

# Frames and Machines

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# Frames and Machines



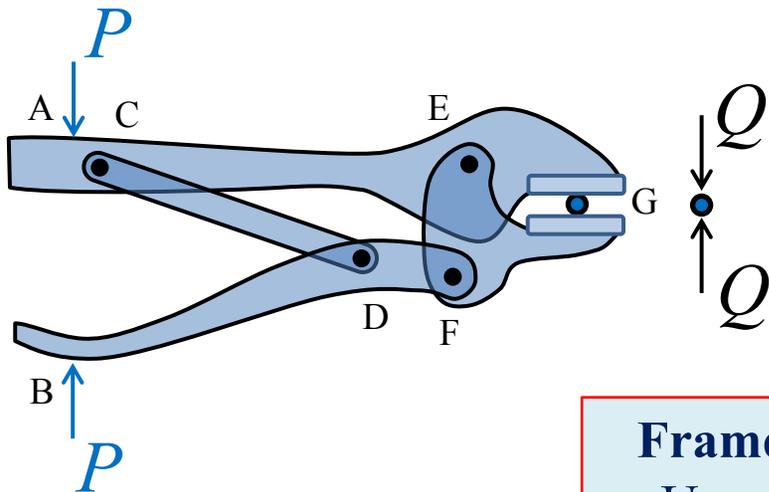
Machine



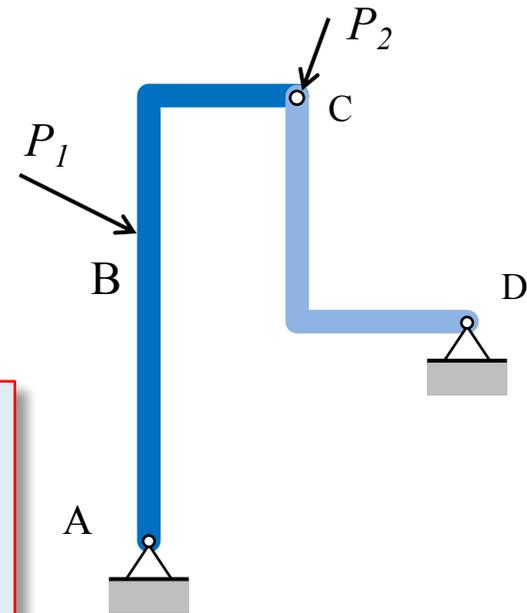
Frame

# Frames versus Machines

## Machine



## Frame



### Machine

- Input force ( $P$ ) and Output force ( $Q$ )
- Usually held in equilibrium

### Frames and Machines

- Usually contain multiple “pieces”;
- Contain at least one multi-force member;
- May contain two-force members;
- Method of analysis is similar.

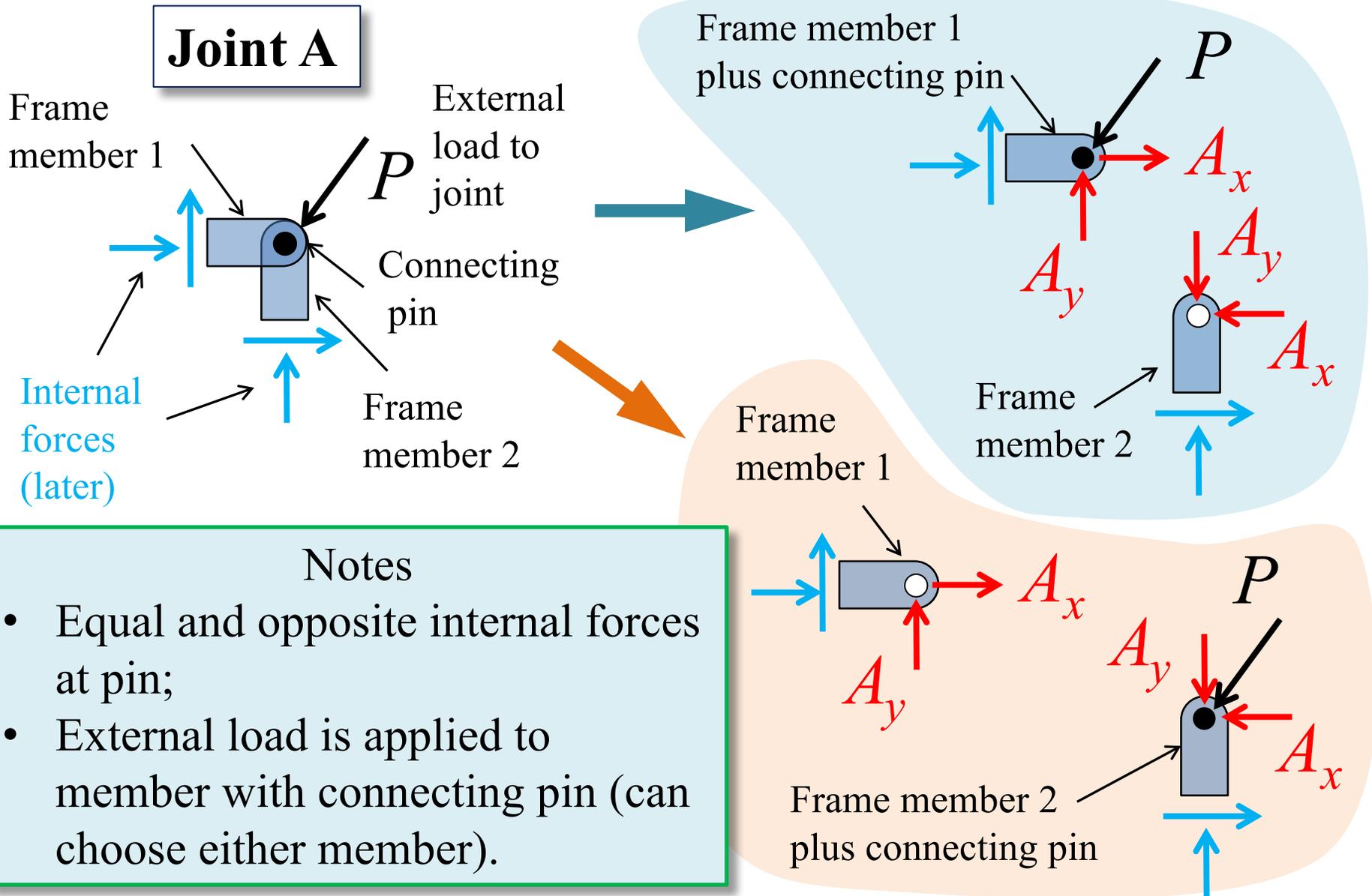
### Frame

- Usually unstable without supports
- Usually subjected to multiple loads

# General Procedure for the Analysis of Frames and Machines

- Draw a **Free Body Diagram (FBD)** of the entire structure isolated from its supports and apply equations of equilibrium (usually this step is not required for machines);
- Draw a **Free Body Diagram (FBD)** of each piece of the structure;
  - Identify pieces that are two-force members,
  - When separating pieces, forces at connections are equal and opposite on each piece,
  - Show all known support reactions from the previous step.
- Apply Equations of Equilibrium to each piece and solve for all unknown forces;
  - Usually there is one piece that is easiest to start the analysis,
  - Analyze the next piece and show all known forces found from the previous analyses,
  - Repeat this step until all unknown forces are found,
  - If the last piece is not in equilibrium, most likely there was an error made in the preceding analyses.

# FBDs of Members Cut at Internal Pin Connections



## Notes

- Equal and opposite internal forces at pin;
- External load is applied to member with connecting pin (can choose either member).