[1]Ruting Ma
[2,*]Ruozhu Wang
[3]Donglei Ju
[4]Yongmei Qian
[5]Wei Tian
[6]Yujie Jin

# Analysis Based on Intelligent Model about Intelligent Integrated Design of Additional Building Components and Solar Heat Collection Facilities for Offshore Residences

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***Abstract:*** - Using an intelligent model, this paper explores the incorporation of supplementary components in offshore buildings and their utilization within offshore residences. Additionally, it investigates the intelligent integration of solar heat collection systems with residential structures. Based on this computer intelligent method, by the building the 3D model, the potential impacts of additional components of offshore residential buildings on heat collection facilities are analyzed and the means for expanding the usage of additional components by the intelligent integrated design with heat collection facilities are explored. By conducting surveys and studying existing buildings, we analyze practical issues and propose viable solutions through integration with architectural design. This procedure lays down a solid theoretical groundwork to propel the intelligent amalgamation of solar water heaters with residential buildings situated offshore.The computer intelligent method discussed in the paper will enhance the analytical approach and efficiency for evaluating intelligent integrated building designs.

***Keywords:*** Intelligent Model (IM), Offshore Residences(OR), Additional Building Components(ABC), Computer Intelligent Method(CIM), Solar Energy(SE), Heat Collection Facilities(HCF), Intelligent Integrated Design (IID).

## I. INTRODUCTION

Offshore areas usually have relatively rich solar energy resources, with annual radiation greater than 4500 MJ/m$^2$ [1]. Since the beginning of the new century, the applications of solar water heaters are attracting more attention and are gradually strengthening in offshore areas. In general, solar water heater applications have three stages, from passive acceptance to simple superposition, and then to intelligent integrated design with buildings. The passive acceptance stage refers to the government and real estate developers passively accepting the spontaneous installation of solar water heaters by users. However, these without order installations bring problems soon after, such as affecting the appearance of the water heater[2], destruction of the original structure[3], damage to the insulation[4] and waterproofing and leave a certain hidden danger to safety [5]. In response to these problems, the government began to adopt policies and corresponding technical regulations, and designers and real estate developers gradually launched the engineering operation. Hence, the initial idea of integrating solar water heaters with buildings was conceived, leading to the development of intelligent integrated design advancing to its second phase, known as the stage of basic overlay[6].Later, through consultations with solar developers, real estate developers began designing solar products with a modular mechanism[7]. As a result, solar water heaters have overcome technical and structural problems and could be perfectly integrated into buildings. Since then, designers have also begun to explore synchronous design, synchronous construction and comprehensive management of buildings and solar water heaters[8]. At the same time, into the related technology of computer intelligent design, in recent years, in the architectural design into intelligent design method is the computer application 3D technology software[9], BIM software[10] and architectural design of new design means[11], can quickly and effectively solve the design speed, design effect and various professional cooperation, effective way to avoid design conflict[12].

The seamless integration of solar water heaters with buildings has successfully progressed through the initial three stages, only requiring the final phase to fully integrate into the building components[13]. People not only need solar water heaters to meet their demands for water heating, but also to beautify buildings and computer intelligent design method. Thus, solar water heaters can become the language of architectural design and an indispensable part of residential buildings [14], at the same time, the design will come into the era of

[1] Xi'an University of Architecture and Technology, Xi'an, ShanXi, China; Jilin Jianzhu University, Changchun, Jilin, China
[2] Jilin Jianzhu University, Changchun, Jilin, China
[3] Jilin Jianzhu University, Changchun, Jilin, China
[4] Jilin Jianzhu University, Changchun, Jilin, China
[5] Jilin Jianzhu University, Changchun, Jilin, China
[6] Jilin Jianzhu University, Changchun, Jilin, China
*Corresponding author: Ruozhu Wang

intelligence[15]. Investigating the potential functionalities of a solar water heater and refining its construction techniques represent the crucial step in the ongoing development of it[16].

At present, residential areas commonly employ solar water heaters, including residential villas, low-rise housing, multi-storey buildings, small high-rise buildings, and high-rise buildings. Positions for their integration include a wall, a balcony and a rooftop. Types of residential districts range from high-grade communities in large cities to residential communities in small counties. In general, the intelligent integrated design of solar water heaters and residential structures has made great progress over the past decade, especially in terms of the quality and aesthetics of the solar water heaters [17]. The thermal efficiency and life span of solar water heaters have been significantly improved, making solar water heaters more acceptable to the public. Moreover, new materials and technical practices have also addressed some of the side effects of solar water heaters on the original building structure during integration. However, solar heat collection facilities continue to have a negative impact on the aesthetics of buildings when integrated into residential buildings. After solar heat collection facilities are integrated into residential buildings, the original order of the building facade cannot be maintained, let alone how to achieve an aesthetic appearance [18]. In this paper, focusing on the commonly used additional components in residential buildings (e.g., the position grilles of air conditioner external units, suspended plates on top of buildings, shutters, etc.), we investigated the potential impacts of additional components of the offshore residential buildings on heat collection facilities and means for expanding the use of additional components by intelligent integrated design with heat collection facilities, which well realizes the intelligent integrated design of solar water heaters with buildings.

