1

NAME # "QAISER SIDDIQUE"

ID # "7863"

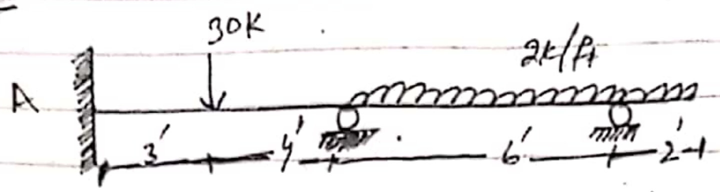
SECTION # 'B'

SMESTER # "SUMMER - 2020"

SUBJECT # "Structural Analysis - II"

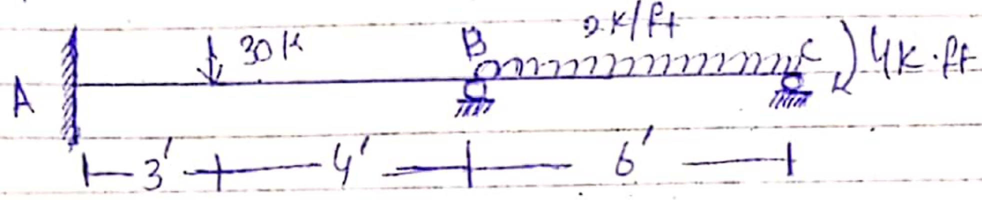
SUBMMITED TO #
"ENGR. ADEED KHAN"

Q.NO:1



⇒ Solution:

⇒ Step no.1:
kinematic Indeterminacy.
$K.I = 5^{\circ}$
So we have to reduce the extended portion.

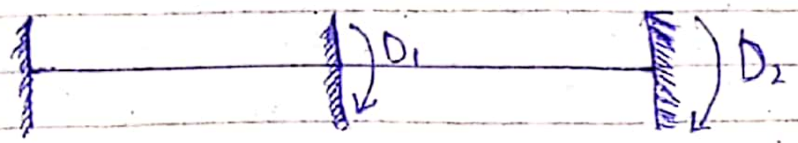


$\Rightarrow \frac{2(2)}{1} = 4\ k.ft.$

Now :-
$K.I = 2^{\circ}$

⇒ Step #02

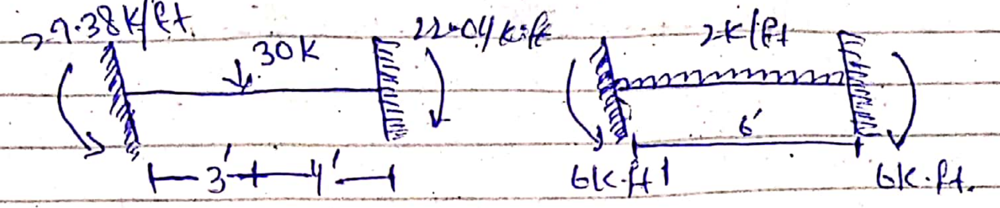
⇒ Determine Unknown Joint displacement.



$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$ $\begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 4 \end{bmatrix}$

Step # 03

compute [ADL] matrix.



⇒ for pointed load (not at mid)
⇒ for left end :-

$$= \frac{Pab^2}{L^2} = \frac{(30)(3)(4)^2}{(7)^2} = 29.38 \text{ k.ft.}$$

⇒ for Right end :-

$$\Rightarrow \frac{Pa^2b}{L^2} = \frac{(30)(3)^2(4)}{7^2} = 22.04 \text{ k.ft.}$$

⇒ for UDL :-

$$\frac{wL^2}{12} \Rightarrow \frac{(2)(6)^2}{12} = 6 \text{ k-ft.}$$

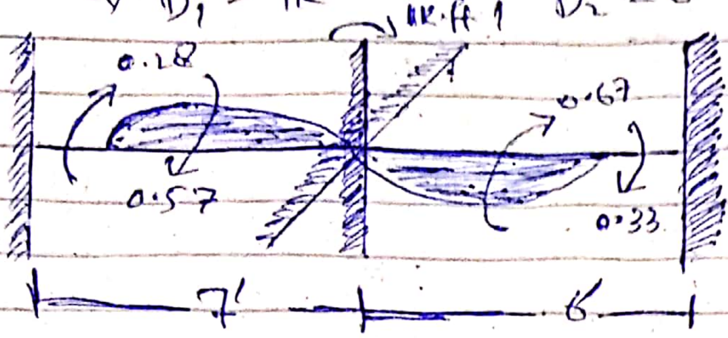
$ADL_1 = +22.04 - 6. = 16.04$ ft.k.
$ADL_2 = 6$ k.ft.

