JNCT GE II VI sem 6CE2A

Q1 Ans Boussinesq Assumption -

1. Soil is homogenous, Isotropic, semi-infinite & elastic.
2. Hook's law valid
3. self wt of soil is negalacted
4. Soil is intially unstressed
5. Anay change of volume due to applied load initially neglacted. Soil is incompressible.
6. The top surface of soil is free from any shear stress. & subjected only point load.
7. Distribution of stresses is symmetric along the vertical axis.
8. Continuity of stress exists in the medium.

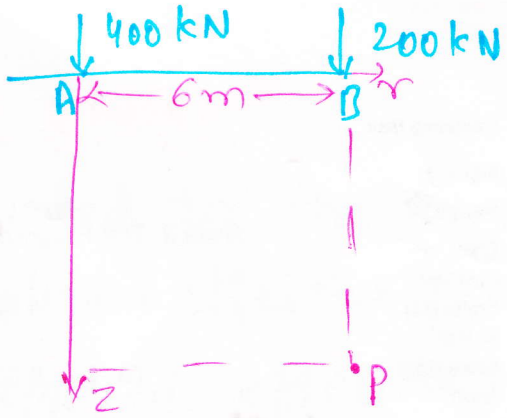
westegaard Assumption -

1. Medium is assumed be homogeonous, semi-infinite elastic & non isotropic.
2. Medium is assumed to be laterally reinforced with fibres of negligible thicknesss ie medium considered to be rigid horizontally & elastic vertically. It means no lateral deformation but only vertical deformation.

effect of 500 kN

$Q = 400$ kN $\quad r = 6$ m

$z = 20$ m



$$\sigma_1 = \frac{3Q}{2\pi z^2}\left(\frac{1}{1+\left(\frac{r}{z}\right)^2}\right)^{5/2}$$

$$= \frac{3 \times 400}{2\pi (20)^2}\left[\frac{1}{1+\left(\frac{6}{20}\right)^2}\right]^{5/2} = \quad \text{kN/m}^2$$

effect of 200 kN

$Q = 250$, $r = 0$, $z = 20$ m

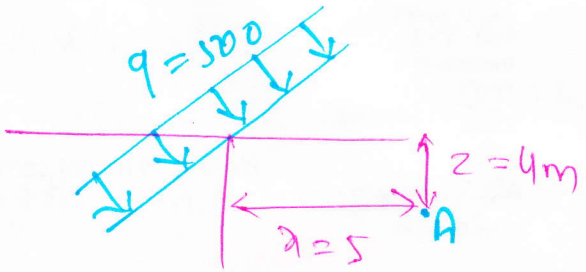
$$\sigma_2 = 0.4775\,\frac{Q}{z^2}$$

$$= 0.4775 \times \frac{200}{(20)^2} = \quad \text{kN/m}^2$$

Resultant stress $= \sigma_1 + \sigma_2$ kN/m^2

Q 3 Ans

$$\sigma_z = \frac{2q}{z\pi}\left[\frac{1}{1+\frac{x^2}{z^2}}\right]^2$$



$q = 500$ kN/m, $x = 5$ m, $z = 4$ m

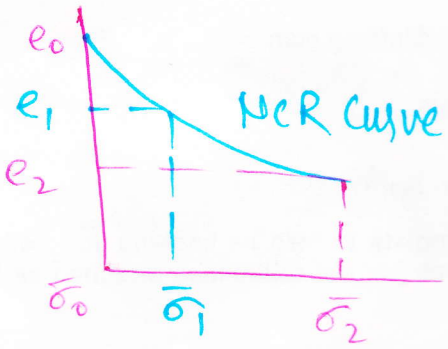
$$\sigma_z = \frac{2 \times 500 \times 4^3}{\pi(5^2+4^2)} = \quad \text{kN/m}^2$$

