Window Design for Natural Ventilation

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Sustainability and Human Response

INDS 328

Semester 2

Week 2B

Date

Outline

- Air movement, Wind pressure and Wind Direction
- Wind Shadow.
- The importance of natural ventilation
- The advantages of natural ventilation in built environment
- The chimney effects

Objectives

When completed this lecture students are expected to:

1-Understand how wind movement is happening in planet earth

2- Relate natural ventilation with thermal comfort in built environment

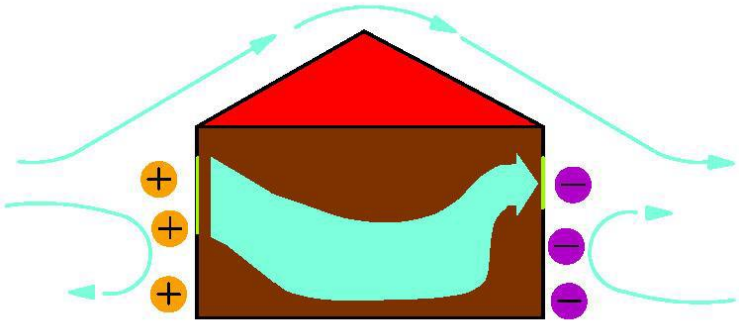
3- Know the windows design to responde to air movement

3-Understand the chimney effect in building ventilation

Air Movement

- The air movement phenomena occurs when there is a pressure difference between different zones on the earth. i.e due to the Solar Intensity (KW/m2) falling on the parts of the earth.
- **Wind Speed:** due to the difference between the any two zones.
- **The Wind Direction:** is defined by the geographical direction from which the wind comes from.

- **Wind High Pressure**: is due to the compression of air layers before barrier or wall.
- **Wind Shadow:** from the high pressure zone the win will bends round building causing stagnant region on the other side called wind shadow. –ve pressure zone at this zone wind starts to recover its original direction. As shown



Natural Ventilation: Wind Effect

The Importance of Natural ventilation

- There are many functions generated by the Natural Ventilation, those are:

a- an air change of the inside air by about 15 to 20% of the total circulated air within the built environment.

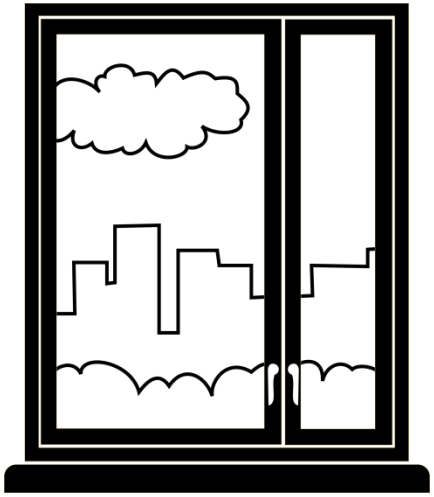
b-the types of the activities of the occupants within building dictate the amount of fresh air needed.

c-Surgical operations theaters and X-ray room requires 100% air change.

- d-**In general about 80%** of air circulated in rooms of normal functions.

Windows and Natural Ventilations

- **The Natural Ventilation influences:**
- window design.
- Window size
- Window location
- Window relative location in relation with other windows.

