

Welcome to my “I could be a Civil Engineer” challenge badge.

I have created this badge because I am a Civil Engineer and I love my job, but so often I have had to explain what a Civil Engineer is! So I thought I would share civil engineering with you and maybe one day you'll grow up to be a Civil Engineer too.

I am also a Rainbow Guider in Hermitage, Berkshire, part of the Ridgeway district and so any profits shall go to the District to support girls on international trips so they can experience our wonderful world and to support families to enable as many girls as possible to go on unit adventures.

The challenges have been chosen to be varied and so that there are choices for all ages and abilities.

To achieve the challenge badge you need to complete the following as a minimum, obviously you can do more or even all of them!

Rainbows – 5 challenges (from at least 3 sections)

Brownies – 5 challenges (from at least 4 sections)

Guides – 6 challenges (from at least 4 sections)

Senior Section / Trefoil Guild – 7 challenges (from at least 4 sections)

Guiders, award yourself a badge when your unit has completed their challenges.

I have put the answers in a separate document so that if you want to search for the answer first you can, and then check back against the answer sheet separately. The answer document also includes some extra waffle/explanations.

I hope you have fun! ☺

Pippa Higgins CEng MICE

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Super structures

1. Build a tower out of newspaper that is taller than you

Here is our attempt!

But searching on Google Images for “newspaper tower challenge” will give you many more ideas.

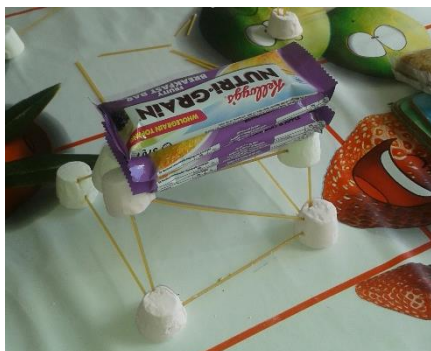
EXTEND: Try with newspaper rolled really tightly, or rolled really loosely, or not rolled but folded into a flat narrow strip.

EXTEND: In construction, the Client (the person or company who is paying for the project), sets out various criteria as to what they require, this is their specification. Set your own criteria – limit the number of points touching the ground to 3 or 4, or enforce a team to have 6 or 8 points touching the ground.



2. Build a structure using spaghetti & marshmallows

Here are our attempts! Hopefully you can see the pieces of spaghetti. But searching on Google Images for “spaghetti & marshmallows” will give you many more ideas.



EXTEND – can you balance a mars bar or a cream egg on it

EXTEND – which group’s structure can support the most mars bars – load to destruction, until it collapses!

EXTEND – which structure can carry the most but use the least material.

As a Civil Engineer we have to design and then build using the correct materials to ensure that our buildings don’t fall down.

3. Investigate famous bridges

Which is the longest?

Which is the tallest?

Which is the highest?

Discuss why they have to be so long or so tall? Also why are some bridge decks so high?

Here are four of my favourite:

Millau Viaduct –

<http://www.ila-chateau.com/caze/Millau-Viaduct.htm>



Gateshead Millennium bridge “the winking eye”

Clifton suspension bridge –

<http://www.ikbrunel.org.uk/clifton-suspension-bridge>



Oresund Bridge “It's a Bridge! A very long bridge”

4. Make Rocky Road bars.

Concrete is a substantial material in the construction of many buildings. As a good excuse to make some tasty bars, I think these rocky road bars represent concrete quite well!

http://www.bbc.co.uk/food/recipes/rockyroadcrunchbars_87104



5. Name the skyscrapers.

Match the eight skyscrapers on the next two pages with their names listed below:

- a) Shard, 32 London Bridge, London
- b) 30 St Mary Axe "Gherkin", London
- c) One Canada Square, London
- d) Burj Khalifa, Dubai
- e) Petronas Towers, Malaysia
- f) Empire State Building, America
- g) Burj Al Arab, Dubai
- h) Yokohama Landmark Tower, Japan

EXTEND – Can you find out how tall are they?