4

Ans

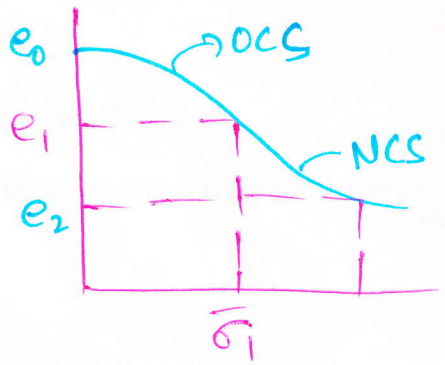
Normal consolidation soil (NCS)

It's those which are loaded for the first time to the present applied effective present stress. It means past applied effective stress was lower than the present applied effective stress. such soil are more compressible



Overconsolidated soil (OCS)

Overconsolidated soil are those which have been for the first time to the present applied effective stress. It's also called pre consolidated or pre-Compressed soil. Such soils are less compressible & have greater shear strength and more stability



Ans $e_0 = 1.052$, $e_1 = 0.932$

$\bar{\sigma}_0 = 207\ kN/m^2$, $\bar{\sigma}_1 = 430\ kN/m^2$

a) Coefficient of compressibility (a_v)

$$a_v = -\frac{\Delta e}{\Delta \bar{\sigma}}$$

$$\Delta e = e_1 - e_0 = 0.932 - 1.052 = -0.12$$

$$\Delta \bar{\sigma} = \bar{\sigma}_1 - \bar{\sigma}_0 = 430 - 207 = 223\ kN/m^2$$

$$a_v = -\left(\frac{\Delta e}{\Delta \bar{\sigma}}\right) = \frac{-(-0.12)}{223} \Rightarrow$$

$$a_v = 5.38 \times 10^{-4}\ m^2/kN$$

b) Compression Index (C_c)

$$C_c = \frac{\Delta e}{\log_{10}\left(\frac{\bar{\sigma}_1}{\bar{\sigma}_0}\right)} = \frac{-(-0.12)}{\log_{10}\left(\frac{430}{207}\right)}$$

$$C_c = 0.378$$

c) Volume compressibility (m_v)

$$m_v = \frac{a_v}{1+e_0} = \frac{5.38 \times 10^{-4}}{1+1.052}$$

$$m_v = 2.62 \times 10^{-4}\ m^2/kN$$

SMIT, JAJNR
Department of Civil Engineering
IM MIDTERM Exam Paper Solution
Subject:- Repair and Rehabilitation of Structure.
Semester:- 7th

Q.1 What is abrasion? Explain in Detail.

Ans Abrasion refers to the wearing of surface of concrete caused by repeated rubbing or frictional actions. This problem mainly manifest itself in pavements or industrial floors carrying wheel or pedestrian traffic.

In itself, hardened concrete paste has a low resistance to abrasion. Hence, the abrasion resistance of concrete is largely determined by the hardness and quality of aggregate used.

It has also shown that concrete abrasion resistance decreases linearly with increasing W/C ratio. It is possible two the factors from:-

- The marginal improvement in resistance of cement paste; and
- The improved aggregate/cement paste bond strength.

Q.2 What are the forms of chemical deterioration? Explain

Ans (1) Soft water attack →

$H_2O + CO_2 \rightarrow H_2CO_3$

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

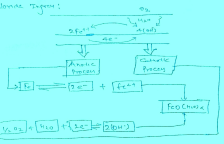
(2) Carbonation of Concrete →

$CO_2 + H_2O \rightarrow H_2CO_3$

$H_2CO_3 + Ca(OH)_2 \rightarrow CaCO_3 + 2H_2O$

$H_2CO_3 + CaO \rightarrow CaCO_3 + H_2O$

Chloride Ingress:



Alkali aggregate reaction (AAR).

It needs - sufficient moisture supply
- high alkali content in concrete
- Reactive amount of reactive minerals in aggregate.

Q.3 What is spalling of concrete? Explain causes, preventive and repair measure?

Ans Concrete can split along the surface, creating tiny holes or cracks, that peel away the once-smooth surface.

Causes →
(a) Accelerators
(b) Frost
(c) Weather
(d) Damage
(e) Spalling techniques.

Preventive & Repair measure →
(a) Fixing with mortar less.
(b) With Pre-mixed epoxy for ½ - then or smaller fit
(c) Cement mortar pouring etc.

