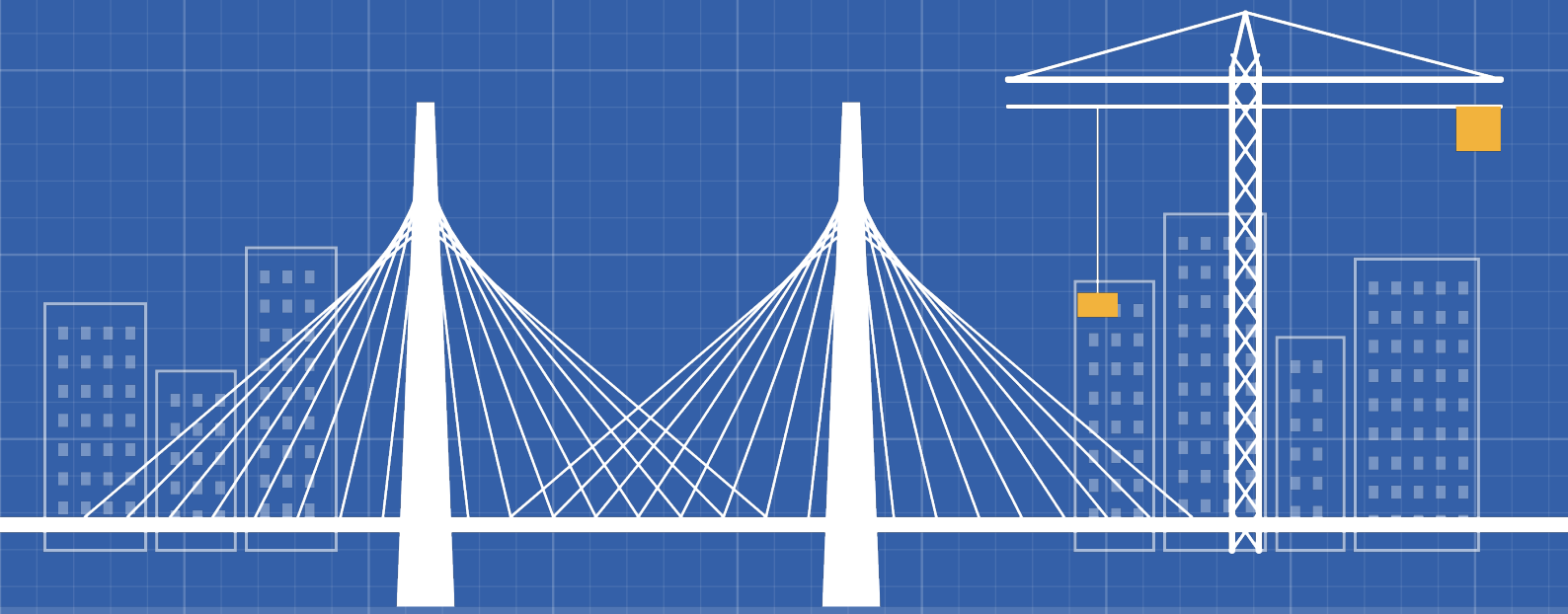


WORKSHEET 2

BRIDGES & FORCES

Six types of bridge, how engineers choose between them, and the forces that push, pull, twist and slice.

Use this worksheet alongside pages 6–12 of your Structural Engineering course notes.

NAME

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WORKSHEET 2

BEFORE YOU START

LEARNING INTENTIONS

We are learning to: **identify** the six main types of bridge · **explain** how engineers choose a bridge and its effect on the environment and economy · **tell the difference** between mass and force · **name** the different types of force.

SUCCESS CRITERIA

I can name a bridge from its shape · I can choose a bridge for a site and give reasons · I can use the units kg and N correctly · I can spot static, dynamic, torsion, shear, tension and compression forces in real life.

TASK 1 NAME THAT BRIDGE

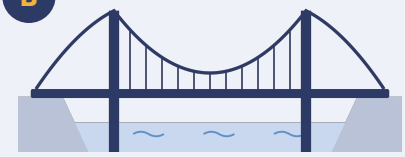
Write the name of each bridge type on the line. Use the word bank.

Word bank: beam · truss · arch · suspension · cable-stayed · cantilever

A



B



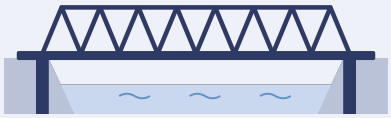
C



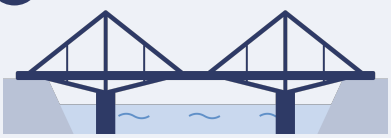
D



E



F



TASK 2 SCOTTISH BRIDGE SPOTTER

Scotland has some of the most famous bridges in the world. Read each clue and decide what type of bridge it is.