EXTEND – The structural frame provides the stability of the building, to stop it from excessive swaying or bending. Can you find out if the frame of these skyscrapers are mostly made from steel or concrete or both?

EXTEND – What is the tallest building near you? How tall is it? How many times would you have to climb it, to climb the equivalent of going to the top of the Shard? Could you visit it and get to the top?

DID YOU KNOW? The lifts in skyscrapers express up to a block of floors and don't stop at every level. They travel at over 22mph and in the Yokohama Landmark Tower, it takes just 40seconds to get to the 69th floor.



1)



2)



3)



4)



5)



6)



7)



8)

Soils and ground conditions

As a civil engineer it is very important to understand the type of ground that we are trying to build on or in, as some are stronger than others, such as clays compared with gravels which have very different properties. Here are some activities investigating the ground!

6. Make sandcastles

If you're lucky enough to be at the seaside, this is a nice trip out of the meeting hall! If not how about a bag of play sand and use a tray or a washing up bowl? Does the sandcastle work better if the sand is slightly damp? It should do! What if you don't compact the sand in the bucket or other container (a yoghurt pot would work well, if you have limited space)?

EXTEND – See how sand behaves when dry, damp, wet and saturated, (try drying the sand in an oven and letting it cool before trying to make a sand castle). How would you make it stronger?

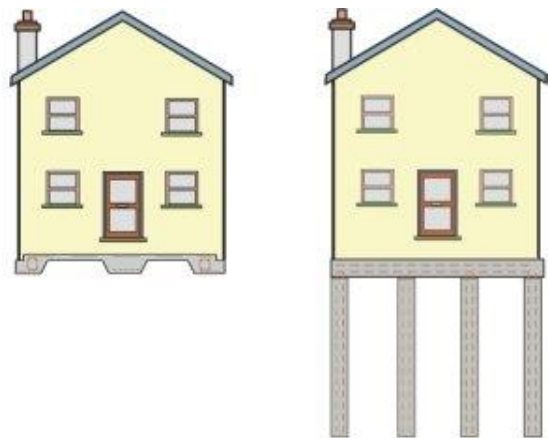
EXTEND – Have a competition. Set conditions for what the sandcastle must have.

For example: "Each entry should include a set of items : 1 flag, 3 shells and 5 pebbles."

7. Sand holes.

Find out what you can push into a bucket or washing up bowl of loose sand, measure how far each item goes into the sand. Here are some things to try: Spikey pencil, round ball, flat book.

DID YOU KNOW? If you have weak ground, you could use a large flat foundation so that your building does not sink into the ground! The pencils are like piles which are used to transfer the weight of the building deep into the ground.



8. The flour game.

With some imagination an upturned compacted bowl of flour with a chocolate on top demonstrates the impact of unstable ground on a building (the chocolate) and is a good excuse for a game.

Method : Fill a bowl with flour and compact it well, turn it out onto a tray and place a chocolate on top, each of the group/six/patrol take turns to roll the dice. If you roll a six, you have to cut away a slice of the flour. If the chocolate falls off the top you need to get the chocolate out of the flour, without using your hands.

Searching on Google Images for "the flour game" will give you many more ideas.



Sewers & tunnels

Sewers are essential for moving clean and dirty water around and tunnels provide transport links through mountains and under seas and rivers.

9. Design a marble run

Use a child's marble run kit and build a marble run. If you don't have one available you could connect cardboard tubes instead.

EXTEND : Set up 2 or more runs and race the marbles along the different routes.

EXTEND : Visit The Great Ball Run at Basildon Park National Trust site, when it is on during the summer months each year. www.nationaltrust.org.uk/basildon-park

10. Design a water run

Using pipes, guttering, or even straws, transport a cup of water from one point to another.

EXTEND : Have a competition, which channel can transport the most water, avoiding leaks and spillages.

ALTERNATIVE : Use plasticine and make a model showing a river near you.

