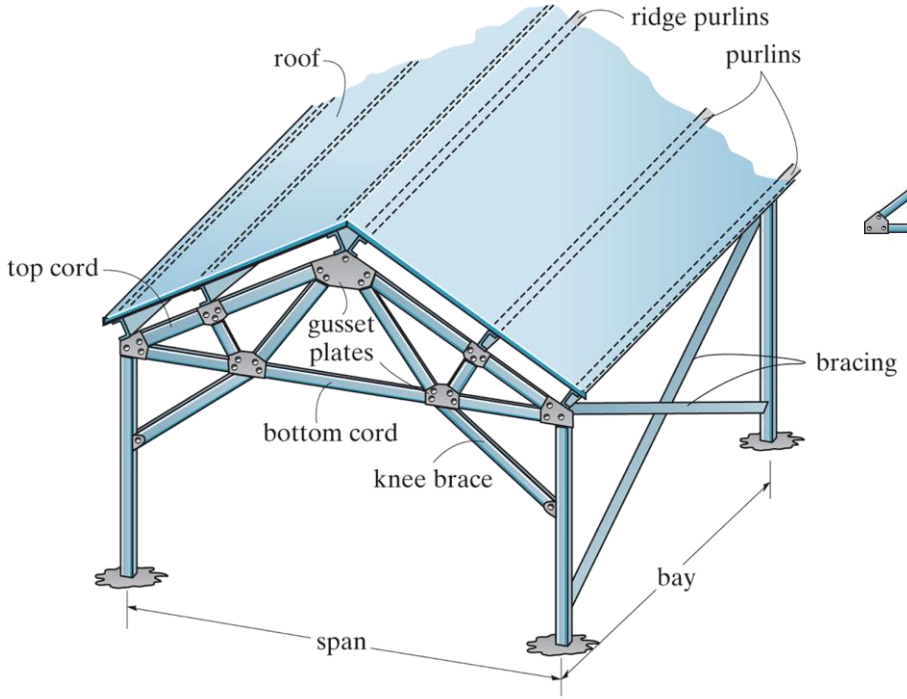
جامعة بيرزيت
BIRZEIT UNIVERSITY

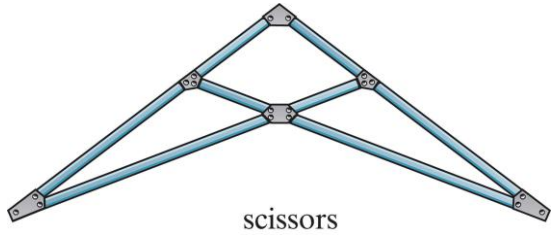
Dr. Khalil M. Qatu

Analysis of statically determinate trusses

Types of trusses

- Roof Trusses

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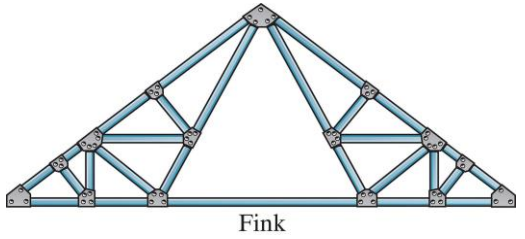
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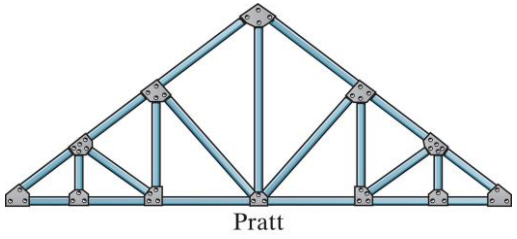
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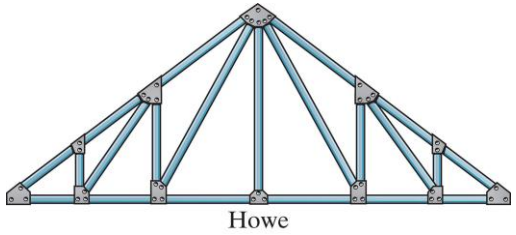
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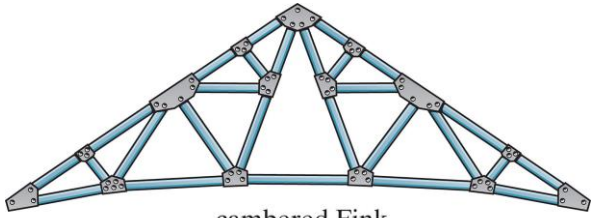
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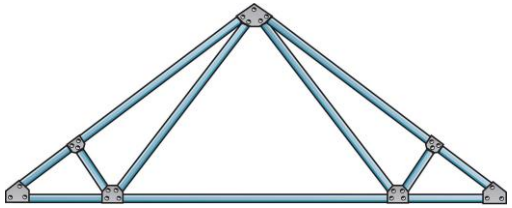
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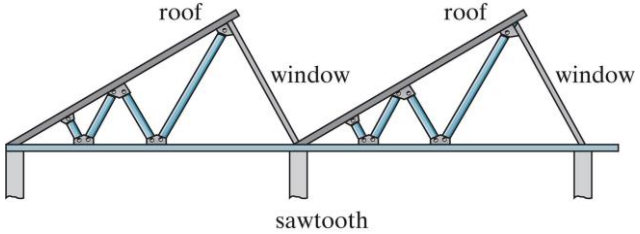

