

١٠٢٥

سلسلة "العبدین الحسینین"

الجزء الاول

استراکشر مدد  
قبله م.ت

Str  
(2) مدتی

درجه عدم التحد "D"  
الشبکیات Trussed Beams

الجزء الاول

## (A) Home work solution

\* Prob (1, 2)

(1)

\* Prob (3, 4) & Prob (5)

(2, 3)

## (B) Degree in case of trusses

(1) Equation "D" الصيغة المستخدمة طابا (3)

(2) Examples أمثلة متنوعة على الشبکیات (3 → 8)

## (C) Degree in case of trussed Frames

(1) Equation "D" الصيغة المستخدمة طابا (8)

(2) Examples أمثلة (7 → 11)

## (D) أمثلة امتحانات

(1) Prob (1) → Nov (2004) (12)

(2) Prob (2) → Nov (2004) (13)

## (E) Home work

\* Prob (1 → 5)

(14, 15)

# (A) Home work Solution

①

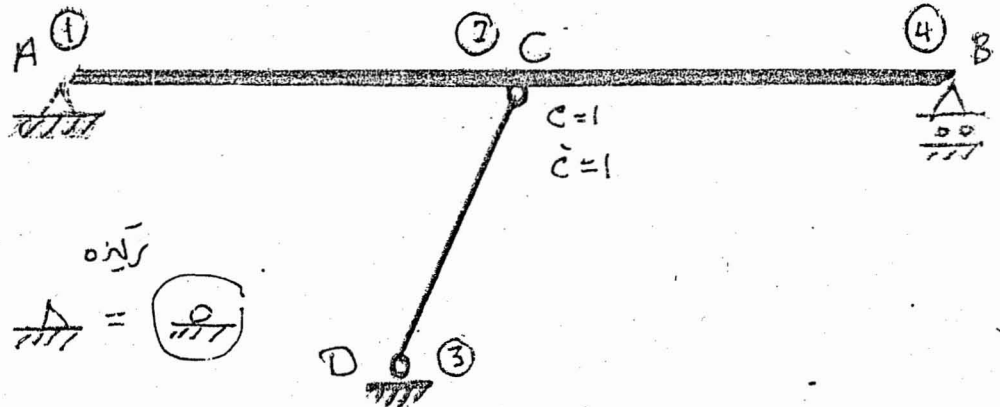
## Prob (1)

$$m = 3$$

$$r = 2 + 2 = 5$$

$$J = 4$$

$$C = 1$$



$$* D = (3m + r) - (3J + C) = (3 \times 3 + 5) - (3 \times 4 + 1) = 1 \text{ once Ind.}$$

$$* D_{ext} = R - (3 + \dot{C}) = 5 - (3 + 1) = 1 \quad * D_{int} = 1 - 1 = 0$$

(B) حث الرابطة M.S (2)

roller (A) حث الرابطة M.S (1)

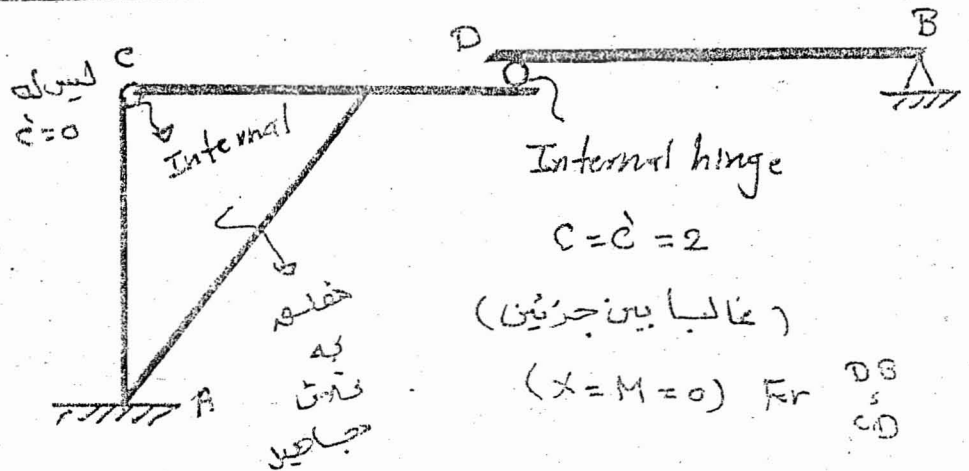
## Prob (2)

$$* m = 5$$

$$* r = 2 + 3 = 5$$

$$* J = 5$$

$$* C = 2 + 1 = 3$$



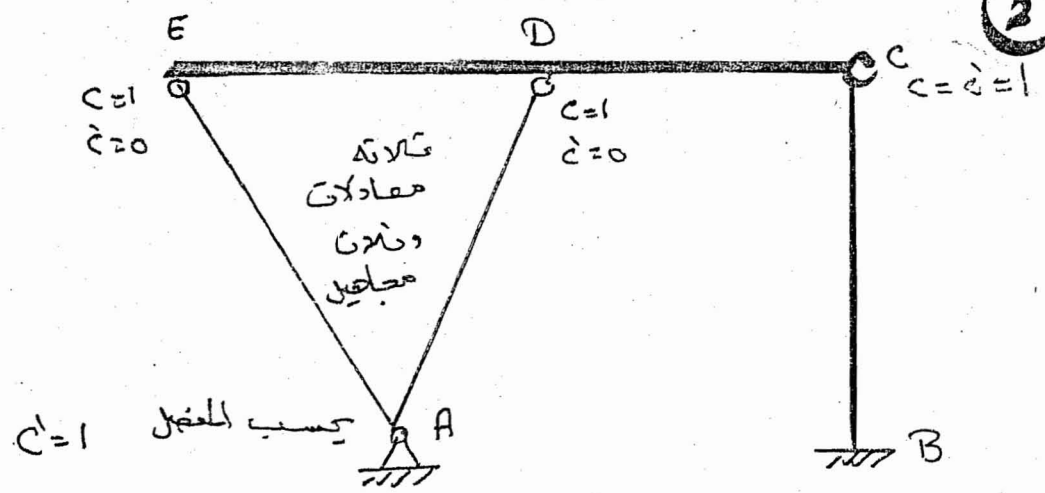
$$* D = (3m + r) - (3J + C) = (3 \times 5 + 5) - (3 \times 5 + 3) = 2$$

$$* D_{ext} = R - (3 + \dot{C}) = 5 - (3 + 2) = 0 \text{ ext}$$

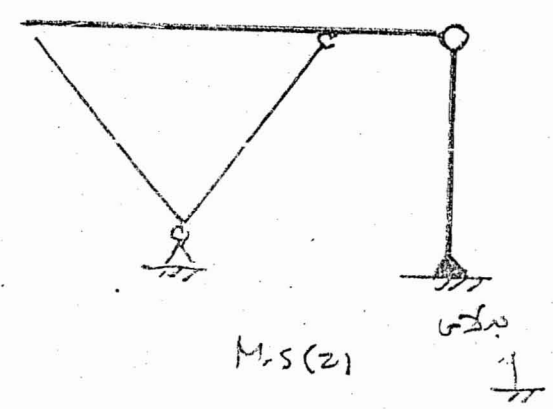
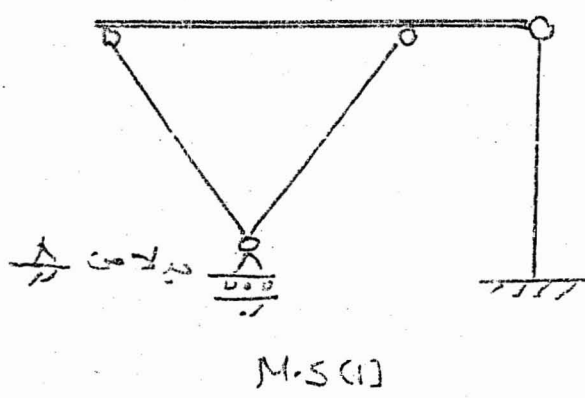
$$* D_{int} = D - D_{ext} = 2 - 0 = 2 \text{ int}$$

