

Study on the Influence of Greening Waterscape on the Thermal Environment of Buildings under Hot and Humid Climate

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Abstract. With the development of society, the formation of architecture has diversified trend. The microclimate of the building environment directly affects the comfort of the building and indirectly affects the energy consumption of the building. Reasonable increase afforestation waterscape shade is an effective measure to improve the micro climate buildings, this paper combining the measured experimental data and software simulation, we do research on typical greening system under hot and humid climate, analysis of different ways to the improvement of building micro climate, for further research, and offer some guidance to design buildings.

1. Introduction

An emerging research theme is how attitudes toward greenery and uses of green spaces can influence people's perceptions of the overall socio-spatial environment [1]. The thermal environment of buildings directly affects the comfort of people in the construction environment, and the research on thermal environment is of great significance to improve building comfort. Under different climate conditions [2-5], the comfort of building thermal environment varies. Especially in the humid climate, the building in the summer comfort is often not good, people in pursuit of high comfort, often need to rely on air conditioning and other equipment, which increases the building energy consumption. In recent decades, due to the rapid development of urbanization, the change of underlying surface structure, and the influence of factors such as traffic exhaust heat and building heat removal, city micro climate deteriorating, "heat island phenomenon" and its negative effect is increasingly protruding. Therefore, people need to study how to effectively improve the home of human beings. It is difficult to change climate conditions by relying on the current scientific and technological means of human beings, but it can control the microclimate of the surrounding buildings more easily.

In the design of building density, building materials, architectural layout, the rate, water facilities, air conditioning and anthropogenic heat factors will affect the outdoor thermal environment, even at the same time, different areas of the building will also exist different thermal environment. This is mainly reflected in the following aspects:

(1) The temperature and humidity of local air are different, and outdoor temperature may appear as "hot island" or "cold island". (2) The influence of monomer building form, architectural layout and plant occlusion will result in regeneration wind and secondary wind. (3) Under the shade of plants and buildings, different areas of the sun are exposed to different solar radiation at the same time.



Now, researchers have in high latitudes in the field test, verify regression greening system in the building room is significant, the influence of thermal environment mainly reflects in the shade of solar radiation. But in low latitudes and hot and humid areas, greening and the influence of water on the thermal environment significantly in high latitudes, block effect of solar radiation and evaporation cooling should be more clearly, to test the default as a result, the author through the measured experimental data and software simulation to return, of virescence and water body in the construction as well as the influence of outdoor thermal Environment Construction of Outdoor Environment Landscape Layout of Hot and Humid Climate Were Studied.

2. Test experiments

2.1. Measured objects and methods

In-situ test is to know the different spatial layout pattern and the teaching building on giant green water scene arrangement micro climate characteristics of the influence of the necessary way of computer numerical simulation for the next step is to provide effective basic data for reference. The measured object of this paper is a huge structural teaching building in a campus, as shown in figure 1. The teaching building is south of Bailu lake, the lake is about 150m wide, the length is about 700m, the north bank is rich in vegetation, the north surface property is rich, and there are large areas of grass, shrubs, trees and so on. In order to further study of different green water in hot summer and warm winter area climate characteristics, the author in the summer of 2016 designated the measured to investigate the micro climate parameters of a teaching building courtyard, including air temperature, relative humidity, black ball temperature, wind speed, etc., and examines the courtyard surrounded the different forms, different opening direction and different height to width ratio and decorate water scene on micro climate of the building courtyard space.



Figure 1. Arrangement of measuring points.

