

ENGINEERING CHALLENGE WORKSHEET

Engineering Challenge: Tunnel Structures

Building railways would be impossible without tunnels. Tunnels allow trains to travel through hills rather than over them and reduce disturbance to houses and woodlands by going under them.

There are three ways of building tunnels. They are either excavated using tunnel boring machines, mined by diggers, or built using a technique called 'cut and cover'.

Cut and Cover Tunnels

When building cut and cover tunnels, the land above the tunnel route is removed, the tunnel is constructed and the land is replaced over the top. The tunnel structure is built of reinforced concrete, to help resist the forces acting upon the tunnel and to prevent collapse.

Challenge 1: Tunnel Forces

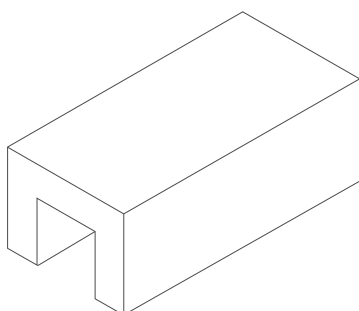
All structures must be built to resist forces that would otherwise make them collapse. Match the force to its description below.

Force
Compression
Tension
Bending
Shearing
Torsion

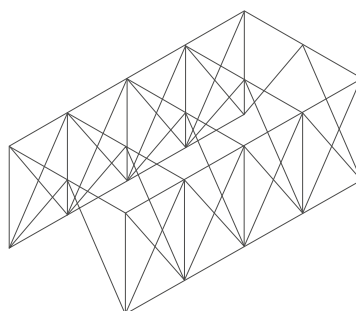
Description
A combination of compression and tension
Forces that cut and tear
Forces that twist
Forces that stretch
Forces that squash

Types of Structure

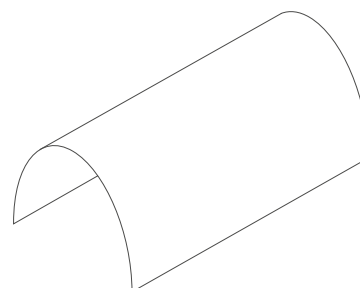
You can build different types of structures to resist or oppose the forces acting upon them. Mass structures are solid and heavy, whilst frames are lightweight and flexible and composed of members joined at either end. Shell structures resist forces using their outside skin.



Mass



Frame



Shell

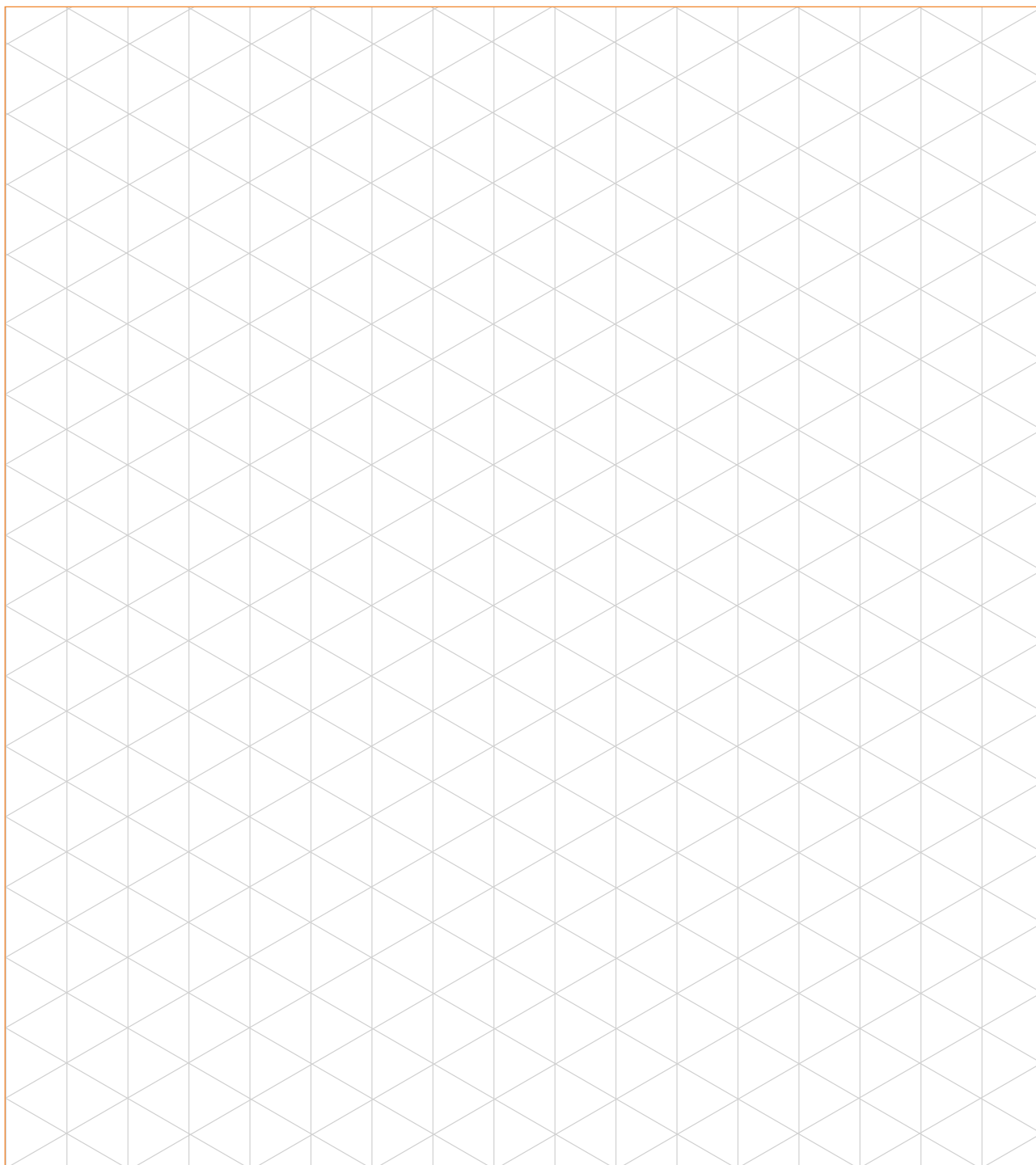
ENGINEERING CHALLENGE WORKSHEET

Challenge 2: Designing a Tunnel Structure

Together with your team, you must design a prototype tunnel structure to span 400mm through the testing jig. Your design should be strong and lightweight, using as few materials as possible to resist the compression forces acting upon the tunnel.

You will be marked particularly on your teamwork, investigation and problem solving.

Sketch your design below.



ENGINEERING CHALLENGE WORKSHEET

Challenge 3: Testing & Evaluating

Tunnel structure weight:

a) How well did your tunnel structure work?

b) What would you improve about your tunnel structure?

c) What were the challenges when designing and building your tunnel?

d) How did you ensure that your tunnel prototype was sustainable?

e) How well did you use your *STEMPowers*?

<i>STEMPower</i>	Low						High
Teamwork							
Investigation							
Problem solving							