Kinematic Inderminacy:

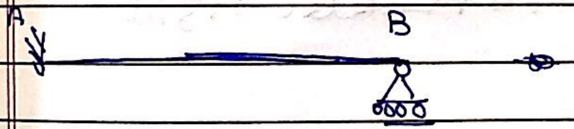
Framed structures can be visualized as a structural system of members connected together by Joints. These Joints undergo displacement (rotations or translations) under load. The number of Independent Joint displacements is referred to as kinematic Indeterminacy or simply Degrees of freedom. It means all possible displacements of the Joint of a structure

In a 2D-structure, a free rigid Joint may undergo 3 displacements

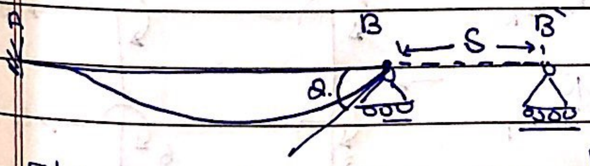
1) Translation in x-direction
2) " " " y-direction
3) Rotation in z direction

Letus consider the following structures.

1) Proped cantilever:



End "A" is fixed. It will not undergo any type of displacement. Under arbitory force end B may move to B` and will also undergo rotation.



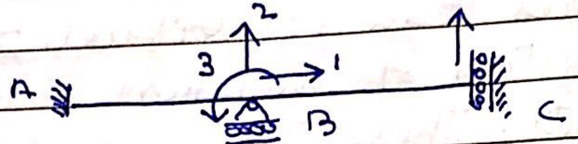
Therefore θ & δ are the ~~dis~~ possible displacement

∴ kinematic degree of freedom $Ki = 2$

Neglecting axial deformation $\delta = 0$ (Members is in-extansable)

∴ $Ki = 1$

2) Continuous Beam.



Here Sinking of support 'B' is considered.

∴ ki = 4

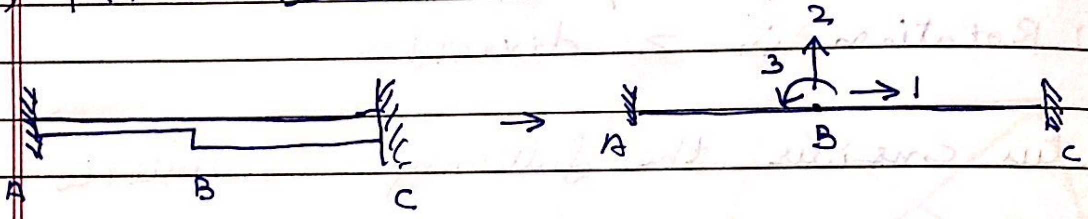
if support does not sink then 2 → 0

∴ ki = 3

if members are In-extensable then 1 → 0

∴ ki = 2

3) Fixed Beam



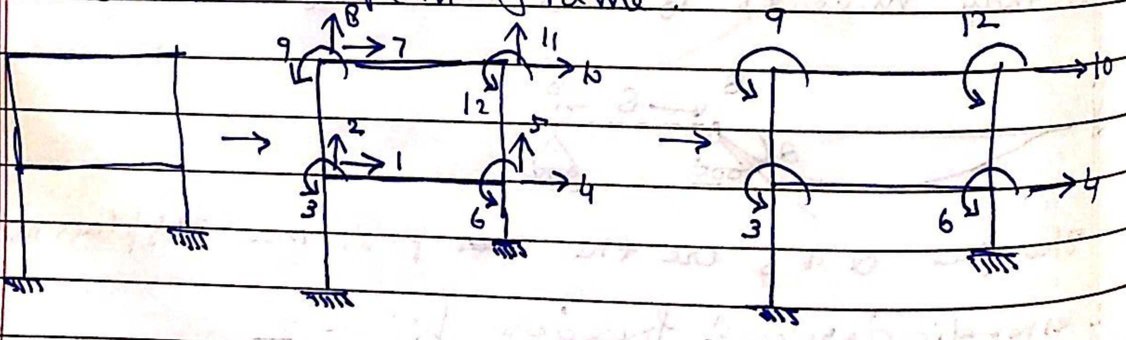
ki = 3

if member is in-extensable (rigid)

1 → 0

∴ ki = 2.

4) Rigid Joined plan frame.

