







THE UNIVERSITY OF HONG KONG 香港大學 **faculty of architecture 建築學院** Community Project Workshop 社區項目工作坊

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Topic 08 Video: Urban Heat Island

Major teaching areas

Physics: Chapter I Heat and Gases

- Values and Attitudes
- STSE connections

Related teaching areas

Physics: Chapter VIII Energy and Use of Energy

- Energy efficiency in buildings and transportation
- Renewable and non-renewable energy
- Values and Attitudes
- STSE connections

Interdisciplinary teaching areas

Design and Applied Technology:

Strand 3 Value and Impact

Liberal Studies:

- Module 2 Hong Kong Today
- Module 6 Energy Technology and Environment

Integrated Science: Module E1 Energy, Weather and Air Quality

Energy use and air quality

Learning objectives

- To understand the basic principles of Urban Heat Island (UHI) effects
- To acknowledge reasons behind Urban Heat Island effects in relation to urban development
- To recognize Government measures to minimize UHI effects
- To suggest urban development solutions in response to UHI effects

Learning plan

Learning plan		
Lesson	Contents	
Lesson 1 • 1.1		What is the Urban Heat Island effect
Urban Heat island	• 1.1.1 Definition of Urban Heat Island (UHI)	
	• 1.1.2	Causes of UHI effects
	• 1.1.3	Indicators of level of UHI effects
	• 1.2	Discussion — UHI measurements across Hong Kong
	• 1.3	Solutions to UHI effects
	• 1.4	Case study — Verbena Heights
	• Exercise	News article on 'wall effect'

Lesson 1 Urban Heat Island

1.1 What is the Urban Heat Island effect?

Introduction - Urban development and environmental impacts





Tung Chung Cresent

High rise in Mid-Levels



[Discussion]

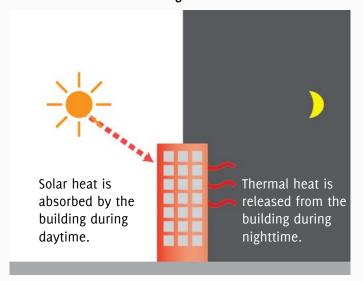
- Are you familiar with this kind of buildings? Why are they built in such manner?
- What are the environmental impacts on the surrounding area?

1.1.1 Definition of Urban Heat Island (UHI)

An Urban Heat Island is a metropolitan area that is significantly warmer than its surrounding area due to urban development. Especially during the night, under cloudless skies and light-wind conditions, the cooling rate in the urban area is much slower than that in rural area.

1.1.2 How is an Urban Heat Island formed?

1 Thermal mass of buildings



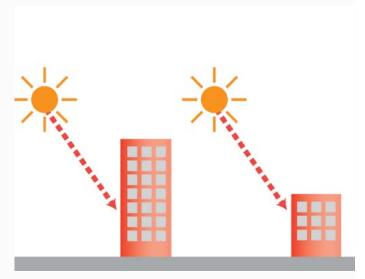
- ▲ Buildings absorb solar energy during daytime and release thermal energy during nighttime.
- 2 Waste heat generated from the operation of machinery



- ▲ Waste heat released from mechanical operations.
- 4 Wall effect and urban canyon effect

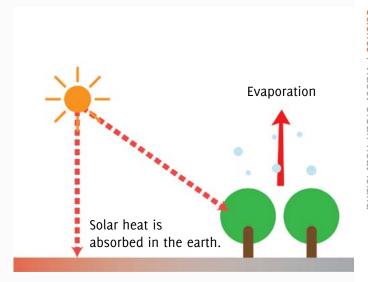


▲ Wall effect

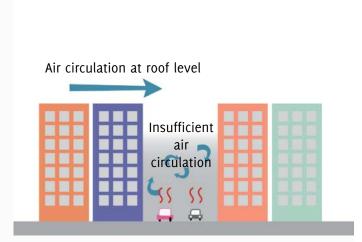


▲ Tall buildings have larger surface area to retain thermal energy.

3 Lack of greenery



▲ Greenery can reduce heat at ground level.



Urban canyon effect

1.1.3 How do we measure Urban Heat Island effects?

By comparing

- · daytime and nighttime temperatures and
- air pollution index,

of the urban centre and suburban centre of a city, we can estimate the effects of an Urban Heat Island on a region or a city.

