3 Bridges and tunnels

Bridges are some of the most famous structures in the world. There are many different types of bridges. There are fixed bridges such as arch bridges and movable bridges which can pivot, fold, tilt, or swing. The *Reading* texts describe four important types of bridge: **truss**, **arch**, **suspension**, and **cable-stayed**. A truss bridge rests on a support, such as a pier, at each end and is held up by a truss superstructure, a network of members linked to each other to resist the forces acting on the bridge. A suspension bridge is supported by cables draped over towers. The cables are fixed to secure anchorages at each end of the bridge. The deck of the bridge is linked to the cables by vertical hangers. In a cable-stayed bridge, the deck is supported directly to cables which are fixed at an angle to towers. Arch bridges transfer their weight to either end.

There are two important forces that every bridge must deal with: **compression** and **tension**. The illustrations in the text show those forces acting in different types of bridges. Compression is a force that acts to compress or shorten the thing it is acting on. Tension is a force that acts to expand or lengthen the thing it is acting on.

The site of a bridge must be carefully selected, not just to interface with the existing road or rail system but to ensure that solid foundations can be provided to support the structure. Bridges must withstand stresses and strains from the traffic they carry and from the extremes of the weather they will be subjected to. They must remain safe, despite the corrosive effects of rainwater, sea spray, and road salt and possible collision damage inflicted by passing ships or trucks.

Tunnels, like bridges, are important links in the transport network. Sometimes a tunnel is the only option. Sometimes the choice between a bridge and a tunnel must be made. Tunneling can be simpler and cheaper than bridge building but this decision can only be made when a geological survey has revealed whether the tunnel will pass through clay, rock, or gravel and how simple or complex the tunneling will be.

Engineers will use a **tunnel boring machine** (TBM) rather than drilling and blasting, whenever possible. There are difficulties in tunneling in urban surroundings when the ground surface must not be disturbed. TBMs do not disturb the surrounding soil or rock making them ideal for use under built-up areas. They produce a smooth tunnel which is easy to line with concrete if this is required.