

Investigate a frame structure: a cell phone tower

KEYWORDS

- **tie beam** – a horizontal beam or crosspiece in a frame structure that supports the other members by holding or pulling the sections together
- **tension force** – a type of force that stretches a member
- **strut** – a diagonal rod or bar in a frame structure that braces or supports the other sections and keeps them in position by pushing against them
- **compression force** – a type of force that squashes a member

Structure of a cell phone tower

In this unit, we will investigate a cell phone tower as an example of a frame structure. As you have already learnt, frame structures consist of many rigid members that are joined together to form the structure. These members are usually beams. The beams have different names depending on their location and function in the structure.

Similarities in frame structures

When you look at different frame structures, you will notice that they share some similar features. These similarities help to strengthen the structure and enable the different sections of the structure to resist the forces acting on them.

A cell phone tower consists of different beams and struts that withstand tension and compression forces. Let's look at the pictures of the two different cell phone towers to see what they have in common:

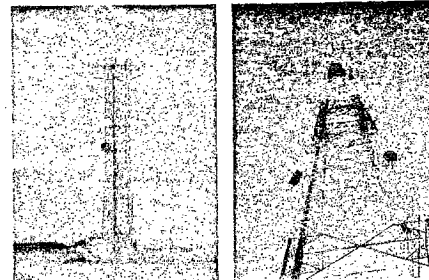


Figure 22 Two different cell phone towers.

- They have wide bases that help to stabilise them.
- The tower members are held together using crosspieces. These are called **tie beams** and support the members by holding or pulling on them. This is called a **tension force**.

Sections of the towers are held in position by beams called **struts**. These struts are diagonal members that support the sections by pushing against them and keeping them in position. A pushing force is called a **compression force**.

The triangular shapes in these towers are very noticeable. A triangular frame is very strong. Many structures and buildings use this shape in their construction.

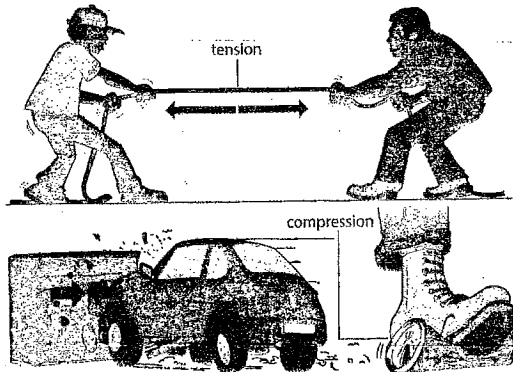


Figure 23 The difference between tension and compression.

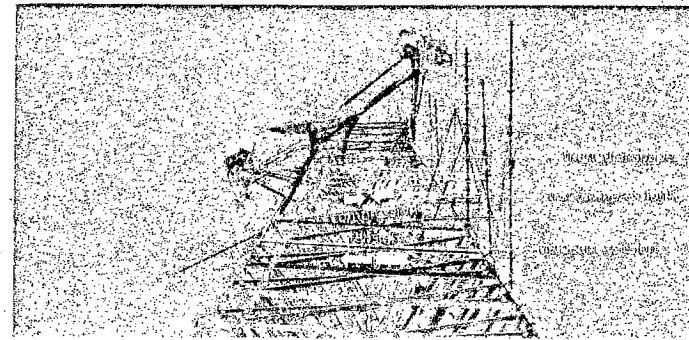


Figure 24 Different members strengthen a frame structure

Enabling tasks: Investigate a cell phone tower

You will need: pieces of firm cardboard (15 cm x 30 cm) and paper fasteners to join the members.

Work individually to answer Questions 1 and 2 in your workbook.
Work in pairs for Question 3.

1. Look at the structures shown in Figure 25 and Figure 26.
 - a) What types of structures are these? (1)
 - b) Why are cables attached to the structure in Figure 25? (2)
 - c) Compare the structures shown in Figure 25 and Figure 26. Refer to the actual structure, what is attached to it and the shapes being formed by the members. (2)
2. The cell phone tower in Figure 26 is positioned on top of a building.
 - a) Suggest a reason why it was constructed there. (2)
 - b) Explain why it was painted the same colour as the building. (2)
 - c) How would you blend the cell phone tower in Figure 25 in with its surroundings? (1)
3. The members of both cell phone towers are joined together to form triangular shapes. Let's investigate why these shapes are used.

With a partner, construct Shape 1 and Shape 2 shown here using pieces of cardboard and paper fasteners. Ask your teacher to help you if you are struggling. Then answer the questions that follow in your workbook.

- a) What happens when you push at the sides of the shapes? What happens when you pull at them? (4)
- b) What forces are being applied to each shape? (2)
- c) Describe how can you modify the square shape so that it becomes more stable? (2)

[Total: 18]

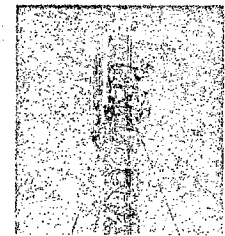
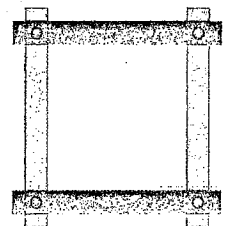


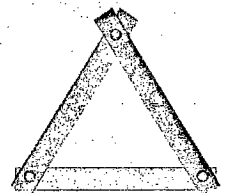
Figure 25



Figure 26



Shape 1 – a square frame



Shape 2 – a triangular frame