Q.4 What do you mean by Cracks in concrete? What are the basic reason of surface cracks?

Ans Why concrete surface cracks →
→ Omission of isolation and contraction joints.
→ Improper subgrade.
→ Use of high slump concrete.
→ Improper finishing
→ Inadequate or no curing.

Types of cracks →
(1) Plastic shrinkage cracks
(2) Expansion cracks
(3) By heaving
(4) By Thermal effect
(5) By Premature drying
(6) Steel Corrosion induced cracks.

Q.5 Short note :-

(1) Plastic Shrinkage Cracks →
When the concrete is in still plastic state, it is full of water. This water helps the space and mass that contain it. As that moisture leaves while curing it gets a bit smaller.
It occurs in 1 to 3 hours of pouring of concrete.

(2) Stitching technique of repair cracks → To repair the cracks in a concrete mass stitching tech is used to

repair small length cracks. For this the surface is cleaned with wire brush and a U-shaped steel device is used. The drill holes are prepared on both side of concrete at multiple spaces crossing the length of crack and the stitch is placed in hole on all the sides and then the holes are filled with epoxy.

(3) Soft water attack → Following chemical reactions takes place when soft water attacks concrete-

$H_2O + CO_2 \rightarrow H_2CO_3$

$CaCO_3 + CO_2 \rightarrow CaCO_3 + H_2O$

$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

(4) Carbonation of concrete → Following chemical activity takes place when carbonation happen in concrete

$CO_2 + H_2O \rightarrow H_2CO_3$

$H_2CO_3 + Ca(OH)_2 \rightarrow CaCO_3 + 2H_2O$

$H_2CO_3 + CaO \rightarrow CaCO_3 + H_2O$

Solution of mid Term question Paper TE-I (BCES)

Q.1 Explain the various modes of Transportation. Also Explain their merits and demerits.

Modes of Transportation

i) Surface mode
   a) Highways / Roadways
   b) Railways

ii) Air mode

iii) Water mode

Roadways

Advantages :-

* High flexibility and ability to move vehicles fastly
* Does door to door services
* High safety for the cargo

Disadvantages :-

* High cost for long distances
* Productivity is low
* Depends upon climatic condition.

Railways

Advantages :-

* Loading and unloading of goods and Services is more
* No traffic congestion easy movement of the vehicles.
* frequency of delivering goods and Passenge over long distances is more

Disadvantages :-

* Initial and capital investments are more
* High material usage for the construction and even the fuel consumption.

Air ways

Advantages :-

*
* Highest speed
* High reliability

Disadvantages :-

* Highest cost of transportation
* Climatic condition effect the transportation

Waterways

Advantages:-

* More safety
* more environment friendly among all modes
* Extensive coverage
* Economical.

Disadvantages:-

* More Time consuming
* Required huge investment

Q.2 What are the recommendations of Jayakar Committee and comparison of all road development plans.?

– Major recommendation of Jayakar committe :-

i) Road development should be considered as National interest

ii) An extra tex should be levied on petrol to create road development fund (CRF- 1929)

iii) Semi official technical body should be established (IRC- 1934)

iv) A research orgnization for road development should be established (CRRF- 1950)

Comparision of different road development plans: -

	Feature	I^st 20yr.	II Road plan	III Road plan
i)	Duration	1943-1963	1961-81	1981-2001
ii)	Name	Nagpur	Bombay	Lucknow
iii)	Road Pattern	Star and Grid	—	Square grid
iv)	Target Density	16 km/100km²	32 km/100km²	82 km/100 km²
v)	Classification of Road	NH, SH, MDR, ODR, VR	—	primary - NH + Express way Selonday - SH + MDR Tertiary - VR + ODR
vi)	Development Allowance	15%.	5%.	Nil
vii)	Express way	No.	1600 km	2000 km

Q.3 Explain the various X-sectional elements of Roadway.

1) Pavement Characteristic

(a) friction

According to IRC coefficient of longitudinal friction = 0.35 to 0.4

coefficient of lateral friction = 0.15

(b) Skid & Slip

Skid = longitudinal movement > Rotational movement

Slip = vise versa.

