exterior wall is set as passive zone. The other building parameters are shown in the Table 1 and Table 2.

***Table 1.*** *Slab Building Model Parameters*

| Case | Building length (m) | Building width (m) | Building exterior area ($m^2$) | Building volume ($m^3$) | Building area ($m^2$) | Building shape coefficient ($m^{-1}$) | Passive volume ratio |
|---|---|---|---|---|---|---|---|
| 1 | 15 | 12 | 1476 | 4320 | 1080 | 0.342 | 1 |
| 2 | 30 | 12 | 2376 | 8640 | 2160 | 0.275 | 1 |
| 3 | 60 | 12 | 4176 | 17280 | 4320 | 0.242 | 1 |
| 4 | 90 | 12 | 5976 | 25920 | 6480 | 0.231 | 1 |
| 5 | 120 | 12 | 7776 | 34560 | 8640 | 0.225 | 1 |
| 6 | 60 | 40 | 7200 | 57600 | 14400 | 0.125 | 0.44 |
| 7 | 90 | 40 | 9840 | 86400 | 21600 | 0.114 | 0.39 |
| 8 | 120 | 40 | 12480 | 115200 | 28800 | 0.108 | 0.37 |

***Table 2.*** *High-rise Tower Building Model Parameters*

| Case | Building length (m) | Building width (m) | Building exterior area($m^2$) | Building volume ($m^3$) | Building area ($m^2$) | Building shape coefficient ($m^{-1}$) | Passive volume ratio |
|---|---|---|---|---|---|---|---|
| 9 | 12 | 12 | 2448 | 6912 | 1728 | 0.354 | 1 |
| 10 | 24 | 12 | 3744 | 13824 | 3456 | 0.271 | 1 |
| 11 | 24 | 24 | 5184 | 27648 | 6912 | 0.188 | 0.75 |
| 12 | 36 | 24 | 6624 | 41472 | 10368 | 0.160 | 0.67 |
| 13 | 36 | 36 | 8208 | 62208 | 15552 | 0.132 | 0.56 |
| 14 | 48 | 36 | 9792 | 82944 | 20736 | 0.118 | 0.50 |
| 15 | 48 | 48 | 11520 | 110592 | 27648 | 0.104 | 0.44 |
| 16 | 60 | 60 | 15120 | 172800 | 43200 | 0.088 | 0.36 |

(1) Meteorological parameters

In this study, Shanghai is selected as typical zone in hot-summer-and-cold-winter area in China. Shanghai meteorological parameters are set in accordance with the database come with DeST-c.

(2) Building envelope

Building orientation is north. Take building envelope structure which comes with DeST compared with the actual construction condition and Design standard for energy efficiency in public buildings of Shanghai, then choose the closer parameters: the heat transfer coefficient of external wall is 0.7126W/($m^2$ K), the heat transfer coefficient of proof is 0.437W/($m^2$ K), the heat transfer coefficient of external window is 2.2W/($m^2$ K), and the shading coefficient of external window is 0.3. The ratio of window to wall is 0.5.

(3) Internal loads

The thermal disturbance of people, lighting and equipment of office buildings are set in accordance with Design standard for energy efficiency in public buildings of Shanghai. The minimum illumination of room is set as 300Lx. Specific parameters are shown in the Table 3:

***Table 3.*** *Thermal disturbance parameter of various functions rooms*

| Occupant density （person/$m^2$） | Per fresh air capacity （$m^3$/h） | Lighting load （w/$m^2$） | Equipment load （w/$m^2$） |
|---|---|---|---|
| 0.2 | 30 | 11 | 20 |

(4)Air-conditioning system

The air condition temperature in summer is designed for 24~26℃, while in winter it is designed for 20~22℃. The relative humidity is designed for 50%~60%. For natural ventilation, the maximum temperature is 26℃,the minimum temperature is 18℃, and the maximum relative humidity is 60%. All rooms are used fan-coil plus fresh air system. Cold source is centrifugal chiller, and its COP is 5.0. Heat source is gas-fired hot water boiler, its efficiency is 95%. The schedule of people, lighting and equipment is shown in Fig 4.

