Pinned Frames

2-Force Members
Multiforce Members
Stability
Timber Frames

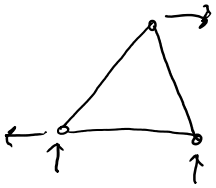


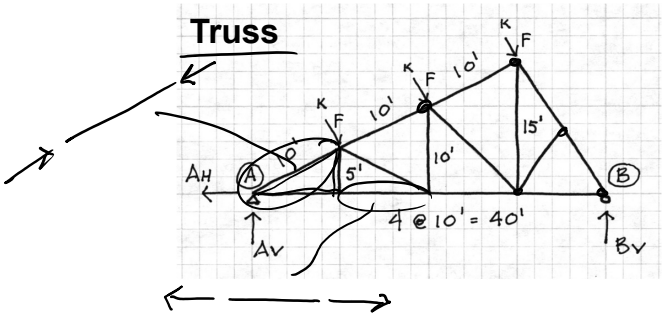
Das Spitzhäuschen. Marktplatz. Bernkastel-Kues

Pinned Frame vs. Truss

Trusses:

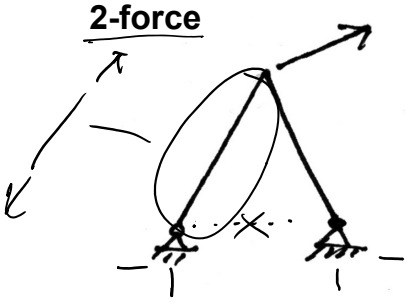
- 2-force members
- ridged bodies

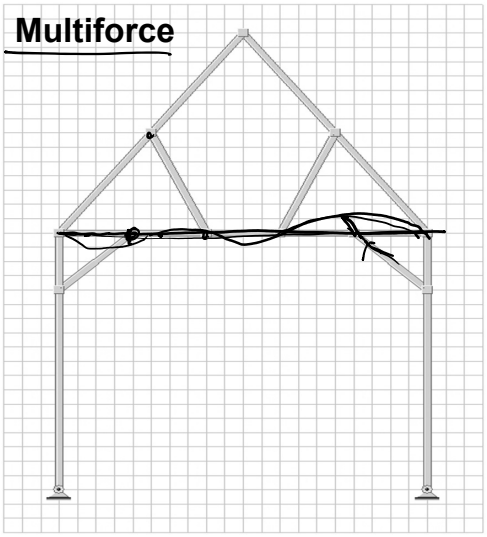




Pinned Frames:

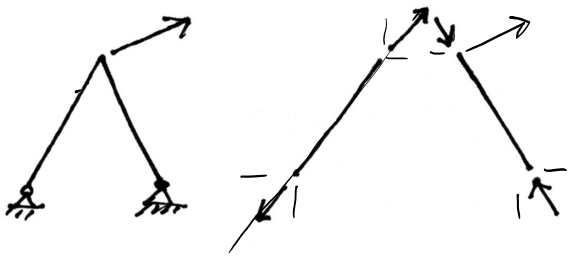
- 2-force or multiforce (axial or bending)
- ridged body or mechanism



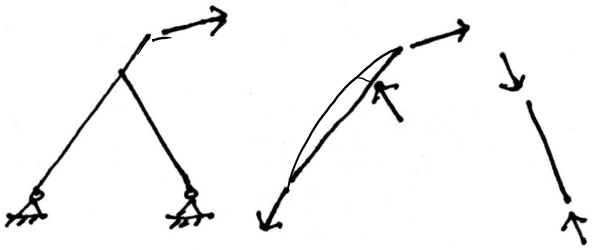


Frame Types

Frames with 2-force members
(axial forces)



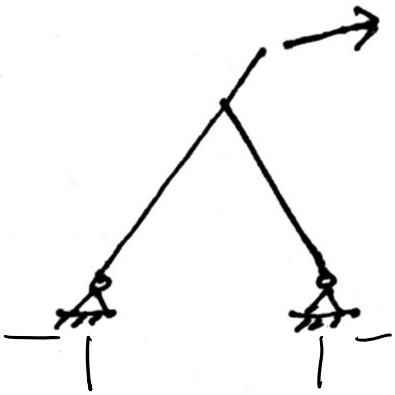
Frames with multiforce members
(bending + axial forces)



