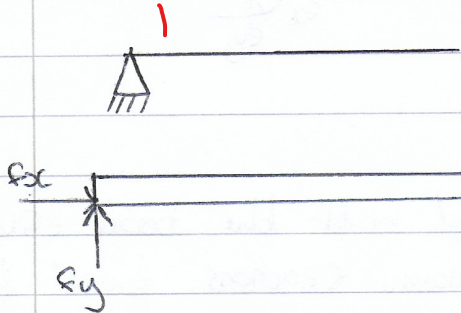


Section A

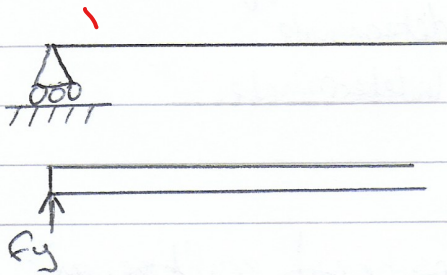
50%

② Pin Support



A pin Support has 2 forces, x and y

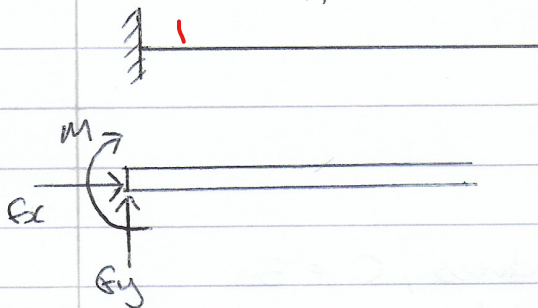
Roller Support



The roller Support only has 1 force which moves in the vertical direction. F_y

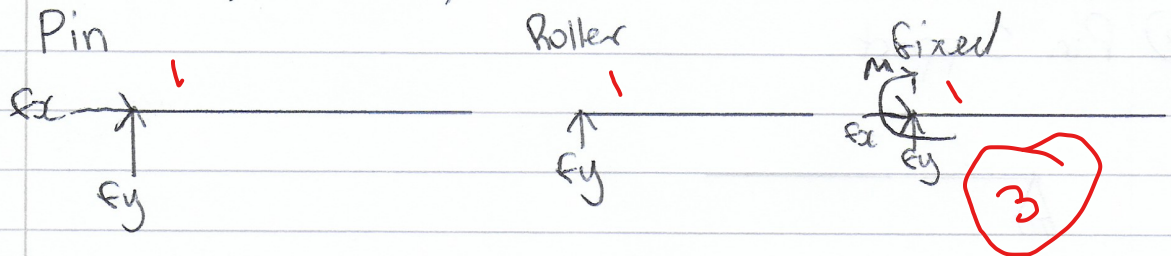
6

Fixed Support



The fixed Support has 3 reaction forces with a Moment

⑥ $\Sigma H = 0, \Sigma V = 0, \Sigma M = 0$



⑦ Determinate Structures are analysed with the basic equilibrium equation, this shows the unknown reactions found for the further determination of stresses. Where Indeterminate Structures are not capable of being analysed by the use of the equilibrium equations. Extra conditions such as are required. Methods like strain energy method, slope deflection method, moment distribution method, column analogy method etc.

If $\Sigma = 3n$, Its statically determinate.

If $\Sigma > 3n$, Its statically indeterminate.

⑧ ~~① = The first equilibrium is~~

~~① = $\Sigma F_x = 0, \Sigma F_y = 0$, translational equilibrium~~

~~② = $\Sigma M = 0$, rotational equilibrium~~

① ① = object is at rest

② = No net force

③ = no net torque

$\Sigma H = 0, \Sigma V = 0, \Sigma M = 0$

⑨ ~~$3m + \Sigma < 3n > + c$~~

For statically determinate structures, $\Sigma = 3n$

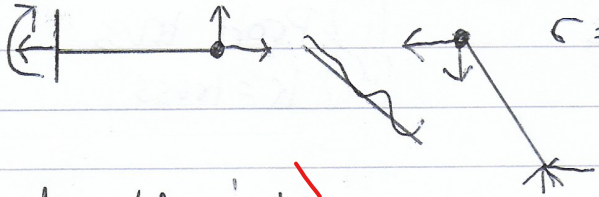
If $\Sigma > 3n$, Structure is statically indeterminate

n = Total number of parts in the structure

Σ = Total number of unknown reactive forces and moment components

⑦ E.1 =  $r = 3, n = 1, 3 - 1 = 2$ (1)

Statically determinate

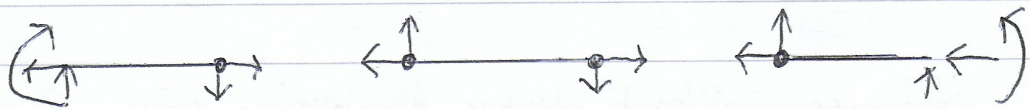
E.2  $r = 6, n = 2, 6 - 2 = 4$ (2)

Statically determinate

E.3  $r = 5, n = 1, 5 - 3(1) = 2$

Statically Indeterminate to the second degree

6

E.4 

$r = 10, n = 3, 10 - 3(3) = 1$ (3) Statically Indeterminate to the first degree

⑧ A framed structure is any material is on that is made stable by a skeleton that is able to stand by itself as a rigid structure without depending on floors or walls to resist deformation.

