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Section = Senior.

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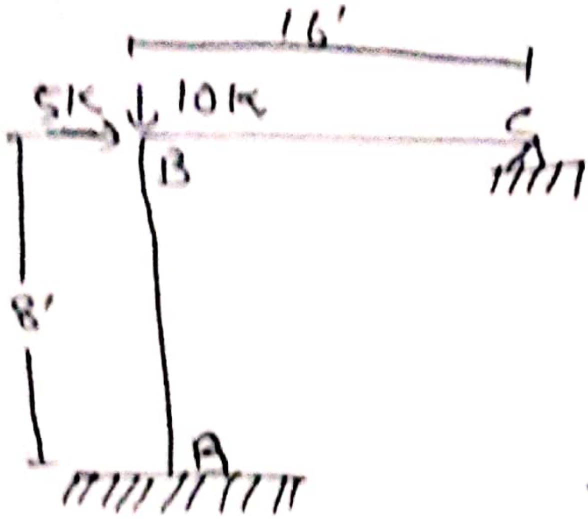
IQRA NATIONAL UNIVERSITY.

Q NO# 03
Problem:-



$E = $ Constant

$I_c = I$

$I_B = 2I$

Solution:

Total Statical indeterminacy.

$\Rightarrow R - 3 = 5 - 3 = 2$°0°

Step# 01 :: Identify Redundant Actions

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \quad \begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Step# 02 :: Compute value of [DRL]

P.T.O

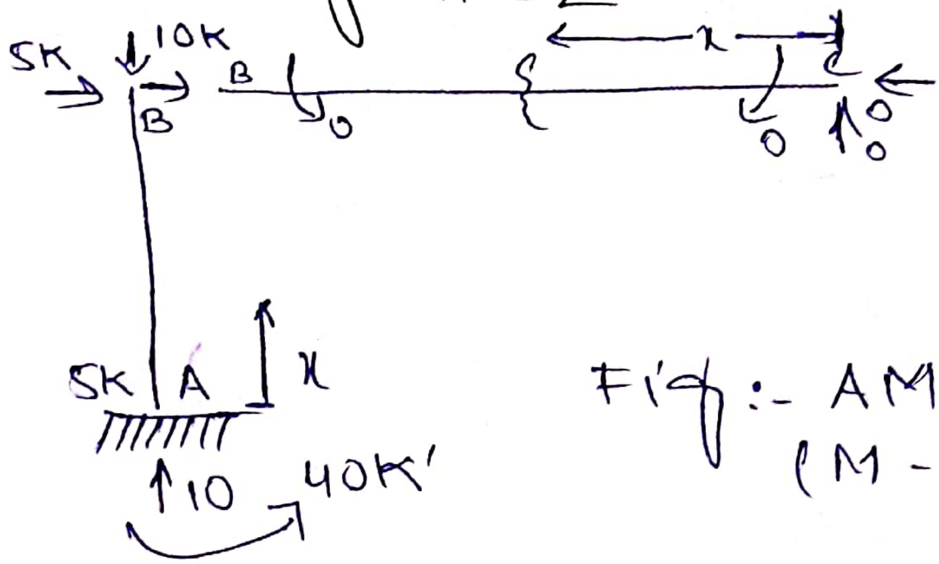


Fig:- AML values (M-values).

Step#03 :- [F]. or [AMR].

a)

