NUCLEUS

ENGLISH FOR SCIENCE AND TECHNOLOGY

ARCHITECTURE AND BUILDING CONSTRUCTION

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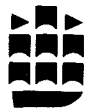

Longman

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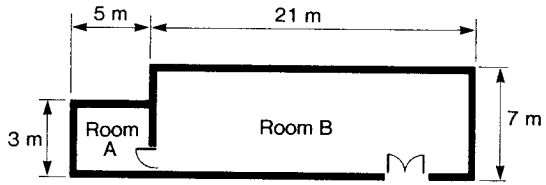
Unit 9 Measurement 3 Proportion

Section 1 Presentation

1. Look and read:

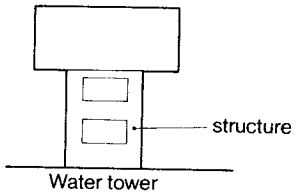


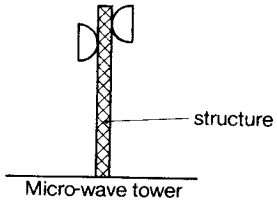
Plan of a building

The *ratio between* the length *and* width of Room A is 5 : 3 (five to three).
The ratio between the length and width of Room B is 3 : 1 (three to one).
Room B is wider than Room A, but its width is less *in proportion* to its length.

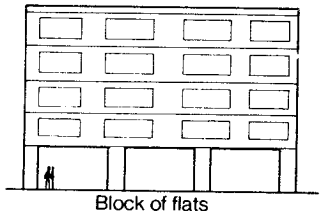
Therefore Room B is { *relatively* narrow. / *proportionately* narrower.

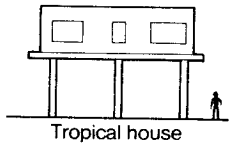
Now look at these diagrams showing the relation between size and supporting strength:





Towers





Residential buildings

Answer these questions:

a) Which tower carries a relatively heavy load?
b) Which building carries a relatively light load?
c) Which part of the block of flats supports its weight?
d) Which part of the tower supports its weight?

e) What is the approximate ratio between the length of the columns of the block of flats and the height of the building?
f) What is the approximate ratio between the length of the columns of the tropical house and the height of the building?
g) Which building has longer columns in proportion to its size?
h) What is the approximate ratio between the length and thickness of the columns of the block of flats? (This ratio is called the slenderness ratio.)
i) What is the approximate ratio between the length and thickness of the columns of the tropical house?
j) Which building has proportionately thicker columns?

2. Make sentences from this table:

In comparison with Compared with	a	water tower, micro-wave tower, block of flats, tropical house,	a	water tower micro-wave tower block of flats tropical house

supports a relatively	heavy light	load and has	a –

proportionately	thicker thinner longer shorter	columns. tower structure.

3. Now read these two paragraphs and add the missing words:

a) If we *compare* the columns supporting the two buildings, we *can see* that the columns of the block of flats are *relatively* short and thick *in proportion* to its size, *while* those of the tropical house ..... We *can conclude* that the heavier building needs *proportionately* shorter and thicker columns, *whereas* .....
b) *The explanation for this is that* short thick columns are stronger than long thin ones *since* the strength of the column *depends on* its thickness and its length. Supporting strength is *directly* proportional to _____ and *inversely* proportional to _____. *Consequently, the heavier* the building, *the* _____ and _____ its columns, and *conversely*, the lighter the building .....

4. Use the words in italics from exercise 3 to write two similar paragraphs comparing the two towers shown in exercise 1.

Note: Substitute 'structure' for 'columns' and 'tower' for 'building', and make any other necessary changes.

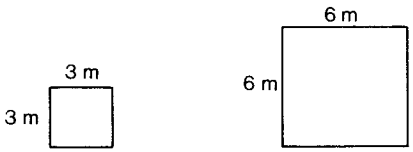
5. Say whether these statements are true or false. Correct the false statements.

a) The ratio between the height and width of the micro-wave tower is higher than that between the height and width of the water tower. (1 : 3 is a higher ratio than 1 : 2).
b) The structure of the water tower has to support less weight than that of the micro-wave tower.
c) The columns of the block of flats have greater supporting strength than those of the tropical house.
d) The strength of a column is directly proportional to its height and inversely proportional to its thickness.
e) Compare with a micro-wave tower, a water tower has a relatively tall structure.
f) The lighter the load on a tower, the thicker its structure.
g) Similarly, the heavier a building, the thinner its columns.

