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Countermeasures to Urban Heat Islands, Berkeley

Urban Planning 9:40-10:00

Effect of Policies for Building Low-Carbon Cities and Evaluating Them in Asia: From Mitigation Around Buildings

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Environment and Energy around Building Blocks (EEBB)

Survey

- Monitoring data
- Thermal environmental observation
- Weather data

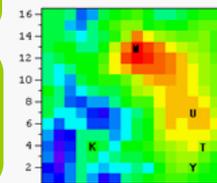
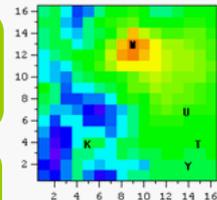
Numerical simulation

- CFD (Computational Fluid Dynamics)

Publishing in WEB

BEMS

Map of Urban Climate



Environmental Information System

- Change of urban form (past - present)
- 3D surface form of land covering and buildings

Buildings

Energy Saving Potential (Household size, Building form, etc)



Building Blocks

Reduction potential estimation in terms of population density etc.



Accumulation + α

Energy Saving Potential Distribution

Figure: Concept of developed system

Collation of building model and survey

→ Making environmental evaluation

Research flow on EEBB

(Environment and Energy around Building Blocks)

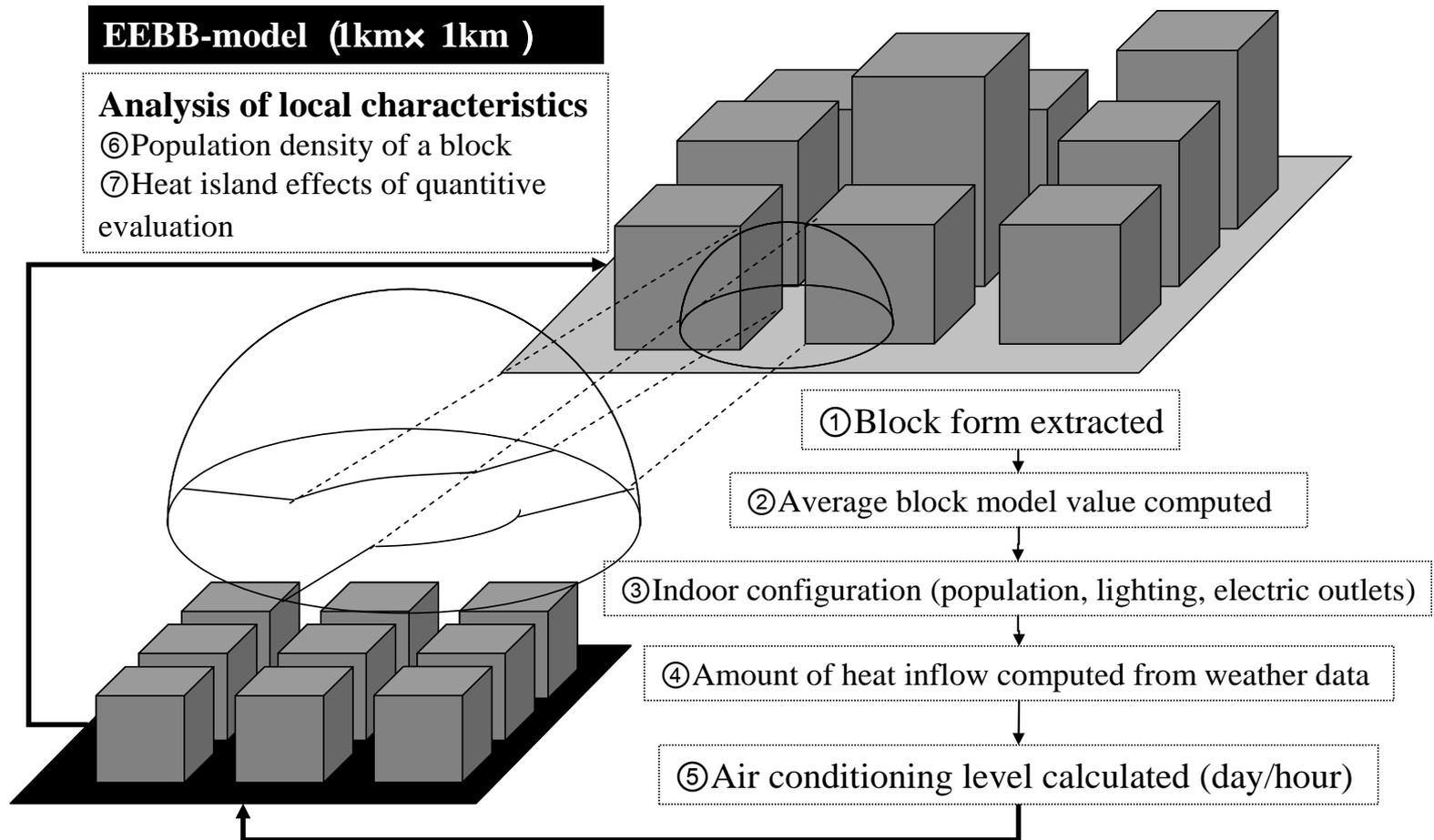


Figure: Research flow on EEBB (Yoshida et al. 2008)

SVF is the key factor in this system

Center of Nagoya in 2005

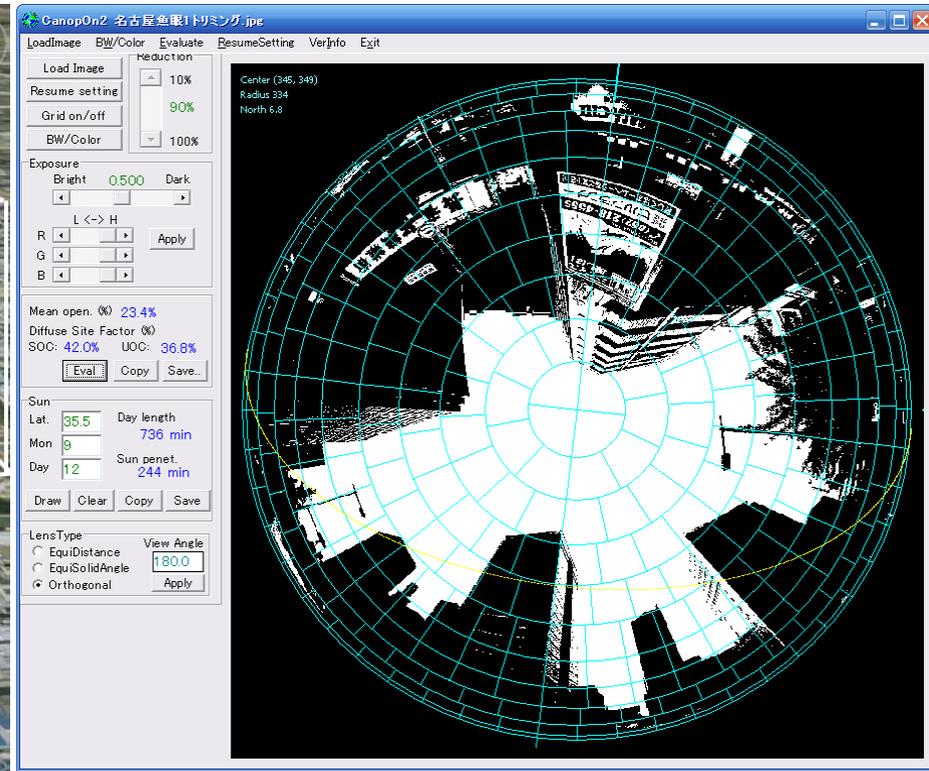
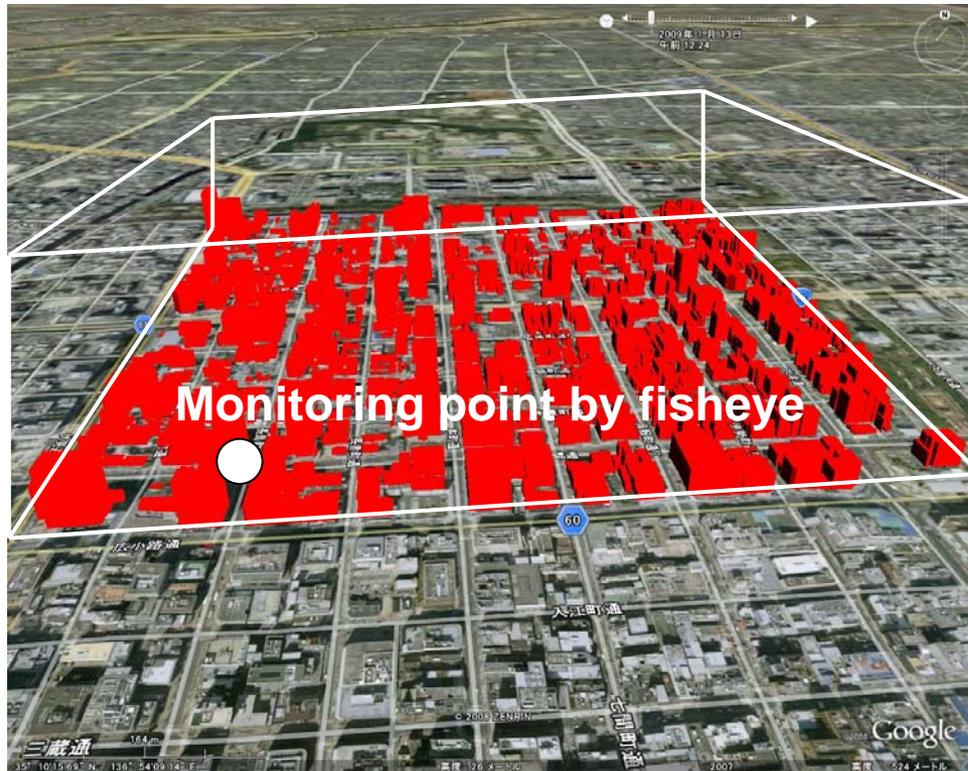