1.2 Current UHI effects in Hong Kong

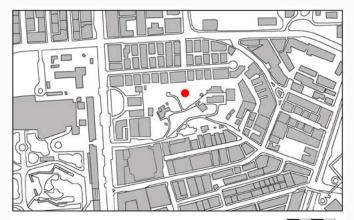
The Hong Kong Observatory (HKO) conducted a simple examination to assess the magnitude of individual UHI effects across Hong Kong by comparing the temperature difference between HKO Headquarters (located in an urban area) and two rural locations: Lau Fau Shan in the northwest part of the New Territories, and Ta Kwu Ling in the far northern part of the New Territories from 1989 - 2005.

	HKO Headquarters	Lau Fau Shan	Ta Kwu Ling
Temperature difference between 1989 - 2005 (°C)	+0.37	+0.25	+0.08
Compared with HKO reading		0.37-0.25 = 0.12	0.37-0.08 = 0.29



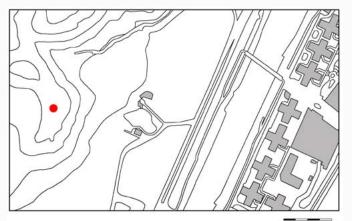
Examined locations © wahaha2005 - Wikipedia User

[Discussion]

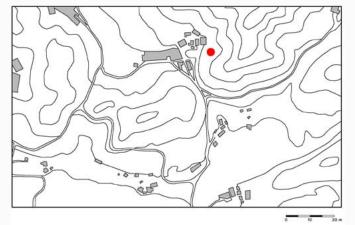


- Compare the three temperature differences and explain the results by looking at the urban development of the three areas.
- Why is there such a temperature difference between the data collected in two rural areas: Lau Fau Shan and Ta Kwu Ling?

HKO Headquarters in 2005



Lau Fau Shan in 2005



Ta Kwu Ling in 2005

Keys

- Buildings and developed areas
- Contour lines
- Roads



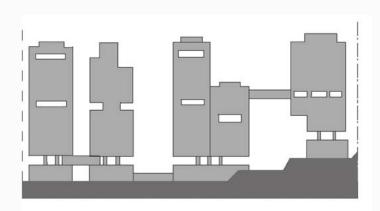
Science | Video: Urban Heat Island

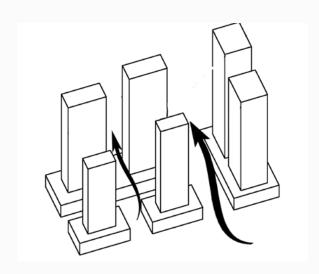
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1.3 Solutions to Urban Heat Island effects

1 Increase permeability of buildings

2 Wider building separation

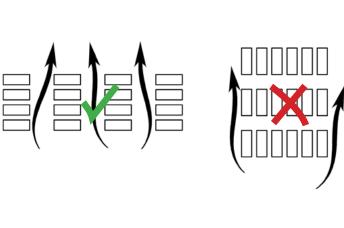


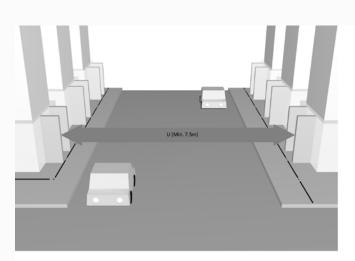


3 Orientation of buildings according to prevailing wind direction









[Discussion]
[DISCUSSIOII]

1	Can you think of any other measures to alleviate Urban Heat Island effect?
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1.4 Case Study - Verbena Heights

Developers : Hong Kong Housing Society

Building type : Residential Estate Location : Tseung Kwan 0 Year of completion : 1996 -1997

Overall arrangement

The buildings are built on the podium which contains a variety of communal facilities. The buildings form three courtyards in between to facilitate wind passage and form communal spaces.

Greenery are introduced between the buildings so as to enhance communal open spaces and lower the temperature within the estates.

Internal arrangement

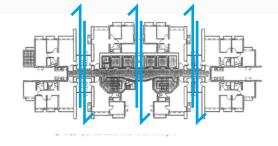
Lighting and cross ventilation is created by openings along the corridors.

