horizontal line that would guarantee the image of a low building hugging the land and the wish to emphasize the long slabs of concrete that constituted the visible image of the headquarters building called for a very creative structural concept that was brilliantly dimensioned by the engineer Sena da Fonseca. Indeed, the structure of the headquarters block was particularly complex and difficult to design, both because of the large spans to be covered and the high loads they were to bear. The problems were augmented by the fact that the architectural design stipulated a thickness of 80 cm for the concrete slab flooring separating the floors.

In addition to this, the thin slab layer also had to incorporate all the service pipes and ducts: from the air conditioning to the electrical installations and from the security to the communication networks. The solution that came up was a grid system of crossed beams, the calculations for which were only possible, in a short period of time, by resolving systems of 32 equations with 32 unknowns, using the computer purchased by the Foundation in 1960, the first in Portugal. This grid corresponded to the hierarchy of spaces into which each floor of the headquarters building is divided up. It resulted in a ceiling design now based on squares, which were used in the interior for the distribution spaces (halls, staircases and elevators), now based on rectangles, which were adapted to the office access corridors disposed along the four façades.

This structural solution had the added advantage of distinguishing the hierarchically most important served spaces from the serving spaces reserved for less significant functions. It allowed for an organization on plan with an internal core reserved exclusively for the serving spaces. These were the circulation and archive spaces, bathrooms, elevators and staircases, which, as they did not require natural lighting or contact with the exterior, were bunched together in this central "core".

01 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, aerial view. © FCG Archive, 1969.



02 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, longitudinal cross-section. © FCG Archive.

03 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, headquarters concrete pillars. © FCG Archive, 1965.

04 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, parking construction. © FCG Archive, 1964.

05 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959–1969, auditorium construction. © FCG Archive, 1966.

06 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, prototype of Critttall frames. © FCG Archive, 1966.

In order to accentuate the three layers constituting the profile of the building, a kind of long window runs the whole length of it between the concrete slab floors. The aim of making this plane disappear is intentional, through the elongated surface of bronze glass, the subtle specification of the frames and by advancing the plane of the concrete slab, giving rise to a magnificent shade-producing effect. The window frames were considered an important issue to be dealt with. For that a prototype was produced in order to evaluate the refinement of the materials chosen for the window frames. In fact, Sir Leslie Martin devoted considerable time to the question of the glass panes and window frames, underlining the important role of these materials in the image of the buildings. Defending the award of the window contract to the *Critall* Company, Leslie Martin affirmed that, "as the building's structure is made of exposed concrete, the use of bronze frames introduces a high-quality material that will provide worthy and effective contrasts. One should note that the frames and glass are not simply inserted into the openings in the façade, as was the traditional process"[14].

The Museum, the lighting question

From the initial studies, in which large glass panels were inserted and an exhibition space on two floors was planned, in the course of the construction process several transformations occurred: the museum space was concentrated on one floor, the library was transferred to the lower floor; the definitive study of the natural and artificial lighting led to the elimination of the zenith lighting planned and the large windows become narrow openings.

The report drawn up by the museologist Garry Thompson advocating the use of soft and artificial lighting, contributed to the widespread popularity of the "bunker museum" built in reinforced concrete without windows[15]

A very clear geometric matrix structured the 60 m by 90 m rectangle, dividing it lengthwise into three sectors, which were divided perpendicularly by five other dividing lines. The structure developed and interpreted this strict geometry, as well as inscribing the museum's two interior courtyards in the centre of the composition. Based on the distribution of long, pre-stressed beams spanning the length (90 m) of the museum, this matrix structure articulates, as in the headquarters building, a hierarchization of the spaces into served and serving spaces. Making use of the 1 m intervals between the pairs of beams, the serving spaces house, in the levels below the museum's principal floor, the service stairwells, bathrooms, archives and other complementary functions.

