Knowledge Organiser

Year: 5 Subject: Design & Technology Unit: Building bridges

Overview

Children will be learning about several types of bridge structures and their purpose. They will learn about stable structures and then apply this knowledge to how bridges are made. They will plan and make their own bridge according to a design brief and evaluate them.

What should I already know?

Design

- Can identify the different components of a photograph frame: -
  - the frame – made of 4 sides
  - glass front
  - the backboard
  - a stand
  - the artwork or picture inside the frame
- Can compare photograph frames and talk about their features
- Apply what they know about photograph frames to design a photograph frame that has a stable structure
- Can create an accurate labelled diagram
- Identify areas that could be improved upon in their design

Make

- Can follow a design to make a functional and decorative photo frame.
- To create a stable structure with paper/card using strengthening techniques.
- To create accurate joins using glue and tape.

Working with tools

- Can select the most appropriate materials, tools and techniques to use and can use them safely (card, paper, glue, tape, ruler)
- Can measure accurately using cm and mm.

Evaluate

- Be able to look at a range of existing photo frames and talk about what makes them successful – sturdy, decorative etc.
- Recognise what has gone well, but suggest further improvements for the finished article
- Suggest which elements they would do better in the future
- Can assess how well their product works in relation to the purpose

Technical Knowledge

- A wide base makes free standing objects more stable.
- Paper and card can be strengthened by: -
  - Rolling to create poles. Short poles are stronger than long poles
  - Layering and gluing to the required thickness
  - Twisting into tight folds
  - Folding repeatedly to make a strip.

What will I know by the end of the unit?

Vocabulary:

suspension	The weight of the deck is supported by vertical cables and suspended over a chasm
truss	A framework that supports a roof, bridge
arch	A curved symmetrical structure spanning an opening and typically supporting the weight of a bridge
beam	A long, sturdy piece of squared timber or metal used to support the floor of a bridge
span	The full extent of something from end to end
load	A heavy or bulky thing that is being carried or is about to be carried.
cross-section	A surface or shape exposed by making a straight cut through something
pillar	A tall vertical structure of stone, wood, or metal, used as a support
abutment	A point at which something abuts against something else

Design

- Can test the effectiveness of different beam designs by constructing two identical beams which can support a flat card deck.
- Can investigate the effectiveness of arches of different shapes and sizes in spreading the load on bridges.
- Can design a prototype for a new bridge based on a design brief: -
  - 100:1 scale
  - must span a gap of 50m
  - must allow traffic to pass in both directions
  - must have a clearance of at least 20m
  - must be strong
  - must be attractive
  - prototype must be made using only scissors, paper/card, sticky tape, glue, paper straws and string
- Can state reasons why they have chosen a particular bridge design.
- Can suggest some alternative designs and discuss the benefits/drawbacks
- Can identify the parts of the process that will be easy and more challenging.
- Identify how they can overcome challenges (ask for help).
- Can explain their design, the reasons for it, the techniques they will use and the process they will need to undertake to make their product

Make

- Can build a range of bridges: -
  - A truss bridge that can span 40cm and support a weight of 500g at its centre.
  - an arch bridge which can take a specified weight and has a specified clearance to allow vehicles to pass beneath it.
  - a model suspension bridge which can support 500g at any point along its length, and hold a smooth deck which a toy car can roll across.

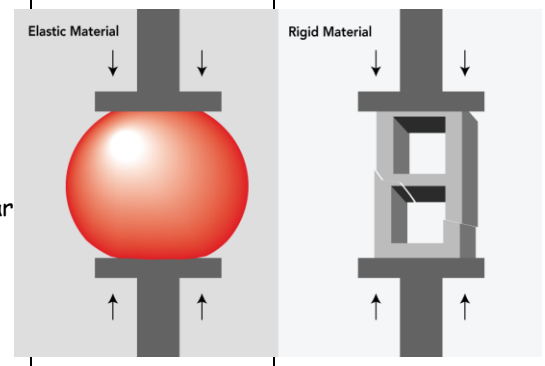
Working with tools

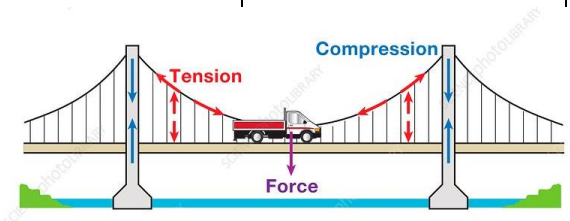
- Can independently organise appropriate equipment and materials needed.
- Can use a range of tools and equipment with good accuracy and effectiveness, within established safety parameters e.g., art straws, sticky tape, string, card, paper, glue, scissors; sets of weights; toy cars;
- Measure and cut precisely to millimetres.

Evaluate

- Can develop own designs through reflection and evaluation of others products
- Can analyse a prototype by asking questions that are based on the design criteria i.e.,
  - Does the bridge span a gap of 50cm?
  - Does it have a clearance of at least 20cm beneath it?
  - Does it have a deck which allows two toy cars to pass each other?
  - Is it strong and attractive?

tension	The state of being stretched tight.
compression	The reduction in volume (causing an increase in pressure) of a liquid
parapet	A low protective wall along the edge of a roof, bridge, or balcony
pier	The pillar of an arch or supporting a bridge.
gravity	The force that attracts an item towards the centre of the earth
deck	The ground or floor.
cable	A thick rope of wire or hemp used for construction





Technical Knowledge

- A beam is a length of sturdy material that has been cut and shaped to span a gap or support a floor or roof
- Beams are formed into different shapes for different purposes.
- The deck is the flat surface of a bridge. A smooth, flat deck allows wheeled vehicles to cross.
- Side sections of bridges (parapets) make the bridge more sturdy
- Pillars allows bridge builders to span bigger gaps. When a bridge spans a river, the pillars stand on man-made islands so they do not wash away.
- Steel and concrete are often used in the construction of modern bridges. Beams and pillars made of these materials can be made much bigger, longer and stronger
- Steel girders are often used in bridge construction. Tubular steel in different shapes is also used frequently
- The Millennium Footbridge in London stands on foundations called piers
- A truss is made up of several beams connected together in different ways. Trusses enable longer, stronger bridges.
- A bridge deck runs through, or on top of the trusses
- Gravity is a downward force acting on bridges. This downward force pulls down on the beams and decks, causing them to squeeze, stretch, twist and bend
- Trusses help strengthen bridges by distributing the weight along its length and transferring the compression forces down through the pillars and abutments
- Lattice truss, Warren truss and Pratt truss are commonly used in bridge design.
- Until developments in technology and engineering meant that engineers could construct large beams made of iron, long bridges were made with brick or stone arches.
- In the past, stone arches were used to build long bridges. Arches help to spread the load by changing the direction of the compression forces caused by the weight of the bridge itself and the weight of the objects crossing
- Suspension bridges are different to many other bridge designs because they spread out the weight of the bridge and the traffic crossing it in a different way. Suspension bridges use tension forces, pulling rather than pushing.
- Modern engineering means that huge suspension bridges can be built. Thick, heavy, twisted steel cables transfer the weight of the bridge to the vertical columns. Their weight means they have to hang in long loops between the columns. The cables are anchored at either side of the bridge deep into hard rock or into tonnes and tonnes of poured concrete. Because the columns of suspension bridges can withstand huge compression forces, they can be built with long decks and big gaps between them. Another advantage is that the deck can be hung high above the gap it is spanning, unlike other bridge designs

Technical drawings and models are often drawn and built to a scale that is smaller than the final product.