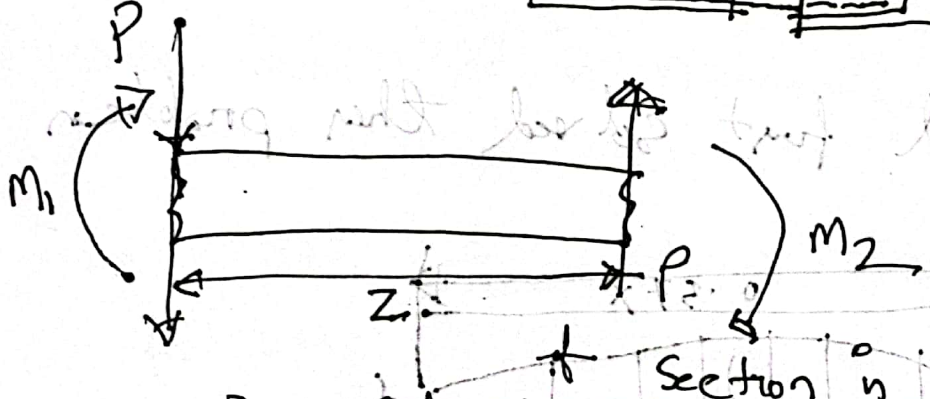


Free Body diagram of dowel cut at Joint enterface.

Equilibrium condition requires that

$$M_1 + M_2 = P.Z$$

For ideal doweling condition $M_1 = M_2 = M$

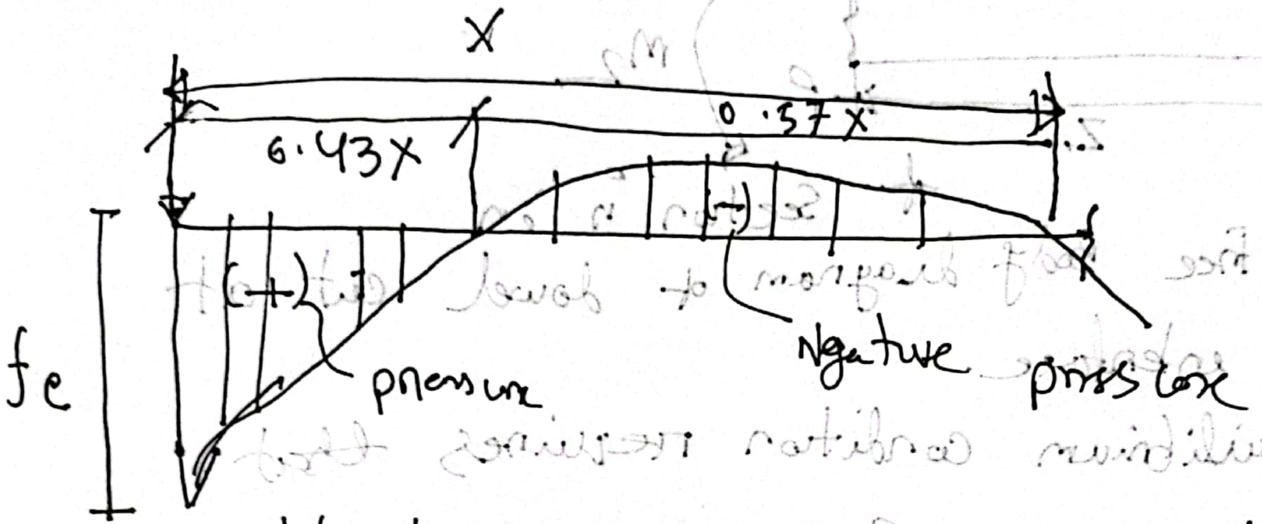
$$2M = PZ$$

$$M = \frac{PZ}{2}$$

~~Embed portions of~~

Portions of ~~bars~~ dowel bars embed in concrete may be considered as being tightly sounded by ~~material~~ elastic material (material of yielding character) and hence for offers resistance either positive or negative deflection of the bar.

Temoshenko ~~and~~ first solved the problem



Distribution of pressure on embed Bar of Infinite length caused by Load applied at End.

