

A Discussion on the Structure and Spatial Composition of Long Museum West Bund

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Abstract: The Long Museum, with its distinctive T-shaped “umbrella-vault” structure, offers a rich array of spatial experiences. This article delves into space from both structural and compositional perspectives. As the construction mediator, the umbrella vault embodies the consistency of construction and implies the causality of the surface. Presented as an element, the space flows freely, showing diverse fields and order. In terms of the liberation of its meaning, the space offers static perception and dynamic experience, creating a rich exhibition atmosphere. As a distinct entity, the umbrella-vault presents the physical nature, and the dialogue between the Long Museum and the city makes it a museum of art for the people.

Keywords: Long Museum; Structure; Spatial composition; Umbrella-vault

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1. Introduction

In *The Four Elements of Architecture*, Gottfried Semper divides the original shack, which served as the prototype of the building, into four basic elements: hearth, roof, enclosure, and mound. The Long Museum is one of the most wonderful designs for the extraction and use of structural elements in China. Its ingenious approach to roof and enclosure design reflects, to a certain extent, both a continuation of and departure from traditional spatial typologies within contemporary architecture. The T-shaped “umbrella-vault” cantilevered structure wraps the exhibition space. On the one hand, the space flows horizontally near the ground. On the other hand, the wall extends and bends upward to form a roof resembling an umbrella or an arch, forming another spatial composition, full of “duality”^[1].

As a structure, the umbrella-vault is also a collection of spatial interfaces, formal symbols, and pipeline wells^[2]. The main load-bearing structure is poured synchronously with the thermal insulation layer, and the external glass and wall can be spread in the same plane, forming a flattened effect (**Figure 1**). On the ground, there are different levels of umbrella-vault structures forming a staggered structure of buildings, echoing the industrial history of the “coal funnel corridor.” The underground is an exhibition hall in pure white square box style (**Figure 2**).

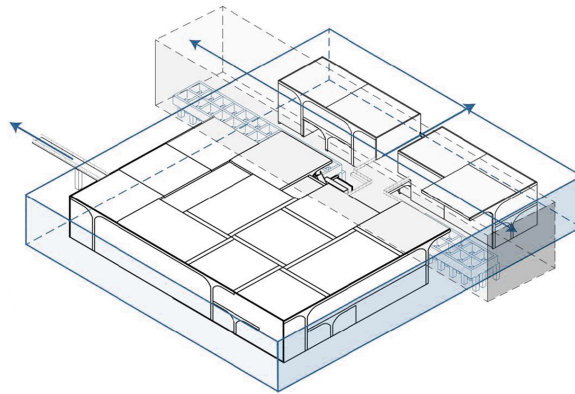


Figure 1. Structure and form of Long Museum (Source: Drawn by author)



Figure 2. Southeast façade (Source: Author's picture)

The interaction between structure as an entity and space is a persistent proposition. To comprehensively and effectively study the space of Long Museum in the context of traditional space type inheritance, this study explores the structure and spatial composition through four lenses: construction mediator, element presentation, meaning liberation, and individual existence.

2. Structure as a construction mediator

2.1. The causality of surface

The cleanliness and purity of the Long Museum are mainly attributed to the consistency of the design language - the use of “surface” [3]. In this space full of “surfaces,” the ceiling slides along the curved surface to the wall, creating an ambiguous boundary (**Figure 1**). Different from the separate and independent system of the load-bearing envelope in the frame structure, the umbrella-vault, as a construction mediator, is a complete structural unit (**Figure 3**). It is composed of two 200 mm thick concrete walls and cavities. The concrete walls are inserted into the basement, “clamping” columns and old beams of the original basement, extending to the necessary height and overhanging on both sides and being horizontally balanced by the upper top

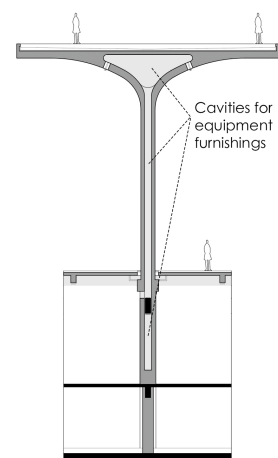


Figure 3. Unit of umbrella-vault (Source: Drawn by author)

plate. A 400 mm thick cavity is formed in the vertical section of the umbrella body, and an inverted triangular cavity for pedestrians is formed in the upper part of the umbrella body. The tube well, ventilation, and sprinkler system are integrated into it, which is the so-called “service space” in Louis Kahn’s concept ^[1], making it possible to have a surface of exposed concrete inside and outside.

