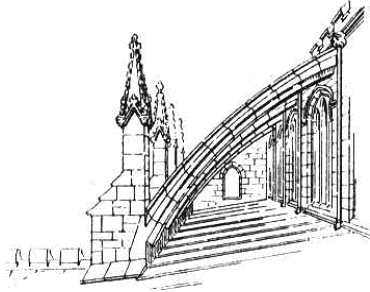


## UNIT D TEST ..... Structures and Forces



This is a Crash Test Dummy.  
Why was it designed to test vehicles impacts?

\_\_\_\_\_ To improve the margin of safety,  
without having to use humans who could be injured or die,  
during the testing of vehicle collisions. \_\_\_\_\_



What kind of support structure is this?

(Hint: it was used on big cathedrals in Europe)

\_\_\_\_\_ **flying buttress** \_\_\_\_\_



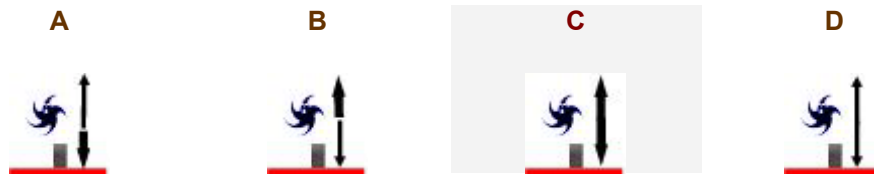
What kind of structure is this?

\_\_\_\_\_ **natural frame structure** \_\_\_\_\_

1. All of the following structures can be classified as natural, EXCEPT a ...
  - A mushroom
  - B spider web
  - C feather
  - D fishing net
  
2. The following are examples of **natural** mass structures ...
  - A dams and mountains
  - B brick walls and coral reefs
  - C ice sculptures and sand castles
  - D mountains and coral reefs
  
3. How a structure is put together, how it is shaped and the types of materials that are used to build it are all part of the structure's ...
  - A design
  - B function
  - C classification
  - D stability
  
4. 'Running bond' is a pattern used for strength in ...
  - A dams
  - B brick walls
  - C beaver dams
  - D omelets
  
5. Frame structures have a skeleton-like appearance and are made of very strong materials so they can support the ...
  - A partition walls
  - B retaining walls
  - C load bearing walls
  - D roof and covering materials
  
6. Egg cartons, food cans, bottles and pipes are examples of ...
  - A manufactured shell structures
  - B natural shell structures
  - C manufactured frame structures
  - D natural frame structures
  
7. Containing, sheltering, transporting, lifting ... are all words to describe a structure's ...
  - A design
  - B stability
  - C function
  - D aesthetics
  
8. When a structure is built to withstand loads - more than it normally would carry - the structure is built with a larger ...
  - A foundation
  - B symmetrical base
  - C set of pilings
  - D margin of safety

9. One important criteria of design - that is usually not written down in the specifications - is that the structure ...
- A has a margin of safety
  - B is esthetically pleasing**
  - C is cost effective
  - D has a solid foundation
10. The following is an example of a composite material
- A a cardboard box
  - B tent
  - C drywall
  - D reinforced concrete**
11. When choosing the most suitable materials to build a structure, architects, engineers and designers should consider all of the following before making their final choice ...
- A cost, appearance, environmental impact, energy efficiency**
  - B cost, color, life expectancy, impact strength
  - C environmental appearance, type of symmetry, type of joints needed, cost effectiveness
  - D flexibility, impact strength, energy efficiency, color
12. Mobile joints are used to secure materials together in a structure. All of the following joints are examples of mobile joints (allowing movement in a structure) EXCEPT ...
- A a trailer hitch
  - B photocopier lid
  - C ball and socket joint (shoulder)
  - D lego**
13. Adhesives are used to bind materials together. A type of adhesive that hardens when it cools is ...
- A thermosetting glue**
  - B therapeutic glue
  - C solvent-based glue
  - D solvent-enriched glue
14. The mass of an egg-sized lump of lead and the mass of an elephant ...
- A are very different**
  - B are about the same
  - C are measured in Newtons
  - D would change if they were measured in different places
15. Weight is a force that is measured by the gravitational pull on the object. It is usually measured in ...
- A Newtons**
  - B kilograms
  - C grams
  - D pounds

16. A student compared his mass in two different places (Vancouver and Banff). Which statement is correct?
- A **His mass was unchanged.**
  - B His mass increased in Vancouver.
  - C His mass decreased in Vancouver because it is at sea level.
  - D His mass decreased in Banff because of the higher altitude.
17. 'Crush It' was an investigation activity that tested the strength of different types of shell structures. The manipulated variable in this activity was ...
- A **weight the shell could hold before it failed.**
  - B mass the shell could hold before it failed.
  - C how long the shell performed its function.
  - D **the different kinds of shell structures used.**
18. Which force diagram show the forces happening with a very active Weepic, while it is directly over the wall?



