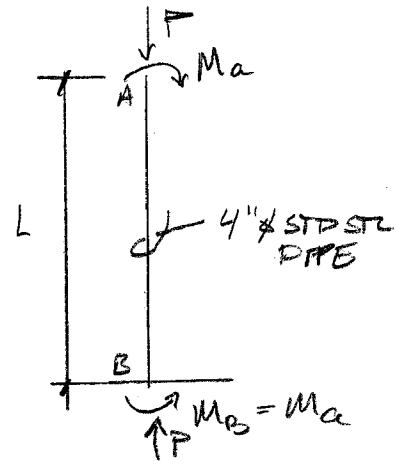


SECOND ORDER ANALYSIS EXAMPLE

$P = 500\#$ $I = 6.82 \text{ in}^4$

$M_A = 1 \text{ k}$

$L = 15'$



LOADS ON UNDEFLECTED SHAPE

ON UNDEFLECTED SHAPE:

$M_B = M_A$

DEFLECTION @ A DUE TO MOMENT, M_A

$$\Delta_0 = \frac{M_A L^2}{2EI} = \frac{1000\# (15')^2 (1728 \text{ in}^3/\text{ft}^3)}{2 (29 \times 10^6 \#/\text{in}^2) (6.82 \text{ in}^4)} = .983''$$

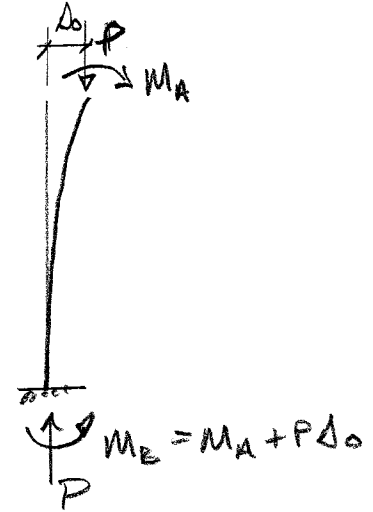
RECOMPUTE M_B

$$M_B = M_A + P \Delta_0$$

$$= 1000\# + 500\# \left(\frac{.983}{12} \right)$$

$$= 41.0\#$$

$M_B = 1041\#$



THIS CAUSES ADDITIONAL DEFL:

$$\Delta_T = \Delta_0 + \Delta_1 = \frac{(M_0 + M_1) L^2}{2EI}$$

$$= .0403 = \Delta_1$$

$$\Delta_T = .983'' + \frac{41.0\# (15')^2 (1728)}{2 (29,000,000) (6.82)}$$

$\Delta_T = 1.023''$

RECOMPUTE M_B

$$M_B = M_0 + M_1 + P \Delta_1$$

$$= 1041\# + 500\# (.0403'')$$

$$= 3.4\#$$

RECOMPUTE Δ -----

RECOMPUTE M_B -----

UNTIL Δ_i & M_i ARE VERY SMALL

SAME PROBLEM USING A TABLE:

STAGE	STAGE MOMENT M_i (FT-#)	M_B (FT-#)	STAGE DEPL Δ_i (IN)	ΔA (IN)
0	1000	1000	.983	0.983
1	41.0	1041.0	.0403	1.023
2	3.35	1044.3	3.30×10^{-3}	1.026
3	4.12×10^{-3}	1044.3	4.05×10^{-6}	1.026

CHANGES ARE INSIGNIFICANT AFTER 2ND STAGE \therefore CONVERGED

INCREASE IN MOMENT DUE TO 2ND ORDER EFFECTS:

$$\frac{1044.3 - 1000}{1000} = \underline{\underline{4.43\%}}$$