The strong character of the structure itself is the unique sense of scale in architecture ^[4,5], with a focus on being rather than being real. The surface with the same texture, the Mondrian-style flat surface, the blurred boundary between the wall and ceiling, and the umbrella’s wrapping and protection of the body collectively create the primitive sense of space - the cave dwelling.

2.2. The classicality of “arch”

From the perspective of spatial composition, the merging of two wall umbrellas forms an “arch” shaped space, and these umbrellas are paradoxically similar to arches when combined. When two umbrellas merge in parallel to form an “arch,” intersect vertically to form a “half arch,” or merge in the shape of a windmill to form a sort of “cross arch” ^[4], the “arch” in these shapes is not a true “arch” in the structural sense, but still points to the place where the arch first appeared – Rome. To explore the influence of arches on space, architects even specifically examined Roman arched architecture ^[1].

In terms of its shape, when the curvature is small, it resembles a folded plate, and when it is large, it resembles an arch. To ensure accurate positioning, the curvature of the umbrella body of the Long Museum has been determined to be an elliptical shape drawn using the four-center method ^[6]. Because the arc curve at the bottom of the umbrella is an elliptical line connected tangentially by two tangent arcs, the starting point is greatly raised compared to the usual circular arch, and a long flat section is formed at the end. With a large scale, it gets rid of the spatial form meaning as an arch.

In addition, the gap between the “umbrellas” suggests that they are not real structural arches. The use of light reflects “destruction” and “construction.” At the moment when light enters through the middle seam, the arch is broken into two simply supported beams, and reinforcement is specially designed for the establishment of the beams. Therefore, it is not an arch in the structural sense, but rather the Vault of Kimbell Art Museum ^[2] (Figure 4). In addition to light, from the rationality of the structure, hard connections are not conducive to earthquake resistance. From the perspective of spatial mobility, the garden concept of “separation” ^[7] also promotes the independence and detachment of umbrellas.

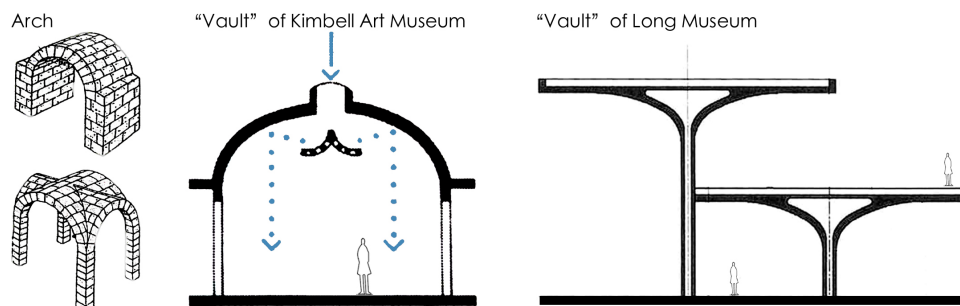


Figure 4. Analogy of arches (Source: Drawn by author)

3. Structure presented as an element

The tension between the integrity of the Long Museum and the structural elements ^[8] makes the “umbrella” displayed as a spatial element, which is similar to the phenomenon that “columns, domes, arches, and arch of wooden architecture participate in the architecture (the meaning of the term “architecture” here comes from the

Japanese word “architecture”, and Ichiro Sakamoto believes that “architecture = structure + place”) and are also appreciated at the same time“. There is order behind different fields: from the Cartesian orthogonal grid systems to the freely open plane ^[1], the flow space of the Long Museum seems to be above the plane flow, incorporating Adolf Loos’ thinking about the design of space volume. The diverse spatial transformations between the same units reduce the fluidity of space, while the free plane creates a rhythm of smooth paths and pauses.

