Analysis of "Green Building" Indicators in a Residential Area Based on Building Information Model

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Abstract

Abstract: In order to analyze the "green building" indicators such as the lighting environment of a residential district in Zibo, this paper builds a building information model based on the general plan of a residential district and the geometric coordinates and dimensions of the household type. From the perspective of solar energy utilization, it emphatically simulates and analyses the sunshine time, sunshine spacing, shielding and projection, indoor lighting environment of the residential district based on the evaluation index standard of green building. The results show that the illumination hours of the residential quarter are more than 2 hours in cold days, the indoor daylighting coefficient is more than 2%, and the ratio of indoor illumination between 269 Lux and 5380 Lux is more than 75%, which basically meets the evaluation index requirements of green buildings. The research results provide effective methods and approaches for building information model based on point coordinates and geometric dimensions, and provide reference and guidance for optimizing district planning, building optimization design and building green buildings.

Keywords: Building Information Model, Sunshine Time, Solar Energy Utilization, Green Building

1. Introduction

At this stage, high-rise and high-density residential buildings have become the main style of new residential buildings in most cities in China. To some extent, high-rise residential buildings achieve the purpose of saving land and improving the plot ratio of residential areas. However, with the continuous rise of the number of medium and high-rise residential buildings in the city, some potential negative problems gradually appear, especially the sunshine dispute (http://gtj.zibo.gov.cn/art/2021/9/30/art_4030_2168112.html, 2021/9/30).

Building information model (BIM) has become an important tool for the transformation and upgrading of the construction industry. It has economic, intuitive, visual and collaborative advantages in analyzing "green construction" indicators such as sunshine time, sunshine spacing, occlusion and projection, indoor light environment, etc. at present, the application of building information model mainly focuses on pipeline synthesis, collision inspection, building planning There are few applications in other stages such as design.

Based on the published geometric coordinates and dimensions of a residential district in Zibo, this paper constructs a building information model, and focuses on the simulation and analysis of the sunshine time, sunshine spacing, shielding and projection, indoor light environment and so on from the perspective of solar energy utilization and based on the green building evaluation index standard. The research results provide effective methods and approaches for building information model based on point coordinates and geometric dimensions, and provide reference and guidance for optimizing community planning, building optimization design and building green buildings.

2. Method of creating building information model based on general planning drawing and house type drawing

The establishment of BIM model is the basis of solar illumination analysis. According to the complete two-dimensional construction drawings, BIM model can be created quickly and accurately. The construction

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drawings are confidential and may not be fully disclosed, but the overall planning drawings of the construction project must be listed and publicized, and the house type drawings of the residence will also be published before the construction project starts. When it is impossible to obtain two-dimensional construction drawings, building BIM model based on the published general planning drawings and house type drawings has become an effective way of solar illumination analysis. The following will first introduce the methods and approaches of building BIM model based on the disclosed general planning drawing and house type drawing.

2.1 A two-dimensional site layout model is constructed based on the building group point coordinates of the general planning drawing

As shown in Fig.1, it is the two-dimensional general planning and design drawing of a community publicized outside the construction site of a community. The drawing contains the planning red line of the community, some corner coordinates of each building complex, building top elevation, roads, greening and other information. With the help of AutoCAD software, a two-dimensional site layout model can be easily constructed, as shown in Fig.2. The numbers in the Fig.represent the number of buildings in the community.

Fig.1: published general layout

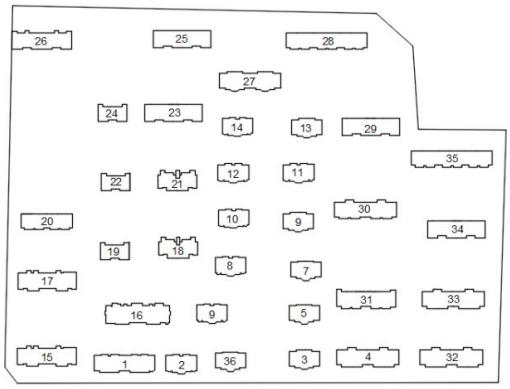

Fig.2: constructed two dimensional model

2.2 Construction of three-dimensional BIM model of standard floor based on two-dimensional house type drawings

As shown in Fig.3, it is the house type diagram of the standard floor of building 34 in the community. The drawing contains the dimensional parameters of the internal and external protective structures of the standard floor of the building, as well as the installation position of doors and windows. With the help of Revit software, it is very convenient to build the BIM model of the standard floor of the building, as shown in Fig.4. In combination with the number of floors of each building in Fig.1, copy and move the standard floor to create the BIM model of the building. The BIM model of building 34 is shown in Fig.5.

Fig.3: house type diagram

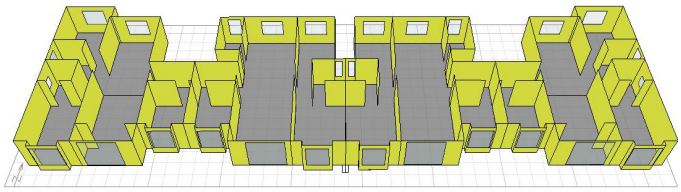

Fig.4: BIM model of standard layer

The BIM models of other buildings are constructed according to the above methods, and the BIM model of the whole community can be constructed by placing the constructed BIM model at the corresponding position of the site model shown in Fig.2, as shown in Fig.6.

