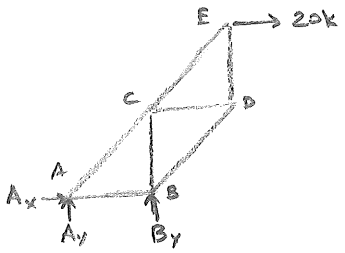
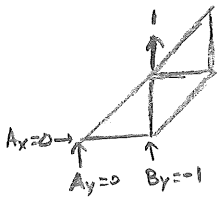
Homework 5 Problem 1

Real



Virtual for Δ_{cy}



a)

Member	N (k) (axial force (real))	n (k) (axial)	L (ft)	A (in.²)	E (ksi)
AB	-20	0	16	3	29000
AC	56.57	0	$16\sqrt{2}$	3	
BC	-20	1	16	3	
BD	-28.28	0	$16\sqrt{2}$	5	
CD	20	0	16	5	
CE	28.28	0	$16\sqrt{2}$	5	
DE	-20	0	16	5	

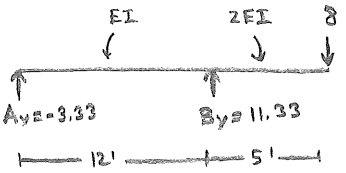
$$(1k)\,\Delta_{cy} = \sum \frac{NnL}{EA} = \frac{(-20)(1)(16)}{(29000)(3)} \times 12 = -0.044 \text{ k·in} \Rightarrow \boxed{\Delta_{cy} = 0.044 \text{ in.} \downarrow}$$

b) Special case

$$(20\,k)\,\Delta_{EX} = \sum \frac{N^2L}{EA} = 15.8 \text{ k·in} \Rightarrow \boxed{\Delta_{EX} = 0.79 \text{ in.} \rightarrow}$$

Homework 5 Problem 2

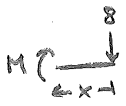
Real



A→B $0 \le x \le 12$

$M = -3.33x$

C→B $0 \le x \le 5$



$M = -8x$

a) θ_A Virtual

A→B

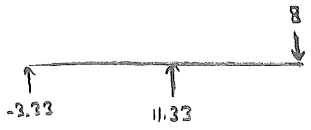
$m = -1 + \frac{1}{12}x$

C→B

$m = 0$

$$(1\ k\cdot ft)\,\theta_A = \left[\int_0^{12} \frac{(-3.33x)(-1+\frac{1}{12}x)}{(29000)(100)}\,dx + \int_0^{5} \frac{(-8x)(0)}{2(29000)(100)}\,dx\right] \times 12^2 = 3.97\times10^{-3}\ k\cdot ft\cdot rad \Rightarrow \boxed{\theta_A = 3.97\times10^{-3}\ rad\ \circlearrowleft}$$

b) Δ_C Virtual (set as 8 to match real)



$$(8\ k)\,\Delta_{C/} = \left[\int_0^{12} \frac{(-3.33x)^2}{(29000)(100)}\,dx + \int_0^{5} \frac{(-8x)^2}{(29000)(100)(2)}\,dx\right] \times 12^3 = 4.608\ k\cdot in. \Rightarrow \boxed{\Delta_{C/} = 0.576\ in.\ \downarrow}$$