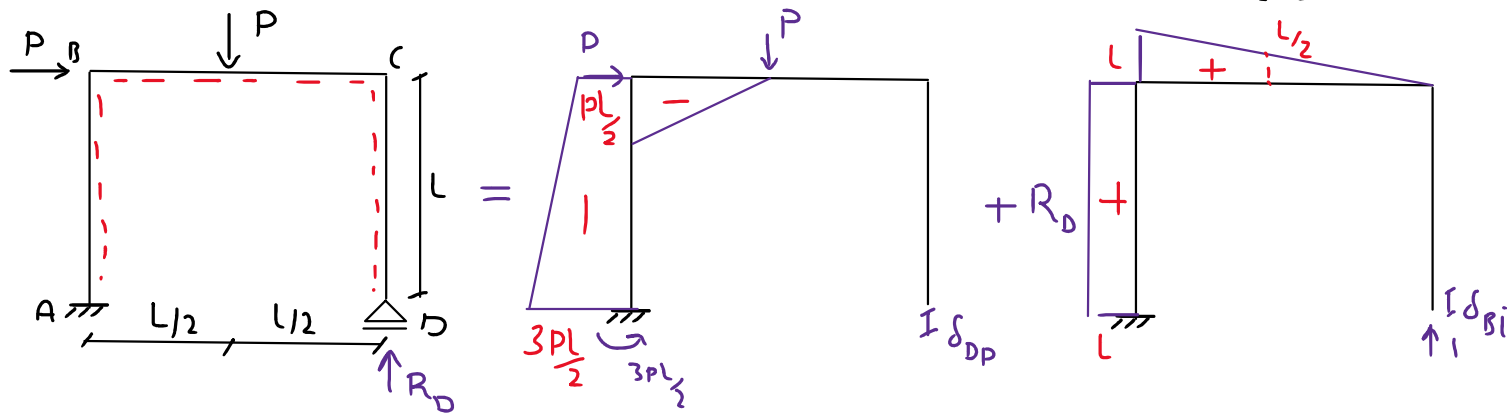تحلیل سازه های نامعین

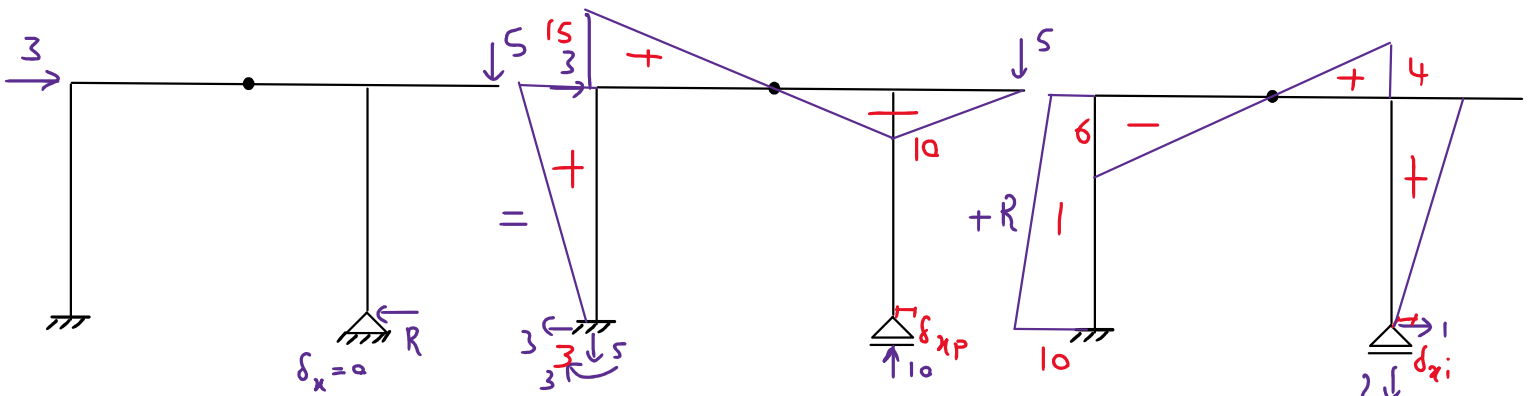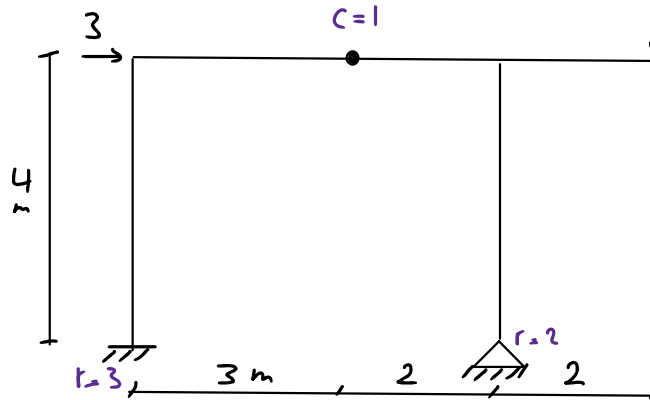مثال: عکس العمل تکیه گاه D را به دست آورید .

