



Department of Environmental Health, Sustainable housing, 2016, 4th Year

# Risk of Tuberculosis in high-rise and high density buildings



# Lecture structure

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1-What is highrise Building

2- Demand for highrise building

3-Are High Rises Bad or Good for People?

4- Behaviour Problems and High-Rise Housing-

5- Crime and the Fear of Crime in High -Rise Residential Environments



# Lecture structure

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8- High Rise Buildings and Tuberculosis

9- The relationships between Sun View Factor  
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# What is a high-rise building?

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“A building whose height creates different conditions in the design, construction, and use than those that exist in common buildings of a certain region and era.”



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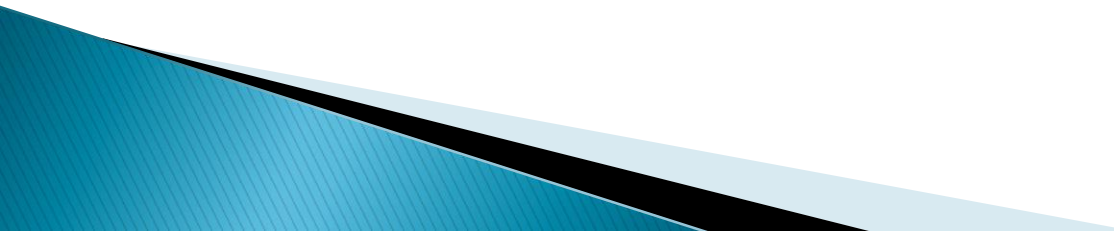
# Demand for High-Rise Buildings

*Scarcity of land in urban areas*

- *Increasing demand for business and residential space*
  - *Economic growth*
  - *Technological advancements*
  - *Innovations in Structural Systems*
  - *Desire for aesthetics in urban settings*
  - *Concept of city skyline*
  - *Cultural significance and prestige*
  - *Human aspiration to build higher*
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# Are High Rises Bad or Good for People?

High rises buildings have been accused of causing many unpleasant outcomes such as:

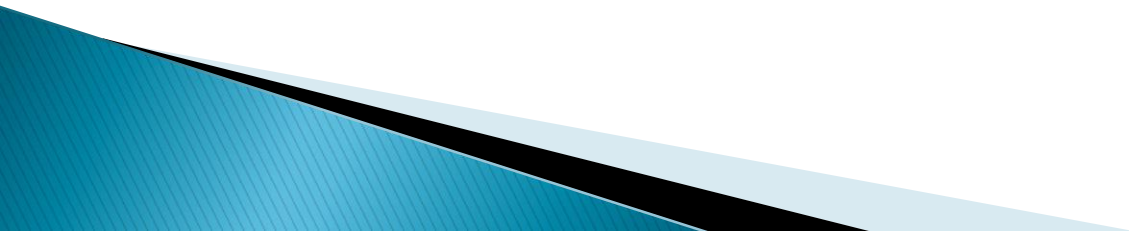
- 1 – Fear,
  - 2 – Dissatisfaction,
  - 3 – Stress,
  - 4 – Behaviour problems,
- 

5– Suicide,

6– Poor social relations,

7– reduced helpfulness, and


8– Hindered child development.






# Behaviour Problems and High-Rise Housing

Human behaviour generally results from many influences, and it is difficult to unequivocally attribute it to any one source. A study suggested that, children who resided in high-rise (versus non-high-rise buildings) were reported to manifest twice as many behaviour problems, such as bedwetting and temper bad temper

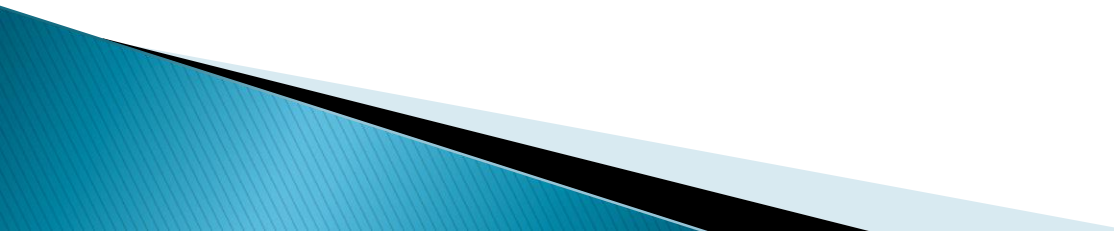


In a study that matched children in terms of gender and economic well-being, children who lived in high-rises were significantly more likely to have severe behaviour problems than children in other forms of housing (Richman, 1977). In another study, boys (but not girls) who lived in 14-versus 3-storey buildings were rated by their teachers as having more behavioural problems, such as hyperactivity and hostility (Saegert, 1982).

