International and Universal Exhibitions: New Building Construction Techniques in Spanish Pavilions from 1937 to 2000

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Exhibition pavilions show such original and varied forms that, in spite of their short life, they are recognised as very important buildings in architectural history. Their interest is not based on their dimensions, which are usually small-scale, but on the experimentation with new design ideas and building construction techniques.

The pavilion built in Paris, in 1937, was the first Spanish exhibition building influenced by the Modern Movement. The five pavilions analyzed in this essay were designed by: Mr José Luis Sert (1902-1983) and Mr Luis Lacasa (1899-1966), in 1937; Mr José Antonio Corrales (1921-) and Mr. Ramón Vázquez Molezún (1922-1994), in 1958; Dr Javier Carvajal (1926-), in 1963/1964; Dr Julio Cano Lasso (1920-1995), Mr Antonio Cruz (1948-) and Mr Antonio Ortiz (1947-), at Expo 2000.

The need for fast processing of building and demolition, reduction of labour costs, preoccupation about the final destiny of the building, and recovery of at least part of the money spent have produced some common characteristics to all these Spanish pavilions. These characteristics are: the election of metallic structure; the integration of prefabricated elements; the design of polyvalent and adaptable spaces with ephemeral elements, which are classified by their mobility, durability and final destiny, and, finally, the reuse and recycling of materials, building elements, or, the whole building.

The authors of the five buildings knew how to merge new building construction and the strict conditions of exhibition buildings, proving also to be masters who were able to maintain the essence of popular Spanish architecture.

METALLIC STRUCTURE

Metallic structure was used in every pavilion because of its easy facility for prefabrication, ensemble and demolition. This type of structure allows an independent wall structure and free floor plan distribution. The structure of the Paris Pavilion could be seen from the exterior and its walls were arranged in the shape of rectangles of standard dimensions. It was a metallic screwed-on structure, which consisted of parallel portals built with H-cross sections, floors with metallic beams and small girders. Parquetry, with dovetailed joints, was fixed on the girders. On the roof, parquetry was exchanged for a concrete screed, because of the water-refrigerated skylight (Martín 1983) **(Fig. 1)**.

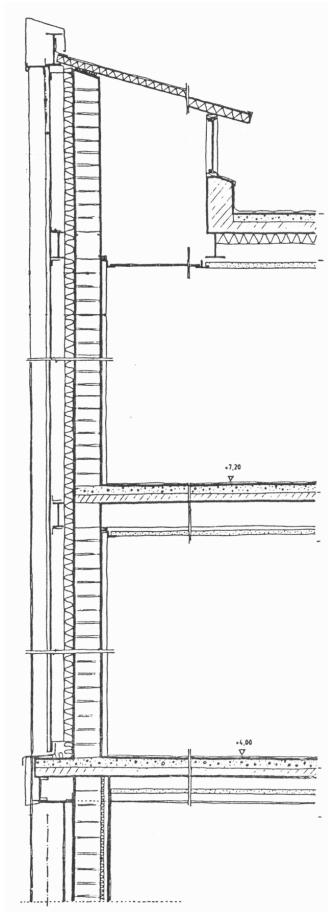

Figure 1. Paris Pavilion, 1937. Wall section.

The building that reflects the improvements of metallic structure during the fifties is Buckminster Fuller´s dome. It was designed with standardized bars and joints, which were assembled following icosahedron geometry. Mr José Antonio Corrales and Mr Ramón Vázquez Molezún used circular tubes, angular and T sections, and hexagonal umbrella-shaped geometric modules. The corolla structure, with six consoles, was inserted in the six slots of a supporting tube. Tympanums were formed by sections soldered and joined to the corolla by rivets. The foundations were resolved by leaving some prepared reinforcing bars which could be threaded to the triangular plate holes made in the base of the column (Fullaondo, 1967) **(Fig. 2)**.

