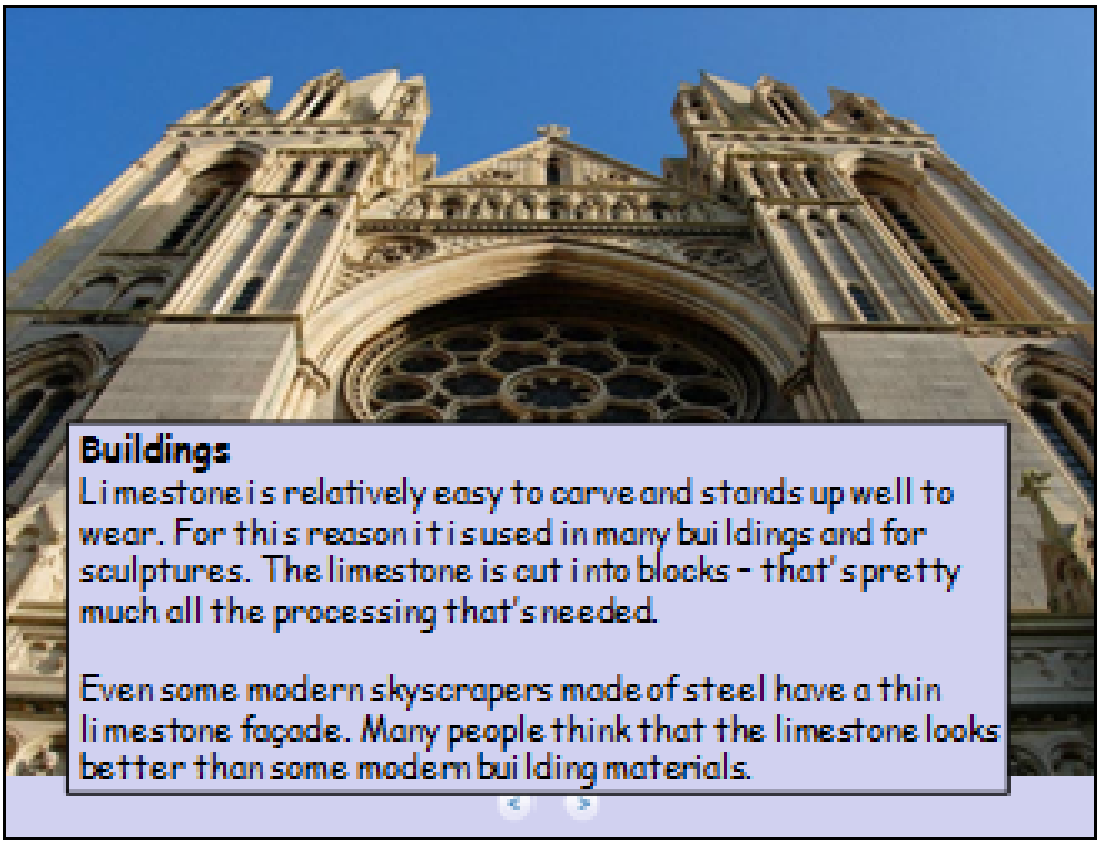
Which mixture makes the strongest concrete?



Buildings

Limestone is relatively easy to carve and stands up well to wear. For this reason it is used in many buildings and for sculptures. The limestone is cut into blocks – that's pretty much all the processing that's needed.

Even some modern skyscrapers made of steel have a thin limestone façade. Many people think that the limestone looks better than some modern building materials.

Building Materials

Slaked lime (or cement) mixed with sand and water makes mortar which sticks bricks together. The Egyptians used it to plaster the pyramids!

So mortar contains slaked lime

slaked lime + carbon dioxide → calcium carbonate + water
(in the air)

So bricks are effectively held together by stone which makes the construction VERY STRONG

Aim – To make up different mixes of concrete and find out which has the greatest tensile strength

General information on concrete

When stones or crushed rocks are added to a mixture of water, cement and sand, it sets it forms a hard stone like building material called concrete. This material is strong, it resists forces that tend to squeeze or crush it. The strength of the concrete depends on the proportions of cement, gravel, sand and water.

Slaked lime (cement) mixed with sand and water makes mortar which is used to stick bricks together. The Egyptians used it to plaster the pyramids. Nearly 4000 years later , the Romans were still mixing slaked lime with sand and water, however this lime mortar would not set under water. This method was used into the 17th century. The mortar is still used today but has been improved and it can be used in a much wider range of ways.

Starter –

Quick Quiz

1. What is produced when powdered limestone is heated with powdered clay?
2. What is mortar used for?
3. How is concrete produced?
4. Why is glass so useful?
5. Can lime mortar set under water?
6. Was the Roman method for making underwater mortar used in the 17th century?
7. Is Portland cement a mixture?
8. Are recent developments in glass allowing building innovations?
9. Is concrete strong?

