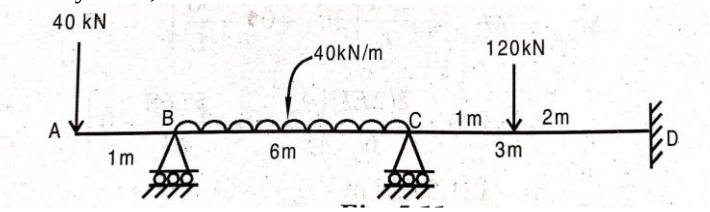
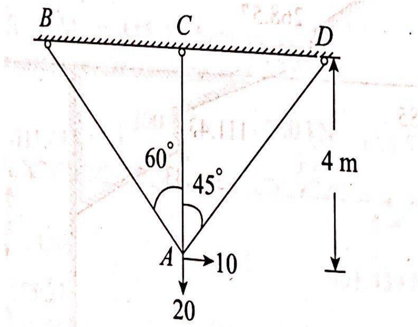
USN										

Internal Assessment Test 3 –Jan. 2022

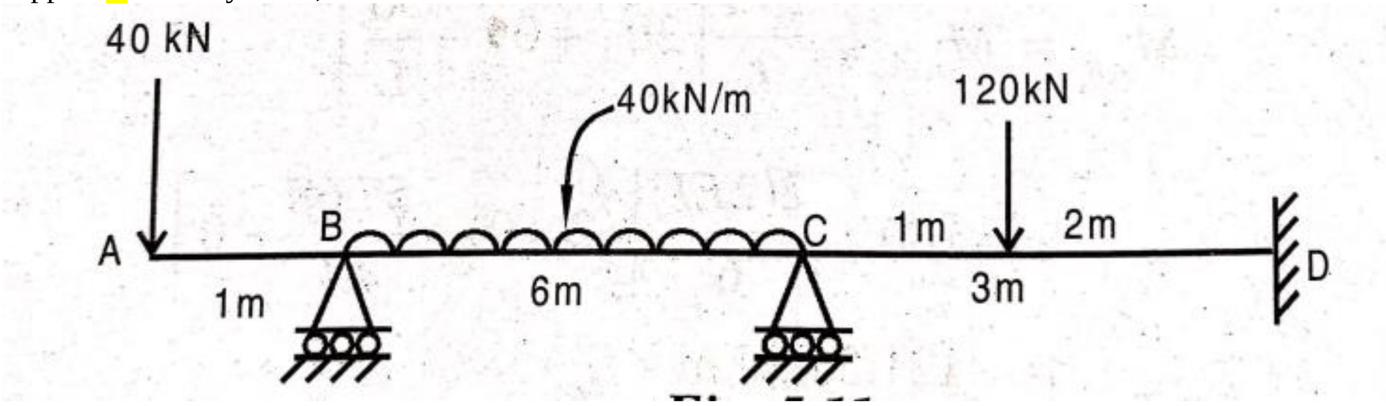
Sub:	Analysis of Indeterminate Structures				Sub Code:	18CV52	Branch:	Civil
Date:	24/1/2022	Duration:	90 min's	Max Marks: 50	Sem / Sec:	5A		OBE

	<u>Answer TWO FULL Questions</u>	MARKS	CO	RBT
1.	Analyze the continuous beam shown in fig by stuffiness matrix method. The support C sinks by 9mm, Take EI= 1000kN.m^2. Draw BMD and SFD  fig 1	[25]	CO1	L3
2.	Analyze the truss shown in fig 2. by flexibility matrix method choosing the force member AD as redundant. Assume EA constant for all members  fig 2	[25]	CO 2	L3

CI
HOD

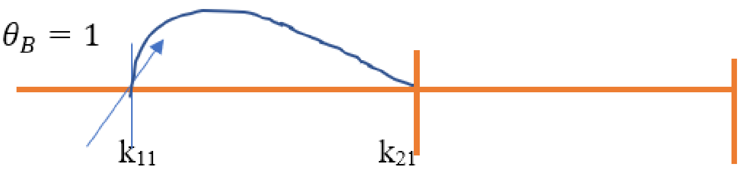
CCI

Problem 1: Analyze the continuous beam shown in fig by stuffiness matrix method. The support C sinks by 9mm, Take EI= 1000kN.m^2