**Prob(3)**

- \*  $m = 5$
- \*  $r = 5$
- \*  $J = 5$
- \*  $C = 4$

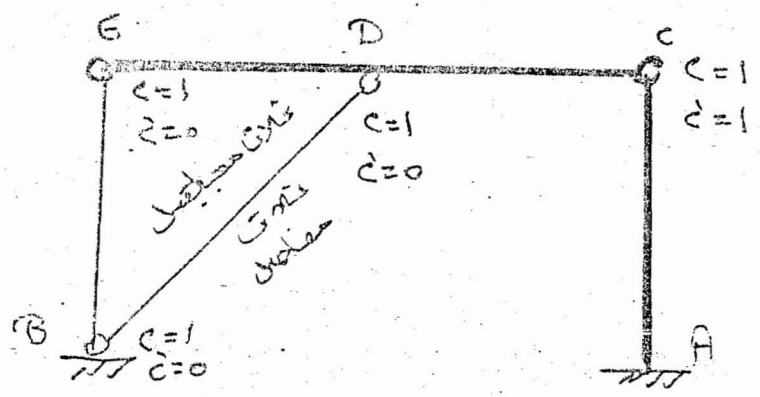


$\bullet D = (3m + r) - (3J + c) = (3 \times 5 + 5) - (3 \times 5 + 4) = 1$   
 $\bullet D_{ext} = R - (3 + c) = 5 - (3 + 1) = 1$        $\bullet D_{int} = 1 - 1 = 0$



**Prob(4)**

- \*  $m = 5$
- \*  $r = 5$
- \*  $J = 5$
- \*  $C = 4$
- \*  $c = 1$

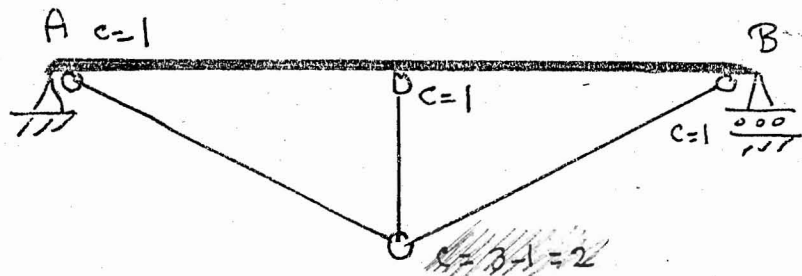


$\bullet D = (3m + r) - (3J + c) = (3 \times 5 + 5) - (3 \times 5 + 4) = 1$   
 $\bullet D_{ext} = R - (3 + c) = 5 - (3 + 1) = 1$   
 $\bullet D_{int} = 1 - 1 = 0$       (2/15)

### Prob(5)

$$* m = 5$$

$$* r = 3$$



$$* J = 4$$

$$* C = 5$$

$$* D = (3m + r) - (3J + C) = (3 \times 5 + 3) - (3 \times 4 + 5) = 1$$

$$* D_{ext} = R - (3 + C) = 3 - (3 + 0) = 0$$

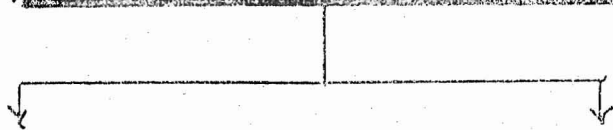
$$* D_{int} = 0 = 1$$

\* هذه العنصر يمكن حلها باستخدام معادله (trussed beam) كما سيأتي

### (1) Equation

### (B) Degree in case of trusses

$$D = (m + r) - (3J + C)$$



$$D_{ext} = R - 3$$

$$D_{int} = D - D_{ext}$$

(m) ← عدد أضلاع الجالون

(R) ← عدد ردود التثبيت للجان

(J) ← عدد وصلات (نقطه التقاء)

(C) ← (أضلاع مع بعضها) للجالون

(D<sub>int</sub>) ← التحد داخليا

(D<sub>ext</sub>) ← التحد خارجيا

(D) ← التحد عموما خارجيا وداخليا معا

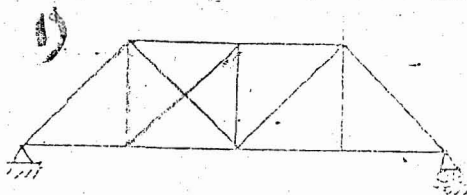
\* لا يوجد (C) لان أضلاع الـ (truss) كلها متماثل تم أخذها في الاعتبار

### (2) Examples

$$m = 14$$

$$r = 3$$

$$J = 8$$

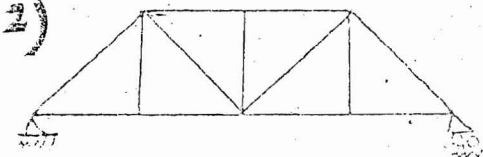


$$m + r = 14 + 3 = 17$$

$$2J = 2(8) = 16$$

once indet

2)



