Theory of Structures

Notes by-

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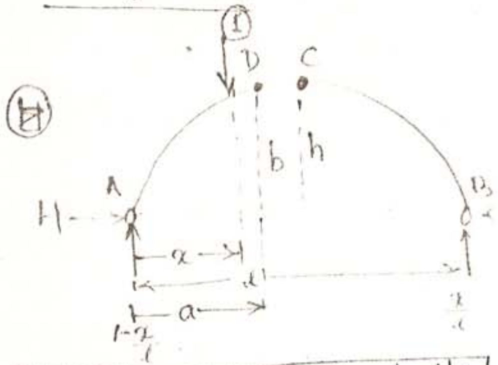
ILD for Arches

3 Hinge Arch



ILD for Horizontal Thrust H :-

A, B, C – Hinges, h = Rise, l = span.

$V_a = 1 - \frac{x}{l}$; $V_b = \frac{x}{l}$

$\Sigma M_c = 0$

$\therefore H \cdot h = \left(1-\frac{x}{l}\right) \times \frac{l}{2} - 1\left(\frac{l}{2} - x\right)$ Load ON $\left[0 \le x \le \frac{l}{2}\right]$

$= \left(1-\frac{x}{l}\right)\frac{l}{2}$ Load OFF $\left(\frac{l}{2} \le x \le l\right)$

$\therefore$ at $x = 0$, $H = 0$

$x = \frac{l}{2}$, $H = \frac{\left(1-\frac{1}{2}\right)\frac{l}{2} - \left(\frac{l}{2}-\frac{l}{2}\right)}{h}$

$= \frac{\frac{l}{2} - \frac{l}{4}}{h}$

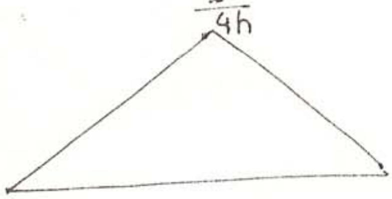
$H = \frac{l}{4h}$ } LOAD ON

at $x = \frac{l}{2}$: $H = \frac{l}{4h}$

$x = l$, $H = 0$ } LOAD OFF

For simplicity,

$H = 0$ to $\frac{l}{4h}$ at 'C' & 0.



ILD for H

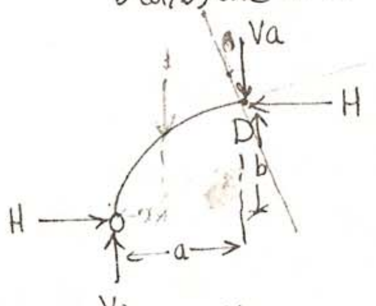
ILD for Ra

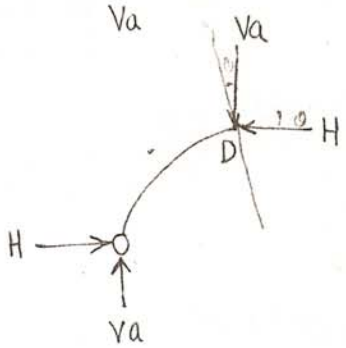
ILD for Rb

ILD for Normal Thrust

Let D be given section.

D(a, b) are co-ordinates.





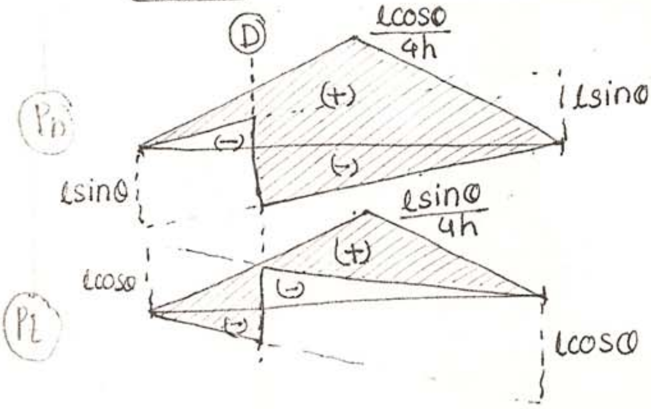
$\therefore$ Load ON : Normal Thurst $(P_n) = H\cos\theta - V_b\cos\theta$.

Load OFF : $P_n = H\cos\theta + V_a \sin\theta$.

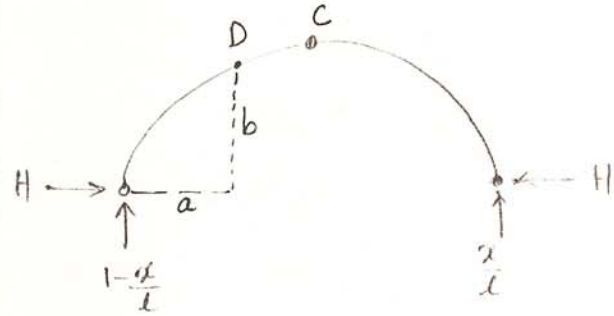
Radial shear

Load ON : $P_T = H\sin\theta + V_b\cos\theta$

Load OFF : $P_T = H\sin\theta - V_a\cos\theta$.



