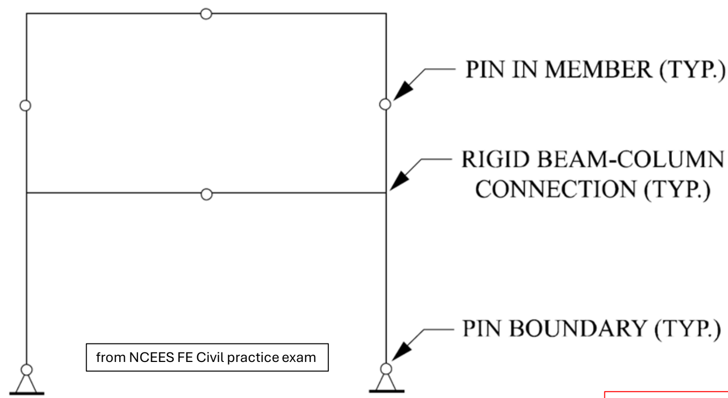
Sunghyun Park (sunghyun.park@ttu.edu)

Determine degree of indeterminacy



B

$\boxed{n + r + s - 2k}$

n: # of reactions
r: # of rigid connections
s: # of elements (members)
k: # of joints (hinge, rigid, support, free end, etc.)

- A. unstable
- B. stable and determinate
- C. indeterminate one degree
- D. indeterminate two degrees

Determine degree of indeterminacy

$\boxed{n + r + s - 2k}$

n: # of reactions
r: # of rigid connections
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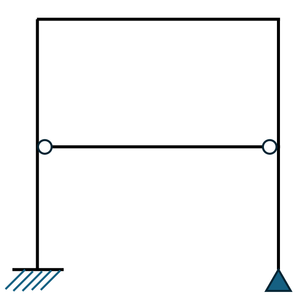
k: # of joints (hinge, rigid, support, free end, etc.)



3 degrees indeterminate

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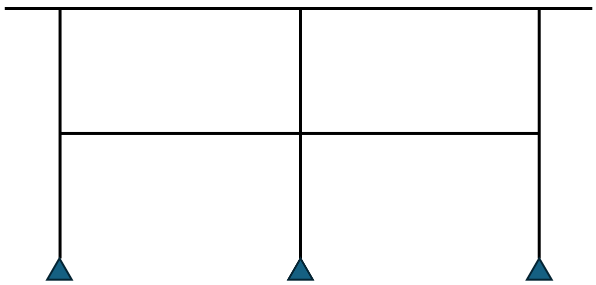
Determine degree of indeterminacy

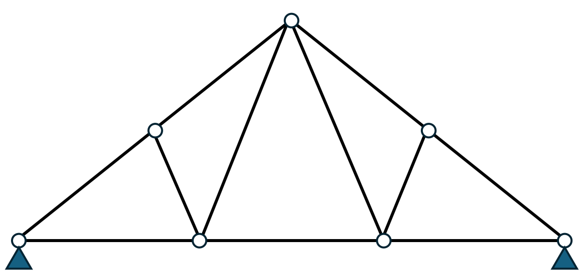


n + r + s -2k

n: # of reactions
r: # of rigid connections
s: # of elements (members)
k: # of joints (hinge, rigid, support, free end, etc.)

9 degrees indeterminate

Determine degree of indeterminacy



n + r + s -2k

n: # of reactions
r: # of rigid connections
s: # of elements (members)
k: # of joints (hinge, rigid, support, free end, etc.)

0 (Stable & determinate)

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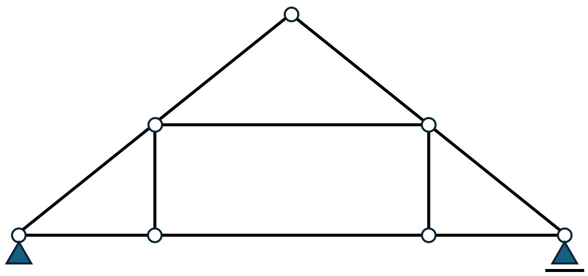
Determine degree of indeterminacy

n + r + s -2k

n: # of reactions
r: # of rigid connections
s: # of elements (members)
k: # of joints (hinge, rigid, support, free end, etc.)

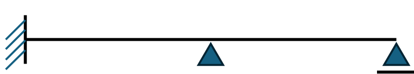


-1 (Unstable)

