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Green Building and Information Model Construction

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Abstract

Building Information Modeling (BIM) provides a new design method and new career direction—architectural planning. Building planners generally propose project components and overall ideas based on project proposals and basic design information including: space requirements, space scale, space combination, usage, environmental protection, structural modeling, equipment systems, construction area, project investment, and construction cycle—a complete implementation of the project plan, to provide a basis for further green building energy conservation development design.

Subject Areas

Civil Engineering

Keywords

BIM, Green Building

1. What Is Sustainable (Green) Construction?

As an extended metabolic mode, the city imports various resources (land, water, food, energy, building materials, etc.) from the outside world through its own internal operational mechanisms (traffic, economic, and cultural, etc.). While creating a variety of livability (such as health, employment, income, education, housing, leisure, etc.), it also outputs a large number of negative effects (such as waste, air pollution, noise and greenhouse gases, etc.) (Newmen and Kenworthy), 1999; Kostas P. Bithas, 2006). Therefore, sustainable cities should be to minimize the input of resources and create their own efficient operating mechanisms, on the one hand, to maximize livability, and on the other hand, to minimize negative output. And architecture is the most basic unit that makes up the

city.

When "sustainable development" has become a global strategy for the coordinated development of humans and nature, green buildings have also become an inevitable trend in the development of the construction industry, and the evaluation of green buildings is a key issue in the development of green buildings. Green building is a new architectural concept put forward today when environmental problems are increasingly serious. It seeks to build a living space where individuals, buildings, and the environment live in harmony. Actively developing green buildings is a major development direction for China's construction industry to change the past high energy consumption and high pollution development methods and complete the transformation and upgrading of the industry. Green building evaluation is an important measure to evaluate the "green" performance of buildings and ensure the quality of them.

Cases of Green Building

1) Burkina Faso, one of the poorest countries in the world, is located in Gando on the southern plains of the country, about 200 kilometers from the country's capital Ouagadougou. It has about 3000 residents, but it does not have any secondary education institutions. This project will bring a modern middle school to Gando's local rural residents and provide them with better educational conditions (See **Figure 1**).

Climatic conditions in Gando are complex and harsh, with temperatures often exceeding 40 degrees Celsius in summer, and the school's diversified design philosophy has fully taken these external factors into consideration. Numerous design elements enhance the cooling effect of natural ventilation systems, such as the laying of underground ventilation ducts, planting of vegetation, and the unique facade design complemented by a double roof. The entire design allows the building unit to achieve an indoor cooling effect of 5 degrees Celsius. A more comfortable indoor environment will significantly improve the quality of education. Due to energy requirements during construction and after completion of investment, it is powered by solar energy and wind energy, so the school's energy consumption has also been kept to a minimum. As the saying goes, "spring rain is more expensive than oil", and local rainwater with scarce rainfall is even more precious. Therefore, rainwater recycling, as an indispensable aid to planting vegetation, has also been integrated into the overall considerations of vegetation planting. At the same time, in order to repair overexplored forest resources, the recovered rainwater will also be used to water newly planted seedlings. The completed construction projects include a primary school and a library to help study design concepts, technologies, and materials science.

2) Extensions of Tipu Sultan Merkez (TSM) are still under construction. The new school will be an organic combination of traditional architectural techniques and new technologies. Not only does it add a unique touch to the local architectural style, but this new architectural technology that combines traditional building methods is also highly potential for widespread promotion in

underdeveloped countries (See **Figure 2**).

3) Education is an indispensable foundation for promoting sustainable development. This project utilizes local resources to develop and build school infrastructure, and further develops local schools to serve learning centers of all ages. Here, lifestyles conducive to sustainable development are being put into practical use—the efficient use of energy, the use of renewable energy, rainwater recovery and local food production are all part of this project (See **Figure 3**).

