



Research Article

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## Exploring on energy-saving design of building based on BIM technology

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### ABSTRACT

*BIM (building information modeling) realizes by using digital technology to create a model of architectural project design, construction and project management process, pioneering the use of digital models for building life-cycle management of new ideas. In the serious situation of social total resource consumption in buildings, energy accounted for thirty percent to 40, people gradually improve the consciousness of the building efficiency, to improve the construction resource to energy efficiency and the building's impact on the environment, to achieve the harmonious development of people and buildings, man and nature, architecture and nature, the combination of green building and BIM technology, forms the concept of green BIM, which has received worldwide attention.*

**Keywords:** BIM; energy efficiency; green building

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### INTRODUCTION

#### BIM TECHNICAL CHARACTERISTICS

BIM technology is based on architectural models, integrates 2D and 3D architectural design technologies to solve architectural design building on the models and drawings. Advantages of using BIM technology for architectural design are mainly reflected in the following aspects:

- 1) Virtual building information model and visual editing. Using of BIM technology to create a virtual building model, various forms of display and expression can be realized (such as 2D view, 3D view). During the design process it can be from a different point of view to design options. In order to achieve real-time look at the architectural design intent of the architect, the architects are freed from the tedious work of building modifications.
- 2) Drawing document is automatically generated. By establishing the complete building information model, BIM can directly exact the construction drawings, documents and charts of wanting to be expressed and output from the model, and automatically generate the corresponding drawings.
- 3) Automatically change and management. Because BIM platform is established on the basis of a database building virtual model, all of the changes and editors are based on the same object, the modified information will be automatically updated in the database, database perfecting, real time data and drawings expressed are modified to make the corresponding adjustment.
- 4) Advanced analysis capabilities. BIM technology improves the traditional 2D CAD drawings, not for simulation and analysis of thermal performance and ventilation, through architectural building information modeling, direct extraction and analysis of the required data, importing simulation analysis software for simulation analysis of the construction can be carried out in stages.

#### BIM ENERGY EVALUATION AND MODEL ANALYSIS

Under the background of sustainable development, the target of BIM in architecture design, is the standardized, integrated, three-dimensional, and intelligent[1]. BIM model contains most building performance analysis data, to

solve the building issues of architectural lighting and daylight analysis, thermal analysis, building energy analysis of buildings and their materials and other building performance by collaboration and information sharing of the software. Architects in the design phase of any program may be subject to energy performance assessment, comparing pros and cons of design strategies in order to make reasonable adjustments to plan in a timely manner.

BIM technology can be in the transformation between the 2 d drawings and 3 d model, through further component parameter information can be added to the component properties, such as the material characteristics, physical properties, mechanical parameters, design attributes, which makes building group intelligence entity. BIM models can be used for building energy analysis, sunlight analysis, structure analysis, acoustics, lighting analysis, material flow analysis of passenger flow and other aspects.

### BIM TECHNOLOGY APPLICATION PROSPECT

BIM technology fundamentally changes the way and process of building design. BIM relies on architectural design to create the digital information, applies relevant analysis, comparing the results for architectural design strategies, which changes the construction project information management and sharing process, and realizes the building life cycle management. The two dimensional design software function and social cultivation system is not perfect, architectural building information model is based on architectural entities, such as doors, windows, walls, building elements of basic data, but building technologies, materials management, quotation information is relatively small, and construction entities of clusters need to be supplemented. With BIM technology promotion and development of the construction industry in our country, the 2 d design software, such as budget software, software of project schedule, project management software, software and the balance conditions and so on, using BIM basic data and the corresponding engineering data will be integrated into the building information model, to supplement and perfect. BIM technology has fundamentally changed the way building information to create and creation process. Using BIM technology, from the beginning of the architectural design, creates building digital information, and applies building life cycle management of related technologies and products, which can change the construction project information management and sharing process, so as to realize building life cycle management. In the whole process of construction project, from beginning to end only a unique building information model, contains the complete construction and engineering data. Using BIM technology to build a building information platform, using a single data structure and the only public database to integrate system and using the parameterized technology, characteristics to complete each professional collaborative design, not only can solve the construction plan design, and also can solve the professional design tasks such as structure, water and electricity. Many people think that BIM technology for construction drawing design is better, actually BIM technology as a kind of design method, has penetrated into building design sketch design stage. Complying with the requirements of architectural aesthetics in modern society, some complex and hard to imagine forms must use computer to accurate description. BIM technology not only can fully express the designer's design theory, but also can save 2% ~ 5% of the construction investment, improve investment benefit, realize the goal of building energy efficiency, promote construction of sustainable development[2].