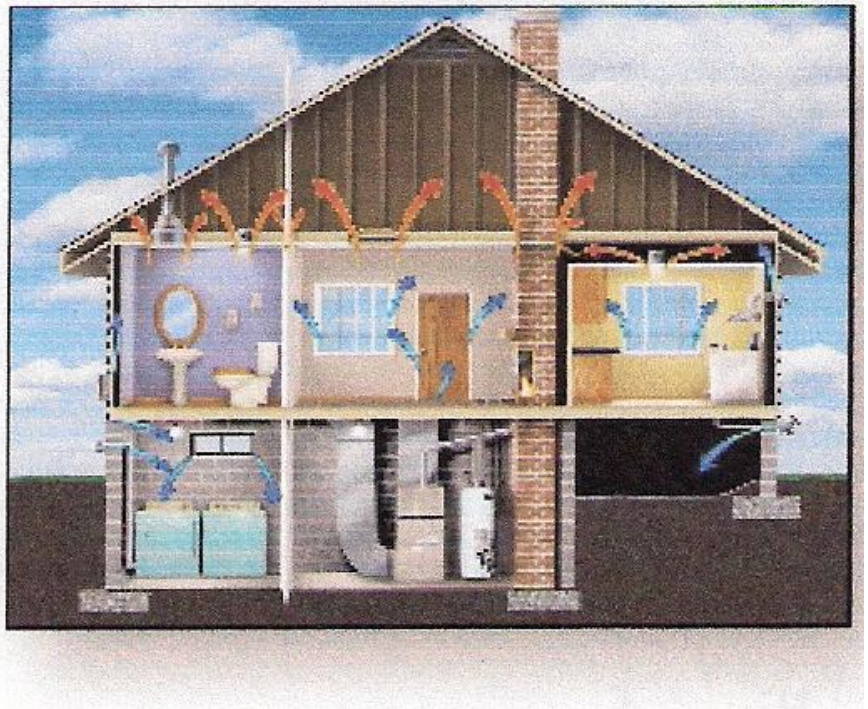


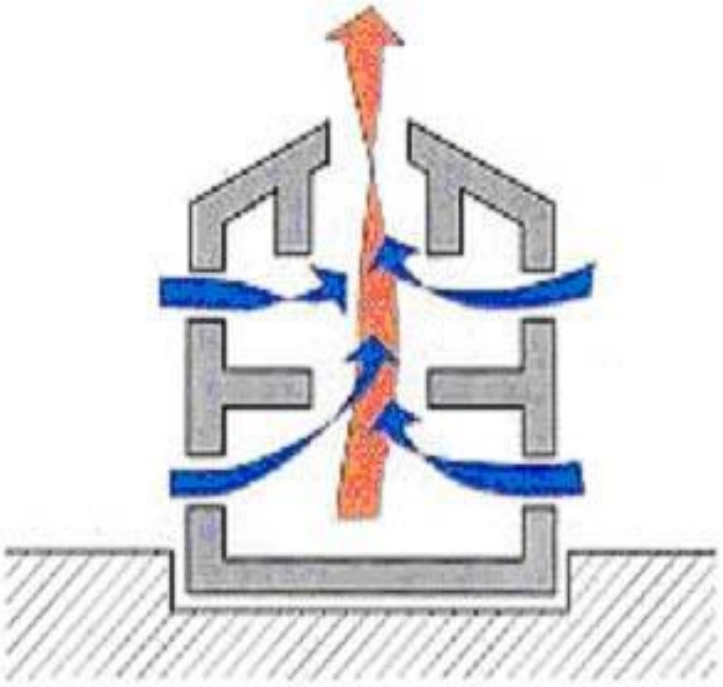
The 167.5 meter tall skyscraper was built to house telephone switching equipment and was completed in 1974.

The Advantages of Natural Ventilations in Built Environment

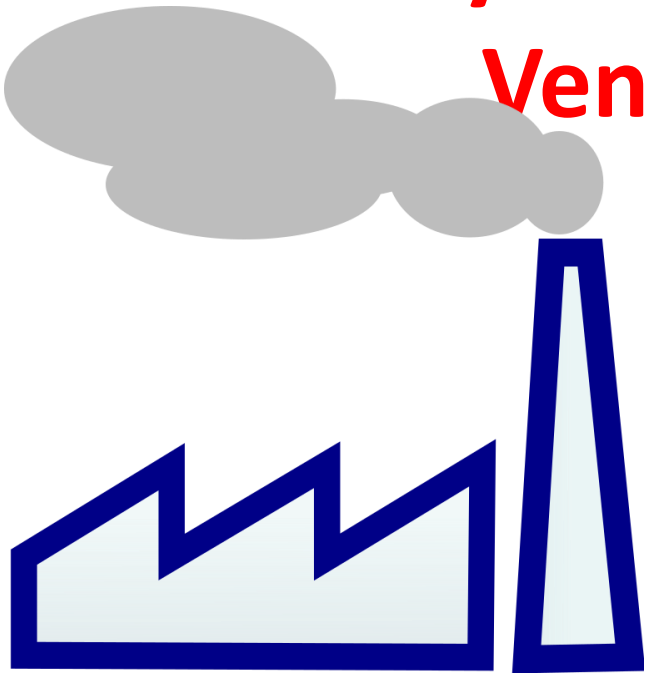
- Advantages of natural ventilation are:
- 1-To provide healthy treated air for occupants-Sick building Syndrome.
- 2-To provide Thermal Comfort: to get rid off the latent and sensible heat from body.
- 3-Structral Cooling ventilation: where there are a reasonable temperature difference between inside and outside environment.

