Tower cranes

Tower cranes are used for lifting large heavy loads. They are so tall that there is a danger that they could topple over. To help prevent this they carry ballast to help them balance. The ballast is also called a 'counterbalance' or 'counterweight'.

Tower cranes are a common feature at most major construction sites. They can be seen rising over a hundred metres into the air and can reach out just as far. The construction crew uses the tower crane to lift steel, concrete, large tools (like acetylene torches and generators) and a wide variety of other building materials.

All tower cranes have four main parts.
- A base which is bolted to a large concrete pad. This helps to stabilise the crane.
- The base is connected to the **mast** or **tower**, which gives the tower crane its height.
- The mast has a **slewing unit** at the top, which contains the gears and a motor to help the crane rotate.
- The **jib** is the working arm of the slewing unit.

The jib is the part of the crane that carries the load. A trolley or sliding pulley block runs along the jib to move the load in and out from the crane's centre. This changes the load that the crane can lift. The shorter horizontal **machinery arm** contains the crane's motors and electronics as well as the large concrete **counterweights**. These help the crane to balance.

When a load is lifted, there is a turning force on the tower. The counterweights provide a moment in the opposite direction to stop the crane falling over. The counterweights can be moved to keep the crane stable.

There is a maximum load that a crane can lift, but the crane cannot lift that much weight if the load is positioned at the end of the jib. The closer the load is positioned to the mast, the more weight the crane can lift safely. For example, if the crane is built to withstand a moment of 300 000 newton metres, this means that if the operator positions the load 30 metres from the mast, the crane can lift a maximum of 10 000 newtons.

The largest tower crane in the world is 120 metres high and lifts loads up to 1 million newtons. It has a rating of 10 million newton metres.
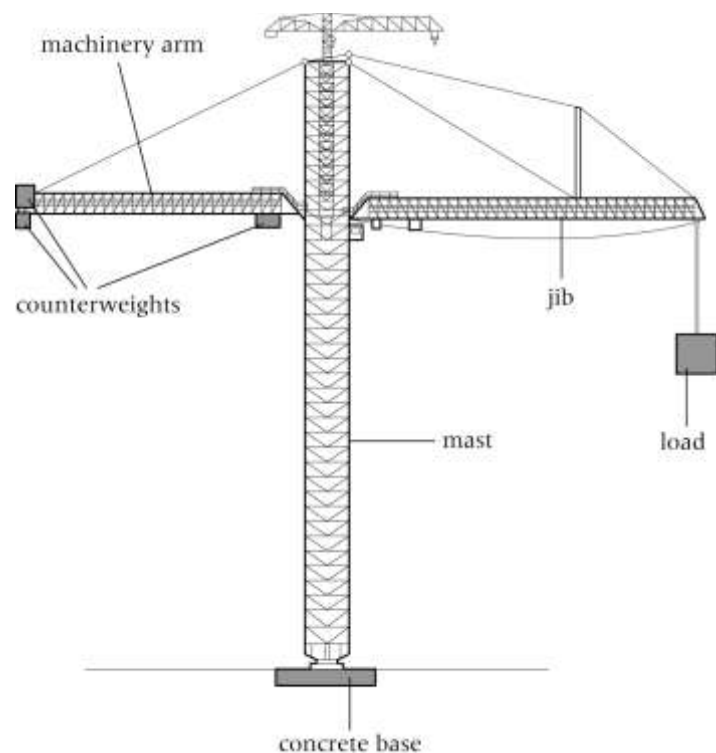
1 Where do you find tower cranes and what are they used for?

2 How is the crane kept stable?

3   How does the crane demonstrate the principle of moments?

4 **a** This tower crane has a sliding pulley block which is 20 m from the mast. The counterweight has a weight of 250 000 N and it is 5 m from the mast. What is the maximum weight the crane can lift?

   b What is the mass of this load?

   c The load moves 10 m along the jib towards the mast. Will the maximum weight that can be lifted increase or decrease? Explain your answer.

   d If the counterweight moves to 6 m from the mast what is the maximum weight that can be lifted if the load is 20 m from the mast? Explain your answer.

   e For health and safety reasons the load lifted should be less than the maximum. Why do you think this is?

5 m   20 m

250 000 N

load