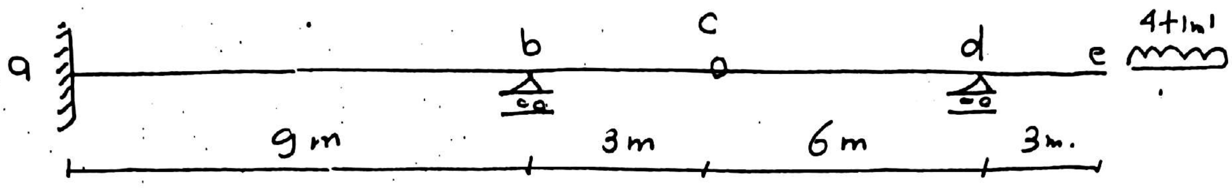
Moving load.

Exam 2015

a) Draw The max & min Curves of S.f and B.M dueto l.l equal 4 t/m'.

b) Calculate The maximum negative and max positive deflection at Point c due to The Given l.l only, use The virtual work Method

Take ($EI = 10000\ m^2.t$)



← sol →

* في البدايـــة يتم عمـــل ٣ حالات تحميل وهما :.

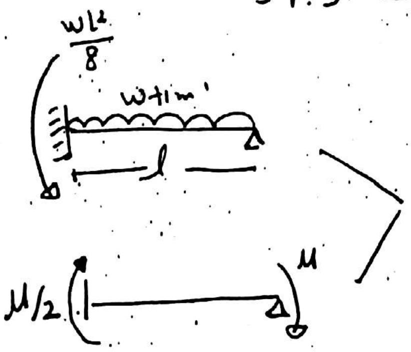
a ⟶ b (Case(1)).

b ⟶ d (Case(2)).

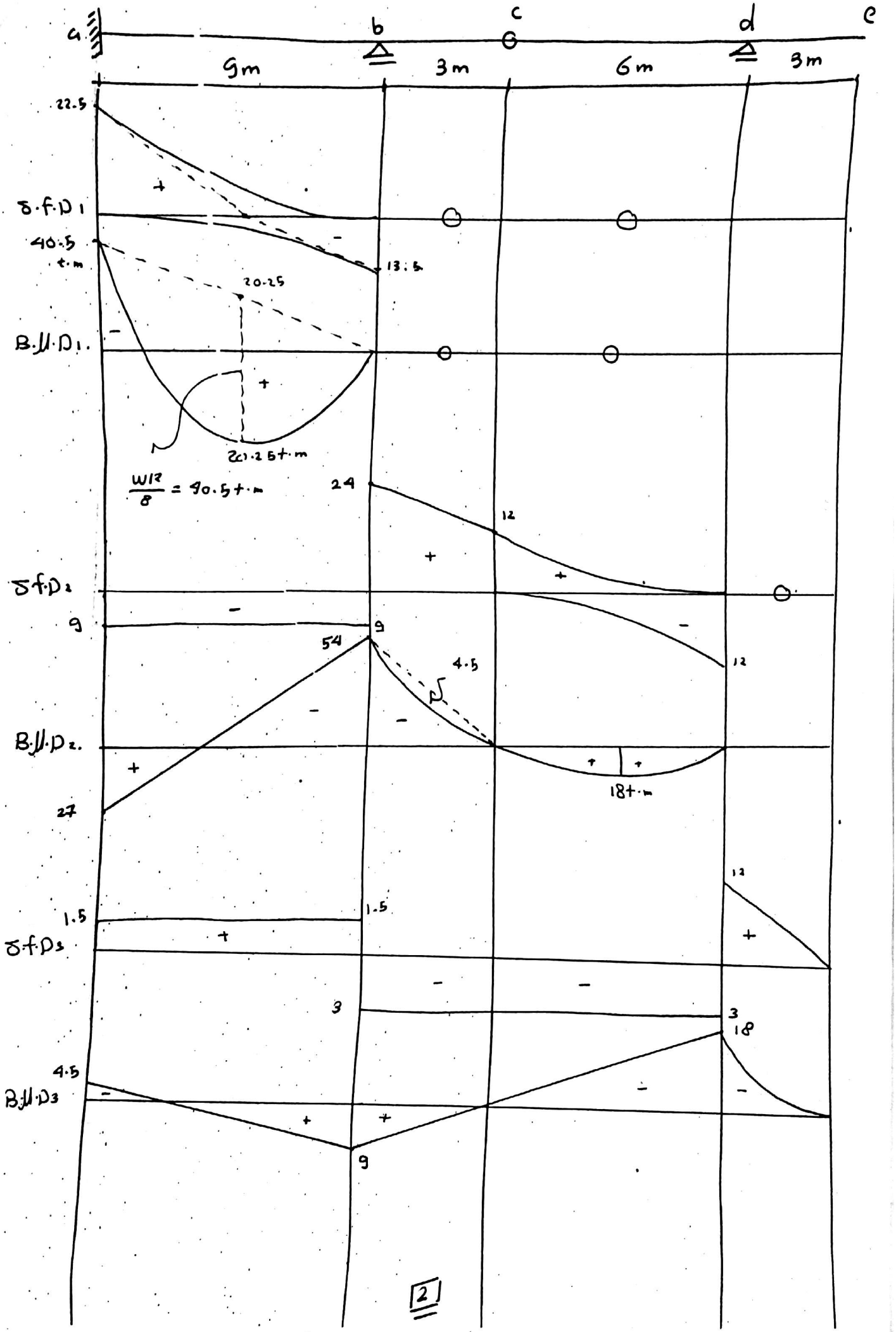
d ⟶ e (Case(3)).