⇒ Step # 04
compute (S) matrix

$$S = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}$$

(4)

a) $D_1 = 1K$ $D_2 = 0$



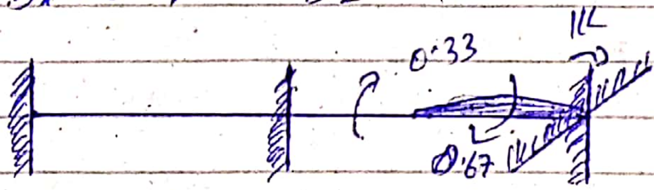
$\frac{4EI}{7} = 0.57$ | $\frac{2EI}{6} = 0.33$

$\frac{4EI}{6} = 0.67$ | $\frac{2EI}{7} = 0.28$

$\delta_{11} = 0.57 + 0.67$
$= 1.24EA$

$\delta_{21} = 0.33\,EA$

(B) $D_1 = 0$, $D_2 = 1K$



$\frac{4EI}{6} = 0.67$

$\frac{2EI}{6} = 0.33$

$\delta_{12} = 0.33$
$\delta_{22} = 0.67$

(5)

Step # 5

Compute "D" matrix

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}^{-1} \times \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} - \begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix}$$

$$= \frac{1}{\begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}} \times \text{adj} A.$$

$$|S| = (1.24 \times 0.67) - (0.33 \times 0.33)$$

$$= 0.8308 - 0.1089$$

$$|S| = 0.7219$$

$$\text{Adj } A = \begin{bmatrix} 0.67 & -0.33 \\ -0.33 & 1.24 \end{bmatrix}$$

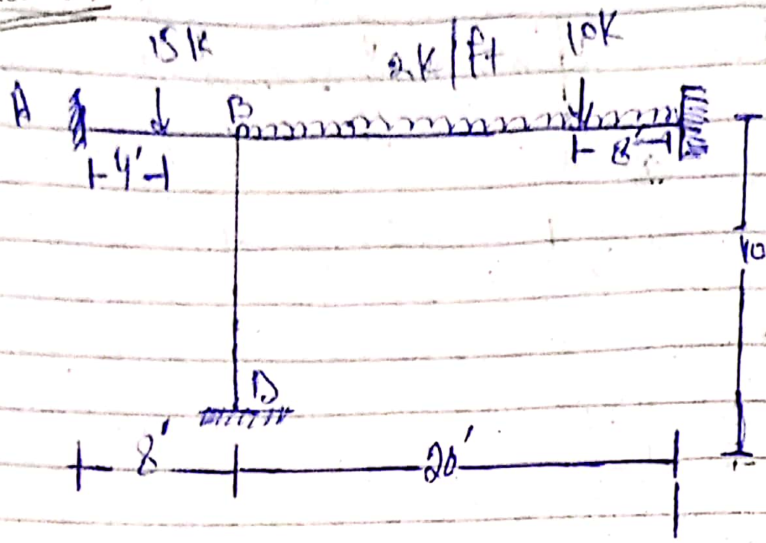
Now

$$\begin{bmatrix} AD_1 - ADL_1 \\ AD_2 - ADL_2 \end{bmatrix} = \begin{bmatrix} 0 - 16.04 \\ 4 - 6 \end{bmatrix} = \begin{bmatrix} -16.04 \\ -2 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \frac{\begin{bmatrix} 0.67 & -0.33 \\ -0.33 & 1.24 \end{bmatrix} \times \begin{bmatrix} -16.04 \\ -2 \end{bmatrix}}{0.7219}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} \quad \end{bmatrix}$$

