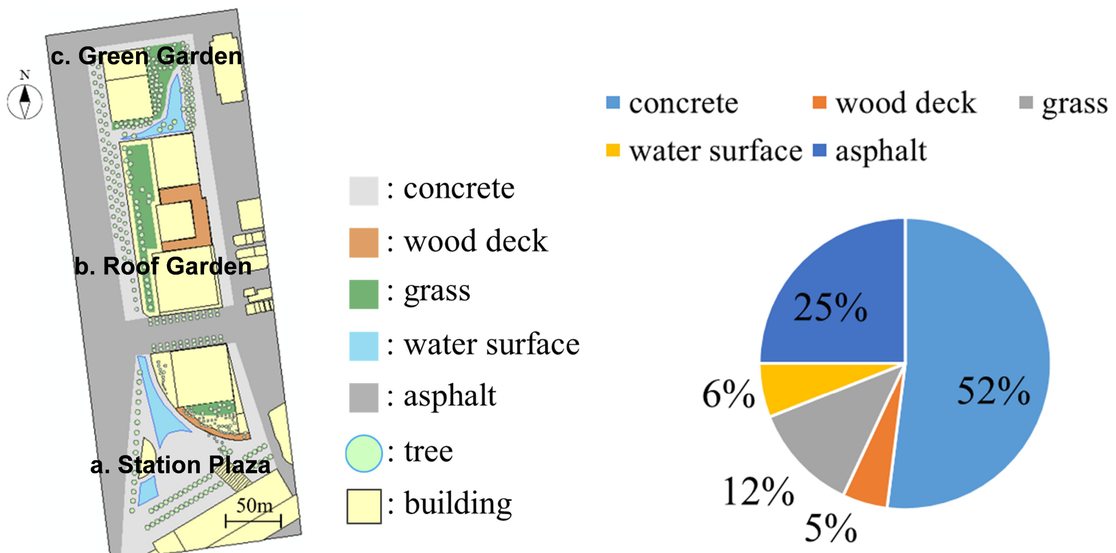
Study on the effect of morphologic features and material properties on microclimatic development and pedestrian comfort

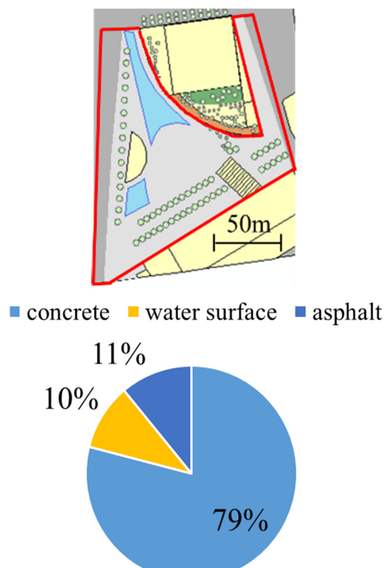
Hideki Takebayashi, Sae Kyogoku, Sintaro Nakayama, Kentaro Aoyama, Etsuko Ishii (Kobe University, Japan)
Makiko Kasahara, Shingo Tanabe, Makoto Kouyama (Nikken Sekkei Ltd, Japan)

Measurements

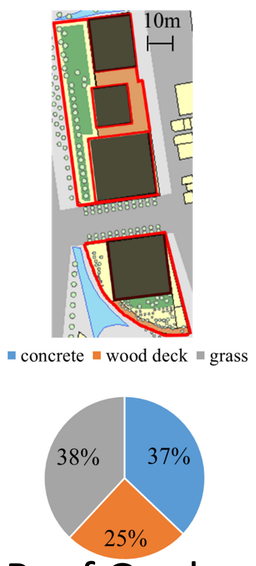
Elements: Air temperature, relative humidity, surface temperature, wind direction and velocity, thermal image
Period: at 10:00, 13:00, 17:00, 20:00 from 22 to 26 July 2013



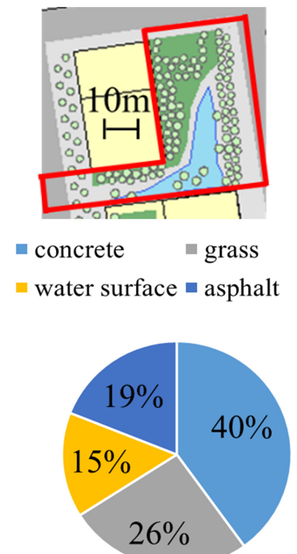
Whole objective buildings and area ratio



