Guidelines and evaluation tools for heat island countermeasures for several cities in Japan and other East Asian countries

Shinji YOSHIDA (University of Fukui, y-shinji@u-fukui.ac.jp),
Hideki TAKEBAYASHI (Kobe University),
Akashi MOCHIDA (Tohoku University),
Ryuichiro YOSHIE (Tokyo Polytechnic University),
Taiki SATO (Taisei Corporation),
Takahiro TANAKA (Hiroshima University),
Ryozo OOKA (I.I.S University of Tokyo),
Qiong LI (South China University of Technology)

0. Summary

- We outlined the existing countermeasure guidelines for urban heat islands in Japan, Japanese local governments, and other East Asian countries, and conducted a detailed comparison of targets and countermeasure menus included in each countermeasure guideline of Japanese local governments.
- The differences between the expected effects of each local government guideline are small. However, those of scale, in which the effects of the countermeasure are expressed, are large. This is caused by the differences between the adopted countermeasure methods in each guideline.

1. Background and purpose

- Degradation of the thermal environment in urban areas during the Japanese summer season causes various environmental problems.
- Proposal of some countermeasure techniques, and introduction them into practical planning and design of urban areas and buildings

  ⇩ For supporting these proposals and introductions …

  Various guidelines for countermeasures against the heat island phenomena have been proposed by the central and local governments in Japan.

  ⇨ Difficulty in performing a comparative analysis of each guideline because of differences of each guideline in format and availability of numerical targets
- Severe urban warming and air pollution beyond Japan during the period of rapid economic growth in China and the Southeast Asian countries.

  ⇨ Necessity of international guidelines for forming a common strategy to address these problems
- This paper describes the investigation of the present situation of the existing guidelines for cities in Japan and other East Asian countries, and the comparison of differences of guidelines in each city in Japan.

2. Outlines of Japanese guidelines for countermeasures against heat island phenomena

(1) Ministry of Land, Infrastructure, Transport, and Tourism (MLIT)

A building design guideline for mitigation of heat island phenomena
〔Considerations for a building design〕

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CASBEE-HI
Building Environmental Efficiency (BEE)
〔Evaluation tool with numerical targets〕

(2) Ministry of the Environment (MOE) and local governments

MOE: Countermeasure guidelines against heat islands

Aims: Reference for the staff of local governments or official agencies promoting effectively the countermeasures against heat islands

⇩ This guideline does not include any quantitative targets because of the assumption of use in a wide range of fields, not limiting to building designs.

The most interesting parts:
Datasheets summarizing the effects, and specific examples of each countermeasure technique.

⇩

Local governments: Tokyo, Osaka and major cities located in the western area in the Kanto region in Japan

- This guideline does not include any quantitative targets.

  ⇨ Local governments prefer browse-able guideline for various purposes, such as redevelopment of cities and local areas, and environmental planning.

Table 2 Relationship of mechanism, purpose, and effective region between each countermeasure technique described in the heat island countermeasure guideline by the MOE.

No	Countermeasure technique		Expected effect of countermeasure: Mitigation Daytime	Mitigation Night-time	Adaptation Daytime	Adaptation Night-time	Reduction in energy consumption	Expected scale of effect: City (A few dozen km)	Area (A few km)	Street (A few hundreds m) Road, pedestrian space, and car park	Street (A few hundreds m) Building and site
1-1	Wind	Utilization of sea wind and mountain–valley wind	*	*	*	*		*	*		
1-2		Utilization of wind from river	*		*			*	*		
2-1	Greening	Utilization of parks and green areas	*	*	*	*		*	*		
2-2		Utilization of roadside trees	*	*	*	*				*	
2-3		Greening of car parks	*	*	*					*	
2-4		Greening of building sites	*	*	*	*					*
2-5		Rooftop greening	*	*			*				*
2-6		Wall greening	*	*	*		*				*
3-1	Water	Utilization of fountains and water landscapes	*		*						*
3-2		Sprinkling and increasing the water-holding capacity of pavements	*	*	*	*				*	
3-3		Increasing the water-holding capacity of building surfaces	*	*			*				*
3-4		Utilization of sprinkling around houses			*	*				*	
3-5		Utilization of mist cooling			*						*
4-1	Reflection	Utilization of shade for pavements	*	*	*	*				*	
4-2		Raising reflectivity of roof surfaces	*	*			*				*
5-1	Energy release	Utilization of district heating and cooling systems	*	*	*	*	*		*		*
5-2		Reduction of exhaust heat from buildings	*	*	*	*	*				*
5-3		Reduction of exhaust heat from cars	*	*	*	*	*	*	*	*	
6-1	Public awareness	Information service for preventing heat stroke			*						

3. Outline of heat island countermeasure guidelines in other East Asian countries

(1) The People's Republic of China (PRC)

Design Standard for the Thermal Environment of Urban Residential Areas

The Standard Design Method (SDM)
The first-step evaluation based on comparison of values for each parameter

The Performance Evaluation Method (PEM)
The second-step fine evaluation

(2) The Republic of China (ROC)

The Ecology, Energy Saving, Waste Reduction, Health (EEWH-HI)

⇨ The format of this guideline corresponds well to that of the CASBEE-HI guideline proposed by the MLIT in Japan.