Put bridges over the river and blockages in the flow to see how the water behaves. Engineers need to make sure that rivers flow well when there is heavy rainfall to get the water away from the towns and villages and out to sea. What happens when there is too much rain? Where does the water go if there is no room in the river?

11. Tunnels game

Play a game using tunnels.

SUGGESTION: Obstacle race crawling through toy tunnels or under tables (obviously with the appropriate risk assessment)



SUGGESTION: Cat & Mouse action game (where the arms of the girls form the free routes / tunnels)

Set up: Line up all but two of the girls in your unit in rows with their arms outstretched. One 'free' girl is the cat and the other one is the mouse.

Playing the game: Let the mouse get a little head start and then let the cat try to catch her. The cat and mouse run between the rows. When the leader calls 'change' the girls who are stood with their arms out turn 90 degrees so that the rows change orientation.

Winning: When the mouse is caught a new pair is chosen.

Railways & Highways

Civil engineers design and construct the transport networks.

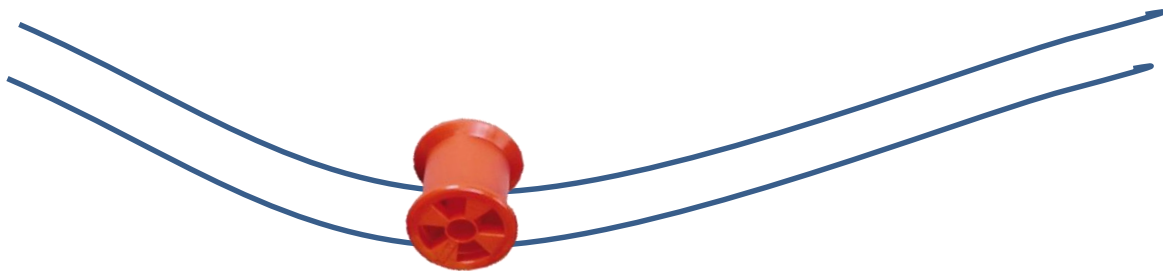
12. Travel on a train

Take a trip on a train. Can you spot these things on your journey?

- A bridge going over the railway line
- A bridge for the railway line to go over a road
- Signals, to ensure you stay on the right track to your destination
- Points, these are the junctions to transfer trains onto another track. (You may feel or hear the train go over them, rather than actually see them)
- Overhead electricity lines (not available in all areas – yet!)
- Spare equipment (look out for spare sections of rail)
- Station car park
- Platform canopy (to protect you from the rain)
- Bird boxes or other environmental feature
- A blue handrail by the tracks (to protect the workforce)

13. Keep your “train” on the tracks

When building new railways or modifying existing ones, it is essential that the tracks are laid parallel so that the trains stay on them. Your challenge is to roll a cotton reel or similar along a set of tracks. The tracks could be two lengths of string or wool, or two bamboo canes. When using the canes I suggest that you use half a kitchen roll tube with a piece of card fixed to each end.



EXTEND: Set it up as a relay race in teams to roll your “train” from one end to the other

14. Motorways route plan

The national road network has been built to connect our major cities and towns.

Can you work out the most efficient / economic way to journey between all of these villages, towns & cities?

C ompton, Berks	E xeter
I lkeston	N ewport, Wales
V ange, nr Basildon	G lasgow
I ngleton	I pswich
L eatherhead	N ewbury
	E dinburgh
	E ly
	R eading

EXTEND: Can you connect towns or cities which are by motorway junctions alphabetically, using only the motorways. Starting with A, how far through the alphabet can you get, note the town/city, the motorway junction that they are next to and the motorways taken to get to the next letter.

Energy

Civil Engineers design and construct the structures that can produce the electricity we need to power our homes. Here are some activities about energy from different sources such as nuclear, wind, water or solar.

15. Make a windmill

Make a windmill using paper and a straw and a split pin

If you search on Google Images for "make a windmill template" this will give you many ideas and template of varying difficulty.

16. Play "The Atom Game"

Civil engineers are building the next generation of nuclear power stations. In a nuclear reactor, energy is produced from splitting the atoms of uranium. This game is the reverse where atoms join together!

