



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

الفصل الخامس

الكمرات الممتدة

EXTENDED BEAMS

إعداد

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أستاذ الهندسة الزراعية

ووكيلاً الكلية لشئون التعليم والطلاب

* Reactions *

$$\sum x = 0 \therefore H = -2.5 + 3 - 6 = \text{---} 5.5 \text{ ton}$$

مجموع العزوم حول نقطة B = مفتر (B)

$$\therefore R_A \times 8 + 4.33 \times 10 + 6 \times 2 + 5 = 10 + 10 \times 5 + 15 \times 2$$

$$\therefore 8R_A = 10 + 50 + 30 - 43.3 - 12 - 5 = 29.7 \text{ ton}$$

$$\therefore R_A = 3.71 \text{ ton}$$

($\sum d = 0$) مفتر (B) = مجموع القوى N1

$$\therefore R_B = 10 + 15 + 6 - 4.33 - 3.71 \therefore R_B = 22.96 \text{ ton}$$

* Moments *

$$M_C = 0.0 \text{ t.m}$$

$$M_A = 4.33 \times 2 = 8.66 \text{ t.m}$$

$$M_D_{\text{left}} = (4.33 \times 5) + 3.71 \times 3 = 32.78 \text{ t.m}$$

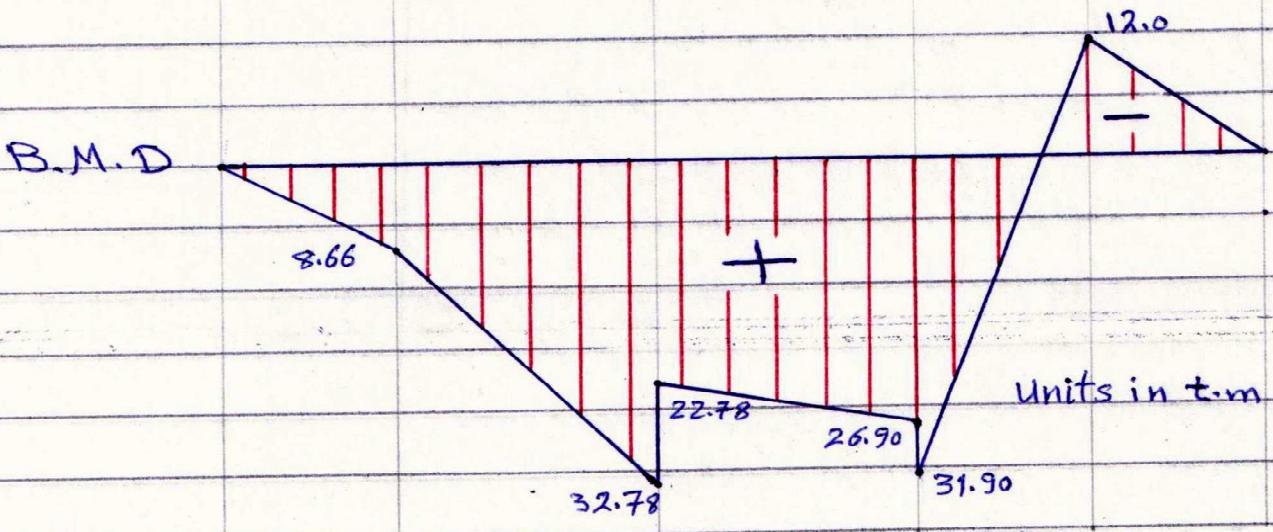
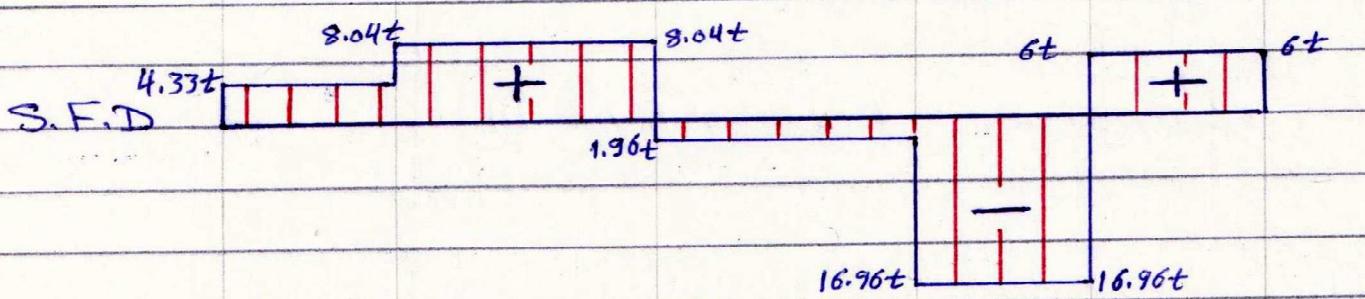
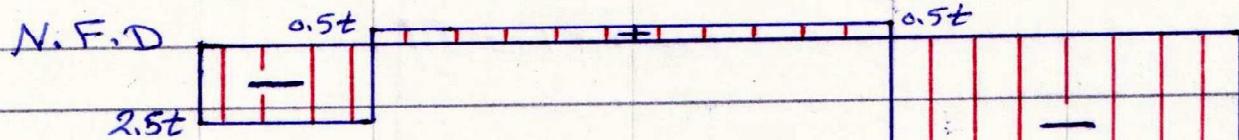
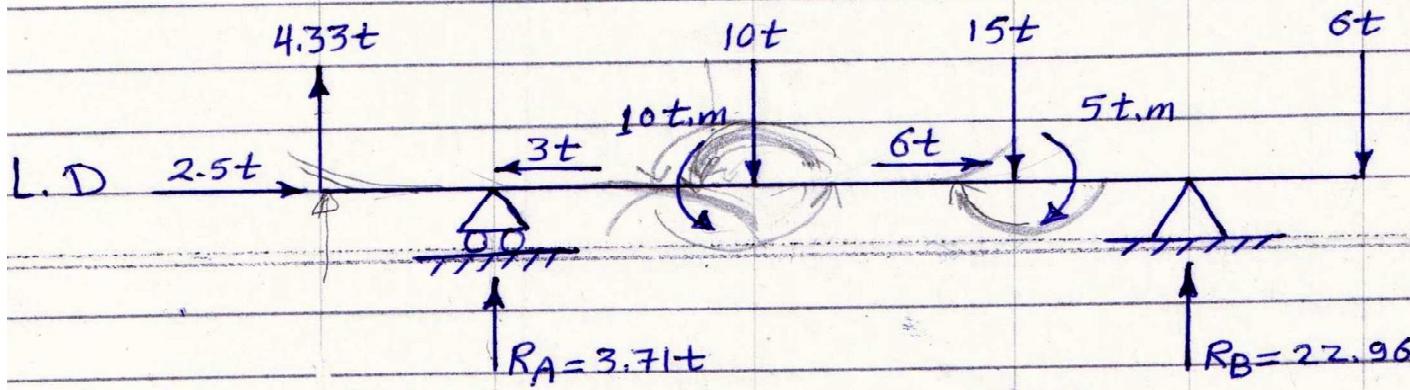
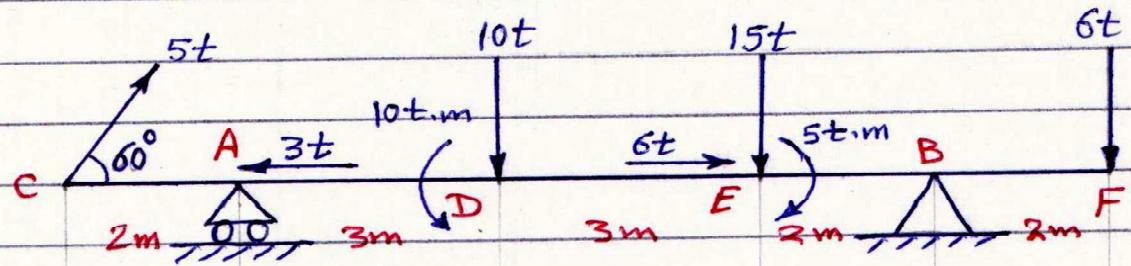
$$M_D_{\text{right}} = 32.78 - 10 = 22.78 \text{ t.m}$$