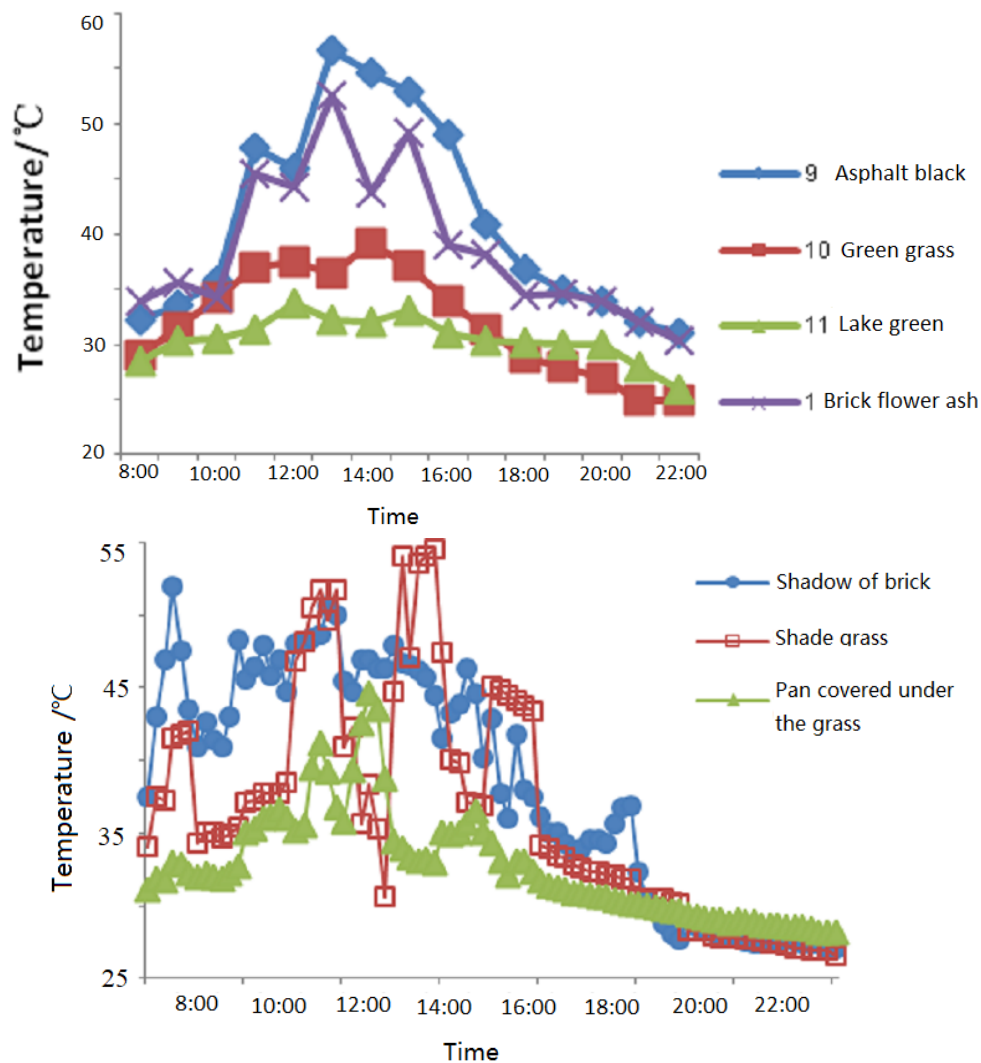
The measured contents include air temperature, relative humidity, black ball temperature, wind speed and surface temperature [6]. According to two principles, one is not to affect the life of teachers and students. Secondly, the probe of each measuring instrument is arranged at the height of 1.5M from the ground. In order to test the accuracy, the temperature and humidity controller is placed under the visor to prevent the solar radiation effect. Therefore, the arrangement of each measuring point has certain similarity. The actual test was conducted on June 27, 2016 and the test time is from 8:00 to 22:00. Under the pad surface, it can not only influence the area of air temperature, surface temperature in the summer, due to higher surface temperature will release more radiation, reducing activity near the thermal comfort of people, so it also affects the human thermal sensation.

Table 1. Measuring point

Number	Measuring point	Measure the ambient conditions around the point
1	Brick pavement	In the shade, on the side of the grass, on the other side is the asphalt pavement
2	In the lawn	There are shrubs, trees and so on
3	In the lawn	They are basically shaded by climbing plants
4	The bushes	The three sides are five stories high and one storey high. A brick road is next to it
7	Waterscape	The four sides are five floors high and the environment is more closed
9	Asphalt road	Under the shade of a small tree, surrounded by artificial lake, on the side is a large area of grassland, one side is asphalt pavement
10	greensward	A large area of grass near the artificial lake
11	Artificial lake (surface temperature measurement point)	Large area artificial lake

2.2. Analysis of measured results

Sorts through the measured experimental data and can draw the following analysis: the figure 3.45, you can see that different material of the surface of the underlying surface temperature distribution trend for lake surface < grassland < floor tile < pitch. In the actual day, asphalt material of underlying surface and the maximum difference in the surface temperature of the lake is 24.4 °C. From figure 3.46, can know the shade of the site of floor tile material black ball average temperature is 38.5 °C, the site of the grass under the tree black ball average temperature is 36.5 °C, the site of climbing plants shade black ball average temperature is 32.7 °C, and it is concluded that the surface of the underlying surface temperature distribution trend for grassland < floor tile, climbing plants shade "the shadow of the tree. Figure 3.47, can know with impermeable floor tile materials built road long time exposure to the sun radiation, does not have the condition of evaporative cooling, makes a significant rise in temperature, on the surface of the surface and by convection and radiation way to make the air temperature rises above, cause tiles above air temperature is relatively high; Bush, have the function of the evaporative cooling, it is at the top of the air temperature is lower than the air temperature above tiles, but because of the grass steamed ability stronger than shrubs, shrub grassland air temperature is above the upper air temperature is low. So the trend surface temperature points cloth for shrub grassland < bush < floor tile.