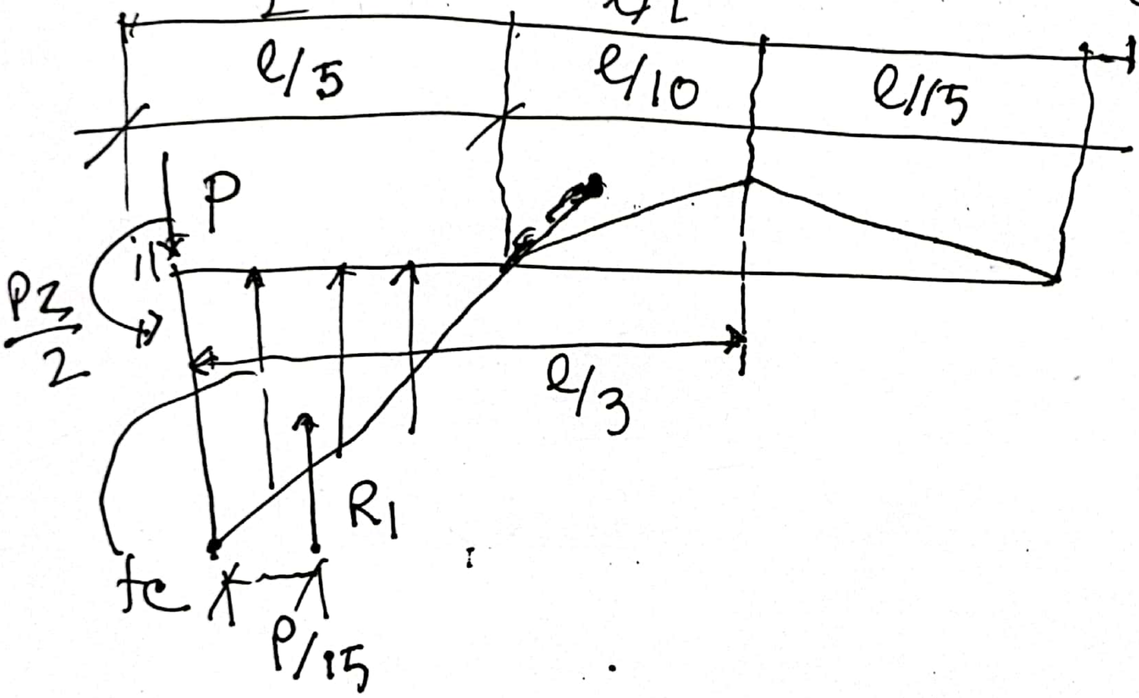
Distance from End	0	0.1X	0.2X	0.3X	0.4X	0.5X	0.6X	0.7X	0.8X	0.9X	X
Pressure Intensity $\times 10^3$	1000	793	448	177	24	-35	-42	-30	-16	-5	0

positive pressure occurs over 0.4 embedment
Negative pressure occurs over 0.6 embedment
Negative pressure is only 4.2%
positive and Negative pressure both can be approximated by 6 straight line very closely.

P-2

pressure beyon X is negligible.

From above observation Bradbury arrived at following approximation of forced both active and reactive (Free body diagram) for $\frac{1}{2}$ embeded length of the dowel bar.

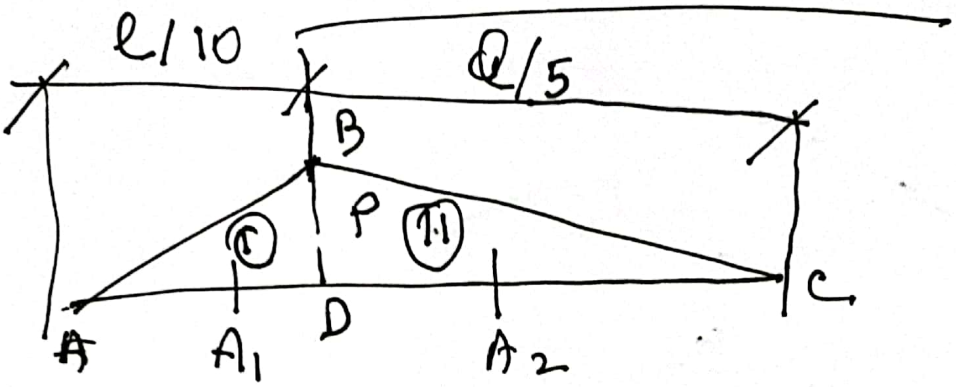


Considering above pressure diagram
R_1 = Resultant positive upward pressure
=

R_2 = Resultant of negative upward pressure
=

P-3

Calculation sheet →]