$$M_E_{\text{left}} = 4.33 \times 8 + 3.71 \times 6 - 10 \times 3 = 26.90 \text{ t.m}$$

$$M_E_{\text{right}} = 26.90 + 5 = 31.90 \text{ t.m}$$

$$M_B = -6 \times 2 = -12 \text{ t.m}$$

$$M_F = 0.0 \text{ t.m}$$



* Reactions *

$$\sum x = 0 \quad \therefore H = 0$$

$$\sum Y = 0$$

• جموع الأوزون حول نقطة (B) = صفر

$$R_1 \times 9 + 5 \times 3 = 9 \times 7.5 + 4.5 \times 4 + 4.5 \times 2$$

$$\therefore 9R_1 + 15 = 67.5 + 18 + 9 \quad \therefore 9R_1 = 79.5$$

$$\therefore \underbrace{R_1 = 8.8 t}$$

• جموع القوى حول نقطة (A) = صفر

$$\therefore R_1 + R_2 = 9 + 4.5 + 4.5 + 5 \quad \therefore \underbrace{R_2 = 14.2 t}$$

* Moments *

$$M_A = 0 \text{ t.m}$$

$$M_C = (8.8 \times 3) - (9 \times 1.5) = 12.9 \text{ t.m}$$

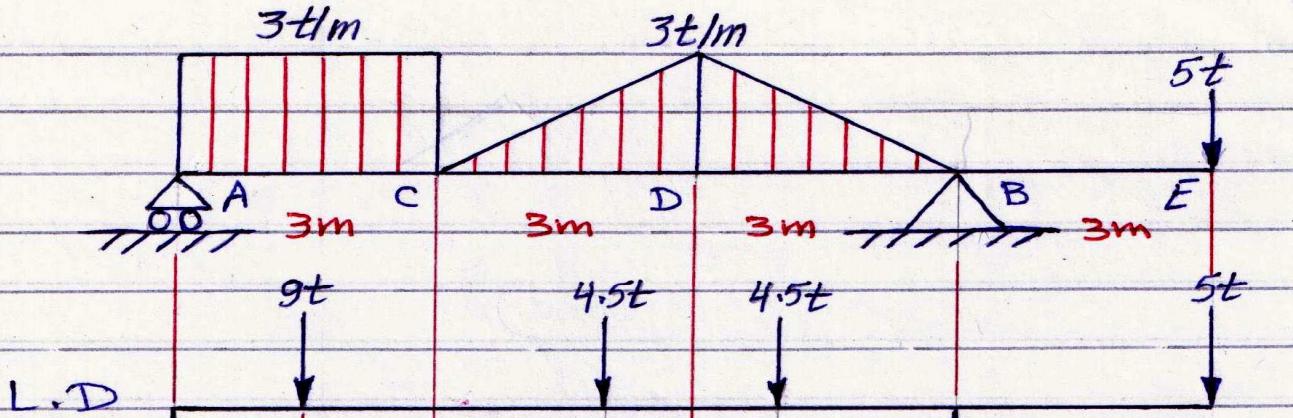
$$M_D = (8.8 \times 6) - (9 \times 4.5) - (4.5 \times 1) = 7.8 \text{ t.m}$$

$$M_B = (8.8 \times 9) - (4.5 \times 4) - (4.5 \times 2) - (9 \times 7.5) = -15.3 \text{ t.m}$$

$$M_E = 0 \text{ t.m}$$

$$x = \frac{Q}{P} = \frac{8.8}{3} = \underline{\underline{2.93 \text{ m}}}$$

$$M_{max} = \frac{1}{2} \times 2.93 \times 8.8 = \underline{\underline{12.91 \text{ t.m}}}$$