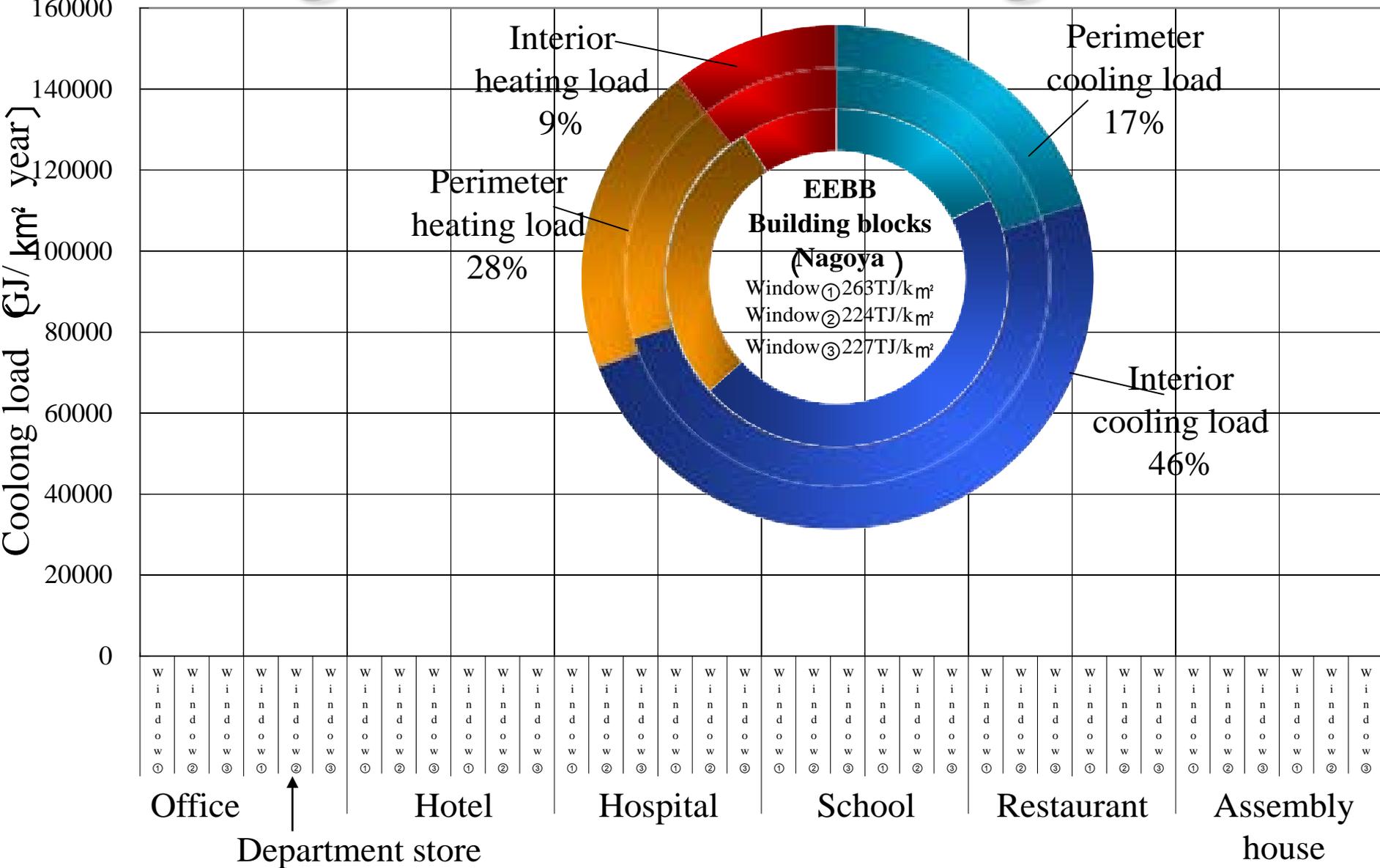
Figure. Research site (Nagoya) on Google earth

Figure. Sky view factor from photo with fisheye (Nikon CoolPix-P5100 +FC-E8)

Building blocks: Average building height 21.5m Number of stories : 7F (floor height 3.2m)
 Daytime population: About 20,000 people Day-and-night population ratio: About 500%

Building coverd ratio		Road coverd ratio		Tree coverd ratio	Bare land ratio
Wlthout roof plant	Roof plant	General pavement	Water retentive		
50	0	13	3	16	18

