# Convection

- Convection is the mechanism of heat transfer through gasses.
- Air in contact with a surface hotter than itself will become warmed.
- Warm air is less dense and will therefore rise, carrying the heat away with it.
- When this air comes into contact with a surface colder than itself, heat is transferred to the surface.

# Ventilation losses

- This is the heat loss associated with air flow through a building by natural means, that is, through small openings and cracks in the structure.

# Infiltration rate

- Wind strength and direction
- Air tightness
- Stack effect

# CIBSE Guide A Natural ventilation rates

(Source http://www.arca53.dsl.pipex.com/index_files/tt6.htm)

| Maximum Average **Air Infiltration rates in Air Changes per hour (AC/h)** | | | |
|---|---|---|---|
| **CIBSE Guide A – Table ref.** | **Building** | **'Leaky' building (does not comply with current regulations)** | **Moderately 'tight' building (complies with 2005 regulations)** |
| Table 4.13 | Office Type 1: naturally ventilated, 100 – 3000 $m^2$ | 0.90 | 0.30 |
| Table 4.14 | Office Type 2: naturally ventilated, 500–4000 $m^2$ | 0.70 | 0.25 |
| Table 4.15 | Office Type 3: air conditioned, 2000–8000$m^2$ | 0.60 | 0.20 |
| Table 4.16 | Office Type 4: air conditioned HQ-type building, 4000–20000 $m^2$ | 0.65 | 0.25 |
| Table 4.17 | Factories, warehouses, halls | 0.65 | 0.25 |
| Table 4.18 | Schools | 0.70 | 0.25 |
| Table 4.19 | Hospitals and Health Care buildings | 0.60 | 0.25 |
| Table 4.20 | Hotels | 0.85 | 0.30 |
| Table 4.21 | Dwellings – 1 storey | 1.15 | 0.40 |
| | Dwellings – 2 storeys | 1.00 | 0.35 |
| | Apartments – 1 to 5 storeys | 1.00 | 0.50 |
| | Apartments – 6 to 10 storeys | 1.60 | 0.55 |

# Calculating Ventilation losses

- Primarily include infiltration only
- Mechanical extraction in bathrooms etc should be allowed for in small buildings

# Formula for ventilation heat loss

**$Q = N \cdot V \cdot Sp.ht \cdot \Delta t$**

**Where**

**Q = Heat loss (W)**

**N = Number of air changes per hour**

**V = Room volume ($m^3$)**

**Sp.ht = Specific heat factor for air (0.34)**

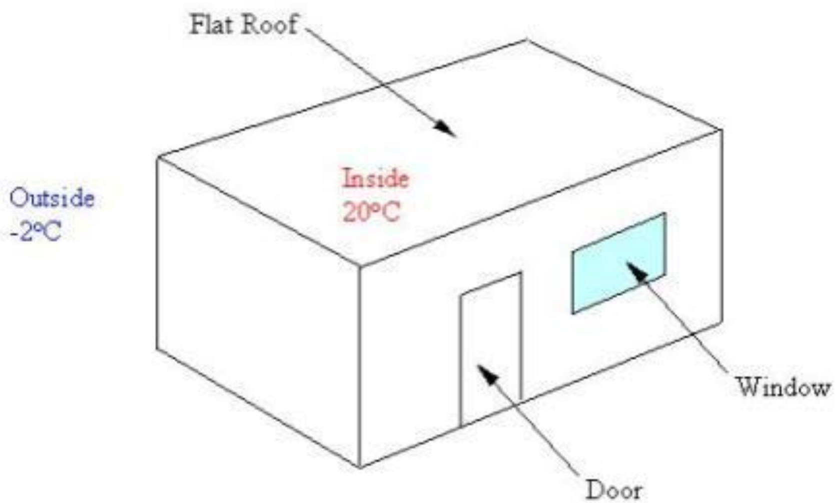
**$\Delta t$ = temperature difference between inside and outside (ºC)**

# Example

Calculate the ventilation heat loss from the building shown below.

Rectangular Building dimensions : 6.0 metres long x 3.0 metres wide x 2.5 metres high.

The air change rate due to natural ventilation is 2 air changes per hour.