	Area	C.g	Moment
I	$\frac{1}{2} P \times \frac{l}{10}$	$l/_{10} \times \frac{2}{3} = \frac{2l}{30}$	$= \frac{1}{2} \times P \times l \times \frac{2l}{30} = \frac{Pl^2}{30}$
II	$\frac{1}{2} \times P \times \frac{l}{5} = \frac{Pl}{10}$	$\frac{l}{10} + \frac{l}{15} = \frac{5}{30} l$	$= \frac{Pl}{10} \times \frac{5}{30} l = \frac{Pl^2}{60}$
I	$\frac{1}{2} P \times \frac{l}{10} = \frac{Pl}{20}$	$\frac{2l}{30}$	$= \frac{Pl^2}{300}$
II	$\frac{1}{2} \times P \times \frac{l}{5} = \frac{Pl}{10}$	$\frac{l}{10} + \frac{l}{15} = \frac{3+2}{30} l = \frac{l}{6}$	$\frac{Pl^2}{60}$
Σ	$Pl \times \left(\frac{3}{20}\right)$		$Pl^2 \left(\frac{1+5}{300}\right) = Pl^2 \times \frac{1}{50}$

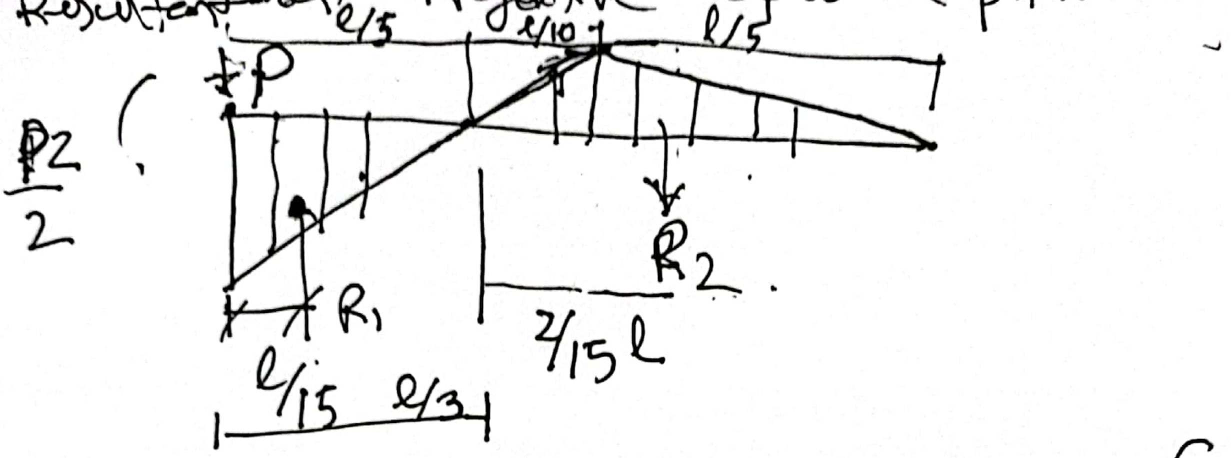
$$\text{c.g wrt A} = \frac{\cancel{Pl}^{\,l} \times \frac{1}{50}}{\cancel{Pl} \times \frac{3}{20}} = l \times \left(\frac{1}{50} \times \frac{20}{3}\right) = \frac{2}{15} l$$

c.g From left end of embedment $= \frac{l}{5} + \frac{2}{15} l$

P-4 $= \frac{l}{3}$

Calculation sheet - 2

Resultant negative upward pressure



taking moment wrt location of R_1 : Cut

$$-R_2 \times \left(\frac{\ell}{3}-\frac{\ell}{15}\right)+\frac{Pz}{2}+P\times\frac{\ell}{15}=0$$

$$\Rightarrow -R_2 \times \frac{4}{15}\ell = -\frac{Pz}{2}-\frac{P\ell}{15}$$

$$\Rightarrow R_2 \times \frac{4}{15}\ell = P\left(\cancel{\frac{\ell}{15}}\ \frac{z}{2}+\frac{\ell}{15}\right)$$

