ALL YEAR HEATING AND COOLING LOAD ANALYSIS FOR SMALL HOTEL BUILDINGS IN GUIYANG CITY CHINA

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ABSTRACT

Guiyang is the capital city of Guizhou province in southwest China, located in the Mild Climatic zone in China. With the economy booming in recent years, the energy consumption in heating and cooling buildings in Guiyang continues to increase. This paper presents a computer simulation study using DeST software package, which is broadly used to simulate building energy consumption in China. The all-year round simulation for cooling and heating load for a small hotel building has been carried out with various parameters, and the results will be useful for the guidance of energy efficient building design in Guiyang.

KEYWORDS

Guiyang, DeST, Cooling load, Heating load

INTRODUCTION

Guiyang is the capital city of Guizhou province in southwest China, located in the Mild Climatic zone in China. The weather in Guiyang is featured comfort in summer, however cool and humidity in winter. With the economy booming in recent years, the energy consumption in heating and cooling buildings in Guiyang continues to increase. As a result of consumption of energy, the pollution from the energy consumption has been becoming more and more serious. In fact, Guizhou province belong to the areas where sour rain and emission of SO_2 is limited by Chinese central government. The demands of coal in Guizhou province in 1990 is 27.14 million tonnes, and it is 45.91 million tonnes in 2000, According to the traditional forecast method, it will be 82.33 million tonnes in 2010. Furthermore, the total emission of SO_2 in 2000 is 2.18 million tonnes, it will be 39.1 million tonnes in 2010.Therefore, the analysis of the all year cooling and heating load in building will be useful for the guidance of energy efficient building design in Guiyang.

RESEARCH METHODS

In order to research the impact of thermodynamic parameters of envelop structure on all-year cooling and heating load of building, We present a computer simulation study using DeST software package, which is broadly used to simulate building energy consumption in China. The all-year round simulation for cooling and heating load for a small hotel building has been carried out with various parameters. The model building consists of three floors, the ground floor consists of hall room and meeting room

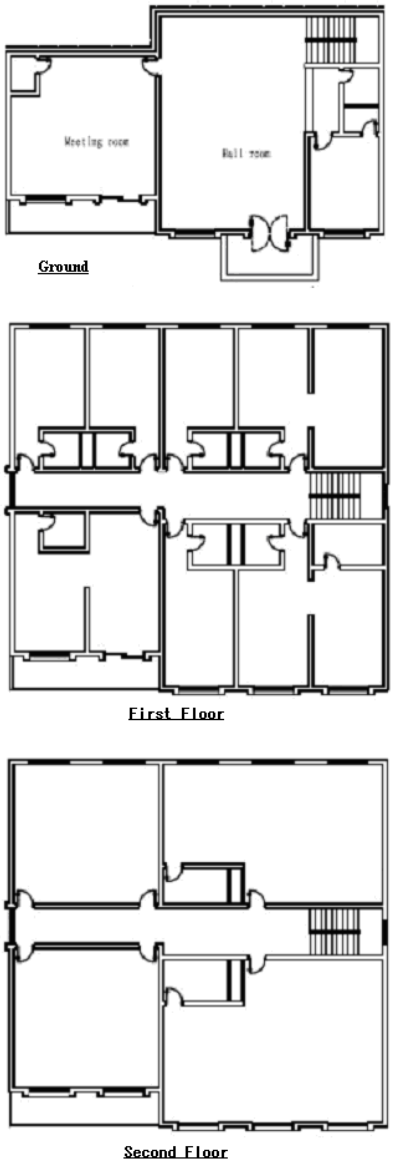

Figure 1 Planform of model building

as well as porter room, it is 3.6 meters height. The first floor is for guests, it is 3.0 meters height. The second floor is for games such as playing card and chess, it is 3.0 meters height. The indoor designed temperature is 27℃, relative designed humidity is 50%, the actual thermodynamic parameters of the envelop structure in the building are as follows: the U-value of exterior wall is 1.49 w/(m^2.k), the U-value of roof is 0.812 w/(m^2.k), the U-value of exterior windows is 4.45 w/(m^2.k). And the heating sources in the building consist of lights and people. The planform of the model building can be seen in Figure 1.

RESULTS

The impact of U-value of exterior wall on the all-year cooling and heating load

In DeST, we set up different U-value for the exterior wall but keep others stable. The result for the all-year cooling and heating load of the building is in Table 1.