$$\delta_D = 0 \rightarrow \delta_{DP} + R_D \delta_{Di} = 0$$

$$1 \times \delta_{DP} = \int \frac{m\,M}{EI}\,dx = \left(\frac{L}{6}\right)\left[2\left(-\frac{PL}{2}\right)(L) + \left(-\frac{PL}{2}\right)\left(\frac{L}{2}\right)\right] + (L)(-PL)(L) = -\frac{53}{48}\frac{PL^3}{EI}$$

$$1 \times \delta_{Di} = \int \frac{m^2}{EI}\,dx = \left(\frac{L}{3}\right)(L^2) + (L^2)(L) = \frac{4}{3}\frac{L^3}{EI}$$

$$-\frac{53}{48}\frac{PL^3}{EI} + R_D\left(\frac{4}{3}\frac{L^3}{EI}\right) = 0 \rightarrow \boxed{R_D = \frac{53}{64}P}$$

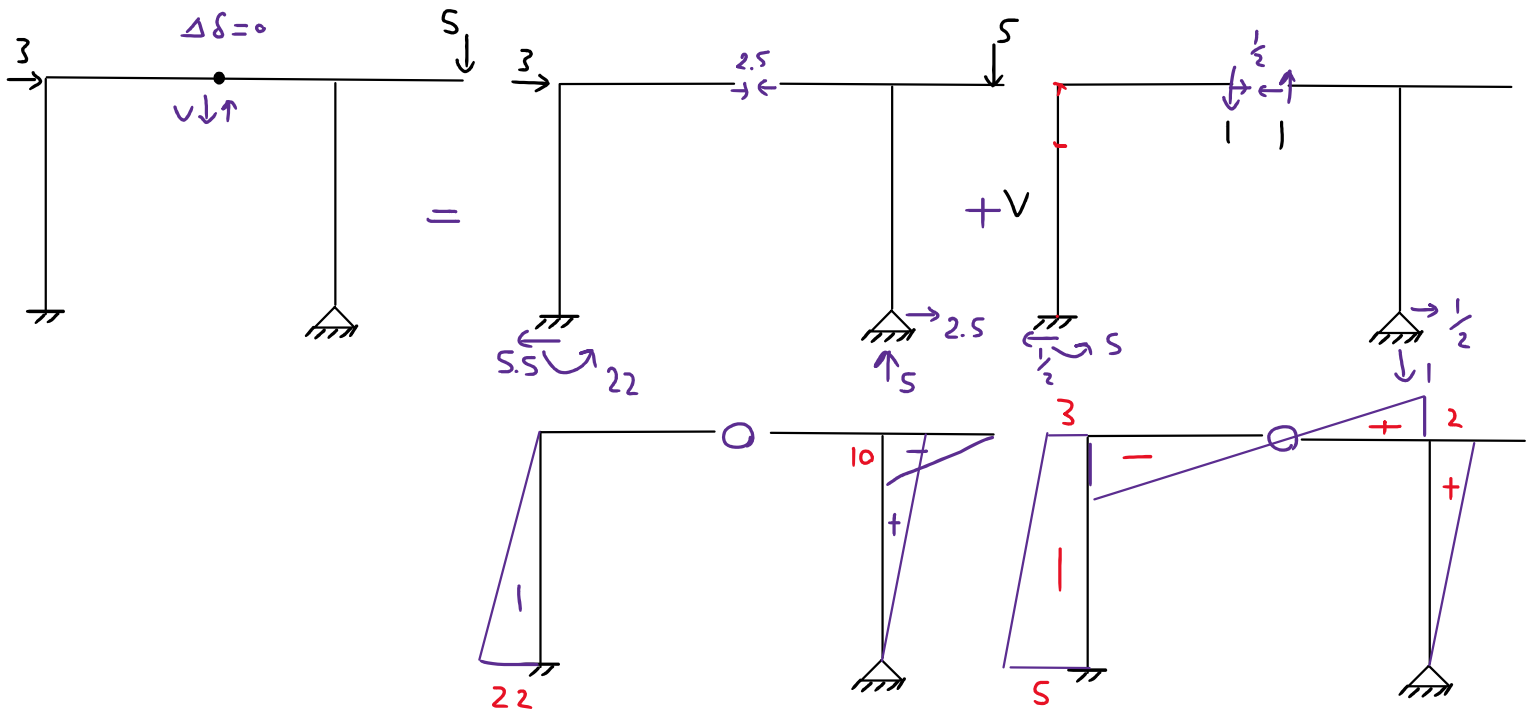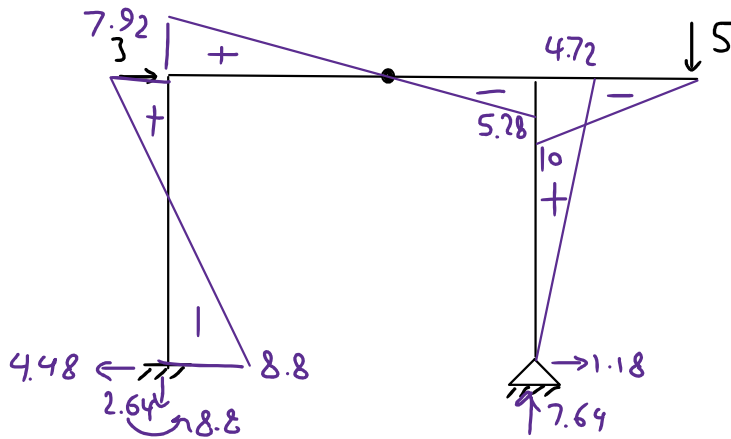مثال: دیاگرام لنگر خمشی شکل زیر را رسم نمایید.

