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Study on Wind Environment Simulation and Comfort Degree of Zhenwu Temple

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Abstract: Outdoor wind environment is an important factor affecting people's experience. Based on the simulation and numerical analysis of wind environment of Zhenwu temple in Quanzhou, and the evaluation index of outdoor pedestrian height wind environment, the comfort degree of wind environment is evaluated, and the improvement measures are put forward to provide guidance for promoting the protection and tourism development of Zhenwu temple.

Keywords: Zhenwu temple; Wind environment; Comfort

1. Introduction

1.1. General situation and parameter setting of Zhenwu Temple

Zhenwu temple, located in Tonggang West Street, Fengze District, Quanzhou City, Fujian Province, is a place where Quanzhou people sacrifice to the sea to pray for the safety of maritime trade vessels in the Song Dynasty. It is one of the representative relics of Quanzhou sea silk culture and history. It was listed as a national key cultural relics protection unit in 2006. The historical sites of the silk sea culture in Zhenwu temple are composed of the mountain gate, the four corner Pavilion, the stone tablet of "swallowing the sea" and the Zhenwu temple built in the Ming and Qing Dynasties. The whole historical site is built on the mountain, facing the southeast and northwest, echoing the stone carvings of praying for wind in jiuri mountain, and jointly completed the complete ceremony "praying for wind" and "sacrificing to the sea" in Song Dynasty, as shown in Figure 1.

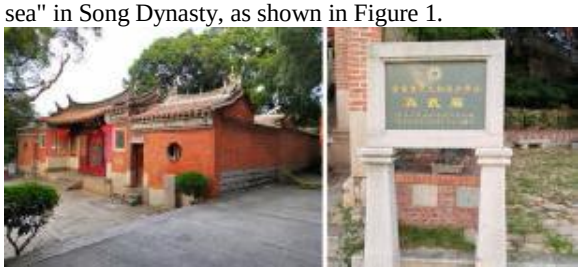

Figure 1. Current situation of zhenwu temple

In this study, Phoenix software is used to simulate the wind environment of Zhenwu temple. The validity, authenticity and practicability of the simulation results have been verified by relevant papers and widely used [1-3]. After confirming the Zhenwu temple as the research object, firstly, field survey and supplementary survey were carried out for many times on the terrain elevation difference, site plane, building plane and elevation within the scope of historical sites of Zhenwu temple; secondly, the plan and elevation were drawn with CAD software, and the 3D modeling of the scene (45m long, 52m wide and 7.2m high) was completed with SketchUp software; secondly, scene III of Zhenwu temple was completed Dimension model is imported into Phoenix software to carry out wind environment simulation. In order to better analyze the wind environment of Zhenwu temple, the two models of no environmental planting and environmental planting were compared (see Figure 2). The simulated wind parameters refer to the statistical data of Quanzhou Meteorological Network: in summer, the maximum wind direction is southwest wind with an average wind speed of 4.7 m/s; in winter, the maximum wind direction is northeast wind with an average wind speed of 6.13m/s.

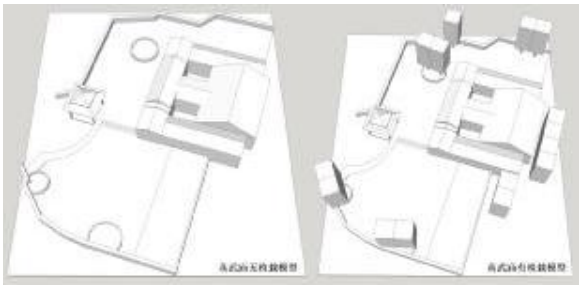

Figure 2. Planting model of zhenwu temple

2. Simulation Results and Analysis

2.1. No environment planting wind environment

The model of no environment planting scene in zhenwumiao was imported into Phoenix software to simulate the wind environment in summer and winter respectively,

and the wind speed value at h = 1.5m was measured, as shown in Table 1, figure 3 and Figure 4.

Table 1. Wind speed in summer and winter (m/ s) of no environment planting in zhenwu temple

Season	Windward area	Angular flow area	Through flow area	Eddy region	Wind shadow area	Wind difference
Summer	2.315	4.093	3.53	3.965	4.142	1.827
Winter	4.633	5.214	3.908	4.153	4.564	1.306

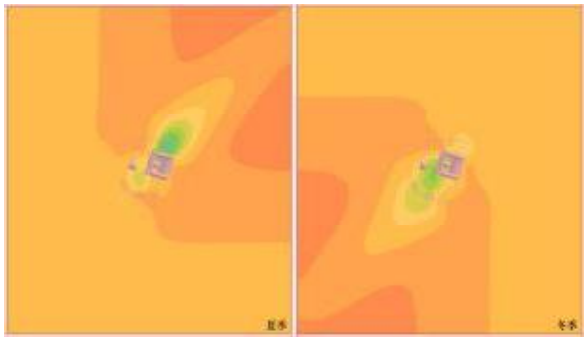

Figure 3. Wind speed map of no environment planting in Zhenwu temple in summer and winter

