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Influence of Room Spacing on Solar Radiation from Summer Active Boards: A Case Study of Sichuan Disaster Area

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Abstract: According to the phenomenon that summer is thermal and comfort is poor in the active slab houses in the earthquake-stricken area, an analysis model was established in the Ecotect Analysis software. The model material and indoor thermal index were set to analyze the solar radiation of the active slab room wall surface and compare the size of the solar radiation of the summer wall under the different spacing. The results show that the amount of summer solar radiation on the wall surface can be effectively reduced when the height of the movable board room and the movable board room is [1.0, 1.2], which has a good effect on the summer heat insulation of the movable board room.
Keywords: movable house, solar radiation, thermal comfort.

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1. INTRODUCTION

China is a country with frequent natural disasters. There have been major earthquakes in Wenchuan in 2008, Yushu in 2010, Ya'an in 2013, Yutian County in 2014, and Jiuzhaigou in 2017. The work plan of the Ministry of Housing and Urban-Rural Development of the People's Republic of China for disaster relief and resettlement housing is temporary, transitional, and permanent. Among them, "transitional resettlement housing" is the longest use of temporary housing, generally more than two years. The activity board room (hereinafter referred to as "Board House") has been selected as a "transitional resettlement house" because it is convenient and quick to transport and dismantle, and it can provide temporary residents with temporary housing.

Take the Wenchuan Earthquake as an example. The hardest hit areas in the earthquake-stricken area are mostly mountainous areas. There are fewer flats available for setting up resettlement areas. Therefore, as many victims as possible are placed on limited land, so the spacing of board houses is often small. In the survey of livable comfort of board houses in the Wenchuan earthquake, the conclusions show that the most common and most influential problem for the respondents' lives is the poor thermal environment in summer.

In this paper, Ecotect Analysis software is used to simulate the active solar radiation for the problem of poor room spacing and summer thermal comfort. On the one hand, it is necessary

to set up as many houses as possible in a limited area. On the other hand, the indoor needs to obtain the right amount of solar radiation. Through the simulation calculation, the appropriate building density geometric model can be determined.

1.1 Analysis object

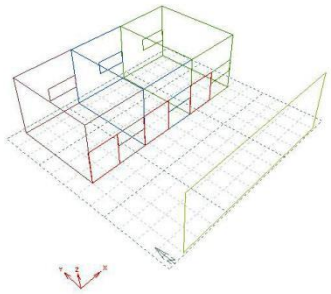

Figure 1

For the convenience of simulation, three double-sided lighting boardroom unit can be seen as a group which is selected as a simulation object. The unit size is 3700mm * 5600mm * 3700. In the south wall, the open door is 1850mm * 2000mm, open window is 1850mm * 800mm. And the open window in the north wall is 1850mm*800mm. In the south and north wall, the windows are opposite. There is a retaining wall in the south of the panel house group, which simulates the shelter from the neighboring active board room units. The retaining wall size is 11100mm*3700mm, and the geometric model is shown in Figure 1.

2. PARAMETER SETTINGS

Through the investigation of the board house market, the wall of the simulated board house adopts the rock wool sandwich color steel plate to set the material parameters (Table 1). Other parameters are the default (when the other conditions are the same, only the solar radiation of the entrance wall is studied. other parameter settings do not affect the results). Under the standard of the current condition of the board house and the electricity load, the condition of the refrigeration equipment is not available, and the active heating and cooling system is set to natural ventilation. The meteorological parameters of Chengdu area is imported, the hottest day in summer is as the selected date, and the cumulative solar radiation in the period from 6:00 to 18:00 is calculated.

Table 1.

Rock wool sandwich Color steel plate	thickness (m)	Thermal Conductivity(W/m • K)	density (kg/m³)	Specific heat (J/kg • K)	Sun radiation Absorption rate	Heat radiation Absorption rate
parameter	0.0005	45.28	8000	460	0.7	0.9

This simulation selected seven cases: D/H=0.6, D/H=0.8, D/H=1.0, D=H=1.2, D=H=1.4, D/H=1.6, D/H. =1.8. D is the distance between the active board room group and the retaining wall, which simulates the distance between the board room and the board room in the actual situation. H is the height of the board room. This simulation takes the board room height H=3700mm which is common in the WenChuan earth quake. The orientation of the board room

is just south, which simulates the amount of solar radiation on the entrance surface of the board room that is the south wall of the board room in the seven cases.