Cooling load of building blocks



Characteristics of building environment using natural ventilation

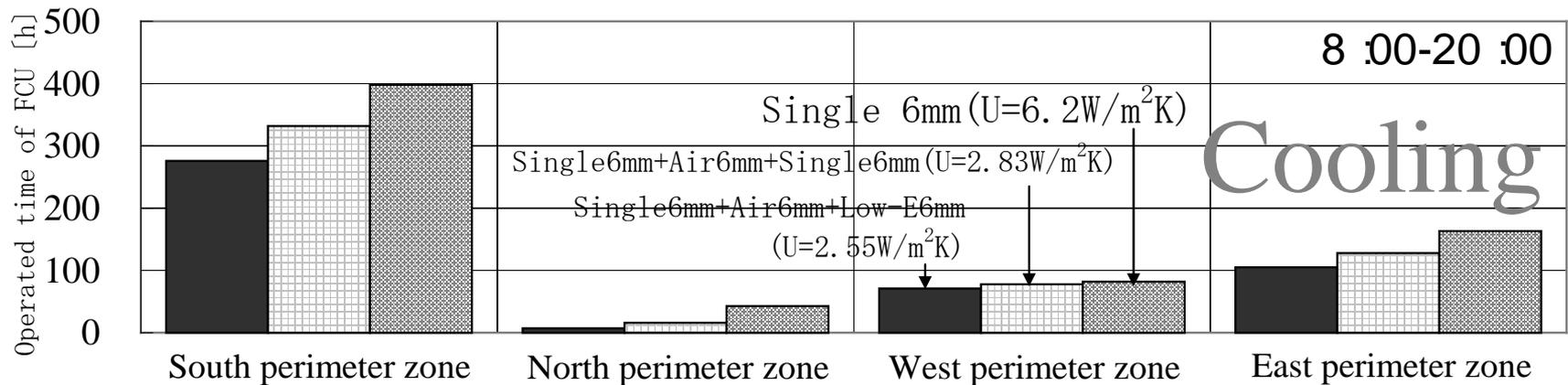
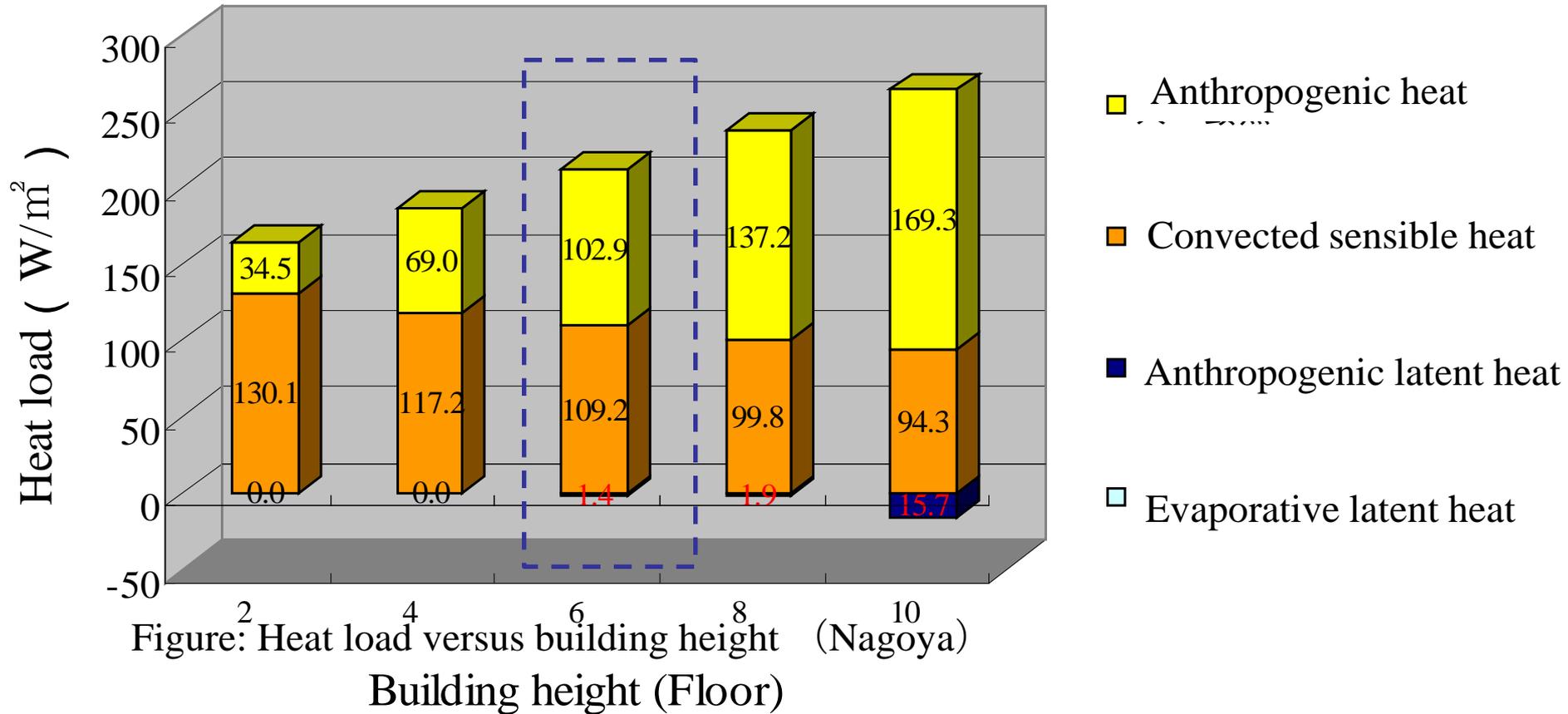


Figure. FCU operation time for cooling load in each perimeter zone

This result shows the southern perimeter zone has a beneficial effect on high specification windows.

The north, west and east sides of buildings have little effect on cooling with the high specification windows in the Nagoya building blocks (road width 8 m, building height 20 m).

Heat load calculation (UCSS-MOE)



Reference: Urban Climate Simulation System (UCSS) developed by Dr. Ashie, Japan.
MOE developed a simple calculation tool, March 2002.

Analysis by RayMan1.2 model Andrea

Albedo : 0.3 , Bowen ratio : 1.3

RayMan 1.2

File Input Output Table Language ?

Date and time

Date (day.month.year) 20.9.2006

Day of year 86

Local time (h:mm) 10:00:00

Now and today

Geographic data

Location: Nagoya, Japan

Add location Remove location

Geogr. longitude (°..'E) 136°54'

Geogr. latitude (°..'N) 35°11'

Altitude (m) 0

time zone (UTC + h) 9.0

Current data

Air temperature Ta (°C) 28.0

Vapour pressure VP (hPa) 18.9

Rel. Humidity RH (%) 50.0

Wind velocity v (m/s) 0.0

Cloud cover C (octas) 0

Global radiation G (W/m²)

Mean radiant temp. Tmrt (°C)

