Application of Universal Effective Temperature to Evaluate Performance of Traditional Pine Hedges

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Rudofsky, B. (1964) Architecture without architects – a short introduction to non-pedigreed architecture –, Doubleday & Company, New York

What is Tsuijimatsu?

- The traditional pine hedges in Izumo city of Japan
- These hedges enclose the west and/or north sides of detached houses
- Rudofsky (1964) introduced as windscreens into "Architecture without architects"
- The hedges also work as sunshades to block the afternoon sun in summer

Purpose

to derive quantitatively the climatically adapted performances of tsuijimatsu in °C by using the thermal index ETU (Universal Effective Temperature)

What is ETU?

- Can consider the solar radiation and heat conduction, as well as air temperature, longwave radiation, humidity, air velocity, metabolic rate, and clothing insulation, based on the human heat balance
- Can indicate simultaneously the universal and separate effects of the thermal factors, in the same unit of degree Celsius °C

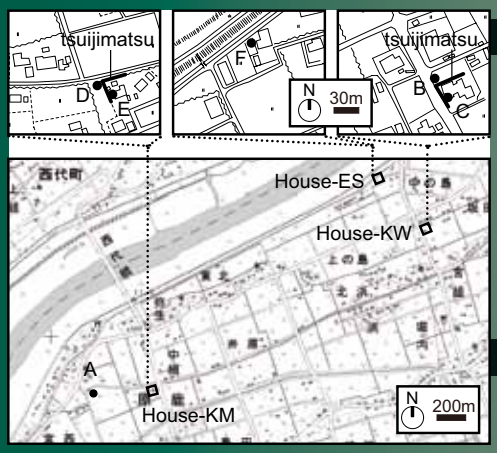
$$ETU = t_{ao} + \frac{NUATF}{h_u} + \frac{TVF}{h_u} + \frac{TVFr}{h_u} + \frac{TVFe}{h_u} + \frac{SERFL}{h_u} + \frac{ERFS}{h_u} + \frac{SEHF}{h_u}$$

ETU: universal effect; NUATF/h_u: effect of air temp. difference; TVF/h_u: effect of velocity; ERFS/h_u: effect of solar radiation

For details about ETU, please refer to the paper below:

Nagano K., Horikoshi T.: New index indicating the universal and separate effects on human comfort under outdoor and non-uniform thermal conditions. Energy and Buildings, 43(7): 1694-1701, 2011

Soon after the conference, you can download the calculation program (Microsoft Excel VBA) at: http://www.nara-wu.ac.jp/daigakuin/nagano/



Observation points

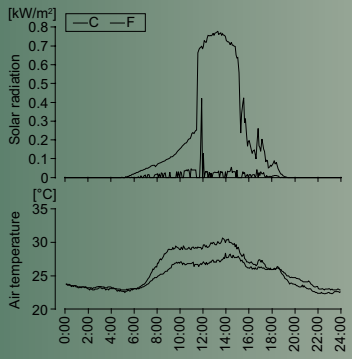
House KW

House KM

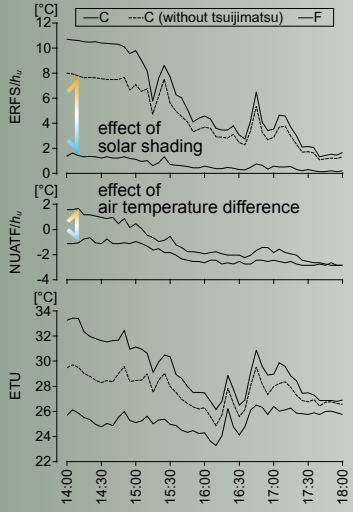
House ES

Climatically adapted performance of tsuijimatsu in this observation

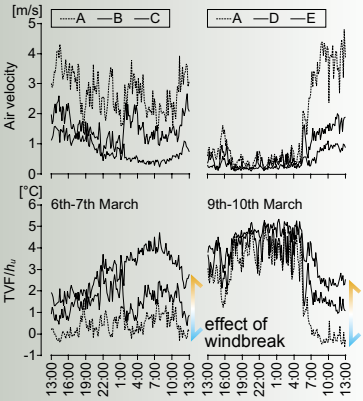
- SOLAR SHADING EFFECT showed approximately equivalent to 6°C at the maximum
- WINDBREAK EFFECT showed approximately equivalent to 3°C at the maximum



Changes in the solar radiation and air temperature at the points C and F on 29th June, 2006



Changes in ERFS/hu, NUATF/hu, and ETU at the points C and F on 29th June, 2006



Changes in air velocity and TVF/hu at the points A, B, and C on 6-7th March, and at the points A, D, and E on 9-10th March, 2006