During the sixties, metallic structure became popular and its use was as simple as a box with parallel portals and walls, both of big dimensions or large spatial structures. The pavilion designed by Mr Carvajal was a clear example of a metallic structure based on portals whose span was 16 metres long and was located inside the width of the walls and above the roof (BH ref. 1). This building belongs to a decade during which Spanish architecture came to be internationally recognised. **(Fig. 3)**

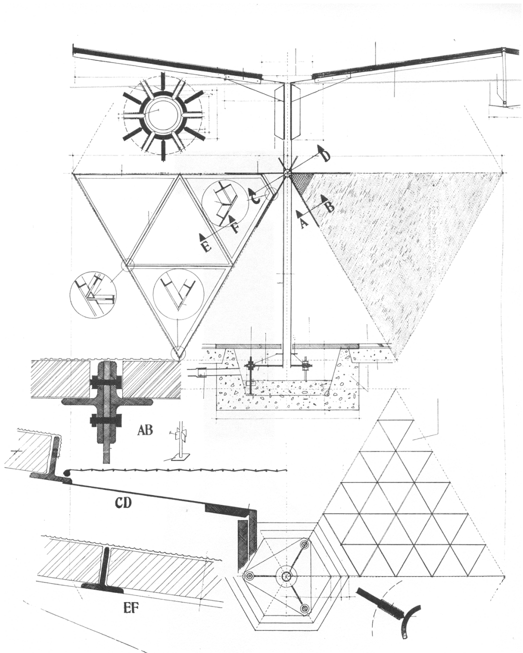

Figure 2. Brussels Pavilion, 1958. Detail of hexagonal module.

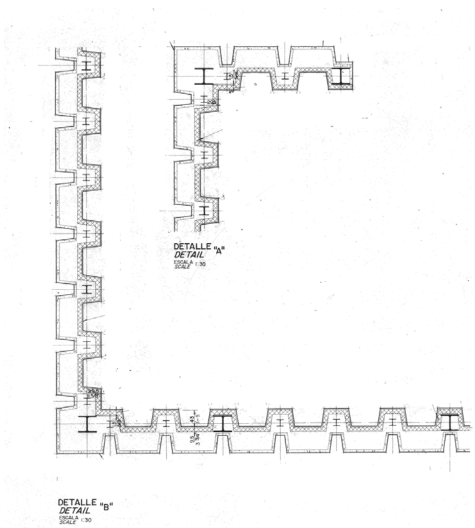

Figure 3. The New York Pavilion, 1963/4. External wall section.

Mr Cano Lasso used a metallic structure to resolve the hemispherical dome and the structure of the big cube. The latter structure is formed by a double skin of small pillars that hold triangular beams with a span of 22 metres. The structure was hidden in a fashion contrary to the High Tech tendency of the exhibition where the general image conveyed was of spectacular structures (Expo 92, 1992) **(Fig. 4)**.

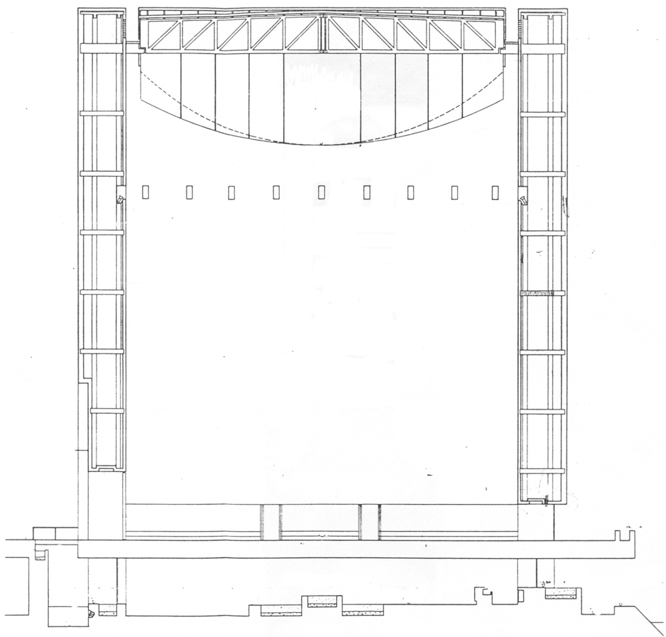

Figure 4. Seville Pavilion, 1992. Cross -section of the main building.

There were no big novelties in metallic structure during the nineties and the architects adopted in this case the solution that was the more adequate. The Hannover Pavilion structure consisted of standardized sections for the portals of the office building. The roof was supported by vierendeel trusses and the lower part of the plaza perimeter was formed by folded plate. Prefabricated concrete panels were screwed to this inverse trough. Finally, a lighter structure, held up by the general structure, formed the skylight and the interior circulation footbridges (Tanner, 2000) **(Fig. 5)**.