Personal data

Height (m) 1.75

Weight (kg) 75.0

Age (a) 35

Sex m

Clothing and activity

Clothing (clo) 0.9

Activity (W) 80.0

Thermal indices

PMV PET SET*

Close

Figure. RayMan1.2 model of parameters

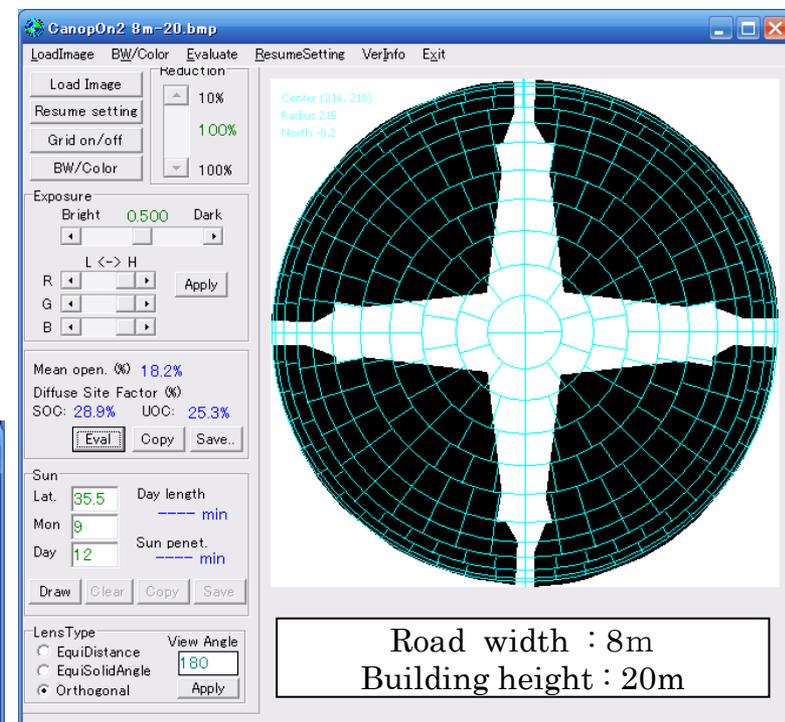


Figure. SVF on 3D- model of Canopy

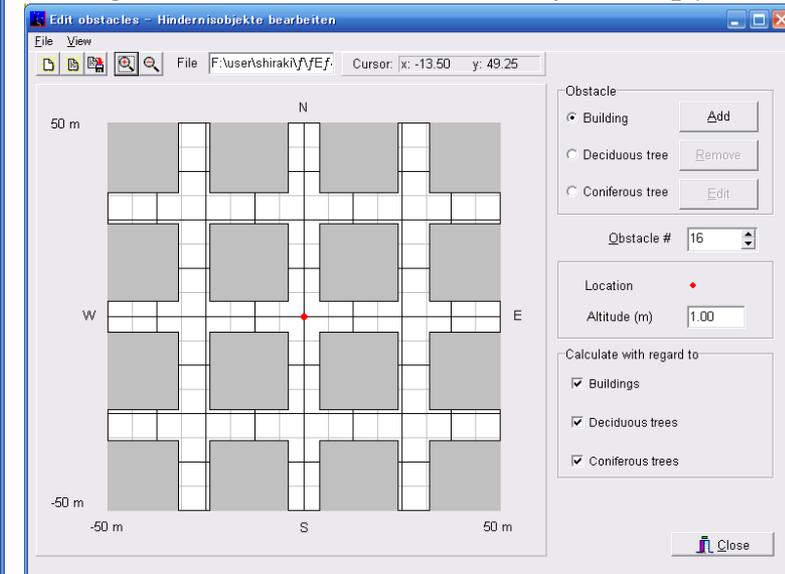
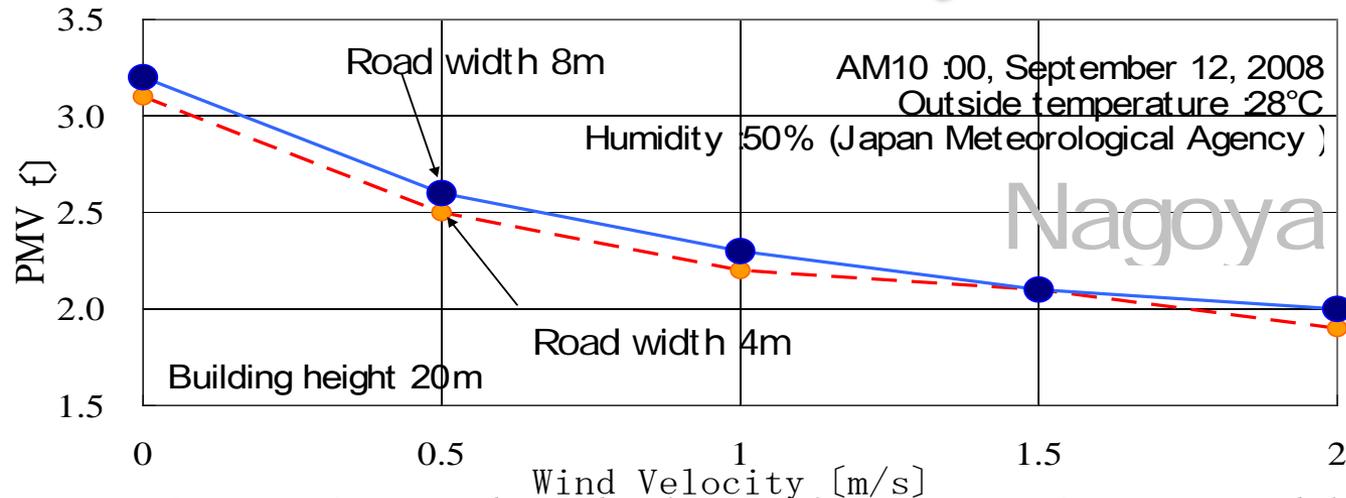


Figure. 3D- model of Canopy

Wind velocity and comfort



When we changed the width of roads to 4m, the effect of wind change of was not significant.

Figure PMV and wind velocity of Nagoya (RayMan model)

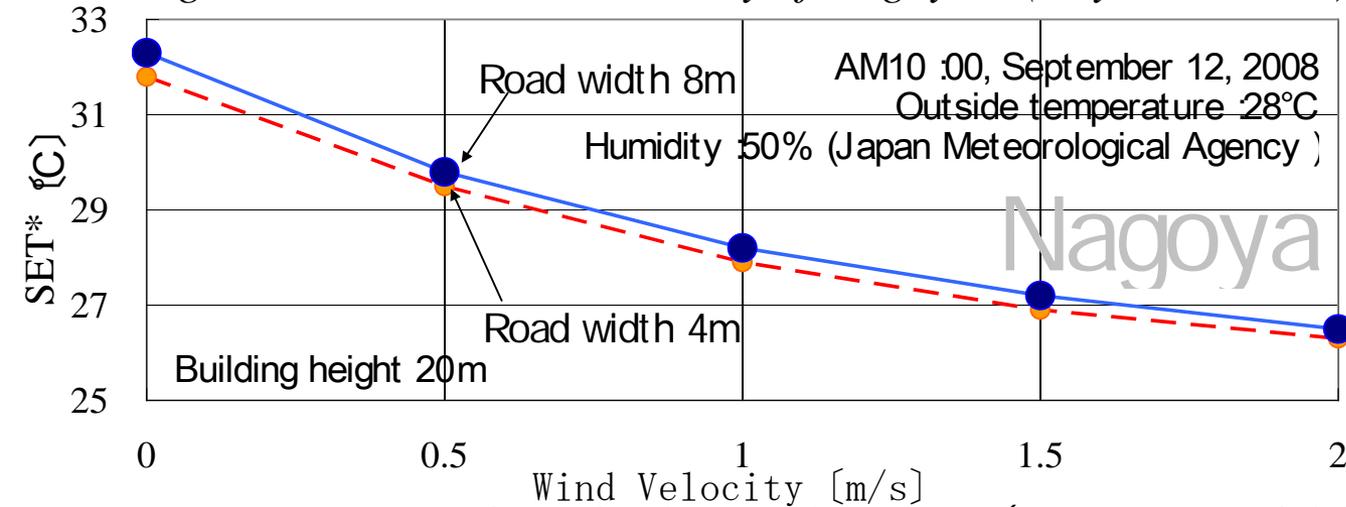


Figure SET* and wind velocity of Nagoya (RayMan model)

When the wind velocity decreased, the PMV/SET* value also decreased, thus reducing the thermal stress.