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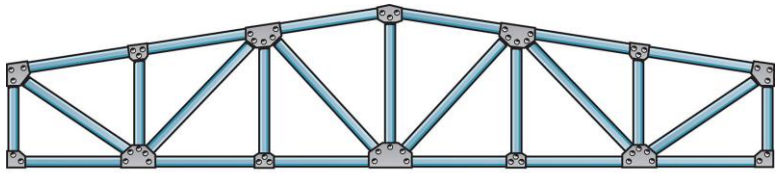
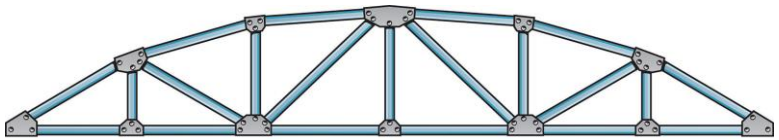
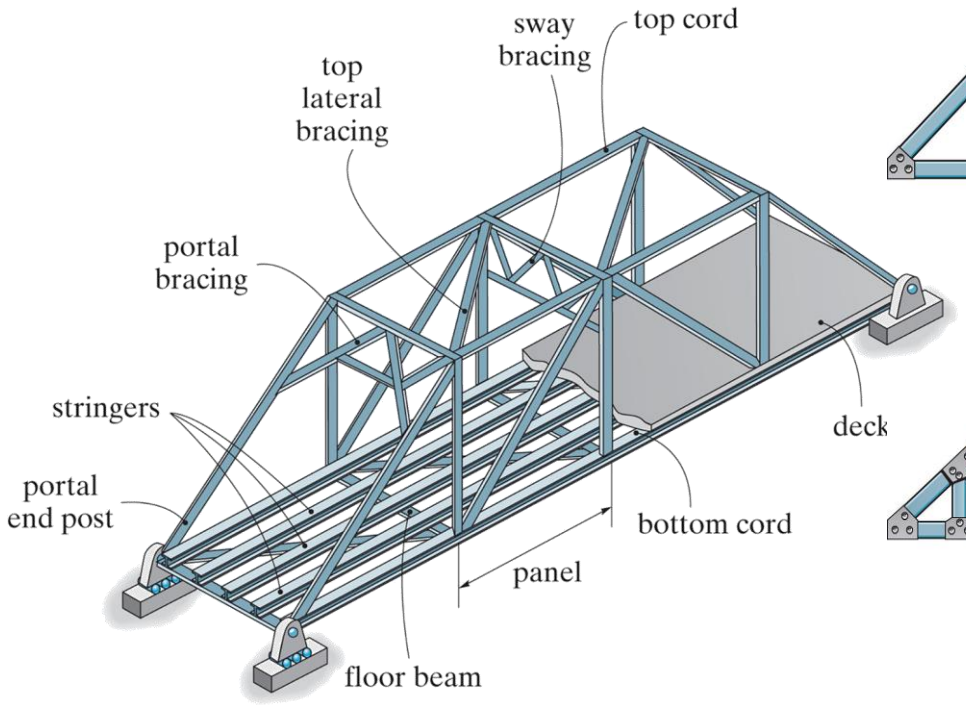
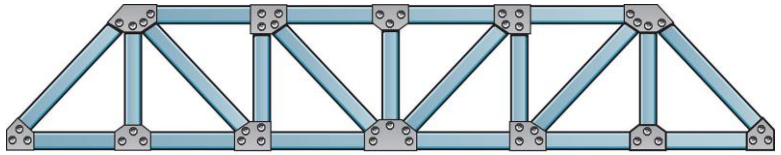