Determine degree of indeterminacy

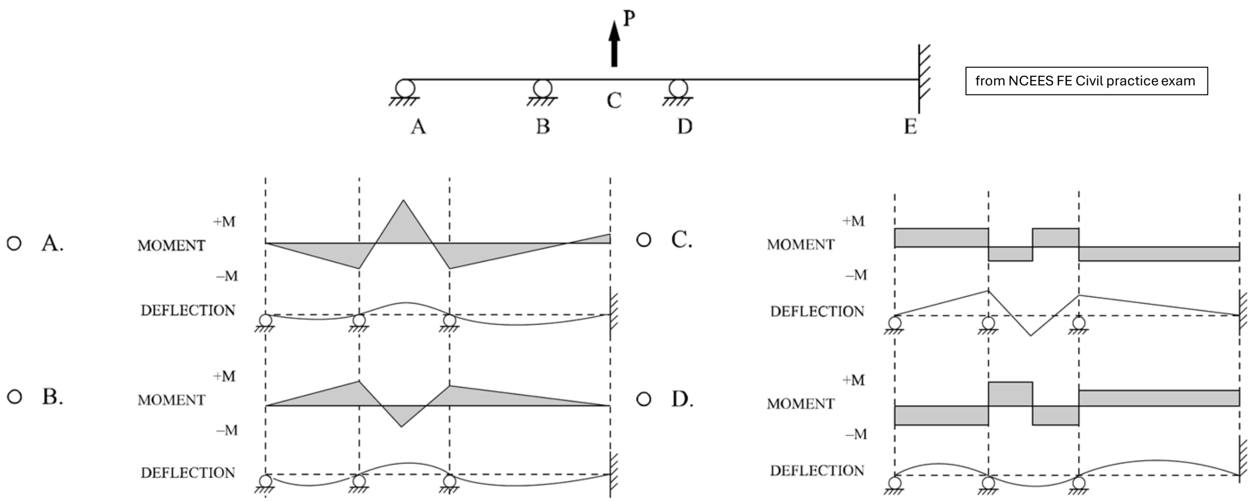
n + r + s -2k

n: # of reactions
r: # of rigid connections
s: # of elements (members)
k: # of joints (hinge, rigid, support, free end, etc.)



3 degrees indeterminate

Moment diagram & deflection shape



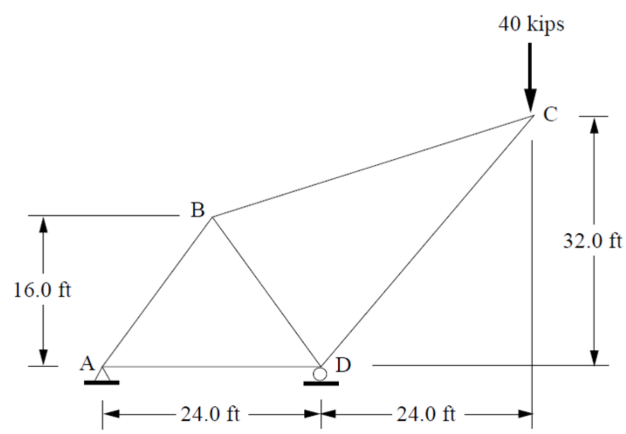
No correct answer: B but needs to have moment @ E

Deflection – Unit Load Method

The 40-kip vertical load at Joint C in the steel truss shown below produces the forces given in the accompanying table. The cross-sectional area of each member is 4.0 in^2, and the length of each member is given in the table. The elastic modulus of steel is 29,000 ksi. The downward vertical displacement (in.) of Joint C is most nearly:

Member	Force, *F* (kips)	Length, *L* (in.)
AB	50.0	240
BC	49.2	473
CD	–75.0	480
AD	–30.0	288
BD	–25.0	240

from NCEES FE Civil practice exam



Deflection – Unit Load Method

Member	Force, F (kips)	Length, L (in.)
AB	50.0	240
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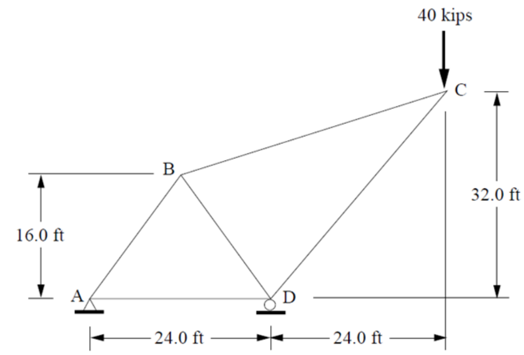


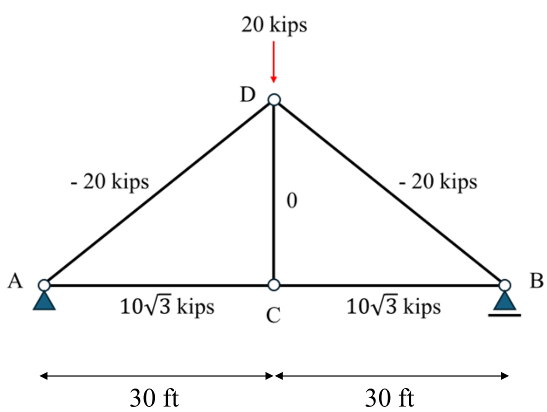
Member	Force, F (kips)	Length, L (in.)	$\frac{FL}{AE}$	f	$f \cdot \frac{FL}{AE}$
AB	50.0	240	0.1034	1.25	0.1292
BC	49.2	473	0.2008	1.231	0.2472
CD	–75.0	480	–0.3103	–1.875	0.5818
AD	–30.0	288	–0.0745	–0.75	0.0559
BD	–25.0	240	–0.0517	–0.625	0.0323