2. Research on Green Architecture Design Method

1) Parabolic Solar Collector: A parabolic collector, also known as a parabolic trough collector, is a line-focus collector that collects solar radiation energy through a trough-shaped reflector with a parabolic cross-section. The research and application of parabolic collectors in our country was earlier, and because of its simple processing and low manufacturing cost, it has been widely used. At present, it has a good prospect for development (**Figure 4**).

2) Sun room is also called a glass room. Foreign name: winter garden. The Sun Room is a non-traditional building constructed of glass and metal frames to achieve the purpose of enjoying the sun and getting close to nature. The Sunshine Room is a building that is highly recommended by people both at home and abroad for the pursuit of nature and fashion. The Sun Room is widely studied in the Shanghai area of North China. Victory Industries needs to design and build according to the needs of the site and personal preferences. The interior layout can be decorated according to personal preferences. The balcony or terrace sun room is located in the whole house, so the visual connection is very important. It needs to be considered in keeping with the overall style of the building, while the overall tone is as consistent as possible (**Figure 5**).

3) Ventilation for reducing energy consumption: By means of ventilation dilution or ventilation exhaustion, under the premise of meeting indoor ventilation requirements, it is possible to use low energy consumption methods to control the spread and harm of air pollutants, and to achieve indoor and outdoor air environmental quality assurance; an architectural environmental control technology.

4) Underground aquifer storage energy (ground source heat pump): Ground source heat pump is a device that the shallow energy on the ground transfers low-grade thermal energy to high-grade thermal energy by inputting a small amount of high-grade energy (such as electric energy). Usually the source heat pump consumes 1 kWh of energy, and the user can get more than 4.4 kWh of heat or cold.

The concept of "ground source heat pump" was first proposed by a Swiss expert in 1912, and the proposal for this technology began in the United Kingdom and the United States. The Nordic countries mainly focus on heating in winter, while the United States focuses on the joint supply in winter and summer. Because the weather conditions in the United States are very similar to those in

China, studying the application of ground-source heat pumps in the United States has implications for the development of ground-source heat pumps in China (Figure 6).

5) Smart skin: There are three layers of skin through the water pipe, translucent, in the warm day can be connected with the geothermal underground storage. The temperature of the indoor glass skin in the colder night reaches 21˚C - 22˚C (Figure 7).

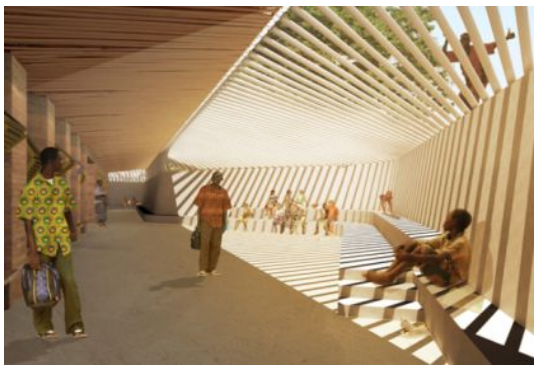

Figure 1. Secondary school with advanced passive ventilation system, Gando, Burkina Faso.

Figure 2. School built using local corn cobs and bamboo, Jar Maulwi, Pakistan.

Figure 3. Developing school infrastructure by using local resources, Vryheid, South Africa.

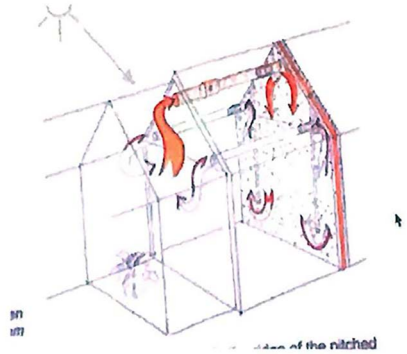

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Figure 4. Parabolic solar collector.