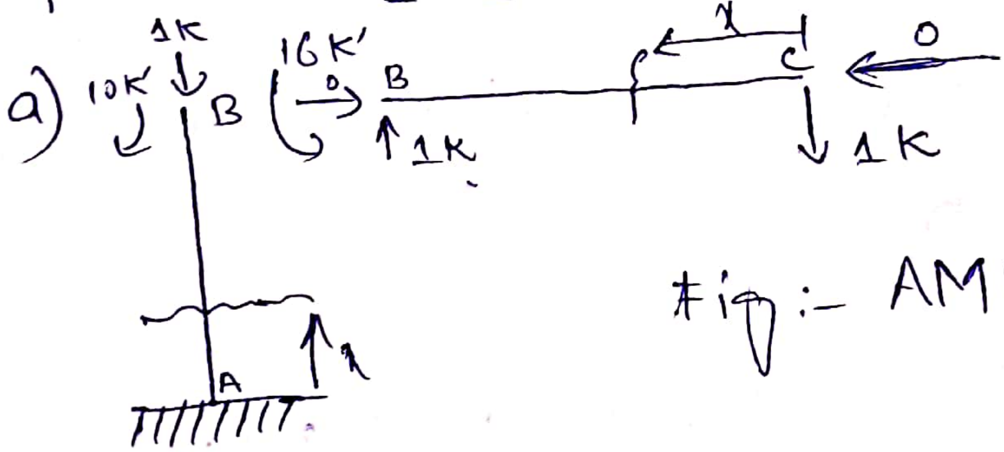


Fig:- AMR-values. (M_1 values)

b)

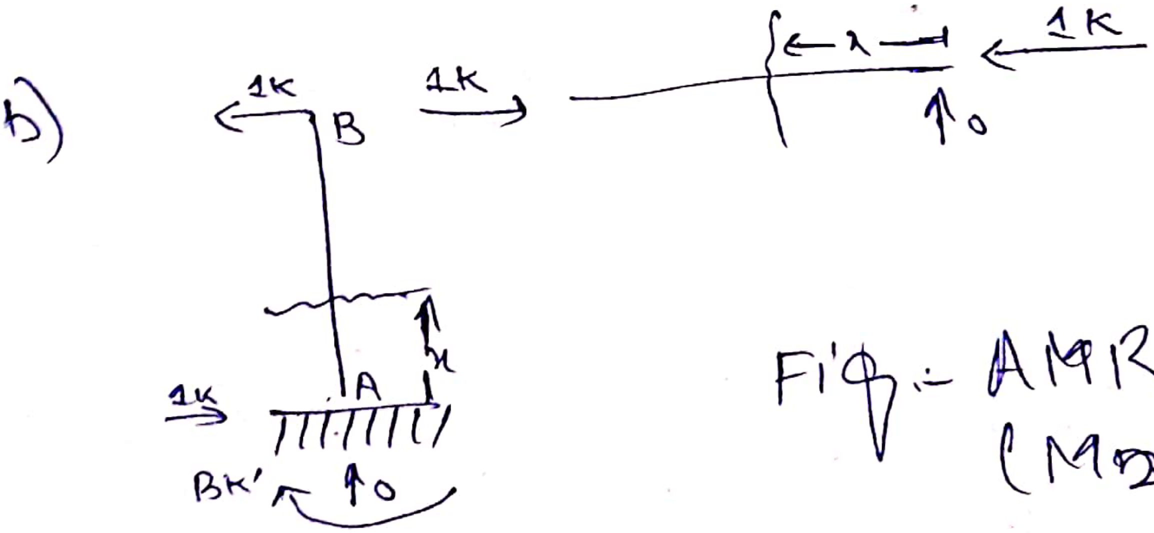


Fig:- AMR values (M_2 values)

Member	AB	BC
Origin	A	c
I	0-8	0-16
M	I	2I

Select origin should be select the support

Take x-section mly AML fig and Find moment

M	$5x - 40$	0
m_1	-16	Tak x section x → mm1 fig from the origin
m_2	$8 - x$	0

⇒ For Finding values of DRL's :-

$$DRL_1 = \int_0^8 \frac{M_{AB} \cdot M_1(AB)}{EI} + \int_0^{16} \frac{M_{BC} \cdot M_2(BC)}{EI}$$

$$= \int_0^8 \frac{(5x-40)(-18)\,dx}{EI} + \int_0^{16} \frac{0 \cdot 0}{E(2I)}\,dx.$$

$$DRL_1 = \frac{2560}{EI}$$

$$DRL_2 = \int_0^8 \frac{(5x-40)(-18)\,dx}{EI} + \int_0^{16} \frac{0 \cdot 0\,dx}{E(2I)}$$

$$DRL_2 = \frac{-853.33}{EI}$$

⇒ Compute Flexibility matrix :-

P.T.O

$$F_{2\times 2}^{q^{2^\circ}} = \begin{pmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{pmatrix}$$