ILD for BM at given section



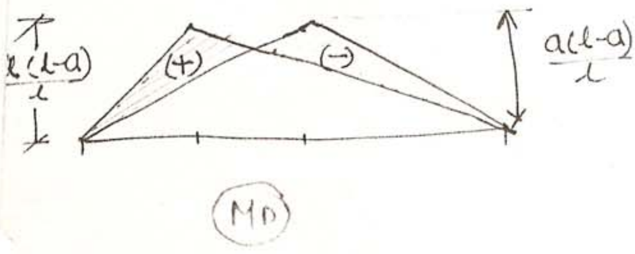
$\therefore BM_D =$ Beam moment $- H\cdot b$

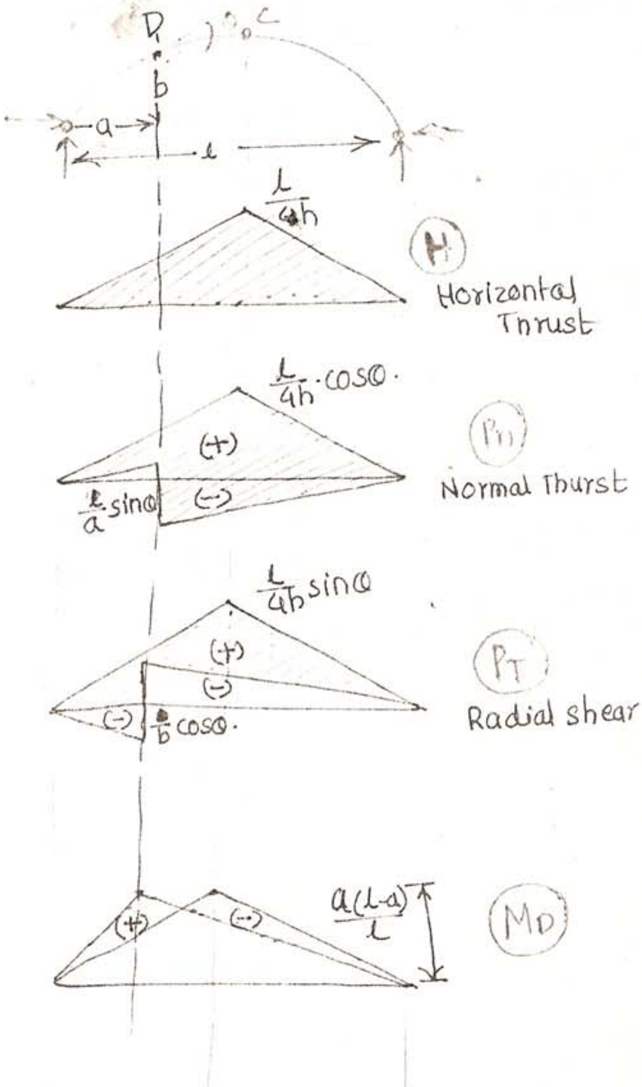
But Beam moment at $D = \left(1-\frac{a}{l}\right)\times a$

$= \left(\frac{l-a}{l}\right)\times a \quad \left(\text{i.e. } \frac{a(l-a)}{l}\right)$ & $H = \frac{l}{4h}$; $b = \frac{4h}{l^2}\cdot a(l-a)$

& $H\cdot b = \frac{l}{4h}\left[\frac{4h}{l^2}\cdot a(l-a)\right] = \frac{a}{l}(l-a)$

$\therefore$



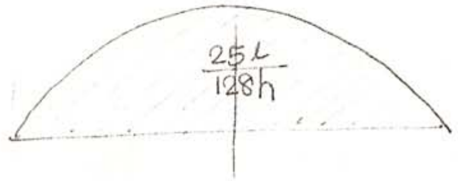


Q.

