

Research on Le Corbusier's Architectural Order -- Modulor

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Abstract: As the deep structure of architecture, architecture order can express the inherent characteristics of architecture. Le Corbusier's Modulor is his expression of architectural order. Modulor is to find a more suitable method to measure the space scale. It can quickly build nodes through geometric rules to form an artificial order beauty. From the Residence of Marseille, which was the first large-scale attempt at modulus values, to the Heidi Weber Museum, which was later combined with prefabricated buildings, the Modulor was applied in different ways in different stages of Le Corbusier's career. This article discusses and analyzes the generation and development of the Modulor, its practical application in different stages, and its development prospects.

Keywords: Modulor; Le Corbusier; Architecture Order; Residence of Marseille; Heidi Weber Museum

1. Introduction

The order of architecture is the logical relationship of architecture. Different architects express architectural order in different ways. For example, Aldo Rossi's order of architecture is "typology". He proposes it based on Jung's "archetype" theory. He believes that the essence of architecture is cultural customs, and typology was the deep structure compiled into the form of expression^[1]; Louis Kahn's understanding of order is reflected in the establishment of material order, structural order, spatial order, and node order^[2]. Structuralism architecture replaces the concept of "form" with "structure" or "order", requiring people to pay attention to the overall organization, and its components can only be understood and meaningful in the connection with the overall work^[3]. For Le Corbusier, the Modulor is his expression of architectural order.

2. Modulor

2.1 Background

Modulor was proposed with the development of the architecture field. At that time, there was a lack of an appropriate measuring tool for architectural design. In addition, the existing measuring tools all had their flaws, and the British measurement (feet, inches) and the metric system were difficult to convert, and could not serve as a unified scale system in the world. Therefore, Le Corbusier created the Modulor measuring method.

For Le Corbusier, the purpose of Modulor is to find a more suitable way to measure the space scale for humans, which can quickly build nodes through geometric rules to form an artificial order of beauty^[4]. Modulor is like a rule to help designers work efficiently, but this rule is not omnipotent. It is only a way to help designers achieve more efficient expression after having inspiration, experience, and creation.

The convenience brought by the Modular method - the beauty of artificial order, the rapid realization of expression, etc. is ingenious, but the ultimate significance of the Modular method is to explore a more suitable scale for humans, which is still in line with the Le Corbusier's humanism thought.

2.2 Concept of Modulor

In the book Modulor, Le Corbusier defined Modulor as a measuring tool generated from human body size and mathematics.

Le Corbusier's Modulor relies fully on mathematics and the human body. The 1.83 m person in Le

Corbusier's Modulor has the golden ratio points at 0.7 m, 1.13 m, 1.83 m, and 2.26 m. Among them, 182 cm is the height of the human body, 226 cm is the distance between the fingertip and the ground, and 113 cm is the distance between the navel and the ground. Le Corbusier's Modulor has two systems: red and blue. The red system is based on 113 cm, the blue system is based on 226 cm, and the number sequence of the two systems is determined according to the golden ratio. There is a multiple relationship between the two series.

3. Application of Modulor

3.1 Early Stage--Residence of Marseille

To solve the problem of housing shortage after World War II, the French government established the Department of City Planning in 1945. Raoul Dautry was responsible for the reconstruction of the country, and Le Corbusier was entrusted to build a collective apartment for the low-income people in Marseille.

Covering an area of 4 hectares, 165m long, 24m wide, and 56m high, the Residence of Marseille has 18 floors with the ground floor on stilts. The main facade faces east and west. It is a large residential complex with 337 apartments, which can meet the living needs of 1200 people. There are 15 basic components, which contain all the ways in which the apartment's internal space proportions are constructed. Each small residential space uses Modulor to control the ratio of length and width, thus controlling the spatial proportion of the entire apartment. The construction idea of the architectural space of the Residence of Marseille fully confirms the principle proposed by Le Corbusier: "In order to create an urban framework, it is necessary to determine an exact proportion of a unit neighborhood... In essence, each organic organization is proportional in size to its environment."^[5]

3.1.1 Size of the Overall Form

The control of the overall form of Residence of Marseille reflects Modulor. The stilts of the cylindrical base lift the nursery, making the roof platform accessible to people, which is in line with Le Corbusier's five principles of the new architecture. The width of the beam in the bottom pillar structure is the Modulor size of the blue system, which is 33cm, and the spacing between the beams is 140cm. The height of the column is 534.5cm, which does not belong to the red system or the blue system but is the closest to the 534cm of the blue system.