$$= F_{11} = \int_0^8 \frac{m_1^2 (BB)}{EI} + \int_0^{16} \frac{m_1^2 (BC)}{EI} = \int_0^8 \frac{(-16)^2 dx}{EI} + \int_0^{16} \frac{x^2}{E(2I}$$

$$F_{11} = \frac{2730.67}{EI}$$

$$F_{12} = F_{21} = \int_0^8 m_1 (AB) \cdot m_2 (AB) + \int_0^{16} m_1 (BC) \cdot m_2 (BC)$$

$$= \int_0^8 \frac{(-16)(8-x)}{EI} dx + \int_0^{16} \frac{(x)(0)}{2EI} dx$$

$$= F_{12} = F_{21} = \frac{-512}{EI}$$

$$= F_{22} = \int_0^8 (m_2)^2_{AB} dx + \int_0^{16} (m_2)^2_{BC} dx$$

P.T.O

$$= \int_0^8 (8-x)^2 dx + \int_0^{16} \frac{0^2}{2EI} dx$$

$$= F_{22} = 170.67.$$

As we know-

$$[DRS] = [DRL] + [AR] \times [F]$$

$$\Rightarrow [AR] = \frac{[DRS] - [DRL]}{[F]}$$

$$(2)\ [AR] = [F]^{-1} \times [DRS - DRL]$$

$$= \begin{bmatrix} 2730.67 & -512 \\ -512 & 170.67 \end{bmatrix}^{-1} \times \begin{bmatrix} 0 - 2560 \\ 0 + 853.33 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.00005 \\ 4.997 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}.$$

1) mode → matrix (disk) (disk)
2) matA (1)
3) select or der.
4) put value &
Click =
5) press [on].
6) shift + 4
7) press 1 (Dim and s)
8) press 2 (Mat B)
9) select order &
put values.
10) press on
11) shift + 4s.
12) mat A × mat B
= Result.

* *

QNO#02:-

Ans:- In the force method of analysis primary unknown are force in this method compatibility equations written for displacement &

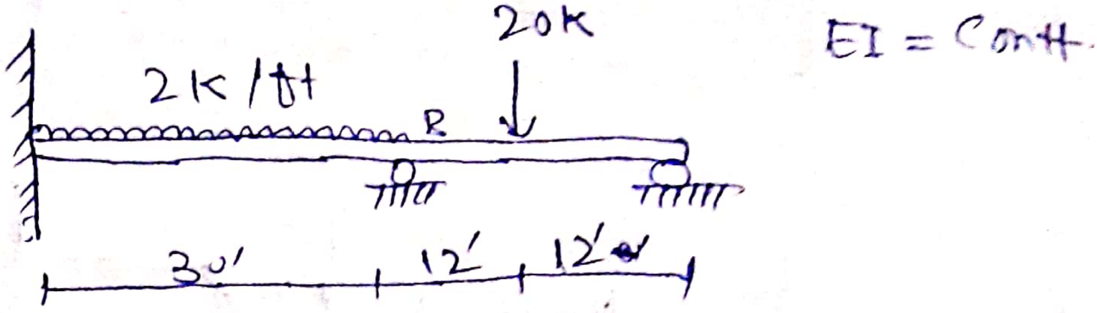
P.T.O

rotations which are calculated by force displacement equation in the displacement method of analysis the primary unknowns are the displacement.

Force methods	Displacement methods
1) method of consistent deformation.	1) Slope deflection method.
2) theorm of least work.	2) moment distribution method
3) Column analogy method.	3) Kani's method.
4) Flexibility matrix method	4) Stiffness matrix method.
⇒ Type of indeterminacy static indeterminacy.	⇒ Types of indeterminacy kinematic indeterminacy.
⇒ Governing Governing equation compatibility equations.	⇒ Governing equation equilibrium equation.
⇒ Force displacement relations flexibility matrix.	⇒ Force displacement relation stiffness matrix.
⇒ Assume force as unknown	⇒ Assumed displacement relation as unknown.
⇒ preferable when structure has less static indeterminacy	⇒ preferable when structure has less kinematic indeterminacy.
⇒ Known as flexibility method eg consistent method of deformation.	⇒ Known as stiffness method eg slope displacement method eg moment distribution method.