(c) Light Reflecting Characteristic - Night visibility of C-C Road Pavement is more than black top Pavement

(d) Pavement Unevenness:- It is the cummulative measurement of vertical undulation measured by "Bump Intigrator"

for good Pavement ∝ 150 cm/km

(e) Camber - Slope provided in transverse direction to drain off rain water

	Type of Pavement	Camber	
		Heavy	light
i>	Cement con'c and High bituminous	2%	1.7%
ii>	Thin Bituminous	2.5%	2%
iii>	WBM or Gravel Road	3%	2.5%
iv>	Earth Road	4%	3%

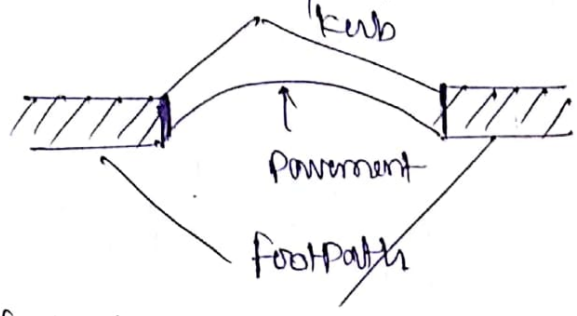
Relation b/w Gradient and camber

$$G = 2C$$

(f) Width of pavement or Carriage way

	Class of Road	Width of Pavement (m)
i)	Single lane	3.75 m
ii)	Double lane	7.0 m
iii)	Double lane with kerb	7.5 m
iv)	Intermediate lane	5.5 m
v)	multilane pavement	3.5 m/ lane

(g) kerb :- Boundary b/w road and shoulder / footpath



Types of kerb

i) Low — 10 cm
ii) Semi barrier — 15 cm
iii) Barrier — 20 cm

Q.4 Calculate the safe overtaking sight distance for a design speed of 96 km/hr assume all other data accordingly ?

$$OSD = d_1 + d_2 + d_3 \quad \text{- for two way}$$

Assume $V_b = 80$ kmph

$t = 2$ sec

$d_1 = 0.28 V_b t = 44.8$ m

$d_2 = 0.28 V_b T + 2S$

<vi>

<vii>

$$S = (0.2 V_b + 6) = 22m$$

$$T = \sqrt{\frac{14.4 S}{A}} = 11.3 \text{ sec}$$

$$d_2 = 297m$$

$$d_3 = V.T \times 0.28 = 303.7m$$

O.S.D for one way $d_1 + d_2 = 341.8 \approx 342m$

OSD for Two way $d_1 + d_2 + d_3 = 645.5m \approx 646m$

Q.5 Length of NH $= \frac{13400}{50} = 1681km$

Length of SH

(a) By Area SH (km) $= 13400/25 = 536 km$

(b) By No. of towns $= 62.5 \times 12 - 13400/25$

$= 482 km$

Adopt SH $= 536 km$

Length of MDR

(a) By Area $13400/12.5 = 1072 km$

(b) By No. of town $= 90 \times 12 = 1080 km$

Adopt MDR $= 1080 km$

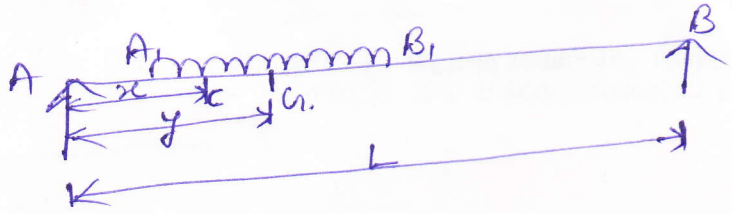
NH + SH + MDR + ODR + VR $= 13400 \times 82/100 = 10988 km$

NH + SH + MDR $= 1884 km$

Length of ODR + VR $= 10988 - 1884 = 9104 km$

Derive that max^m B.M. at a section occurs when the section divides the udl span & beam span in the same ratio.

Soln



When load is in AC span

$$M_x = +R_B\,(L-x)$$

When load head approach the section C, B.M. goes increasing. When head of udl crosses the section C, the B.M. still goes on increasing till it attains max^m value at specific load position.