3.1. Elements and fields

The multiple fields scattered throughout the Long Museum make it out of homogeneity ^[9]. When entering the main hall, people are separated from the lower corridor space of the coal hopper at the entrance, and the suddenly raised hall liberates people from their depressed psychology. Guided by the partition walls, they turn right and climb down to another elevated space. The scale of the steps strengthens the sense of falling in the space. The transformation of spatial volume, the displacement, rotation, and height difference between units enhance the narrative.

The importance of the field is not only reflected through the scale but also through the hierarchical organization (the overlap between the coverage space of the top unit and the main space of the bottom unit ^[10]). The higher the level of the main space is, the more units it covers and the more complex the organization is. Almost every main exhibition space is covered by two or more umbrella arches (**Figure 5**). In the horizontal division, the unit wall shapes the primary and secondary spaces at once, and the windmill plane is formed between the walls. The scale of the exhibits determines the relationship between the primary and secondary spaces, which are located at the side of the building and are half the size of the main space (**Figure 5**).

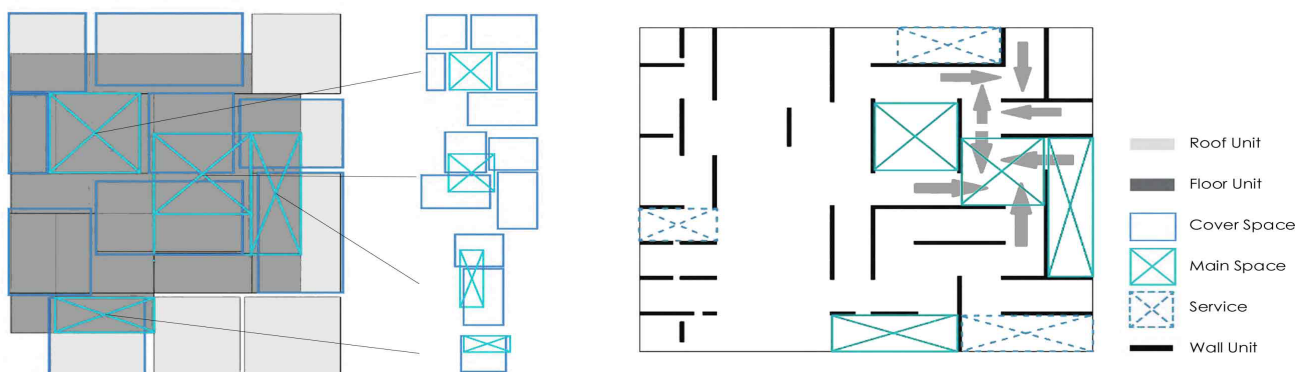


Figure 5. Left: The order of overlapping the top and bottom surfaces; Right: The order of horizontal separation (Source: Drawn by author)

3.2. Elements and order

Unit aggregation space is a way of spatial organization, and its combination reflects the order. The huge umbrella arch resembles the tree-shaped pillars of the Sagrada Familia in Catalonia ^[4], which blocks and cuts the light in the space in five ways, and different combinations introduce light in different directions into the interior (**Figure 6**). The first type is “union,” where light enters from both sides. The second type is “separation,” where the gaps between the bodies bring the top light. The third type is “lining,” where one large and one small form a staggered layer, bringing side light. The fourth type is “intersection,” where a large part and a small part are interlaced, and the light is separated by upper and lower parts. The fifth category is “stacking,” which is decomposed into four independent and homogeneous spaces. These combinations diversify the visual images and perceptual associations of the exhibition.