$$m = 13$$

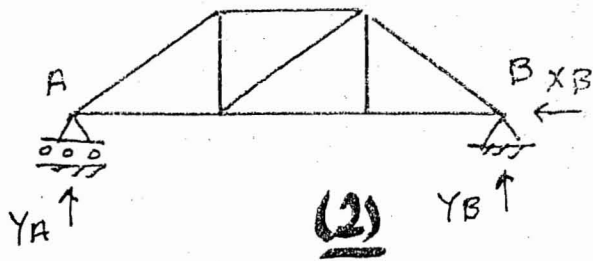
$$r = 3$$

$$J = 8$$

$$m + r = 13 + 3 = 16$$

$$2J = 2(8) = 16$$

det



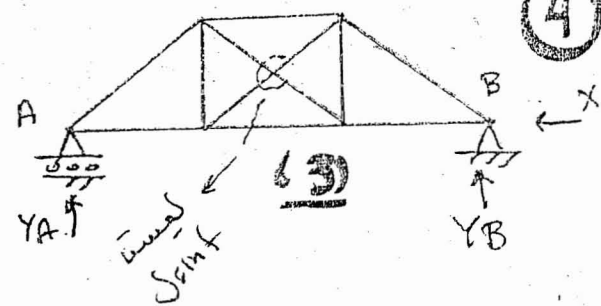
$$* m_t = 9 \quad * R = 3$$

$$U = m_t + R = 9 + 3 = 12$$

$$* J_t = 6 \quad \therefore E = 2J_t = 12$$

$$D = U - E = 12 - 12 = 0$$

Determinate



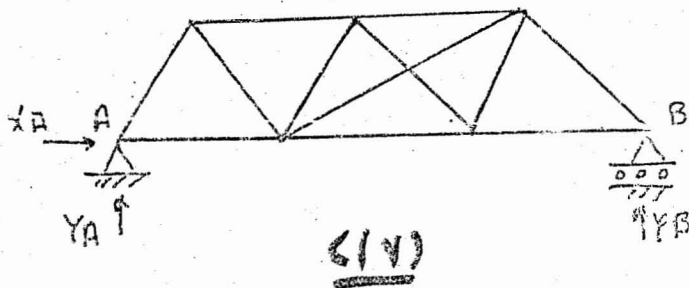
$$* m_t = 10 \quad * R = 3$$

$$\therefore U = m_t + R = 13$$

$$* J_t = 2 \quad * E = 2J_t = 12$$

$$\therefore D = U - E = 13 - 12 = 1 \text{ once indet}$$

$$* D_{ex} = 3 - 3 = 0 \quad * D_{int} = 1$$



$$* m_t = 12 \quad * R = 3 \quad * J_t = 7$$

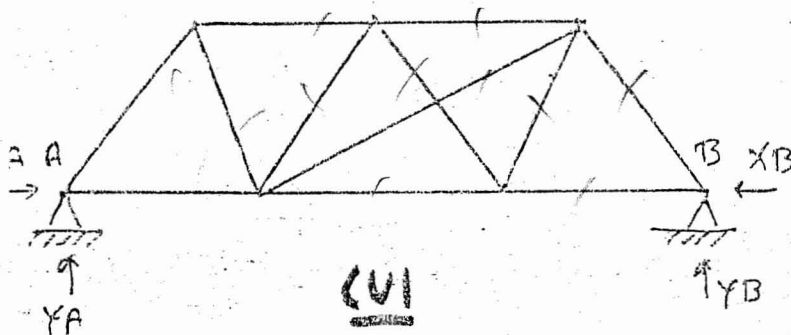
$$\therefore U = m_t + R = 12 + 3 = 15$$

$$\therefore E = 2J_t = 2(7) = 14$$

$$* D = U - E = 15 - 14 = 1 \text{ once Ind.}$$

$$* D_{ex} = R - 3 = 3 - 3 = 0 \text{ ext}$$

$$* D_{int} = D - D_{ex} = 1$$



$$* m_t = 12 \quad * R = 4 \quad * J_t = 7$$

$$\therefore U = m_t + R = 12 + 4 = 16$$

$$\therefore E = 2J_t = 2(7) = 14$$

$$* D = U - E = 16 - 14 = 2 \text{ twice Ind.}$$

$$* D_{ex} = R - 3 = 4 - 3 = 1 \text{ ext}$$

$$* D_{int} = D - D_{ex} = 2 - 1 = 1$$

مقاوله خارجي ☐ cross (مقاوله) ☒ تقيد الـ (تقييد خارجي) ☐



$$\therefore U = m_t + R = 10 + 4 = 14$$

$$\therefore E = 2 T_E = 2(7) = 14$$

$$\Delta D = U - E = 14 - 14 = 0.0 \text{ dB}$$

(vii)

$$\alpha J_t = 8$$

$$\therefore u = m_t + R'_2 \quad 13 + 4 = 17$$

$$\therefore E = 2 J_{\text{H}} = 2(8) = 16$$



$$* D = U - E = 17 - 16 = 1 \text{ 'in det'}$$

$$\alpha \text{ Dext.} = R - 3 = 4 - 3 = 1$$

$$\Rightarrow \text{D}f_{\alpha-1} = 0 - 0x_2 \cdot 1 = 0$$



$$* m_t = 11 \quad * R = 3 \quad J = 7$$

$$\therefore E = 2 \cdot J_t = 2 \times 7 = 14$$

$$\therefore u = m_t + R = 11 + 3 = 14$$

$$\therefore D = u - E = 14 - 14 = 0$$

statistically determined



$$\therefore m_f = 26 \quad R = 4 \quad J_f = 14$$

$$E = 2J_t = 2(14) = 28$$

$$\therefore u = m + R = 2G + 4 = 30$$

$$x \oplus = 30 - 28 = 2 \text{ take}$$

$$\text{Det} = 4 - 3 = 1$$

\* خارجہ - نصف اول و فصل

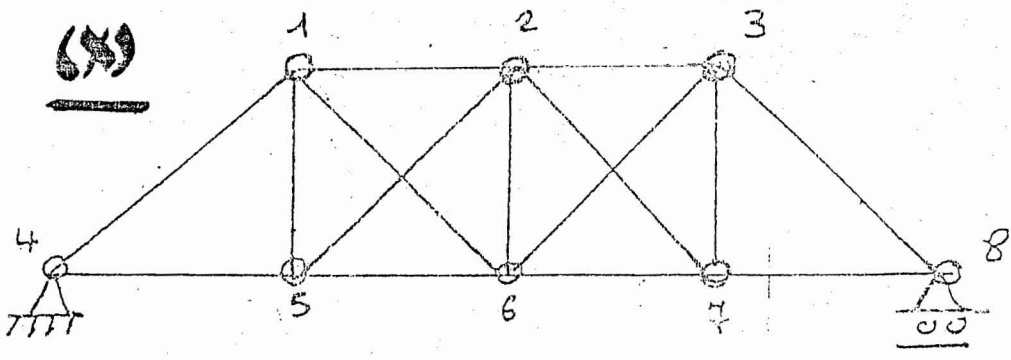
*Chrysomelids*

15/10/0

1004-7-1-11



6



\*  $m = 15$

\*  $r = 3$

\*  $J = 8$

twice indet

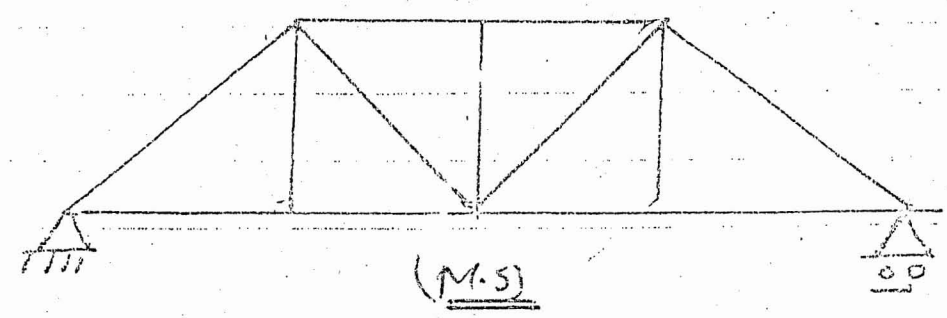
\*  $D = (m + r) - 2J = (15 + 3) - (2 \times 8) = 2$  غير محدد من الدرجة الثانية

\*  $D_{ext} = R - 3 = 3 - 3 = 0$

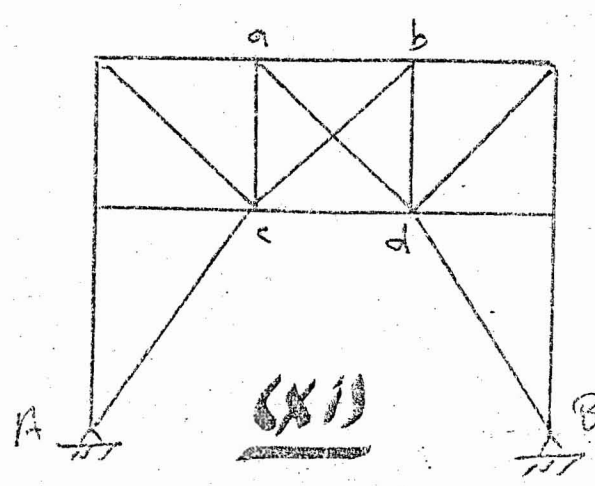
\*  $D_{int} = 2 - 0 = 2$

الحصول على (M.S) يجب حذف ضلعين مع الاحتفاظ بالاعتزافا .