a. Station Plaza



b. Roof Garden

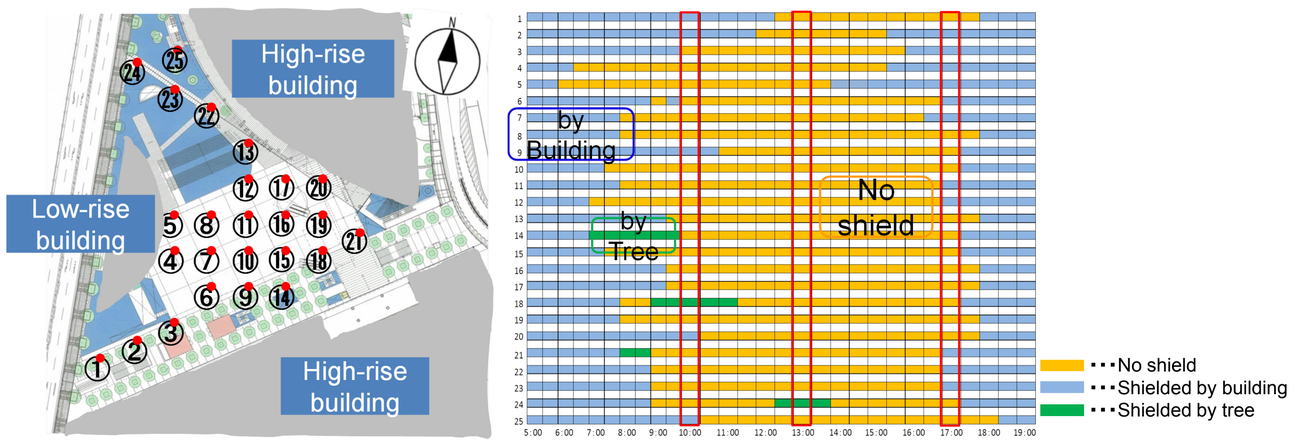


c. Green Garden

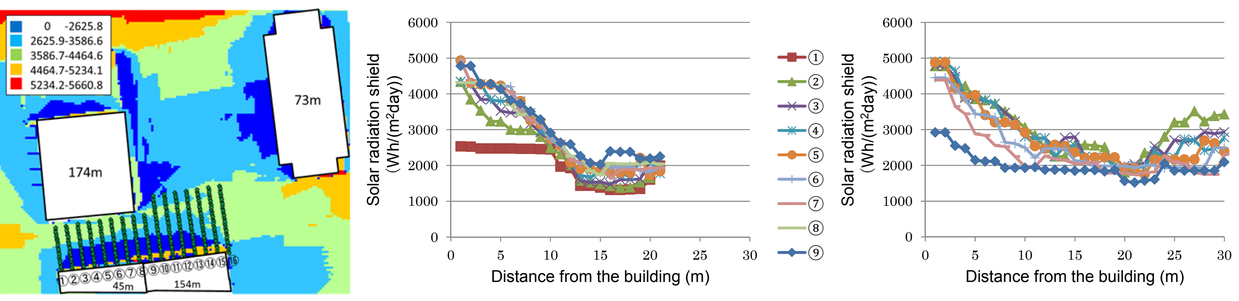
Objective buildings, trees and covering materials arrangement and area ratio of each ground cover materials

Solar radiation shield by buildings and trees

In both Station Plaza and Green Garden, direct solar radiation is shielded by mainly buildings on the back of trees rather than trees.
Solar radiation shield by the trees is required in the range of more than 10m from the south side building, based on the relationship between the distance from south side buildings and the daily integrated solar radiation shield.

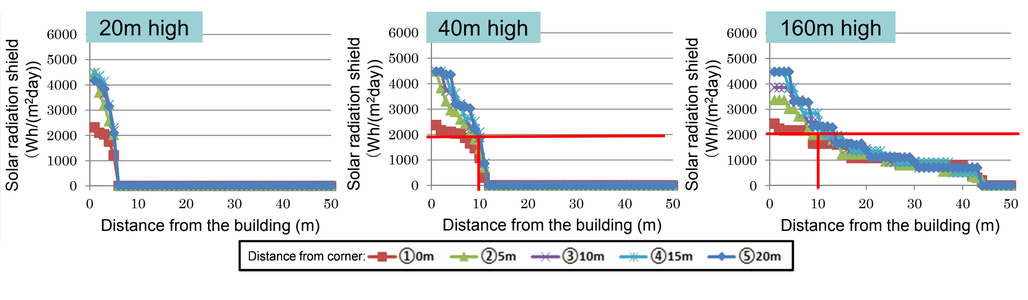


Evaluation results of hourly solar radiation shield by buildings and trees in Station Plaza