The openings in the façade were organized in harmony with the structure's modular definition. The windows emerged precisely in the intervals between the pairs of beams framed by the beams that complete the plat band. The structural solution also gave rise to the design of the ceilings and their lighting, because it called for coordination with the design of the electrical, air conditioning and security networks integrated into one coherent whole.

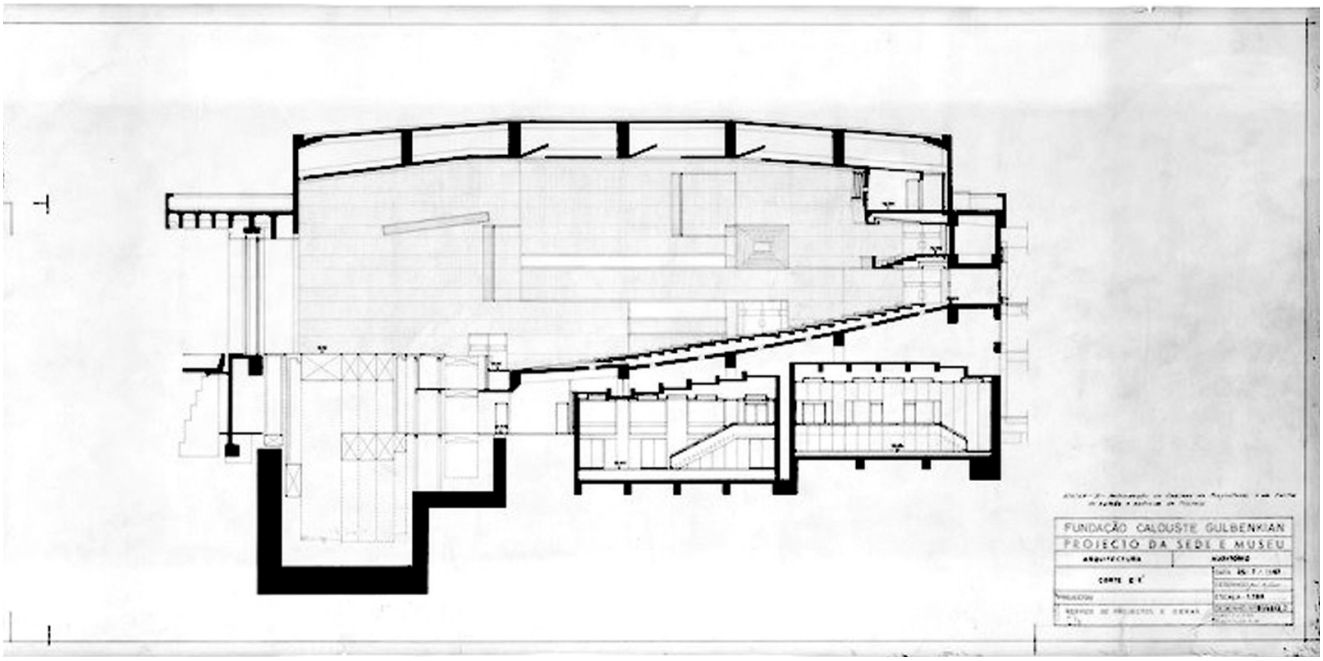
The acoustics demands of the Auditorium

In the auditorium it was necessary to create an innovative space that guaranteed excellent acoustics at the same time. Located to the south of the headquarters and temporary exhibitions wings, it is the most internal element in the complex, implanted in the heart of the park.

The establishment of a visual relationship with the exterior by placing a large window at the back of the stage, so as to provide interaction with the garden and the pond, and alterations to the design decided from 1962 onwards to house the corps de ballet rehearsal rooms underneath the auditorium required thorough studies by William Allen and the engineer Cavaleira e Silva from the LNEC[16].