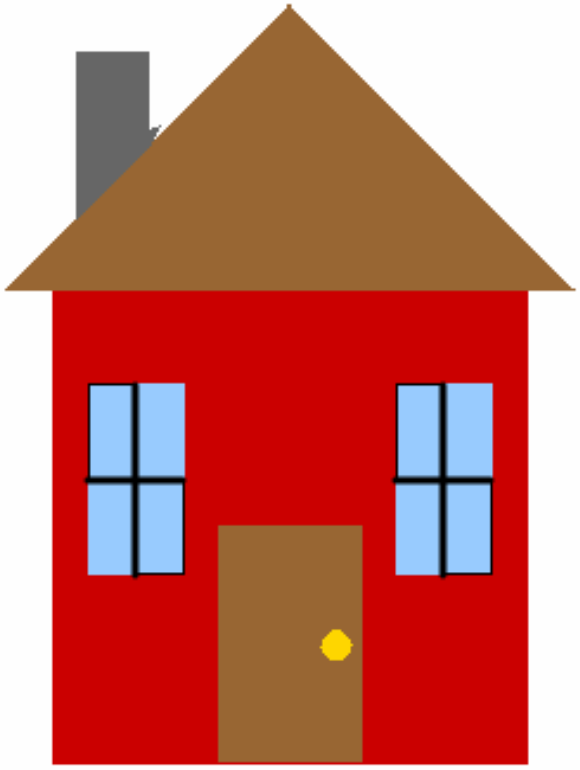
The Advantages of Natural Ventilations in Built Environment





Chimney Effect and Natural Ventilation





WINDOW DESIGN FOR NATURAL VENTILATION

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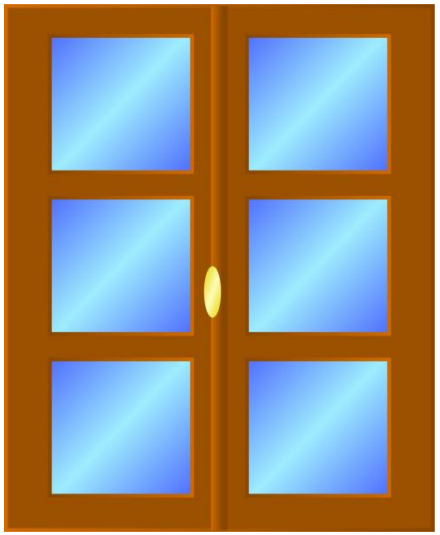
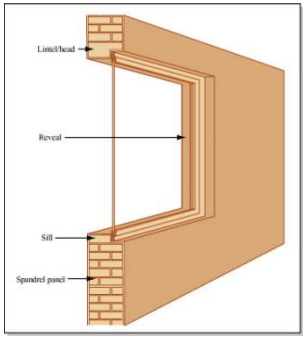
WINDOW DESIGN FOR NATURAL VENTILATION

- External and internal factors influence the air movement and its speed within the built environment, they are:
- Window location
- Orientation of the window opening
- Area of the opening
- Types of window opening



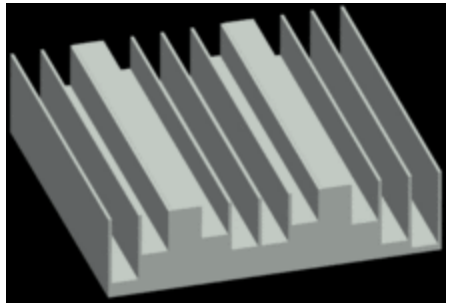


WINDOW DESIGN FOR NATURAL VENTILATION

- External Factors are:
- Horizontal extensions, cantilever
- The vertical extensions
- Trees

WINDOW DESIGN FOR NATURAL VENTILATION

- Internal Factors are:
- Space dimension
- Internal partitions within space.



