

Sun Simiao Memorial Hall Engineering Project: Architectural Oath of Traditional Chinese Medicine

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Abstract: Sun Simiao Memorial Hall is the largest monomer pseudo-classic reinforced concrete roofing architecture with gable and hip roof designed by Yeong Studio in Tongchuan, Shaanxi province. It has won the Chinese National quality Engineering Award in 2019. As one of the landmark buildings in King Of Medicine Mountain cultural scenic spot, its completion is conducive to the protection of historical heritage resources of King of Medicine Sun Simiao, the in-depth excavation of King of Medicine cultural resources, the promotion and inheritance of medical skills, medical morals and medical spirits of King of Medicine Sun Simiao, and the revitalization of King of Medicine Sun Simiao traditional Chinese medicine culture. Its completion is helpful for Tongchuan to establish the “King of Medicine” brand, vigorously develop industries such as traditional Chinese medicine, life cultivation and health preservation, and leisure tourism by virtue of King of Medicine culture, and promote Tongchuan transforms to a resource-based city. This essay will mainly introduce the technical difficulties, creative expansion concrete technology solutions, the architectural features, the Structural features, the water supply and drainage features, the Electrical design features and the HVAC features of the project.

Keywords: Sun simiao memorial hall; Yeong studio; King of medicine; Monomer pseudo-classic reinforced concrete roofing; Expansion concrete technology

1. Introduction

Sun Simiao Memorial Hall, designed by Chinese famous architect Zhang Ning and members of his Yeong Studio in Shaanxi Province. It is a newly-built history museum located in 300 meters west of the core scenic spot of King of Medicine Mountain with a total investment of 189 million yuan. Based on the geological conditions of the mountain, the memorial hall houses make full use of the terrain to build a terraced building with two floors aboveground and one floor underground, and with a total building area of about 15,000 square meters. According to different functions, the memorial hall is divided into three functional areas, including the exhibition area with a total building area of about 7,800 square meters and a total exhibition line length of 753.629 meters, displaying 221 pieces of exhibits that mainly exhibit the life story, medical works and academic contributions of the King of Medicine Sun Simiao, as well as the development course of Chinese traditional medicine culture; the business complex area covers a building area of 2,300 square meters, which mainly provides related supporting services, including warehouses, business research rooms and administrative rooms; in terms of equipment and parking area, its building area is about

4,800 square meters, mainly including underground parking garage, equipment rooms and business rooms.



Figure 1. Bird view of sun simiao museum

2. Analysis of Technical Difficulties and Solutions

2.1. Analysis of technical difficulties

There were mainly four aspects of difficulties urge to solve [1]. First, expansion concrete technology adopted to solve the structural problem of large roof of traditional form innovatively. Second, the project has built the largest monomer pseudo-classic reinforced concrete

roofing architecture with gable and hip roof in Shaanxi province at present. Third, in terms of the exterior wall of the architecture, the loess in Sunyuan Town, the hometown of King of Medicine, is used to independently develop rammed-earth bricks for building the wall. Fourth, a great number of oblique glass curtain walls are used to enrich indoor lighting.

2.2. Analysis of construction difficulties and solutions

The roof adopts 24m-span pinnacle door structure with a clearance height of 23.95 m, all beams and slabs are curve surface structure with a maximum outer cantilever of 8.40 m, the maximum cross section of the structural beam is 450×1800 mm, and the architecture is a domestically rare complex four-pitched pseudo-classic reinforced concrete roofing with long span, super length and super height, so the construction is quite difficult [2].

The large section beam of reinforced concrete long-span door structure on the roof is consolidated with truss-type bracing technique at the beam bottom to enhance the bearing capacity and stability of the frame. For the four-pitched inclined roof with an expanded area of more than 7,800 square meters and a concrete volume of more than 3,500 cubic meters, the four-pitched symmetrical casting method is adopted to ensure the safety of concrete casting on the roof, and the concrete components after molding can meet the design and specification requirements through inspection.