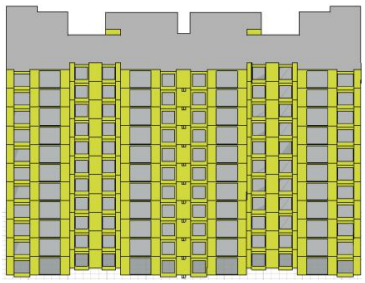

Fig.5: BIM model of building 34

Fig.6: BIM model of the whole cell

3. Sunlight analysis based on green building evaluation index standard

The main factors affecting solar illumination analysis are geographical location, solar altitude angle, atmospheric transparency, sky cloud amount and altitude. Zibo is located in East China and the middle of Shandong Province, with 35 ° 55 ′ ～ 37 ° 17 ′ N and 117 ° 32 ′ ～ 118 ° 31 ′ E. the average altitude is 34.5 m (Meng, 2016).

3.1 Sunshine hours simulation

The severe cold day is the standard day for calculating the sunshine time stipulated by the state, and it is also the standard day for measuring the indoor daylighting time of residential buildings. If the accumulated daylighting on a cold day is less than 2 hours, you can claim corresponding compensation. If the standard of sunshine on cold days is selected, the effective sunshine time zone is 8:00 to 16:00 local time (Gao, 2014).

The distance between the high-rise residence and all kinds of houses behind shall meet the requirement that the effective sunshine time of the sheltered residence on a cold day shall not be less than 2 hours; In the old area reconstruction project, the new residence shall meet the requirement that the effective sunshine time on a cold day shall not be less than 1 hour. The minimum distance between high-rise residential buildings and various residential buildings behind shall not be less than 30 m (http://www.mohurd.gov.cn/wjfb/201905/t20190530_240717.html, 2019/5/30).

Based on Autodesk Ecotect software, the simulated cold sunlight hours on different ground level in the residential area are shown in Fig.7-Fig.10. It can be seen from the Fig.that the sunshine hours on the ground of the residential area meet the requirements of 2 hours, and with the increase of ground height, the more sunshine hours are received on the plane.

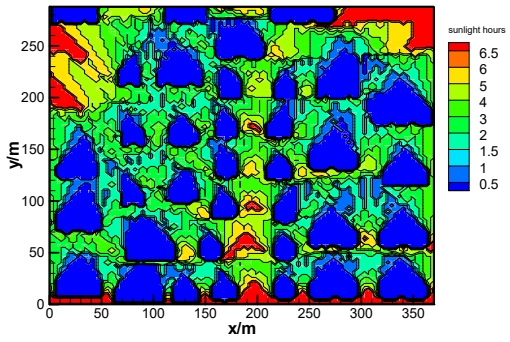

Fig.7: ground sunshine hours on a cold day

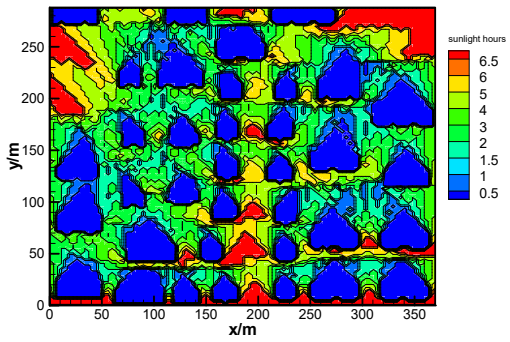

Fig. 8: sunshine hours at a distance of 3m from the ground on a cold day

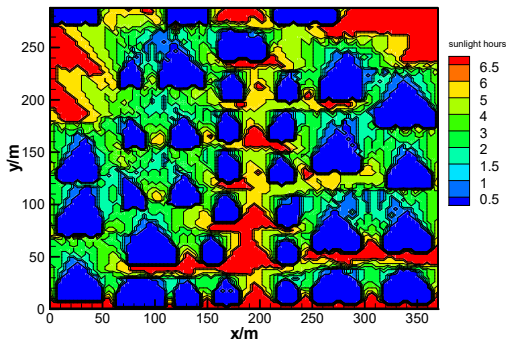

Fig. 9: sunshine hours at a distance of 6m from the ground on a cold day

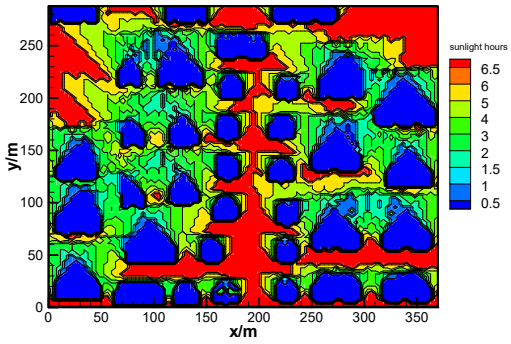

Fig.10: sunshine hours at 9m from the ground on a cold day

Figures 11-12 show the simulation results of sunshine hours on the south facade of building 34 in the residential community. It can be seen from the Fig.that except for the self shielding at the shape of the south facade, the lighting time in other areas of the south facade of the building exceeds 2 hours, and the longer and more uniform the lighting time with the increase of floor height. This is consistent with the conclusion drawn in figures 7-10.