يمكن حذف الضلع  
(1-2)  
(2-3)



(M.S)



\*  $m = 18$

\*  $R = 4$

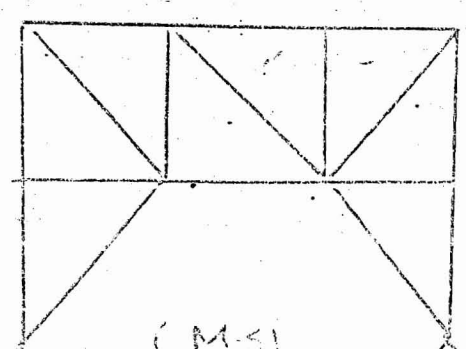
\*  $J = 10$

\*  $D = (m + r) - (2J) = (18 + 4) - (2 \times 10) = 2$  twice ind.

\*  $D_{ext} = 4 - 3 = 1$  once ext

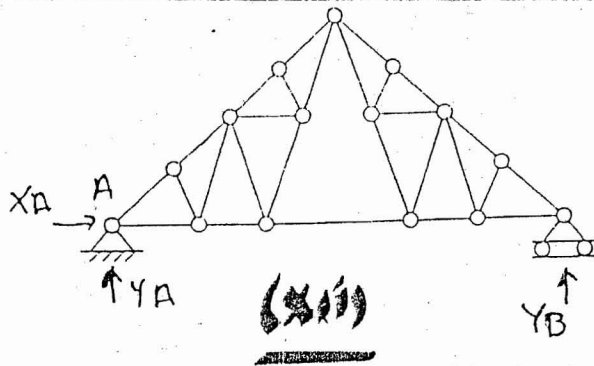
\*  $D_{int} = 2 - 1 = 1$  once int.

\* سيكون (M.S) كالآتي



(M.S)

حذف (ad أو bc) لأنه غير محدد حائليا من الدرجة الاولى  
لحذف (B أو A) roller لأنه غير محدد خارجيا



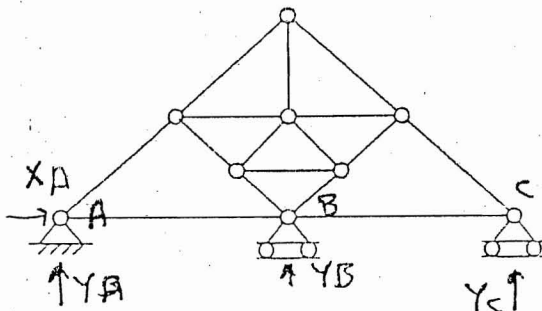
$$* m_t = 27 \quad * R = 3 \quad * J_t = 15$$

$$\therefore U = m_t + R = 27 + 3 = 30$$

$$\therefore E = 2 J_t = 2(15) = 30$$

det.

$$* D = U - E = 30 - 30 = 0.0$$



$$* m_t = 16 \quad * R = 4 \quad * J = 9$$

$$\therefore U = m_t + R = 16 + 4 = 20$$

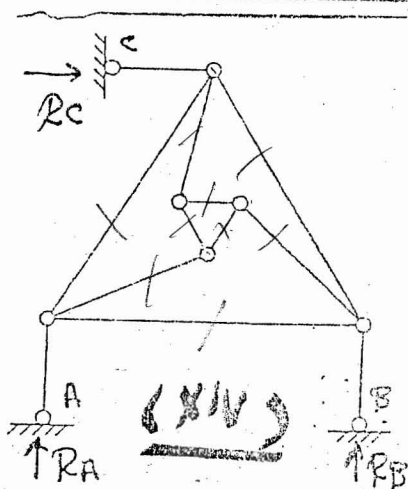
$$\therefore E = 2 J(t) = 2 \times 9 = 18$$

$$* D = U - E = 20 - 18 = 2$$

twice  
Indet

$$* D_{\text{ext}} = R - 3 = 4 - 3 = 1 \text{ ext.}$$

$$* D_{\text{int}} = D - D_{\text{ext}} = 2 - 1 = 1 \text{ Int.}$$



$$* m_t = 9 \quad * R = 3 \quad * J_t = 6$$

$$\therefore U = m_t + R = 9 + 3 = 12$$

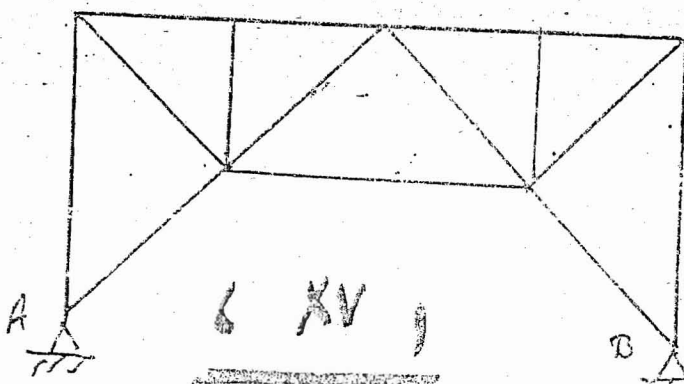
$$\therefore E = 2 J_t = 2(6) = 12$$

$$* D = U - E = 12 - 12$$

statically

$$* D_{\text{ext}} = R - 3 = 3 - 3 = 0.0 \text{ ext. determinate}$$

$$* D_{\text{int}} = D - D_{\text{ext}} = 0.0 \text{ int.}$$



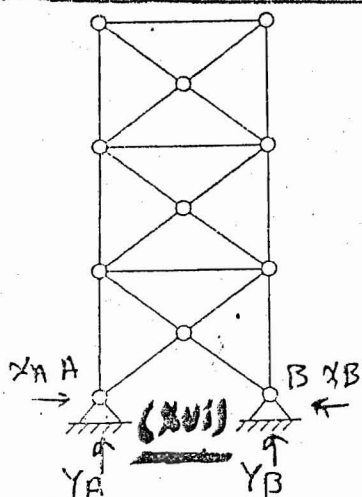
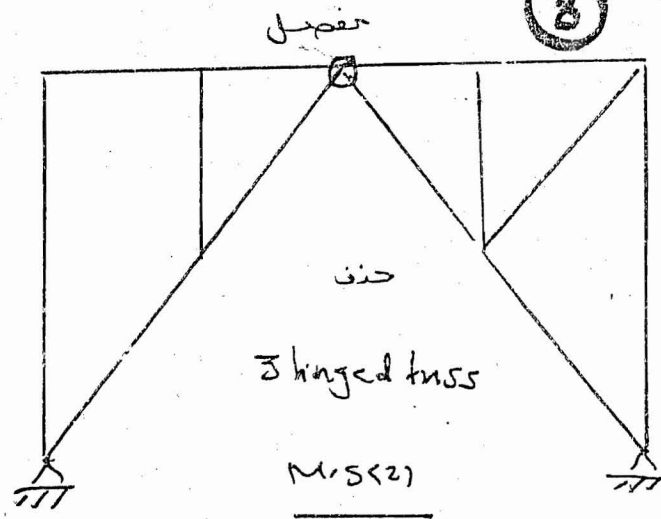
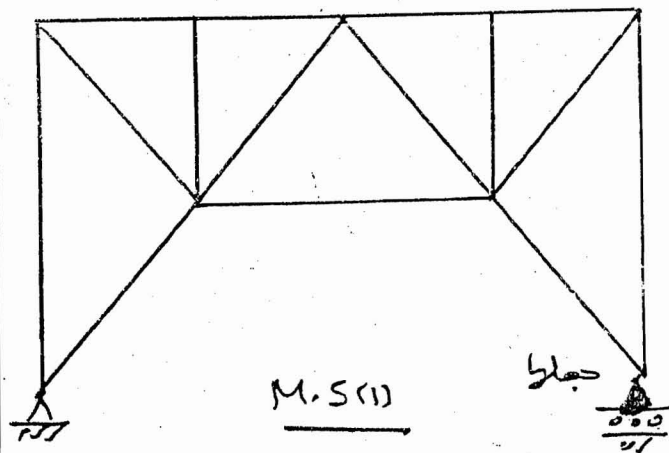
$$* m = 15 \quad * r = 4 \quad * J = 9$$

