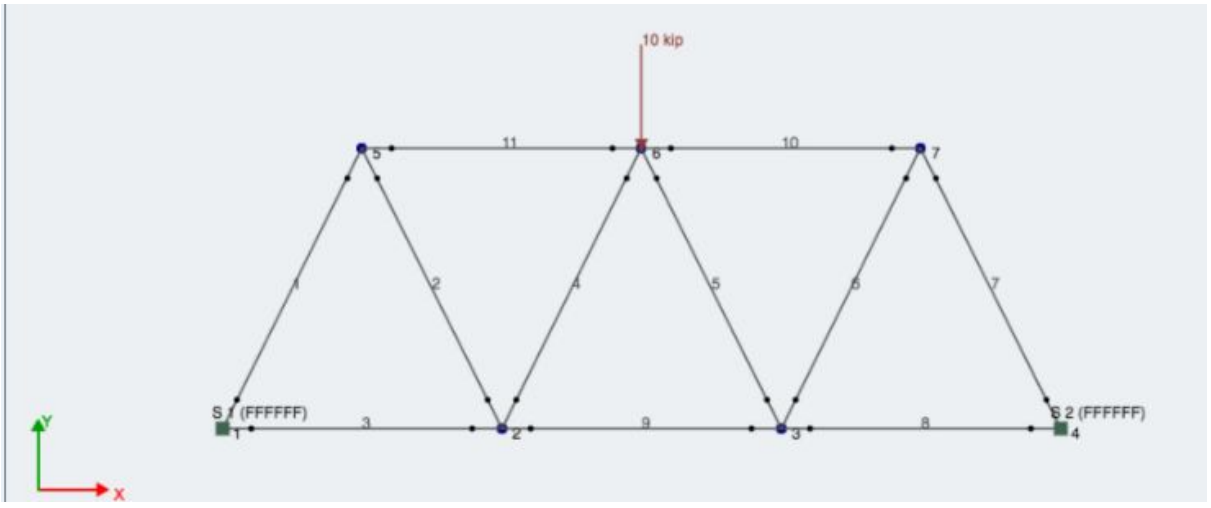
BASIC STRUCTURAL ANALYSIS

CIVIL ENGINEERING VIRTUAL LABORATORY

EXPERIMENT: 7 **ARCHES**

Q1) What is a truss?

Ans: A Truss is an important structure type in structural engineering. So what are trusses? A Truss is a triangulated system of members that are structured and connected in a way such that they only incur axial force. These members are considered two-force members as the forces are only applied at either end of the member, resulting in either a compression or tension force. They are commonly used as bridge designs, given their ability to efficiently span long distances. A typical truss might look something like this

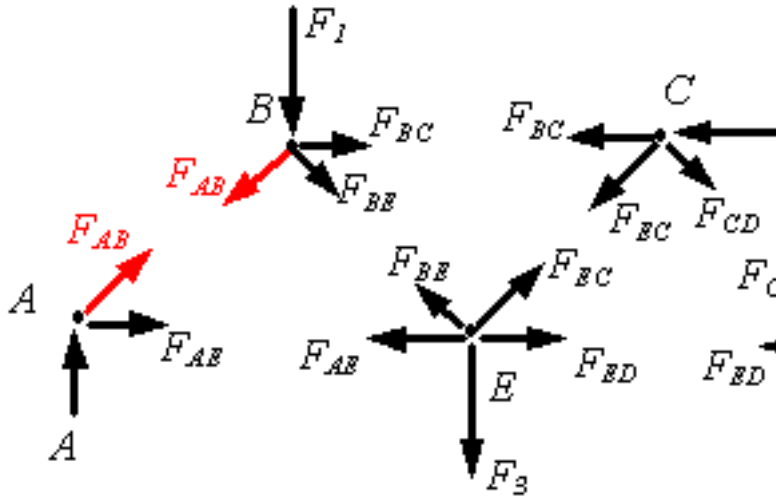


The joints are typically pinned connections, such that no shear or moment forces are transferred from member to member. This is a major, yet commonly misunderstood, the difference between truss and frame structures. A frame member will typically take a combination of shear, axial and bending forces; whereas a truss member will only take axial force.