SMALL BUILDING

# Answer

Q = N . V . Sp.ht. . dt

Q = 2.0 x 6.0 x 3.0 x 2.5 x 0.34 ( 20 - - 2)

Q = 2.0 x 45 x 0.34 x 22

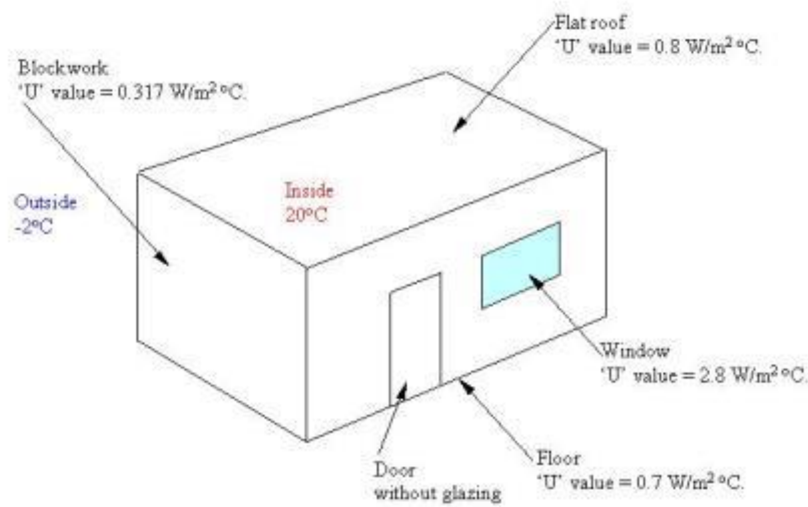
Q = 673.2 Watts

# Total heat loss calculations

Calculate the total heat loss from the building shown below i.e. the fabric and ventilation losses.

Rectangular Building dimensions : 6.0 metres long x 3.0 metres wide x 2.5 metres high.
The window size is 2.0 m long x 1.0 m high.
The air change rate due to natural ventilation is 2 air changes per hour.

It is normal to ignore the door without glazing and add it into the wall area in most calculations although for very accurate methods the door could be calculated separately.




SMALL BUILDING

$$Q = \text{'U'} . A . \Delta t$$

- First Calculate the heat loss through the window

| | | |
|---|---|---|
| Q window | = | 2.8 x 2.0 x 1.0 x ( 20 - - 2 ) |
| Q window | = | 2.8 x 2.0 x 22 |
| Q window | = | <u>123.20 Watts</u> |

$$Q = 'U' . A . \Delta t$$

- Second calculate the heat loss through the blockwork.

| | | |
|---|---|---|
| Q front wall | = | 0.317 x ( 15.0 - 2.0) x ( 20 - - 2 ) |
| Q front wall | = | 0.317 x 13 x 22 |
| Q front wall | = | 90.66 Watts |
| Q rear wall | = | 0.317 x 15 x 22 |
| Q rear wall | = | 104.61 Watts |
| Q side walls | = | 0.317 x 2 ( 3.0 x 2.5 ) x 22 |
| Q side walls | = | 104.61 Watts |
| Q walls total | = | 90.66 Watts + 104.61 Watts + 104.61 Watts = 299.88 Watts |

**Q = 'U' . A . Δt**

- Third calculate the heat loss through the floor

| | | |
|---|---|---|
| Q floor | = | 0.7 x 6.0 x 3.0 x 22 |
| Q floor | = | 277.20 Watts |

- Fourth ( roof

| | | |
|---|---|---|
| Q roof | = | 0.8 x 6.0 x 3.0 x 22 |
| Q roof | = | 316.80 Watts |

$$Q = N \cdot V \cdot Sp.ht \cdot \Delta t$$

- Fifth calculate the heat loss by ventilation

$$Q = 2.0 \times 6.0 \times 3.0 \times 2.5 \times 0.34\,(20 - -2)$$

$$Q = 2.0 \times 45 \times 22$$

$$Q = \underline{673.2 \text{ Watts}}$$

# Finally calculate the total heat loss

Q total = heat loss window + heat loss blockwork + heat loss floor + heat loss roof + ventilation heat loss

Q total = 123.20 + 299.88 + 277.20 + 316.80 + 673.2

Q total = **1690.28 Watts**

It can be seen from the above calculations that the ventilation heat loss accounts for:

( 673.2 / 1690.28) x 100 = 40% of the total heat loss for the building.