Q No. 2



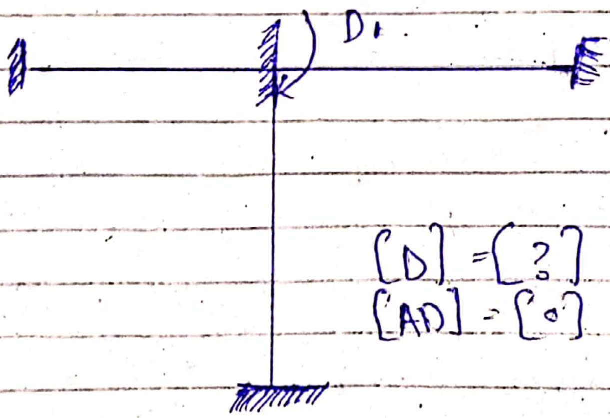
⇒ Step no. 1 :

~~Determinacy~~ Kinematic Indeterminacy

$K.I = 1^{\circ}$

⇒ Step : 02

Determine unknown Joint displacements

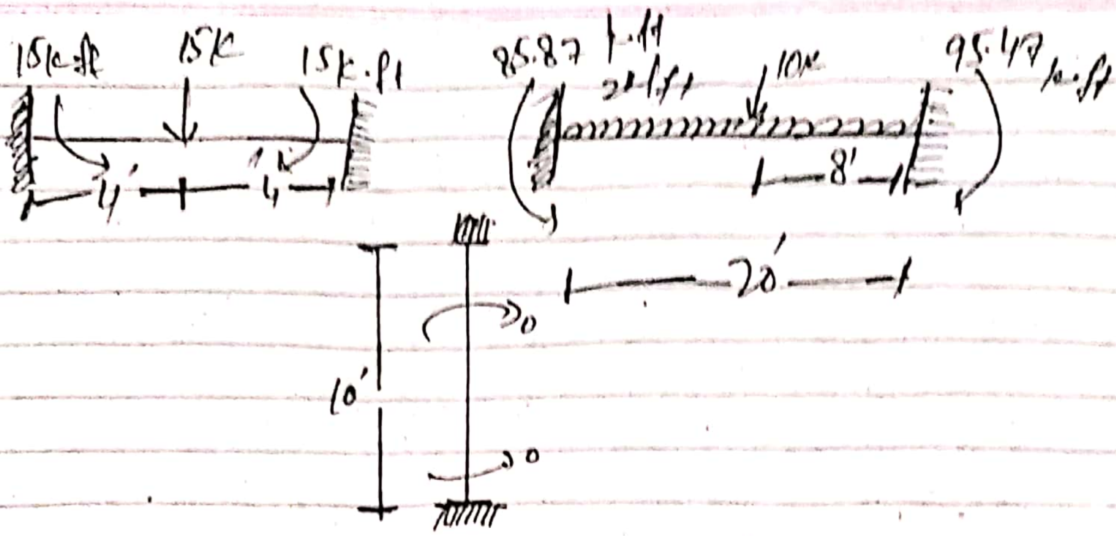


$[D] = [?]$

$[AD] = [0]$

⇒ Step # 3

Compute [ADL] Matrix.



→ Point load at centre :-

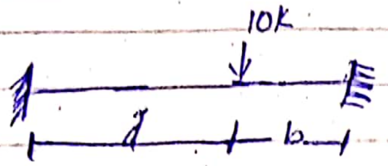
$$\frac{PL}{8} \Rightarrow \frac{(15)(8)}{8} = 15 \text{ kip.ft}$$

⇒ Uniformly Distributed Load :-

$$\frac{wL^2}{12} \Rightarrow \frac{(2)(20)^2}{12} = 66.67 \text{ k.ft}$$

⇒ point load (Not a mid) :-

Suppose :-



* For left END :-

$$\frac{Pab^2}{L^2} = \frac{(10)(12)(8)^2}{(20)^2} = 19.2 \text{ k-ft}$$

* For right End :-

$$\frac{Pa^2b}{L^2} = \frac{(10)(12)^2(8)}{(20)^2} = 28.8 \text{ k.ft}$$

So total movement at left end.