Daily integrated solar radiation shield and the distance from southern building

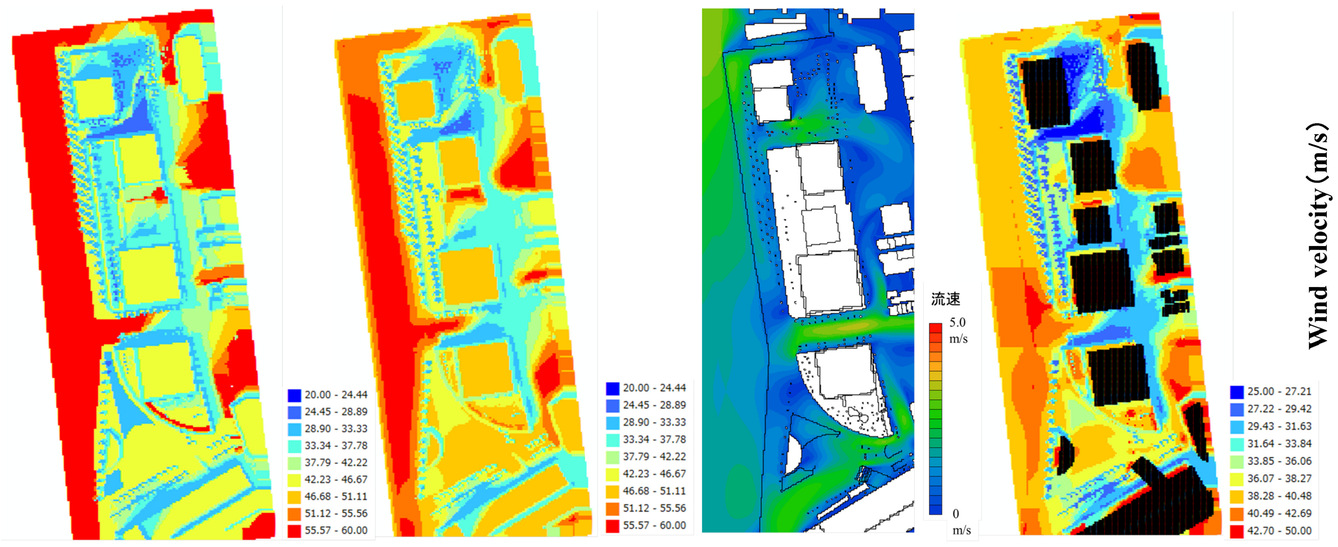
Evaluation results of hourly solar radiation shield by buildings and trees in Green Garden



Daily integrated solar radiation shield and the distance from southern building with several heights

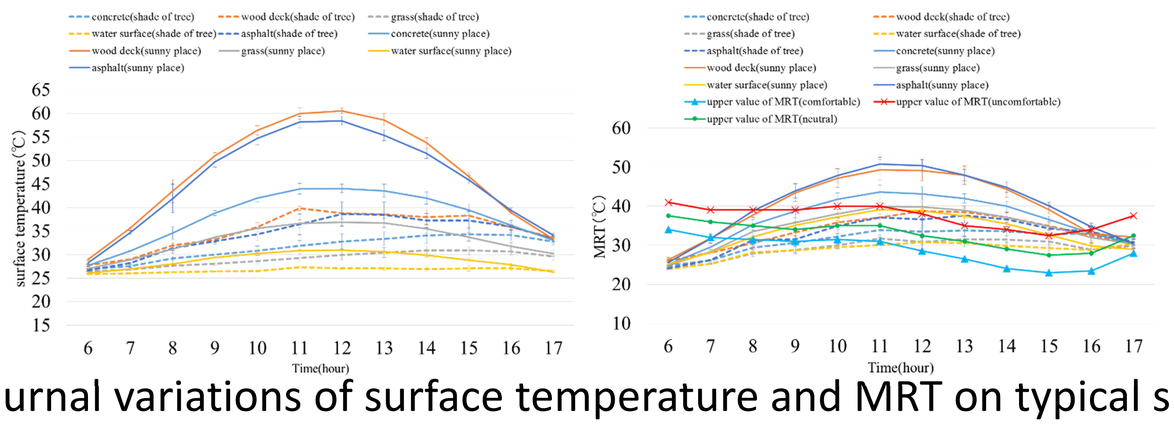
Discussion of SET* distribution

In Station Plaza, MRT is high and the variation in wind velocity is large. In Roof Garden, MRT is also high, while the wind velocity is generally high.
In Green Garden, the variation in MRT is large as well, but the wind velocity is low.



Surface temperature, MRT, wind velocity and SET* distribution at 13:00 on typical summer day

Effects of MRT and wind velocity on SET* at 13:00 on typical summer day (left: observation, right: calculation)



Diurnal variations of surface temperature and MRT on typical summer day

Summary

The improvement of the surface cover material to such as grass or water is effective for the mitigation of urban heat island, i.e. surface temperature reduction.
Solar radiation shield by trees or buildings is effective for the improvement of outdoor thermal environment, i.e. MRT reduction.