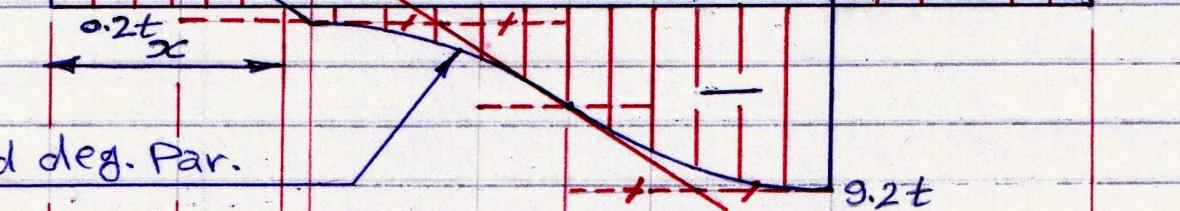
L.D

$$R_1 = 8.8$$

$$R_2 = 14.2$$

S.F.D

2nd deg. Par.



15.3 t.m

3rd deg. Par.

B.M.D

2nd deg. Par.

13.2

12.9 t.m

7.8 t.m

$M_{max} = 12.91 \text{ t.m}$

• مجموع العزوم حول نقطة (B) = مغفر

$$(R_A \times 6) + (4.5 \times 1) = (8 \times 8) + (4.5 \times 4) + (4.5 \times 2)$$

$$\therefore 6R_A + 4.5 = 64 + 18 + 9 \therefore 6R_A = 86.5$$

$$\therefore R_A = 14.40 \text{ t}$$

• مجموع القوى المأكسدة = مغفر

$$R_A + R_B = 8 + 4.5 + 4.5 + 4.5 \therefore R_B = 7.1 \text{ t}$$

Moments:-

$$M_C = 0.0 \text{ t.m}$$

$$M_A = (-8 \times 2) = -16 \text{ t.m}$$

$$M_D = (-8 \times 5) + (14.40 \times 3) - (4.5 \times 1) = -1.30 \text{ t.m}$$

$$M_B = (-4.5 \times 1) = -4.5 \text{ t.m}$$

$$M_D = (-8 \times 5) + (14.40 \times 3) = 3.20 \text{ t.m} \quad (\text{وأى الثالث})$$

$$M_E = 0.0 \text{ t.m}$$

∴ (Z) حساب وقتاً = .

