The Physics Of Bridges Essay, Research Paper

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Bridges are a very important part of everyday life. They can save hours in traveling time each day or connect to pieces of land together. The everyday man may not appreciate them but they are by engineers and fans of physics. Bridges are perfect examples of physics. There are different types of bridges, each with a specific purpose. The ones that we chose to talk about are beam, arches, and suspension bridges.

Beam bridges are the cheapest type of bridge to make. They are the most simplest to construct compared to the others. The simplest form of a beam bridge would if you took a board of any size and placed it over two desk that are closer than the boards length. If the gap is to great or too much of a load is added then the board will sag greatly. This may be solved if, the thickness of the board is increased or there are supports that are put in.

The arch bridge is one of the oldest forms of a bridge. It is like a inverted suspension bridge, with all the tension replaced by compression, and vice versa. There are differences in the stability of the system. An example would be if you, hung a rope across a gap, and it will return to its original position, after some oscillation. Though you cannot hang it in the shape of an arch, even if it could be done the slightest disturbance would send it flying. One reason that an arch bridge has good support is that the volume between the road and the arches is it is filled with masonry, which adds rigidity. The other is that the arch has substantial thickness, so that even with variation in the load, the line of thrust passes through the voussoirs.

Suspension bridges are the light and strong and can span distances of 2,000 to 7,000 feet, which is far longer than any other type. Though they are very good they are the most expensive. What a suspension bridge does it suspends the roadway from huge main cables, which extend from one end of the bridge to the other. The towers enable the main cables to be draped over long distances. Most of the weight of the bridge is carried by the cables to the anchorages, which are imbedded in either solid rock or massive concrete blocks. Inside the anchorages, the cables are spread over a large area to evenly distribute the load and to prevent the cables from breaking free. Some of the earliest cables were made from twisted grass, then in the early 19th century they used iron chains. Today they are made of thousands of individual steel wires bound tightly together. A single wire, only 0.1 inches thick can support a half of a ton without breaking.

Stress is produced by forces. One force acting alone is not a common occurrence, usually it is many more than just one acting at any given time. As a load as applied to an object, that object deforms just the right amount to produce the required opposing force. Such a change, as a fraction of the original size, is called a strain. The ratio of stress to strain is called a modulus – it measures the stiffness of the material. But it tells nothing about the ability to absorb energy. Glass is not easy to bend, but you wouldn’t build a bridge from it. It snaps when very little energy has been absorbed.

Forces also produce acceleration. This is extremely important in structures because there are live loads – people walk across upper floors, trains and vehicles go across bridges, and the wind can blow from any direction. These forces can set the structure vibrating at its resonant frequencies – the ones at which it naturally oscillates. If the forces vary at one of the resonant frequencies, things can go wrong. Breaking step on a small, flimsy bridge is good idea. Even worse, more than one resonant frequency could coincide. Worse, still, a small but fairly steady force can produce oscillations because of the interaction of the structure with the air. Tacoma Narrows bridge is only the most famous example of several collapses. This is an extreme example – in fact the effects of forces are never instantaneous – they always take time to propagate through the medium. As the speed of waves in structural materials is so high, we are normally not aware.

Compression differs from other stresses in producing inherent instability. Tension is the opposite stress of Compression. While Tension forces pull apart, compression pull together. Torsion is not a good idea in a bridge. It is a twisting of the structure. In a long suspended span, the presence of many heavy vehicles traveling in one direction, with few on the other side, will cause the deck to twist. A long motorway over pass may support by single columns to reduce the effects on roadways below. It must then be stiff enough to transmit asymmetrical loads to the abutments without undue torsion.

Bending would seem to be easy top explain, but it isn t. If you bend a long rectangular rubber eraser it tends to bend in two different axes. This effect is very small for structural materials, but we do need to remember that bending a beam causes compression on one side and tension on the other. There is a neutral surface where the length remains unchanged.