The auditorium's compact volume was determined by its direct relationship with the science of acoustics, which governed the whole design. The auditorium's curve, a logarith-

07 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, auditorium section. © FCG Archive, 1967.



mic spiral, which forms its base, was studied in great detail, with drawings and models[17]. The evolution of the drawings reveals how the low, horizontal body was transformed when, in order to guarantee effective acoustics, the ceiling height was raised by 5 m, thus significantly altering the initially desired expression. The roof was then given the form of a "turtle shell", which was suggested by Keil do Amaral as a compromise between the need to raise the height and the desire to guarantee the greatest possible horizontality.

At any rate, the need to create an "inverted" web meant that excavation work for five floors below the stage level had to be carried out, giving rise to an enormous basement level from which emerge, by means of silent elevating platforms, the five stages. The decision to use an inverted "web" on the stage, consisting of a system of elevating platforms, combined with the revolving walls and the canopy suspended above the stage characterizes a conception essentially designed for musical performances but also one that was sufficiently versatile for conferences, cinema, ballet, and modern theatre performances. This work was diligently monitored by Hall Stage, a British company specializing worldwide in this field.

Due to the dimensions and volume of the auditorium, a complex structural solution was required, which was designed on the basis of a series of portal frames in reinforced concrete[18]. The concrete portal frames were necessary to span the distance of 27 m because, in addition to supporting the roof, they also had to support the concrete slab floor of the services level above, to which the bronze sheeting that formed the hall's ceiling was fixed. The stage area also took on additional complexity[19]. The canopy, that formed the adjustable 250 m² acoustics panel, weighing more than 50 t, had to be suspended from the uppermost beam. In addition to this, the last portal frame also had to serve to support the suspended large window across the rear of the hall. This double glass wall behind the stage provides a natural scenario overlooking the pond to the south and a direct relationship between the hall's interior and the park and open-air amphitheatre beyond. The contract for the work was awarded to the German company *Glasbau* which, in addition to supplying the enormous glass panels, also installed them. This project has been recorded as a highlight of the construction work. The placing of the stage on a level with the pond, separated only by the glass wall, symbolizes the close, almost physical, relationship between the interior and the exterior that was a constant aim in the project.

Space as a *continuum*

The Calouste Gulbenkian Foundation is representative of the maturity of modern Portuguese architecture, achieving a condition of contemporaneity through the high quality of the construction work at all levels. The most up-to-date methods were used, namely in the execution of the pre-stressed and, in some cases prefabricated, reinforced concrete and in the design of the electrical and air conditioning equipment and all the sophisticated technical service networks. The construction work began with large-scale earthworks, opening up the land at the northern end for the construction of the underground car park. It was an enormous construction project that was carried out on-site at the same time as the design was still being perfected, consolidated and calculated. The building complex is distributed over several floors, some of them underground, with a total area of some 64,000 m². Of this area, only somewhat more than one third, approximately 25,000 m², occupies the area of the park. These figures give one an idea of the complexity of the project and the earthworks carried out for the construction.

The structures were defined in agreement with the large dimensions of the main spans. Thus, the dominant horizontal disposition and the suspension-like implantation of the building are revealed by the larger dimensions of the struc-

08 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969. © FCG Archive, 1969.

09 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, main auditorium. Renovation by Teresa Nunes da Ponte, 2014. © Márcia Lessa, 2014.

10 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, Calouste Gulbenkian Foundation, Lisbon, Portugal, 1959-1969, hall of the Headquarters and Grand Auditorium. © FCG Archive, 1969.

tural spans used, with a length of 13.5 m in the headquarters building and reaching 17 m in the museum wing. The pillars, the section of which is 2.5 m (length) by 50 cm (width), are adapted to this metrical scanning, which is mathematically organised in modules. The construction firmly asserted the principle of "served" and "serving" spaces, defined on the basis of the structural rule: in the Museum body, the secondary serving functions are located in the interstitial space between the double beams; in the headquarters building, a kind of internal "core" houses the support services, bathrooms and archive spaces.