$$\bar{Z} = 5 \sqrt{\frac{a}{b}} = 3 \sqrt{\frac{2.60}{4.5}} = 2.28 \text{ m}$$

$$\therefore Z = 3 - 2.28 = 0.72 \text{ m}$$

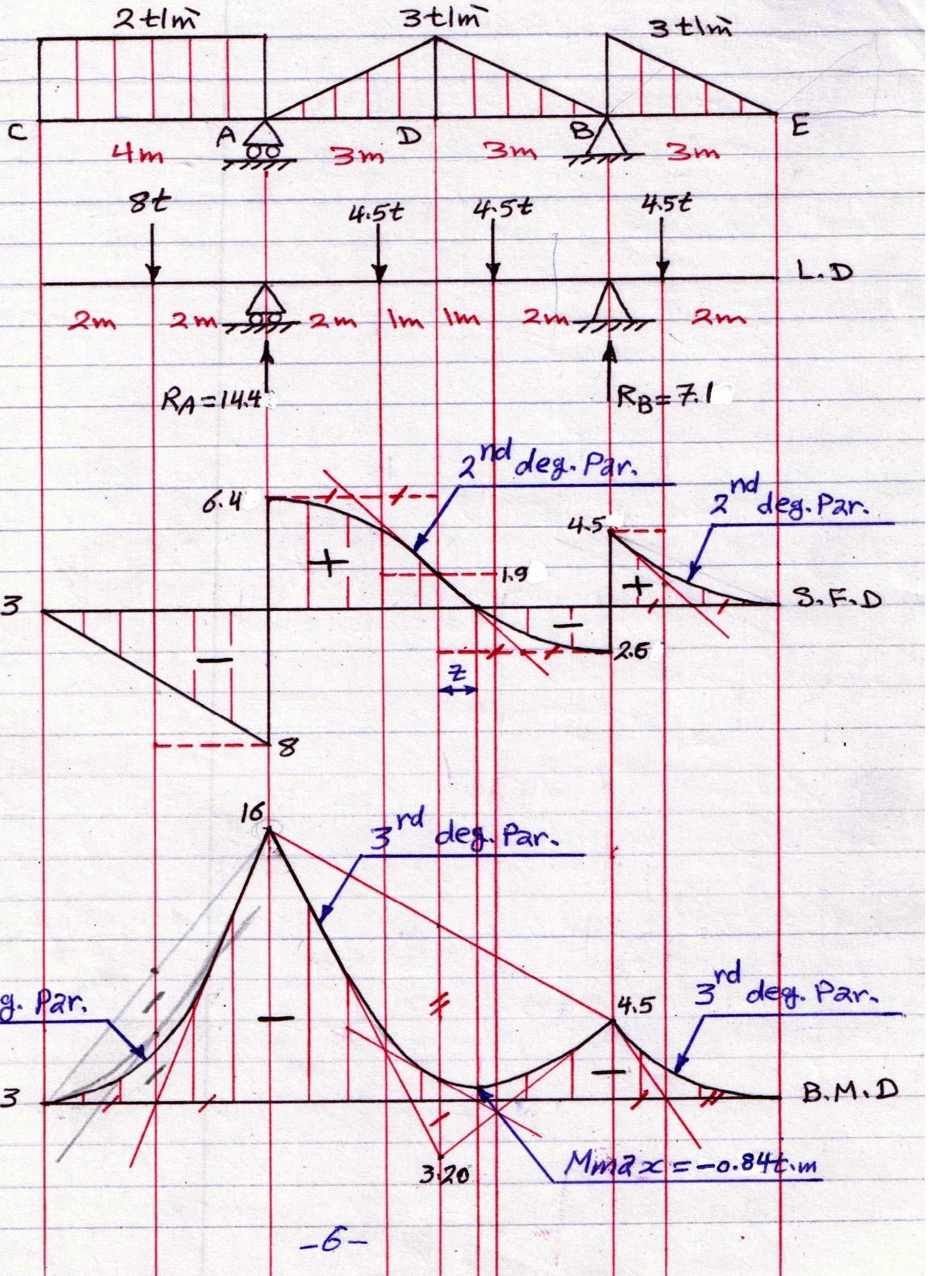
-: (Mmax) حساب وقتاً = .

$$M_{max} = \left(\frac{2}{3} \times 4.5 \times 3 \right) + (1.90 \times 3) + \left(\frac{1}{3} \times 1.90 \times 0.72 \right)$$

$$9 + 5.70 + 0.46$$

$$\therefore M_{max} = 15.16 - 16 = -0.84 \text{ t.m}$$

العزم في بداية القطاع



• مجموع العزوم حول نقطة (B) = حفر

$$(R_A \times 10) + (8 \times 2) = (4.5 \times 8) + (4.5 \times 6) + (5 \times 2)$$

