Civil Engineering: Truss Bridges

There are three major types of bridges:

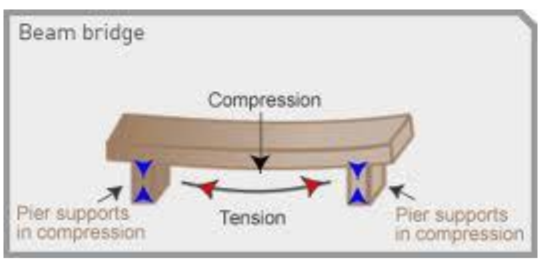
- The beam bridge (span 200 ft.)
- The arch bridge (span 1000 ft.)
- The suspension bridge (7000 ft.)

The difference span length depends upon the methods to handle compression and tension forces.

Truss Bridges

A single beam spanning any distance experiences compression and tension. The very top of the beam experiences the most compression, and the very bottom of the beam experiences the most tension. The middle of the beam experiences very little compression or tension. If the beam were designed so that there was more material on the top and bottom, and less in the middle, it would be better able to handle the forces of compression and tension. (For this reason, I-beams are more rigid than simple rectangular beams.)

A beam bridge is basically a rigid horizontal structure that is resting on two piers, one at each end. The weight of the bridge and any traffic on it is directly supported by the piers. The weight is traveling directly downward.



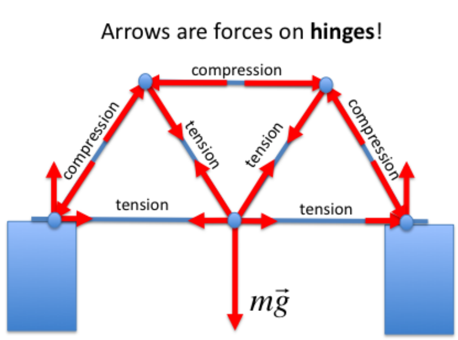
Compression: The force of compression manifests itself on the top side of the beam bridge's deck (or roadway). This causes the upper portion of the deck to shorten.

Tension: The result of the compression on the upper portion of the deck causes tension in the lower portion of the deck. This tension causes the lower portion of the beam to lengthen.

Dissipation: Many beam bridges such as highway overpasses use concrete or steel beams to handle the load. The size of the beam, and in particular the height of the beam, controls the distance that the beam can span. By increasing the height of the beam, the beam has more material to dissipate the tension.

http://science.howstuffworks.com/engineering/civil/bridge2.htm

Truss Bridge



To create longer beams, bridge designers add supporting lattice work, or a truss, to the bridge's beam. This support truss adds rigidity to the existing beam, greatly increasing its ability to dissipate the compression and tension. Once the beam begins to compress, the force is dissipated through the truss.

Despite the ingenious addition of a truss, the beam bridge is still limited in the distance it can span. As the distance increases, the size of the truss must also increase, until it reaches a point where the bridge's own weight is so large that the truss cannot support it.

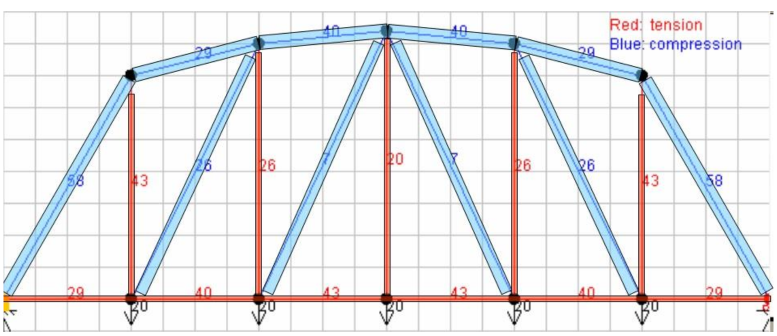
http://www.ic.sunysb.edu/Class/phy141md/doku.php?id=phy141:lectures:21

Think of one side of a truss bridge as a single beam. The center of the beam is made up of the diagonal members of the truss, while the top and bottom of the truss represent the top and bottom of the beam. Looking at a truss in this way, we can see that the top and bottom of the beam contain more material than its center (corrugated cardboard is very stiff for this reason). In addition to the above-mentioned effect of a truss system, there is another reason why a truss is more rigid than a single beam: A truss has the ability to dissipate a load through the truss work. The design of a truss, which is usually a variant of a triangle, creates both a very rigid structure and one that transfers the load from a single point to a considerably wider area.

Buckling occurs when the force of compression overcomes an object's ability to handle compression, and **snapping** occurs when the force of tension overcomes an object's ability to handle tension. The best way to deal with these forces is to either dissipate them or transfer them.

Force Dissipation: To dissipate force is to spread it out over a greater area, so that no one spot has to bear the brunt of the concentrated force. To transfer force is to move it from an area of weakness to an area of strength, an area designed to handle the force.

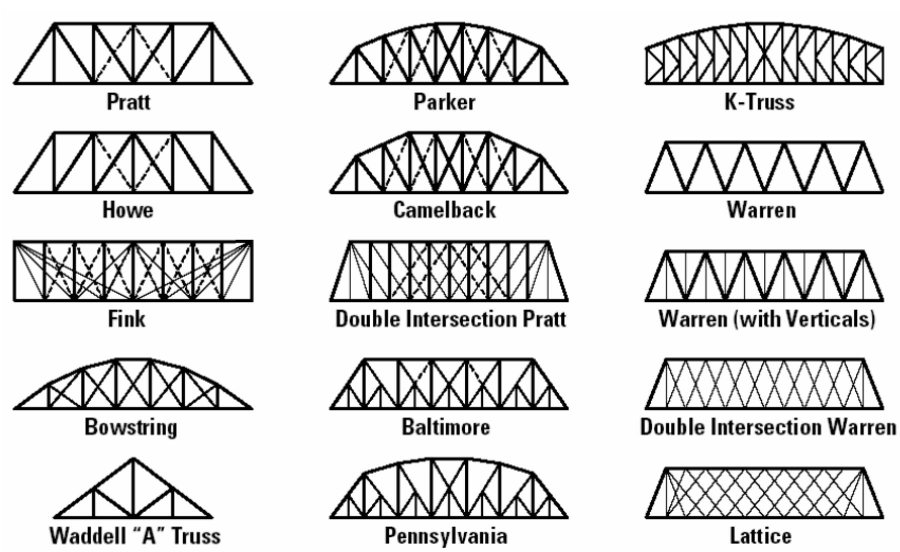
Compression and tension are present in all bridges, and it's the job of the bridge design to handle these forces without buckling or snapping.



100 N downward force. Maximum tension force on any beam is 43 N. Maximum compression force is 58 N.

http://www.siue.edu/SIPDC/Library/lesson%20plan/Science%20Session%20CD/ABE-GED%20Activity%209--Building%20Bridges-The%20Basics.pdf

Examples of Truss Bridges



http://technicalstudiescsat.myblog.arts.ac.uk/2013/02/18/task-4/