$$* U = m + r = 15 + 4 = 19$$

$$* E = 2 J = 2 \times 9 = 18$$

$$* D = 19 - 18 = 1 \text{ once indet}$$





$$* m_t = 15 \quad * R = 4 \quad * J_t = 11$$

$$* u = m_t + R = 15 + 4 = 19$$

$$* E = 2 J_t = 2(11) = 22$$

$$\therefore D = u - E = 19 - 22 = -3$$

Indeterminate (unstable)

## (C) Degree in Case of trussed Frames

### (4) Equation

\* يمكن استخدام الصيغة السابقة لـ (Frame) فقط  
(أو مع صيغة لـ (truss))

$$D = (3m_f + m_t + R) - (3J_f + 2J_t + C)$$

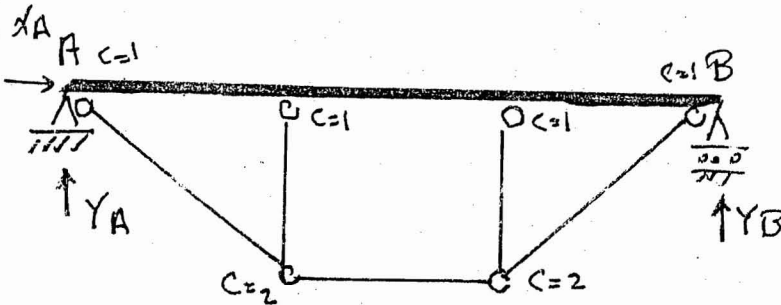
\* يمكن هناك العلاقة الموضحة التي  
تجمع بين علاقة لـ truss و لـ Frame

$3m_f + m_t + R$   
↓  
أضلاع  
↓  
أضلاع  
↓  
عدد  
↓  
الاجزاء  
↓  
الاجزاء  
↓  
الاجزاء

$3J_f + 2J_t + C$   
↓  
المفاصل  
↓  
المفاصل  
↓  
المفاصل  
↓  
المفاصل  
↓  
المفاصل

\* و لكنه حساباً على نقطة واحدة  
حداً وهي الاقواس عند المفاصل  
المستقرة بين الاطراف المتجاورة

## (2) Examples



(P) طريقة الاطار (Frame)

\*  $m = 8$     \*  $r = 3$     \*  $J = 6$     \*  $C = 8$

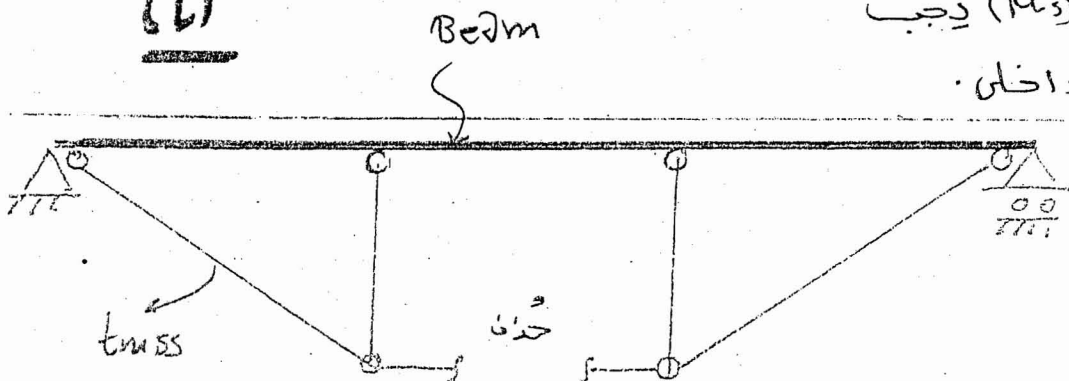
$$\begin{aligned} D &= (3m + r) - (3J + C) \\ &= (3 \times 8 + 3) - (3 \times 6 + 8) \\ &= 27 - 26 = 1 \end{aligned}$$

\*  $D_{ext} = R - (3 + c) = 3 - 3 = 0$

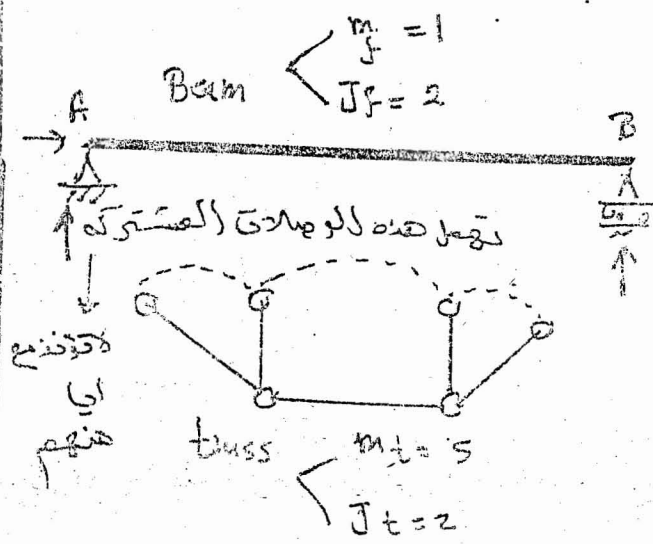
\*  $D_{int} = 1 - D = 1$

الحصول على (M) يجب  
حذف قطع داخلي

(ii)



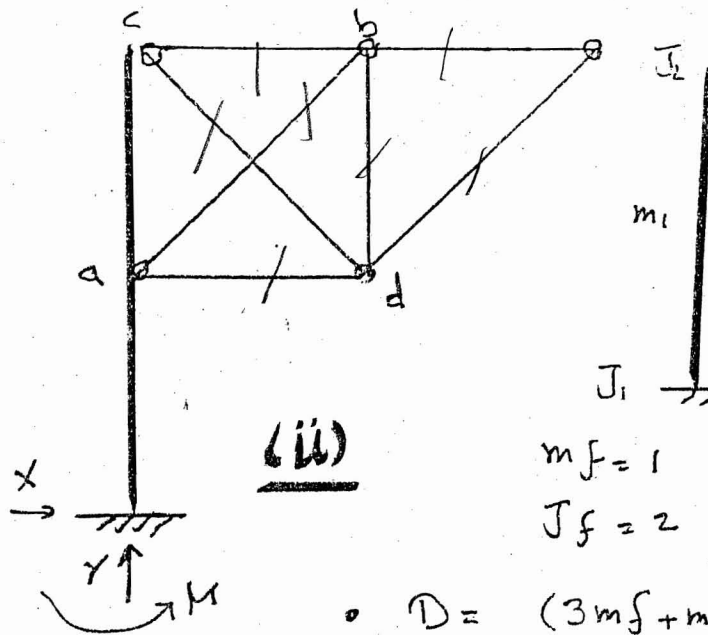
(ii) طريقة الفصل بينهم (تفكيكها)



$$\begin{aligned} D &= (3m_f + m_t + R) - (3J_f + 2J_t + C) \\ &= (3 \times 1 + 5 + 3) - (3 \times 2 + 2 \times 2 + 0) \\ &= 11 - 10 = 1 \text{ once.} \end{aligned}$$

$$\begin{aligned} D_{ext} &= R - (3 + c) \\ &= 3 - (3 + 0) = 0 \end{aligned}$$

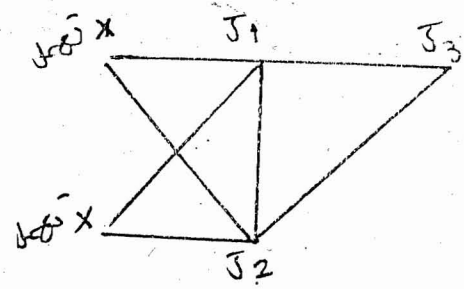
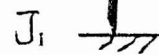
$$\begin{aligned} D_{int} &= D - D_{ext} = 1 - 0 \\ &= 1 \end{aligned}$$



