

# Establish cool spots for preventive medicine

Subtitle: Cool spots for city dwellers using transpiration system

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Abstract: Heat illness is a very serious problem in Japan. From social health infrastructure point of view, it will have to take part in our health issue. From urban designs point of view, it could be prevent outbreaking of heat illness by sheltering city dwellers from the heat. Additionally, it could make city dweller of preventing heat illness. There are 3 elements from extra factors to prevent heat illness which are “to decline temperature” ”prevent from sun shine” ”take a rest”. Therefore, it might prevent from heat stroke by providing some rest spaces which have shades and lower temperatures than the surroundings. Plants radiate heat by evaporating water, which roots suck up from the soil, from mainly the back of a leaf. This phenomenon is called “transpiration”. Using this principle, it would support thermoregulation of human body by decreasing surrounding temperature by water evaporation and making some shades. It would also make some chances to rest and be aware of preventing heat illness.

***Key words: Heat illness, Urban heat island, transpiration, Prevent medicine, Health care design***

## 1.1 Background

Heat illness is a very serious problem in Japan. 21,082 people were taken to the hospital within a month in July 2012. It is a problem that the temperature is higher in the urban areas rather than the suburbs. It is called Urban Heat Island : UHI. There are some causes of UHI. Cultivated areas and green spaces have been decreasing because of urbanization. This reduces the amount of water that sinks into the ground and its retention capacity. Therefore it decreases the amount of evaporation and transpiration. In addition, optical reflectance decreases and heat absorptivity increases owing to asphalt of pavement and concrete of buildings. Furthermore, anthropogenic waste heat caused by office buildings and vehicles can be mentioned. The more UHI carries out, the more air condition's power will be needed. This would increase the amount of wasting heats, which would proceed UHI. It could cause such vicious circle.

## 1.2 Aim

So far our health have been supported by doctor or medical instrument. From social health infrastructure which environment surrounding people point of view, it will have to take part in our health issue. The aim of this study was to extract of design requirement which create cool spots enable to shelter from the heat for city dwellers. Thereby, it could be improve qualities of outdoors living in urban area. Furthermore, it would be connected to preventive medicine by aware of prevention of heat stroke for city dwellers. And it could lead to good health care.

## 2. Urban Heat Island : UHI

UHI defined by guidelines for general principles for UHI in Japan, “UHI means that the temperature increase in the central part of urban area like islet shape rather than suburbs, there have been remarkable in recent years for a peculiar environmental problem in urban area[1].”[2]. UHI have been researched by many fields since over 100 years ago. There are 3 causes for urban warming by UHI[3].

**- Change ground surface to artificial**

For urbanization, natural ground like green or water area change to low permeability ground surface like concrete or asphalt. Therefore, it is difficult to stock rain water in ground surface. Thereby, It will decrease that transpiration system for restraining temperature increase.

**- Increasing artificial exhaust heat**

Artificial exhaust heat have been increasing because of spread of car or air conditioning. Heats will be released into the atmosphere after using energies like electronics, gases and oil.

**- Densification of urban system**

The diffusion of heat air has been obstructed by crowded with high building because of wind blowing near the ground has been weakened. Additionally, radiative cooling has been obstructed by decreasing of sky factor.

UHI cause many problems. The following 4 effects by UHI are arranged by Ministry of the Environment in Japan.

**- Health effect**

Heat illness, heat stress, viral infection, tired feeling, sleep disorder etc

**- Influence on an ecological system**

Cherry trees in urban start flowering earlier than suburban.

**- Influence on an weather and air quality**

Torrential rains or increasing of air pollution cause of breaking up a balance of atmosphere.

**- Influence on an energy consumption**

It will be getting worse of UHI because of electric power demand for cooler will be increase cause of increased temperature.

There are some activity or facilities which the way of prevent from UHI. Concrete measures for UHI are as below which according to guidelines for general principles for UHI published by Ministry of the Environment and MLIT (Ministry of Land, Infrastructure and Transport)[5].

**- Decreasing artificial exhaust heat**

Adjust temperature of air-conditioner or turning off a vehicle engine when stopped for save the amount of using energy.

**- Improvement of ground surface**

Promoting water evaporation to make a road using water holding property prevent from increasing temperature using vaporization heat.