THE INTEGRATION OF PREFABRICATED ELEMENTS

Industrial materials, prefabrication, or, recycling of organic materials are other innovative constructional examples. Mr Sert and Mr Lacasa used fibro concrete panels and windows frames for the walls **(Fig. 1)**, with standardized dimensions taken directly from catalogues, thereby achieving a new image almost without any manipulation of the dimensions and finishes of these elements (Alix, 1987). Mr Corrales and Mr Vázquez Molezún designed a totally dismountable structural module whose lightness allowed a space without permanent walls that was easily adaptable to the topography. They achieved this by means of a detailed metallic module, more than a final form for the pavilion, a prefabricated building system of great spatial flexibility and quality **(Fig.2)**.

Mr Carvajal experimented with visible prefabricated concrete panels for the walls. The new image of the pavilion changed the traditional concept of concrete as a material used in industrial buildings, and associated with mediocre finishes. Mr Carvajal designed dwellings with concrete facades, and he demonstrated that this material was compatible with artwork such as glassworks, grates, and latticed wooden windows **(Fig. 3)**.

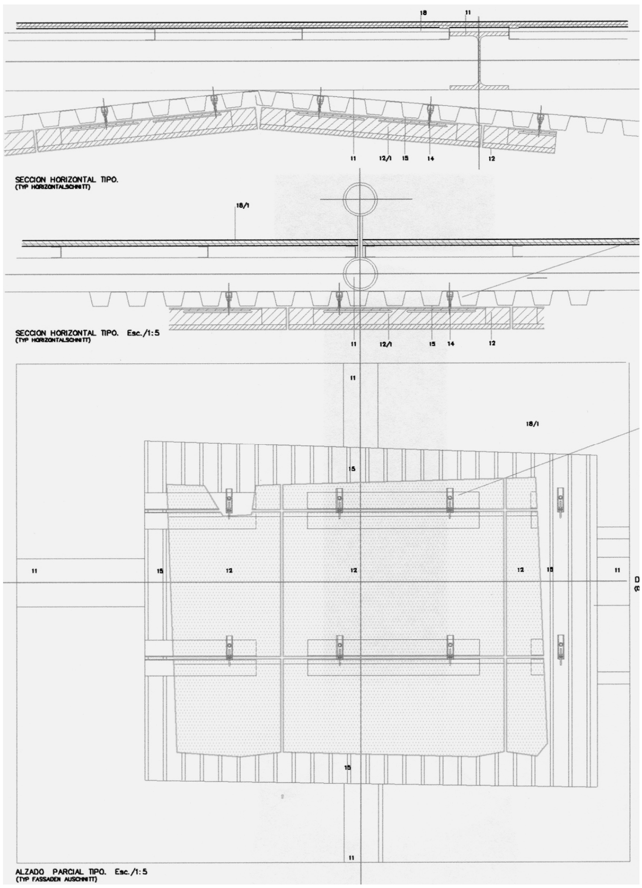

Figure 5. Hanover Pavilion, 2000. Metallic structure and cork panels

The Seville Pavilion is based on traditional materials and looked for the adaptation to the climate by means of fountains or cross ventilation, techniques used in popular Spanish architecture. Mr Cano Lasso managed to solve a complex building without using too many technological devicess. He rather created sober and quiet spaces that differentiated the pavilion from the rest of the exhibition buildings.

The prefabricated elements of the Seville and Hanover pavilions are smaller in size than the ones from the preceding pavilions. Recycling the materials was one of the main objectives, materialized in the cork panels. Once the Hanover exhibition was finished, the cork panels were to be transformed into raw material. Mr Cruz and Mr Ortiz did not pay attention to the Spanish popular architecture typologies, but they knew the inherent possibilities of traditional materials and took advantage of their sustainable and recycling properties**. (Fig. 5)**

THE DESIGN OF POLYVALENT, TRANSFORMABLE SPACES BY MEANS OF EPHEMERAL ELEMENTS

Because of their rapid assembling and disassembling capabilities, the pavilions allow us to classify constructive elements into permanent and ephemeral ones. The permanent ones are defined as those which stay in the same place without mutation and the ephemeral are those that change, modify or take another nature, state, form, place, etc.

