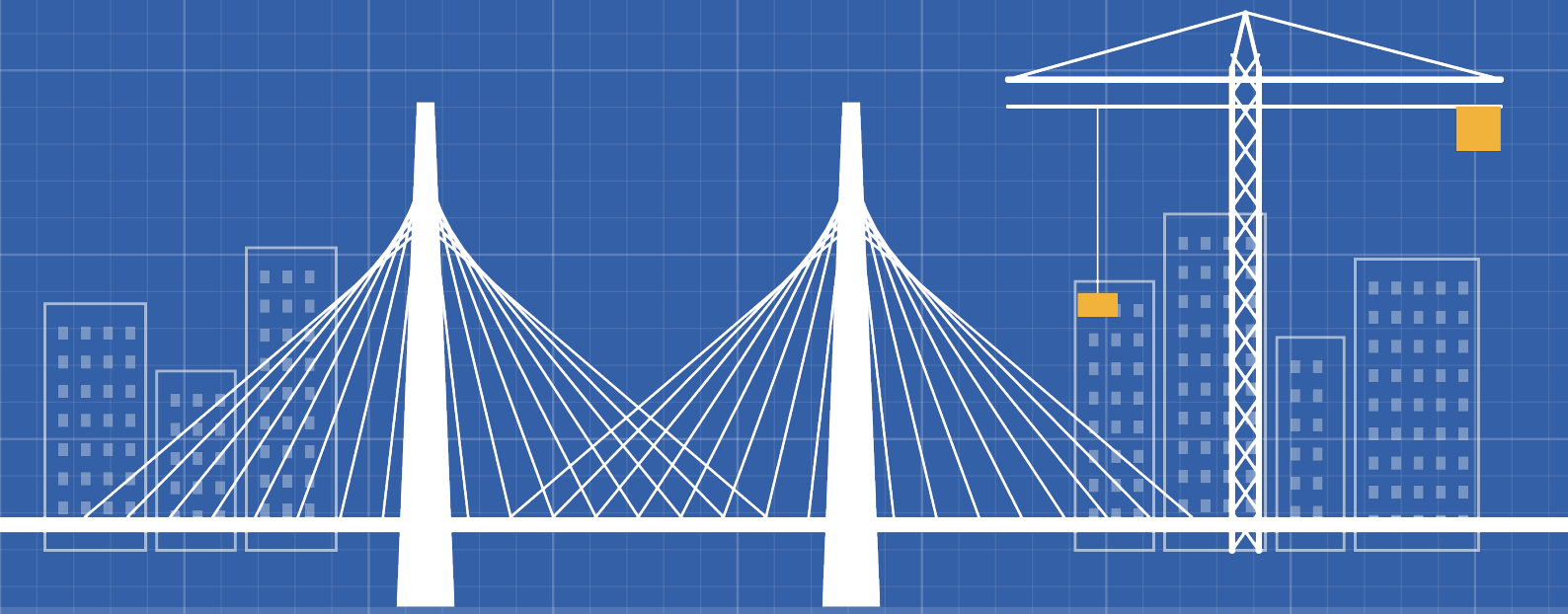


DESIGN & MAKE PROJECT

BRIDGE TRUSS CHALLENGE

Design, make and test a model truss bridge — then use real data to prove how good it is.

Work through the stages in order. Your teacher will assess the design, the make, the testing and your evaluation.

NAME

CLASS

TEACHER

designclass
design | engineering | technology

STAGE 1

THE BRIEF

CLIENT BRIEF

A country park in Aberdeenshire needs a new footbridge across a burn. Before building it full size, the engineers want **scale models** designed and tested. Your job is to design, make and test a model **truss bridge** that is as **strong as possible for its weight**.

Specification — your bridge must meet every point. Tick each one when you have checked it on your final design.

#	Specification point	Checked
1	It must cross a **300 mm gap** between two supports.	
2	Overall length **350–400 mm**, so it rests at least 25 mm on each support.	
3	Width **60–80 mm**, with a flat deck along its full length.	
4	Height **no more than 120 mm** above the deck.	
5	Mass **no more than 100 g**.	
6	Both sides must be a **truss** — members joined to make triangles.	
7	Use **only** the materials provided (e.g. 5 mm square strip wood, lolly sticks, card gussets, PVA glue).	
8	A loading point (loop or hole) at the **centre of the deck** so a load hanger can be attached.	

YOUR TEACHER MAY CHANGE THE NUMBERS

Different schools have different materials. If your teacher changes a specification point, cross it out and write the new value beside it.

a Rewrite the brief in your own words. What is the **main** thing your bridge must do?

STAGE 2

RESEARCH: TRUSS TYPES

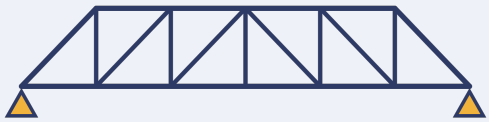
A truss is a frame made of straight members joined in **triangles**. Triangles cannot rack, so the frame keeps its shape and spreads the load. Here are four classic truss designs used on real bridges.