The Atom Game. The girls run around the gym in all sorts of directions like atoms. The Guider then calls out "Atom___" and a number. Whichever number is called, the children have to get into groups of that number. For example, if the Guider calls "Atom 6!" then the girls get into groups of 6. Those left out of a group, are out.

17. Solar car trail

You will need a solar powered car for this activity.

One per six or patrol is probably a good idea, however they are available on line for as little as £1.20 each, try a shopping search for "mini solar car".

Bring torches and guide your car along a trail around your meeting room or outside. You could set out you trail using skipping ropes or chalk or a ball of wool!

18. Make a lava lamp

Movement of water creates energy, this could be through tidal movement or by a controlled release of water from a dam. As you may have gathered Civil Engineers are very imaginative in the work they do, therefore I have used my imagination and thought that the movement of water in oil would be a suitable activity for this section.

What you will need:

- A clear plastic bottle
- Water
- Vegetable oil
- Food colouring
- Alka-Seltzer tablets (or other tablets that fizz)

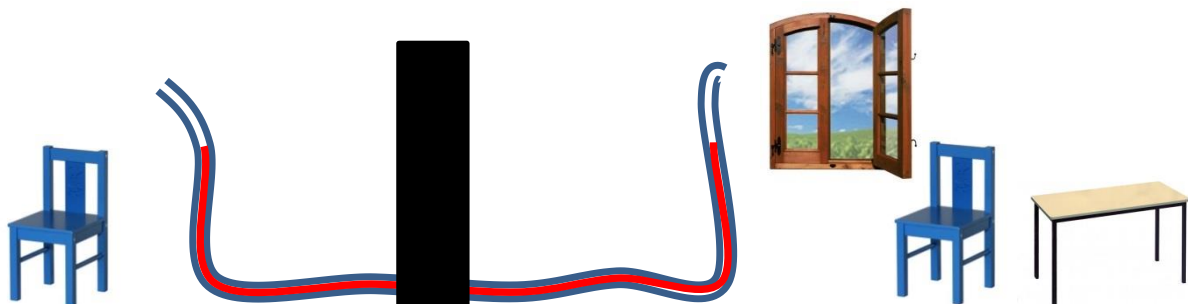
Instructions:

- Fill the bottle or jar $\frac{3}{4}$ full with vegetable oil
- Carefully fill the rest of the bottle/container with water
- Wait until the oil and water have separated.
- Add about 12 drops of food colouring so that it mixes with the water
- Break an Alka-Seltzer tablet into 6-8 pieces
- Drop one of the pieces of the tablet into the bottle or jar. It will fizz and bubble!
- When the fizzing stops, add another piece, and then another and so on.
- Once you have used up the whole tablet, put the lid on tightly and swirl the liquid around, tip it slowly up and down, watching the coloured blobs move around!

Design & Build

19. Make a levelling tool

It is very important that everything is built in the right place and at the correct level. You will need a thin piece of clear plastic tubing approximately 10m long. Fill this carefully with water using a funnel. If you add food colouring it will be easier to see the water in the pipe. Now you are ready to measure things or people to see if they are the same height, what about the window ledges or some different door handles? The water will always settle to a level position even if the ends of the tube are in different rooms.



EXTEND: using a longer piece of tube that can reach another room or behind a screen and have two sets of identical objects, (eg chair, table, box, child). The opposite team then needs to guess what is being measured based on the level of the water in the tube.

20. Build it

This challenge is to communicate a design from one end of the room to the other, so that the builder is given enough information to build it correctly even if she has not seen the original object.

What to do:

Ask the girls to get into groups of at least three, a designer, a project manager and a builder. At one end of the room an object should be built out of blocks or Lego or similar and hidden from view. At the other end of the room there should be a pile of blocks (the blocks needed to build the hidden object and some spares).

The Rules:

- The Designer is the only one who can look at the object and must describe what it looks like to the nominated Project Manager.
- The Project Manager must remember what she has been told and accurately pass the message on to the Builder.
- The Builder is the only one that can touch the blocks from the pile and so must build what is described to her.