$19.2 + 66.67 = 85.87$ k.ft.

Similarly at right end:

$28.8 + 66.67 = 95.47$ k.ft.

So; $(ADL) = -85.87 + 15 = 70.87$ k.ft.

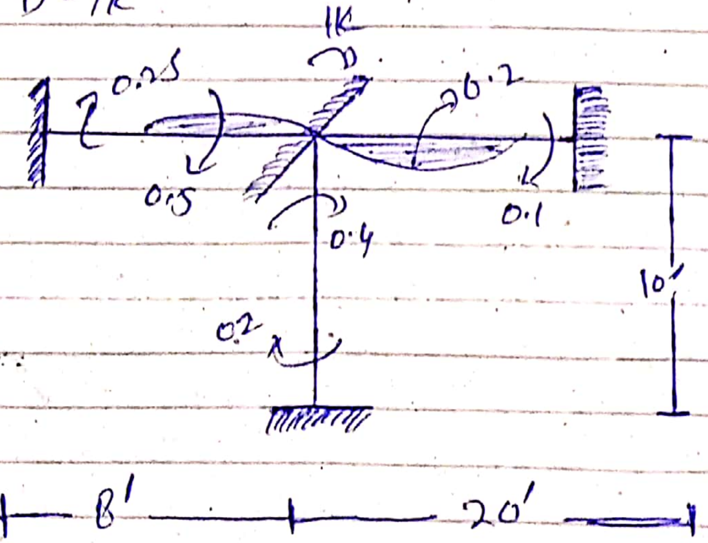
⇒ **Step#4:**

Determin [S] matrix.

$[S] = [S_{11}]$

Now:-

$D = 1k$



$= \frac{4EI}{8} = 0.5$ $\qquad \frac{2EI}{8} = 0.25$

$\Rightarrow \frac{4EI}{20} = 0.2$ $\qquad \frac{2EI}{20} = 0.1$

$\Rightarrow \frac{4EI}{10} = 0.4$ $\qquad \frac{2EI}{10} = 0.2$

$[S] = (0.5 + 0.4 + 0.2)\, EI$

$= 1.1 \; EI$

$[S] = 1.1\, EI$

$\Rightarrow$ **Step # 05:**

Compute $[D]$ matrix.