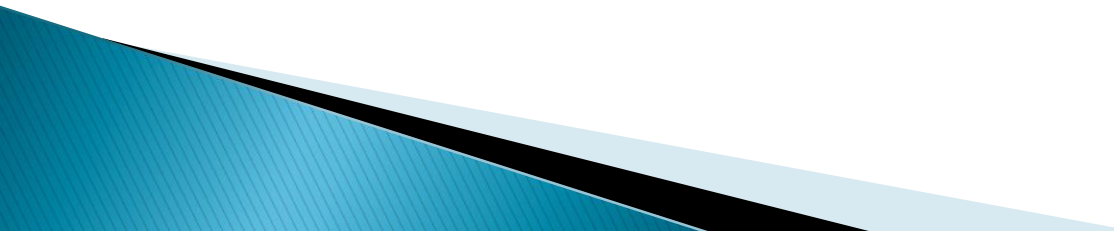


# Crime and the Fear of Crime in High-Rise Residential Environments

the lack of semi-private space “atomized” potential community feeling among the residents in the development’s 2762 apartments. The lack of semi-private or defensible space was, in Yancey’s view, a prime cause of crime and fear of crime in the complex.



the high-rise dormitory (a large room, especially at a school or institution, containing several beds) was the site of more crime than a nearby low-rise dormitory. Nevertheless, it may be that, within any given income group, more crime (per capita) will occur in high- than comparable low-rises buildings.

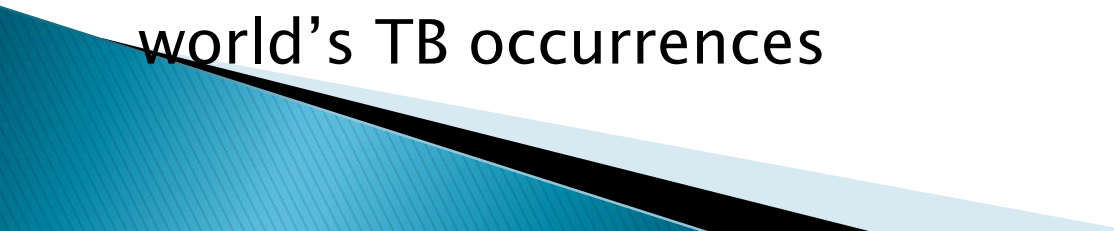


# Tuberculosis

Tuberculosis (TB) is caused by *Mycobacterium tuberculosis*, a bacteria that often affects the lungs. Although TB is curable and preventable, it is highly contagious and spread from person to person through inhaling TB germs in the air.

The World Health

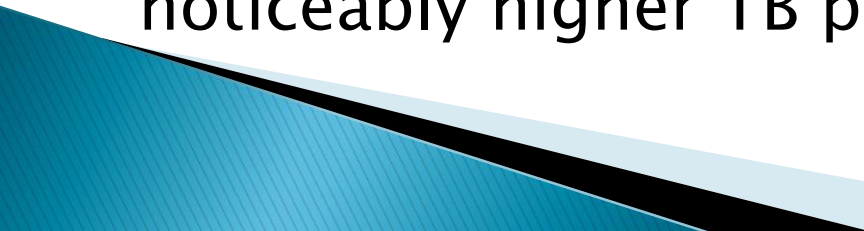
Organization (WHO, 2012) reported that the burden of TB remains enormous and is highest in Asia and Africa, with China and India accounting for almost 40% of the world's TB occurrences



# What is Tuberculosis associated with

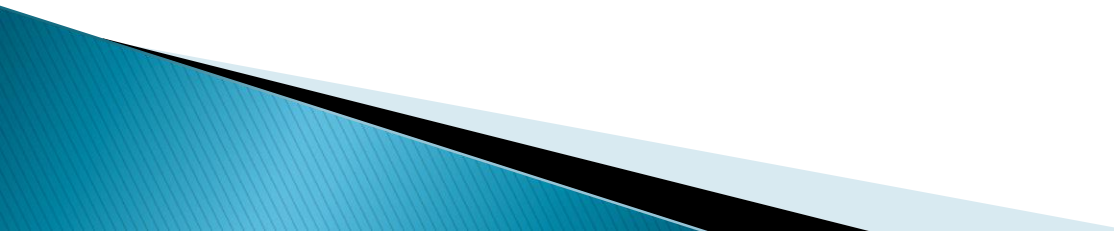
The World Health Organization (2005) considers Hong Kong as a region with good health infrastructures that bears an intermediate burden of TB.