Rigidity

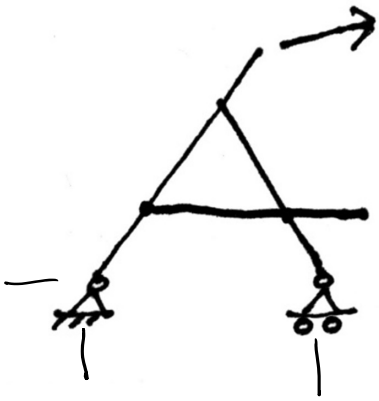
Nonrigid frames (require 4 or more reaction components for stability)

Without supports they collapse.



Rigid frames (only require 3 reaction components)

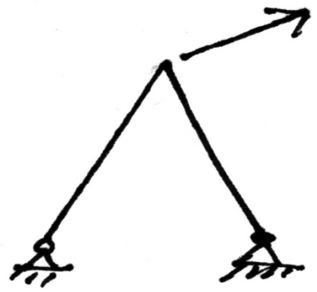
Remain a rigid body even without supports.

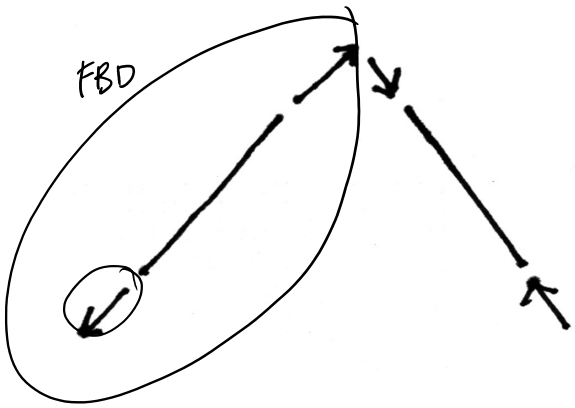


2-Force Member Frames

Procedure

1. Solve external supports
   - FBDs
   - Simultaneous equations
2. Cut FBD of each member
3. Solve member forces

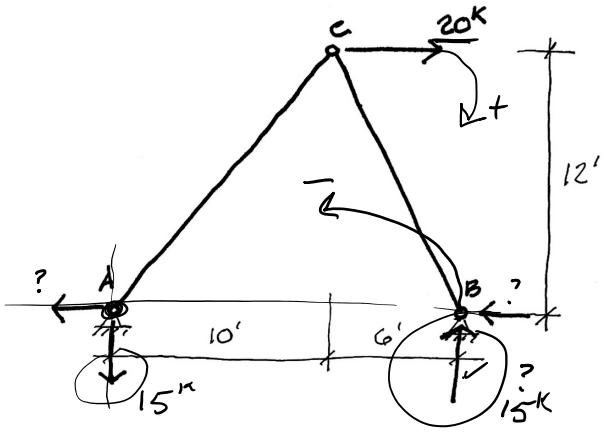




2-Force Member Frames

Analysis

1. Solve external supports
   - FBDs
   - Simultaneous equations



$\Sigma M_{@A} = 0 = 20(12) - B_V(16)$