**Figure 2.** Temperature profile.

3. Construction and simulation of different greening waterscape models

In hot summer and warm winter area huge structural type teaching buildings in vegetation is rich, various types of landscape, usually grow or layout has a large area of grass, shrubs, trees, water, etc. [7]

Table 2. The physical properties of the underlying surface

Number	Simulation point	Short wave reflectivity	Long wavelength emissivity	heat conductivity coefficient	density	Specific heat
1	Building external wall	0.35	0.95	1.16	2150	1600
2	Concrete pavement	0.35	0.95	1.16	2000	1000
3	Macrophanerophytes	0.9	0.2	2	100	2000
4	The bushes	0.9	0.15	2	100	2000
5	The grass	0.9	0.15	2	100	2000
6	Climbing plants	0.9	0.15	2	100	2000
7	Water	0.2	0.95	0.5	1000	4000

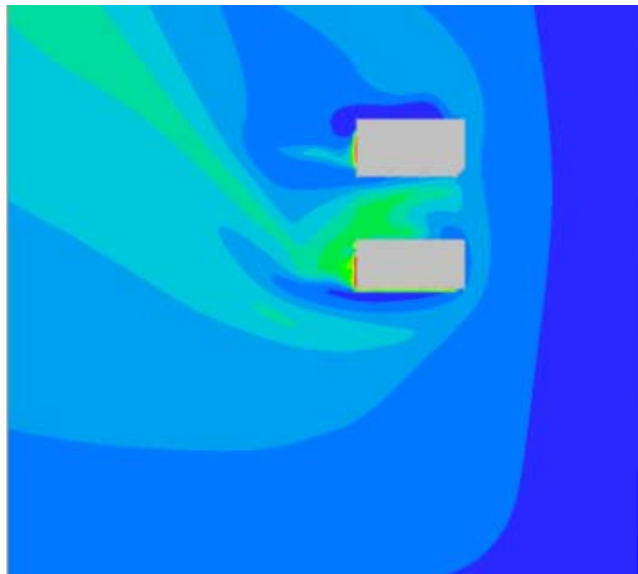


Figure 3. Temperature map at 1.5m above the grassland

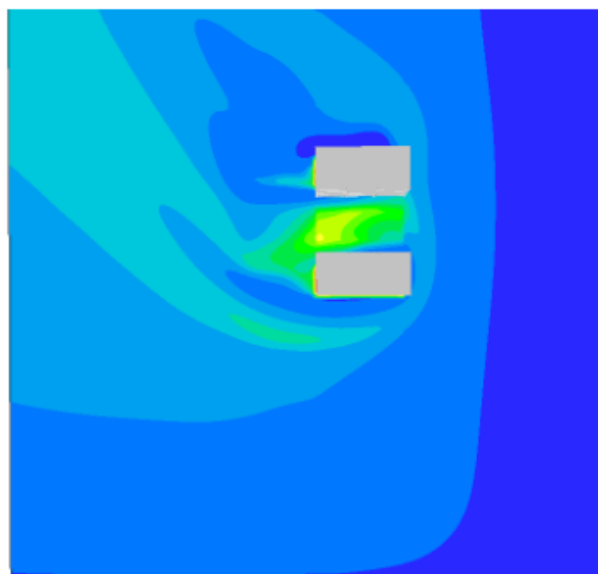


Figure 4. Shrub 1.5m high temperature char

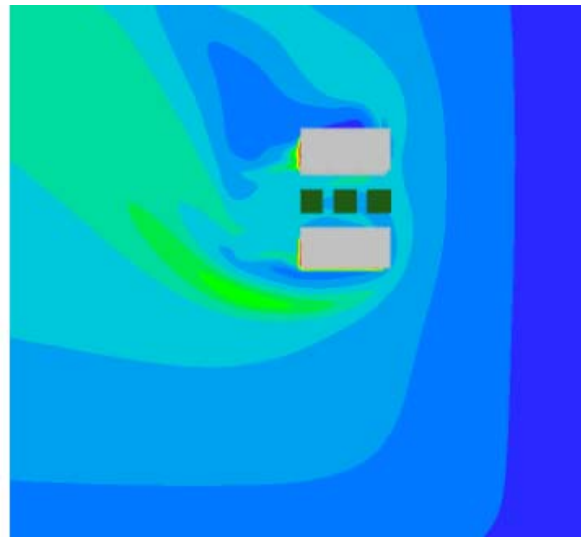


Figure 5. The temperature chart of the 1.5m height of the tree

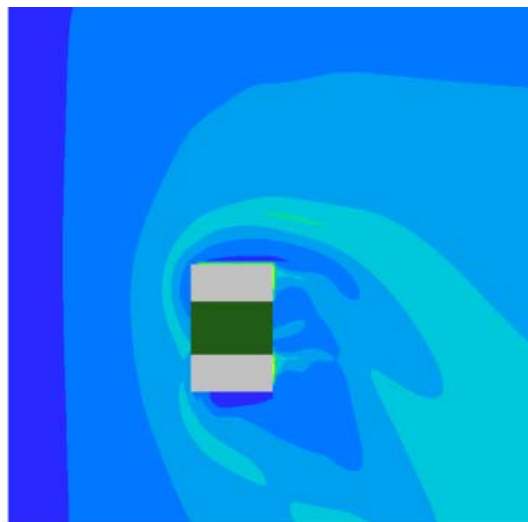


Figure 6. The temperature chart of the 1.5m height of climbing plant

Simulation boundary conditions: the turbulence model is set as KECHEN model [8], and the roughness is set to 0.03 m. Model of due north direction for the Y axis is the direction. Set simulation time is China building thermal environment analysis special meteorological number according to the concentration of typical meteorological year in summer climate parameters, select the strongest solar radiation time 12:00, wind direction for southeast wind, the wind speed 2 m/s, to 10 m high to flow the air temperature is 32.3 °C, relative humidity 64%. The local latitude 24.48, the sun radiation intensity 694 W / m², 198 W/m². Two meters for constant temperature underground layer (28 °C). Objects and turbulent initial temperature setting for the dew point temperature of 26.7 °C.