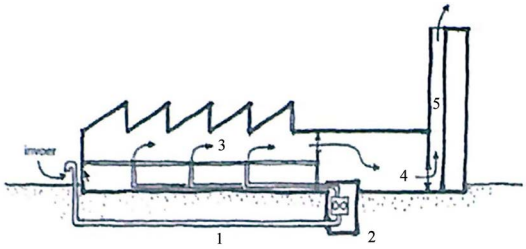

Figure 5. Sun room.

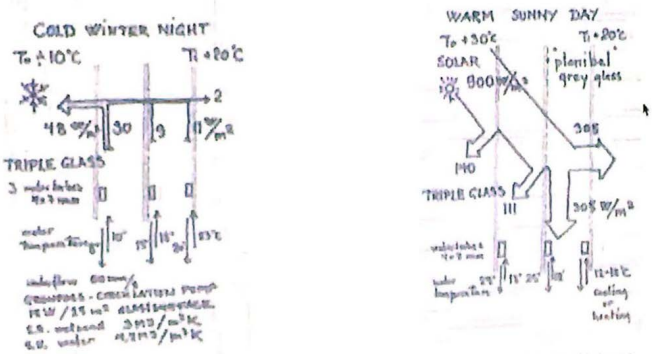

Figure 6. Underground aquifer storage energy.

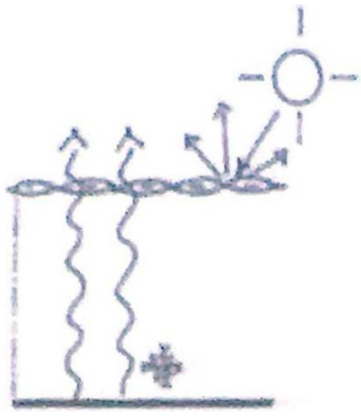

Figure 7. Smart skin.

3. BIM-Information Model Construction

3.1. Architectural Performance Design

Building Information Modeling (Building Information Modeling) or Building Information Management (Building Information Management) or Building Information Manufacture (Building Information Manufacture) is based on various related information data of a construction project and simulates buildings through digital information simulation. The real information it has, through the three-dimensional architectural model, realizes functions such as engineering supervision, property management, equipment management, digital processing, and engineering management [1]. It has eight characteristics: information completeness, information relevance, information consistency, visualization, coordination, simulation, optimization, and portability [2]. Participants of the project, such as construction units, design units, construction units, and supervision units, share the same building information model on the same platform. It is conducive to project visualization and fine construction. BIM is no longer just a piece of software like CAD, but a management tool. It is an important tool for the refinement and information management of the construction industry. Therefore, BIM is an information-based model construction method.

3.2. The Combination of BIM and Green Building Design

GeoPraxis is an industry leader in the development and implementation of building energy analysis tools and networked solutions. The company's Green Building Studio web service and XML connector integrates analysis tools and major building information model solutions, including Autodesk Revit Building, Autodesk® Architectural Desktop, and Autodesk® Building Systems. With this capability, architects can use the better information built into the building information model more efficiently to test building effectiveness and validate design choices over the Internet.

Green Building Studio is a great breakthrough in achieving green building design and LEED qualifications. The integration of our connectors through major building information models and CAD vendors can enable Green Building Studio web services to use rich information in models of early design time. It can establish a structurally correct equivalent thermal model and can quickly provide feedback on energy deductions in architectural designs.

Green Building Studio relies on a large network of relational databases that contain hourly weather data, design data, and a regional repository of pre-defined building characteristics with generic energy codes. It may even suggest building type products suitable for your project (this will greatly simplify the early specification process).

4. Conclusion

Green Building Studio Web Services integrates better information available in the building information model solution as an application, and the huge cost

barrier in green building design no longer exists. This combination can provide more accurate energy analysis, making the design of buildings more efficient and lowering the owner's operating costs. In addition, it allows architects to perform these functions on their own, thus reducing the cost for customers to pay for sustainable design services, increasing the profits of construction companies, and making the building information model a win-win choice for everyone.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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