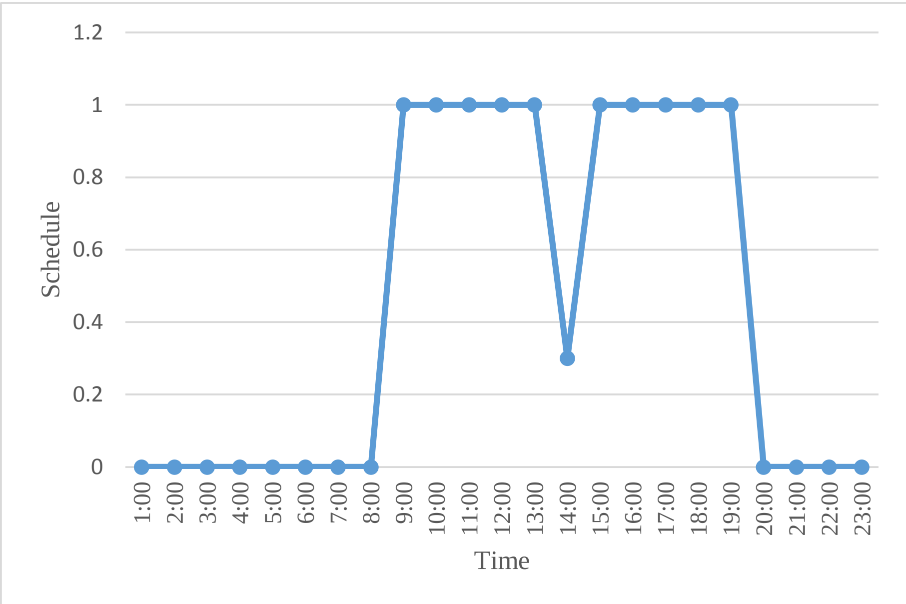


***Fig 4.*** *The schedule of people, lighting and equipment*

## RESULTS AND DISCUSSION

Heating load per building area and cooling load per building area of slab buildings are shown in Fig5. Air-conditioning consumption per building area, lighting consumption per building area and the sum of AC consumption and lighting consumption per building area of slab buildings are shown in Fig 6. Heating load per building area and cooling load per building area of high-rise tower buildings are shown in Fig7. Air-conditioning consumption per building area, lighting consumption per building area and the sum of AC consumption and lighting consumption per building area of high-rise tower buildings are shown in Fig8.