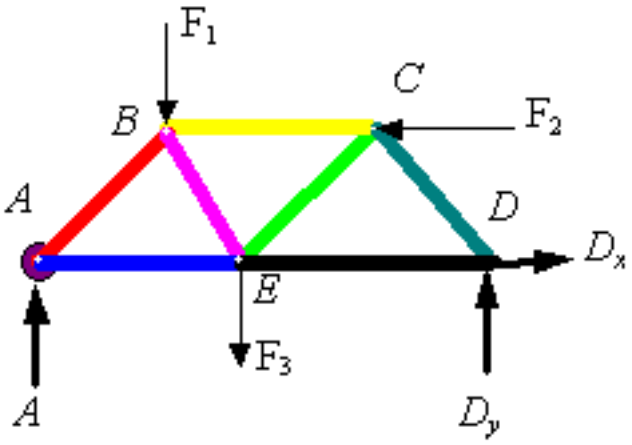
Q2) What are the methods to analyze truss members?

The method of joints: This method uses the free-body-diagram of joints in the structure to determine the forces in each member. For example, in

the above structure, we have 5 joints each having a free body diagram as follows



Note how Newton's third law controls how one introduces F_{AB} on the joints A and on the joint B. For each joint one can write two equations ($\sum F_x = 0, \sum F_y = 0$). The moment equation is trivially satisfied since all forces on a joint pass trough the joint. For example, for the above truss we have 5 joints, therefore we can write 10 equations of equilibrium (two for each joint). In the above example there are seven unknown member forces (FAB, FBC, FCD, FED, FEC, FBE, FAE) plus three unknown support reactions (A, Dx, Dy), giving a total of 10 unknowns to solve for using the 10 equations obtained from equilibrium.



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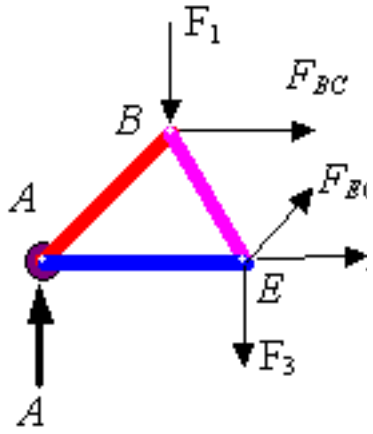
The method of sections: This method uses free-body-diagrams of sections of the truss to obtain unknown forces. For example, if one needs only to find the force in BC, it is possible to do this by only writing two equations. First, draw the free body diagram of the full truss and solve for the reaction at A by taking moments about D. Next draw the free body diagram of the section shown and take moments about E to find the force in BC.



In the method of sections one can write three equations for each free-body-diagram (two components of force and one moment equation).

Things to consider:

· Zero force members: Some members in a truss cannot carry load. These members are called zero force members. Examples of zero force members are the colored members (AB, BC, and DG) in the following truss.

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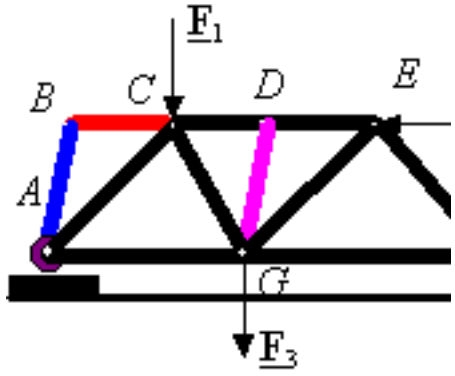
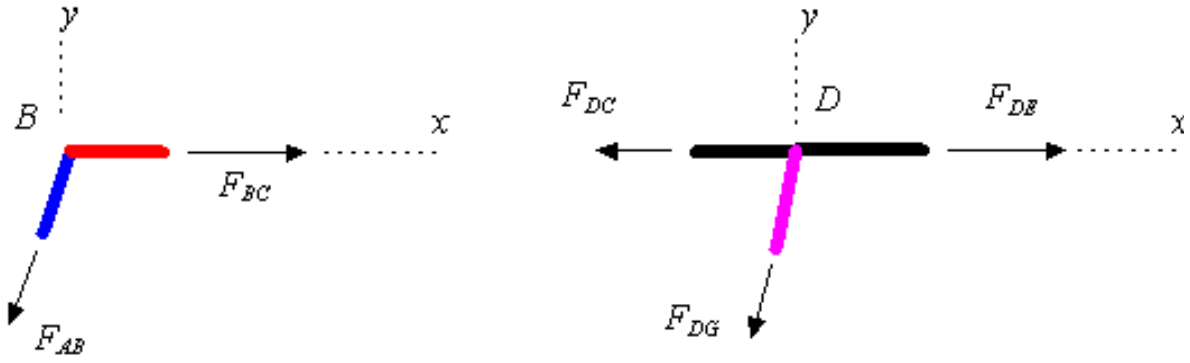