The disease has been found to have association with smoking and Areas dominated by the socially deprived, and those living in crowded areas of poor ventilation have been reported to have noticeably higher TB prevalence.



# Tuberculosis (TB) Disease: Symptoms & Risk Factors

Tuberculosis (TB) is a disease caused by bacteria that are spread through the air from person to person. If not treated properly, TB disease can be fatal. People infected with TB bacteria who are not sick may still need treatment to prevent TB disease from developing in the future.




# Signs of TB Symptoms

TB bacteria most commonly grow in the lungs, and can cause symptoms such as:

- 1– A bad cough that lasts 3 weeks or longer
- 2– Pain in the chest
- 3– Coughing up blood or sputum (mucus from deep inside the lungs)


**Other symptoms of TB disease may include:**

- 1– Weakness or fatigue
  - 2– Weight loss
  - 3– No appetite
  - 4– Chills
  - 5– Fever
  - 6– Sweating at night
- 



# High Rise Buildings and Tuberculosis

Hong Kong has a compact urban built form comprising of high-rise and high density buildings. This high density high-rise built form gives rise to an efficient transport infrastructure with low carbon consumption, to which, the area is described as a model of sustainable urban development.



However, the condensed city structure is also criticized for its poor air quality and unpleasant living conditions that pose environmental health risks to its residents.


Studies have shown that high-rise blocks constructed close to each other result in severe sky obstructions and poor air ventilation especially for the lower floors.

It is known that poor sunlight penetration, unsatisfactory air quality and impeded ventilation



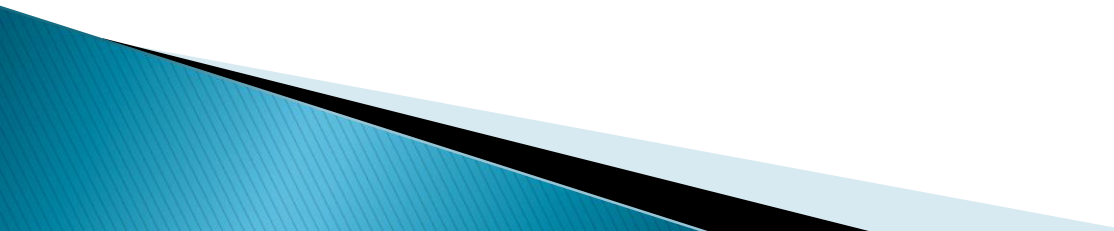
prevail in many urban communities of Hong Kong closely packed with mid-rise to high-rise buildings.

It is also known that ultraviolet radiation from the sun kills bacterium in dwellings but the shading effects from surrounding buildings in many communities of Hong Kong have prevented direct sunlight to reach even pockets of small open spaces at the street level. Furthermore, the daylight quality within housing units are determined by many factors, these are:



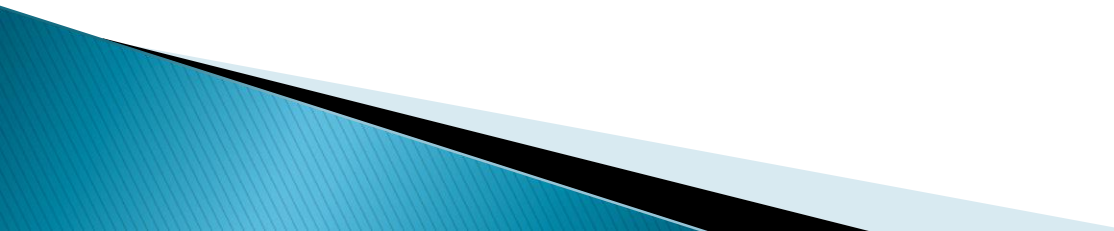
- 1) Window size,
- 2) obstruction from other buildings, and
- 3) distance between buildings.

Because of short separation distances between buildings, windows facing neighbouring blocks are always fitted with window shades and kept closed most of the time thus defeating the purpose of bringing in light and ventilation.



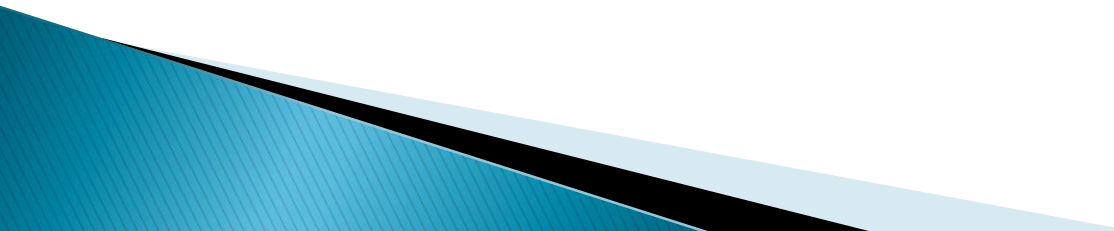
High density and vertical urban development will become away of life for the expanding Asian cities because of rapid urbanization and diminishing non-renewable land resources.