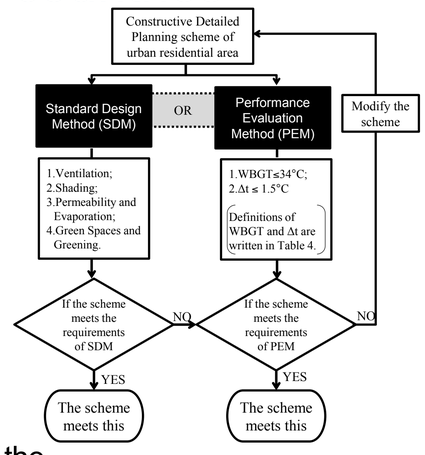

Fig. 1 Evaluation Scheme for PRC.

4. Comparison and investigation of Japanese heat island guidelines

- We compare the various types of Japanese guideline using Table 2 included in the MOE guideline as the reference guideline.

(Comparison of targets described in each guideline)

- We can see some interesting targets in a few of guidelines.

  Tokyo: Individual countermeasures for each area or utilization of a building.

  Osaka: Numerical targets as uncontrollable natural phenomena as proposing policy.

(Comparison of countermeasure menus included in each guideline)

- We extract the property of each guideline by counting the number of asterisks (*) in Table 2.
- Differences of the effective regions of improvement by installing items from each guideline are large, as shown in Fig. 3.

  ⇨ Effects of adopting countermeasure method, as shown in Fig. 4.

Table 3 Investigation objects

1. Prefectural governments: 3
1-1 Tokyo, 1-2 Osaka, 1-3 Saitama
2. Municipal governments: 5
2-1 Chiyoda, 2-2 Chiba-city, 2-3 Osaka-city, 2-4 Hirakata-city, 2-5 Sakai-city
3. Local area: 6 (in Tokyo)
3-1 Shinagawa and Tamachi stations area, 3-2 Otemachi, Marunouchi, and Yurakucho area, 3-3 Shibuya station central area, 3-4 Nakano station area 3-5 Shibuya station central area 3-6 Area around loop line 2 of city planning road in Tokyo

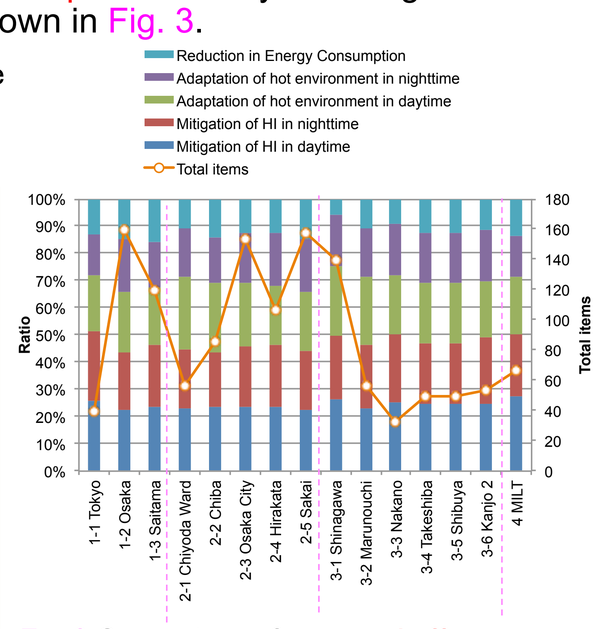

Fig. 2 Comparison of expected effect between each guideline.

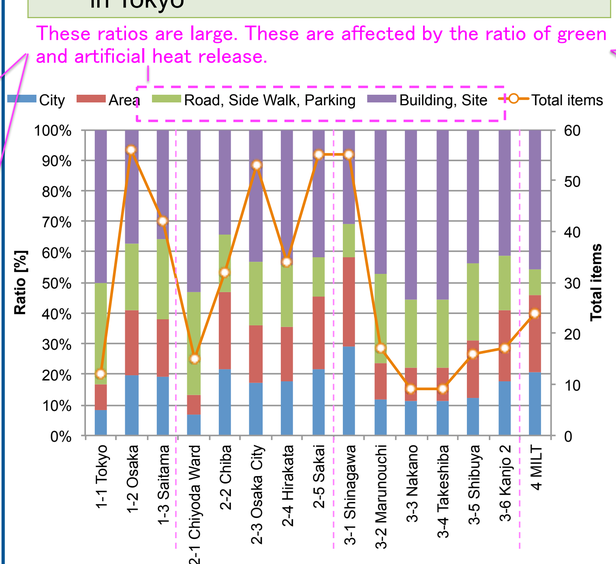

Fig. 3 Comparison of space length expressed effects of countermeasure between each guideline.

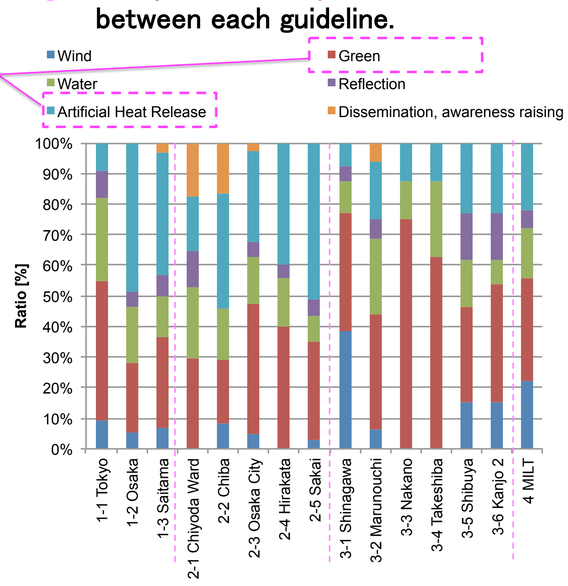

Fig. 4 Comparison of adopted countermeasure method between each guideline.