Warren (with verticals)


bowstring

Types of trusses

- Bridge Trusses

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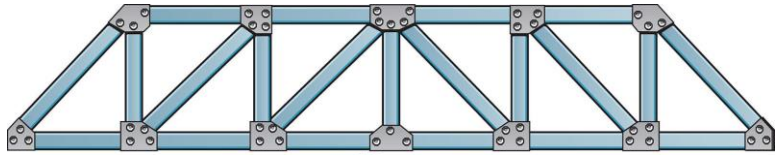
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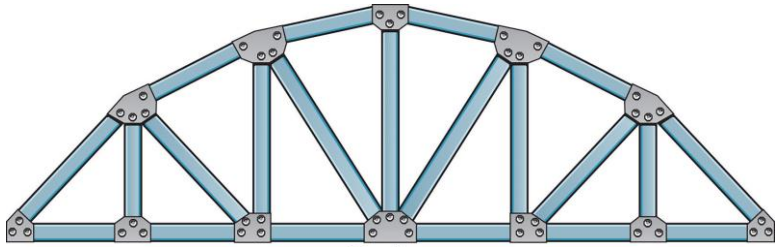
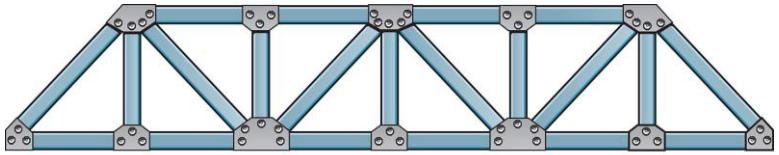
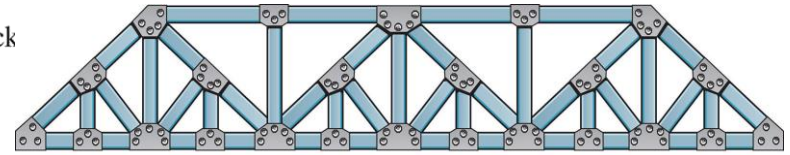
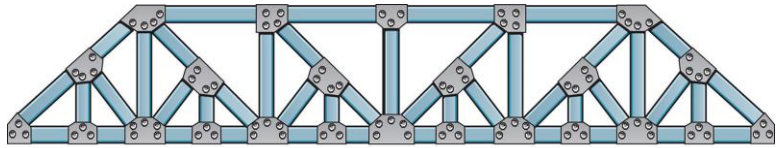
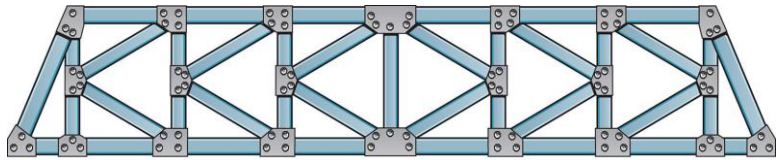

Parker


Warren (with verticals)