* ولحل القدرة نتيجة حالات التحميل المختلفات توجد طريقتين :.

1) 3.M. equation.

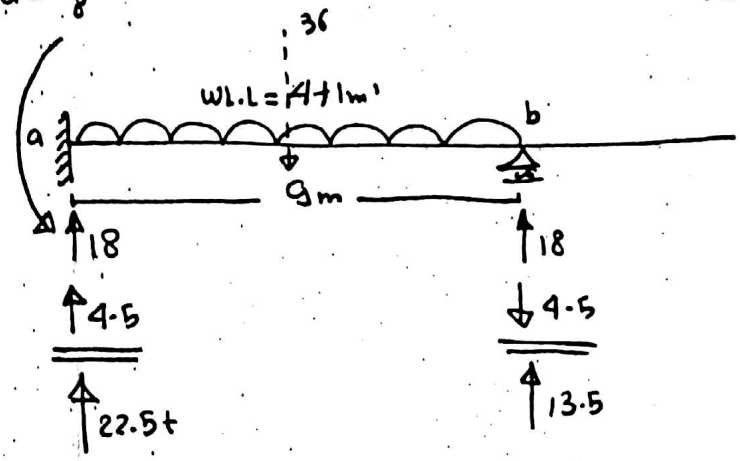


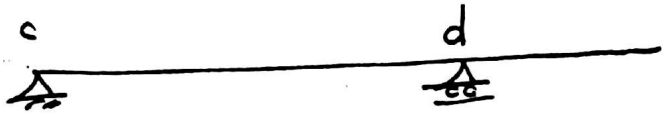
2) القوانين المحفوظات :.