Sky view factor and comfort

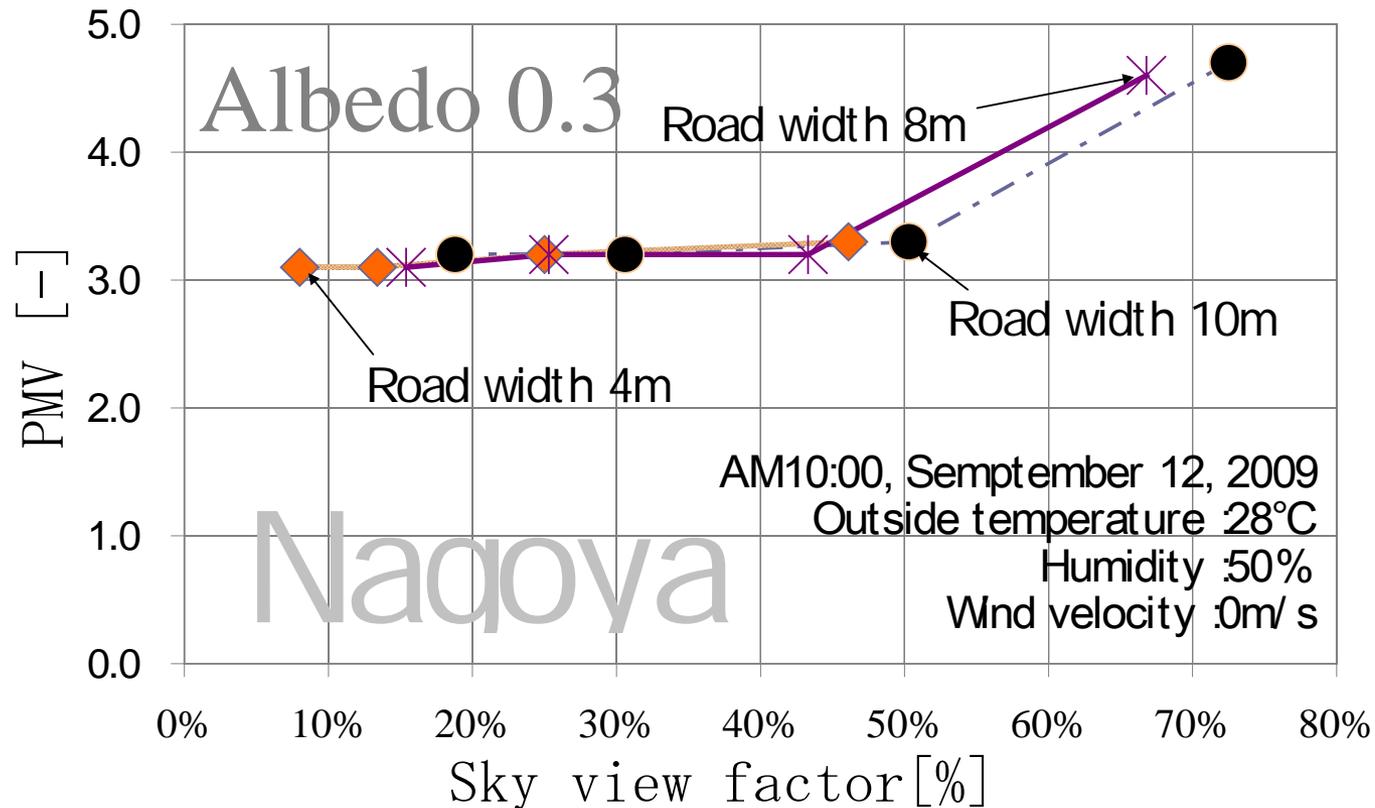


Figure PMV and sky view factor in Nagoya (RanMan model)

When planning the building blocks in Nagoya we found that the values of SVF less than 45% are appropriate.

Sky view factor and comfort (AM

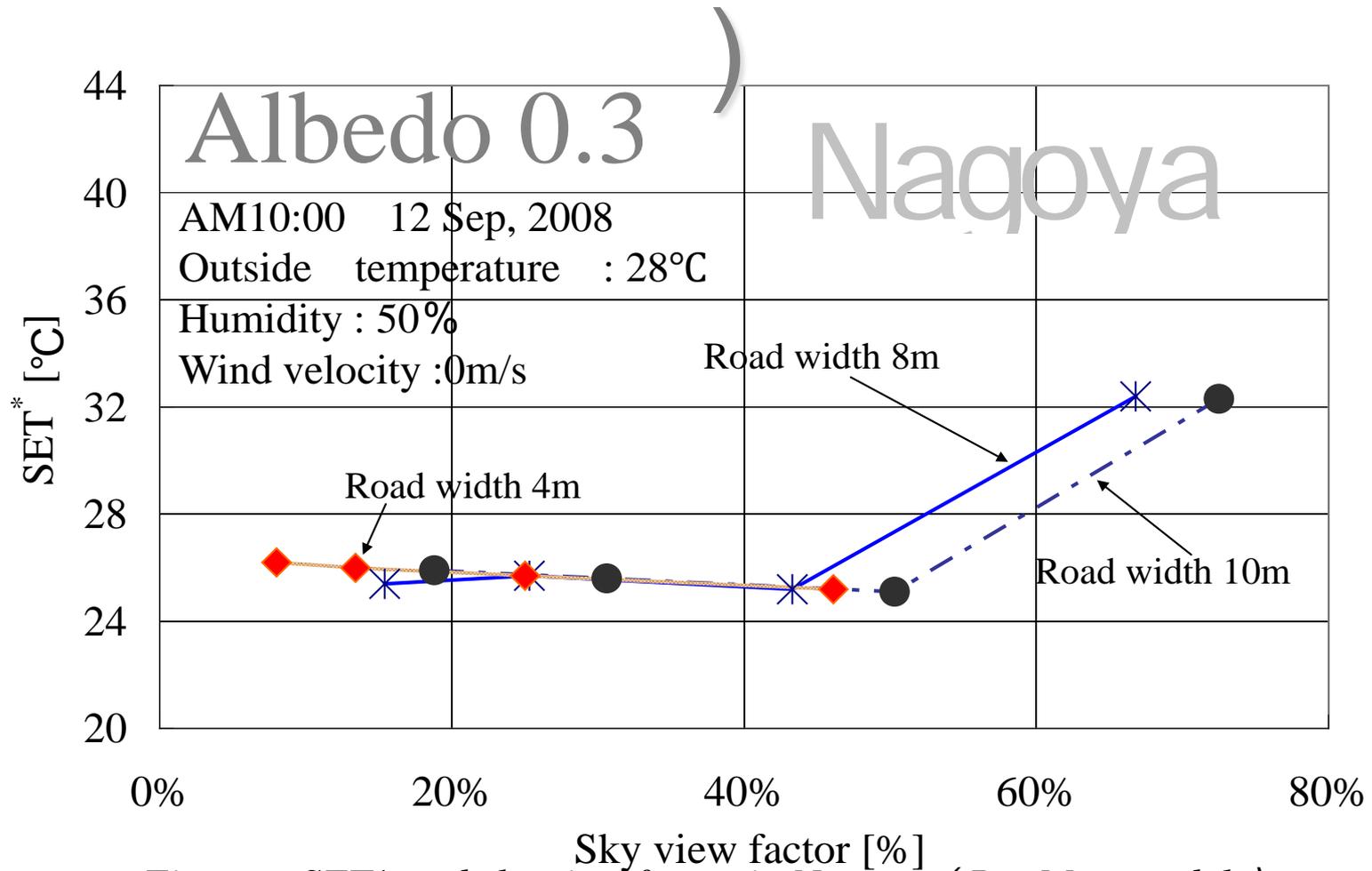


Figure SET* and sky view factor in Nagoya (RanMan model)

When planning the building blocks in Nagoya we found that the values of SVF less than 45% are appropriate at AM.