1. Fixed end moment:
   Mfbc= -40*6*6/12- 6EIδ/l*l = -120-6*1000*0.009/6*6 = -121.5kN.m
   Mfcb= 120-6*1000*0.009/6*6= 118.5kN.m
   Mfcd= -120*1*2*2/3*3-6*1000*(-0.009)/3*3= -47.33
   Mfcb= 120*1*1*2/3*3-6*1000*(-0.009)/3*3=32.67kN.m

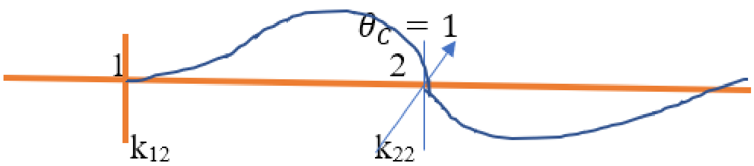
2. [Δ], [P], [P_L]
   $[\Delta] = unknown\ displacment\ matix = \begin{bmatrix} \theta_B \\ \theta_C \end{bmatrix}$
   [P]= moments acting -External $= \begin{bmatrix} -40 \\ 0 \end{bmatrix} =$
   [P_L]= joint moments $= \begin{bmatrix} \cancel{M_{FBA}} + M_{FBC} \\ M_{FCB} + M_{FCD} \end{bmatrix} = \begin{bmatrix} -121.5 \\ 118.5 - 47.33 \end{bmatrix} = \begin{bmatrix} -121.5 \\ 71.17 \end{bmatrix}$
3. Stiffness matrix= to find the θ_B, θ_c
   Applying the unit rotation along the co-ordinate 1



$k_{11} = \frac{4EI}{6} = 0.67EI$

$k_{21} = \frac{2EI}{6} = 0.33EI$

Apply unit rotation at B = coordinate 2



$k_{12} = \frac{2EI}{6} = 0.33EI$

$k_{22} = \frac{4EI}{6} + \frac{4EI}{3} = 2EI$

$\begin{bmatrix} k_{11} & k_{12} \\ k_{21} & k_{22} \end{bmatrix} = [EI] \begin{bmatrix} 0.67 & 0.33 \\ 0.33 & 2 \end{bmatrix}$

[Δ] = $[k]^{-1}$ [P-P_L]

$\begin{bmatrix} \theta_B \\ \theta_C \end{bmatrix} = \frac{1}{EI} \begin{bmatrix} 0.67 & 0.33 \\ 0.33 & 2 \end{bmatrix}^{-1} \begin{bmatrix} -40 - 121.5 \\ 0 + 71.17 \end{bmatrix}$

$\theta_B = \frac{151.75}{EI}, \theta_C = \frac{-60.91}{EI}$

4. Substitute the above values in the slope deflection equation

$M_{BC} = M_{FBC} + \frac{2EI}{l}(2\theta_B + \theta_C - \frac{3\partial}{l})$

$= -121.5 + 2*1000/6(2*\frac{151.75}{1000} - \frac{60.91}{1000}) = -40.63$kN.m

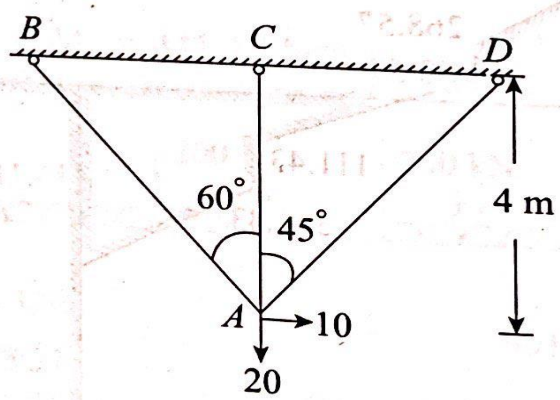
$M_{CB} = M_{FCB} + \frac{2EI}{l}(2\theta_C + B - \frac{3\partial}{l})$

$= 121.5 + 2*1000/6(\frac{151.75}{1000} - 2 * \frac{60.91}{1000}) = 128.47$N.m

M_{CD}= -128.47 kN.m

M_{DC} = -7.93 kN.m

Example 4.18 Analyse the truss shown in Fig. 4.129 by the flexibility matrix meth choosing the force member *AD* is redundant. Assume *EA* constant for all member



Steps:

1. **Determine the static indeterminacy**

   3-2=1

2. **Selection of redundant: member AD considered as redundant**

   Length of the members

   AB= 8m

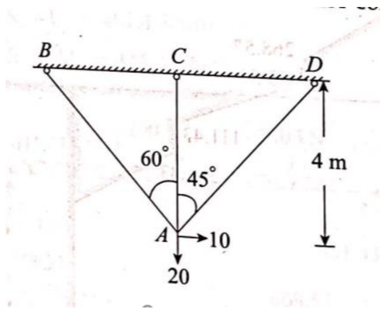
   AC= 4m

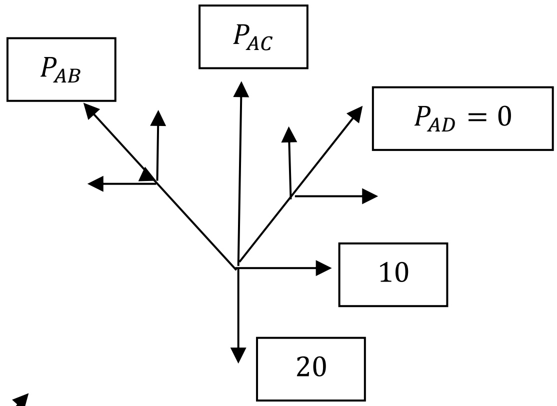
   AD= 5.65m

3. **Computing the axial force- actual force (P): by method of joint =**

   P_{AD}=0

   Consider the joint A





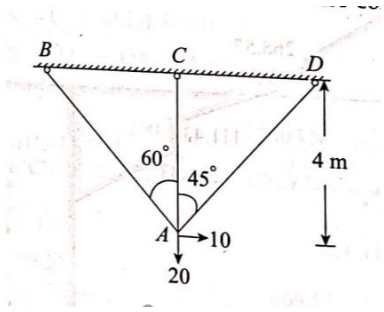
Horizontal forces $\sum H = 0$,= **$\cancel{P_{AD}}$Sin 45+10- P_{AB}Sin60=0**

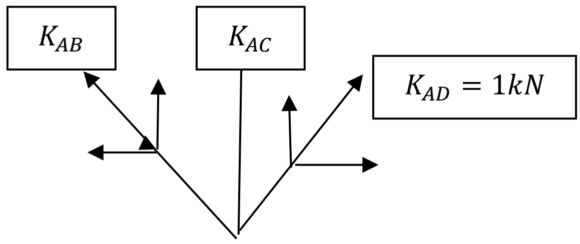
10= P_{AB}Sin60

P_{AB}= 11.54(T)

$\sum V$= 0=,= **$\cancel{P_{AD}}$Cos 45-20+P_{AB}Cos60+ P_{AC} =0**

4. Computing the axial force – Unit load application at redundant (K)





Horizontal forces = 0,= **K_{AD}Sin 45- K_{AB}Sin60=0**

1Sin 45- K_{AB}Sin60=0

K_{AB}= 0.816kN

$\sum V$= 0=,= **K_{AD}Cos 45+K_{AB}Cos60+ K_{AC} =0**

1Cos 45+0.816Cos60+ K_{AC} =0

5. Force in the member – actual load and unit load

Member	Length(L) m	Area (mm^2)	E (kN/mm^2)	P (kN)	K(kN)	$\frac{PKL}{AE}$	$\frac{K^2L}{AE}$
AB	8	A	E	11.54	0.816	75.33/AE	5.32/AE
AC	4	A	E	14.22	-1.11	-63.13/AE	4.92/AE
AD	5.65	A	E	00	1	0	5.65/AE
						12.26/AE	15.89/AE

6. Calculation of deflection

$$\Delta_L = \sum \frac{PKL}{AE} = 12.26/AE$$

7. Compatibility equation

$$F = \sum \frac{K^2 L}{AE} = 15.89/AE$$

$$\{\Delta - \Delta_L\} = [F]\ \{R\}$$

$$\{0-12.26\} * [15.89]^{-1} = \{R\}$$

$$\frac{-12.26}{15.89} = -0.77$$

8. Final moment

Member	P (kN)	K(kN)	R(kN)	P_F=P+KR (kN)	Nature of force
AB	11.54	0.816	-0.77	10.91	T
AC	14.22	-1.11	-0.77	15.07	T
AD	0	1	-0.77	-0.77	C