Safety

1. Wear eye protection
2. Look at the hazard symbols on any chemicals
3. Wash any chemical that comes in contact with your skin
4. Wash hands after handling chemicals
5. Make sure if you understand how to use the equipment and ask if you are not sure

Equipment

Containers, clingfilm, masses

Chemicals

Cement, sand, gravel

Procedure

Part 1 – making the 'concrete beams'

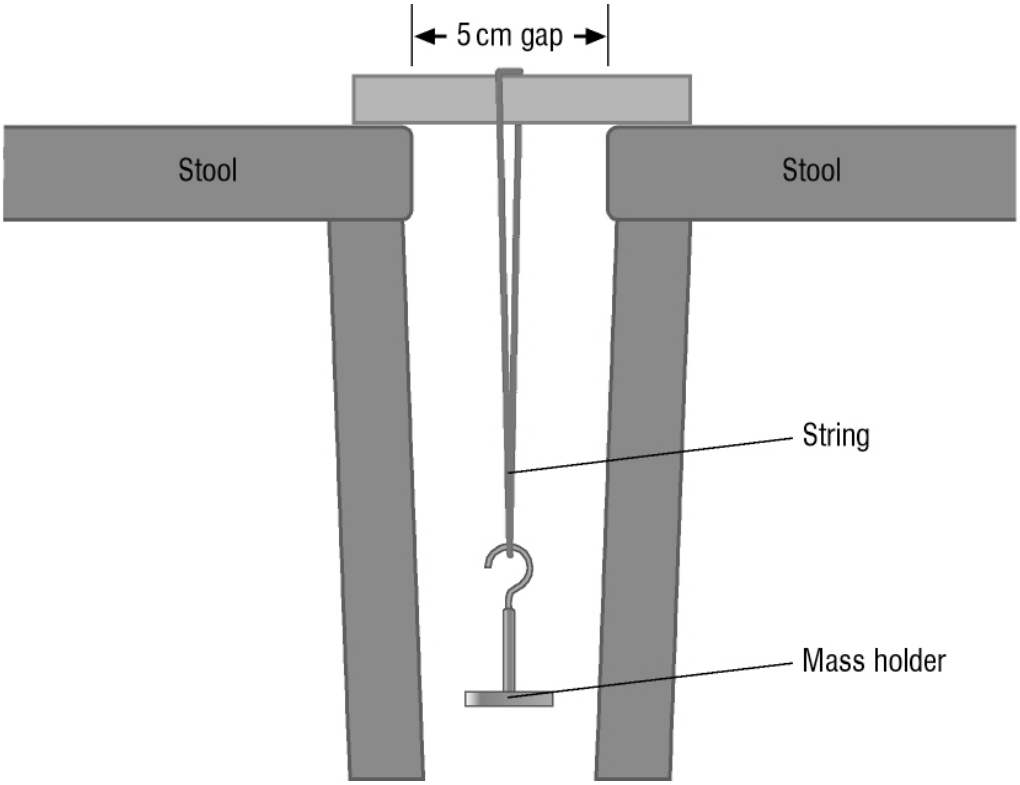
1. In your pot, make up the mixes of concrete separately. Mix the dry substances first. Then add just enough water to make a thick paste. Each mix should be like porridge.
2. Line your mould with Clingfilm and then pour your mix into it. Smooth the top with a piece of paper and label it.
3. Place your moulds onto a tray or ice cream tray and leave to set over a couple of days.

Mould	Spoonful's of cement	Spoonful's of sand	Spoonful's of gravel	Other additions
A	2	6	None	None
B	1	3	4	None
C	1	3	4	Straw mixed in before water added
D	1	3	4	Wire reinforcement

Part 2

Testing the strength of beams of concrete

Aim: To record, analyse and evaluate the results of an investigation.



- **Wear eye protection for the whole of the experiment**

1. **Very carefully** remove your beams one at a time from their moulds.

2. Place two stools 5 cm apart and place your first beam over the gap between them.

3. a) Using a piece of strong string, hang a 100 g mass holder from the beam as in the diagram.

b) The mass holder should be close to the floor and if possible have some newspapers under it so that when it drops it does not damage the floor!