Figure 2. Roof beam model drawing



Figure 3. Cast-in-place appearance of roof beam

The inclination angles of the back taper hetero-morphism glass curtain wall under the cornice in the

north-south and east-west directions are different with the height difference between the top and the angle opening is 2cm, the angles intersect in a line at the up-turned roof-ridge, and the vertical imitation rafter frame of the glass curtain wall is a spatial twist structure at the upturned roof-ridge, so the spatial positioning and installation are quite difficult [3, 4].

In the construction of the back taper hetero-morphism glass curtain wall of 2,385 square meters, the BIM Technology is used for the secondary in-depth design, for the BIM model can be combined with the site space positioning to ensure the accuracy of the spatial position relationship of the components to meet the design requirements.

There is no such kind of material for the raw soil block, so the construction technology needs to be repeatedly studied and developed according to the design requirements, and there is also no construction experience for reference for the masonry of the dislocation backward inclined raw soil block decorative wall, so the design and construction are domestic initiatives [5].

After many experiments by the design and material production units and practical verification by the project department, the raw material ratio of raw soil blocks and the dislocation backward inclined masonry technology are finally determined, and a group company level scientific research achievement, that is, Research and Application of Construction Technology for Dislocation Backward Inclined Decorative Wall of Raw Soil Block, is formed.



Figure 4. Raw soil decorative block



Figure 5. Decorative wall made of raw soil block

3. Architectural Design Features

Sun Simiao memorial hall is situated in the due west of the new Mountain Gate of King of Medicine Mountain, backed by King of Medicine Mountain, facing the junction of Juhe River and Qishuihe river. It adopts the traditional Chinese hipped roof with gable and hip roof to solve the problem of building structure and equipment by virtue of new technology. In the architectural design, the non-structural decorative components of “antique” architecture are abandoned, and it is a modern architecture which inherits the traditional construction cultural context and applies innovative design and construction methods to the maximum extent [6]. The memorial hall covers a total area of 15,000 square meters, of which the exhibition hall covers 6,800 square meters; the roof is 135 meters long and 50 meters wide; the structural beam supporting the roof is 7.6 meters out.

The architecture adopts the pattern of single bay on the surface and seven bays in the dark, and the seven bays in the dark metaphor that Sun Simiao’s achievements are actually qualified for the regulation of “King” level; on the surface, with a single bay like a folk house and with the “wordless monument” of the architecture, Sun Simiao’s decency of not seeking power and fame is praised. Similarly, the roof tiles of the architecture adopt tiles of Tang Dynasty style of the same period, that is, wide raised tiles, round imbricated tiles, and the diameter of imbricated tile’s eaves tile is seven Tang inches (about 20 cm), which is also the scale of “King” grade; as for the main wall, modify the loess around Sunyuan Town with new technology, tamp it into a kind of brick, use the brick as the exterior wall of the memorial hall.

The general layout of Sun Simiao Memorial Hall building complex is in the shape of “品” in Chinese character. It takes the watch tower as the door to praises Sun Simiao’s achievements and takes the three-level Sumeru seat as the base to show the rank. The large roof covers the platform base and the skyline echoes the mountain shape, while the low-lying roof exactly represents the self-confidence and humility of King of Medicine who didn’t eagerly pursue fame when he was alive. Ascending the stairs step by step, the architecture is getting larger and larger, and the width of the grand architecture volume has reached the visual maximal limit of panoramic observation from a single angle; the oblique glass curtain wall under the cornice vaguely reflects the surrounding light, and the reflected the light that is not so strong is projected onto the square, forming a subtle “light field”. It shows the admiration for the of King of Medicine Sun Simiao through architecture. Approaching the architecture, the “medicine boxes” on both sides of the gate will be found. It refers to Sun Simiao who inherited the achievements of Zhang Zhongjing in Han Dynasty and physicians of successive dynasties. The design

finally made TCM and Chinese medicine form a relatively complete system, highly praising that he is the founder of a complete traditional Chinese medicine system that passed on for thousands of years.

4. Structural Design Features

The memorial hall is an antique pitched roof architecture with a cornice elevation of about 12.6 m and a roof height of about 26.2 m. The overall dimension of the axis net is about 33.6x120 m, and the external dimension of the roof is about 49.97x135.31 m. The horizontal direction of the architecture is quite long, and because it is not suitable to have parting due to architecture functions, the seamless design and construction technology of super long structure are adopted.