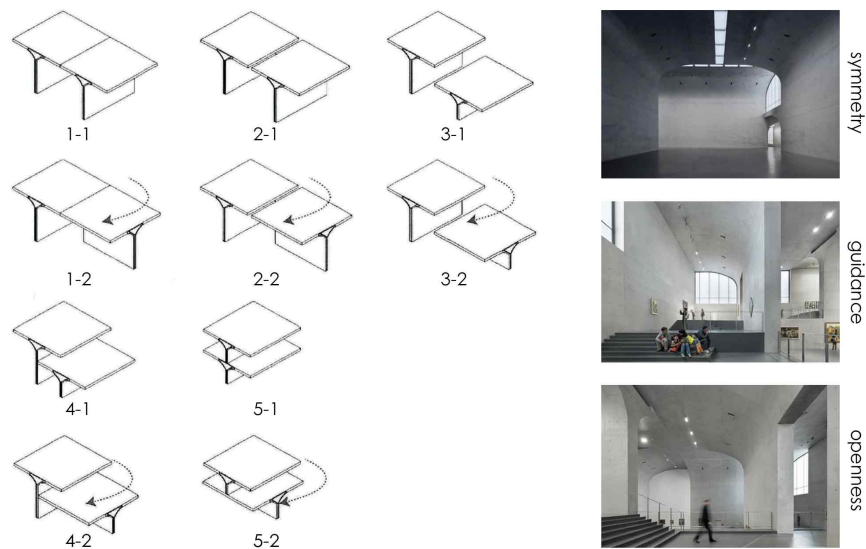


Figure 6. Combination methods and visual effects (Source: Drawn by author)

4. Structure as the meaning of liberation

“One of the intentions of the exhibition is to create indescribable and continuous surprises for everyone. If you go to a building and want to constantly walk inside, you can enjoy surprises while watching, feel at home, and life is a celebration.” —Dorsey (from an interview with Dorsey in “Art Review”)

Art museums need elements of “surprise” and “freedom,” and also need to meet the “contemplative” characteristics of the exhibition space^[9]. The integration and balance of the two have shifted the Long Museum from an artistic container to an atmosphere creation. At this time, the umbrella arch has also achieved the liberation of static perception and dynamic experience and is integrated under a large roof.

4.1. Static perception

Yichun Liu believes that “when the structure begins to associate with our body and actively adapts to the characteristics of the place, it is at that moment that it is breaking away from being solely a physical property of mechanics and entering the realm of culture”^[5]. In other words, the static perception of structure can be understood from two perspectives: the association with the body and the imprint of time.

In addition to the translation of the coal hopper bridge structure and the adaptation to the completed underground garage^[5], the umbrella-vault can evoke the imagination of the audience about the shelter, and the ventilation and temperature control system is also integrated, resulting in the association between the structure and the body. The temporal nature of the structure enhances the spatial narrative, triggering the audience’s association with the story that takes place in the specific site and scene. The scale and materialization analogy of materials reveal the spirit of the place: the umbrella-vault makes the whole space a net height of 12 m and an average span of 16 m, corresponding to the size of the coal hopper bridge with a height of 8 m and a width of 10 m, and the thickness of the vertical part reaches 800 mm, enabling the audience to connect with the industrial culture behind the site when facing the huge structure^[3]. In addition, different construction methods using the same materials are also a dialogue between reality and history.

4.2. Dynamic experience

“Viewing” and “action” are the behavioral themes of the exhibition space. In traditional exhibition space, “action”

serves “viewing.” In contemporary times, the experiential nature of “action” has become increasingly active, which is an important way to enrich the audience’s senses and stimulate enthusiasm for exploration [6]. The combination of umbrella-vault gives the dynamic experience with “surprise” and “freedom,” mainly reflected in the freedom of flow and the penetration of vision.

The exhibition space of Long Museum adopts a flowing spatial pattern composed of independent and dispersed vertical walls (Figure 7): the wandering flow line combined with the visual sense of natural light penetrating through the arboreal forms the spatial characteristics of the shuttle in the forest [1]. The penetration of vision is mainly reflected between the transportation space and the exhibition hall, as well as between the exhibition halls. The discrete umbrella-vault gradually reveals the exhibition hall on the way to the underground floor. The second-floor exhibition hall interacts with the first-floor elevated exhibition hall through the gap between the umbrella arches.