Sky view factor and comfort (PM

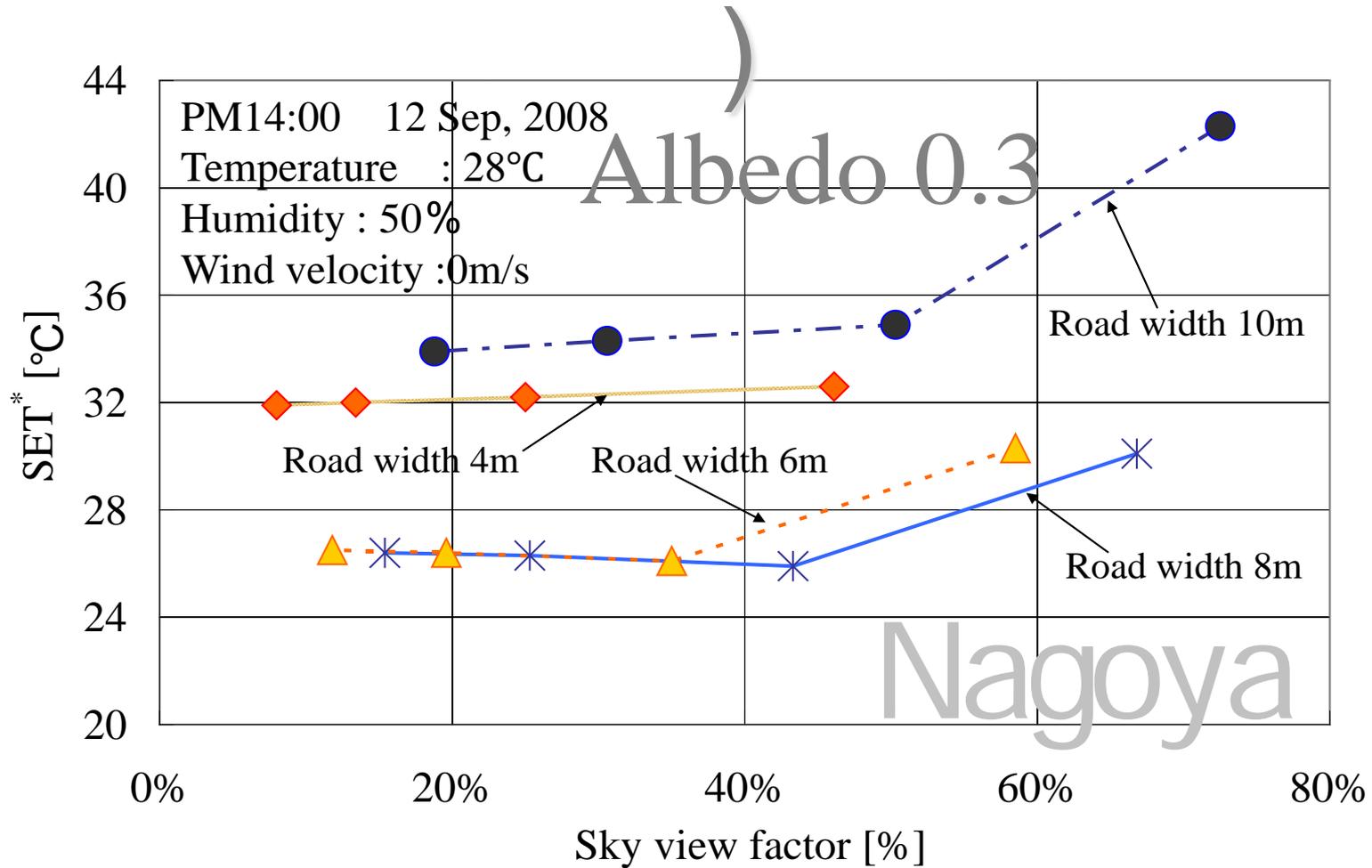


Figure SET* and sky view factor in Nagoya (RanMan model)

When planning the building blocks in Nagoya we found that the values of Road width 6m or 8m are appropriate.

Sky view factor and comfort (PM

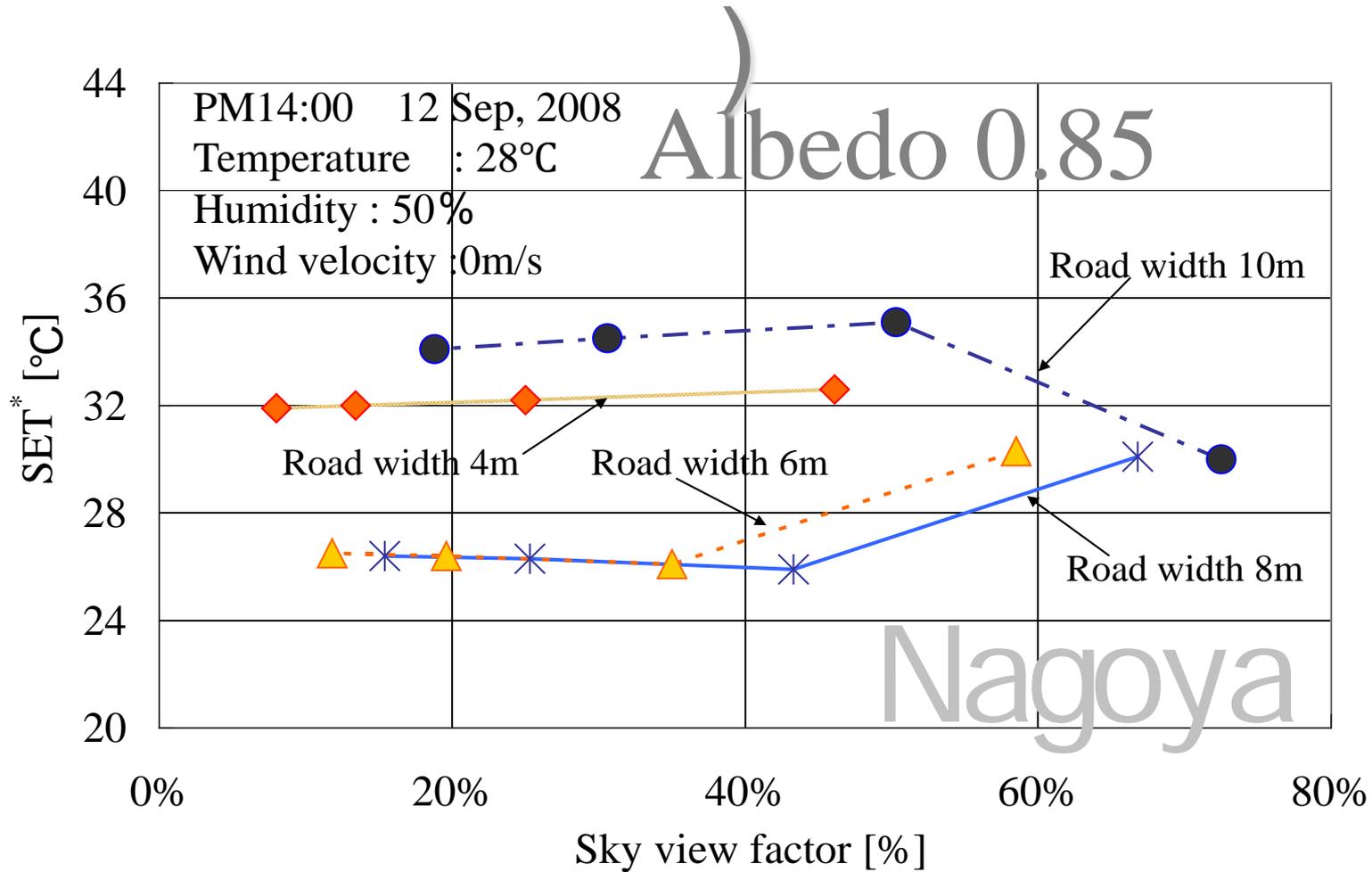
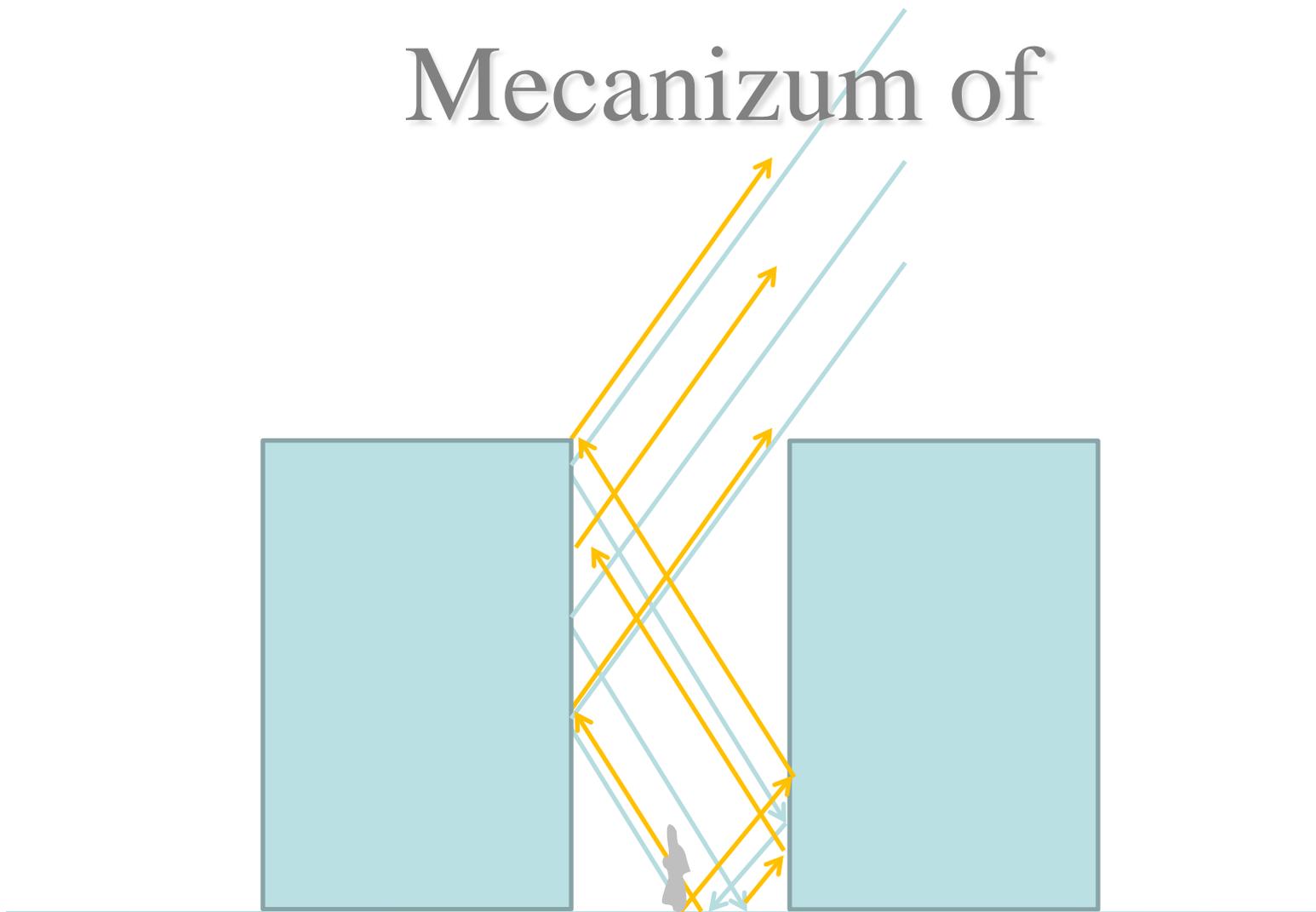