For given arrangement

$x \rightarrow$ section position

$y \rightarrow$ position of C.G. of udl

$$R_B = w a \cdot \frac{y}{L}$$

$$M_x = +R_B \cdot (L-x) - \frac{w\,(CB_1)^2}{2}$$

$$\left\{ CB_1 = \left(y - x + \frac{a}{2}\right) \right.$$

$$= w.a\,\frac{y}{L}(L-x) - \frac{w}{2}\left(y-x+\frac{a}{2}\right)^2$$

For max^m B.M. $\quad \frac{dM_x}{dy} = 0$

$$\Rightarrow w\,\frac{a}{L}(L-x) - \frac{w}{2} \times 2\left(y-x+\frac{a}{2}\right).1 = 0$$

$$\Rightarrow \frac{a}{L}(L-x) = \left(y-x+\frac{a}{2}\right) \qquad \{ A_1B_1 = a$$

$$\frac{CB}{CB_1} = \frac{AB}{A_1B_1}$$

$$\Rightarrow \frac{CB}{CB_1} = \frac{AB - CB}{A_1B_1 - CB_1} = \frac{AC}{A_1C}$$

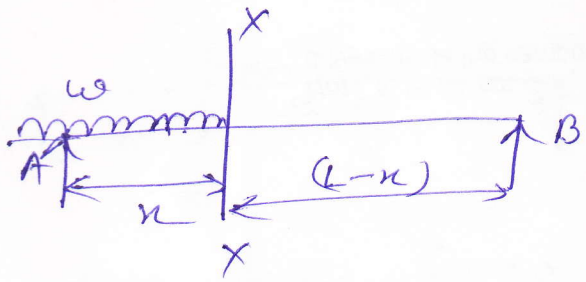
$$\boxed{\frac{A_1C}{CB_1} = \frac{AC}{CB}}$$

Thus for max^m B.M. at a section, the load position is such that the section divides the load in the same ratio as it divides the span.

Q.2 A udl of 1 kN/m, 6m long crosses a girder of 12m span. Construct the max^m positive & negative shear force diagrams.

Soln (a). Max^m Negative S.F. Diagram

Negative S.F. occurs when the load is in left span to the section. And Max^m -ve S.F. occurs when head of udl. touch the section.



For above condition

When $x \leq a$

Shear force $F_x = -R_B$

$$R_B = \frac{w x^2}{2L}$$

upto 6m.

$$F_x = -\frac{1 \times x^2}{2 \times 12} = -\frac{x^2}{24} \quad \text{(Parabolic)}$$

$$x = 6, \quad F_x = -\frac{6^2}{24} = -1.5 \text{ kN}$$

$x > 6$m

$$F_x = -\frac{wa}{L}\left(x - \frac{a}{2}\right) \quad \left\{ \begin{array}{l} \text{straight line} \\ a = 6\text{m} \end{array} \right.$$

$x \rightarrow 6$ to 12m.

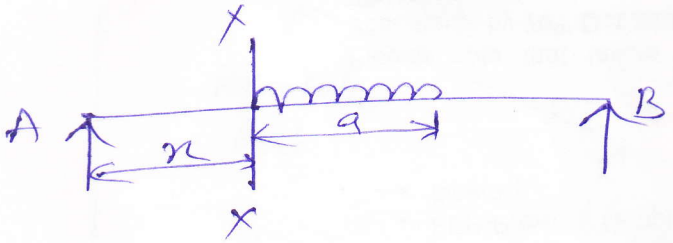
$$F_{x=6} = -\frac{1 \times 6}{12} \times \left(6 - \frac{6}{2}\right) = -1.5 \text{ kN}.$$

$x = 12$m

$$F_{x=12} = -\frac{1 \times 6}{12} \times \left(12 - \frac{6}{2}\right) = -4.5 \text{ kN}.$$

(b). Max^m positive S.F. Diagram — ~~occurs~~

+ve S.F. occurs when tail of udl touch the section.