subdivided Warren


Baltimore

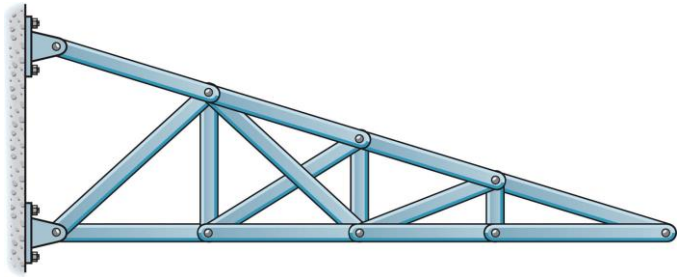

K-truss

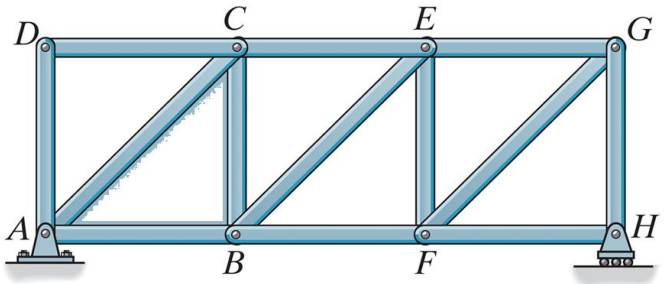
Determinacy and stability of trusses

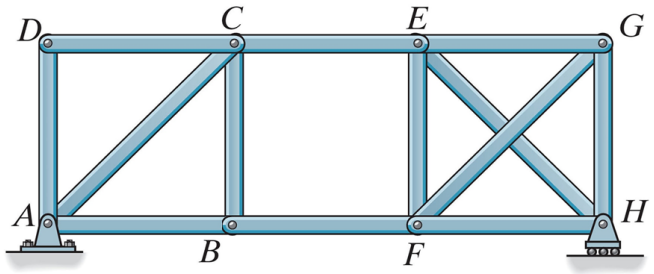
- Criteria for the static classification of structures can be stated as
  - If there are more equations than there are unknowns → the structure is statically unstable
  - If there is the same number of equations as unknowns → the structure is statically determinate
  - If there are fewer equations than unknowns → the structure is statically indeterminate

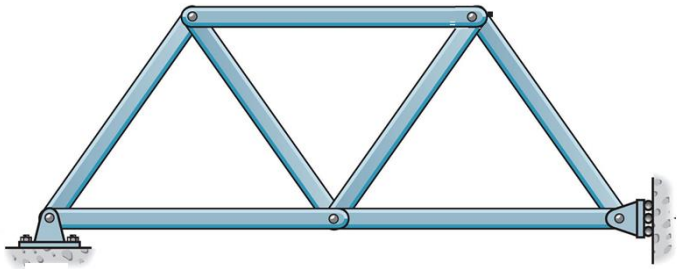
$b + r < 2j$	unstable
$b + r \geq 2j$	unstable if truss support reactions are concurrent or parallel or if some of the components of the truss form a collapsible mechanism

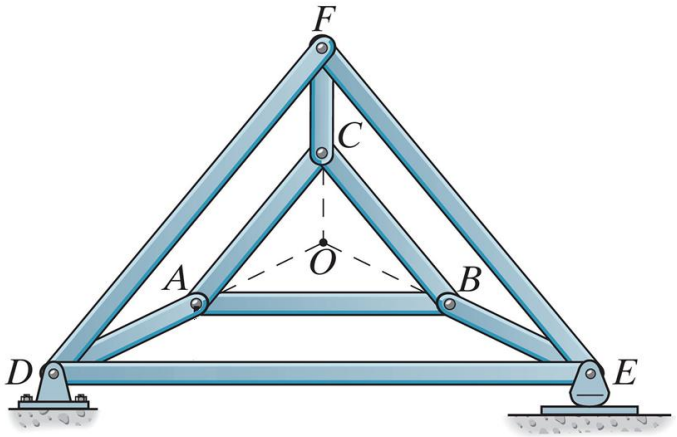
$b + r = 2j$	statically determinate
$b + r > 2j$	statically indeterminate