Consider the following free-body-diagrams



If you sum the forces in the y-direction in the left free-body-diagram, you will see that FAB must be zero since it is not balanced by another force. Then if you sum forces in the y-direction you will find that FBC must also be zero. If you sum the forces in the y-direction in the right free-body-diagram, you will see that FDG must be zero since it is not balanced by another force.

· A redundant joint: Sometimes a joint is redundant. For example, in the following free-body-diagram, the load is directly transmitted from each member to the one opposite it without any interaction.

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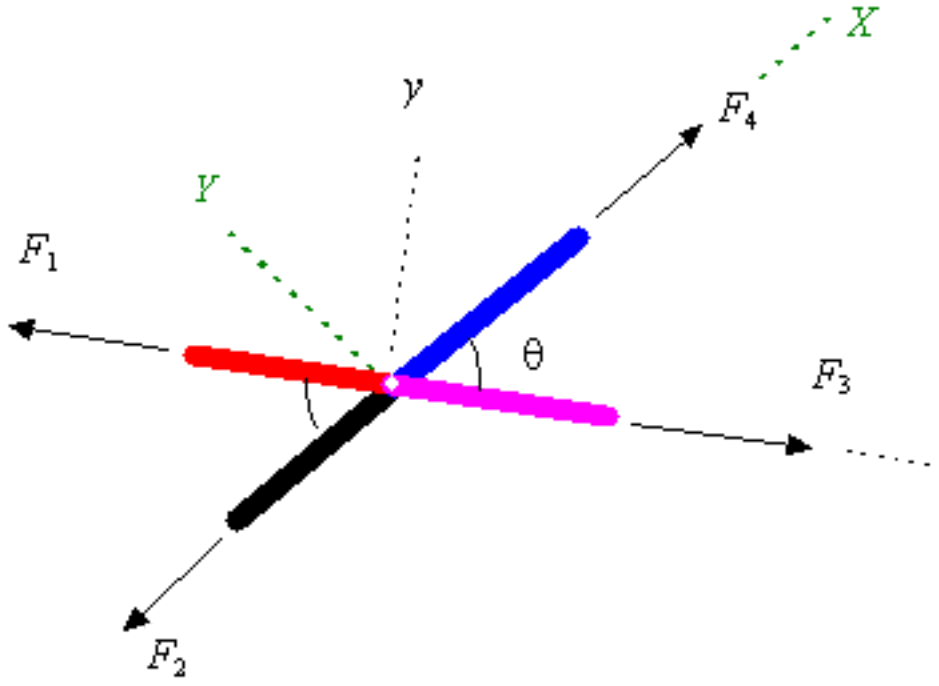
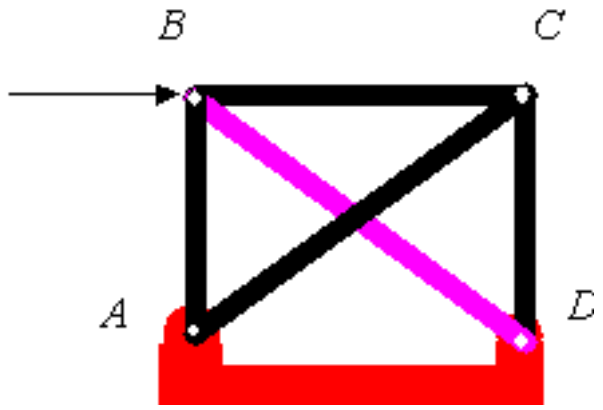
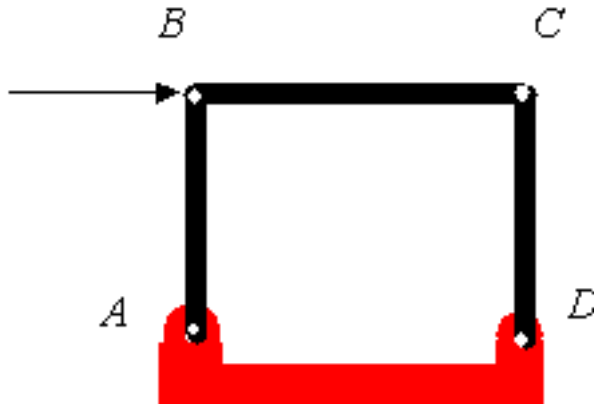
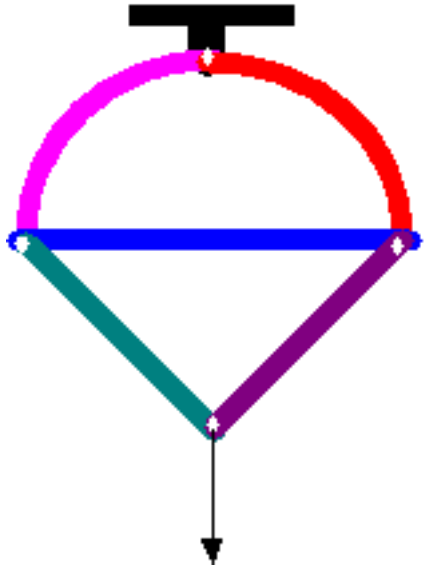