+ve Shear force $F_x = +R_A$

When x vary zero to (L-a)

$$R_A = \frac{wa}{L}\left(L - x - \frac{a}{2}\right)$$

Max^m +ve S.F.

$x = 0 \qquad F_{x=0} = \frac{1 \times 6}{12} \times (12 - 0 - 3) = +4.5\,kN$

$x = 6m, \qquad F_{x=6} = \frac{1 \times 6}{12} \times (12 - 6 - 3)$

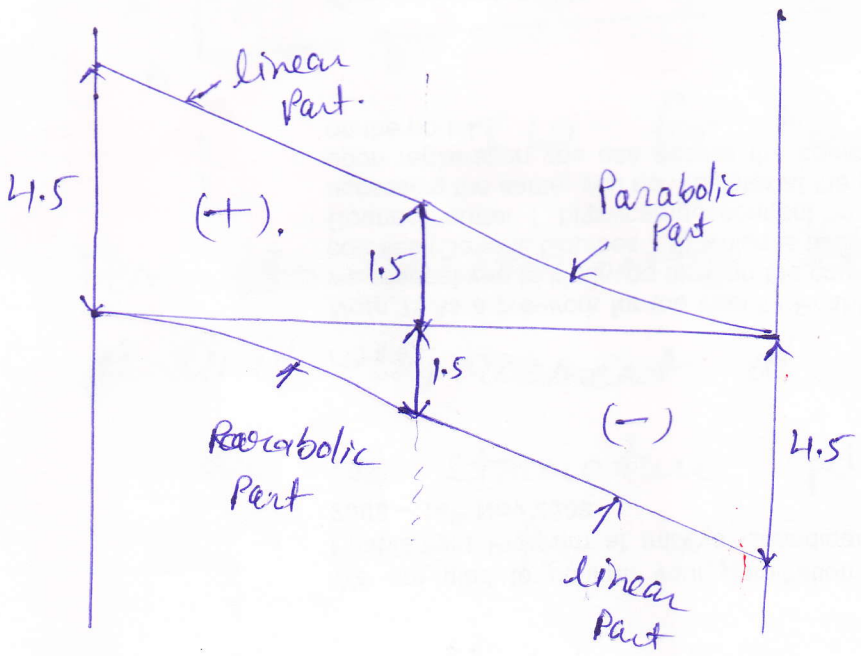
$= +1.5\,kN.$

When x between 6m to 12m

$$F_x = +\frac{w}{2L}(L - x)^2$$

$x = 6 \qquad F_x = +\frac{1 \times (12-6)^2}{2 \times 12} = +1.5\,kN.$

$x = 12 \qquad F_{x=12} = +\frac{1 \times (12-12)^2}{2 \times 12} = 0$

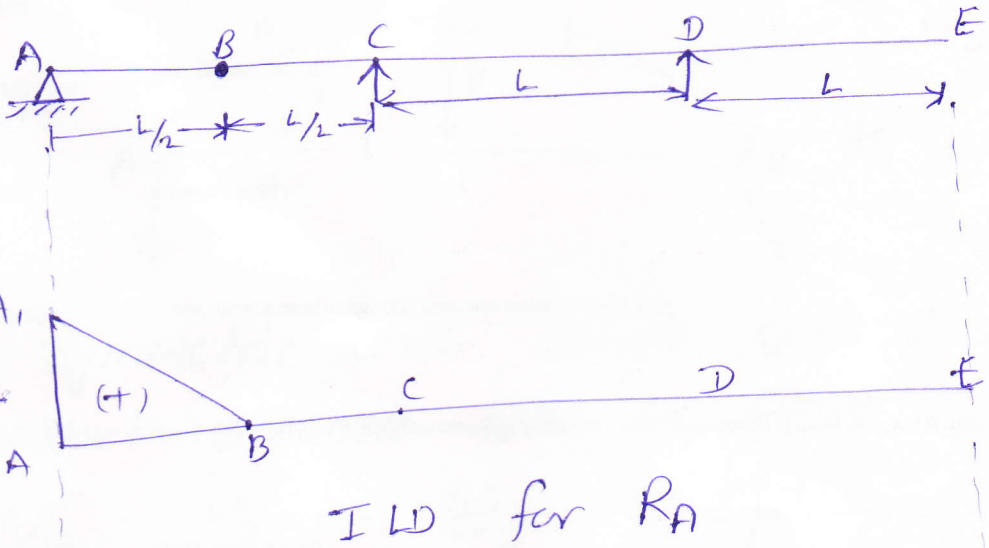


Max^{m}. S.F.D.