## II. Methods of Building Model and Design

This section mainly introduces the methods of intelligent modeling and intelligent integrated design using computer software. It mainly includes the steps of software modeling and several intelligent design methods.

### *A. Using Computer Software for Intelligent Modeling*

The architectural design must first build the plane, elevation, section design according to the design requirements, the concept of integrated design, and need to achieve the purpose of intelligent modeling, through professional computer software modeling, make the effect of facade to be real, at the same time, according to the requirements, the parameters can be modified at any time, form a new effect of facade, until integration design effect to be satisfactory of owner. Otherwise, because it involves the coordination and coordination of solar collector, pipelines and components and building components, the three-dimensional modeling can be realized through BIM software, and the relevant parameters can be modified to achieve the best matching effect of building and equipment. In this process, the advantages of computer software can be fully played, and the integrated design goal can be completed quickly, reasonably and with high quality.

### *B. Intelligent Integrated Design of Position Grilles of Air Conditioner External Units and Heat Collection Facilities in Buildings*

The invention of air conditioners has greatly improved the living environment of residential buildings so that residents can change the indoor temperature and humidity according to their preferences. Therefore, air conditioning has become a necessary household appliance for most families [19]. Thus, the residential design evolves in tandem with contemporary needs, considering the placement of external air conditioner units. The most common practice is to design small platforms between two rooms on which the air conditioner external units can be placed, and in the meantime to install handrails to protect the external units. With the gradual improvement of air conditioning technology, various brands of air conditioners have appeared on the market. To reduce the effects of different colors and dimensions of air conditioners on the architectural appearance, designers developed the grille structure to conceal the external units. This design solution does not affect the efficiency of the air conditioner and ensures the integrity of architectural modeling.

However, this design has not achieved a good effect in offshore areas. The main reasons can be attributed to windy weather and suitable indoor temperature in offshore areas. In this case, it is difficult for air conditioners to play their role. As a result, many families choose not to install air conditioners. Even if air conditioners are installed, they are installed only in the living room, which is a relatively open space. Given this circumstance, many designers have designed only air conditioner external units that are reserved for the living room. Yet, users may encounter issues when installing air conditioners in different rooms, such as finding that the distance between the external units and the designated positions for the living room's is either too large or the space available for the living room's external units is insufficient. Consequently, the external units for air conditioners

of other rooms can only be installed on the external wall of the room. Such work not only leads to a loss of protection of the external units, but also produces a poor visual effect (as shown in Figure 1).

(a)detail of elavation (b)elavation of project

Figure 1: Air Conditioner External Unit Positions in Two Communities

The problems of air conditioner external units in offshore areas can generally be summarized in two aspects. One is that the position are idle and are not used; the second is that the number of it is not sufficient, which leads to the random placement. According to the current degree of dependence of people on air conditioners they are bound to become a necessary household appliance in every household, so there is no need to worry about the first problem. As for the second problem, it can be perfectly solved by designing the grille-type positions for air conditioner external units. The number and positions of external units can be well designed according to the number of rooms, and then the external units can be arranged neatly. The existence of grilles can effectively cover the external units and weaken the effects of different colors of external units on the overall order of buildings. At the same time, aligning air conditioner units in a row can add rhythm and variety to residential building styles, regardless of protrusion or recession.

The texture of vacuum tubular heat collection equipment closely resembles that of air conditioner grilles, suggesting that vacuum tubular heat collectors could serve as substitutes or derivatives of air conditioner grilles. The intelligent integrated design of vacuum tubular heat collection equipment and air conditioner external unit positions not only favors the layout design of air conditioner external unit positions at an early stage of the project, but can organically infuse heating equipment into buildings, making these two additional components part of buildings.

### *C. Intelligent Integrated Design of Suspended Plates on Top of Buildings and Heat Collection Facilities in Buildings*

The appearance of suspended plates is mainly the result of the rise of modern and simple style houses [20]. With the rise in popularity of European-style and classical-style residences in China, designers actively searched for innovative design strategies to increase their mass appeal. The minimalist style, characterized by its distinct lack of architraves and diverse color palettes, swiftly emerged as the latest trend among designers. Consequently, numerous minimalist-style homes started to populate major cities. The suspended plates on the top of the buildings play a decorative role in the architectural modeling effect and have a sunshade function in buildings with a roof garden. The suspended plates are mostly made of light metal materials with a small load, so they require a lower load-bearing capacity of the roof, which can be satisfied by most residences. In addition to the decorative function, the suspended plates can also be used for shading the roof of the machine room. Therefore, they are often found in lower buildings (as shown in Figure 2).