Q NO# 01:

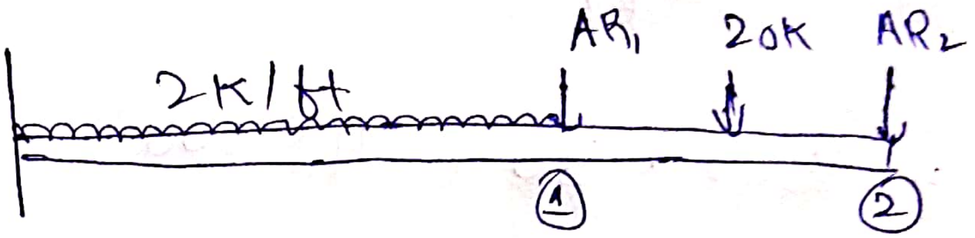
Solution:-



Sol:-

Structure indeterminancy = 2°

Step # 01 Select Redundant Actions.

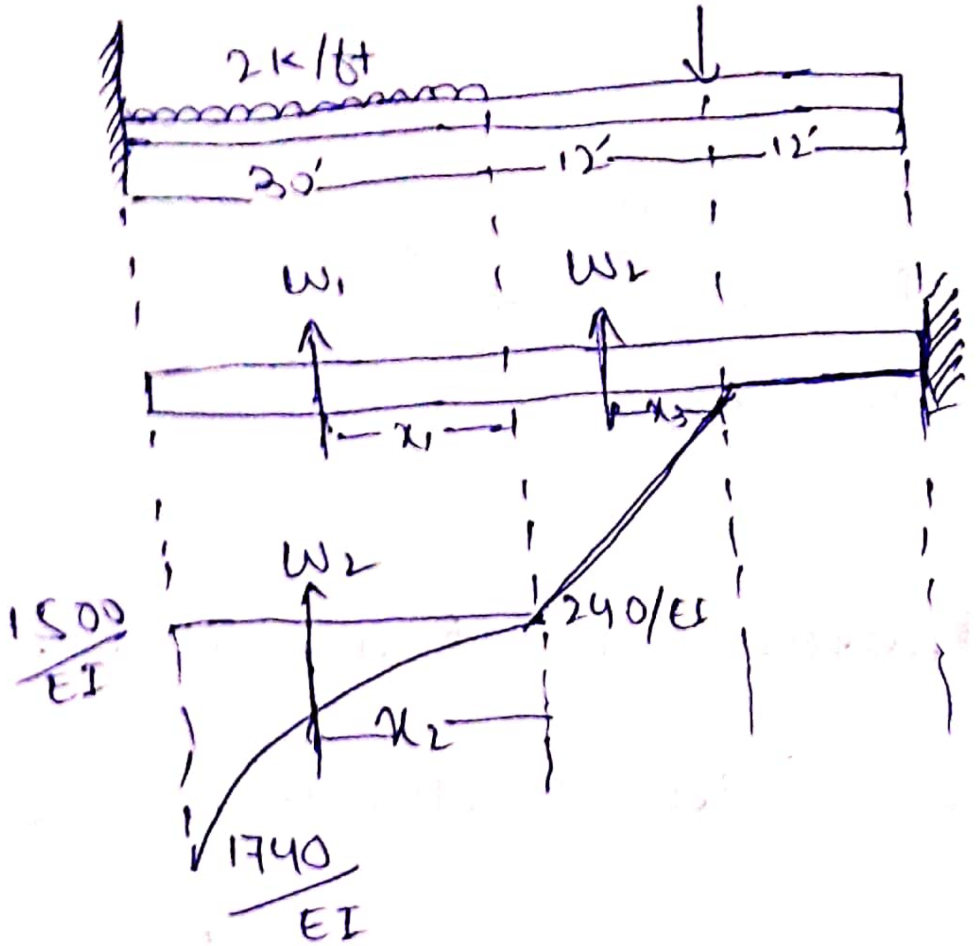


$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

$$[DRS] = [DRL] + [F] \times [AR].$$

Step #02: Compute the value of [DRL]