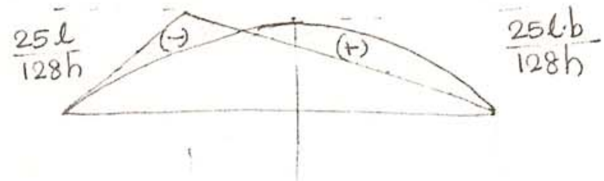
V. Imp

ILD for 2Hinge Parabolic arch

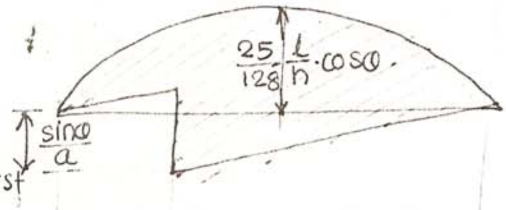
(H) Horizontal Thrust



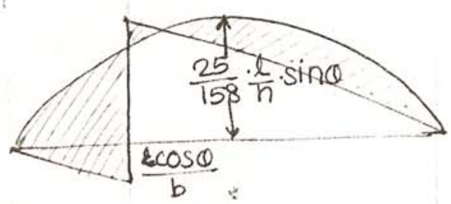
(M_D) BM at D



(P_n) Normal Thurst



(P_T) Radial shear



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ILD for statically Indeterminate structures :-

ILD for proped cantilever

If n = Given interval of span :- Say 0.5 m, 0.25m etc. Say 0.25m

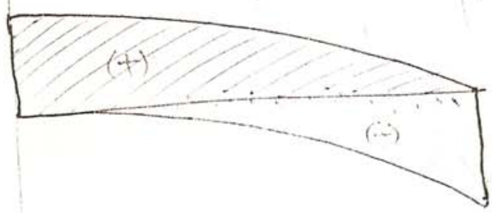
ordinate for

$R_b = \frac{n^2(3-n)}{2}$
$R_a = \frac{2-3n^2+n^3}{2}$
$M_a = -n(1-n)(2-n)\cdot\frac{l}{2}$
$M_d = \frac{ba^2}{2l^3}(3l-x)$

mmt at A → M_a

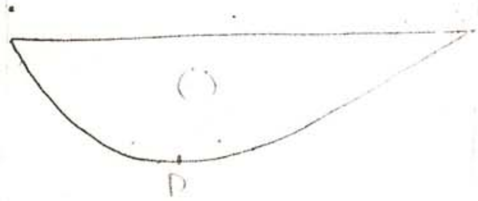
using this equations, find ordinates at 0.25, 0.5, 0.75, 1.0, 1.25 ⋮ so on upto l. & Plot ILD by join all ordinates.

(Ra) Va Reaction at A

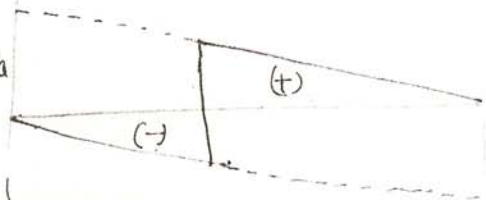


(Rb) Reaction at B

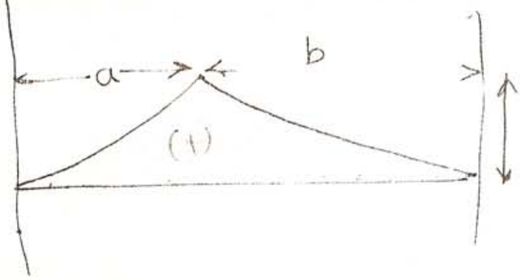
(Ma) mmt at A (By formula)



(VD) SF at D



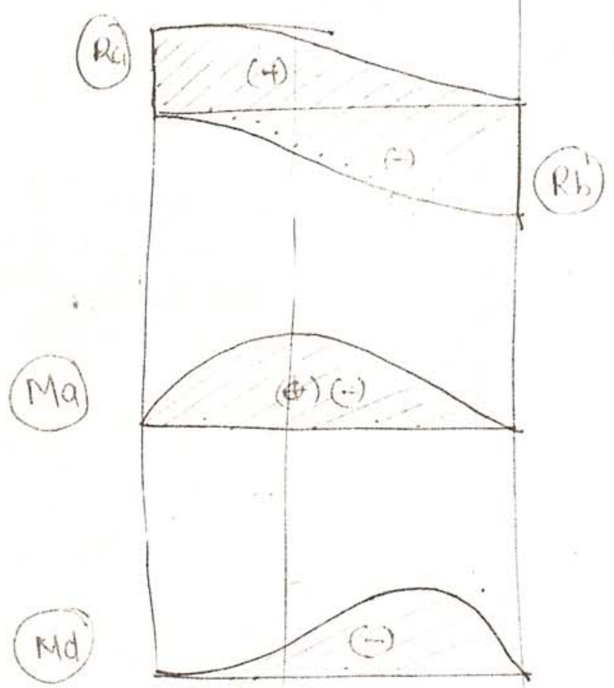
(Md) mmt at given section



ILD for fixed beam

$Ra = (1-n)^2(1+2n)$
$Rb = n^2(3-2n)$
$Ma = n(1-n^2).l$
$M'd = n^2(1-n).l$

ILD for Two span Continuous Beam



See J.P. George 'sir's Notes