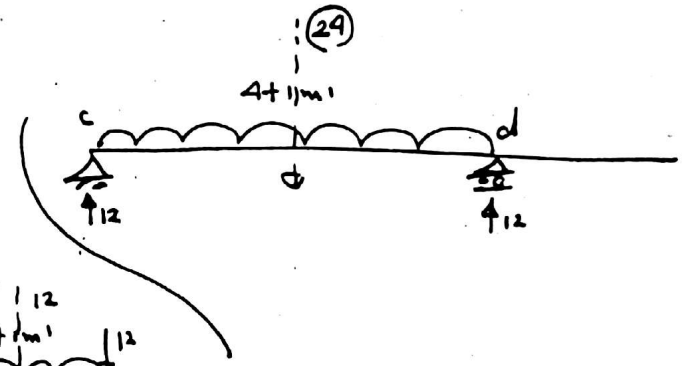
Case (1) :-

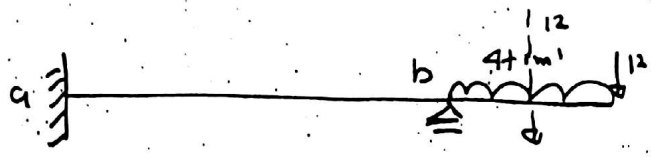
$$Ma = \frac{wl^2}{8} = 40.5 t\cdot m$$

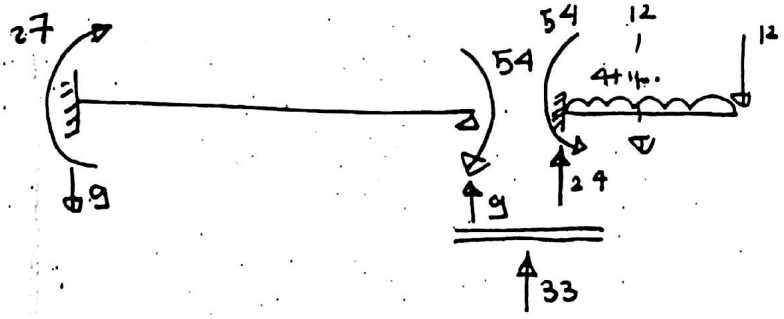




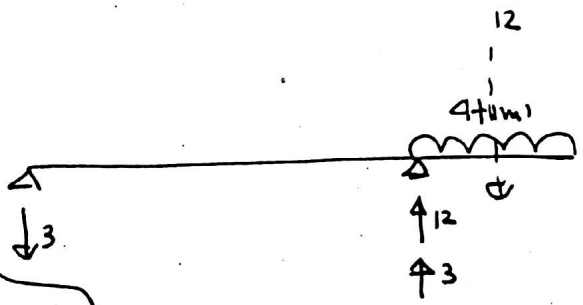
Case (2) :-

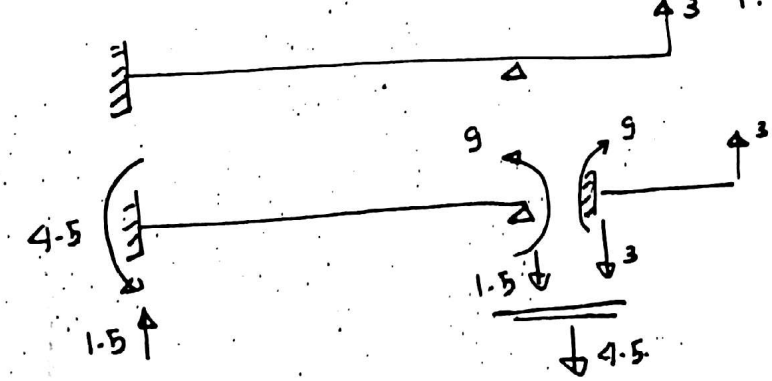


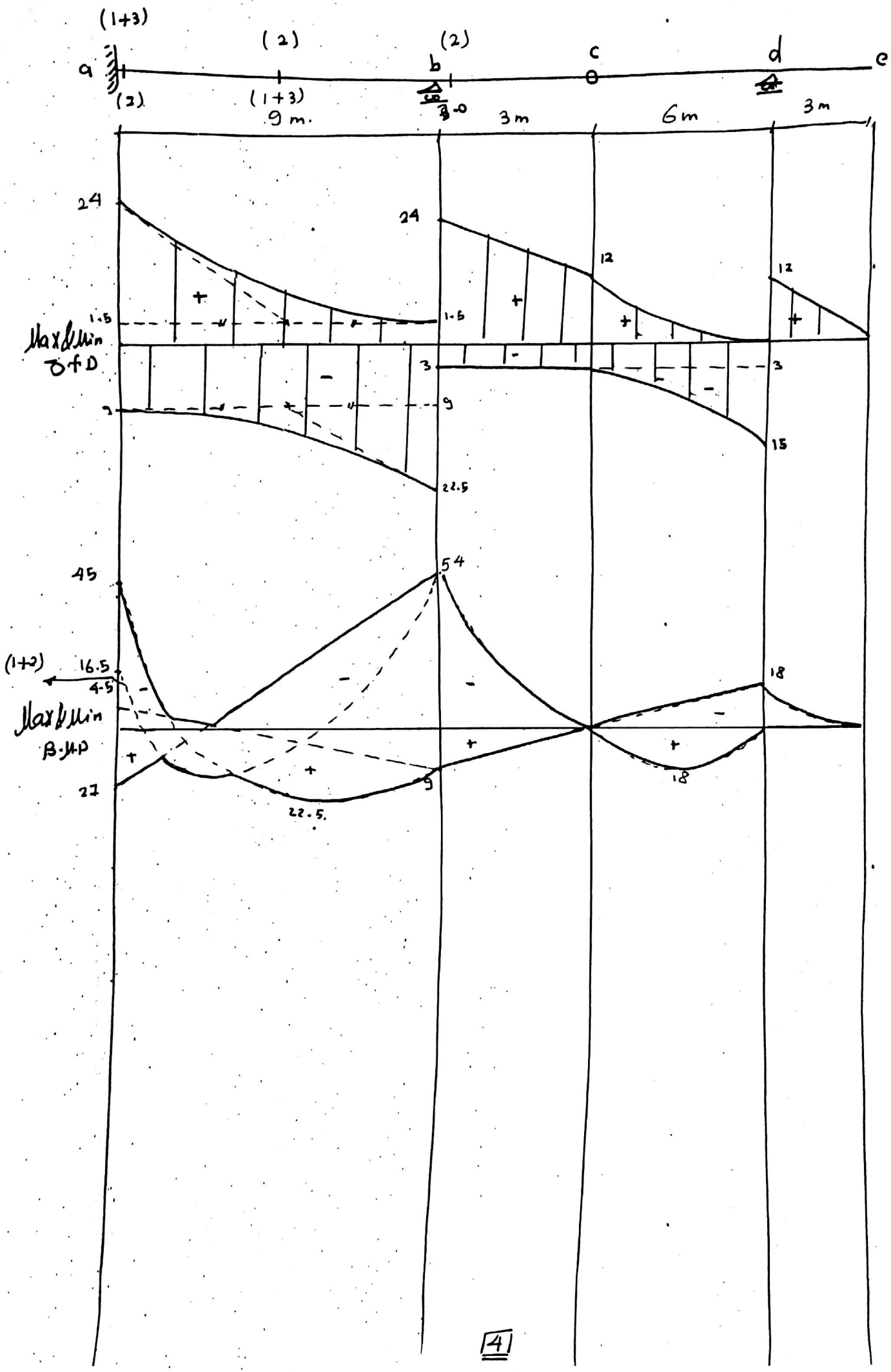




Case (3) :-





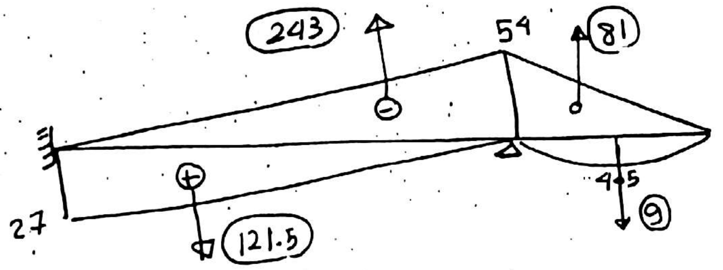


* لإيجاد أقصى deflection موجب داخل باكيات معينة يتم تحميل هذه الباكيات فقط ورسم الـ B.M.D لأي رجعيته الـ Super Position فيكون هو (M_o) بعد ذلك نلغي الزوايد ونضع عند النقطة المراد حساب الـ deflection عندها حمل 1t رأسي واختيار الـ s.d مثبتة ونرسم (M_1^*)

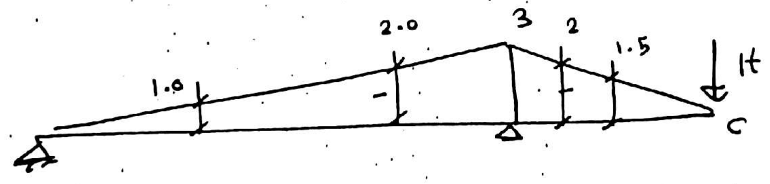
$$\therefore \delta^{+ve}_{max} = \frac{1}{EI}\int M_o M_1^* \, dl$$