The growing preoccupation with the final destination of pavilions and their generated residues has increased the amount and degree of temporary elements employed in the Hanover pavilion of 2000, compared to the one built in Paris in 1937. The areas with most ephemeral elements in the pavilion are the interior exhibition spaces and the courtyards. Every Spanish pavilion corresponds in this characteristic, even the one built in Seville, which was designed to remain in the same place after the end of the exhibition. The necessity of recovering part of the investment made that building suitable for different purposes after the end of the exhibition and the architects subdivided office spaces with modular panels.

The ephemeral elements are classified as: practicable, replaceable, reusable and recyclable, depending of their mobility, durability and final destiny. Practicable and replaceable elements are reusable, but not vice versa. A practicable element refers to one that can be used daily. A replaceable element suggests one that can be changed for another one on a limited number of occasions, during the exhibition. Finally, reusable elements allude to those that can be used in other pavilion with the same or different purpose. In order to be reused they had to be disassembled, removed and assembled again in other place. At the Hanover exhibition there was a change from the reusing to the recycling concept; the difference is the possibility of reusing the element’s raw material not the element itself.

We find windows, awnings, curtains, lattices and furniture, including stages, television screens, and projecting cabins among the practicable elements of every pavilion. These elements have been reduced and their function changed. In the early pavilions, such were related to the passive adaptation to the climate **(Fig. 6)**, later on they were used to modify spaces at different times of the day and, lately, they were used to provide information. The Hanover Pavilion had very few practicable windows for climatic modification. On the other hand it had a big screen that displayed a digital exhibition which changed constantly with new information.

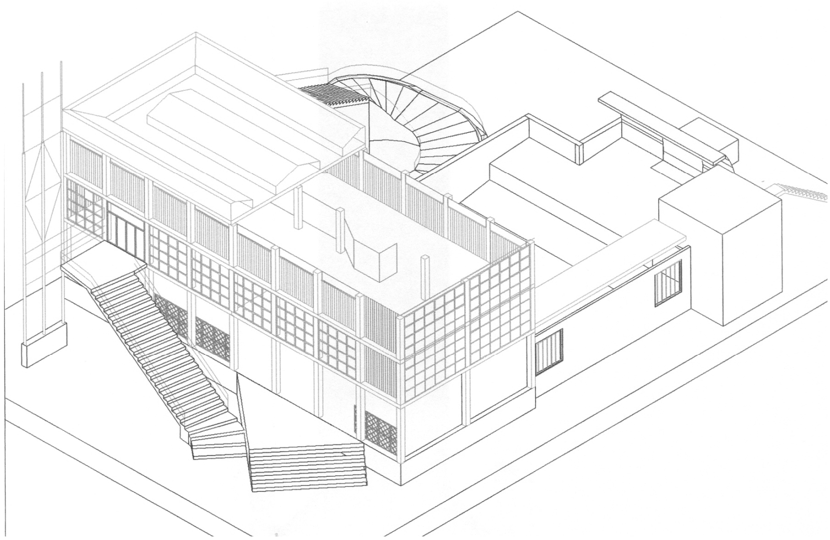

Figure 6. Substitute elements on the walls of the Paris Pavilion.

Replaceable elements were found in the first analysed pavilion dedicated to the provision of information. Big photomontages located on the walls were changed, but, obviously, not at the same speed as the television screen of the pavilion of 2000. In the same way, panels and temporary exhibition furniture were modified, but in few occasions only, not as often as the changing images of the hemispheric dome or the night projected images on the façade of the Seville Pavilion. **(Fig 7)**

THE RE-USE AND RE-CYCLING OF MATERIALS, ELEMENTS, OR, THE WHOLE BUILDING

The Paris Pavilion was cheaper and quicker to build than the Hanover one, which seems at odds with the logical progress of technique. Nevertheless, Mr Sert designed the delimiting façades of the pavilion and the plinth with permanent constructive elements, while Mr Cruz and Mr Ortiz thought of, since the first stages of the design, of a wooden pavement and a foundation made of sand, both recyclable. This advance has not proven to be progressive, because the Brussels Pavilion contained more ephemeral elements than the New York one. Besides, we can verify that the reusable elements of the Paris Pavilion, such as the fibro concrete panels, windows, skylight and metallic structures, located in the exhibition block, could have been reused. This block was the part of the pavilion that represented Modern Movement concepts such as prefabrication and universality most clearly. It is also the part of the building that would be removed and built again in Spain if the Civil War had not taken place at that moment. The building was eventually rebuilt in Barcelona in 1992 by Mr Hernández León and Espinet/Ubach team.