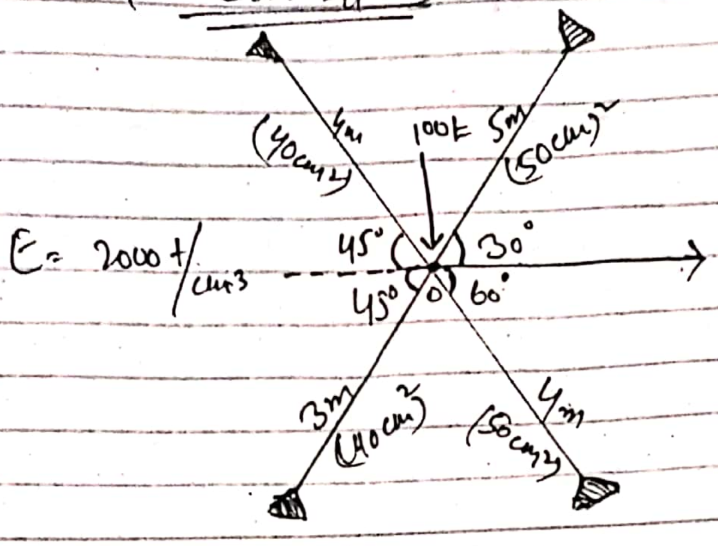
$[D] = [S]^{-1} \times [AD] - [ADL]$

$[D] = \frac{1}{1.1} \times [0] - [-70.87]$

$= \left[\frac{70.87}{1.1}\right]$

$[D] = [64.42]\; {}^{1}/_{EI}$

Problem # 03 :-



Sol :-

For A :-

$$\sin 45^\circ = \frac{P}{h} = \frac{P}{4}$$

$$\Rightarrow P = 2.828 \text{ m}$$

$$\cos 45^\circ = \frac{b}{4}$$

$$\Rightarrow b = 2.828 \text{ m}$$

For B :-

$$\sin 45^\circ = \frac{P}{3}$$

$$\Rightarrow P = 2.12 \text{ m}$$

$$\cos 45^\circ = \frac{b}{h}$$

$$\Rightarrow b = 2.12 \text{ m}$$

For C :-

$$\sin 30^\circ = \frac{P}{h=5}$$

$$\Rightarrow P = 2.5 \text{ m}$$

(11)

$\cos 30^\circ = \frac{b}{5}$

$b = 4.33\,m$

Now,

$EA(A) = 2000 \times 40 = 80,000\ t$

$EA(B) = 2000 \times 40 = 80,000\ t$

$EA(C) = 2000 \times 50 = 100,000\ t$

$EA(D) = 2000 \times 50 = 100,000\ t$

⇒ Step # 01

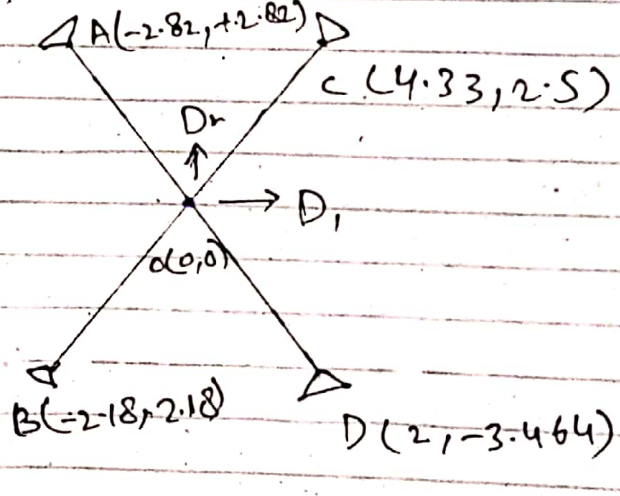
K.I

$K.I = 2J - r$

$= 2(5) - 8 = 2$

⇒ Step # 02

Select unknown joint displacement



$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \quad \begin{bmatrix} AD_1 \\ AD_1 \end{bmatrix} = \begin{bmatrix} 50 \\ -100 \end{bmatrix}$$

(12)

⇒ Step # 03

$[AMD]_{4\times 2} \quad \& \quad [S]_{2\times 2}$

1) $D_1 = 1 \quad , D_2 = 0$

$$AmD_{11} = \frac{80,000}{(400)^2} \times (0 + 282) = 141$$

$$AmD_{21} = \frac{80,000}{(300)^2} \times (0 + 212) = 188.44$$

$$AmD_{31} = \frac{10,0000}{(500)^2} \times (0 - 433) = -173.2$$

$$AmD_{41} = \frac{100,000}{(400)^2} \times (0 - 200) = -125$$

⇒ Now $\quad S_{11} = \sum_{i=1}^{m} \frac{EA}{L^3} (X_k - X_J)^2$

$$= \frac{80,000}{(400)^3} \times (282)^2 + \frac{80,000}{(300)^3} \times (212)^2 + \frac{100,000}{(500)^3} \times (-433)$$

$$+ \frac{100,000}{(400)^3} \times (-200)^2$$

$$S_{11} = 99.405 + 133.107 + 149.99 + 62.5$$

$$S_{11} = 445.063$$

$$S_{12} = S_{21} = \sum_{i=1}^{m} \frac{EA}{L^3} \times (X_k - X_J)(Y_k - Y_J)$$

$$= \frac{80,000}{(400)^3} \times (282)(-282) + \frac{80,000}{(300)^3} \times (212)(212)$$

$$+ \frac{100,000}{(500)^3} \times (-433)(-250) + \frac{100,000}{(400)^3} \times (-200)(346)$$