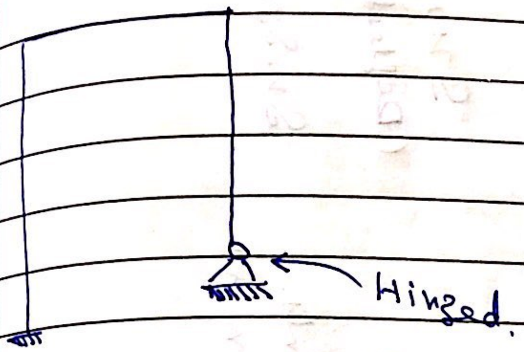


ki = 12

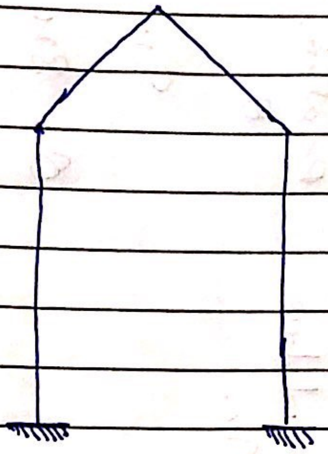
ki = 6

Exercise / Assignment - 2.

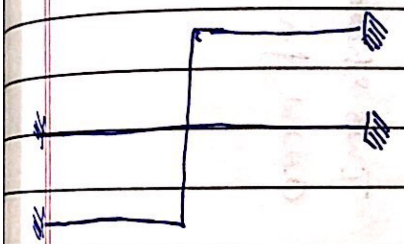
Find the Degrees of freedom of the following structures.



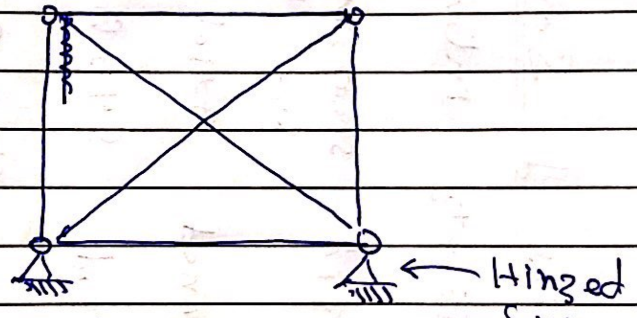
(a)



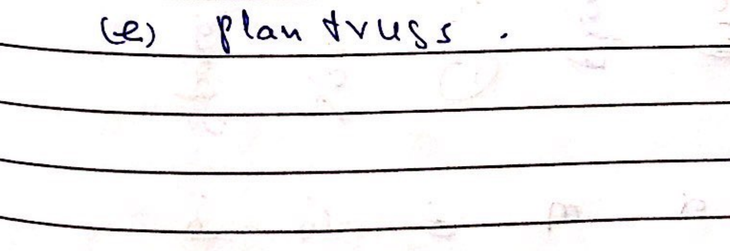
b (Gable frame)



(c)



(d) Plan truss



(e) plan truss.

Scanned with CamScanner

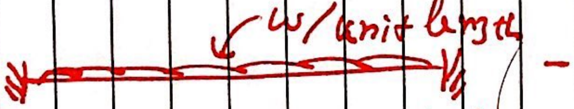
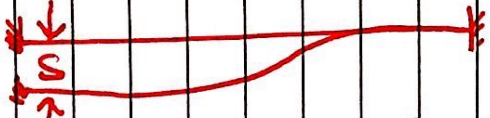
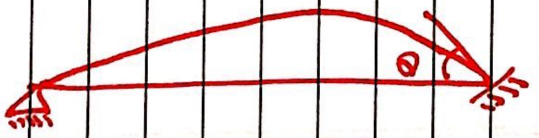
12

chapter 2 : ~~Stiffness approach (Beams)~~

Sign convention : Clockwise moments and clockwise rotations are considered as positive.

+ve end actions.

Fixed End Actions of Some Beams

No.	Beam	M_A	M_B	R_A	R_B
1.		$-\frac{wab^2}{l^2}$	$\frac{wba^2}{l^2}$	$\frac{Pb^3}{l^3}(3a+b)$	$\frac{Pa^3}{l^3}(3b+a)$
2.		$\frac{Mb(2a-b)}{l^2}$	$\frac{Ma(2b-a)}{l^2}$	$-\frac{8Mab}{l^3}$	$\frac{8Mab}{l^3}$
3.		$-\frac{wl^2}{12}$	$\frac{wl^2}{12}$	$\frac{wl}{2}$	$\frac{wl}{2}$
4.		$-\frac{wl^2}{30}$	$\frac{wl^2}{20}$	$\frac{3wl}{20}$	$\frac{7wl}{20}$
5.		$\frac{6EI\delta}{l^2}$	$\frac{6EI\delta}{l^2}$	$-\frac{12EI\delta}{l^3}$	$\frac{12EI\delta}{l^3}$
6.		$\frac{2EI\theta}{l}$	$\frac{4EI\theta}{l}$	$-\frac{6EI\theta}{l^2}$	$\frac{6EI\theta}{l^2}$
7		-	$\frac{3EI\theta}{l}$	$-\frac{3EI\theta}{l}$	$\frac{3EI\theta}{l}$.
8.		$\frac{3EI\delta}{l^3}$	-	$-\frac{3EI\delta}{l^3}$	$\frac{3EI\delta}{l^3}$