**- Improvement of urban system**

Prevent radiant heat by increasing green space area which tree-planting or roof and wall greening. Designing urban system with good ventilation.

**- Improvement of lifestyle**

Replacing by buying something new product which using less energy. riding together or using car sharing system when ride on a car.

In addition to prevent from UHI, decline of temperature spraining mist water by vaporization heat. It is inevitable to some degree for changing to artificial ground surface or increasing artificial exhaust heat in urbanization. However, we have to take measures as much as possible for not holding extra heats in ground surface and decreasing redundantly artificial exhaust heat. In order to do that, it is necessary for design to consider about green or water area and flow of air currents in the atmosphere[6][7][8].

### 3. Heat illness

Heat illness is maladjustment of human body caused by high temperature environment. As shown in the following figure that severity of a heat illness by The Japanese congress on Neurological Emergencies correspond with divided into conventional type [9].

Table 1. Severity of a heat illness

Severity of a heat illness				
Severity	I		II	III
Conventional type				
	heat syncope	heat cramp	heat exhaustion	heat stroke
conscious	disappearance	normality	normality	serious disorder
temperature	normality	normality	~39°C	over 40°C
skin	normality	normality	cool	hot
sweat	existing	existing	existing	no existing

Heat illness can be divided broadly into two categories “non-exertional heat illness” which outbreaks in daily living and “exertional heat illness” which outbreaks sporting or physical laboring. There are two causes of outbreaking heat illness as bellow.

#### [Environmental factor]

- The day of rose in temperature suddenly than the day before
- The day of high humidity
- Suddenly go outside to work who worked inside room

#### [Human factor]

- Aged people and babies cannot correspond to change of heat environment
- Caused of anamnesis or lack of sleep
- Lack of water in body. It is important to get some water frequently

As shown in the following figure is “people who emergency transported by heat illness in 2012 (change of the week) and (change of the time)” . It was happened intensively from the 3rd week of July to 1st week of August (Jul.16 ~ Aug.5). And it was happened intensively from 11:00 to 17:00.

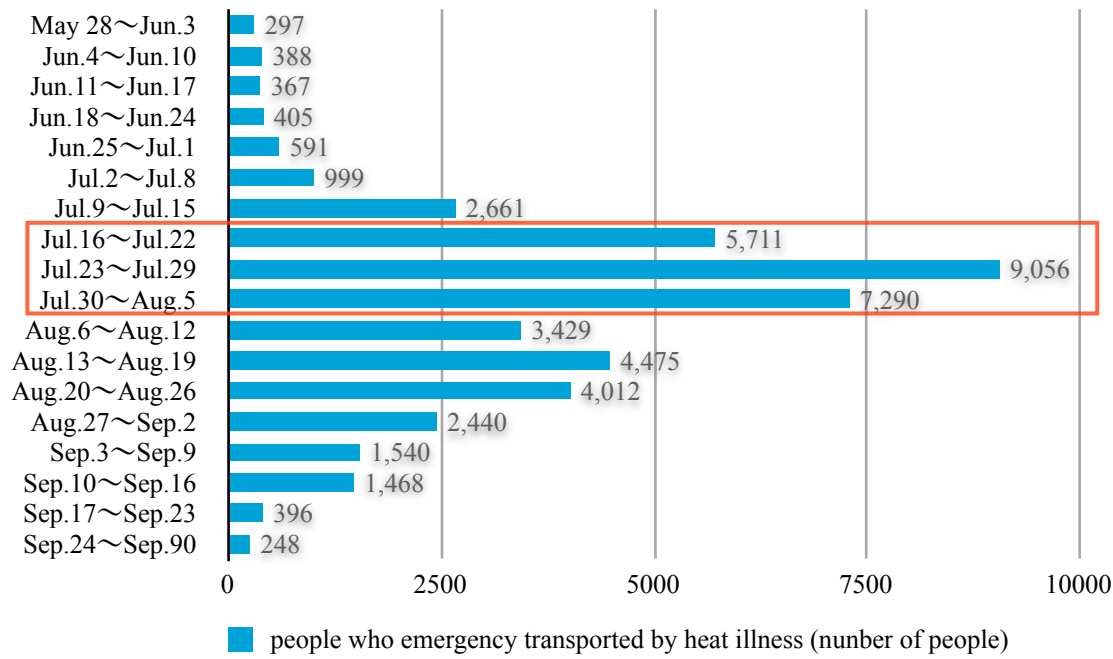


Figure 2. Emergency transported by heat illness in 2012 (change of the week)[10]

