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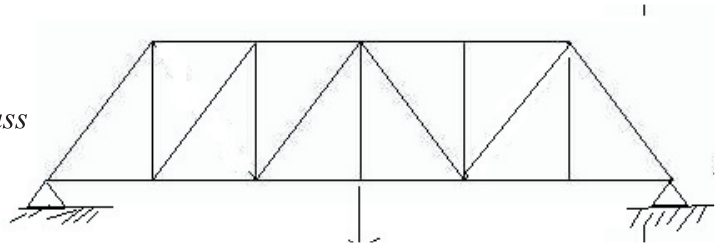
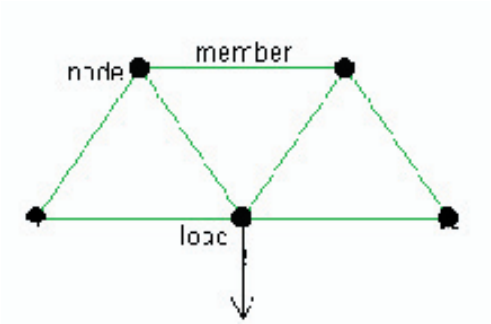
Dear xxx,

How are you? From your previous letter, you mentioned that you show interest in bridge. The basic structure of bridge is truss. Let me explain to you what is a truss and how does it work. Before introducing the principle of truss, it is essential to know some important terms. I would like to explain the meaning of members, nodes, compression, tension and bending.

One Basic Type of truss: Hess' truss





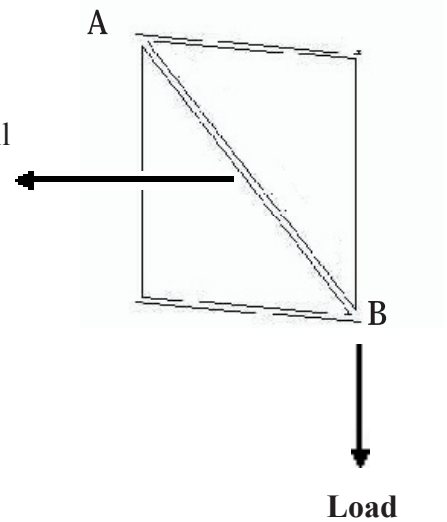
A truss is actually a beam, but it is made up of many small elements, members and nodes.

Members make up trusses. Truss is formed by straight members connected at their ends by hinged connections to form a stable configuration.

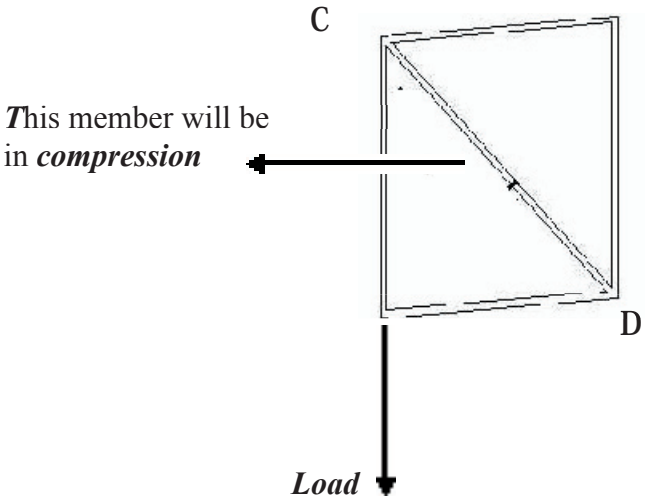
Nodes are joints. Members attached to nodes to form trusses.

Tension is a state in which an object tends to be stretched. As shown from the below diagram, when a frame with a diagonal member ***AB*** is pulled downward, the member ***AB*** tends to be stretched and become longer, therefore, it is said to be in the state of tension.

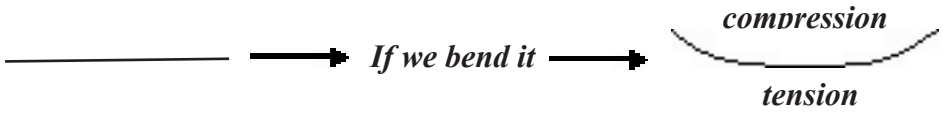
This member will be in ***tension***



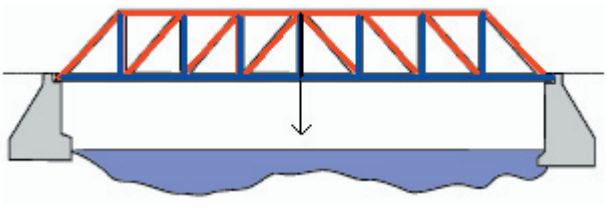
Compression is a state in which an object tends to be compressed. As shown from the below diagram, when a frame with a diagonal member ***CD*** is pulled downwards, the member ***CD*** tends to be compressed and become shorter, therefore, it is said to be in the state of compression.



Bending is the state in which some fibers of the object are in tension and others are in compression. When a truss carries a load, it works by bending. As shown in the below diagram.