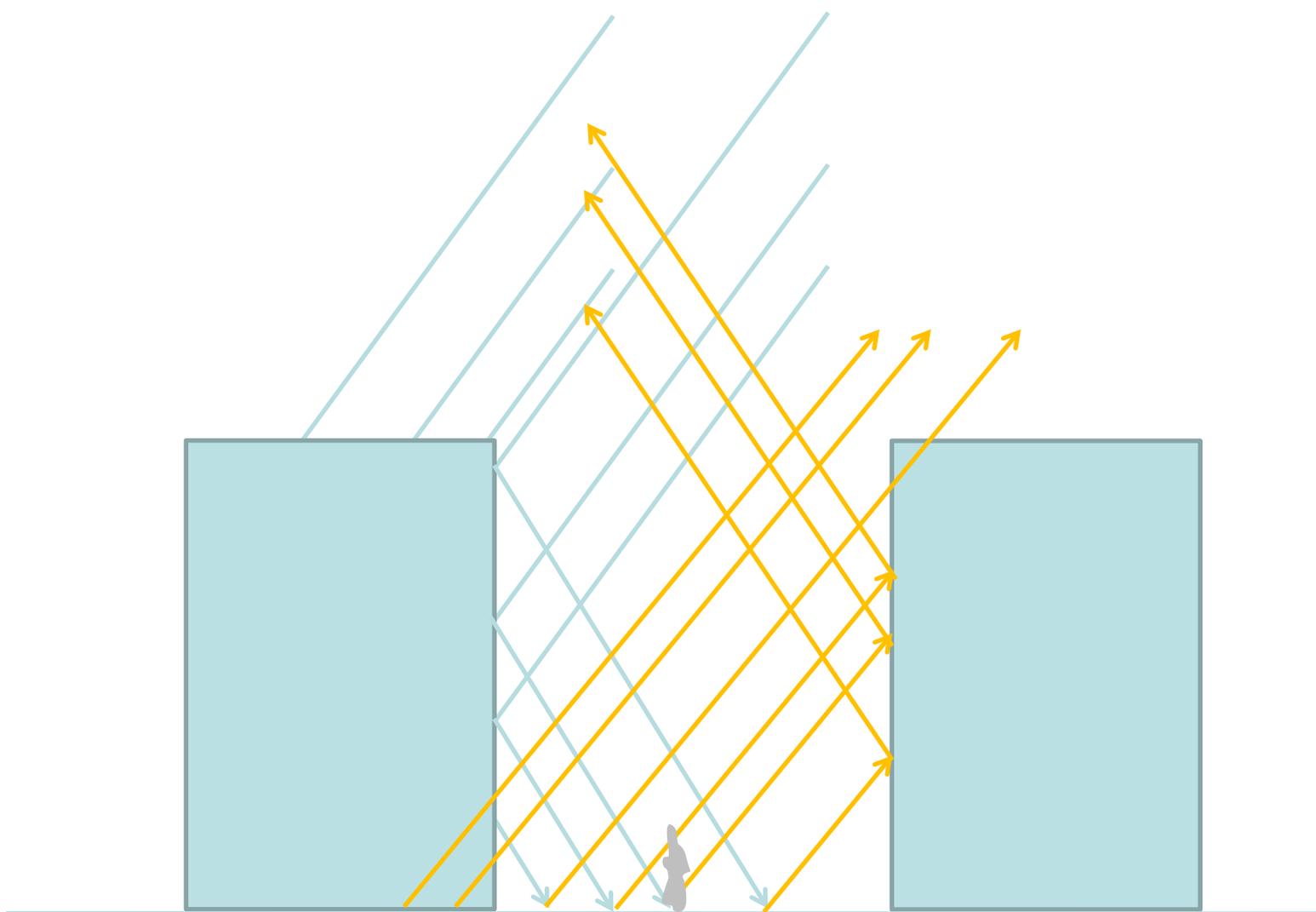
Figure SET* and sky view factor in Nagoya (RanMan model)

When planning the building blocks in Nagoya we found that the values of Road width 6m or 8m are appropriate.