$B_V = 15^K$

$\Sigma F_V = 0 = -A_V + B_V$

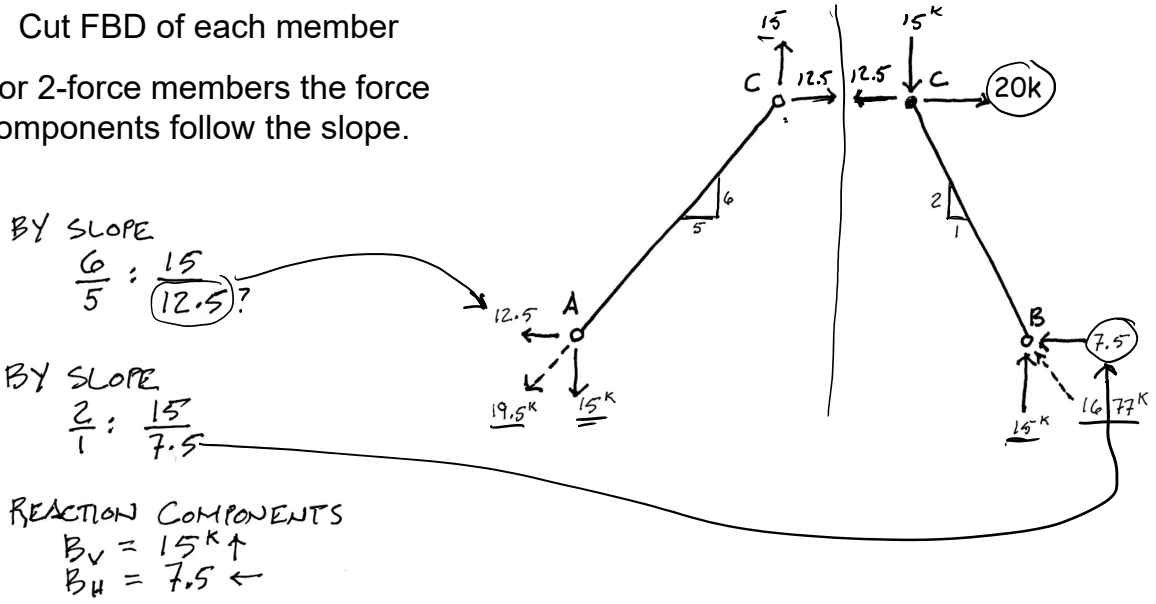
$A_V = 15^K$

2-Force Member Frames

Analysis

2. Cut FBD of each member

For 2-force members the force components follow the slope.



2-Force Member Frames

Analysis

3. Check member forces and balance forces.

LEFT FBD

$\Sigma F_V = 0 = -15 + C_V$

$C_V = 15^K$

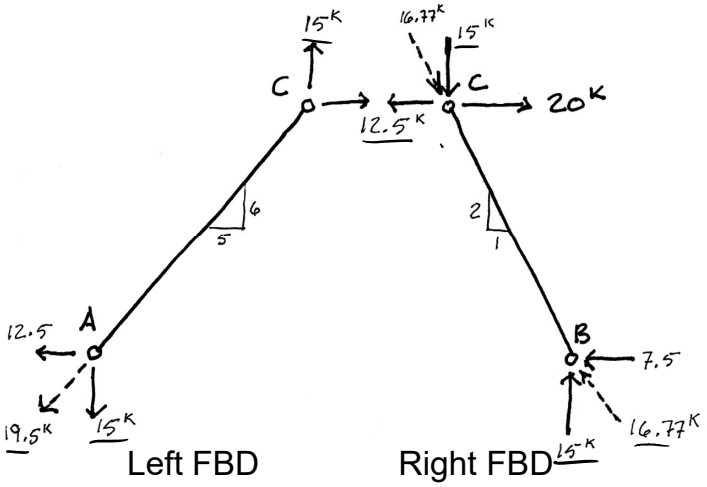
RIGHT FBD

$\Sigma F_V = 0 = 15^K - C_V$

$C_V = 15^K$

$\Sigma F_H = 0 = 20^K - 7.5 - C_H = 0$ (12.5)

$C_H = 12.5^K$



Left FBD Right FBD

2-Force Member Frames

Find the force in the shear legs assuming a point load of 20 **lbs**.
Members **2:1 slope** (63.4° at base)