End:

The challenge ends when the first team has accurately built the hidden object. Alternatively you can set a time limit and at the time see which team has the most pieces in the right place.

SIMPLIFY: For Rainbows this could be simplified to a single shape. If you have a set of logi-blocks, the designer is limited to giving one piece of information eg it is a triangle/circle/square, it is thick/thin, it is red/blue/yellow. The 'builder' should then be able to select the correct object from her pile of choices.

21. Lego evening

Have an evening building things out of Lego, or other building blocks. Use your imagination and have fun.

General

22. Watch “what is a civil engineer” video

Go to the website for the Institution of Civil Engineers and watch the ICE’s video on “What is Civil Engineering”. Leaders, may I suggest that you do this anyway, even if your unit does not do this one as a challenge.

<http://www.ice.org.uk/What-is-civil-engineering>

EXTEND – take it further and take a look around the ICE website

23. Visit a building site

You must ensure you arrange a visit with the site manager as building sites are dangerous places, DO NOT enter unless you have been invited. There is usually a contact number on the hoarding or security fence surrounding the site. Alternatively maybe someone from the site could visit you at your meeting place and tell you about their project.

24. Wordsearch

Find all these civil engineering words in the grid below:

CIVIL

PIPES

BRIDGE

ENGINEER

PORTS

AIRPORT

TUNNEL

RAILWAYS

ENERGY

ROAD

DESIGN

WASTE

HIGHWAY

CREATE

AMAZING

D	Y	E	P	G	Y	A	W	H	G	I	H	Q	K
T	U	N	N	E	L	D	X	I	N	R	C	R	K
Y	I	G	P	R	I	E	H	G	W	E	R	H	N
V	H	I	G	P	A	S	Z	Y	G	R	E	N	E
I	G	N	C	I	V	I	L	W	N	O	A	W	G
C	R	E	A	P	N	G	L	A	I	A	T	A	D
P	G	E	P	E	R	N	K	W	Z	D	E	S	I
P	O	R	T	S	F	O	A	D	A	K	R	T	R
H	O	B	G	V	I	H	A	G	M	Y	H	E	B
F	O	R	T	R	O	P	R	I	A	Z	S	G	K

25. Hunt the civil engineering

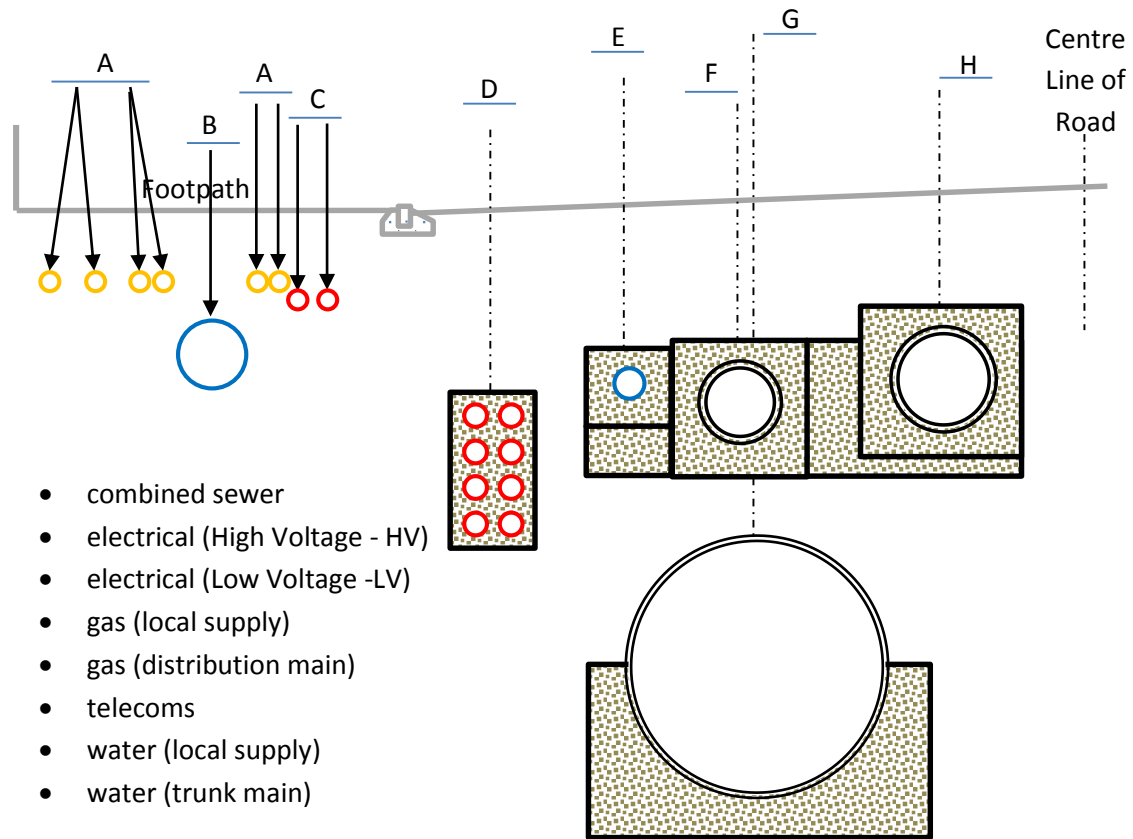
Draw a ring around all the examples of civil engineering and civil engineers at work. There are 28 to find.