In recent years, the quality of urban life or the well-being of people living in a specific place has gained increasing attention.

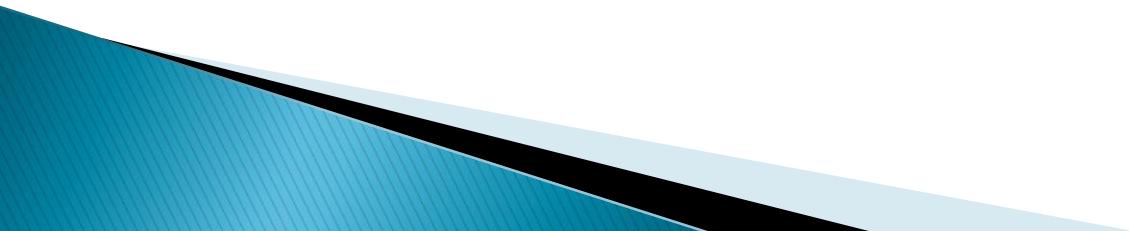


# The relationships between Sun View Factor and Tuberculosis

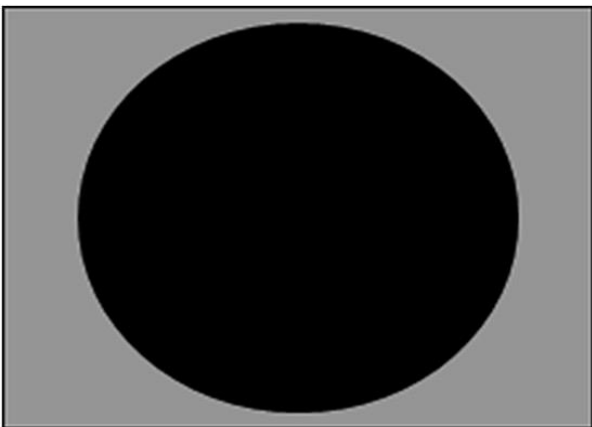
A study was carried out to examine the relationships between TB incidence and the neighbourhood environment, with specific reference to natural daylight capacity. The sky view factor (SVF) has been used to indicate the impact of urban geometry on daylight and heat



island effects in cities SVF is a measure of the openness of the sky relative to a specific location with values ranging from 0 (no sky visible) to 1 (no foliage/obstruction visible) as shown in (Fig. 1).



**Fig. 1. Sample results of sky view factors (SVF). SVF ranges between 0 and 1, with near zero values indicating very little visible sky and values closer to 1 indicating no obstruction of the sky.**



**SVF = 0**



**SVF  $\approx$  0.2**



**SVF  $\approx$  0.4**



**SVF  $\approx$  0.6**



**SVF  $\approx$  0.8**

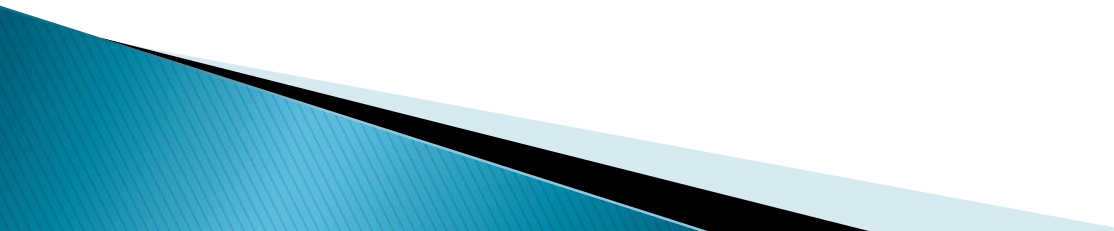


**SVF  $\approx$  1.0**



The SVF in an urban environment with little vegetation, as in the case of Hong Kong, is influenced primarily by building heights and street canyon widths or spaces between buildings.