∴ لإيجاد أقصى deflection موجب للنقطة c يتم تحميل الجزء (bd) بـ 4 t/m' حيث أنا أجري حلها قبل كدا في الطلب الأول نفس Super Position

M_o



M_1^*



$$\delta^{+ve}_{max\,c} = \frac{1}{EI}\left[\,243*2 - 121.5*1 + 81*2 - 9*1.5\,\right]$$

$$= \frac{513}{EI} = \frac{513}{10000} = 0.0513\,m$$

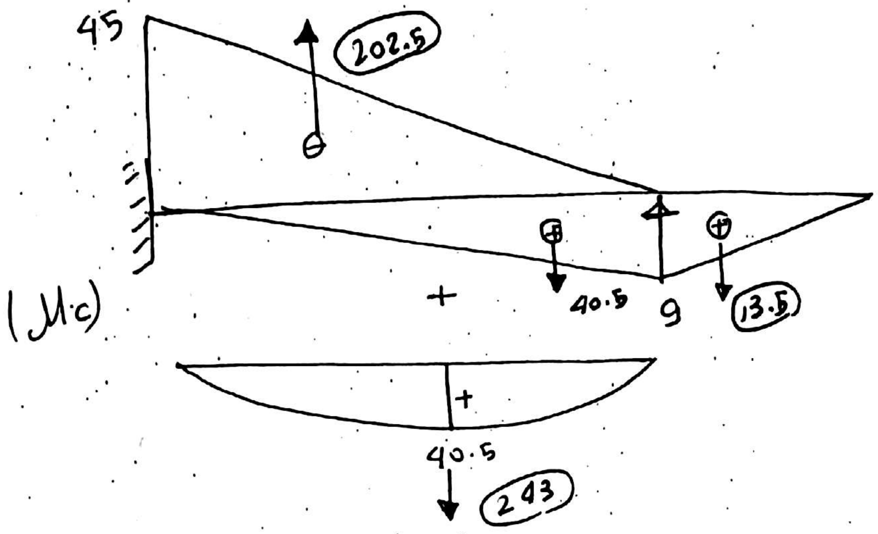
* لإيجاد أقصى deflection سالب داخل باكية معينة

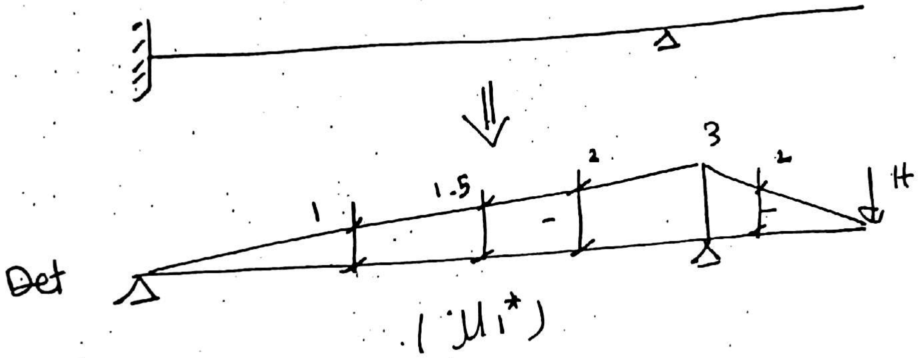
نحمل عينيط وشارط ب 4t/m' ونرسم (Mo) له

يتم جمع هنا الحالتين ① & ③ أو تحميلها معاً ونرسم

من جديد. ونكامل Mo ده مع *M1 أيضاً نحصل

على الـ deflection السالب عند (c).



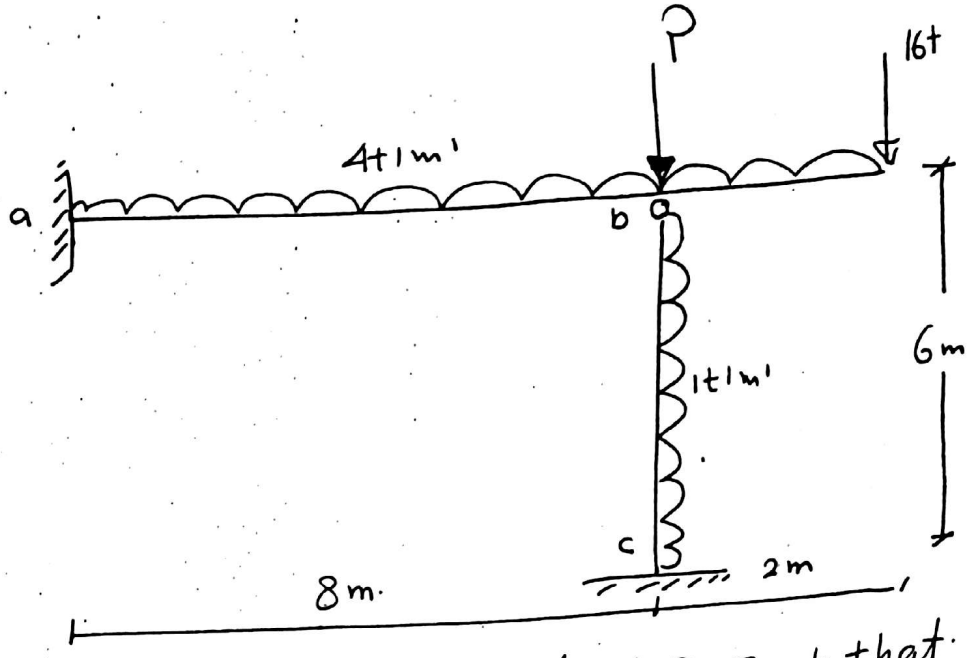


$$\delta_c^{-ve} = \frac{1}{EI}\left[(202.5*1) - (40.5*2) - (243*1.5) - (13.5*2)\right]$$