Bridge and clue	Bridge type
Forth Bridge (1890), South Queensferry. Huge red steel "diamonds" reach out from three towers, and a short span hangs between them. It is a UNESCO World Heritage Site.	
Forth Road Bridge (1964). Two tall towers hold up giant main cables. Thinner cables hang straight down from them to carry the road.	
Queensferry Crossing (2017). Three towers with straight cables fanning down to connect directly to the road deck.	
Glenfinnan Viaduct (1901), Lochaber. 21 curved concrete spans carry the West Highland railway across the valley.	
Tay Bridge (1887), Dundee. Long, straight girders rest on a row of piers stretching over 3 km across the River Tay.	
A **railway footbridge** at a station. Each side is a steel framework made of lots of triangles.	

TASK 3 CHOOSING THE RIGHT BRIDGE

Engineers think about **span**, **cost**, **volume of traffic**, **weight of traffic**, **environment and weather** and **lifespan** before choosing a bridge.



THE BRIEF

A Highland community needs a road bridge across a sea loch. The gap is **1500 m** wide, the water is deep, and winter winds are strong. Lorries carrying timber will use it every day, and it must last at least 100 years.

a Deep water means only a few piers (supports) can be built. Which **two** bridge types are best for very long spans between supports?

b Choose **one** of them and explain why it suits this site. Use at least two of the factors above.

c Building the bridge will affect the **economy** (money, jobs, travel time) and the **environment** (wildlife, pollution). Give one good and one bad effect of each.

	Good effect (+)	Bad effect (-)
Economy		
Environment		

TASK 4 MASS OR FORCE?

REMEMBER
Mass is the amount of matter in an object. It is measured in **kilograms (kg)**.
Force is a push or a pull. It is measured in **newtons (N)**.

a Is each of these a mass or a force? Write **M** or **F**.

Quantity	M or F?	Quantity	M or F?
A 5 kg bag of potatoes		A 20 N push on a door	
A 70 kg engineer		An 800 N pull on a rope	
A 1500 kg car		The 2 N force needed to press a key	

b Engineers want structures that are as **light** as possible but hold as **much** as possible. This is called the **strength-to-weight ratio**. Two pupils test model bridges:

Bridge	Mass of bridge	Largest load it held
Bridge A	50 g	5000 g (5 kg)
Bridge B	80 g	6000 g (6 kg)

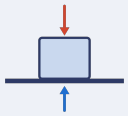
Work out **load ÷ mass of bridge** for each one. Which bridge has the better strength-to-weight ratio?

WORKING

Better bridge: _____

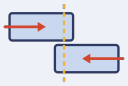
TASK 5 FORCE DETECTIVES

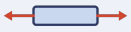
Choose the **best** type of force for each situation: **static**, **dynamic**, **torsion**, **shear**, **tension** or **compression**.

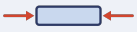

Static


Dynamic


Torsion


Shear

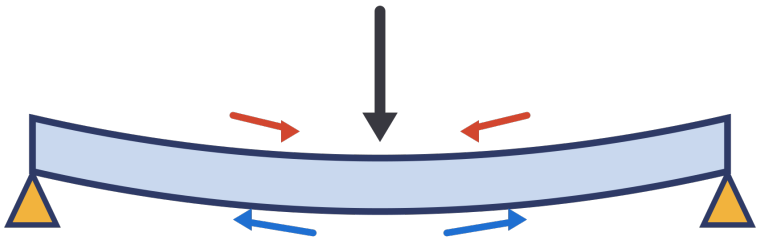

Tension


Compression

Situation	Force type	Situation	Force type
Cutting card with scissors		Wringing out a wet towel	
A lorry driving over a bridge		A heavy box resting on a shelf	
The rope in a tug-of-war		The legs of a stool when you sit on it	
Gusts of wind hitting a tall tower		Turning a key in a lock	

TASK 6 SQUASH AND STRETCH

When a load pushes down on a beam, the beam bends. One face is **squashed** and the other is **stretched**.



a Which face of the beam is in **compression** — the top or the bottom?

b Which face is in **tension**?

c Concrete is very strong in compression but cracks easily in tension. Builders put **steel bars** inside concrete beams. Near which face should the steel go, and why?

d You can hang a weight from a strand of dry spaghetti, but if you push the ends together it snaps. Is spaghetti stronger in tension or compression?

REFLECT

HOW CONFIDENT AM I?

	Not yet	Getting there	Got it!
I can name the six types of bridge from their shape.	◯	◯	◯
I can choose a bridge for a site and explain my choice using span, cost, traffic, environment and lifespan.	◯	◯	◯
I know mass is measured in kg and force in N.	◯	◯	◯
I can identify static, dynamic, torsion, shear, tension and compression forces.	◯	◯	◯

GREAT EFFORT.

Next up: **Worksheet 3 — Beams, Frames & Moments.**

Stuck? The course notes and video tutorials are free at **detscotland.co.uk**.

"Engineering is the art of directing the great sources of power in nature for the use and convenience of man."

Thomas Tredgold, civil engineer (1788–1829)

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