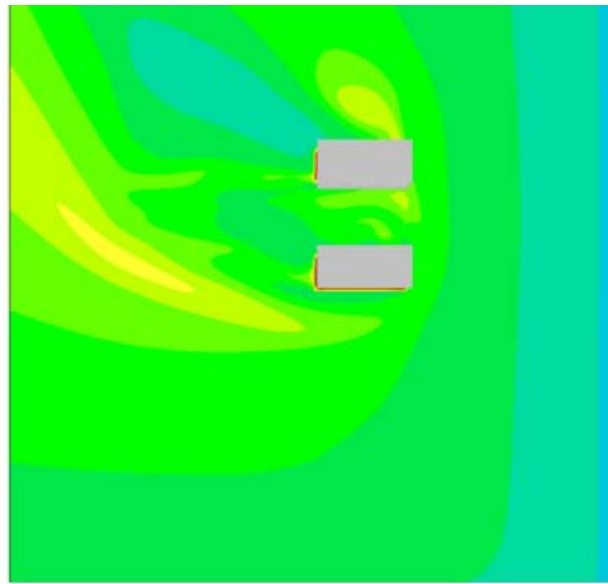


Figure 7. Water 1.5m high temperature chart

Figure 3-7 shows the simulation results show that by comparison with 1.5 m high air temperature and air temperature on the surface of the underlying surface contrast, can know all kinds of landscape elements to building a summer microclimate and followed by the effect of the improvement is climbing plants > grassland > shrub > tree > water.

4. Conclusion

The landscape elements to building a summer micro climate of the effect of the improvement is climbing plants > grassland > shrub > tree > water. In this paper, the giant structural type teaching buildings in hot summer and warm winter area environment has carried on the preliminary discussion, but there are still many problems remain to be further explored. Plant species, for example, the influence of the teaching building on giant micro climate, xiamen overseas Chinese big learning campus greening tree type many, canopy shape also have differences, different trees have different season of falling leaves, all of these factors on giant structure type teaching building micro climate condition has an effect. In addition, the giant structure type material laying the ground of the teaching building is also affecting factors, simulation of this article only discusses the concrete rigid floor, different color of stone material, or permeable brick paving influence on teaching building micro climate environment, also need to be further discussed. For giant compose type teaching building environment design, micro climate environment condition is only one of these aspects, and the micro climate of the giant building mode of teaching environment is not under building space form features and the influence of green water scene arrangement.

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