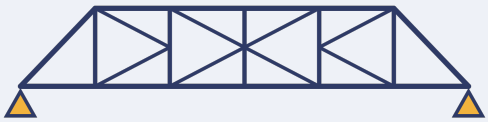
Warren — equal triangles, no verticals. Diagonals take turns: tension, compression, tension…



Pratt — diagonals slope **down** towards the centre. Under load the diagonals are in tension; the verticals are in compression.



Howe — the opposite of Pratt. Diagonals slope **up** towards the centre and are in compression; the verticals are in tension.



K truss — the verticals are split into shorter pieces, so long thin members are less likely to buckle.

IN EVERY ONE OF THESE TRUSSES…

When a load presses down in the middle, the **top chord** (top edge) is squashed — **compression**. The **bottom chord** is stretched — **tension**. Long, thin members in compression can bend sideways and snap; this is called **buckling**.

a Why are trusses built from **triangles** rather than squares?

b Which members of your bridge will be in **compression**? How could you stop them buckling?

c Find a **real** truss bridge or truss roof (online or near you). Where is it, and which truss type does it use?

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STAGE 3

INITIAL IDEAS

Sketch **three different** ideas for one side of your bridge (the side elevation). Add notes: truss type, number of triangles, how the deck joins on, where it might be weak.

IDEA A

Type-in version: describe your idea here, or sketch on paper / a tablet and attach a photo.

Notes:

IDEA B

Type-in version: describe your idea here, or sketch on paper / a tablet and attach a photo.

Notes:

IDEA C

Type-in version: describe your idea here, or sketch on paper / a tablet and attach a photo.

Notes:

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STAGE 4

CHOOSING AN IDEA

Score each idea from **1 (poor)** to **5 (excellent)** for each criterion. Then add up the totals.

Criterion	Idea A	Idea B	Idea C
Likely strength (strong triangles, short compression members)			
Low mass (uses the least material)			
Easy and accurate to make in the time			
Meets every point of the specification			
Looks good / would suit a country park			
Total (out of 25)			

a Which idea will you develop? Justify your choice using your scores.

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STAGE 5

FINAL DESIGN

Draw your final design accurately. Show the **side view** with the main **dimensions in mm** (length, height, width, triangle sizes).

FINAL DESIGN — SIDE VIEW WITH DIMENSIONS (MM)

Type-in version: describe your idea here, or sketch on paper / a tablet and attach a photo.

Cutting list — every piece you need to cut.

Part	Material	Length (mm)	How many?

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STAGE 6

MAKING LOG

MAKE IT ACCURATELY

- Build both sides on top of a full-size drawing so they match exactly.
- Use small card **gussets** to strengthen glued joints.
- Let PVA dry fully before joining the sides with cross-members.
- Weigh your bridge before testing.

Lesson	What I did	Problems and how I solved them
1		
2		
3		
4		

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STAGE 7

TESTING

SAFETY
Wear **eye protection**. Put a box or tray under the load hanger to catch it. Add load **slowly** and keep hands and feet clear. Your teacher will supervise every test.

a Prediction: what load do you think your bridge will hold, and where do you think it will fail?

Measurement	Result
Mass of my bridge (g)	
Largest load held before failure (g)	
Strength-to-weight ratio = largest load ÷ mass of bridge	
Where and how did it fail? (snapped, buckled, joint came apart…)	

STAGE 8

CLASS RESULTS

Collect results from **five** other bridges in your class. Engineers make decisions from data, not opinions.

Bridge (name)	Truss type	Mass (g)	Load held (g)	Ratio

a Which bridge had the best strength-to-weight ratio? What did it do that others did not?

STAGE 9

EVALUATION

Specification point	Met? (yes / no / partly)	Evidence
Crosses 300 mm gap; length 350–400 mm		
Width 60–80 mm		
Height no more than 120 mm		
Mass no more than 100 g		
Truss on both sides		
Central loading point		

a Describe **two** improvements you would make if you built it again. Use your test data to explain why.

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HOW YOU WILL BE MARKED

ASSESSMENT

Area	Developing	Secure	Excelling	Self	Teacher
Research	Names one truss type.	Explains why triangles are used and names tension/compression members.	Links truss types to tension, compression and buckling with real examples.		
Ideas & choice	One idea, few notes.	Three different ideas, scored fairly.	Three well-annotated ideas; choice justified with evidence.		
Final design	Sketch with some sizes.	Clear side view with main dimensions and a cutting list.	Accurate, fully dimensioned drawing; complete cutting list.		
Making	Bridge built with help; some joints weak.	Neat, matching sides; meets most specification points.	Accurate, strong joints; meets every specification point.		
Testing & data	Records load held.	Calculates strength-to-weight ratio correctly.	Compares class data and explains patterns.		
Evaluation	Says if it worked.	Checks against spec with evidence.	Improvements justified with test data and engineering terms.		

Write **D**, **S** or **E** in the Self column. Your teacher will complete the Teacher column.

REFLECT

HOW CONFIDENT AM I?

	Not yet	Getting there	Got it!
I can explain how triangles and trusses carry loads.	☐	☐	☐
I can design to a specification and justify my choices.	☐	☐	☐
I can test fairly and use data to evaluate a design.	☐	☐	☐

BUILT IT. TESTED IT.

Real engineers test, learn and improve — exactly what you just did.

Share a photo of your bridge with your teacher — the best designs may feature on **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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