(ii)

$$m_f = 1$$

$$J_f = 2$$



$$m_t = 7$$

$$J_t = 3$$

$$C = 0$$

$$R = 3$$

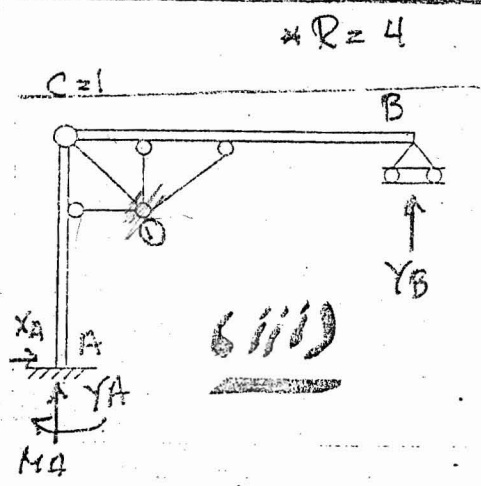
$$D = (3m_f + m_t + R) - (3J_f + 2J_t + C)$$

$$= (3 \times 1 + 7 + 3) - (3 \times 2 + 2 \times 3 + 0) = 1$$

$$D_{ext} = 3 - (3 + 0) = 0$$

$$D_{int} = 1 - 0 = 1$$

(M.S) يكون يضاف أيضا الصلعتين (ab) و (cd)



(iii)

$$R = 4$$

$$m_f = 2$$

$$J_f = 3$$

$$m_t = 4$$

$$J_t = 1$$

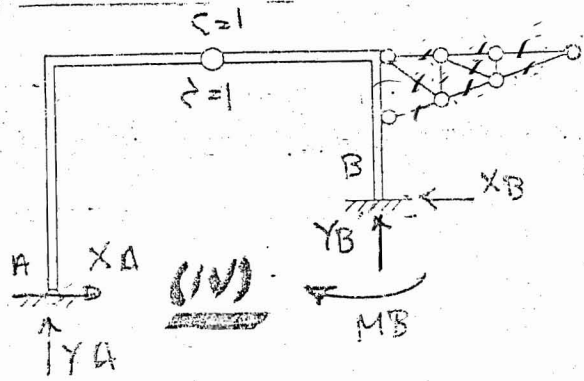
$$U = 3m_f + m_t + R = 6 + 4 + 4 = 14$$

$$E = (3J_f + 2J_t + C) = 9 + 2 + 1 = 12$$

$$D = U - E = 14 - 12 = 2 \text{ twice Indef}$$

$$D_{ext} = R - (3 + 0) = 4 - (3 + 0) = 1 \text{ (ext)}$$

$$D_{int} = 2 - 1 = 1 \text{ (int)}$$



(iv)

$$m_f = 3$$

$$m_t = 10$$

$$R = 5$$

$$U = 3m_f + m_t + R = 9 + 10 + 5 = 24$$

$$J_f = 4$$

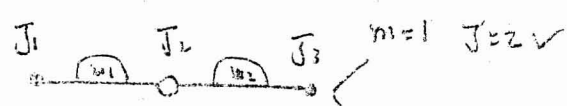
$$J_t = 5$$

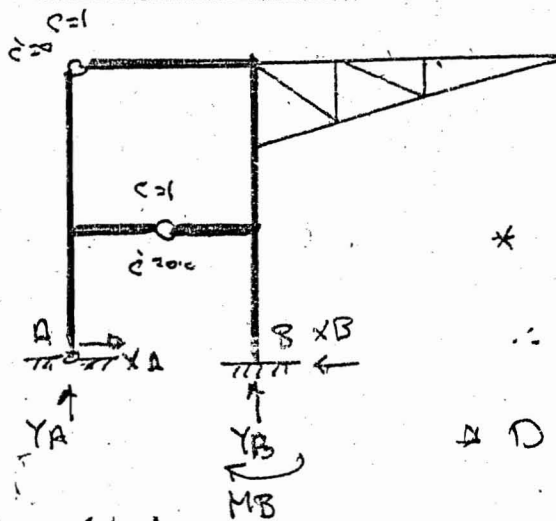
$$C = 1$$

$$E = 3J_f + 2J_t + C = 12 + 10 + 1 = 23$$

$$D = 24 - 23 = 1$$

$$D_{ext} = 5 - (3 + 1) = 1$$





(vi)

$$* m_f = 6 \quad * m_t = 10 \quad * R = 5$$

$$\therefore U = 3m_f + m_t + R = 18 + 10 + 5 = 33$$

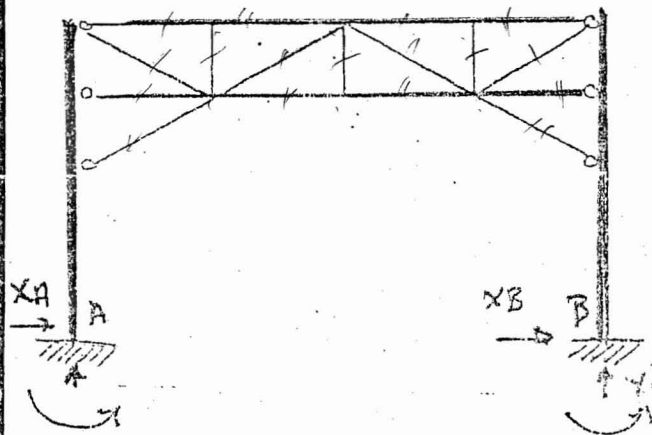
$$* J_f = 6 \quad * J_t = 5 \quad * C = 2$$

$$\therefore E = 3J_f + 2J_t + C = 18 + 10 + 2 = 30$$

$$* D = U - E = 33 - 30 = 3 \text{ 3rd Indet.}$$

$$D_{ext} = R - (3 + \dot{c}) = 5 - (3 + 0) = 5 - 3 = 2 \text{ twice e}$$

$$D_{int} = D - D_{ext} = 3 - 2 = 1 \text{ once int.}$$



(vii)

$$* m_f = 2 \quad * m_t = 17 \quad * R = 6$$

$$\therefore U = 3m_f + m_t + R = 6 + 17 + 6 = 29$$

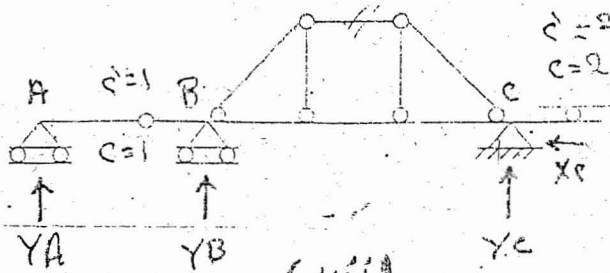
$$* J_f = 4 \quad * J_t = 6 \quad * C = 0$$