As a whole, the cast-in-place reinforced concrete frame structure is adopted, and at 7.8m elevation, many big holes are punched, taking into account the building craft streamline and the space effect; the roof is a four pitched antique roof, the partial middle frame columns are removed, and the overhanging double-height columns are only connected with the pitched roof, which satisfies the craft and space requirements of the museum. The floor adopts the cast-in-place multi-ribbed floor system, which makes the architecture, structure and mechanical and electrical equipment in a perfect combination; the beam of the pitched roof adopts the regular herringbone beam to realize the transparent interior space and the elegant big cantilever eaves. The architecture’s beauty of flexibility is organically combined with the structure’s beauty of heaviness and simplicity.

The site belongs to a self-weight collapsible site; the foundation of the memorial hall has a collapsible grade of IV refers to extremely serious, and the foundation treatment adopts lime soil compaction pile.



Figure 6. The cast-in-place reinforced concrete frame



Figure 7. The cast-in-place reinforced concrete frame

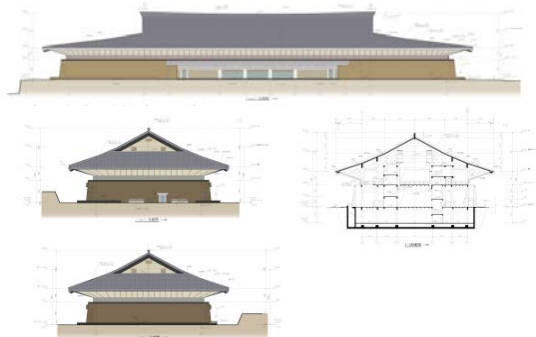


Figure 8. Integral frame structure

For the overlength issue and the part with relatively large punched holes of the project, following strengthening measures shall be taken: In the super long direction, the expansion strengthening post-pouring belt is set; the long-direction reinforcement ratio of floor slab (exterior wall) and the long-direction beam side waist reinforcement ratio are increased; the high-efficiency crack resistant expansion agent is added to the concrete, and the expansion strengthening belt is set; higher requirements are put forward for the construction. The floor slab is equipped with double-layer two-way tension reinforcement; the thickness of the girth sheets of large holes is thickened; the four corners of holes are equipped with oblique anti-crack reinforcement.

5. HVAC Design Features

The exhibition hall takes the ground source heat pump as the cold and heat source and utilizes the soil insulation performance to conduct a heat exchange between soil and water, which fully makes use of the natural energy.

Indoor air conditioning system adopts floor radiation cooling and heating system to reduce the load of cooling and heating by 20% to 30%.

The second floor of the exhibition hall adopts the replacement air supply system to ensure the comfort of the area where people stay, so as to save energy.

The fresh air system adopts the exhaust air condensation heat recovery fresh air handling unit, which takes advantage of the cold heat recovered from the exhaust air to make the fresh air meet the indoor design requirements.

6. Conclusion

The completion of the Sun Simiao Memorial Hall project contributes to the strengthening of the construc-

tion of public cultural service facilities in local, the all-sided demonstration of life story of King of Medicine Sun Simiao to the public, the research and learning of Sun Simiao's exquisite knowledge and technology of traditional Chinese medicine, the revelation and learning of his noble medical morals and medical style, the promotion and learning of Sun Simiao's way of keeping good health, the acceleration of the healthy development of traditional Chinese medicine cause, and the improvement of people's spiritual civilization and health level. At the same time, we will further promote the construction of King of Medicine Mountain cultural scenic spot, expand the tourism pattern of King of Medicine Mountain scenic spot, improve the scenic spot quality, form a regional space with equal emphasis on comprehensive service and cultural theme sightseeing, enrich tourism experience projects, enlarge tourism consumption categories and highlight tourism characteristics, so as to promote the creation of King of Medicine Mountain as a nationally-known leisure health-preservation scenic spot, facilitate the rapid development of Tongchuan's cultural tourism industry and the construction of "Four Tongchuan", and make Tongchuan become an important window and tourist reception base for the inheritance and display of King of Medicine Sun Simiao traditional Chinese medicine culture, as well as an important host city of China's Sun Simiao Traditional Chinese Medicine Culture Festival.

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