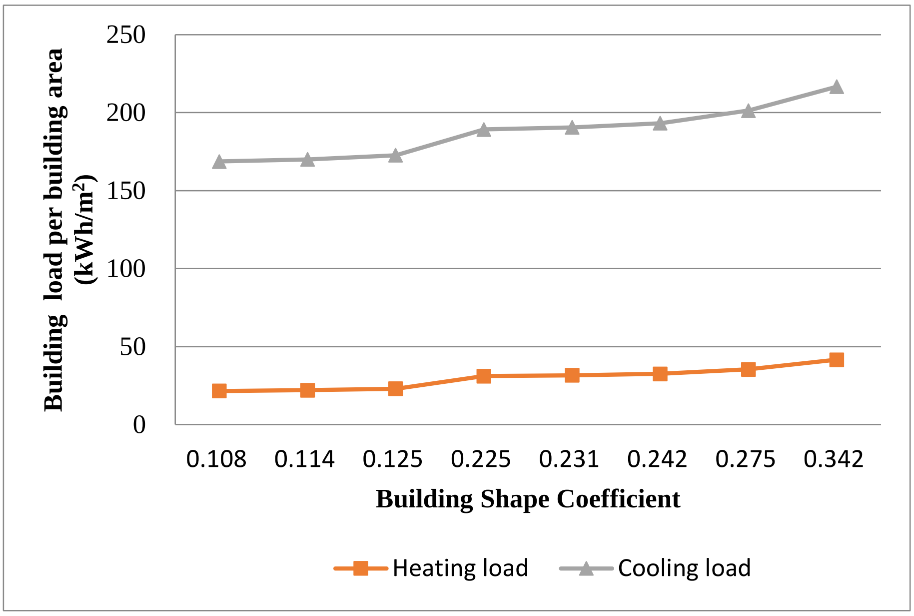


***Fig 5.*** *Building load per building area of slab buildings*

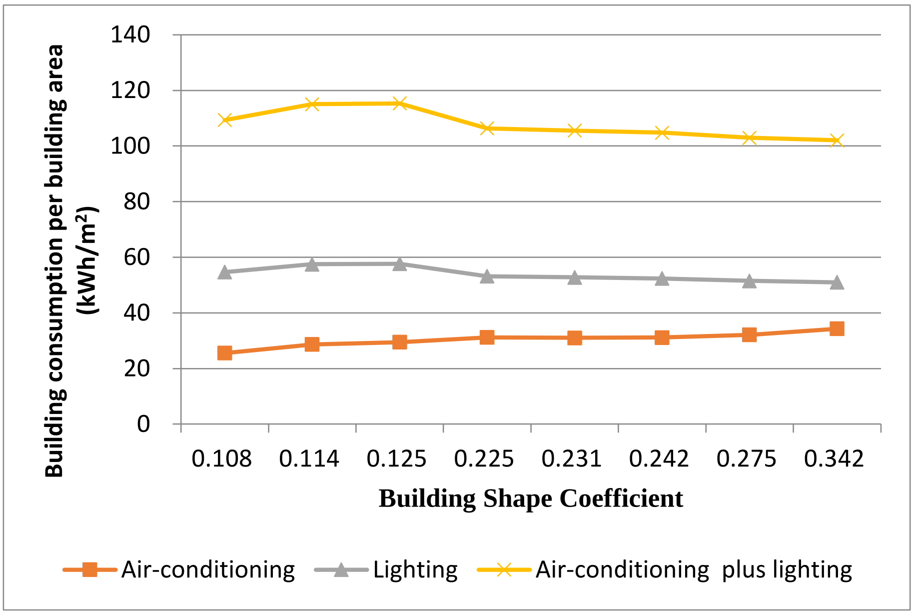


***Fig6.*** *Building consumption per building area of slab buildings*

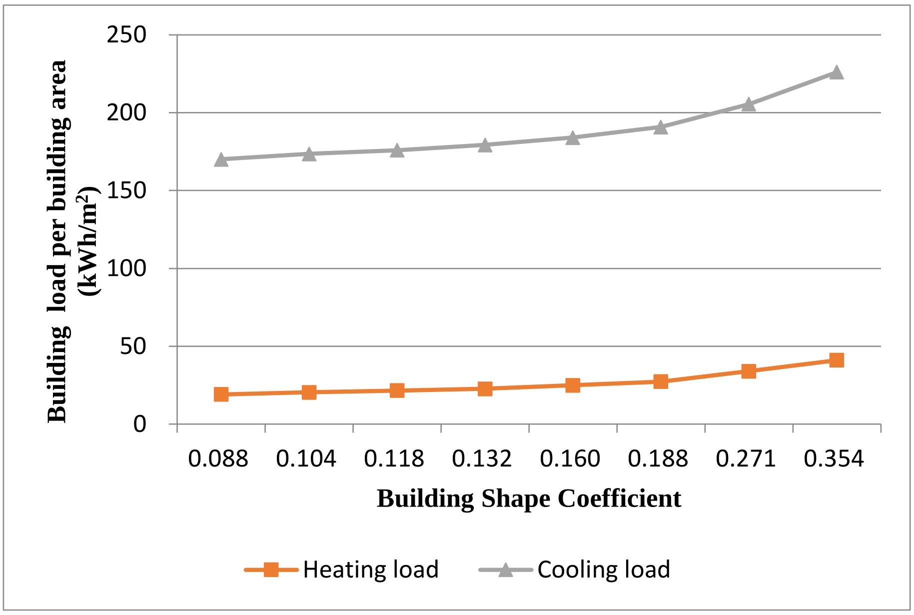


***Fig7.*** *Building load per building area of high-rise tower buildings*

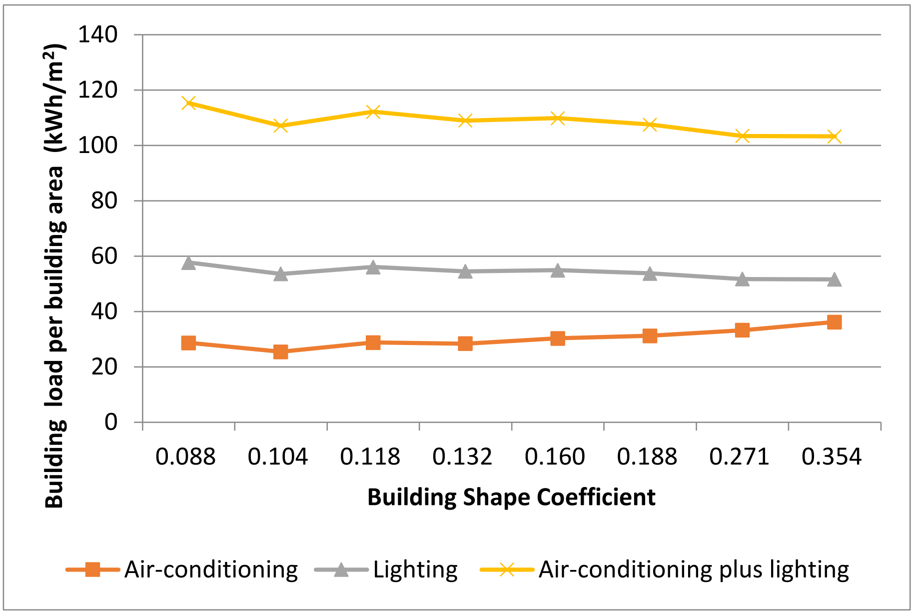


***Fig 8.*** *Building consumption per building area of high-rise tower buildings*

Due to the constant reference scenario, these simulation data can be comparatively analyzed. Both slab office building and high-rise tower office building, the bigger the building shape coefficient, the bigger heating/cooling load. So air-conditioning consumption per building area is increasing with the building shape coefficient. However, with the increasing shape coefficient, lighting consumption per building area and the sum consumption of air-conditioning and lighting is decreasing. This is because, the bigger shape coefficient, the bigger passive volume ratio, the more potential to use passive energy, such as natural ventilation and daylighting, decreasing building total energy demand.

## CONCLUSION

Building Shape coefficient has been a good indictor to building load. Minimizing heat losses requires minimization building shape coefficient; but this implies a reduction of the building envelope exposed to the outside environment, thus reducing the availability of daylight and sunlight and increasing energy consumption for artificial lighting, natural ventilation, etc. Building air-conditioning energy demand is only a part of building total energy demand. Considering the passive design technologies and the total energy consumption, the passive volume ratio is a good index at the architecture conceptual design period. When the passive volume ratio is less than 1, it is increasing with the building shape coefficient. So, to apply passive design technologies in hot-summer-and-cold-winter area in China, architectures can select the bigger shape coefficient for bigger passive volume ratio to reduce building energy demand.

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