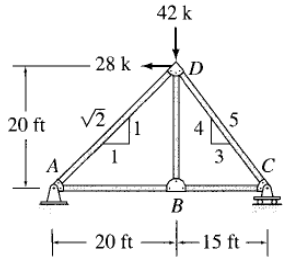


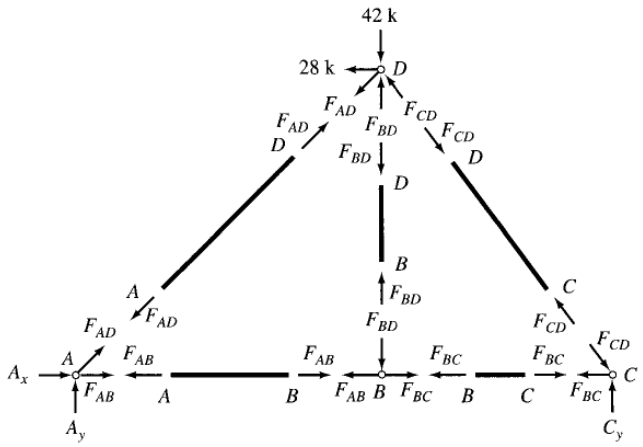


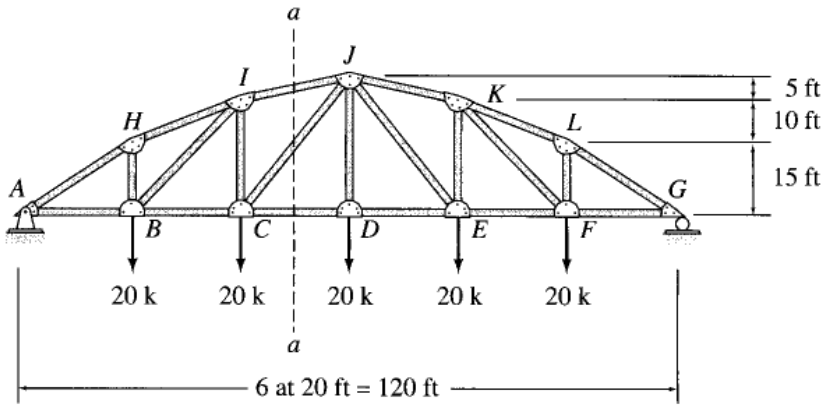


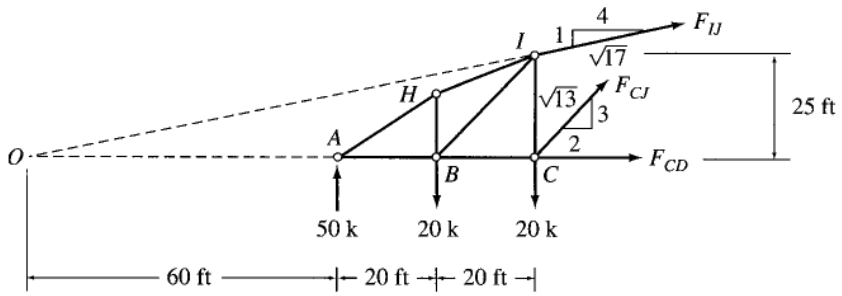
Analysis of Trusses

- There are two main methods to analyze statically determinate trusses
  - Method of joints, helpful to identify zero force members
  - Methods of sections