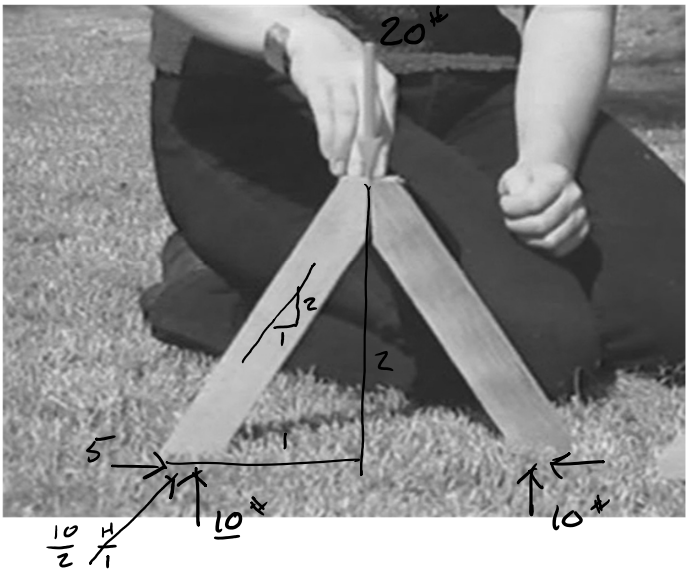
Determine the horizontal and vertical end reactions.

Reactions:
Horizontal _____ LBS
Vertical _____ LBS

Axial member force:
_____ LBS

tension or compression?

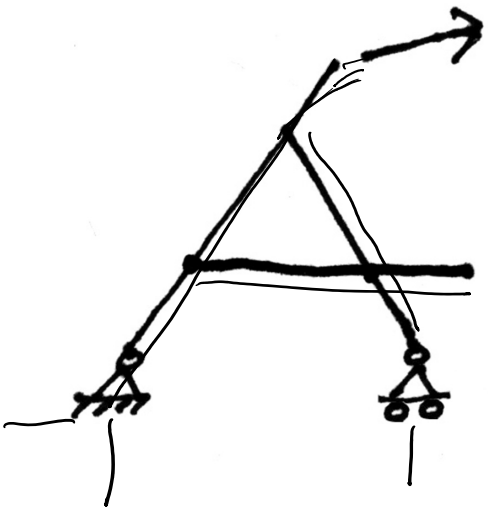
_____



Multiforce Member Frames

Procedure

1. Solve external supports
2. Cut FBD of each member
3. Solve forces at joints.
4. Some members will be multiforce, they will be in bending.



Analysis

1. Solve external supports

Get vertical components by summing moments.