$$\therefore E = 3J_f + 2J_t + C = 12 + 12 = 24$$

$$* D = U - E = 29 - 24 = 5 \text{ 5th Indet.}$$

$$\therefore D_{ext} = R - (3 + \dot{c}) = 6 - 3 = 3 \text{ ext}$$

$$\therefore D_{int} = D - D_{ext} = 5 - 3 = 2 \text{ Int}$$



(viii)

$$* m_f = 3 \quad * m_t = 5 \quad * R = 6$$

$$\therefore U = 3m_f + m_t + R = 9 + 5 + 6 = 20$$

$$* J_f = 4 \quad * J_t = 2 \quad * C = 3$$

$$\therefore E = 3J_f + 2J_t + C = 12 + 4 + 3 = 19$$

$$* D = 20 - 19 = 1 \text{ once Ind}$$

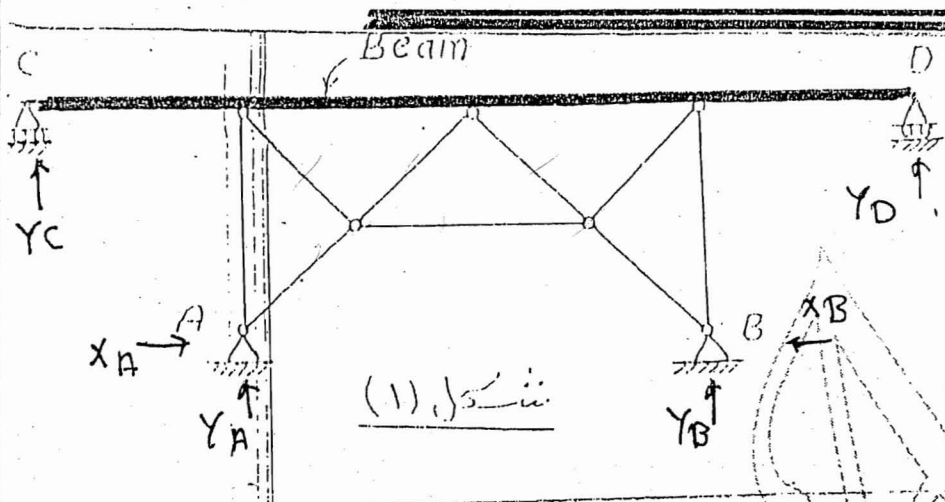
$$* D_{ext} = 6 - (3 + 3) = 0$$

$$* D_{int} = 1 - 0 = 1$$

Not a rigid

# مثلة امتحانات (د)

12



للعمرة الشبكية المبينة بشكل (1)  
المطلوب:

(أ) تحديد الحالة الإستاتيكية للعمرة.

(ب) بيان أحد الأنظمة الأساسية  
للعمرة (Main System)

Prob(1)

(P) Degree

$$* m_f = 1 \quad * m_t = 9 \quad * R = 1 + 1 + 2 + 2 = 6$$

$$\therefore U = 3m_f + m_t + R = 3(1) + 9 + 6 = 18$$

$$* J_f = 2 \quad * J_t = 4 \quad * C = 0.0 \quad c = 0.0$$

$$\therefore E = 3J_f + 2J_t + C = 6 + 8 + 0 = 14$$

$$* D = U - E = 18 - 14 = 4$$

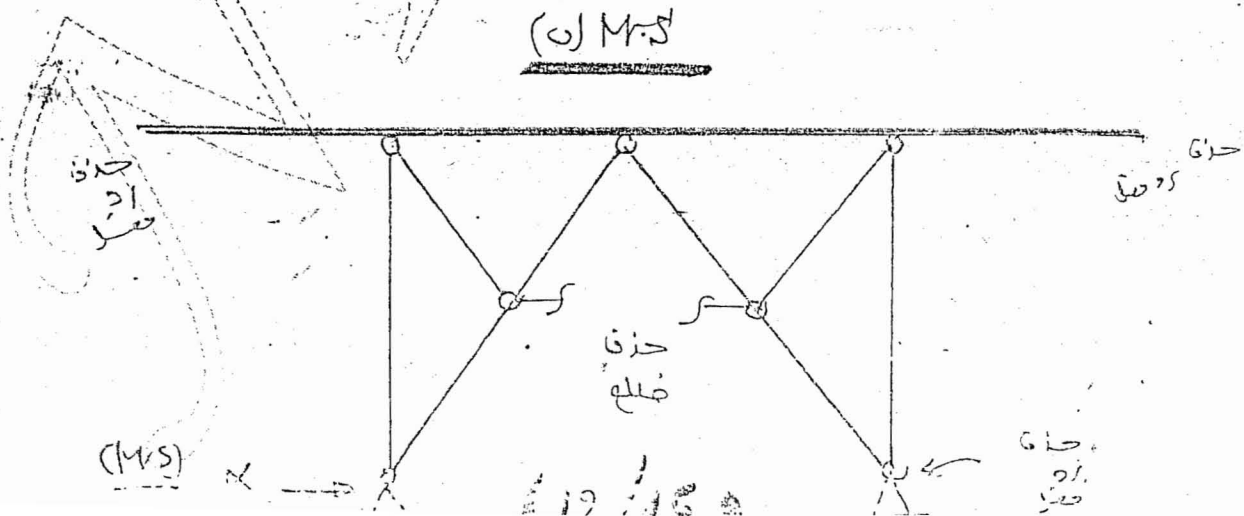
$$* D_{ext} = R - (3 + c)$$

$$\therefore D_{ext} = 6 - (3 + 0) = 3$$

$$* D_{int} = D - D_{ext} = 4 - 3 = 1$$

حذف ضلع

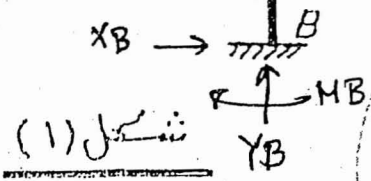
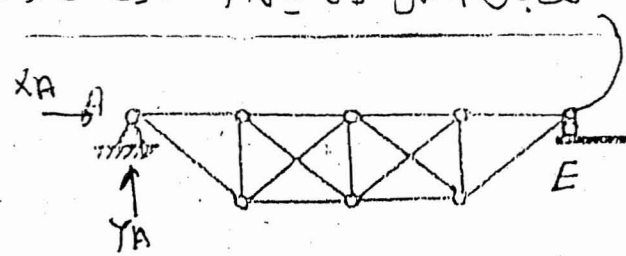
(ن) M.S



تعتبر Joint لأنه على الصوص على البركة

Prob (2)

13



شكل (1)

المنشأ المبين بشكل (1)

المطلوب :-

(1) تحديد الحالة الإستاتيكية للمنشأ.

(2) بيان عدد الأنظمة الأساسية

لل منشأ (Main System)

A) Degree

\*  $m_f = 3$       \*  $m_t = 15$       \*  $R = 6$

$\therefore u = 3m_f + m_t + R = 30$

\*  $J_f = 3$       \*  $J_t = 8$       \*  $C = 2$

$\therefore E = 3J_f + 2J_t + C = 27$

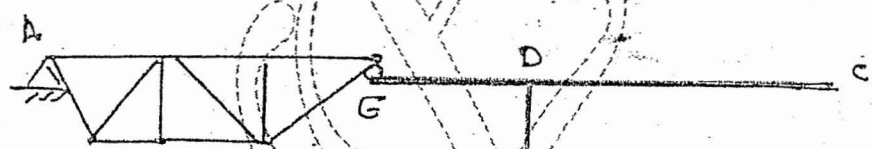
\*  $D = u - E = 30 - 27 = 3$  Indet.