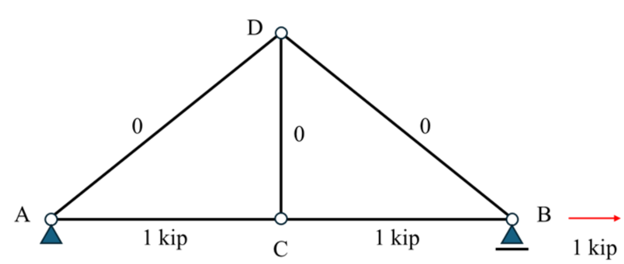
$$\boxed{\delta = \sum f \frac{FL}{EA}}$$

1.046 in

Horizontal Deflection @B?

$$\boxed{\delta = \sum f \frac{FL}{EA}}$$





$A = 2\ in^2, \qquad E = 29{,}000\ ksi$

0.215 in

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Steel Column

The proportional limit and modulus of elasticity for a material are 40 ksi and 30,000 ksi, respectively. A square column made from this material has a moment of inertia equal to 6.8 $in.^4$ and an area equal to 9 in^2. Assume a pin-pin connected column so that the effective length factor K is equal to 1.0. The **maximum** column length (in.) based on the Euler formula is most nearly:

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- A. 42.2
- B. 74.8
- C. 195.0
- D. 224.3

B

Steel Beam

The W21 × 57 steel beam shown in the figure has its compression flange laterally braced at the one-third points over its full length. Assume F_y = 50 ksi and C_b = 1.0 for the critical segment. The maximum factored load w_u (kips/ft) that the beam can carry for this length is most nearly:

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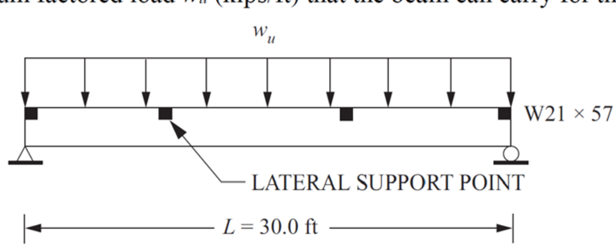


B

- A. 2.658
- B. 3.360
- C. 4.302
- D. 4.778

Beam Behavior – Limit States

Nominal flexural strength (M_n) is determined by considering the following limit states:

1. Local Buckling
   - Flange local buckling (FLB)
   - Web local buckling (WLB)

2. Lateral torsional buckling (LTB)

3. Development of a fully-plastic cross-section (M_p)

   Failure by excessive deformation

Computing M_n For Uniform Moment ($C_b = 1$)

- If $L_b \leq L_p$

$$M_n = M_p = Z_x F_y$$

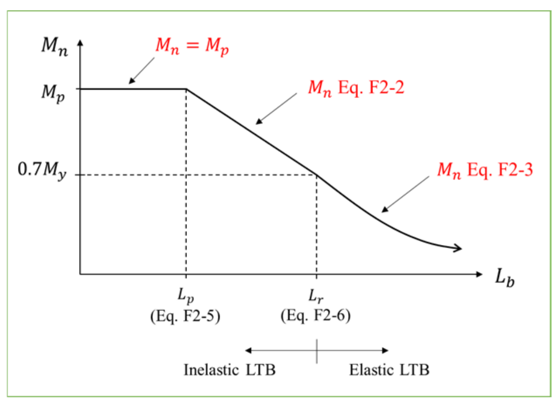
- If $L_p < L_b \leq L_r$

$$M_n = M_p - (M_p - 0.7M_y)\left(\frac{L_b - L_p}{L_r - L_p}\right)$$

- If $L_b > L_r$

$$M_n = F_{cr} S_x$$

$$F_{cr} = \frac{\pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2}\sqrt{1 + 0.078\frac{J}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2}$$



RC Beam

A reinforced concrete beam is subjected to a factored moment M_u = 648 ft-kips. For concrete, f'_c = 4,000 psi. For steel, f_y = 60,000 psi. The beam is reinforced with eight #8 bars in two rows, positioned as shown in the figure. Assume that ϕ = 0.90. The minimum adequate overall width b for this beam is most nearly:

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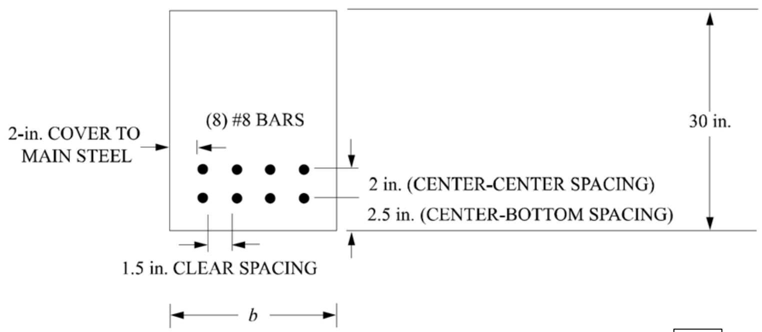

D

- A. 10
- B. 12
- C. 13
- D. 15

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CE 129
Tuesdays/Thursdays 12:30 pm – 2:00 pm