Section 2 Development

6. Read this and follow the instructions:

Perimeter in relation to size and shape
The ratio between the perimeter and floor area of a building has an important effect on the cost of the enclosing wall element. The perimeter/area ratio depends on the size and shape of the plan of the building.
To show how the perimeter varies with size:
Calculate the floor areas of the buildings illustrated below.
Calculate their perimeters.
Find the ratio between the perimeter and the floor area for each building.



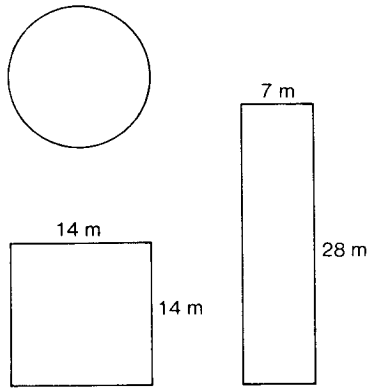
Building A Building B

a) Floor area =
b) Perimeter =
c) Perimeter/area ratio =
d) Floor area =
e) Perimeter =
f) Perimeter/area ratio =

Now complete these statements:
g) By comparing the ratio of perimeter to floor area for the two buildings we can see that the _____ building has a higher perimeter/area ratio.
h) We can conclude that smaller buildings have a _____ (longer or shorter) perimeter in proportion to floor area than larger buildings.

7. Now read and complete these:

To show how perimeter also varies with shape
a) These floor plans have the same area but they differ in shape. Do they have the same perimeter? Calculate the perimeters of the square and rectangular buildings.



	floor area	*perimeter*
	196 m^2	49·6 m
	196 m^2	.....
	196 m^2	.....

b) The circular building, which has the most compact shape, has the smallest perimeter in proportion to area, whereas the ....., which has the least ..... has the _____ perimeter in proportion to area.
c) If we _____ the perimeters of buildings with the same floor area but different shapes, we will _____ that the more compact the shape .....
d) We can _____ that ..... ratio depends on _____ as well as _____.

8. Now use exercise 7 to help you show how surface area varies with shape. Calculate the surface areas of a sphere, a cube and a rectangular prism which all have the same volume.

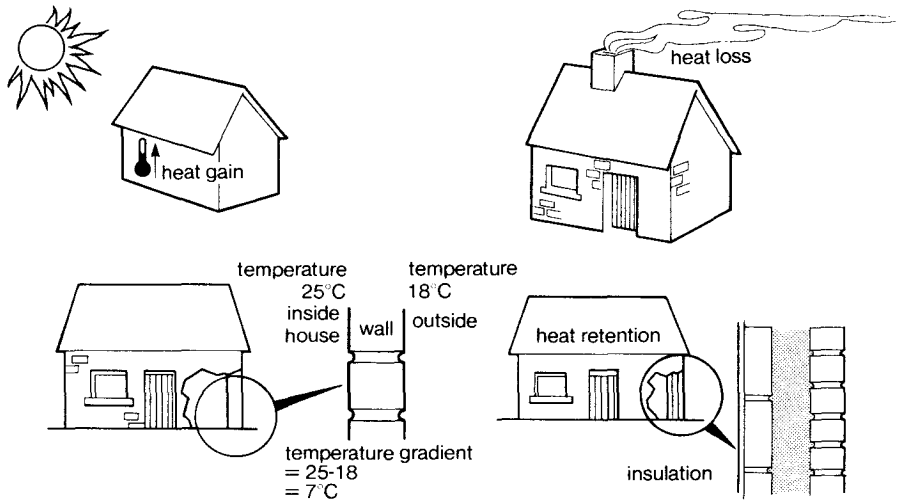
Section 3 Reading

9. Read this passage and look at the diagrams:

The effects of the surface area/volume ratio in architecture

The relation between surface area and volume has many effects on the performance of buildings. For example, the rate at which a building gains or loses heat through its walls depends on its surface area/volume ratio. Heat transfer is directly proportional to surface area and inversely proportional to volume. Thus a building with a proportionately large surface area, such as a one room house, will lose or gain heat relatively rapidly. Conversely, a building with a large volume in relation to its surface area, such as a block of flats, will retain more heat.

Heat losses from a building are reduced by using insulating materials such as expanded polystyrene. Thickness of insulation is in inverse proportion to heat transfer.



Make true statements from these tables:

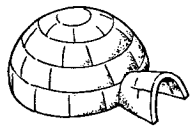
Heat transfer Heat loss Heat gain Heat retention	is	directly inversely	proportional to	air temperature gradient. thickness of insulation. surface area. volume.