\*  $C' = 2$

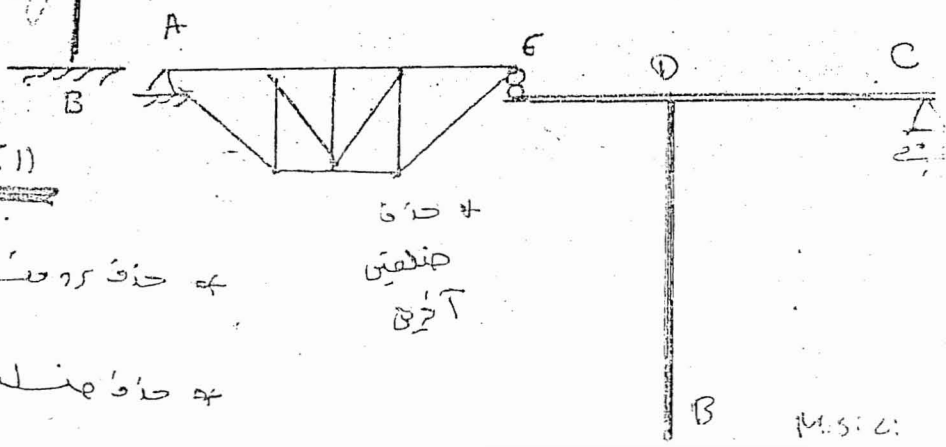
$\therefore D_{ex} = R - (3 + C') = 6 - (3 + 2) = 1$

$\therefore D_{int} = D - D_{ex} = 3 - 1 = 2$

(u) M.S.



M.S. (1)



\* حواف متصلة خارجي (C) \*  
\* حواف متصلة داخلي (I) \*  
\* حواف متصلة (C) \*  
\* حواف متصلة (I) \*

حواف متصلة  
داخلية

B

M.S. (2)



# (E) Home work

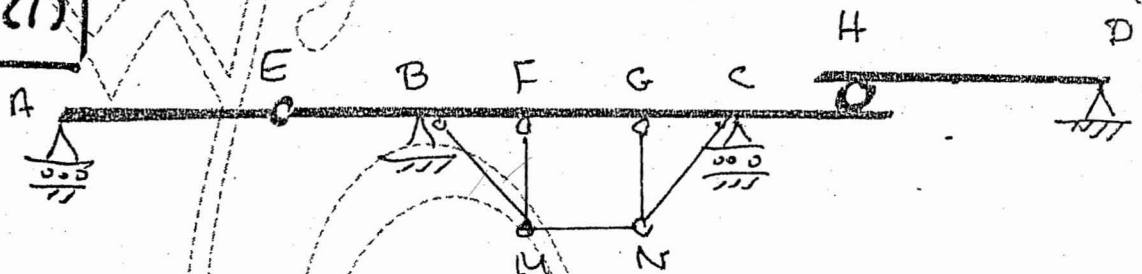
14

\* For The following structures

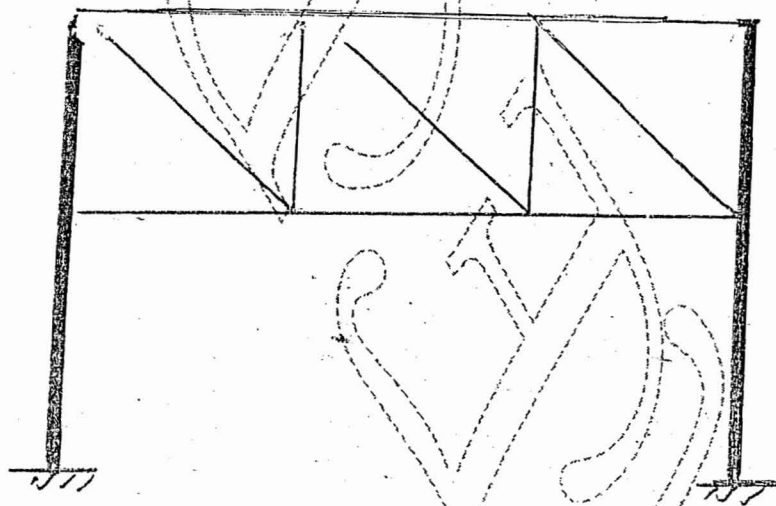
(i) Calculate The degree of indeterminacy

(ii) Suppose one suitable main system

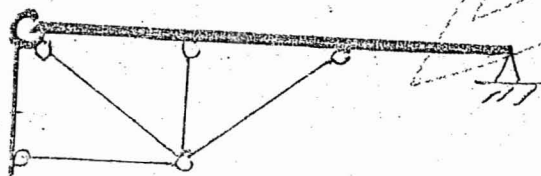
prob(1)



prob(2)

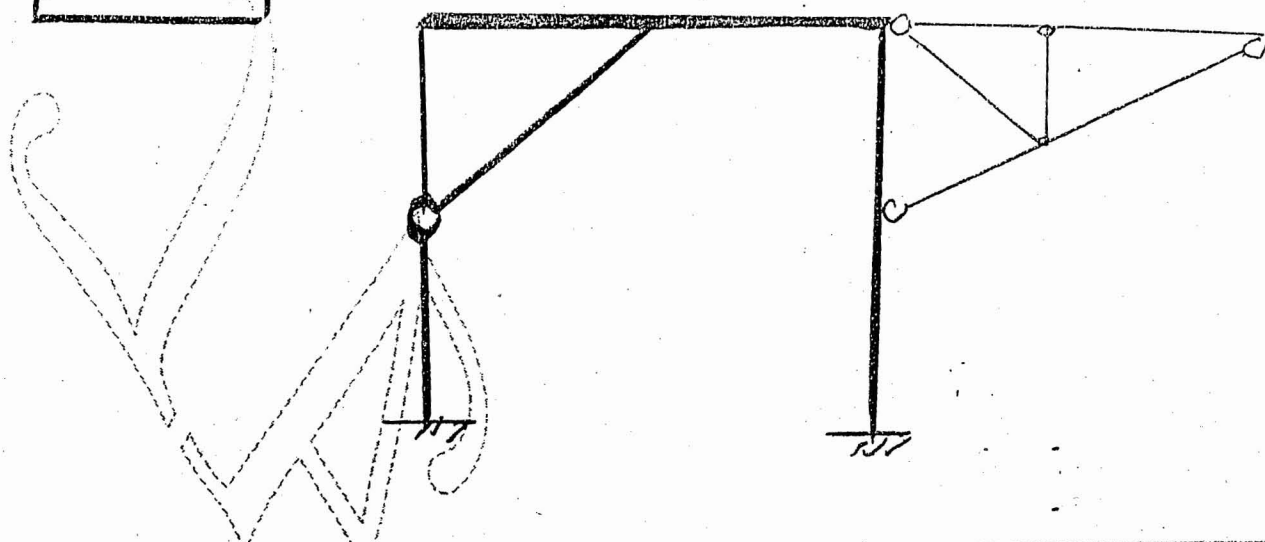


prob(3)



Prob (4)

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Prob (5)