Explain Muller Breslau Principle with an example.

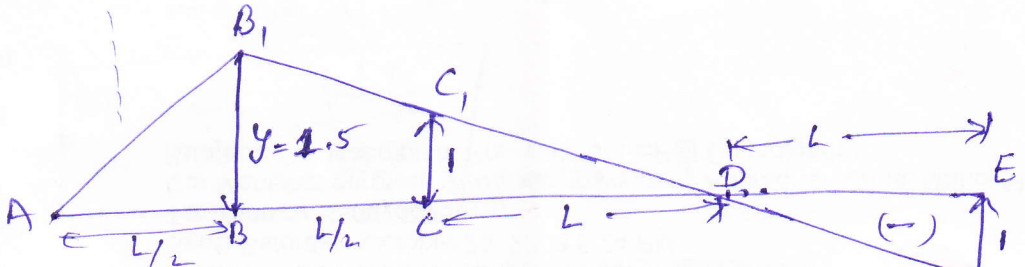
The Muller-Breslau principle may be stated as "If an internal stress component, or a reaction component is considered to act through some small distance and thereby to deflect or displace a structure, the curve of the deflected or displaced structure will be, to some scale, the influence line for the stress or reaction component."

example

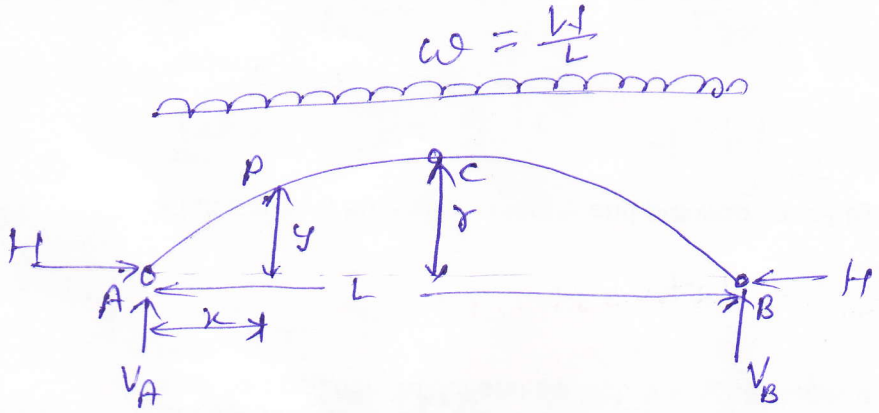


ILD for R_A

For constructing ILD for reaction R_A, ~~gi~~ unit displacement at 'A' given & deflected ~~curve of~~ structure plotted which is the ILD for R_A.



A symmetrical parabolic arch with a central hinge, of rise 'r' and span 'L', is supported at its ends on pins at the same level. Find the expression of horizontal thrust when a load 'W' which is uniformly distributed over whole span. Also find the B.M. at any section.



For symmetric arch, whole span loaded, the vertical support reaction will be same

$$V_A = V_B = \frac{w \cdot L}{2} = \frac{W}{L} \cdot \frac{L}{2} = \frac{W}{2}$$

For Horizontal thrust, taking moment about central hinge 'C'

$$H \times r - \frac{V_A}{2} \times \frac{L}{2} + \frac{W}{L} \times \frac{L}{2} \times \frac{L}{4} = 0$$

$$H = \frac{1}{r}\left(\frac{W}{2} \cdot \frac{L}{2} - \frac{WL}{8}\right)$$

$$\boxed{H = \frac{WL}{8r}}$$

any section 'x' distant from support 'A'

eqn of Parabola is given by $y = \frac{4f}{L^2} x(L-x)$

Moment about 'P'

$$M_x = -H.y + V_A.x - \frac{W}{L}.\frac{x^2}{2}$$

$$= -\frac{WL}{8f}.\frac{4f}{L^2}x(L-x) + \frac{W}{2}.x - \frac{Wx^2}{2L}$$

$$= -\frac{Wx}{2} + \frac{Wx^2}{2L} + \frac{W}{2}x - \frac{Wx^2}{2L}$$

$$\boxed{M_x = 0}$$

Hence B.M. at any point in the three hinge symmetric arch is zero.