4. Gradually add 100 g masses at a time to the mass holder until the beam snaps.

5. Make up a results table and record your results in the table. Remember 100 g is equivalent to a 1N force!

6. Repeat 1–5 with the other three moulds.

Recording the results

Mixture	Force required to break concrete (N) (100g = 1N)			
	Trial 1	Trial 2	Trial 3	Mean
A 2 spoons cement, 6 spoons sand				
B 1 spoon cement, 3 spoons sand, 4 spoons gravel				
C 1 spoon cement, 3 spoons sand, 4 spoons gravel and straw				
D 1 spoon cement, 3 spoons sand, 4 spoons gravel and wire				

Analysis of results

a) Draw a suitable graph of your results. Do not forget to label your axes and write the units.

b) We repeated the results because ……..

c) We calculated …….. with the results.

d) The independent variable was ……

e) The dependent variable was ……..

f) Wire reinforcement made the beam ……

g) Straw made the beam ……

3. Evaluation

a) What was good about your experiment? Explain why it was good.

b) Was it a fair test? Explain your answer.

c) What was bad about the experiment? Explain how you could improve it.

Resources

Photograph of Hansons quarry kindly provide by Paul Harris

Which mixture makes the strongest concrete?

Aim – To make up different mixes of concrete and find out which has the greatest tensile strength

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Starter –

Quick Quiz

1. What is the connection between the front photo and limestone?
2. Is mortar a mixture or a compound?
3. How is concrete produced?
5. Is concrete a mixture or a compound?
5. Can lime mortar set under water?
6. Was the Roman method for making underwater mortar used in the 17^{th} century?
7. Is Portland cement a mixture?
8. What is the connection between the front photo and cement?
9. I s concrete strong?

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Equipment

Containers, Clingfilm, masses

Chemicals

Cement, sand, gravel

Procedure

Part 1 – making the 'concrete beams'

6. In your pot, make up the mixes of concrete separately. Mix the dry substances first. Then add just enough water to make a thick paste. Each mix should be like porridge.

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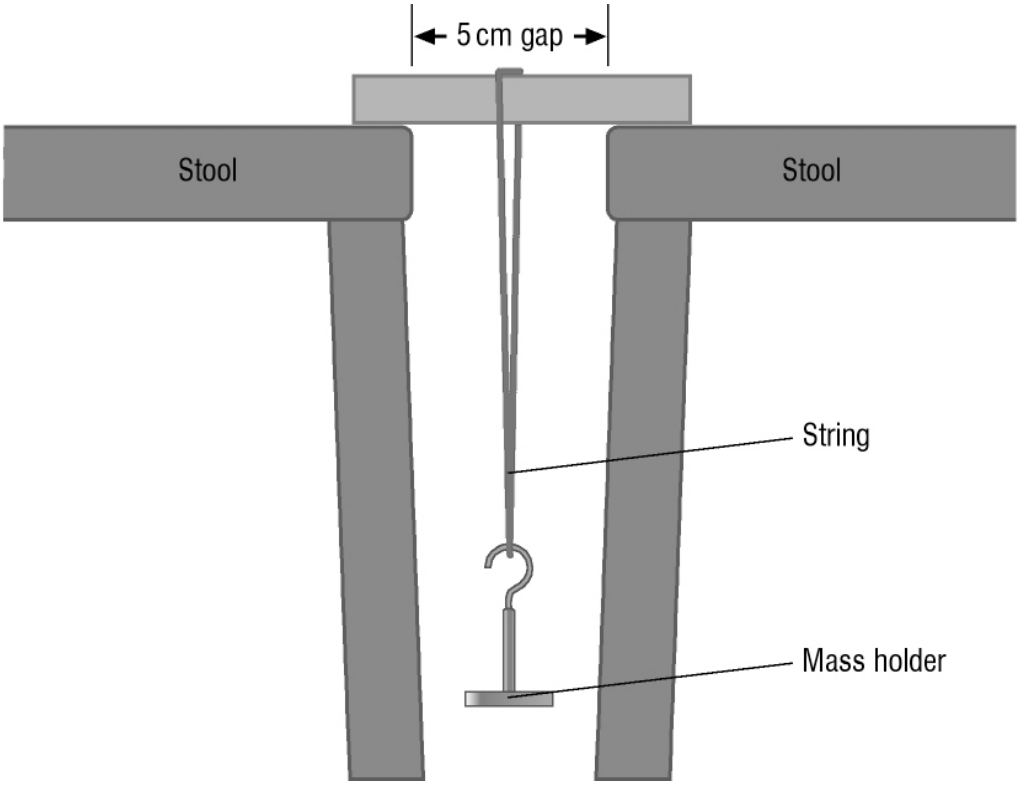

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D 1 spoon cement, 3 spoons sand, 4 spoons gravel and wire				

Analysis of results

a) Draw a bar graph of your results. X axis, the mixture, Y axis, the force required to break the concrete. Do not forget to label your axes and write the units.

b) We repeated the results because ……..

c) We calculated …….. with the results.

d) The independent variable was ……

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