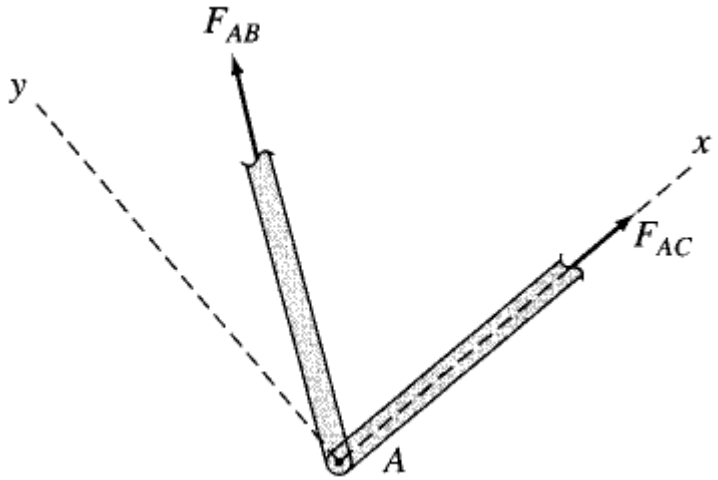


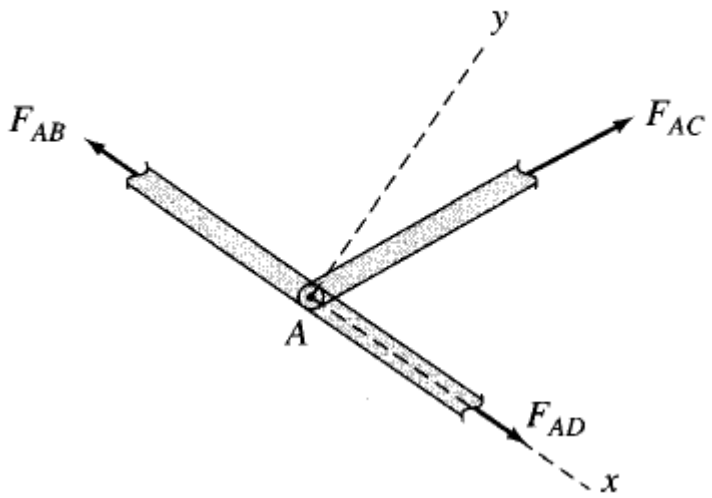




Analysis of Trusses

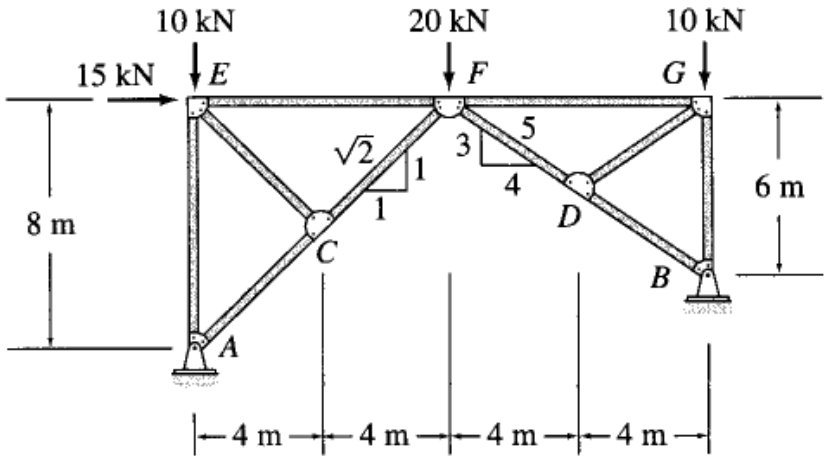
- Zero Force members
  - If only two noncollinear members are connected to a joint that has no external loads or reactions applied to it, then the force in both members is zero.
  - If three members, two of which are collinear, are connected to a joint that has no external loads or reactions applied to it, then the force in the member that is not collinear is zero.