Q.5 Draw ILD for horizontal thrust & B.M. for three hinged arch.

Sol^n (i) ~~If~~ Influence line for horizontal thrust 'H'

~~Undil~~ A unit load rolling 'A' to 'B'. At any instant load be at a distance αL from 'A'.

Reaction at 'A' = $(1-\alpha)$, Reaction at 'B' = α

For 'H', B.M. at 'C' = 0

$$M_c = 0 = H.f - \alpha.\frac{L}{2}$$

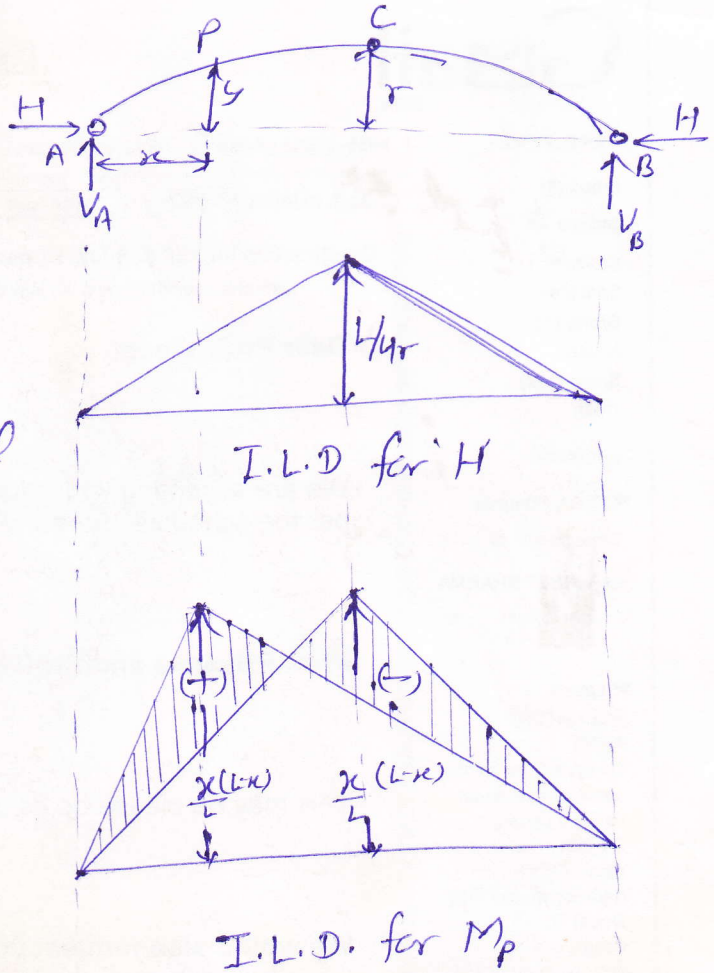
$$\Rightarrow \boxed{H = \frac{\alpha L}{}}$$

Influence line for B.M. at 'P'

$M_p = M - H.y$

Thus I.L.D for M_p consists I.L. for M & I.L. for $-Hy$.

$M \rightarrow$ moment due to vertical forces under unit load. same as simple beam, having max^m ordinate at section $= \frac{x(L-x)}{L}$ with, triangular variation.



I.L.D for 'H'

I.L.D. for M_p

I.L. for $H.y$ will also triangle having max^m ordinate $= \frac{L}{4r} \cdot y$

~~at central hinge with $y = r$~~

$= \frac{L}{4r} \cdot \frac{4r}{L^2} \cdot x(L-x)$

$= \frac{x}{L}(L-x)$.

I.L.D for 'H' & M_p shown in figure.