$\Sigma M_{@A} = 0$

$+20^K(12') + 15^K(20') - B_V(20') = 0$

$B_V = 27^K \uparrow$

$\Sigma F_V = 0$

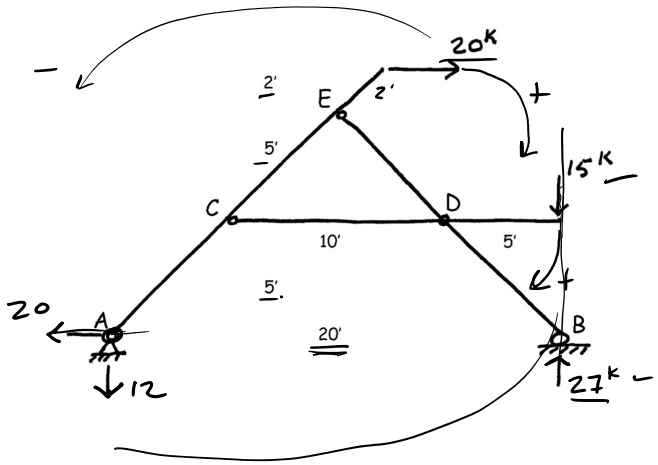
$-A_V - 15^K + 27^K = 0$

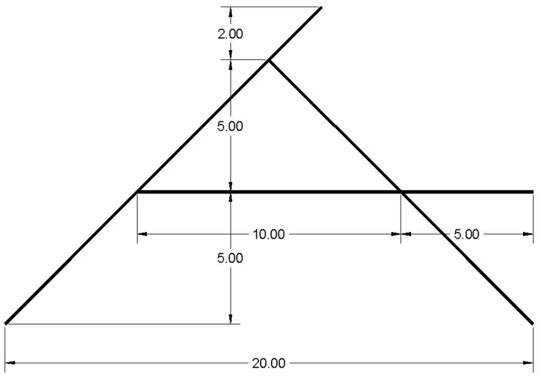
$A_V = 12^K \downarrow$

$\Sigma F_H = 0$

$-A_H + 20^K = 0$

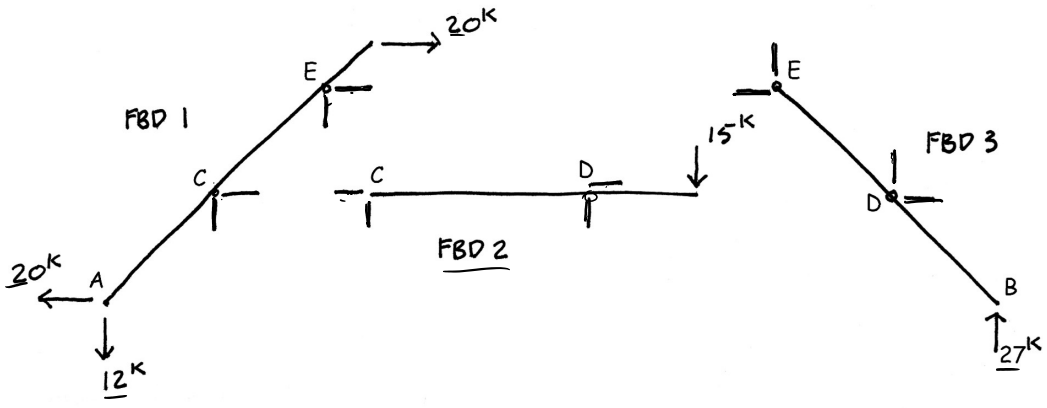
$A_H = 20^K \leftarrow$





Analysis

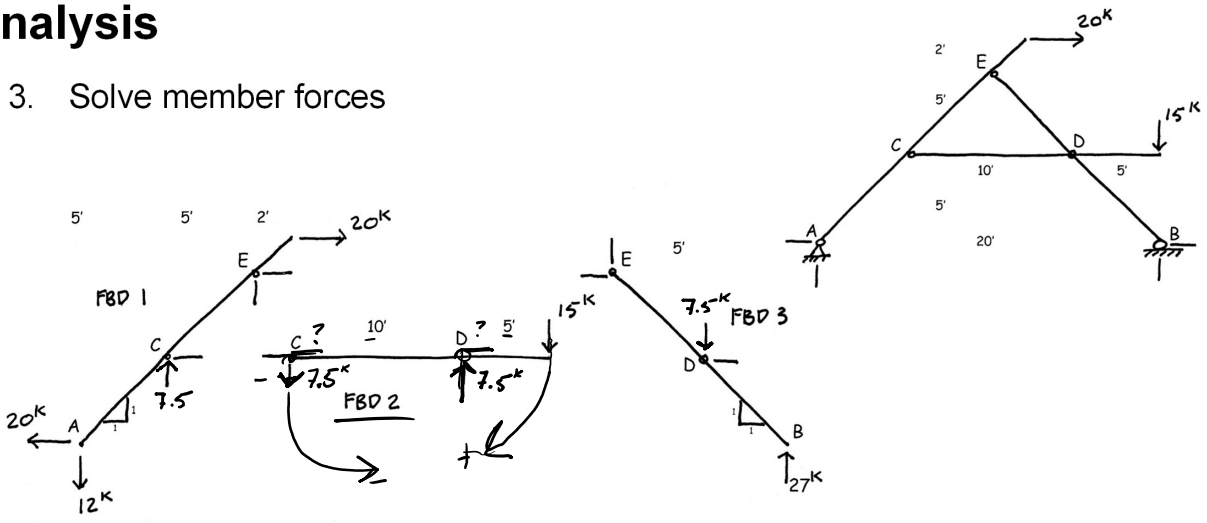
2. Cut FBD of each member



- Work between the FBDs using 3 equations of statics.
- End force components can be solved as axial and normal forces.
- The normal forces are “shear” forces and result in moments or “bending” forces.
- Not all systems are statically determinate and may then require other methods.