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13

$S_{12} = S_{21} = 12.237.$

(ii) $D_1 = 0$, $D_1 = 1K$

$$AmD = \frac{EA}{L^2}(Y_K - Y_J).$$

$$AmD_{12} = \frac{80{,}000}{(400)^2}(-282) = -141$$

$$AmD_{22} = \frac{80{,}000}{(300)^2}(212) = 188.44$$

$$AmD_{32} = \frac{100{,}000}{(500)^2}(-250) = -100$$

$$AmD_{42} = \frac{100{,}000}{(400)^2}(346) = 216.25$$

Now, $$S_{22} = \sum_{i=1}^{m} \frac{EA}{L^3}(Y_K - Y_J)^2$$

$$S_{22} \Rightarrow \frac{80{,}000}{400^3}(-282)^2 + \frac{80{,}000}{300^3}(212)^2$$

$$+ \frac{100{,}000}{(500)^3}(-250)^2 + \frac{100{,}000}{(400)^3}(346)^2$$

~~$S_{22} = 100.250$~~

$$S_{22} = 469.628$$

Step # 04

$$[D] = [S]^{-1} \times [AD]$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} 445.063 & 12.237 \\ 12.237 & 469.628 \end{bmatrix}^{-1} \times \begin{bmatrix} 50 \\ -100 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} 0.1183 \\ -0.216 \end{bmatrix}$$

Step # 06 [Am]

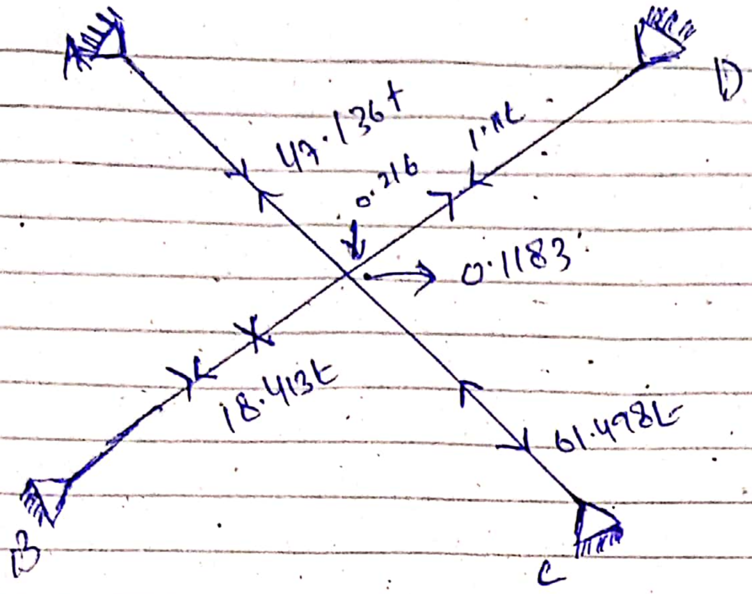
$$\begin{bmatrix} Am_1 \\ Am_2 \\ Am_3 \\ Am_4 \end{bmatrix} = \begin{bmatrix} 141 & -141 \\ 188.44 & 18.44 \\ -173.2 & -100 \\ -125 & 216.25 \end{bmatrix} \times \begin{bmatrix} 0.1183 \\ -0.216 \end{bmatrix}$$

$$= \begin{bmatrix} 141 \times (0.1183) + (-141) \times (-0.216) \\ 188.44 \times (0.1183) + (188.44) \times (-0.216) \\ -173.2 \times (0.1183) + (-100) \times (-0.216) \\ -125 \times (0.1183) + (216.25) \times (-0.216) \end{bmatrix}$$

$$\begin{bmatrix} Am_1 \\ Am_2 \\ Am_3 \\ Am_4 \end{bmatrix} = \begin{bmatrix} 16.68 + 30.46 \\ 22.29 + 40.70 \\ -20.49 + 21.6 \\ -14.79 - 46.71 \end{bmatrix}$$

$$\begin{bmatrix} Am_1 \\ Am_2 \\ Am_3 \\ Am_4 \end{bmatrix} = \begin{bmatrix} 47.136t \\ -18.413t \\ 1.11t \\ -61.4984t \end{bmatrix}$$

15



"THE END"