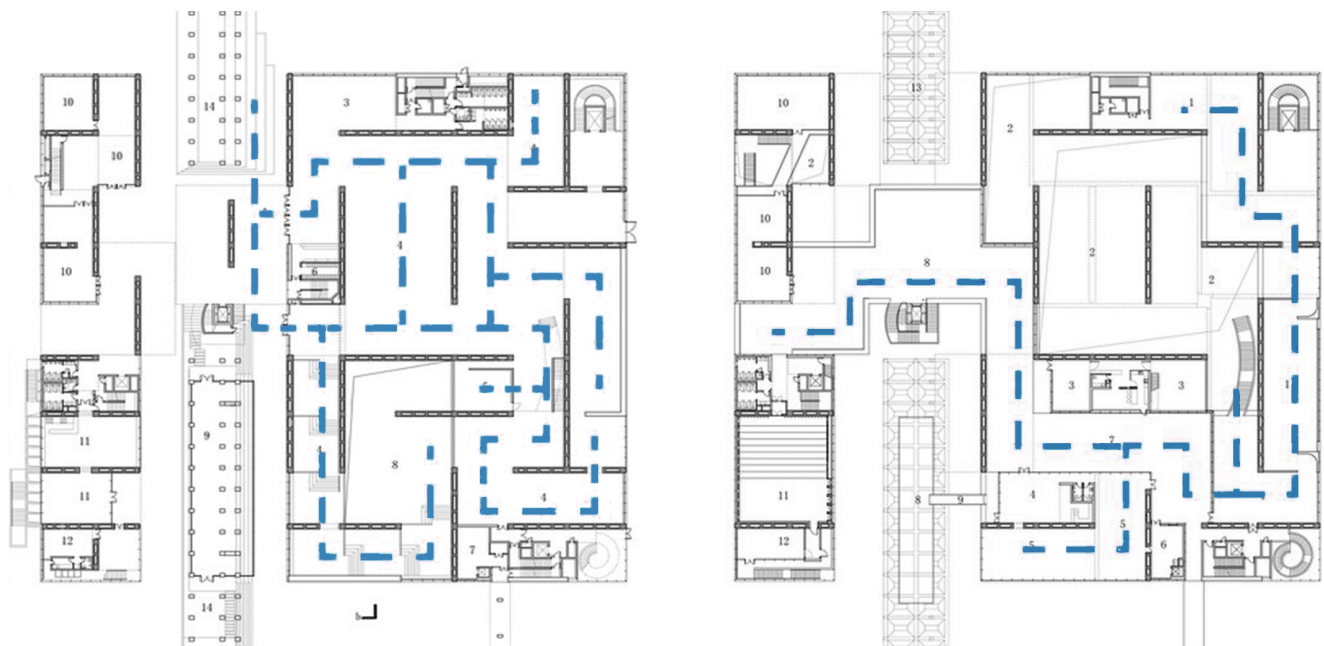


Figure 7. Left: Traffic flow on 1F; Right: Traffic flow on 2F (Source: Drawn by author)

5. Structure as an individual existence

5.1. Individuality of umbrella-vault

The “pure space” created by the umbrella-vault fully highlights its individuality (or physical properties [1]): the single material and pure light avoid excessive spatial expression elements, allowing the senses to focus on the material itself and the spatial details. By utilizing the same batch of concrete materials, it achieves pure unity in the overall tone. After pouring, the protective agent is added to reduce the color difference between walls. On the other hand, the use of colored glazed glass with fine holes, combined with the aluminum alloy mesh on the exterior wall to limit the incident hole, purifies the light and makes the overall light environment uniform and soft [6]. Analogously, the circular hole at the top of the Pantheon fixes the visual focus of the human eye in a specific position, with light exhibiting in a focused circular pattern. The Long Museum guides the moving people to observe the light of the sky through the wall. Concurrently, the reflection of the umbrella-vault unit forms a layer of “light ground,” making the audience behave more freely.