$$= \frac{-270}{10000} = -0.027\,m$$

Buckling of Column

Exam 2015



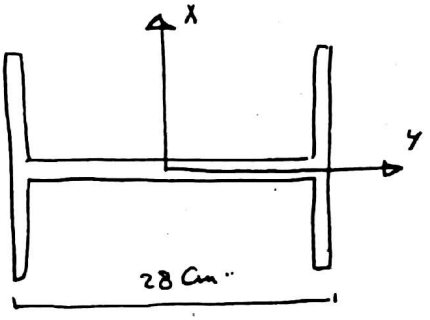
* Calculate the maximum value of the load P such that the steel column (cb) is safe due to buckling the cross section is H.E.B 280 with the given properties:

use steel 44:

$A = 118\ cm^2$

$I_x = 14920\ cm^4$

$I_y = 5130\ cm^4$



$\sigma_{P.C} = 1.6\ t/cm^2$.

$$\sigma_{P.b} = \begin{cases} 1.6 - 0.000085(\lambda)^2 & , \text{ For } \lambda < 100. \\ \dfrac{7500}{\lambda^2} & , \quad \lambda > 100. \end{cases}$$

1 تحديد الـ buckling length :.

$$l_{b\,in} = l_{b\,out} = 0.87\,l$$

$$\therefore l_{bx} = l_{by} = 0.87 * 600 = \boxed{522\,cm}$$

2 إيجاد الـ λ_{max} :.

في حالة : $l_{bx} = l_{by}$ تكون λ_{max}

كالآتي :.

$$\lambda_{max} = \frac{l_b}{i_{min}} \quad , \quad i_{min} = \sqrt{\frac{I_{min}}{A}}$$

$$\therefore i_{min} = \sqrt{\frac{5130}{118}} = 6.59\,cm$$

$$\therefore \lambda_{max} = \frac{522}{6.59} = \boxed{79.17}$$

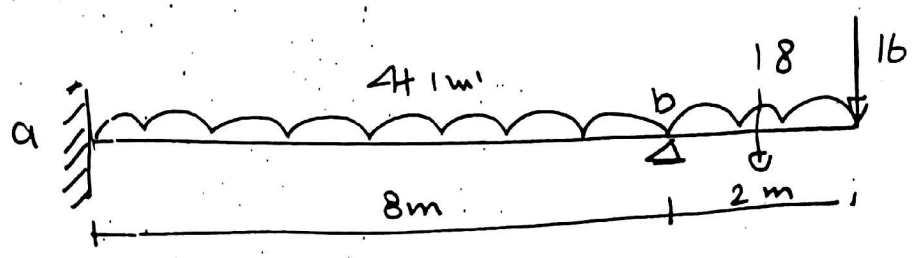
3 إيجاد الـ $G.P.b$:.

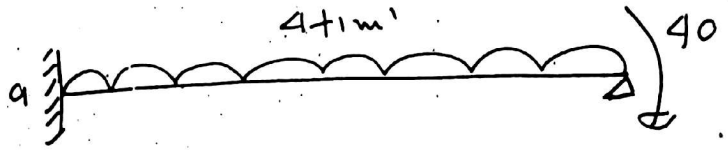
$$\lambda_{max} = 79.17 < 100$$

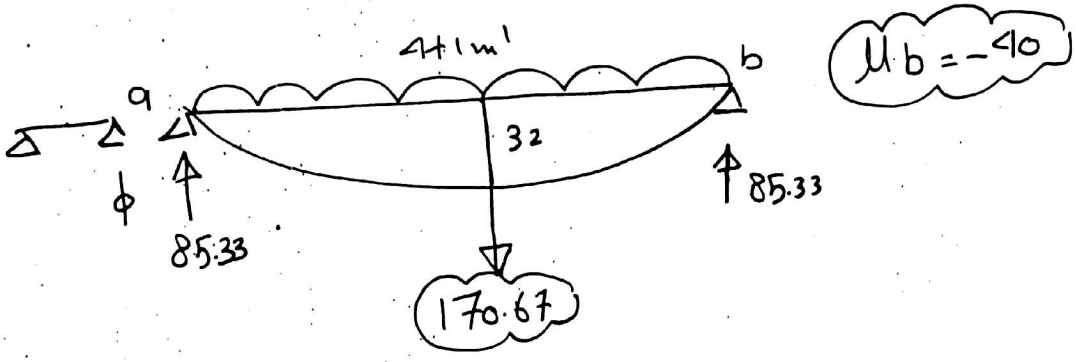
$$\therefore G.P.b = 1.6 - 0.000085\,(79.17)^2 = \boxed{1.067\ t/cm^2}$$

$$G.P.c = 1.6\ t/cm^2 \quad (Given).$$

∴ إيجاد M & N بدلالة (P)