19. The change in the shape or size of a structure ( due to internal forces which are produced by external forces acting on the structure) is called ...
- A **structural instability**
  - B dead loads
  - C live loads
  - D **deformation**
20. Bending or tearing a certain material, by pressing on different parts, in opposite directions, at the same time. The force you are creating is called ...
- A **shear force**
  - B tension force
  - C torsion force
  - D **compression force**
21. A hurricane or tornado is an example of a force that can cause extreme damage to a structure when it acts on the structure, even for a short time. The environmental event is classified as a ...
- A **live load**
  - B dead load
  - C deformation
  - D **torsion event**
22. Cross-country skis are designed to bend when a force is applied. Bending allows the middle of the ski to contact more snow, giving the skier a better grip when pushing off. The bending forces that are applied to the 'camber' (middle part of the ski) are ...
- A **compression and torsion**
  - B **tension and compression**
  - C torsion and tension
  - D **shear and torsion**

23. The strength of a certain material has been described by scientists as the forces between the tiniest particles of the material. Because the particles have yet to be seen, scientist can only make ...
- A **inferences**
  - B **observation**
  - C **analysis**
  - D **conclusions**
24. Structures fail for a number of reasons. Engineers study failed structures so they can design stronger, more durable structures. A flagpole that has been blown over in a strong wind happens because of the increased force that is applied to the base of the structure making it act like a ...
- A **rib**
  - B **lever**
  - C **stringer**
  - D **Inclined plane**
25. When a solid material is compressed, small microscopic cracks in the material can enlarge or break apart. This can cause one section of the material to break away from the other part. This action is called ...
- A **bend**
  - B **buckle**
  - C **shear**
  - D **twist**
26. Auto safety designers and inspectors to identify impact points when material fails in a collision use crash test dummies. When the car is rammed into a solid wall, the front end buckles. This happens to better protect the Crash test dummies (us) in a real accident. The metal deforms because of the energy it absorbs in the impact. Designers ...
- A **identify where to reinforce the front end.**
  - B **determine what materials buckle the least.**
  - C **identify the weaknesses and try to fix them.**
  - D **do this on purpose to increase the margin of safety.**
27. The designers of spinning wheels work to ensure that the fibers, that are twisted together, are done so tightly that they lock together. If the fibers are twisted too much they tangle and shorten, unless you keep pulling them apart. This can be useful if you are wanting to make ...
- A **lighter fabrics**
  - B **stretchy fabrics**
  - C **stronger fabrics**
  - D **more durable fabrics**
28. Metal fatigue happens because metal is ...
- A **not made properly**
  - B **too old to be used any more**
  - C **exposed to extreme conditions**
  - D **bent or twisted over and over again**
29. Designers generally use three key methods to help structures withstand forces. They include all of the methods below, **EXCEPT** for ...
- A **distribute the load evenly**
  - B **direct the forces along angled components**
  - C **place lighter materials above heavier materials**
  - D **shape the parts for the forces they are likely to face**

30. Construction of a roof truss utilizes an important principle. Certain shapes will determine greater strength. Because roofs need to be very strong, roof trusses are shaped in ...
- A rectangles
  - B squares
  - C triangles
  - D parallelograms
31. A frame structure can support a very heavy roof because of one of the principles of design. The vertical supporting posts in the structure visibly demonstrate this principle. The principle followed is ...
- A distribute the load evenly
  - B direct the forces along angled components
  - C shape the parts for the forces they are likely to face
  - D place lighter materials above heavier materials
32. When a structure has a single horizontal load bearing beam, supported by two columns - one at each end, the beam will likely bend in the middle (A box and girder bridge spanning a 'raging river' is a good example). This bending exerts pressure outward on the vertical supporting beams. **To strengthen this type of bridge**, so that heavy vehicles can cross it, you should ...
- A reinforce the columns at both ends with braces
  - B place additional columns in the middle
  - C use a double cantilever design
  - D utilize flying buttresses
33. Science fiction often gives us exciting ideas about materials that can withstand almost any force. In reality, the perfect material has not been discovered yet. One material (if it could be made the thickness of a pencil - could stop a 747 jet). It is currently being synthetically developed and will have widespread use because of its strength. The material is known as ...
- A Kelvar®
  - B rice grain
  - C spider silk
  - D industrial bamboo
34. Remember when you put your hands on your desk and put all your weight on them - then tried to move them forward? This demonstration was used to identify that your hand (much like a structure) resists movement forward because of ...
- A static forces
  - B kinetic forces
  - C external forces
  - D frictional forces
35. Stability in a structure is dependant on a number of factors. One of these factors is whether or not a structure could fail if an extreme force was applied to the structure that was not in the original design specifications. The World Trade Center Tower's collapse is example of a structure failing because it encountered a force beyond what it was designed to withstand. The Empire State building is a steel frame building that survived the crash of a USAF Bomber hitting it between the 78th and the 79th floors. The design component that likely enabled the Empire State building to withstand this incredible force was its ...
- A mass
  - B central location
  - C reinforced concrete
  - D lack of glass materials used

36. The Leaning Tower of Pisa is an example of a mass structure. The Tower was built with a lean originally and it had been getting worse, because of the foundation on which it was built. The structure has not fallen over yet, because its center of gravity still keeps it relatively stable. Once it started to lean more, engineers knew that the center of gravity shifted. The reason that the Tower is moving is because ...
- A it is very windy in Pisa
  - B Pisa has many earthquakes
  - C the thrust line is inside the foundation
  - D the thrust line is outside the foundation
37. A firm foundation is necessary to support a structure. Solid ground is not always firm and stable. There are environmental and man-made conditions which make the soil loosen and become compact, which makes the soil relatively unstable. Three strategies are used to ensure a structure is built on a firm foundation. The three strategies include all of the following, **EXCEPT** ...
- A spread the load
  - B make a soil layer
  - C find something solid
  - D utilize pressure and density
38. Sometimes if a new invention comes along, it is based on a scientific principle. Again that is the case with the 'Segway. The one person motorized vehicle, that was recently unveiled, uses the principle - **to gain stability of a forward moving object, you need to increase its speed.** This new invention utilizes this principle with one of its components, a ...
- A gymnosperm
  - B gyroscope
  - C spinacre
  - D rotator disk
39. The mass of a container of shampoo is 256 g. Its weight would be ...
- A 0.256 kg
  - B 2.56 kg
  - C 0.256 N
  - D 2.56 N

40.



What kind of bridge is the illustration an example of ?

- A trestle
- B box and girder
- C supported arch
- D double-cantilever