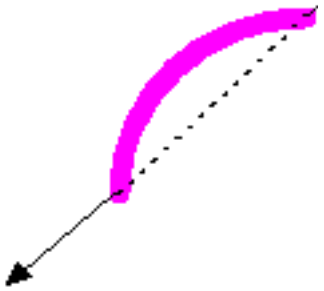
By summing forces along the y-direction one will get F2=F4, and by summing forces along the Y‑direction one will get F1=F3.· Redundant members: Sometimes a structure contains one or more redundant members. These members must be removed from the truss, otherwise one will have an insufficient number of equations to solve for the unknown member forces. Slender members are not very useful in compression since they buckle and, as a result, lose their load carrying capability. For example, in the following truss one of the two members AC or BD is redundant. To solve the problem, we remove member BD which will go into compression as a result of the applied loading (i.e., the diagonal AC will have to increase in length and the diagonal BD will have to decease in length for the structure to bend to the right). If we did not remove this member we would have 9 unknowns (five member loads and four support reactions) and only 8 equations (two for each joint).



· Mechanisms: Sometimes there is too much freedom in a structure. For example, the following structure cannot carry any load since it will collapse under the load.







Read more:
http://www.engineersdaily.com/2011/01/3-methods-for-truss-analysis.html

3) Give some applications of trusses.
Ans: Trusses are used in a broad range of buildings, mainly where there is a requirement for very long spans, such as in airport terminals, aircraft hangers, sports stadia roofs, auditoriums and other leisure buildings. Trusses are also used to carry heavy loads and are sometimes used as transfer structures. This article focuses on typical single storey industrial buildings, where trusses are widely used to serve two main functions:

-To carry the roof load
-To provide horizontal stability.

Read more : https://www.steelconstruction.info/Trusses

4) What are the types of trusses ?
Ans : 1) Pratt truss ('N' truss)
2) Warren truss

3)North light truss
4) Saw-tooth truss
5)Fink truss

5) If a truss is in equilibrium, then each of its joints must be in equilibrium.
Ans: True

6) Truss members are all straight two-force members lying in the same plane.
Ans : False, Explanation: If all the members connected at the ends do not lie in a same plane then the structure (truss) is called as space truss. If the members lie in the same plane, then the structure is called plane truss.

7)The flexibility matrix method is used to analyze statically indeterminate planar trusses.
Ans: True