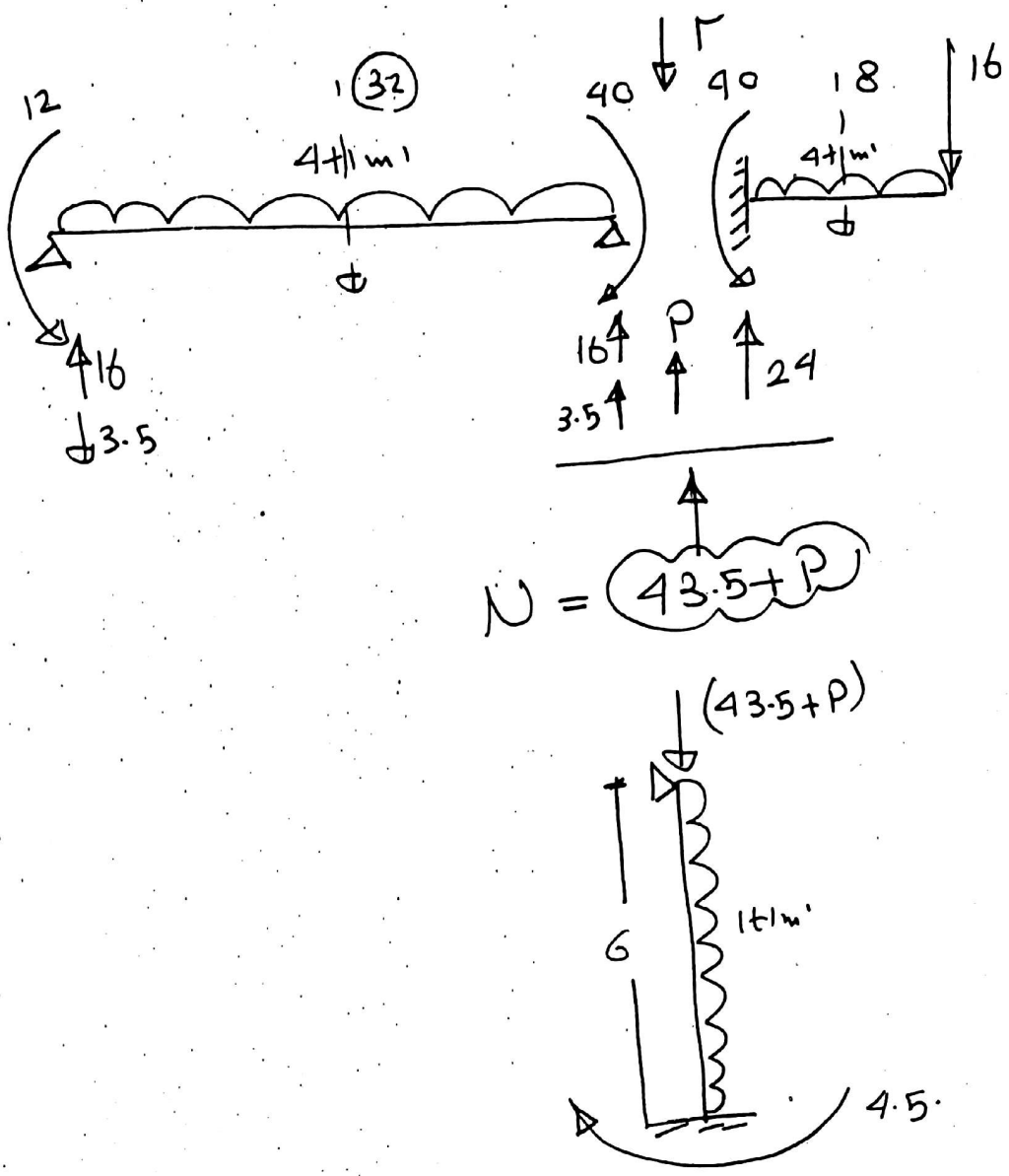


3. Mata:

$$0.0 + 2Ma(0+8) - 40(8) = -6\left[0 + 85.33\right]$$

$$16Ma - 320 = -512$$

$$\therefore Ma = \frac{-192}{16} = -12 \text{ t.m}$$



$$\therefore N = (43.5+P)$$

$$M_x = 4.5 \times 100 = \boxed{450\ t\cdot m}$$

$$\sigma_c = \frac{N}{A} = \frac{(43.5+P)}{118}$$

$$\sigma_{b.x} = \frac{M_x}{I_x} \cdot y = \frac{450}{14920} * 14 = \boxed{0.422}\ t/cm^2$$