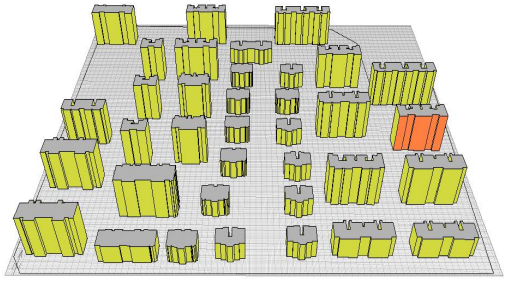

Fig.11: South elevation lighting analysis building

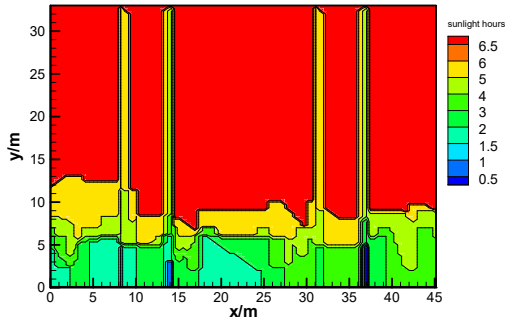

Fig.12: sunshine hours of south elevation

3.2 Indoor daylighting coefficient and light intensity

Daylighting coefficient refers to the ratio of the illuminance generated by directly or indirectly receiving the sky diffuse light from the assumed and known sky brightness distribution at a point on the indoor reference plane to the sky diffuse light illuminance generated by the sky hemisphere on the outdoor unobstructed horizontal plane at the same time. According to the standard for daylighting design of buildings (http://www.mohurd.gov.cn/wjfb/201509/t20150908_224720.html, 2015/9/8), Zibo area belongs to four areas in China's light climate zoning.

The simulation results of daylighting coefficient and indoor illuminance are shown in Fig. 13-fig. 18. It can be seen from the Figures that the daylighting coefficient and illuminance value near the window are large, and the setting of indoor interior wall has a great impact on the indoor daylighting coefficient and illuminance distribution.

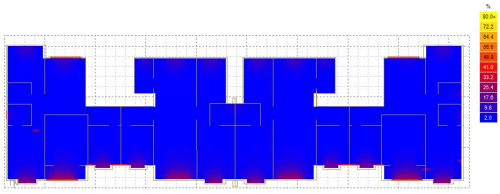

Fig.13: Daylighting coefficient of the first floor

Fig.14: Daylighting coefficient of the first floor (without barrier)

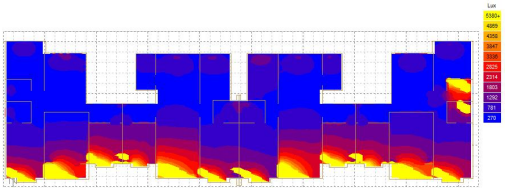

Fig.15: illuminance of the first floor -9a.m.

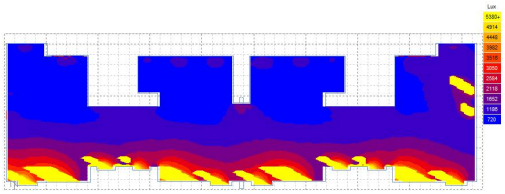

Fig.16: first floor illumination -9a.m. (without barrier)

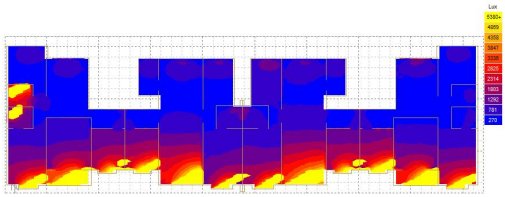

Fig.17: illuminance of the first floor -15p.m.

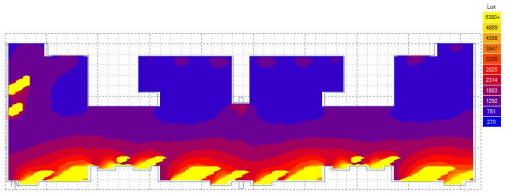

Fig.18: first floor illumination -15p.m. (without barrier)

4. Conclusion

Based on the geometric coordinates and dimensions of a public plot plan and house type, this paper constructs a building information model, and focuses on the simulation and analysis of the sunshine time, sunshine spacing, shielding and projection, indoor light environment and so on from the perspective of solar energy utilization and based on the green building evaluation index standard. The results show that the light hours in the residential area on cold days are more than 2 hours, the indoor daylighting coefficient is more than 2%, and the proportion of indoor illuminance between 269lux and 5380lux is more than 75%, which basically meets the evaluation index requirements of green buildings. The research results provide effective methods and approaches for building information model based on point coordinates and geometric dimensions, and provide reference and

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5. Acknowledgments

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