A total of 1668 cases with TB positive specimens were available from the 2007–2009 out-patient data provided by the Tuberculosis and Chest Services of hospitals in the Kowloon West Cluster



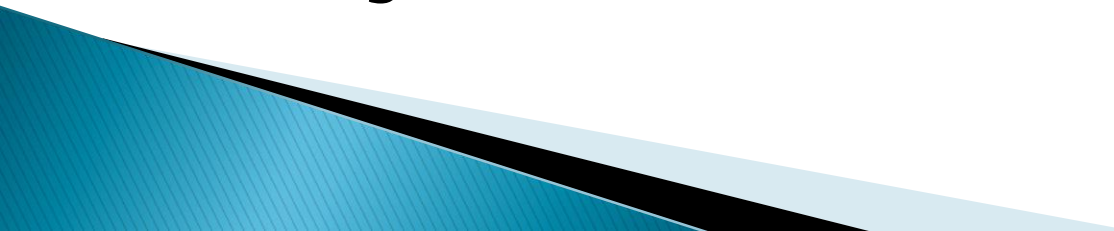
The residential addresses of these cases were geocoded for spatial analysis .

The quintile group of Q1 indicates the lowest floors as opposed to Q5 representing the highest floors. The buildings were also classified into 5 BUILDING groups by maximum storey ( $\leq 8$ ; 9–16; 17–24; 25–32;  $\geq 33$ ). As shown in Table 1

Table 1 – Summary statistics of TB cases by QUINTILE and BUILDING groups.

BUILDING	QUINTILE					Subtotal
	Q1	Q2	Q3	Q4	Q5	
≤8	25	19	17	5	9	75
9–16	139	56	49	39	35	318
17–24	94	51	31	38	33	247
25–32	47	40	43	27	26	183
≥33	90	94	81	80	59	404
Subtotal	395	260	221	189	162	1227

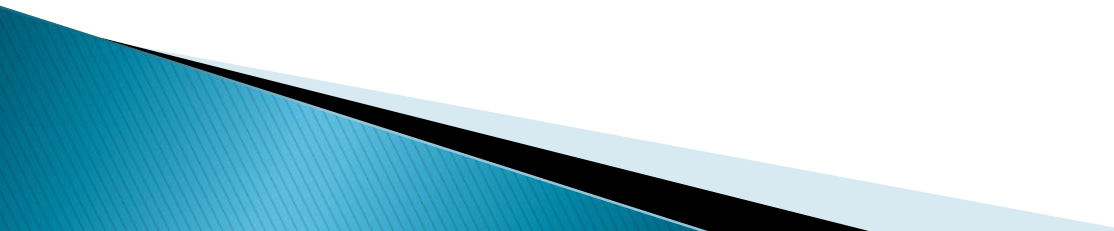
Table 1 shows the number of TB positive cases by QUINTILE and BUILDING groups. It is observed that a larger number of TB cases tended towards the lower quintile groups (Q1 and Q2), irrespective of the building heights (whether  $\leq 8$  or  $\geq 33$  storeys). A graphics plot of TB QUINTILE percentages by each BUILDING groups highlights the fact that more than 50 percent of TB cases were found in the two lower quintile groups of Q1 and Q2 for buildings shorter than 25 storeys



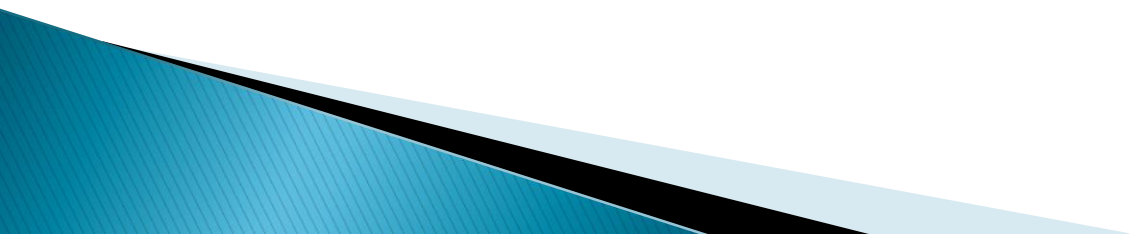
Even for buildings taller than 25 storeys, nearly half of the observed TB cases were found in the two lower quintile groups of Q1 and Q2.

the result suggests that TB prevalence by storey level (as classified by QUINTILE groups) is dependent on BUILDING heights.

BUILDING groups and the interaction between BUILDING and QUINTILE groups both show statistically significant association with Sun View Factor (SVF).




This is to say that the interaction between the vertical position of a diseased residence and the height of the building is related to natural daylight capacity as reflected through SVF. More diseased residence on lower floors for taller buildings.



# The outcomes

The result is lower floors in the midst of high-rise buildings are sheltered from direct sunlight, more thoughts should be given to the layout, orientation, and separation distance between built structures. For example, an increase in the vertical height of a building should command a corresponding increase in the horizontal separation to allow for penetration of natural daylight and permit better air flow.



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