

M01 – Bridge Design – Pupil Sheet (1)

You only need to design and calculate the costs for the bridge. The local council have agreed to design and pay for the stairs and wheelchair access to the bridge.

You must make the bridge from either aluminium or steel. The information for each material is listed below.

	Aluminium	Steel
Cost per metre (£)	15,000	14,000
Support Intervals (m)	15	20
Price per Support (£)	12,000	10,000
Coating required	No	Yes
Plastic Coating (£/m) (lasts 2 years)	N/A	100
Paint (£/m) (lasts 6 months)	N/A	25
Maintenance per year (£/m)	100	50

Points to remember:

- The bridge needs to be 100m long.
- You have up to £2,000,000 to spend.
- Maintenance costs cannot exceed £50,000 per year.

M01 – Bridge Design – Pupil Sheet (2)

You must make the bridge from either aluminium or steel. The information for each material is listed below.

	Aluminium	Steel
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Price per Support (£)	12,000	10,000
Coating required	No	Yes
Plastic Coating (£/m) (lasts 2 years)	N/A	100
Paint (£/m) (lasts 6 months)	N/A	25
Maintenance per year (£/m)	100	50

You must also remember to include the cost of stairs and wheelchair access to the bridge. The bridge will need to be 18m high to allow 20m above the water. This means you need an 18m high staircase and an 18m high wheelchair ramp. An 18m high staircase is 20m long, at a cost of £1000 per metre. A wheelchair ramp 18m high must be 216m long, at a cost of £1000 per metre.

Points to remember:

- The bridge needs to be 100m long.
- You must include stairs and/or ramps on **both sides** of the bridge.
- You have up to £2,000,000 to spend.
- Maintenance costs cannot exceed £50,000 per year.

M01 – Bridge Design – Pupil Sheet (3)

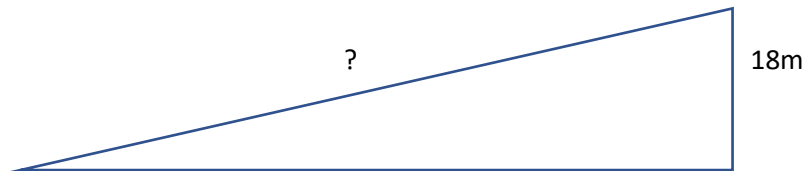
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An 18m high staircase is 20m long, at a cost of £1000 per metre.

A wheelchair ramp must be built to a 1:12 ratio. This means for every metre you want to go up the ramp must be 12m long. The Ramp costs £1000 per m.



Points to remember:

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General Maintenance per year (£/m)	100	50

Points to remember:

- The bridge needs to be 100m long.
- You have up to £2,000,000 to spend.
- Maintenance costs cannot exceed £50,000 per year.

Aluminium Bridge Costs:

Build: $15,000 \times 100 = 1,500,000$ for walkway structure.

5 Supports required: $5 \times 12,000 = 60,000$.

Total Bridge Cost = £1,500,000 + £60,000 = £1,560,000 – Within Budget.

General Maintenance costs = $£100 \times 100\text{m}$

Maintenance = £10,000 per year – Within Budget

Steel Bridge + Plastic Coating

Build: $14,000 \times 100 = 1,400,000$ for walkway structure.

4 supports required: $4 \times 10,000 = 40,000$.

Plastic coating: $100 \times 100 = 10,000$

Total Bridge Cost = £1,400,00 + £40,000 + £10,000 = £1,450,000 – Within Budget

General Maintenance Costs = $50 \times 100 = 5,000$

Plastic coating = £10,000 every 2 years, so £5,000 a year.

Total Maintenance = £10,000 per year – Within Budget

Steel Bridge + Paint Coating

Build: $14,000 \times 100 = 1,400,000$ for walkway structure.

4 Supports Required: $4 \times 10,000 = 40,000$.

Paint Coating = $100 \times 25 = 2,500$

Total Bridge Cost = £1,400,000 + £40,000 + 2,500 = £1,442,500 – Within Budget

General Maintenance Costs = $50 \times 100 = 5,000$

Painting = £2,500 every 6 months, so £5,000 per year.

Total Maintenance = £10,000 per year – Within Budget

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Maintenance per year (£/m)	100	50

You must also remember to include the cost of stairs and wheelchair access to the bridge. The bridge will need to be 18m high to allow 20m above the water. This means you need an 18m high staircase and an 18m high wheelchair ramp. An 18m high staircase is 20m long at a cost of £1000/metre. A wheelchair ramp 18m high must be 216m long, at a cost of £1000/metre. (These are real life measurements. Public stairs are allowed to be a maximum of 45° and wheelchair ramps 4.8°)

Points to remember:

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- Maintenance costs cannot exceed £50,000 per year.

Aluminium Bridge Cost, stairs & ramps.

Walkway	£1,500,000
Supports	+£60,000
Stairs	+£40,000
Ramps	+£432,000
Total	=£2,032,000 – Not Within Budget.

Aluminium Bridge Cost , Ramps only.

Walkway	£1,500,000
Supports	+£60,000
Ramps	+ £432,000
Total	£1,992,000 – Within Budget

General Maintenance costs = £100 x 572m

Maintenance = £57,200 per year – Not Within Budget

Steel Bridge + Plastic Coating, ramps and stairs

Walkway	£1,400,000
Supports	+£40,000
Stairs	+£40,000
Ramps	+£432,000
Coating (Walkway, Ramps, Stairs)	+57,200
Total	£1,969,200 – Within Budget

General Maintenance Costs = £50 x 572m = 5,000

Plastic coating = £57,200 every 2 years, so £28,600 a year.

Total Maintenance = £33,600 per year – Within Budget

Steel Bridge + Paint Coating, Ramps & Stairs

Walkway	£1,400,000
Supports	+£40,000
Stairs	+£40,000
Ramps	+£432,000
Paint (Walkway, Ramps, Stairs)	+£14,300
Total	£1,926,300– Within Budget

General Maintenance Costs = 50 x 572 = £28,600

Painting = £14,300 every 6 months, so £28,600 per year.

Total Maintenance = £57,200 per year – Not Within Budget

The only bridge build which meets budget criteria is the Steel bridge with ramps and stairs, with plastic coating.

It costs a total of £1,969,200 to build and £33,600 per year to maintain.

M01 – Bridge Design – Pupil Sheet (3) Solution

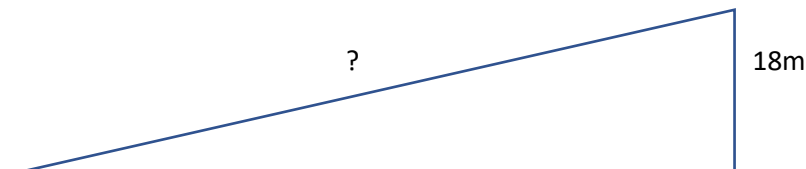
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Ramp Costs –

$$1:12 - 18 \times 12 = 216$$

The ramp must be 216m long, 2 ramps are required (One for each side of the bridge) so 432m of ramp.

$$432 \times 1,000 = £432,000$$

The ramp will cost £432,000. It must be coated if made from steel.

Aluminium Bridge Cost, stairs & ramps.

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Supports	+£60,000
Stairs	+£40,000
Ramps	+£432,000
Total	=£2,032,000 – Not Within Budget.

Aluminium Bridge Cost , Ramps only.

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