The "profiles" of the beams are registered expressively on the exterior and finished off with long, horizontal "belts" which assert the rawness of the simply exposed concrete, comprehended with the same refinedness of the coverings in granite, the window frames and the bronze roof sheeting.

The simplicity revealed in the choice and use of the materials seems to pervade the intimate dialogue between interior and exterior. The qualities of this building complex — sobriety and character, discretion and assertion — announce the revision of the path of Modern Movement architecture in placing building science above superfluous formalism, and in enlighten the team work values rather than the primacy of the architect in the leading role.

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Notes

1 See Ana Tostões (2015), "Towards a New Monumentality: the Creation of a Cultural Landscape", *Architektúra & urbanizmus Journal,* XLIX, No. 3–4, Bratislava, Slovak Academy of Sciences, 240–257.

2 Cf. "The authors testemony", in *Arquitectura*, No. 111, 1969.

3 José de Azeredo Perdigão, *Chairman's Report, 20 July 1955–31 December 1959*, Lisboa, Calouste Gulbenkian Foundation, 1961.

4 Dec-Lei nº18/2010, 28th December 2010.

5 Who had been responsible for the creation and renovation of some of the more recent museums in Italy.

6 Professor of Architecture at Cambridge, a former London County Council architect, co-designer of the Royal Festival Hall, and who was then currently working on the extension of the Oxford University Library with funding from the Foundation.

7 The innovative museologist of the day, who was also Director-General of UNESCO-ICOM (International Council of Museums).

8 An architect from the Building Research Centre in London, specializing in architectural technique, with particular expertise in the area of building physics.

9 AAVV, "Assessment Report on the Three Preliminary Design Studies for the Construction of the Calouste Gulbenkian Foundation Head Offices and Museum", 1 (cf. Annexed Document, vol. 2, 188–207).

10 Alberto Pessoa, Pedro Cid, Ruy Jevis d'Athouguia, *Descriptive Note,* case 40276/961, July 15, 1961; Descriptive Memoir, proc. 40276/ 961, 15 July 1961.

11 FCG, *Relatório de Apreciação dos três estudos de ante-projecto da construçao da sede e Museu da Fundação Calouste Gulbenkian.* Lisboa, Arquivo Fundação Calouste Gulbenkian, 1960.

12 *Idem.*

13 The area set aside for construction of the winning project was 36 536 m2, as opposed to the 50 314 m2 of the team project by Arménio Losa, Formozinho Sanchez and Pádua Santos, or the 63 677 m2 proposed in Analdo Araújo, Frederico George and Manuel Laginha's project. They corresponded, respectively to 13%, 20% and 30% occupation of the area of the garden. Cf. *Relatório de Apreciação dos três estudos de ante-projecto da construçao da sede e Museu da Fundação Calouste Gulbenkian*, Lisboa, March 1960.

14 Leslie Martin, *Report to Sr. Luís de Guimarães Lobato,* Lisboa, Calouste Gulbenkian Foundation archive, 1965.

15 One example is the Whitney Museum of American Art (1963–1966) in New York, by Marcel Breuer.

16 William Allen, *Acoustics in the Orchestra and Choir Rehearsal Rooms, 4 September 1969*, Lisboa, Calouste Gulbenkian Foundation archive, 1969.

17 William Allen, *Correspondence between William Allen and Guimarães Lobato, 4 January 1963*, Lisboa, Calouste Gulbenkian Foundation archive, 1963.

18 Carlos de Barros Vidal, *Meeting on Acoustics in the Grand Auditorium (attended by William Allen, Cavaleiro e Silva, Camacho Simões, Mr. Cabrera, Luís de Guimarães Lobato, Alberto Pessoa, Ruy Athouguia, Pedro Cid and Carlos Vidal), 26 July 1965*, Lisboa, Calouste Gulbenkian Foundation archive.

19 William Allen, *Acoustics in the Orchestra and Choir Rehearsal Rooms, 4 September 1969*, Lisboa, Calouste Gulbenkian Foundation archive, 1969.

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