P.T.O



$20 \times 12 = 240$

$20 \times (12 + 30) + 2 \times 30 \times 15) = 1740$

$w_1 = 1500 \times 30 = 45000$

$w_2 = \frac{1}{3} \times 30 \times 240 = 2400$

$w_3 = \frac{1}{2} \times 12 \times 240 = 1440$

$x_1 = b/2 = \frac{30}{2} = 15'$

$x_2 = \frac{3}{n+2} \times 1 = \frac{3}{2+2} \times 30 = 22.5'$

P.T.O

$x_3 = 2/3 \times L = 2/3 \times 12 = 8'$

Now finding DRL :

$DRL_2 = W_1 \times (x_1 + 24) + W_2 \times (x_2 + 24) +$
$W_3 \times (x_3 + 12)$

$= 45000(15+24) + 2400(22.5+24) +$
$1440(8+12)$

$= 1755000 + 111600 + 28800$

$DRL_2 = 1895400/EI$

$DRL_1 = W_1(x_1) + W_2(x_2)$

$= 45000(15) + 2400(22.5)$

$= 675000 + 54000$

$= 729000$

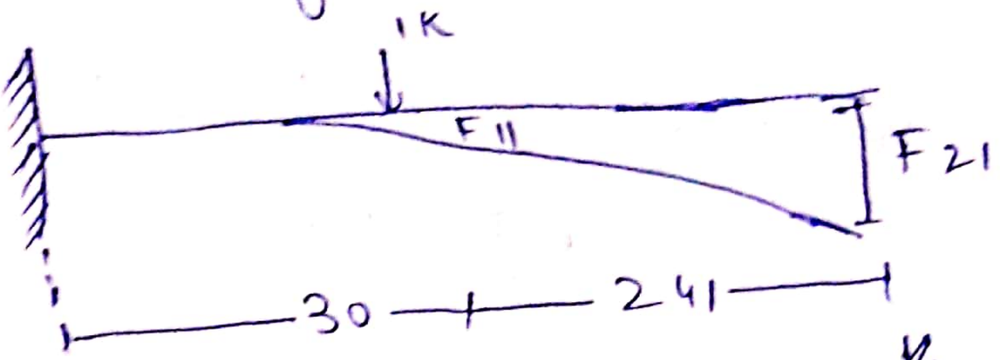
So, $DRL = \frac{1}{EI}\begin{pmatrix} 729000 \\ 1895400 \end{pmatrix}$

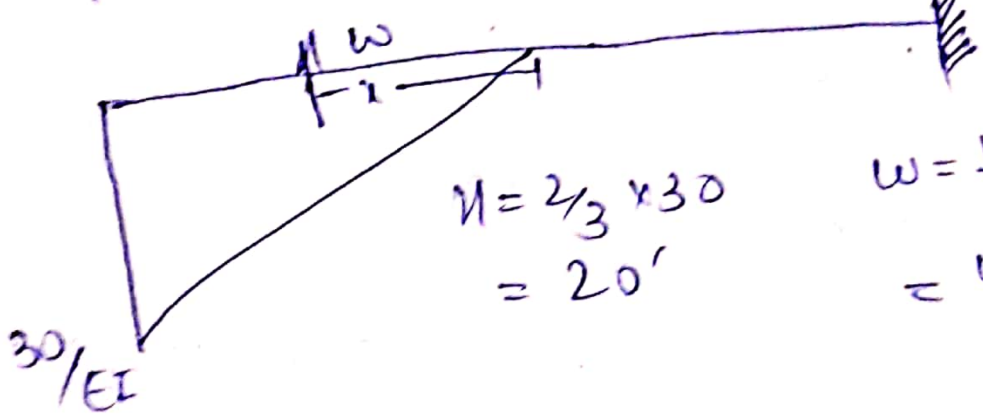
P.T.O

Step # 03 :- Flexibility matrix.

$$[F]_{2\times 2} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}.$$

a) Applying unit load on AR_1.