Analysis

3. Solve member forces



FBD 2

$\Sigma M_{@D} = 0 = -C_V(10') + 15^K(5')$

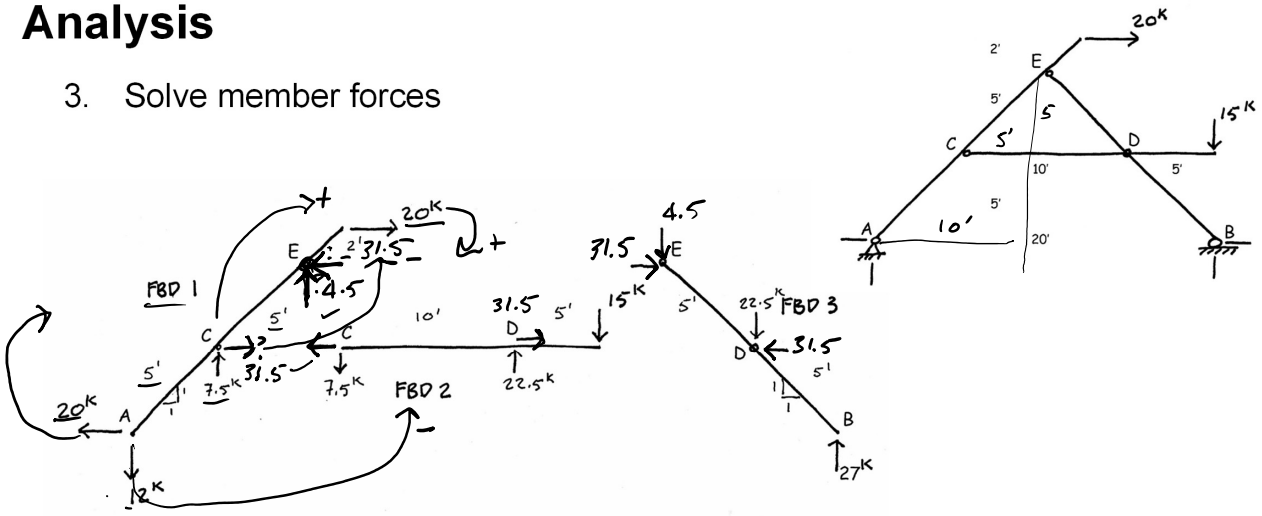
$C_V = 7.5^K$

$\Sigma F_y = 0 = -7.5^K + D_V - 15^K$

$D_V = 22.5^K$

Analysis

3. Solve member forces



FBD 1

$\Sigma M_{@E} = +20^K(10') - 12^K(10') + 7.5^K(5') - C_H(5') + 20^K(2') = 0$

$200 - 120 + 37.5 - C_H(5) + 40 = 0$

$+C_H = 31.5^K$

$\Sigma F_V = 0 = -12^K + 7.5^K + E_V\uparrow$

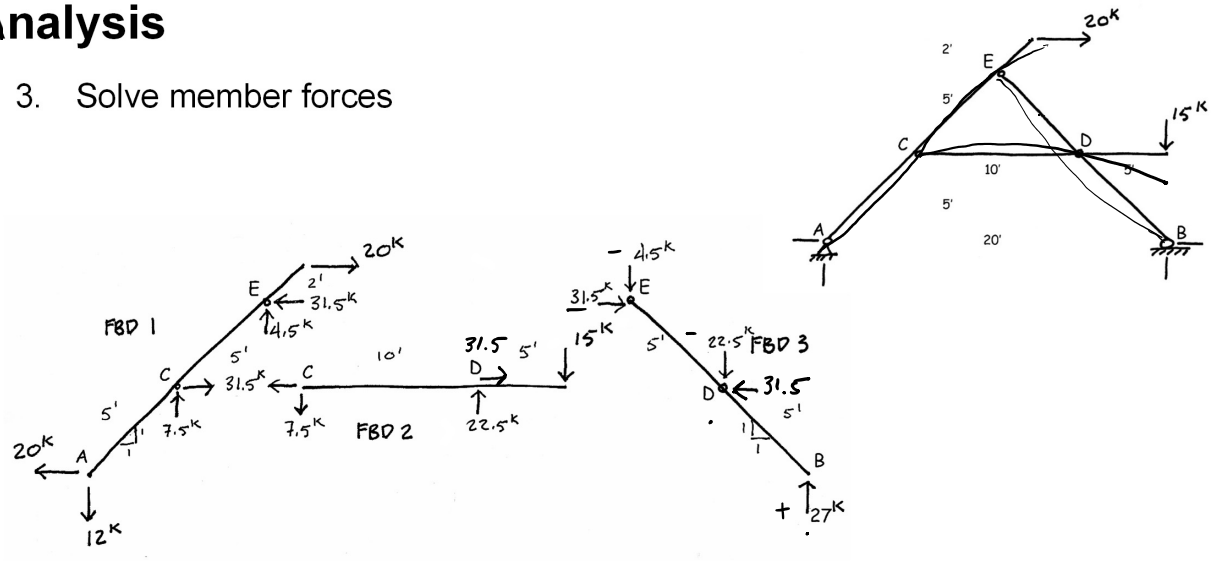
$E_V = 4.5^K$

$\Sigma F_H = 0 = -20^K + 31.5^K - E_H + 20^K$

$E_H = 31.5^K$

Analysis

3. Solve member forces



FBD 2

$\Sigma F_H = 0 = -31.5^K + D_H$

$D_H = 31.5^K$

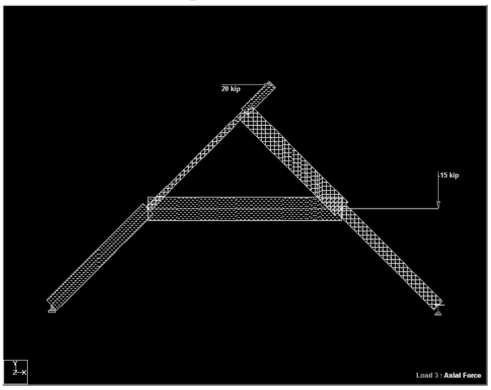
FBD 3 - CHECK

$\Sigma F_H = 31.5^K - 31.5^K = 0$ ✓

$\Sigma F_V = -4.5^K - 22.5^K + 27^K = 0$ ✓

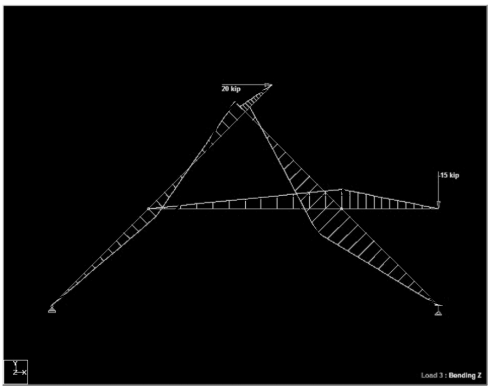
Analysis

4. Determine multiforce members

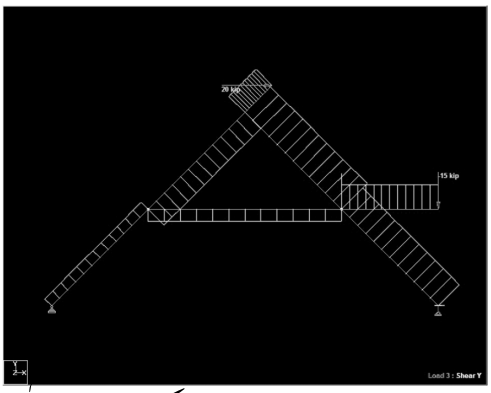


Axial Force

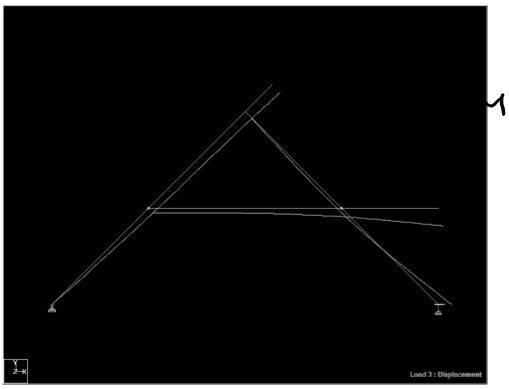
AND →



Bending Moment



Shear Force



DEFLECTION

Deflection

Riverbend Timber Framing

https://www.riverbendtf.com/



Marty Birkenkamp