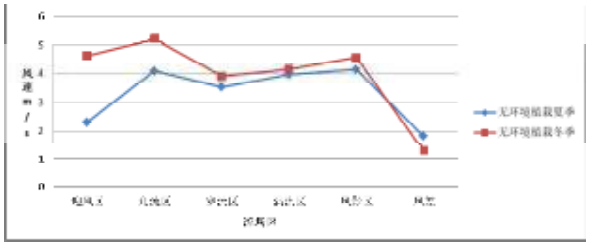

Figure 4. Comparison of wind speed in summer and winter of no environment planting in zhenwu temple

It has been proposed that the relationship between human comfort and wind speed: wind speed less than 1.0 m / s "can not feel the wind", 1.0-5.0 M / s "comfortable", and more than 5.0 m/s "uncomfortable" [4], the following conclusions are drawn by comparing Table 1 with it:

When there is no environment for planting in Zhenwu temple, the wind speed in each flow field area is between 1.0-5.0m/s in summer, which is "comfortable"; in winter, it is generally "comfortable", only the angle flow area makes people feel "uncomfortable"; the wind speed fluctuation in summer is greater than that in winter, and the wind speed in winter is greater than that in summer.

2.2. Environment planting wind environment

The environmental planting scene model of zhenwumiao was imported into the Phoenix software to simulate the wind environment in summer and winter respectively, and the wind speed value at h = 1.5m was measured, as shown in Table 2, figure 5 and Figure 6.

Table 2. Wind speed in summer and winter (m / s) of environmental planting in zhenwu temple

Season	Windward area	Angular flow area	Through flow area	Eddy region	Wind shadow area	Wind difference
Summer	2.043	3.965	3.516	3.673	3.881	1.922
Winter	4.376	5.67	3.718	3.126	3.68	2.544

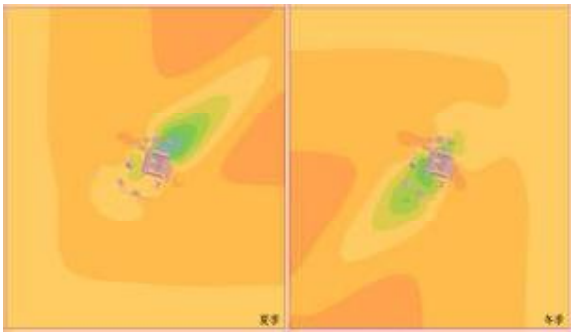

Figure 5. Wind speed map of planting environment in Zhenwu temple in summer and winter

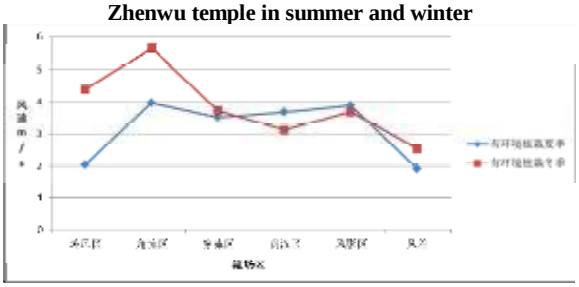

Figure 6. Comparison of wind speed in summer and winter with environmental planting in zhenwu temple

When there is environmental planting in Zhenwu temple, in summer, the wind speed in each flow field area of Zhenwu temple is also between 1.0-5.0m/s, which is "comfortable"; in winter, except for the angle flow area, it is "comfortable"; the wind speed fluctuation in winter is greater than that in summer, because of the influence of plants, the wind speed in eddy current area and wind shadow area is lower in winter than that in summer.

2.3. Comparison of planting wind environment in Zhenwu Temple

Combined with table 1 and table 2, the wind speed comparison diagram of Zhenwu temple in summer and winter

with or without environmental planting is obtained (see Figure 7).

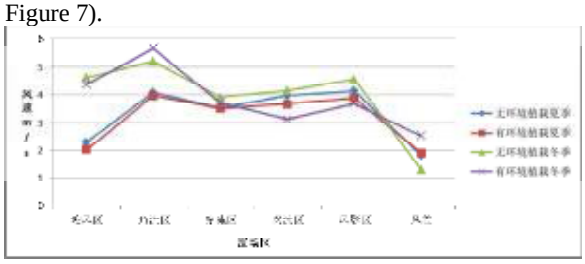

Figure 7. Comparison of wind speed in summer and winter with or without environmental planting in zhenwu temple

According to figure 7, the following conclusions can be drawn:

After the increase of environmental planting, the wind speed in each flow field area decreased significantly in summer and in winter, except for the angle flow area, which indicated that environmental planting can effectively reduce the wind speed and improve the environmental comfort.

After the increase of environmental planting, the change of wind difference in summer or winter is significantly higher than that in the absence of environmental planting, which shows that the change of environmental planting position can achieve the effect of increasing or reducing the wind speed of each flow field.

3. Conclusion

With or without environmental planting, the wind environment of Zhenwu temple is generally "comfortable" in summer and winter. Only in winter, there is "uncomfortable" situation in the corner flow area, and after increasing the environmental planting, the wind speed in the corner flow area in winter is significantly reduced. Therefore, it is suggested to increase facilities to block the northeast wind in winter in the corner flow area (northeast side of the scene), such as planting trees in patches, adding fences, and reducing the wind speed in winter.

4. Acknowledgment

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