Thanks to the **Institution of Civil Engineers** for their kind permission for using this activity.

26. What's under your feet?

Label this picture of all the different services under our pavements.



The image above is from a real road, wherever everything has plenty of space, the photo below is of some other utility diversions that I worked on. Can you spot any of these things?

- Gas pipe
- BT ducts
- Another telecoms supplier
- And another telecoms supplier
- Data cable ducts
- LV electric cable
- Really old clay ducts

We were clearing some space to fit a new water main and a new gas main under the footpath.



DID YOU KNOW? Different services need to be spaced apart and each provider needs to have access to their pipes and cables, so you can't just stack them all on top of each other. A sewer pipe must always cross under a clean water supply pipe just in case either break, you don't want the sewer to contaminate the clean water.

Order form

Thank you for taking part in
"I could be a Civil Engineer" Challenge Badge

Please complete and return this badge order form with
payment to receive your badges.



UNIT: _____

CONTACT NAME: _____

ADDRESS TO WHERE BADGES SHOULD BE POSTED:

_____ POSTCODE: _____

PHONE or EMAIL (in case of queries): _____

DATE OF EVENT WHEN BADGES NEEDED FOR: _____

TOTAL NUMBER OF BADGES @ £1 EACH: _____

Please add the following amount of postage depending on how many badges you order

1-10 Badges - 80p

11-30 Badges – 1.20

31-100 Badges - £2.40

100+ badges or international delivery - Please contact me in advance badges@1sthermitagerainbows.uk

TOTAL AMOUNT ENCLOSED: £ _____

As I have released this badge in some very public forums, please complete this form and email it to badges@1sthermitagerainbows.uk . I shall then happily advise you where your cheque is to be sent to.

Cheques are payable to 1ST HERMITAGE RAINBOWS.

We will advise you by email if there is likely to be a delay for any reason – eg badge re-ordering or holidays

BADGE FEEDBACK

We would be very grateful if you could give us some feedback on what you thought about this badge – which activities did you do, what was good or bad? Thank You!

General badge enquiries can also be emailed to: badges@1sthermitagerainbows.uk
Electronic payment details available on request.

I built these. I love my job! ☺



Marriott hotel, Kensington London.
Seven storeys of glass hung from the top



Kings Cross station, London
Mosaic panels that curve in every direction



A Crossrail portal, London – TBM* Jessica has since broken through



Orion Building, Birmingham
26 storeys high, that was a climb



Harbourside Building 9, Bristol
Another challenge, pontoons this time