Classification

- Rigid frame structure
- Braced frame structure

3

⑨ Under rigid truss is one in which number of members are not sufficient to maintain the stability of structure under external loading, over rigid truss, in which number of members are full sufficient to maintain the structure stable under external loading.

i) $M = 2J - 3$

M = Number of Members
 J = Number of Joints

3

i) = Warren truss

iii) = Howe truss

v) = Fink truss

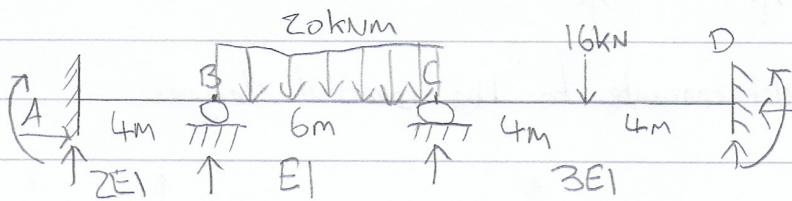
(ii) Pratt truss

(iv) K truss

5

21-37

Section B



Stiffness Coefficient Member AB (k_{AB}) = $\frac{2EI}{L} = \frac{2}{4}$

Stiffness coefficient Member BC (k_{BC}) = $\frac{3EI}{L} = \frac{3}{6}$

Stiffness coefficient Member CD (k_{CD}) = $\frac{3EI}{L} = \frac{3}{8}$

Distribution factor BA (DF_{BA}) = $\frac{k_{AB}}{(k_{AB} + k_{BC} + k_{CD})} = \frac{2/4}{(2/4 + 3/6 + 3/8)} = 0.36$

4

Distribution factor BC (DF_{BC}) = $\frac{k_{BC}}{(k_{AB} + k_{BC} + k_{CD})} = \frac{3/6}{(2/4 + 3/6 + 3/8)} = 0.36$

Distribution factor CD (DF_{CD}) = $\frac{k_{CD}}{(k_{AB} + k_{BC} + k_{CD})} = \frac{3/8}{(2/4 + 3/6 + 3/8)} = 0.27$

Fixed-end moment

Fixed-end Moment ~~AB~~ BC

$$BC \text{ } \cancel{AB} \quad \frac{WL^2}{12} = \frac{20 \times 4 \times 6}{12} = 40 \text{ kN/m}$$

$$CD \text{ } \cancel{BC} \quad \frac{WL^2}{12} = 16 \text{ kN/m}$$

Modified Stiffness

	BC		CD	
DF	1	~~0.40~~	0.27	0
FEM	40	-40	16	-16
BM	-40	-0.72	~~-0.54~~	~~-0.54~~
COM		-20		
BM		0.72	1.14	
F _M		←		→ x
F _M	0	-60	16	-16

$$(V_{AB}^{BC} \times 4) - (20 \times 6 \times 2) - 6 = 0$$

$$4V_{AB}^{BC} - 240 = 0$$

$$V = \frac{240}{4} = 60 \text{ kN}$$

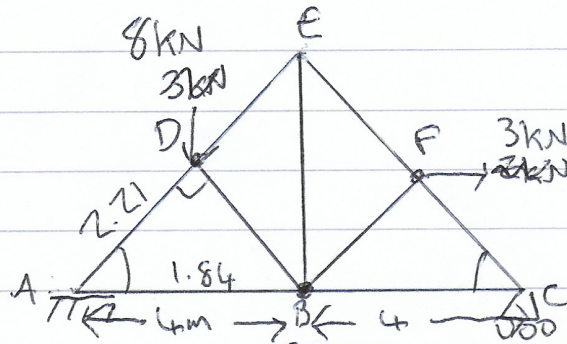
$$(V_{CD} \times 4) + (16 \times 8 \times 2) + 6 = 0$$

$$4V_{CD} + 256 + 6 = 262 \quad 256$$

$$V_{CD} = \frac{262}{4} = 65.5 \text{ kN} \quad 64 \text{ kN}$$

①

Q2-7



Using $\sum M_A = 0 = R_C \times 8 - 8 \times 1.5 - 3 \times 1.5 = 0$

$R_C = 1.5 \text{ kN} \uparrow$

$V_A = 8 - 1.5 = 1.5$

$H_A = 1.5$

$V_B = 8 - 1.5$

$V_B = 6.5 \uparrow$

Horizontal = $3 \text{ kN} \leftarrow$

Reaction at A = $\sqrt{V_A^2 + H_A^2}$

$= \sqrt{(1.5)^2 + (3)^2} = 3.35 \text{ kN}$

$\sum F_y = 0$

$F_{AD} \cos 45^\circ + V_A = 0$

$0.707 F_{AD} + 1.5 = 0$

$F_{AD} = 2.21 \text{ kN}$

$F_{AC} = F_{AC} + F_{AD} \cos 45^\circ - H_A = 0$

$F_{AC} - 2.21 \times 0.707 - 2 = 0$

$F_{AC} = 1.84 \text{ kN}$

DE and DC

$8 - F_{DE} \sin 45^\circ + F_{DC} \sin 45^\circ - F_{AD} \sin 45^\circ = 0$

$8 - 2.21 - 3 - 0.707 F_{DE} + 0.707 F_{DC} - 2.21 \times 0.707 = 0$

$1.25 - 0.707 F_{DE} + 0.707 F_{DC} = 0$

Q4-5