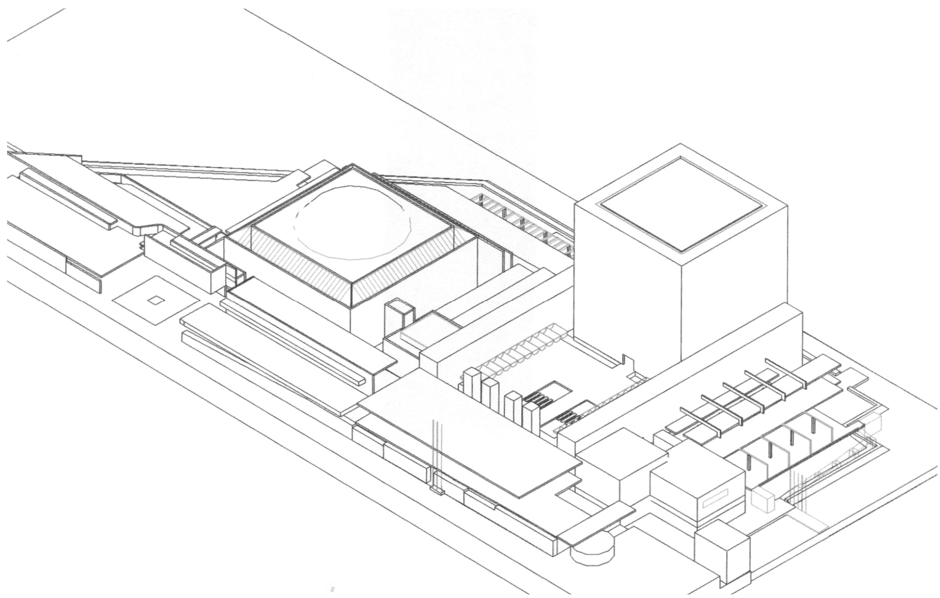

Figure 7. Seville Pavilion. Cubic and hemispheric practicable surfaces for information

The Brussels Pavilion's ephemeral elements were tested during the moving of the building. 130 hexagonal roof pieces and 527 aluminium frames from the exterior walls, in addition the joint pieces to the brick fabric, illumination material and furniture could be reused. The lack of enough reusable wall elements for the new distribution, in the Casa de Campo in Madrid, forced the construction of larger brick walls. The brick walls were built before the hexagonal roof pieces were located. This decision produced some roof pieces that were not completely orthogonal. This problem would have been avoided if the ephemeral elements had been laid out on the ground first and permanent elements, with a greater degree of adaptation, had been built afterwards. On the other hand, plinths, the horizontal drainage installation and the pavements were permanent. Due to the impossibility of removing them from Brussels, they were built in a different way in Madrid. The Brussels pavements were made of triangular glazed ceramic pieces, and Madrid floors were made of bricks placed rowlock fashion. This change eliminated the concordance between the floor and the hexagonal roof. The lack of maintenance has also led to the deterioration of the reused hexagonal roof pieces, but the walls are still up. This situation makes impossible a further removal and constrains the rebuilding of the whole pavilion. **(Fig. 8)**