Table 1 All-year cooling and heating load on declining U-value of exterior wall

U-VALUE OF WALL (W/(M^2.K))	ALL-YEAR HEATING LOAD (KW.H)	ALL-YEAR COOLING LOAD (KW.H)
2.095	95857	43566
1.519	85897	42567
1.275	81589	41999
1.079	79245	42545
0.976	77265	41819
0.902	76315	42363
0.824	74970	42212
0.706	72421	41543
0.591	70994	41863
0.532	70344	42202

The Table 1 shows: with U-value of exterior wall decreasing each 0.1 w/(m^2.k), the all-year heating load in the building drops 1.98% in average, but the all-year cooling load almost holds the line.

The impact of U-value of window on the all-year cooling and heating load

Table 2 All-year cooling and heating load on declining U-value of glaze

U-VALUE OF WALL (W/(M^2.K))	ALL-YEAR HEATING LOAD (KW.H)	ALL-YEAR COOLING LOAD (KW.H)
5.8	79245	42545
4.5	77405	39967
3.2	72048	40068
2.5	69496	40137

In DeST，we set up the U-value of exterior wall as 1.0 w/(m^2.k), and keep other parameters stable, but change U-value for exterior windows, the result for the all-year cooling and heating load of the building is as Table 2.

We get a result from the Table2 as follows: with U-value of exterior window decreasing from 5.8 w/(m^2.k) to 2.5 w/(m^2.k), the all-year heating load in the building drops 12%, but all-year cooling load does not change.

The impact of glazing ratio on the all-year cooling and heating load

In DeST，the U-value of exterior wall is set up as 1.0 w/(m^2.k), and the U-value of windows is kept as 3.2 w/(m^2.k), as well as 0.812 w/(m^2.k) for roof, in addition, we change the glazing ratio (window area to wall area), the result of the all-year cooling and heating load of the building can be seen in Table 3 and Table 4 respectively.

Table 3 All-year heating load on rising glazing ratio（kw.h）

GLAZING RATIO	SOUTH	NORTH	EAST	WEST
0.05	71037	71721	71667	73884
0.10	71454	74824	71496	73059
0.15	74957	80166	71352	72387
0.20	78920	85703	71234	71846
0.25	83134	91361	71139	71415
0.30	87514	97111	71065	71074
0.35	92013	102933	71008	70829
0.40	96597	108810	70969	70694
0.45	101253	114733	70946	70610
0.50	105970	120692	70937	70570
0.55	110740	126683	70952	70671
0.60	115556	132698	71014	70813
0.65	120408	138738	71087	71123
0.70	125294	144801	71170	71596

Table 4 All-year cooling load on rising glazing ratio（kw.h）

GLAZING RATIO	SOUTH	NORTH	EAST	WEST
0.05	45220	48399	45627	36843
0.10	58175	59225	46385	39361
0.15	71359	69698	47185	42071
0.20	84478	79981	47984	45004
0.25	97547	90171	48799	48138
0.30	110575	100334	49641	51368
0.35	123499	110446	50512	54668
0.40	136363	120504	51432	58046
0.45	149140	130516	52389	61456
0.50	161808	140503	53358	64901
0.55	174412	150470	54346	68312
0.60	186988	160407	55372	71769
0.65	199497	170336	56336	75196

0.70	211976	180274	57330	78574

The results from the Table 3 and Table 4 show: with the south glazing ratio increasing each 5%, the all-year heating load in the building grows 4.47% and the all-year cooling load grows 12.8% in average ;With the north glazing ratio increasing each 5%, the all-year heating load in the building grows 5.56% and the all-year cooling load grows 10.74% in average; it is interesting that with the changes of the east and west glazing ratios, the all-year heating load have no significant changes; with the east glazing ratio increasing each 5%, the all-year cooling load grows 1.17% in average; with the west glazing ratio increasing each 5%, the all-year cooling load raises 6.00 % in average.

CONCLUSION

From above case study, we draw the conclusions as the followings:

The U-value of exterior wall and window is important factor to the all-year heating load of small hotel buildings in Guiyang city, but it almost has no significant impact on the all-year cooling load;

The glazing south and north ratios have significant impact on all-year heating load, but those in east and west have relative less impact;

The glazing ratios in all orientations have significant impact on cooling load with an importance order of north, south, east and west.

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