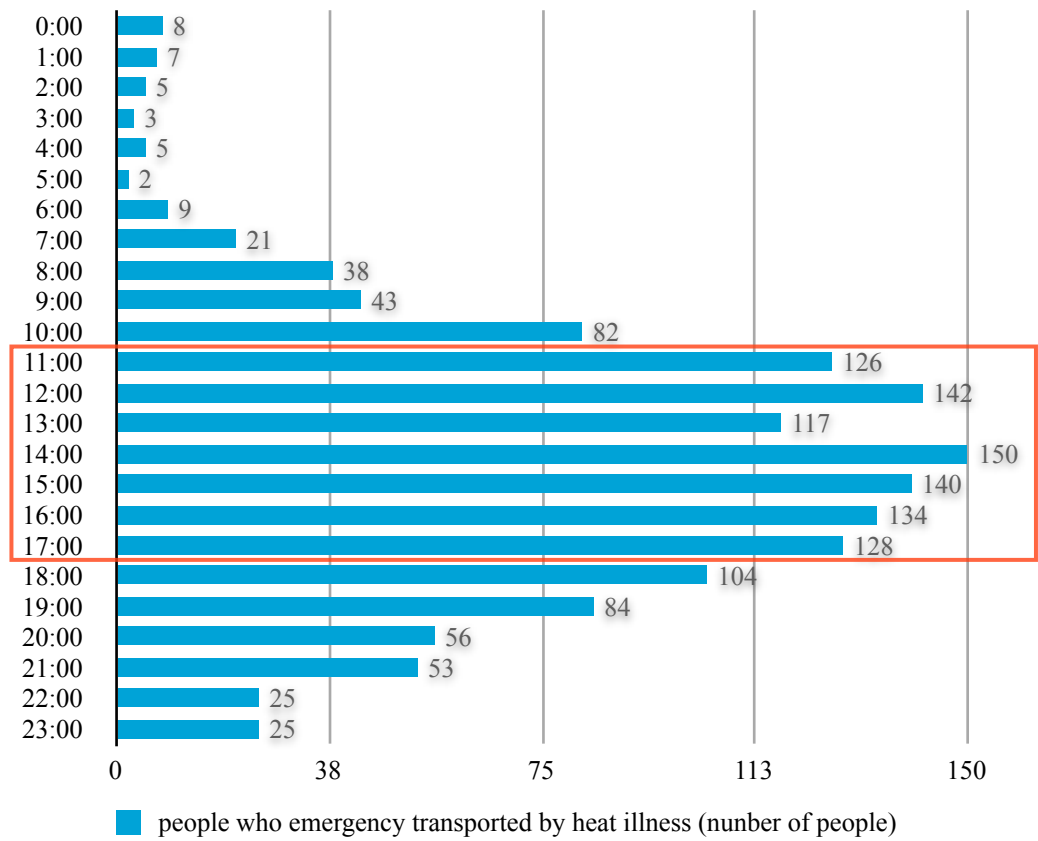


Figure 3. Emergency transported by heat illness in 2012 (change of the time)[11]

#### 4. Health care design for urban area

According to the above, I researched about relation of between UHI and heat illness. In this paper aim at prevention of heat illness from urban facility. I regard as requirements of prevention of heat illness “decline of temperature”, ”Prevent sunlight”, ”Provide rest space”. Therefore I expect that if requirements enable to satisfy in urban area, it would improve quality of living in there.