$$x = \tfrac{2}{3} \times 30 = 20'$$

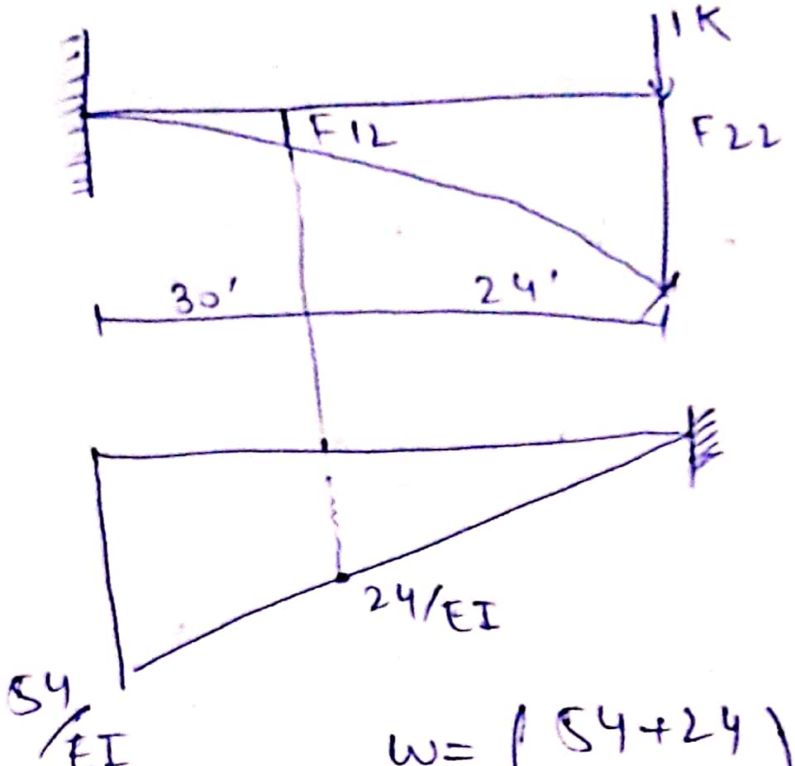
$$w = \tfrac{1}{2}\left(\tfrac{30}{EI} \times 30\right) = 450/EI$$

So, $F_{11} = \dfrac{450}{EI}(20) = 9000/EI$

$F_{21} = \dfrac{450}{EI}(20+24) = 19800/EI$

Now. Apply unit load on AR_2 :-

P.T.O



$$w = \left(\frac{54+24}{2EI}\right) \times 30$$

$$= 1170/EI.$$

Now the distance,

$$\Rightarrow F_{12} = x = \frac{L}{3}\left[\frac{b+2(a)}{a+b}\right]$$

$$\Rightarrow F_{22} = \frac{30}{3}\left[\frac{24+2(54)}{54+24}\right] = \frac{19796.4}{EI}$$

Hence.

$$F_{2\times2} = \begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix} \frac{1}{EI}$$

Step # 04:: Compute the values of AR.

$$[DRS] = [DRL] + [F] \times [AR]$$

$$[AR] = [BRS - DRL] \times [F]^{-1}.$$

$$[F]^{-1} = \frac{1}{|F|} \times Adj\ F$$

$$= \frac{1}{\begin{vmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{vmatrix}} \times Adj \begin{bmatrix} 9000 & 197964 \\ 19800 & 478764 \end{bmatrix}$$

$$|F| = (9000 \times 47876.4 - 19796.4 \times 19800)$$

$$(430887600 - 391968720)$$

$$\Rightarrow |F| = 38918880.$$

$$\Rightarrow Adj\ A = \begin{bmatrix} 47876.4 & -9796.4 \\ -19800 & 9000 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} \frac{1}{EI} \times \frac{1}{3918880} \begin{bmatrix} 47876.4 & -9796.4 \\ -19800 & 9000 \end{bmatrix}$$

$$= \begin{bmatrix} -729000 \\ -1895400 \end{bmatrix} \frac{1}{EI} \times \frac{\begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}}{38918880}$$

P.T.O

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 66.193 \\ -67.505 \end{bmatrix}$$

*** the End of paper. ***