Mecanizum of



4m



6m 10m 8m

Heat load calculation (UCSS-MOE)

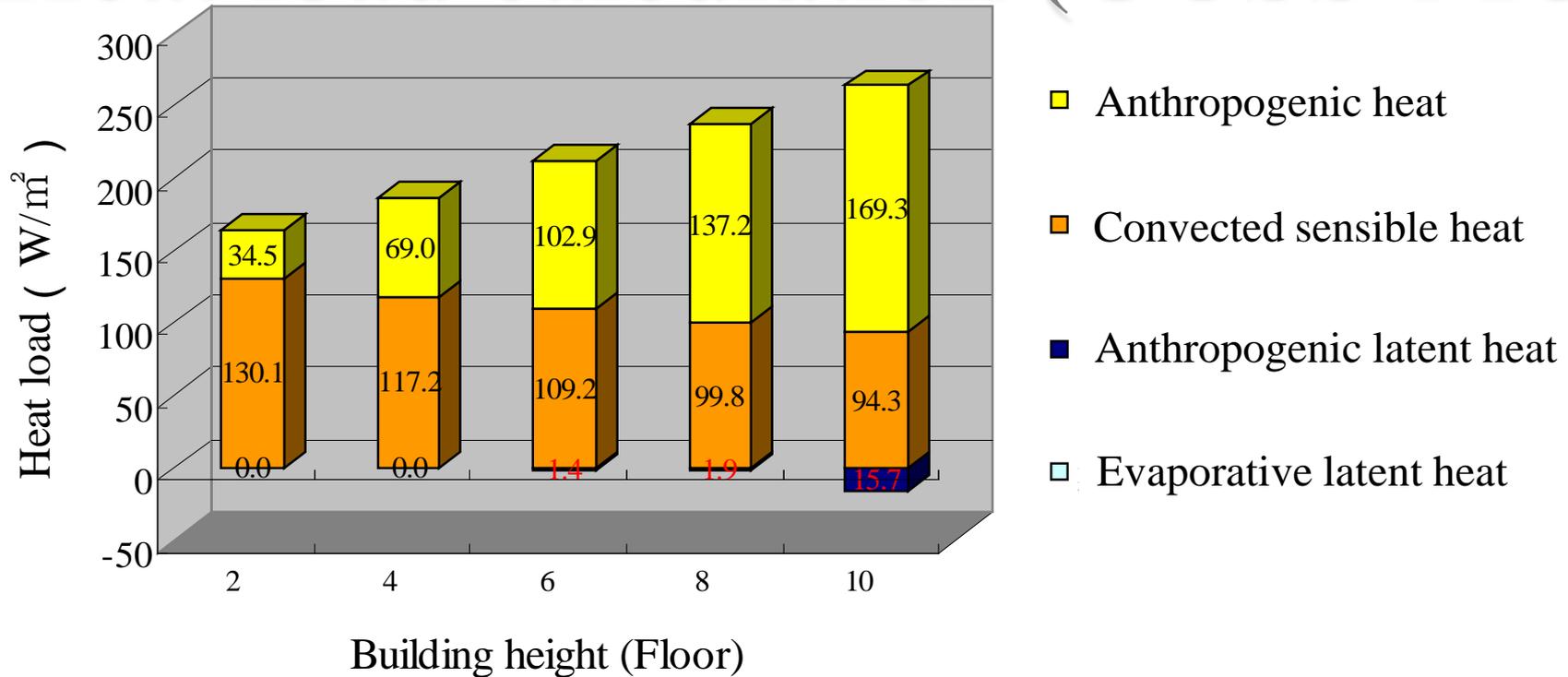


Figure: Heat load versus building height (Nagoya)

- Compare heat balance of outdoor and indoor environments for energy saving.
- Determine whether natural ventilation can be used to improve cooling.

Reference: Urban Climate Simulation System (UCSS) developed by Dr. Ashie, Japan. MOE developed a simple calculation tool, March 2002.

Conclusion

For comfort the sky view factor can be set to 45% or less, such as in case of Nagoya.

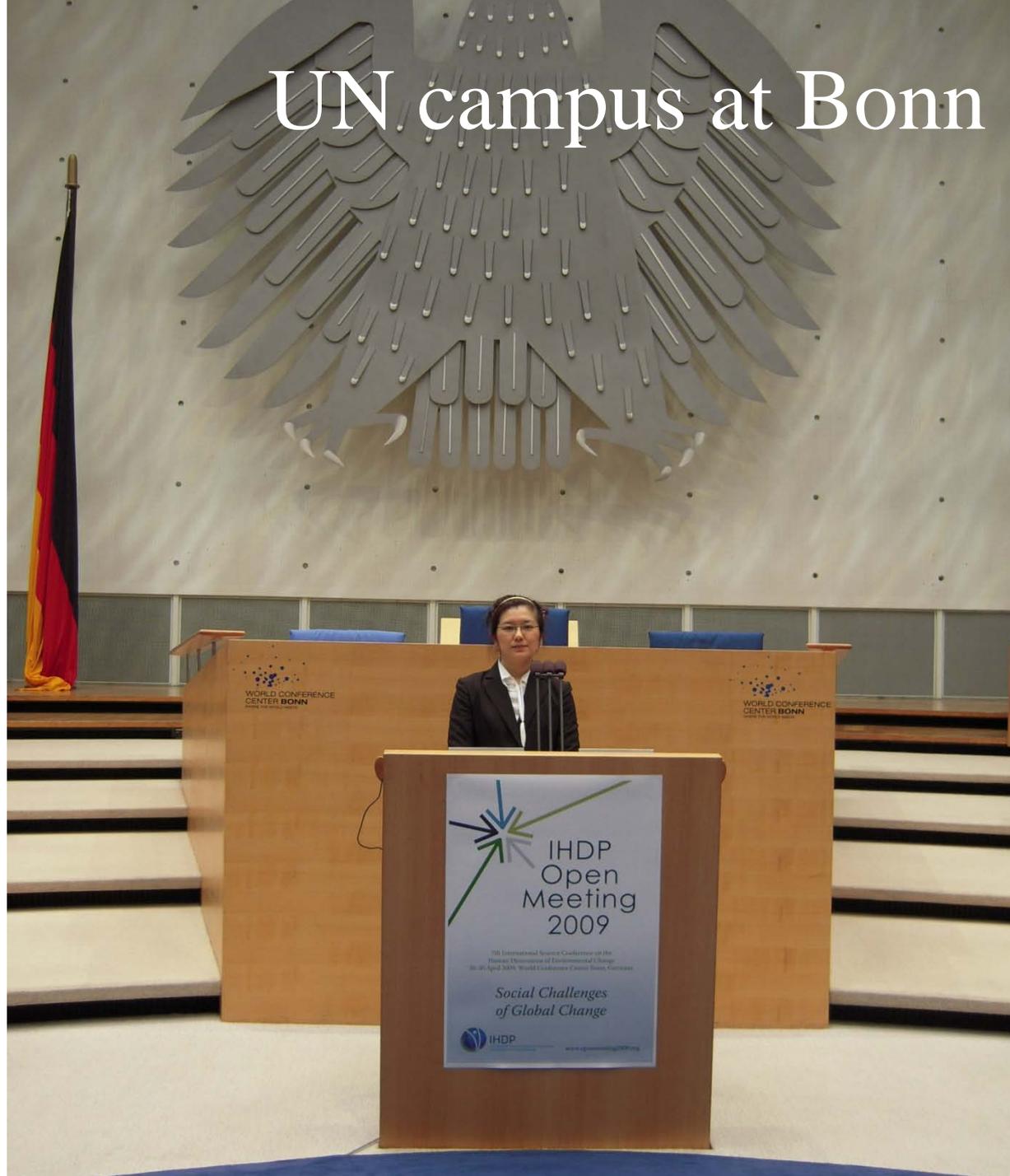
When planning the building blocks in Nagoya we found that the values of Road width 6m or 8m are appropriate (without tree).

This study can be applied to calculate energy saving potentials using basic data from different areas of Asia.

Acknowledgements

- This report constitutes part of the results of the research project, “Study on the Strategic Urban Planning and Assessment of Low-Carbon Cities”, The Global Environment Research Fund (Hc-086: FY2008), Ministry of Environment (Head investigator: Prof. Hidefumi Imura, Nagoya University).

UN campus at Bonn



Thank you