The higher the ratio between surface area and volume,	the more quickly it gains or loses heat.
The lower the ratio between surface area and volume,	the more it retains heat.
The smaller the size of the building,	the faster the rate of heat transfer.
The larger the size of the building,	the less it retains heat.
The thicker the insulation of a building,	the more slowly it gains or loses heat.
The more compact the shape of a building,	the slower the rate of heat transfer.
The less compact the shape of a building,	

10. Now read this passage:

We can conclude that the more compact the shape of the plan of a building for a given area the less the heat loss. It can also be shown that for a given required total floor area in a two or more storey building, the higher the building the greater the heat loss. However, buildings gain heat from the sun as well as losing heat to the cold. The more directly the face of a building is at right angles to the sun the greater the heat gain.

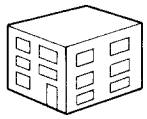
The following examples illustrate the effects of the perimeter/area ratio, the surface area/volume ratio and orientation of the building on heat transfer. Explain them by answering the questions:

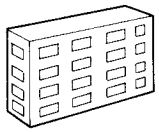


a) Igloos are built by Eskimos in the Arctic where the cold is very intense. Why do they build them this shape?

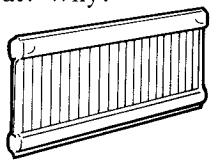
b) Mud houses are built by people in the tropics where the heat is very intense. Why do they build the walls so thick?

c) Why are some houses in tropical climates built with plans shaped like this?

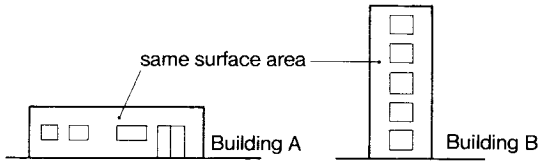




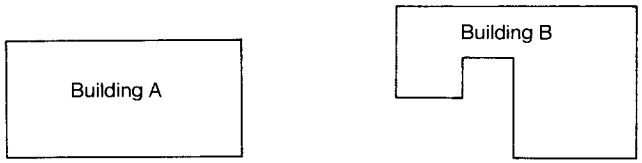
d) These two buildings have identical floor areas. Which of them loses the greater amount of heat? Why?



e) Why do radiators have fins?



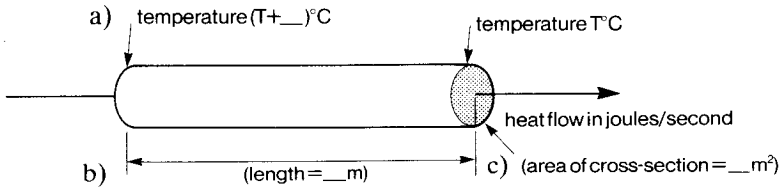
f) Which of these two south-facing elevations will receive the greater amount of solar radiation. Why? Will the solar radiation be greater in summer or winter?



g) Both these buildings have the same floor area and the same height. Which one will be more expensive to heat?

Section 4 Listening

11. Listen to the passage. Copy and complete the diagram, the notes and the table:



d) k = $\frac{\ldots\ldots}{\ldots\ldots \times \ldots\ldots}$

The units of k are

e) $\frac{\ldots\ldots}{\_\_\_\_\_} \times \_\_\_\_\_ \times \ldots\ldots$

that is

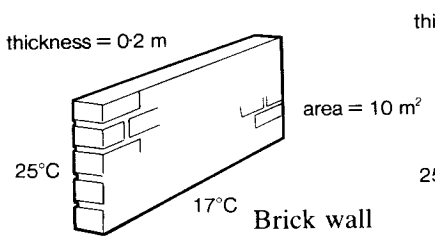
f) .....

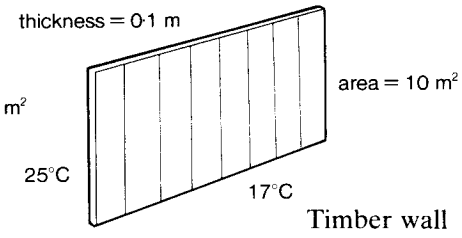
or

g) .....

h) Material	k value
copper	380
_____	_____
_____	_____
_____	_____
_____	_____
_____ _____	_____

12. Calculate the number of joules of heat flowing through these two walls during one hour:





Now complete the statements:

a) The ratio between the rates of flow of heat through the two walls is .....
b) The brick wall has a _____ thermal conductivity than the timber wall.
c) The rate of flow of heat through a material is _____ proportional to its coefficient of thermal conductivity.
d) If we _____ the two materials we can see that _____ is a relatively poor insulating material compared with _____.
e) We can _____ that the material with a _____ coefficient of thermal conductivity needs a relatively _____ wall to achieve the same degree of insulation.