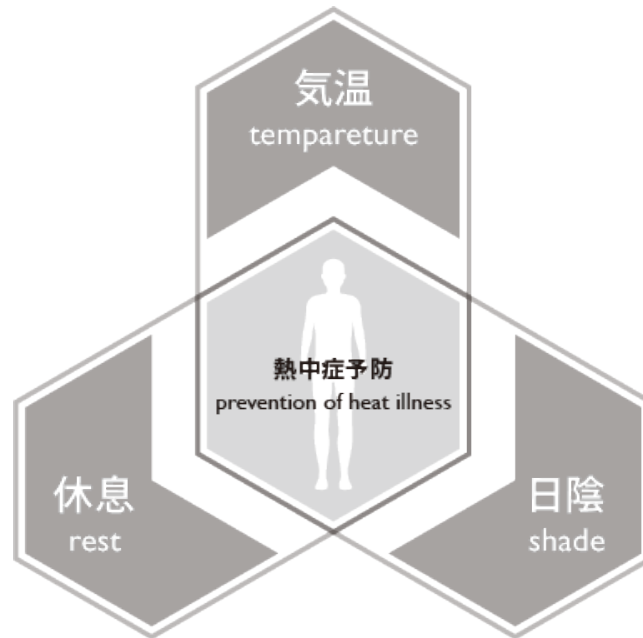


Figure.4. Requirements of prevention of heat illness

#### 5. Conclusions

Plants radiate heat by evaporating water, which roots suck up from the soil, from mainly the back of a leaf. This phenomenon is called “transpiration”. Using this principle, it would support thermoregulation of human body by decreasing surrounding temperature by water evaporation and making some shades. It would also make some chances to rest and be aware of preventing heatstroke. In order to evaporate water, it reuses rain water and uses sun heat. By using capillary phenomenon it makes a situation which the water is always full. Therefore, it is a sustainable design without using commercial electric power nor solar panel.



Figure.5. Evaporating from leaf

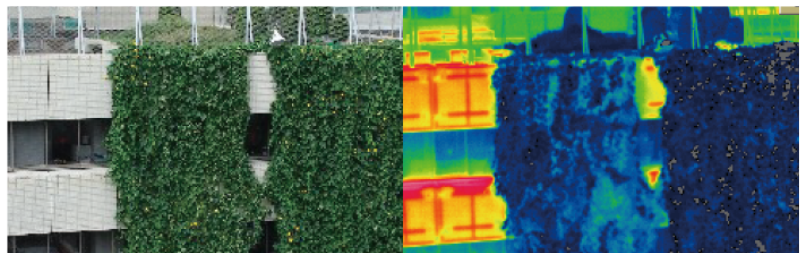


Figure.6. Compared with temperature existing evaporation or not

This cool spot takes rainwater into a tank inside of a seat from the upper part. Water absorbency panels make shades and suck up water from the tank using capillary phenomenon. Therefore, decreasing surrounding temperature by water evaporation. It would make some chances to rest and be aware of preventing heatstroke. It would also lead to health care design.