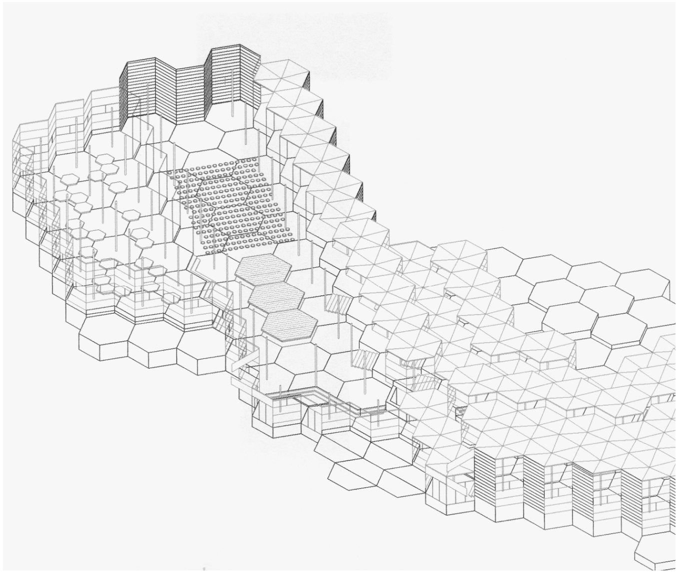

Figure 8. Reusable hexagonal elements of the Brussels Pavilion

Mr Carvajal designed the first floor of the New York Pavilion with reusable elements not in an intercalated way, but in a scheme of superimposed skins. The exterior skin was made of reusable prefabricated concrete panels and the interior one was made of a permanent brick fabric that followed the same, toothed form than the exterior one. The panels, metallic structure and reusable elements of the floor level were recuperated in the new building, a hotel built in Saint Louis, Missouri. On the lower floor, grates, lattice works, glass windows and enamelled panels designed by important Spanish artists were placed side by side with whitewashed permanent walls. The furniture was made of a wood panel work with squared sections and glass urns held by aluminium tubes with inside lights. It was recuperated in the same way than in the others pavilions

Mr Cano Lasso designed a permanent building, but organized reusable elements which contrasted with plane walls. Skylights, pergolas, stairs, handrails, and awnings are placed not only in the courtyard, but also on the terraces that look out towards the lake. These elements give scale to the building and adapted the exterior living spaces to the climate. The Seville Pavilion was an example of the integration of permanent elements, which gave a representative austere and monumental image to the building and replaceable elements. These last elements could be dismounted when they deteriorated or when new distribution of functions was needed. Mr Cano Lasso designed installations with the same concept of integration between traditional and modern systems with awnings, water pools and cross ventilations and the most technological advanced systems such as solar panels and remote centralized control. Both systems consist of practicable elements. The first mentioned elements require human supervision while the latter ones are controlled by a computer.

Mr Cruz and Mr Ortiz designed the Hanover pavilion with the condition of leaving the site, once the exhibition ended, the same way as they found it. This condition required a great number of reusable elements such as a metallic structure and recyclable elements to substitute those that deteriorated. For example, cork panels placed on the façades and wooden paving pieces could be recycled as conglomerated when they wore down. This concept is new because it was not taken into account in the rest of the pavilions at the fair. In those pavilions architects only considered the reuse or replacement of the elements, but not their durability and the ability to be recycled as raw material.**(Fig. 9)**

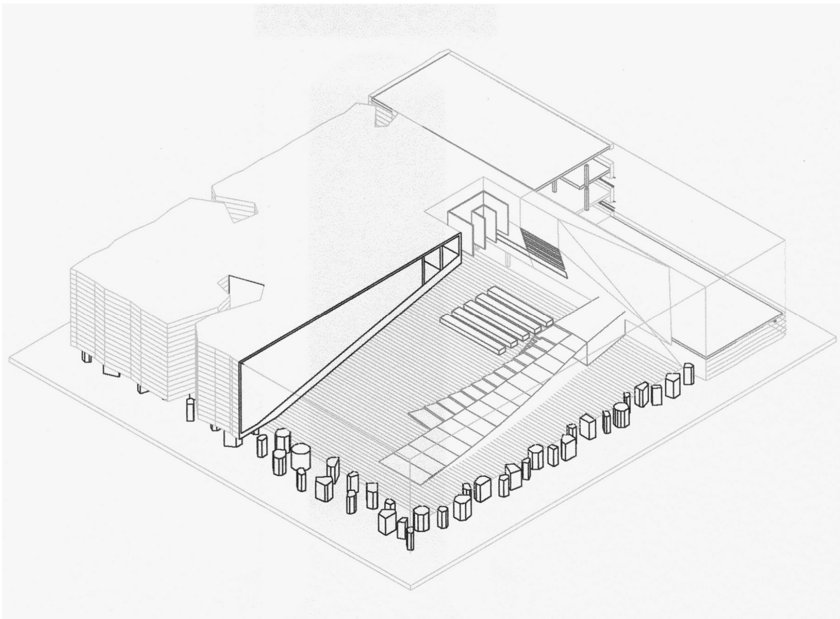

Figure 9. Recyclable cork panels and wood paving at the Hanover Pavilion

To conclude: this paper demonstrates that the architects of these Spanish exhibition pavilions knew how to integrate the latest constructive tendencies with the more ephemeral architectural conditions, thus managing to design buildings that kept the essence of popular Spanish architecture alive.

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