Stepping heights of building blocks

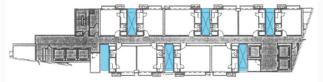
The heights of the building blocks are gradually stepping up according to the prevailing wind direction. Wall effect is largely reduced and buildings at the rear can enjoy natural ventilation.



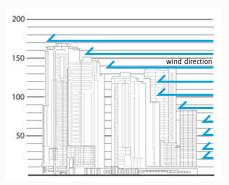
Air flow in the estate



▲ Blue arrows show how wind passes through the buildings



▲ Openings that increase permeability of the building blocks facilitate cross ventilation



▲ Stepping heights of the building blocks allow wind to reach the rear of the estate.



Topic: News article on "Wall Effect"

Read the following article and answer the questions below.

Hong Kong Short of Breath from 'Wall Effect'

HONG KONG: World-famous for its skyscrapers, Hong Kong's bustling urban landscape now faces a shortage of good air ventilation.

Medical experts and environmentalists have expressed concern over the growth of the concrete jungle creating a 'wall effect' that is blocking the flow of fresh air. Many residential high-rises are built along the waterfront where the sea views are a prime real estate commodity. However, for many residents living in apartment buildings further back, the availability of fresh sea air has become less of a right and more of a privilege.

According to a study conducted by community group Green Sense, 104 out of 138 private residential estates developed over the past 10 years met three or more criterias of the wall effect. The criterias included less than 15-meter spacing between buildings, building height over 35 storeys, building facing prevailing winds and the existence of shorter buildings behind taller ones. The green group was concerned that the problem would worsen as the plot ratio*, which defines the total floor area of buildings permitted to be constructed on a site, for 36 district redevelopment projects had been increased by 5 to 12 times. The higher the plot ratio, the taller the buildings are.

Hong Kong Medical Association council member Alvin Chan said the ventilation of areas behind tall buildings would be affected. He expressed concern that the temperature in these areas would go up, making it stuffy and uncomfortable for the residents.

The Hong Kong Observatory found that the wind speed in some urban areas dropped by 0.57 meters per decade from 1968 to 2005. The average wind speed of remote Waglan Island in October was 17.6 kilometers per hour, while that in urban areas like King's Park was only 7.1 kilometers per hour.

The Housing, Planning and Lands Bureau and the Environment, Transport and Works Bureau recently jointly issued a notice that listed ventilation as a main concern for redevelopment and large infrastructure projects. The Government will also encourage the private sector to voluntarily assess ventilation before starting building projects, and will restrict building heights in certain areas.

Green Sense chairman Roy Tam Hoi-pong said the Government should make the notice a law, making ventilation a compulsory concern for infrastructure projects. 'Only making it a voluntary consideration is not enough,' Tam said. Apart from limiting building height and plot ratio, Tam suggested a compulsory requirement that the distance between buildings be at least 15 meters. Bernard Lim, a Town Planning Board member, said developers should create models before starting building projects. The models will be used to test the ventilation to find out whether the spaces between buildings and the scale of the projects should be maintained.

by Teddy Ng, China Daily, April 03 2007

*Plot Ratio = Total floor area of the building / Total site area. In Hong Kong, the maximum plot ratio for office buildings is 15, and for residential buildings is 10.



- According to Green Sense, what are the criterias for 'wall effect'?
- What are the average wind speeds of the urban area and rural area in Hong Kong? Explain the difference.

3	assessment test voluntarily?
4	Apart from regulating the plot ratio and building height of the site, some people think that the Government should include minimum building separation in the conditions of sale. What do you think?
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Summary

- 1. Urban Heat Island is an urban area where the temperature is higher than its surrounding rural area due to urban development.
- 2. Major effects of UHI are poor ventilation, poor air quality and higher regional temperature.
- 3. Hong Kong suffers from UHI effects.
- 4. Careful urban development can solve the UHI effects.
- The Government and private sectors should contribute together to minimize the UHI effects in Hong

Key words

Urban Heat Island Permeability Wall effect Microclimate Urban canyon effect **Cross Ventilation** Greenery

Further reading

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Organizer