Riverbend
TIMBER FRAMING

Pariseau Barn

Example



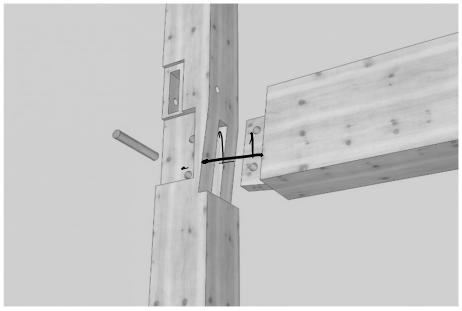


Pariseau Barn Example

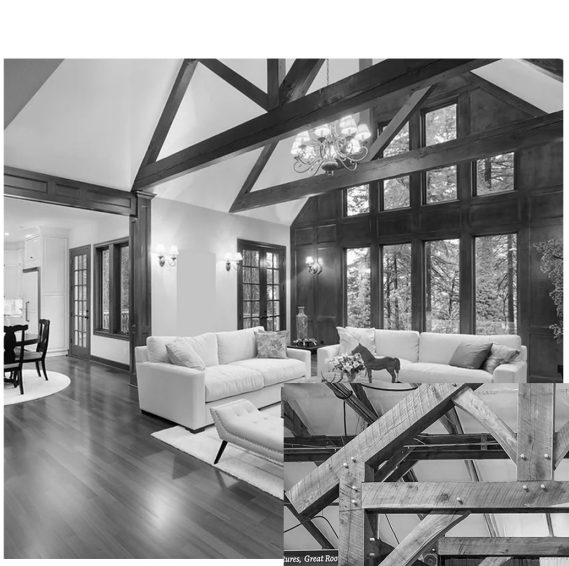




Motise and Tenon Joint



Highland Timber Framing - https://www.highlandtimberframing.com/







Highland Timber Framing - https://www.highlandtimberframing.com/

HIGHLAND TIMBER FRAMING & TREE SERVICES
An Ann Arbor Family Company Building Things *"Like They Used To."*
(734) 646-3650

HOME | TIMBER FRAMING | TREE SERVICES | ABOUT US | OUR BLOG | CONTACT US

Our Stock Pavilion Series

Are you looking for a backyard pavilion that will be beautiful and long-lasting? That won't look run down like the pavilions that big box stores sell? We now offer various timber frame pavilions in several stock sizes! All stock pavilions are offered in 4-post or 6-post configurations. We're happy to create one in your preferred size.

Browse The Collection Below



Queen Post Purlin Pavilions

Commonly used historically in covered bridges, this truss boasts greater spanning capabilities than its brother the king post truss. Featuring two posts connecting the rafters to the tie beam, it combines functionality, strength, and simple elegance. The two posts create a focal point, perfect for a large window in a great room, or the chimney of a fireplace.



King Post Rafter Pavilions

This is the simplest of the Highland Pavilion frames, with a heightened focus on simplicity and strength. It is based on the American timber framing tradition and boasts fewer joints than its sister frame the Queen Post Rafter Style.



Vaulted Purlin Pavilions

This truss is a Highland original, echoing techniques used in England in the high middle ages. It features struts transferring load from the rafters down to the posts. The continuous struts create a vaulted soaring effect for the onlooker found often in chapels.



Queen Post Rafter Pavilions

Commonly used historically in covered bridges, this truss features more complexity, timber, and strength than its brother the king post (Rafter style) truss. This frame is based on the American timber framing tradition and echoes common lines seen in 17th-19th century barns.