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Heat in the city

The researchers placed simulated buildings within the parks and also at certain distances away. Computerised tabulated findings revealed that a building located 100m from the park would generate 9% savings in energy required to bring temperature down as compared to one which is 400m away. For buildings within the parks, energy consumption is cut down by up to 10%.

Did you know that you could save energy consumption by up to 9 per cent, if you paint your building a light colour? A change in the colour of the façade – from a dark to a light colour, could bring surface temperature down by 6 degrees Centigrade.

Colour is very important when it comes to keeping cool, as a research team from the Department of Building, School of Design and Environment, has found out. So are construction materials and greenery. Marble has a cooling effect, but black marble facades – as well as those with metal claddings would lead to a rather "warm" building. To keep cool and bring down your cost of air-conditioning, it would be a good idea to have your roof painted white. Better still, have a roof garden to keep temperature down!

The team led by Associate Professor Wong Nyuk Hien, Programme Director, MSc (Building Science) has been researching the impact of colours, construction materials and plants have on the temperature of a place. Their research "A Study of Urban Heat Island in Singapore" has for the first time, quantified energy-saving -- taking into account ameliorating measures such as vegetation in the form of roof gardens and vertical landscaping, parks, choice of construction materials and even colours.

"Urban Heat Island" is a phenomenon where the temperatures in the city are higher than the suburban rural areas. The causes of Urban Heat Island are primarily due to the absorption of solar radiation by building/urban materials that is subsequently re-radiated to the surroundings. Heat generated from combustion process and the use of air-conditioning coupled with the greenhouse effect of pollutants also contributes to the increase in temperatures. This condition may lead to smog. Another major concern is the rising cost in cooling down buildings.

The study, in collaboration with the Building

Vertical greenery for cooling down

NUS working with construction firm Shimizu Corporation, is developing a technology for "vertical greenery". The project, spearheaded by Assoc Prof Wong Nyuk Hien, will be for use in the tropics. The technology works by growing plants on building walls to cool buildings down.

Buildings located close to one another in many areas have resulted in a lot of direct and diffused radiation of heat. Greenery on roof and walls will help absorb radiation and reduce the heat temperature. Assoc Prof Wong said that the main challenge is to develop a system that is cheap and easy to maintain.

The technology, called the

and Construction Authority and Centre for Total Building Performance (NUS) was started in 2001 and completed in 2004. "For the study, we first needed an overall island temperature profile," said Associate Professor Wong. "So we worked with the NUS Centre for Remote Imaging, Sensing and Processing (CRISP) to obtain satellite images of Singapore for a temperature profile. From the images, we found that the western side of Singapore around the industrial area of Tuas has the highest ambient temperature, of around 33.6 degrees Centigrade. The Central Business District also has quite high temperature, as well as Changi Airport. The lowest temperature is along the north-western part of Singapore near Tengah and the central water catchment area."

Parabienta Green Wall, uses a lightweight 5cm-thick sponge-like sheet of polyester-blended soil heated with steam and moulded together. It has good water retention and drainage properties.

Exposed hard surfaces are normally the "hot" spots while the "cool" spots are the large parks, the landscape in-between housing estates and the catchment areas. The study shows that the difference in temperature is about 5 degrees Centigrade between the "cool" areas of Singapore and the "hot" areas.

Said Associate Professor Wong: "We also went around Singapore to about 50 areas to check temperature. The results tally with the satellite images."

Besides the choice of façade materials and colours, there are two other "natural" ways to keep temperature down: Through greenery and air movement.

Greening effect

"Greenery is the most effective. We studied the effectiveness of urban green such as town parks as well as the Bukit Batok Nature Park and Clementi Woods. Our study confirmed that parks do bring down temperature of the surrounding areas," said Associate Professor Wong.

The researchers placed simulated buildings within the parks and at certain distances away. Computerised tabulated findings revealed that a building located 100 metres from the park would generate 9 per cent savings in energy required to bring temperature down as compared to one which is 400 metres away. For buildings within the parks, energy consumption is cut down by up to 10 per cent.

Surface temperature of concrete without cover can go up to 58 degrees Centigrade. Uncovered soil's temperature measures as high as 42 degrees Centigrade. But temperature of surfaces covered by shrubs is only 26 degrees Centigrade.

One reason why the area around Changi Airport has a higher temperature is probably because of its runways. Asphalt road surface contributes to the temperature increase as it absorbs heat readily and re-radiates it back to the surroundings. However, the team found out that high towers can enhance the airflow and help reduce temperature.



Associate Professor Wong at the Department of Building's wind tunnel which could simulate the effects of air movement.

Concrete data

Though scientists have known that colours, vegetation and various building materials affect the temperature of a place, there have so far been no concrete data. Often, it is the cost which deters real estate developers from considering the building of roof gardens. The cost of maintaining them is also daunting.

However, this is going to change. In fact, roof gardens are increasingly common in Singapore nowadays. The team has gathered concise findings as well as projected the savings in energy consumption, and the time needed to "break even". "Nowadays, the cost of maintaining a roof garden may not be all that high. Shrubs need not be watered for example, as roof gardens now come with little built-in reservoirs. Companies can break even from installation cost in three to five years," said Associate Professor Wong.

The team is also working with Jurong Town Corporation to look at how by appropriately introducing vegetation in industrial estates can help lower temperature.

"We need to monitor long term, the impact of Urban Heat Island. For example, with the help of the Meteorological Services of Singapore, we have been monitoring since 1982, certain spots in Singapore. The area around Tengah has been constant. But Changi Airport has gone up by 1 degree Centigrade.

"Using the wind tunnel at our department, we experimented with models of buildings to see how for example, tower blocks can help in creating air movement. We also studied the optimal gap between buildings as well as the height. Wind is a complex phenomenon," said Associate Professor Wong.

The findings of their study have been compiled by Associate Professor Wong into a 340-page book. It is available at the NUS Department of Building.

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