3. RESULTS ANALYSIS

Table 2.

Object	D/H=0.6	D/H=0.8	D/H=1	D/H=1.2	D/H=1.4	D/H=1.6	D/H=1.8
Sum total (Wh/m^2)	7017944	7303040	7499180	7643149	7749636	7829457	7892255

The amount of solar radiation in each case includes both direct solar radiation and reflected solar radiation. As shown in Table 2, it can be seen that when the inlet faces southward, the total amount of solar radiation gradually increases as the ratio of the height of the slab room to the height of the slab house increases. When the ratio is less than 1.0, the total solar radiation decreases. When the ratio is within the range [1.0, 1.4], the solar radiation has a gentle increase. When the ratio is [1.6, 1.8], the total increase in solar radiation is small. In order to make rational use of land resources, the ratio of board room height to boardroom height should not exceed 1.6. From Figure 2, the ratio of board room to boardroom height and the total amount of solar radiation is linearly increasing in the interval, and as the ratio increases, the growth rate of solar radiation gradually decreases. That is, the increase is more and more, the increase in total solar radiation is also slow. The fastest increase in solar radiation is in the interval [0.6,1], followed by [1,1,2]. In the interval [0.6, 0.8], the solar radiation in winter (February 26) is lower than the solar radiation in summer hottest day, and the smaller the ratio, the greater the solar radiation difference in summer and winter. This should be avoided.

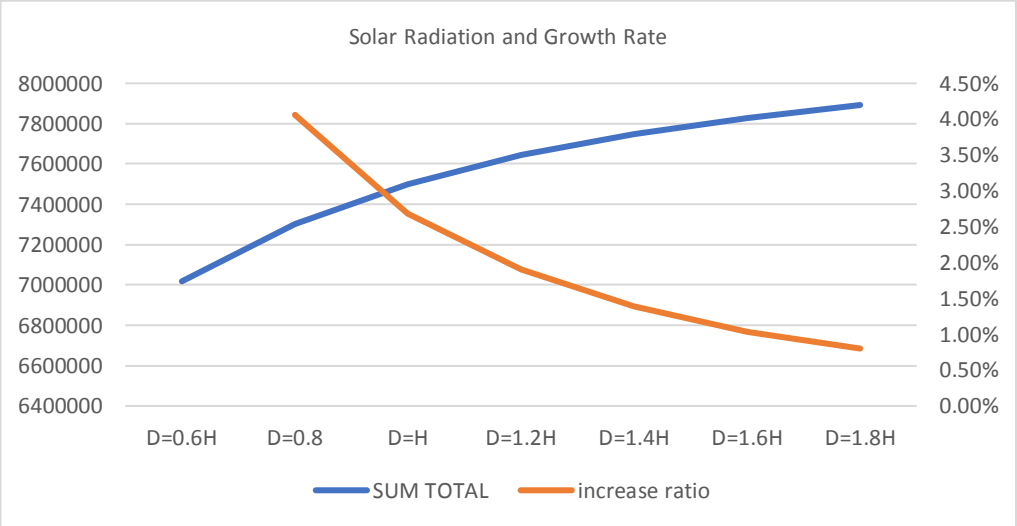

Figure 2.

On the other hand, according to the "Fire Prevention Code for Transitional Resettlement Sites in Disaster Areas" and "Technical Guidelines for the Construction of Transitional Resettlement Housing in Earthquake-Stricken Areas", the building spacing within the group is not less than 4m. According to the fire cases in the movable house, in general, about 4m between the color steel sandwich panels is a basic safety fireproof distance, and about 6m is the fireproof distance

with a certain safety reserve. In actual construction, due to various conditions, the spacing may not be able to meet the regulatory requirements.

4. CONCLUSION

To sum up, under the premise of efficient land use, meeting the requirements of fire protection specifications in transitional residential areas, the most unbearable problem facing tenants is the high indoor temperature in the summer board room. Combined with consideration of indoor thermal environment comfort in winter, when the entrance to the board room faces south, the ratio of the board room to the height of the board room should be [1.0, 1, 2], and the room distance of the board room should not be less than 4m.

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