### CHARACTERISTICS OF ENERGY CONSUMPTION IN OFFICE BUILDINGS IN HENAN PROVINCE

#### Building age and energy consumption

Architecture is the product of certain age background characteristics, must reflect the time building techniques, and the corresponding is also an era of architectural meaning materials, such as Mies Van Delo's West Gramm building is to reveal financial background of glass, steel, and reflects the era of progress. Office building construction technology and material factors constitute the energy consumption of buildings. From the point of view of the development of architectural technology, along with the development of the era, building technology as the medium of reflecting the progress of human civilization has been moving forward. According to relevant data, based on the survey of office buildings, 10 years as one level, from the 1980 of the 20th century to early 21st century, the building is divided into four separate stages of development. According to statistics, age of buildings with building energy consumption density and gap is shown in the following table[3].

Tab.1 The office's building age and energy consumption density

Building age	Before 1980	1981—1990	1991—2000	2001—2010	After 2011
The proportion	1	11	50	35	2
Energy density (kWh/m <sup>2</sup> ·a)	146.60	131.29	115.11	112.29	110.50
Reduced energy density rate(%)		10.4	12.3	2.5	1.8

Office buildings in Henan province are mainly concentrated in 1991-2010 by 85% percent of research, the average power density is up to 114.7kWh/sqm·a, after 1991 the energy density compared to previous building energy density has fallen by around 10%, before 1991 the energy density is very large, after 2001 the building energy consumption density becomes stable. With the change of building, building energy-conserving technology also complies with the energy efficiency requirements of the times and development, building energy consumption density is gradually declining. In the 1880 of the 19th century to 20th century early, Chongqing in economic aspect has made leaps and bounds of development, and corresponds to social progress, building is also constant development, after 2000, building energy conservation speed enters bottleneck stage of energy conservation development, delving into restricted building energy development of fundamental causes, energy design technology development speed is difficult to adapt social requirements on building energy, energy conservation measures and policy cannot match energy technology development[4].

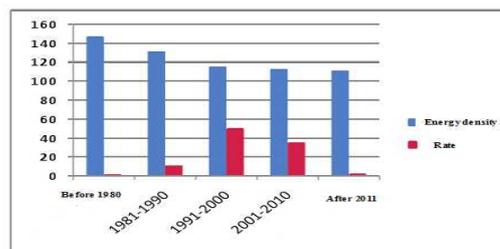


Fig.2 The chart of building's age and corresponding energy

#### Building energy consumption structure

Xinxiang office building energy consumption is mainly electricity consumption, gas consumption accounts for only 11%(shown as Fig.3), and natural gas is almost used to the canteen, a small portion is used for air conditioning and hot water supply.

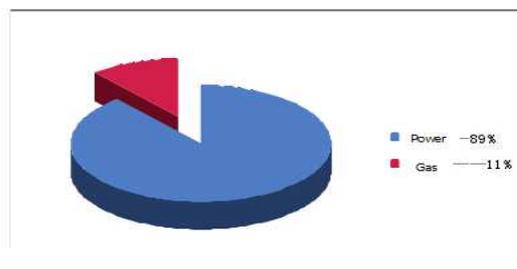


Fig.3 Distribution chart of energy consumption density

#### Building energy-saving design goals

Using building information modeling (BIM technology) and related building energy simulation software, works with low skills of "passive" energy-efficient design strategies, backing up by "active" energy saving technology, studying rational design strategy on building, reducing the construction process is designed to keep the indoor thermal environment and the necessary energy consumption. The goals of design are:

- 1) In the architectural design process, according to the construction site on regional climate features, following the principle of building environment control technology, comprehensive function and appearance design of building and other needs, organizes and handles the various architectural elements to make office buildings rely on air conditioning equipment as less as possible and achieve the purpose of saving energy, creates human physical and mental requirements of good interior and exterior environments, meets the energy efficiency requirements.
- 2) Implementation architecture to the use of natural lighting, natural ventilation, reduces dependence on artificial lighting and mechanical ventilation, and creates a design strategy which meets the requirement of green energy saving and is better combined with architectural form.
- 3) Using CAD architectural building information modeling(shown as Fig.4). The integrated use of energy-saving design of a mature technology already certificated by practice, from the construction of natural ventilation, natural lighting, and through appropriate building energy efficiency design strategy implementation effectively reduces the energy consumption of building in the future.



Fig.4 Using CAD architectural building information modeling

### CONCLUSION

Based on BIM technology, this paper embarks from energy-saving design of office buildings in Henan province, on the basis of the system analysis for the relationship of climate and energy, to put forward a building energy conservation design method following adapted regional climatic environment, analyze the factors of these buildings in architectural design process through the BIM technology, and has a specialized research for office building energy conservation design in Henan region.

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