5.2 Existence of Long Museum

“For a city, “passing” an art museum is more important than “going” to an art museum.” —Keyang Tang^[11]

The combination of the Long Museum and the Binjiang Landscape Belt has made it an important focus of the “West Bund Cultural Corridor Initiative.” The “Beipiao Dock” built in 1929 also completed its transformation from a productive waterfront to a cultural public space (**Figure 8**). Liu Yichun talked about her first impression of the base in an interview with *The Architect*: “Driving from Longhua West Road and Fenggu Road perpendicular to Longteng Avenue, the view of the city, which had just been dense, suddenly widened. In the blink of an eye, we reached the edge of the river, and a huge ship lay in front of us, like a mountain. Some railway tracks and gantry cranes were preserved along the northern route, and the slopes were filled with reeds, which was quite wild”. The architect’s initial impression of the site was derived from the dramatic transition between industry and daily life^[5,12].

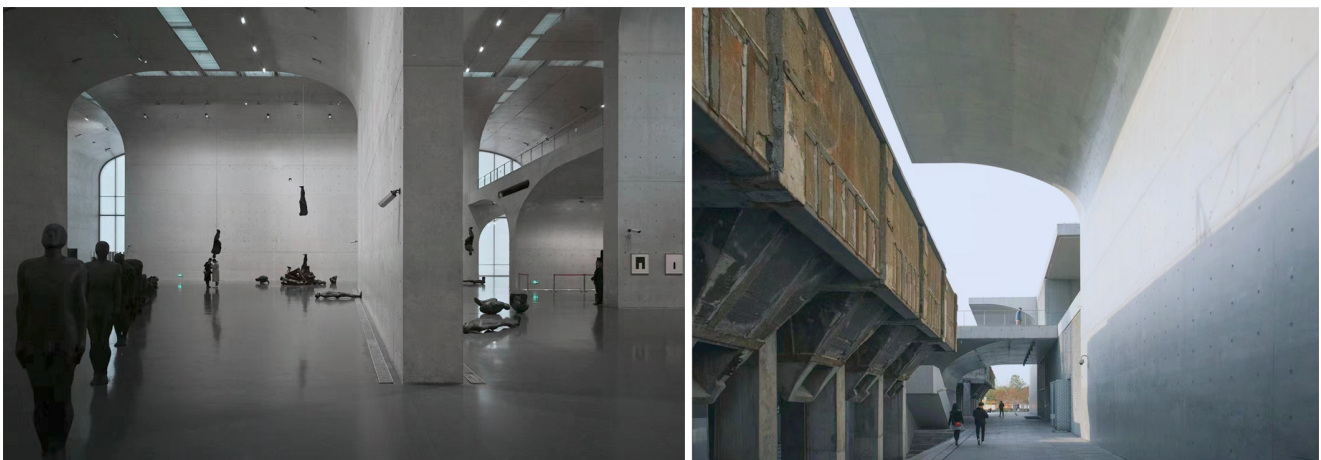


Figure 8. Left: Current situation of public space; Right: Old photos of post-industrial sites (Source: Author’s picture)

The boundary between the city streets, the landscape, as well as the almost classical unit scale, separated the Long Museum, which is only three or four kilometers away from Xujiahui, from the more “secular” city. However, through a clear, complete, and open interface, as well as a boundary space that can carry out public activities, the distance between the public and the art museum is shortened (**Figure 9**). Entering an art museum is precisely a deviation from daily life and entering a “different kind of space”^[12].

The design of the transportation routes, such as crossing the coal hopper from the intersection to the riverside, crossing the restaurant courtyard from the elevated walkway to the art museum, and entering the art museum from the south side of Longteng Avenue, has been influenced by the garden. The architects expect the public to wander, pause, or move in the venue.

“I hope that people around me can come over for lunch, and some people can buy something or take a cup of coffee and come to sit on the platform after visiting the art museum on weekends. Then the art museum truly belongs to the city” —Yichun Liu^[5]



Figure 9. Long Museum in the city (Source: Drawn by author)

6. Conclusion

From the classicism of arches and the protection of umbrellas to the order of space, the freedom of flow line, the penetration of light, and then to the spirit and physical character of places, to the art museums of cities, and the art museums of people, umbrellas in the air allow the consciousness of body to be directed towards infinite distances, maintaining the relationship between post-industrial sites and urban public spaces in a unique posture.

Disclosure statement

The author declares no conflict of interest.

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