CALCULATIONS OF NATURAL VENTILATION FLOW RATE

- VENTILATION ENHANCED IN BUILDINGS EITHER BY:

A-Natural Ventilation due to strong wind.

- Q=Cv.A.v
- where Q=air flow m3/s
- A=area of inlet opening m2
- Wind velocity m/s
- Cv opening effectiveness
- 0.5 to 0.6 for perpendicular winds
- 0.25 to 0.36 for diagonal winds

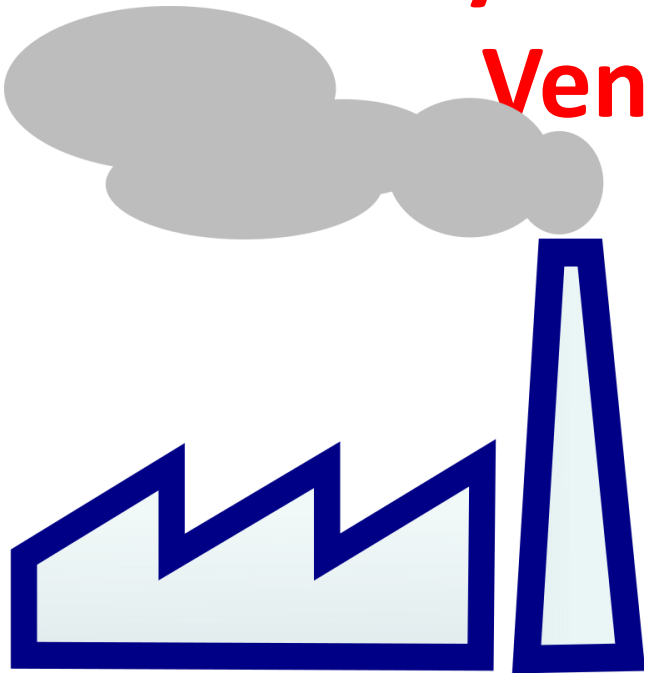
Chimney Effect and Natural Ventilation

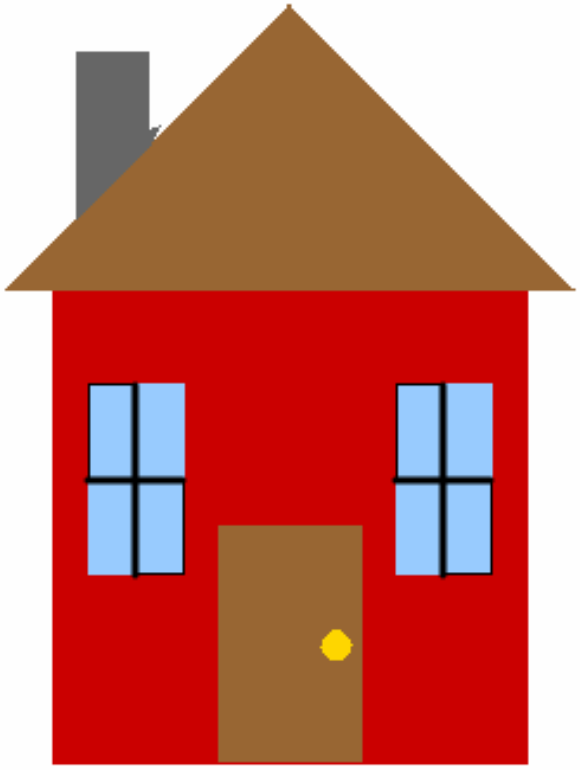
B-The natural ventilation due to air temperature difference between inside and outside of the built space is called buoyancy effect or stack effect or ṣhimney effect as shown in figure

Ex: outside wind speed north-western direction 20 km/hr, area of window crack is .001 m*2 estimate the volume of air infiltrating the through the window.?

Q=Cv.A.v Q=0.3x.001x20x1000/3600= **0.0017m cub/s** i.e **3.6 cfm**

Chimney Effect and Natural Ventilation





The Advantages of Natural Ventilations in Built Environment