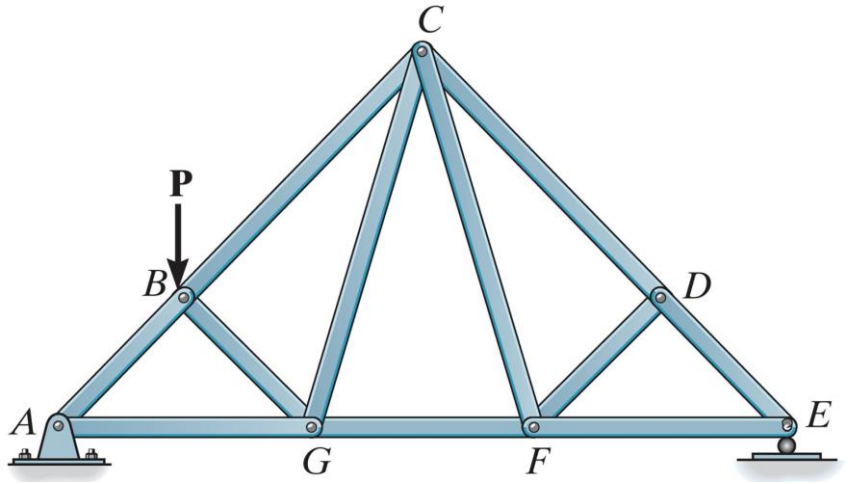


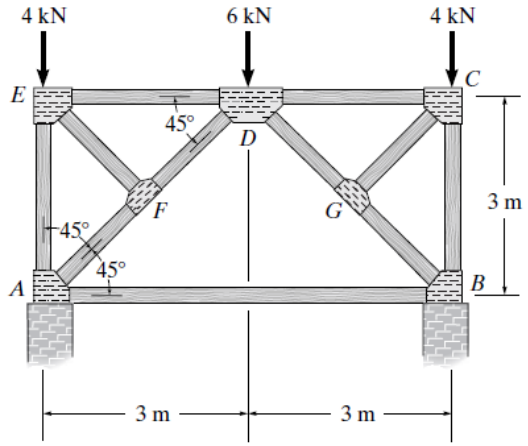


Analysis of Trusses

- Zero Force members

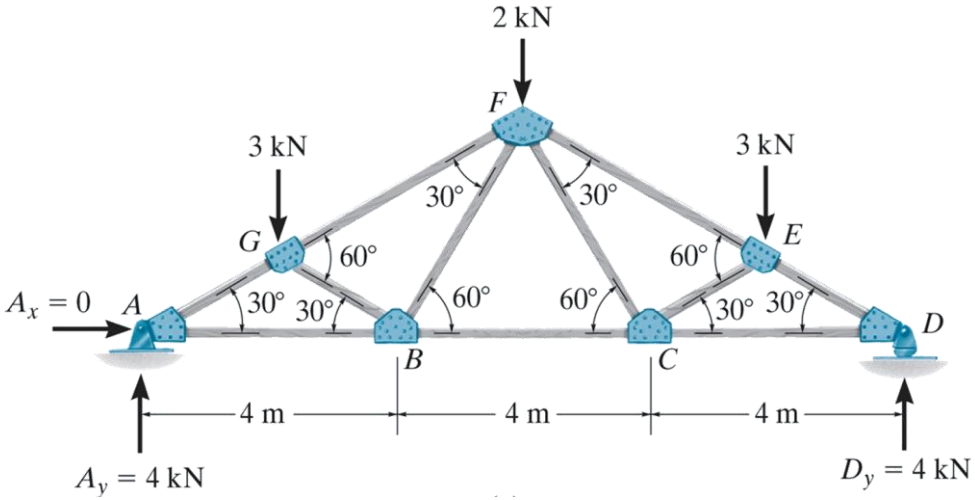


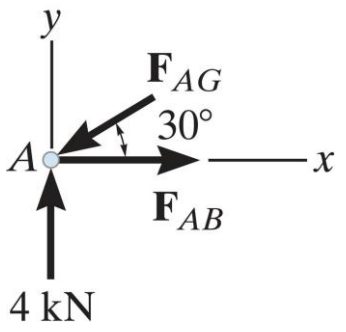


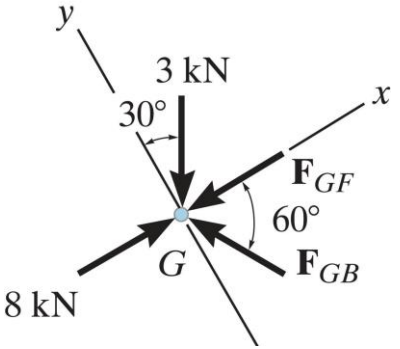


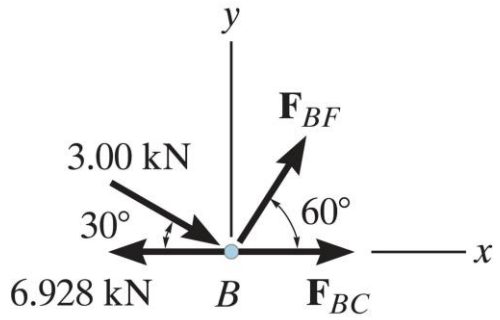
Analysis of Trusses

- Method of Joints
  1) Check the truss for static determinacy
  2) Identify by inspection any zero-force members of the truss.
  3) Determine the slopes of the inclined members (except the zero-force members) of the truss.
  4) Draw a free-body diagram of the whole truss, showing all external loads and reactions. Write zeros by the members that have been identified as zero-force members.
  5) Examine the free-body diagram of the truss to select a joint that has no more than two unknown forces (which must not be collinear) acting on it.
  6) Determine reactions by applying the three equations of equilibrium to the free body of the whole truss; then select a joint with two or fewer unknowns and go to the next step.
  7) Draw a free-body diagram of the selected joint, showing tensile forces by arrows pulling away from the joint and compressive forces by arrows pushing into the joint. It is usually convenient to assume the unknown member forces to be tensile.
  8) Determine the unknown forces by applying the two equilibrium equations $\sum f_x = 0$ and $\sum f_y = 0$.
  9) A positive answer for a member force means that the member is in tension, as initially assumed, whereas a negative answer indicates that the member is in compression.









Analysis of Trusses

- Method of Sections
  1) Select a section that passes through as many members as possible whose forces are desired, but not more than three members with unknown forces.
  2) we should select the portion that will require the least amount of computational effort in determining the unknown forces.
  3) select the portion of the truss for analysis of member forces that has the least number of external loads and reactions applied to it.
  4) Draw the free-body diagram of the portion of the truss selected, showing all external loads and reactions applied to it and the forces in the members that have been cut by the section.
  5) The unknown member forces are usually assumed to be tensile and are, therefore, shown on the free-body diagram by arrows pulling away from the joints.
  6) Determine the unknown forces by applying the three equations of equilibrium.