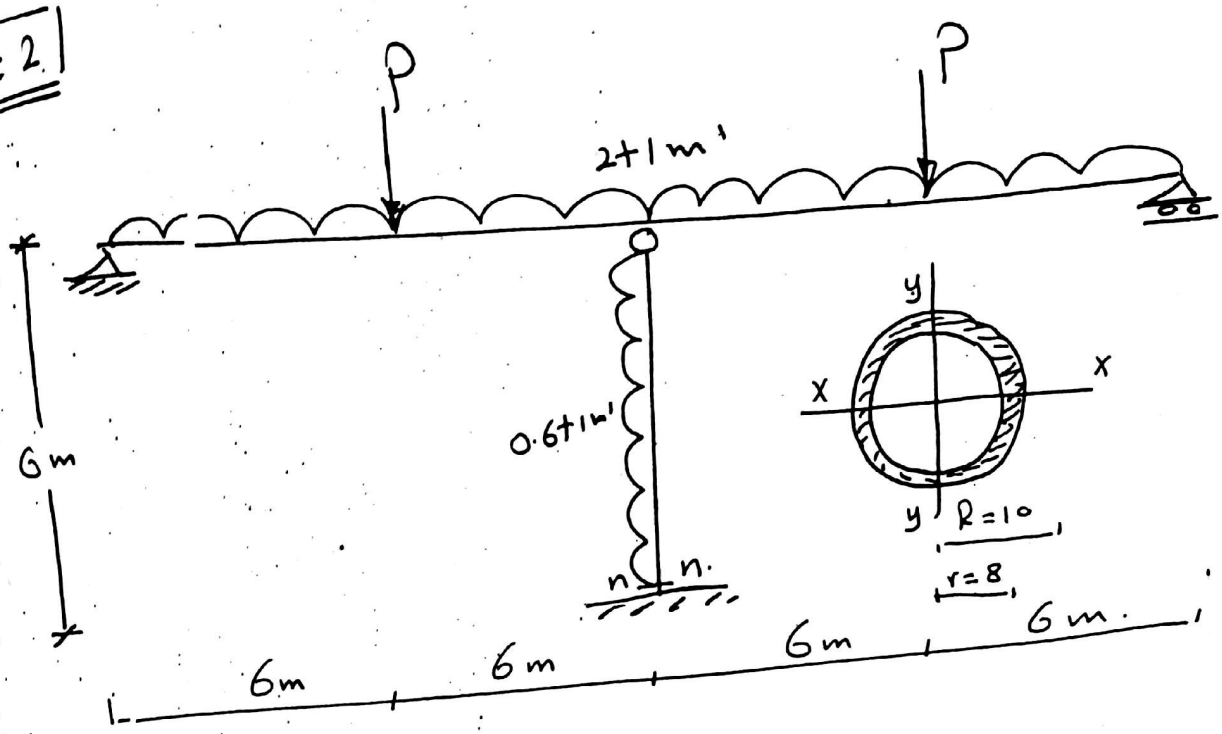
$$\frac{(43.5+P)}{118 * 1.067} + \frac{0.4122}{1.6} \leq 1.0$$

$$\frac{43.5+P}{125.906} + 0.26375 = 1.0$$

$$(43.5+P) + 33.2 = 125.906$$

$$\therefore P = 49.19\ t$$

EX: 2



Required:

Find P so that the stresses will be safe. Taking into consideration buckling effect.

← scl →

1 Buckling length:

$$l_{bx} = l_{by} = 0.87\,l = 0.87 * 600 = 522\,cm$$

2 Properties of area:

$$A = \pi(10)^2 - \pi(8)^2 = 113.1\,cm^2$$

$$I_x = I_y = I_{min} = \frac{\pi}{4}\left[10^4 - 8^4\right] = 4636.99\,cm^4$$

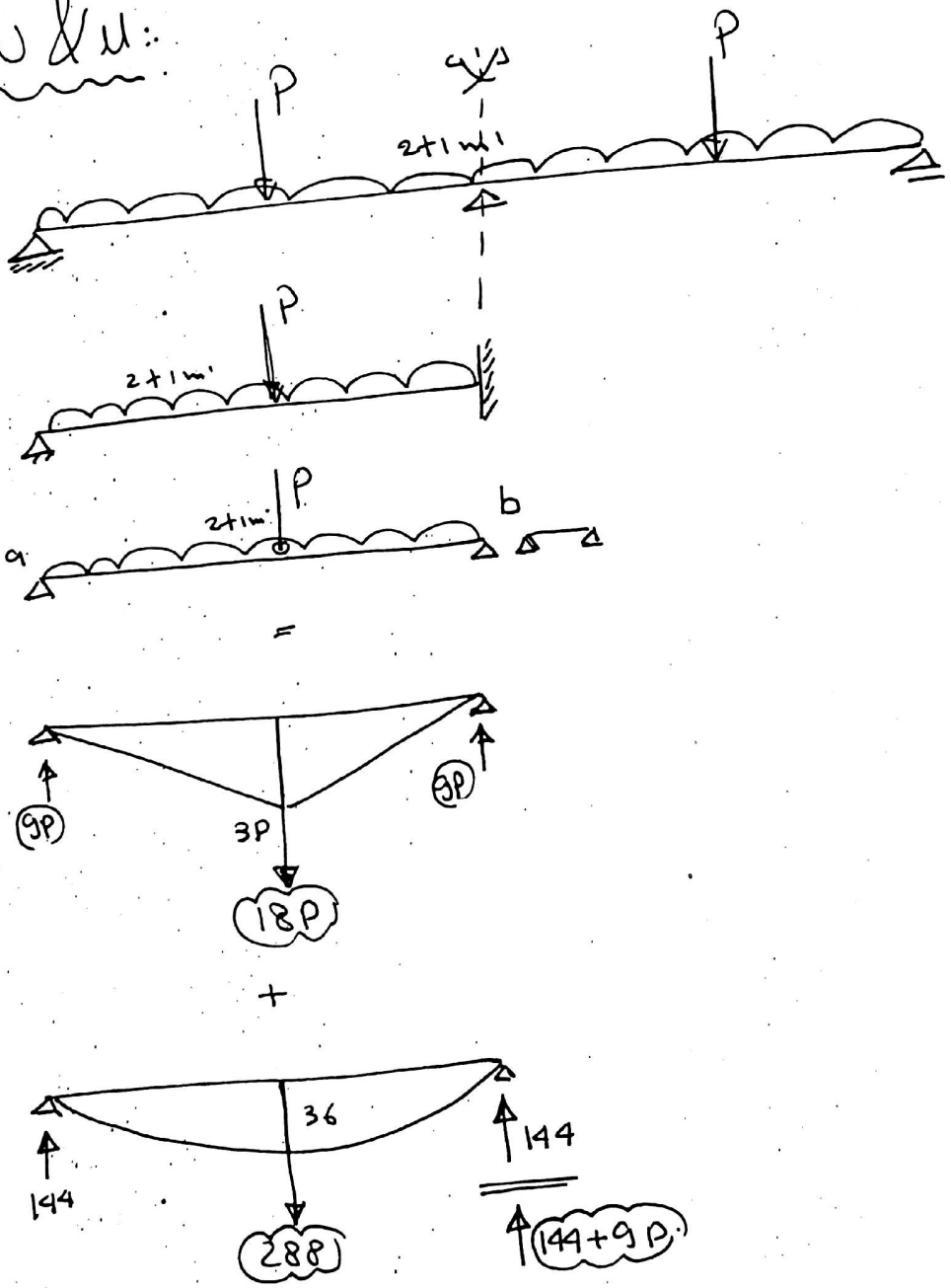
$$\therefore\ c_{min} = \sqrt{\frac{I_{min}}{A}} = \sqrt{\frac{4636.99}{113.1}} = 6.4\,cm$$