(a)The project of tall building (b)The project of multil building (c)The project of quinta

Figure 2: Suspended Plates on the Top of Buildings in Two Communities

Metal materials are the best choice for suspended plates, but if they are not well protected by appropriate measures, they will rust due to rain. Rust not only contaminates the suspended plates, but also drips from them and contaminates the lower wall. Wooden suspended plates are light and have a good texture, but they often cause hidden safety hazards due to corrosion problems. Although reinforced concrete suspended plates are not easy to damage, their own load is high, which causes unnecessary bearing for the roof. Therefore, reinforced

concrete is not the best choice for suspended plates. To summarize, for the suspended plate materials, it is appropriate to choose light metals with a good rust prevention effect, which not only have a good visual effect, but also reduce the load pressure of the roof layer.

The gridding effect of vacuum tubular heat collection equipment can be combined with the design of suspended plates to avoid the inconvenient use of the suspended plates only as decorative components. The thickness of vacuum tubes and suspended plates, as well as their spacing can be coordinated by the building itself, thus achieving consistency of design styles.

### *D. Intelligent Integrated Design of Shutters and Heat Collection Facilities in Buildings*

Modern shutters originate from the United States and are designed to reflect direct sunlight through wooden window sashes that can be opened and closed freely. Later, this technology was extended to Europe. At that time, European villas did not master the beam structure technology and still relied on thick walls for carrying loads, which had only small open-window sizes. After that, some European artisans discovered that wooden grille boards can reduce the heavy feeling brought by the too small open-window sizes, so they widely adopted this type of architectural components in residences. Only after the extensive application of steel structures in the 19$^{th}$ century, the walls were freed from the supporting structure and the open-window area gradually increased. Despite that, the shutters were still installed on both sides of the window, which became a symbol of high-grade residences.

After the spread of villa culture to China, a large number of villas began to be built. At that time, the material and cultural demand of the Chinese was not great and most of them longed for a better life as in the West. Chinese designers at the time caught the lack of vanity of the Chinese people and literally copied the outlines of some Western-style villas to satisfy the vanity of most consumers. Thus, the "shutter culture" was also lost in the "plagiarism movement". Fortunately, with rapid economic growth and the surge of people's material and cultural needs, the Chinese are no longer satisfied with the form of Western-style villas. In response, designers are also beginning to learn about the design of Western-style villas and foreign-style houses, and the shutter element has been re-added to the design of high-grade residences (as shown in Figure 3).

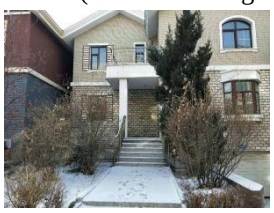

Figure 3: Shutters of Two Villa Residences

In the contemporary age of advanced era, shutters have largely relinquished their traditional function, with people turning to automated venetian blinds for controlling indoor lighting. These blinds are not only easy to operate but also offer safety benefits, making them a suitable replacement for shutters that meets all technical criteria. However, despite their diminished functionality, shutters persist as a symbolic element in modern villas. This observation is supported by interviews with numerous non-architect residents, who commonly associate villas with pitched roofs, spiral staircases, and shutters, emphasizing the enduring symbolic significance of shutters despite their evolution.

Ultimately, redundant elements will be phased out of modern buildings. As a result, the intelligent systems and shutters becomes feasible. The striking resemblance between vacuum tubular heat collection equipment and shutters enables their placement on both sides of high-end residential windows, effectively serving as functional shutters. This inventive design not only maintains the significance of shutters in luxury residences but also fulfills the additional function of heat collection.

## III. CONCLUSIONS

Our study indicates that, based on intelligent model analysis, the commonly used additional components for residential buildings, including grilles of air conditioner external unit positions, suspended plates on top of buildings and shutters, are indispensable parts in the design of residential buildings. Through intelligent integrated design, the above-mentioned additional components for residential buildings can be organically combined with the installation of solar heat collection facilities, which not only completes building design ideas but also meets the functional requirements of using solar energy in buildings. This intelligent integrated design can be considered a perfect combination of modern buildings and green buildings.

Non-standard installation, caused by the lack of precise early design, hinders to some extent the integrated development of solar water heaters in China. In this regard, solar water heaters can be viewed as an architectural design language, and their appearance, structure and use mode should be considered from the beginning of architectural design. This aspect is pivotal in driving forward the integration of solar water heaters into buildings, promoting a seamless and visually appealing blending of these technologies in China.

This paper analyzed the intelligent integrated design of solar water heaters and additional components of residential buildings in offshore areas from the design point of view. As a type of architectural design language, solar water heaters could be infused into residential buildings to become one of the building components. It is believed that our work has a positive practical significance for the intelligent integrated design and offshore residential buildings in China.

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