For the size of each small room, Le Corbusier used parts of the Modulor values. The primary starting point of the numerical value of spatial scale is to combine the scientific nature of ergonomics.

3.1.2 Size of the Interior Furnishings

The interior of Residence of Marseille takes full account of the use requirements and greatly saves indoor space on the premise of achieving basic functions. The concept of Modulor is widely adopted in each small space with a height of 226cm and a width of 366cm. The size of the double doors in the indoor space is 113 cm of the red system, the size of the bathroom cabinet is 140 cm and 113 cm, and the height of the bar is 296 cm.[1] One of the walls has the storage function, and the partition and other components are embedded in the wall. The numerical values conform to the human body dimension through Modulor, and the partition of its storage partition fully uses the value of the blue system and red system.

Residence of Marseille is the embodiment of Le Corbusier's first large-scale attempt at Modulor. He uses more Modulor values in the dimensions of the room (such as interior furnishings), but when it comes to the larger dimensions of the external architecture, such as the width and length of the occupied area of Residence of Marseille, the application of Modulor is less. For large spaces that are not directly used by people, their size will not directly affect people's comfort, nor will they reflect the "body" of the Modulor, so the application of Modulor no longer makes sense. For this situation, the tool offered by Le Corbusier is the golden ratio generated by Modulor. For example, the facade of the Residence of Marseille is horizontally divided into two sections by the outer wall of the staircase, and the solid building above the suspended floor is vertically divided into two parts by the sky commercial street.

3.2 Later Stage-- Heidi Weber Museum

Heidi Weber Museum (the Centre Le Corbusier, Zurich) is a representative of the late period of Le Corbusier's Modulor. During this period, it developed into simple data, and the standards for data selection became more flexible.

The most classic use of Modulor at the Heidi Weber Museum is the "226cm×226cm×226cm" system. The arrangement is like "basic building blocks" assembled according to a certain rule, and the net distance between the "cross" columns of these assembled "basic building blocks" is 226cm in the Modulor system.

At this stage, Le Corbusier's application of Modulor was connected with this kind of regular prefabricated building. In my opinion, the initial role of Modulor (the efficient tool for measuring building scale) is reflected less and less in this period, and choosing 226cm is more like using an inertia value. Heidi Weber Museum is a concentrated embodiment of the assembly meaning of Modulor system.^[6]

In the main part of the building, the scale of the application of the Modulor data continues to decrease. The involvement of steel structure and steel material provides new opportunities for prefabricated assembly construction and space diversity. Le Corbusier's structural form has stepped forward. The use of the Modulor in the late period is connected with prefabricated buildings, but the significance of Modulor to prefabricated buildings can be further discussed.

4. Insights into Modulor

The proposal of the Modulor reflects Le Corbusier's desire for a unified standard when he reached a certain level in the field of architecture design, painting, sculpture, etc. However, in the process of examining the current status and details of the development of the use of Modulor, there are still some unclear points. First, the causes of its emergence are not clear enough. As it is difficult to convert between the British measurement and the metric system, efforts have been made to find a way to solve this problem, but Modulor did not solve this problem. The fact is that the value of the red and blue systems need to be calculated by the golden ratio, which is complicated and even obscure. Secondly, in the later period, Le Corbusier did not use the data of Modulor as precisely as he had done before. Thus the values became meaningless. This phenomenon is related to the usage habits since Modulor was proposed. Since the establishment of Modulor standard, not all dimensions have been used equally. Some data have been used frequently, but some data have hardly been used. In addition, Le Corbusier also processed the data in the actual operation process. Since Modulor is not easy to control in some scenarios, some modified data were produced. For example, in the Convent of La Tourette, the distance of the columns outside the floor of the activity area was rounded, from 226cm to 220cm.

5. Summary

Undoubtedly, Modulor is a great attempt to achieve order and standardization for design. A series of classic and ever-lasting architectures, such as the Residence of Marseille, La Chapelle de Ronchamp, and Heidi Weber Museum, have emerged under the influence of Modulor. The traces of the Modulor can be found in many of Le Corbusier's architectural designs.

The Modulor values are no longer directly applied in current architectural practice, and it is difficult to find examples of building design based on them now. Modulor is like a brilliant star traversing the long history. Once mysterious and worshipped by many, however, its significance in the field of architectural design today remains to be discussed.

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