[3] $\lambda = \frac{l_b}{i_{min}} = \frac{522}{6.4} = 81.5625 < 100$

[4] $\sigma_{P.b} = 1.6 - 0.000085 (81.5625)^2 = 1.034 \text{ t/cm}^2$

[5] $\sigma_{P.C} = 1.6 \text{ t/cm}^2$ (Given).

[6] M & M:



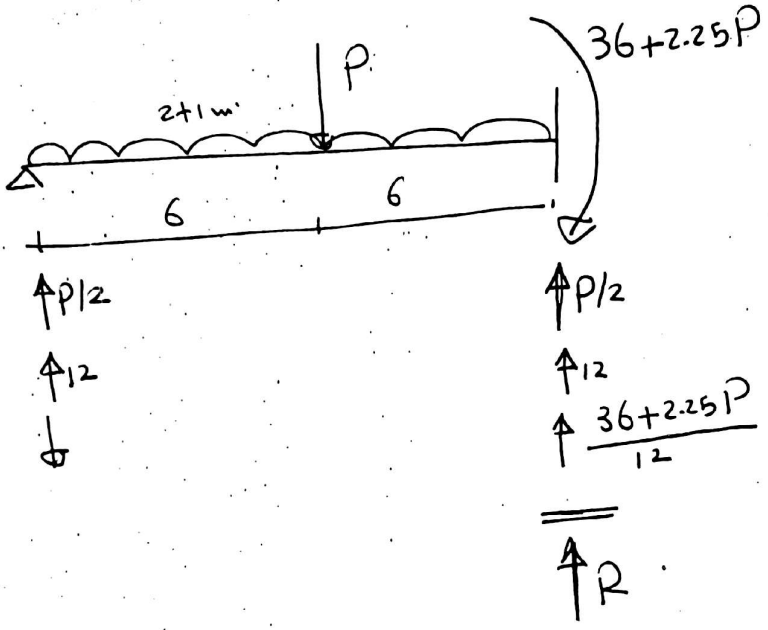
[7]

3. Mequat to b:

$$0.0 + 2Mb(12+0) + 0.0 = -6[144+9P]$$

$$24Mb = -864 - 54P \Rightarrow$$

$$Mb = -36 - 2.25P = \boxed{-(36+2.25P)}$$

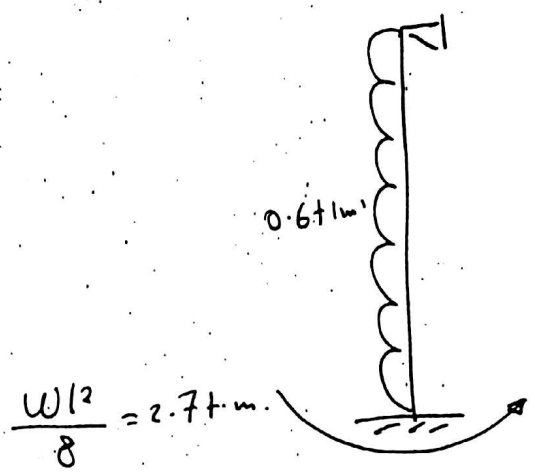


$$\therefore R = P/2 + 12 + 3 + 0.1875P$$

$$= \boxed{0.6875P + 15}$$

$$\therefore N = 2 * (0.6875P + 15)$$

$$= \boxed{30 + 1.375P}$$



$$\therefore \quad N = (30 + 1.375P)$$

$$M_x = 2.7 * 100 = \boxed{270 t.cm}$$

$$\sigma_c = \frac{(30 + 1.375P)}{113.1}$$

$$\sigma_{b.x} = \frac{270}{4636.99} * 10 = \boxed{0.582 \ t/cm^2}$$

$$\frac{(30 + 1.375P)}{113.1 * 1.034} + \frac{0.582}{1.6} = 1.0$$

$$\frac{(30 + 1.375P)}{116.9454} + 0.5325 = 1.0$$

$$30 + 1.375P + 62.2734 = 116.9454$$

$$\therefore P = \frac{24.67}{1.375} = \boxed{17.94 t}$$