$$\therefore 10R_A = 57 \quad \therefore R_A = 5.7 \text{ t}$$

• مجموع القوى المسمدة = حفر

$$R_A + R_B = 4.5 + 4.5 + 5 + 8 \quad \therefore R_B = 16.3 \text{ t}$$

Moments:-

$$M_A = 0.0 \text{ t.m}$$

$$M_C = (5.7 \times 3) = 17.1 \text{ t.m} \quad (\text{رأس المثلث})$$

$$M_D = (5.7 \times 6) - (4.5 \times 4) - (4.5 \times 2) = 7.2 \text{ t.m}$$

$$M_E = (5.7 \times 8) - (4.5 \times 6) - (4.5 \times 4) = 0.6 \text{ t.m}$$

$$M_B = -8 \times 2 = -16 \text{ t.m}$$

$$M_F = 0.0 \text{ t.m}$$

∴ (Z) حساب قيمة

$$\bar{Z} = 5 \sqrt{\frac{a}{b}} = 3 \sqrt{\frac{3.3}{4.5}} = 2.58 \text{ m}$$

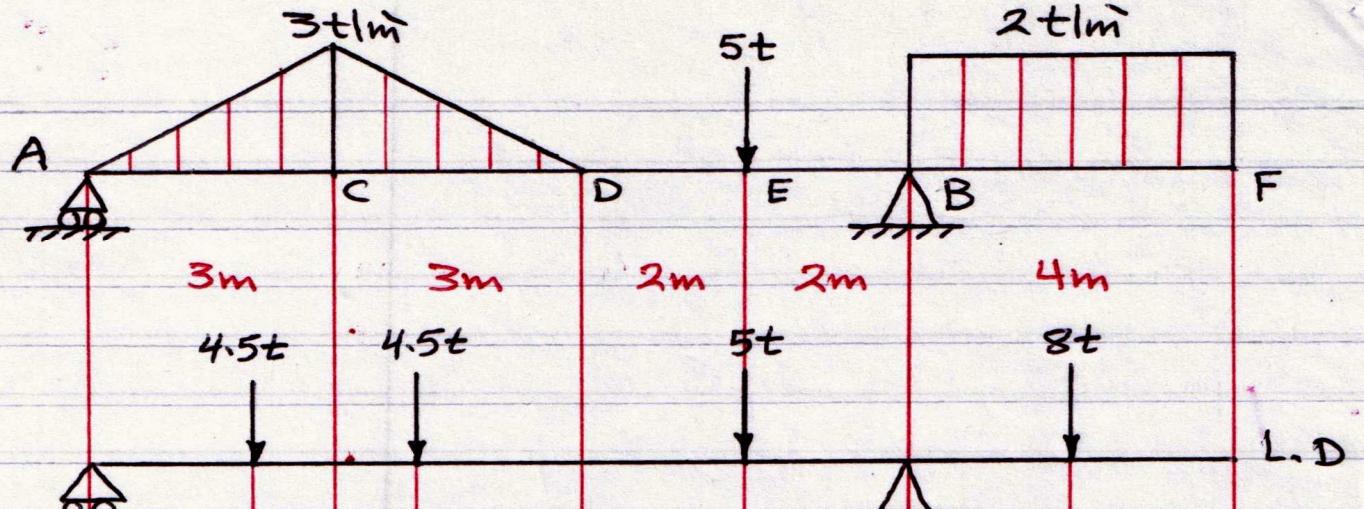
$$\therefore Z = 3 - 2.58 = 0.42 \text{ m}$$

∴ (M_{max}) حساب قيمة

$$M_{max} = (3 \times 1.2) + \left(\frac{2}{3} \times 3 \times 4.5\right) + \left(\frac{1}{3} \times 0.42 \times 1.2\right)$$

$$3.6 + 9 + 0.17$$

$$\therefore M_{max} = 12.77 \text{ t.m}$$



$$R_A = 5.7$$

$$5.7$$

Scale 1:3

3.3

8.3

16

8.3

2nd deg. Par.

Scale 1:4

0.6

7.2

3rd deg. Par.

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$M_{max} = 12.77 \text{ t.m}$