$$1 \times \delta_{xP} = \int \frac{mM}{EI} dz = \left(\frac{4}{6}\right)\left[(3)(-10) + 4(9)(-8) + (15)(-6)\right] + \left(\frac{3}{3}\right)(15)(-6) + \left(\frac{2}{3}\right)(-10)(4) =$$

$$\delta_{xP} = \frac{-388.67}{EI}$$

$$1 \times \delta_{xi} = \int \frac{m^2}{EI} dx = \left(\frac{4}{6}\right)\left[(-10)^2 + 4(-8)^2 + (-6)^2\right] + \left(\frac{3}{3}\right)(-6)^2 + \left(\frac{2}{3}\right)(4)^2 + \left(\frac{4}{3}\right)(4)^2 = \frac{329.33}{EI}$$
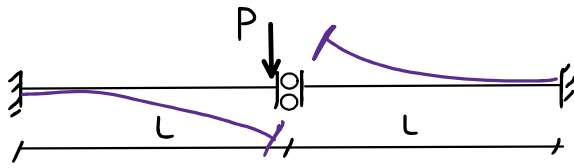
$$\delta_{xP} + R\delta_{xi} = 0 \rightarrow \frac{-388.67}{EI} + R\frac{329.33}{EI} = 0 \rightarrow \boxed{R = 1.18} \rightarrow$$
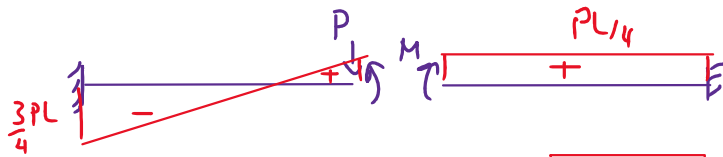

$$1 \times \Delta\delta_P = \int \frac{mM}{EI} dx = \left(\frac{4}{3}\right)\left[2(-22)(-5) + (-22)(-3)\right] + \left(\frac{4}{3}\right)(10)(2) = \frac{217.3}{EI}$$

$$1 \times \Delta \delta_i = \int \frac{m^2}{EI} dx = \left(\frac{4}{6}\right)\left[(-5)^2 + 4(-4)^2 + (-3)^1\right] + \left(\frac{3}{3}\right)(-3)^2 + \left(\frac{2}{3}\right)(2)^2 + \left(\frac{4}{3}\right)(2^2) = \frac{82.3}{EI}$$
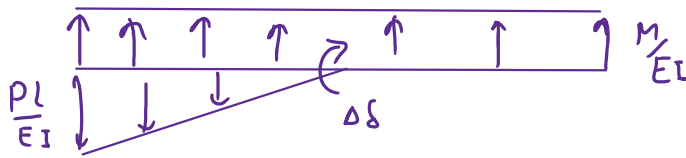
$$\frac{217.3}{EI} + V \frac{82.3}{EI} = 0 \rightarrow \boxed{V = -2.64}$$

مثال : مطلوب است تحلیل یترشکل زیر .

سازگاری تغییر شکل ها

$$\theta_L = \theta_R$$

$$\frac{PL^2}{2EI} - \frac{ML}{EI} = \frac{ML}{EI} \longrightarrow \boxed{M = \frac{PL}{4}}$$

تعادل تیر مزدوج

θ	V
δ_1 , δ_2	M_1 , M_2

$$\sum F_y = 0 \rightarrow \frac{M}{EI}(2L) - \frac{1}{2}\left(\frac{PL}{EI}\right)(L) = 0 \rightarrow \boxed{M = \frac{PL}{4}}$$