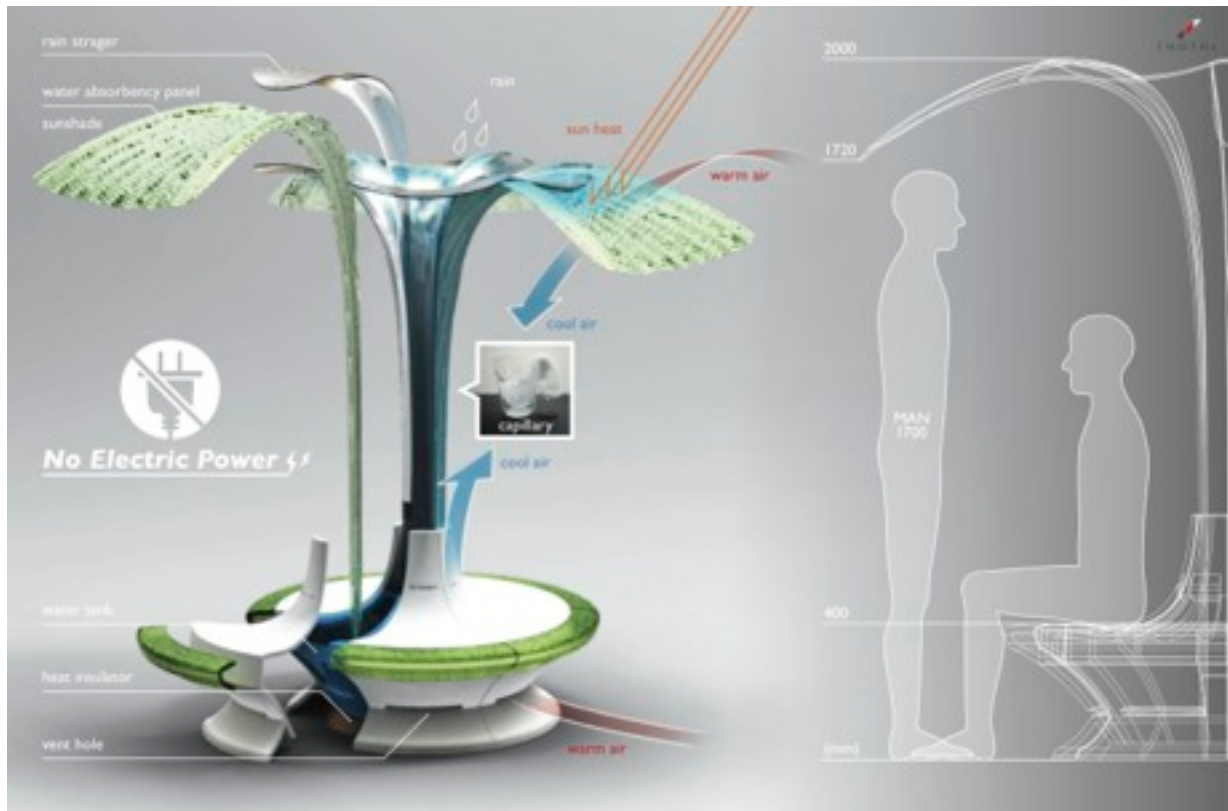


Figure.7. Cool spot using transpiration system

## 6. References and Citations

- [1] Ministry of the Environment. (2004). Guidelines for general principles for UHI [Online PDF]. Available at <[http://www.env.go.jp/air/life/heat\\_island/taikou.pdf](http://www.env.go.jp/air/life/heat_island/taikou.pdf)> [Accessed 9 March 2013]
- [2] Architectural Institute of Japan. (2007). What is the heat island problem. *Heat island and Architecture•Urban: Vision of measure and Problem*, p 16. Shiba, Tokyo Japan, Architectural Institute of Japan.
- [3] Ministry of the Environment. (2002). Report of investigation and examination business about environmental effect of UHI [Online PDF]. Available at <[http://www.env.go.jp/air/life/heat\\_island/guideline/chpt1.pdf](http://www.env.go.jp/air/life/heat_island/guideline/chpt1.pdf)> [Accessed 9 March 2013]
- [4] Architectural Institute of Japan. (2007). What is the heat island problem. *Heat island and Architecture•Urban: Vision of measure and Problem*, pp 19-27. Shiba, Tokyo Japan, Architectural Institute of Japan.
- [5] Architectural Institute of Japan. (2007). Effort to spread measure of heat island. *Heat island and Architecture•Urban: Vision of measure and Problem*, p 164. Shiba, Tokyo Japan, Architectural Institute of Japan.
- [6] Applied technology co.,ltd. (2001) Analysis of UHI [Online PDF]. Available at.<[http://www.apptec.co.jp/technical\\_report/pdf/vol13/treport\\_vol\\_13-07.pdf](http://www.apptec.co.jp/technical_report/pdf/vol13/treport_vol_13-07.pdf)> [Accessed 9 March 2013]
- [7] Yamaguchi, T. (2009). Various ways measure of heat island. *Heat island and urban tree-plantation*, p 120. Minamimotomachi, Tokyo Japan, Seizando-shoten Publishing co., Ltd.
- [8] Saito, T. (1997). Simulation of heat island. *Heat island: Megalopolis change to burning*, p 137. Otowa, Tokyo Japan, Kodansha Ltd.
- [9] <http://ja.wikipedia.org/wiki/熱中症>. Available at.<<http://ja.wikipedia.org/wiki/%E7%86%B1%E4%B8%AD%E7%97%87>> [Accessed 9 March 2013]
- [10] Fire and disaster management agency. (2012) Situation of emergency transported by heat illness in 2012 [Online PDF]. Available at.<<http://www.fdma.go.jp/neuter/topics/heatstroke/pdf/sokuhouti.pdf>> [Accessed 9 March 2013]
- [11] Tokyo fire department. (2011) Feature of emergency transported by heat illness in 2011. Available at.<<http://www.tfd.metro.tokyo.jp/lfe/topics/201205/heat/sheet04.html>> [Accessed 9 March 2013]