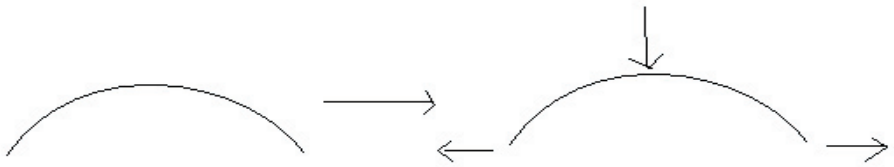
So, how did a truss work? It works by some members in the truss being tension and the other in compression state. Thus, the force of the load is being transmitted to the members. The whole structure and its parts did not move. The whole structure remains in equilibrium and is stable.



When many small frame connected together to form a truss, indicated as below, the members in **blue** indicate it is in ***tension*** and the members in **red** indicate it is in ***compression.***

In reality, when constructing a bridge, in order to maximize the load to truss weight ratio, the members, which will be in tension state when carrying load, will be made by light and tensile materials like string. String can be easily stretched without breaking, and at the same time, it is not heavy. On the other way, the members, which will be in compression state when carrying a load, will be made with some material which can resist the compressive force. One of the examples is steel.

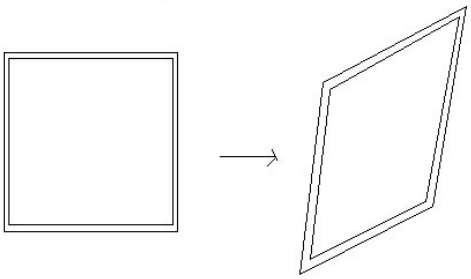
Different from an arch, a truss does not generate outward thrust. Since an arch carries a load through compression, it generates outward thrust. As shown from the below diagram.



Load

After introducing to you about trusses, I would like to give you more information related to truss. Indeed, truss faces a lot of problems, like racking and buckling. Below I would discuss with you some ideas of racking and buckling, and the solutions to them.

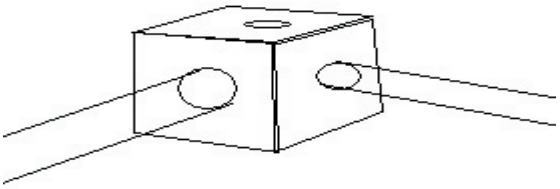
By definition, racking means distortion of a frame. As shown on the diagram.

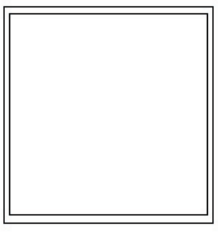


In order to prevent the truss from changing shape (racking) or moving, the joints must be rigid. To rigid is to keep the members remain a certain angle with one another all the time

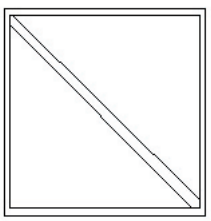
Firstly,. One of the method is using some materials and shown on the left hand side.

Each member is fixed and cannot be moved.

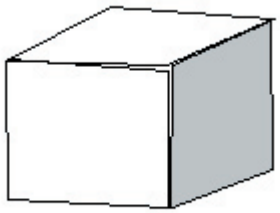




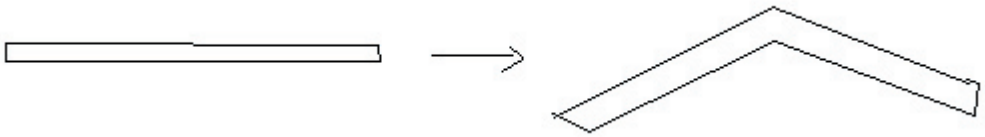
Secondly, this could also be done using diagonal bracing. Bracing is to support something, to make it steadies or holds it erect. In the case of truss, inside a frame, a diagonal brace is added to replace squares with triangles. This ensures that the angle between one and another is always fixed. The frame will not change shapes if their members do not change in length.



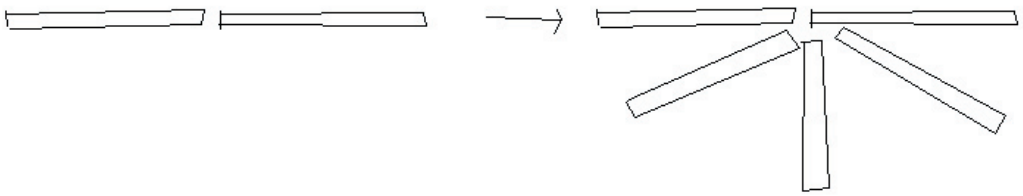
Thirdly, we could also use infill panel to prevent racking. That is to fill one frame with any material that is rigid.



Another problem faced by the members in truss is buckling. It usually occurs in slender members in compression. During compression, the following may happen.



This can be solved by increasing the cross sectional area, or reducing the length. Hence, the straws are more resistant to compressive force. Bracing could also prevent bucking by not allowing movement. As shown from the below diagram.



Here are some explanations to truss, the basic structure to bridge. Hope that I have answered your question. If you still have any problem, feel free to contact me. Wish you good luck!

Your sincerely,

Priscilla