$$\Rightarrow p\ell d\left(\frac{\cancel{3}}{\cancel{20}_{5}}\right)\times\frac{\cancel{4}}{\cancel{15}_{5}}\ell = \frac{P\ell}{15}+\frac{Pz}{2}$$

$$\Rightarrow \frac{1}{25}p\ell^2 d = \frac{P}{15}(\ell+7.5z)$$

$$\cancel{p} = \frac{P}{15}$$

$$p = \frac{P\times \cancel{25}^{5}}{\cancel{15}_{3}}\times\frac{\ell+7.5z}{\ell^2 d}$$

$$= \frac{5P(\ell+7.5z)}{3\ell^2 d}$$

P - 5

$$R_2 = \frac{3}{20} p l d$$

$$= \frac{\cancel{3}}{\cancel{20}_{4}} \times l\cancel{d} \times \frac{\cancel{5}P}{\cancel{3}l^{\cancel{2}} \cancel{d}_{l}} (l+7.5z)$$

$$= \frac{P}{4l}(l+7.5z)$$

From Force equilibrium $\Sigma f_y = 0$

$$R_1 = P + R_2$$

$$\Rightarrow R_1 = P + \frac{P}{4l}(l+7.5z)$$

$$\Rightarrow \frac{P}{4l}[4l + l + 7.5z]$$

$$= \frac{P}{4l}(5l + 7.5z)$$

$$= \frac{5P}{4l}(l+1.5z)$$

~~From Area~~

$$R_1 = \frac{1}{2} f_c \times \frac{l}{5} \times d = \frac{f_c l}{10}$$

$$\frac{5P}{4l}(l+1.5z) = \frac{f_c l}{10}$$

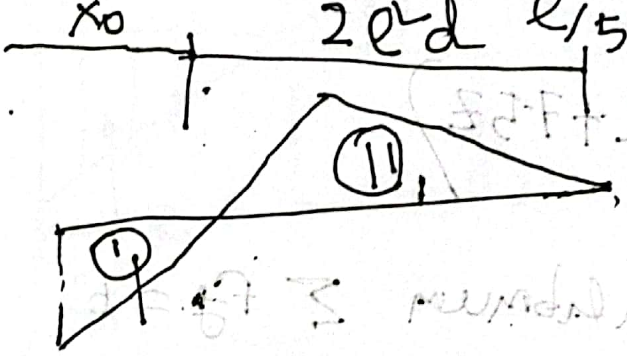
$$\Rightarrow \frac{f_c \cancel{l}d}{10} = \frac{5P}{4l}(l+1.5z)$$

$$\Rightarrow f_c = \frac{10}{ld} \times \frac{5P}{4l}(l+1.5z)$$

P-6.

$$f_c = \frac{25P \cancel{(\ell+1.5z)}}{2\ell d} (\ell+z)$$

$$f_c = \frac{25P(\ell+1.5z)}{2\ell^2 d}$$



Determenation of point of zero shear

Concrete (+) stress slope $= \frac{f_c}{\ell/5} = \frac{5 f_c}{\ell}$

at x_0 concrete ~~shear~~ (+) stress $= \frac{5 f_c}{\ell} \times x_0$

total ~~one~~ concrete ~~stress~~ (+) force

$$= \frac{1}{2} \times x_0 \times \frac{5 f_c}{\ell} \times x_0 \times d = \frac{2.5}{2} \frac{x_0^2}{\ell} f_c d$$

total ~~negative (-) fo~~ (-) force at concrete

$$R_2 = \frac{3}{20} P \ell d = \frac{P}{4\ell}(\ell+7.5z)$$

at $x_0 \rightarrow$ shear force zero so positive and negative forces are equal

$$\frac{5}{2} \frac{x_0^2}{\ell} f_c d = \frac{P}{4\ell}(\ell+7.5z)$$

$\Rightarrow$

p-7

$$\Rightarrow \frac{5}{2} \cdot \frac{x_0^2}{l} f_c \cancel{d} = \frac{3}{20} p l \cancel{d}$$

$$\Rightarrow x_0^2 = \frac{3}{\cancel{20}_{10}} \times \frac{\cancel{2}}{5} \times p l^2$$

$$= \frac{3}{50} \frac{p l^2}{f_c}$$

$$\Rightarrow x_0 = \sqrt{\frac{3}{50}} \times \sqrt{\frac{p}{f_c}} \times l$$

$$= \sqrt{\frac{3}{5p}}$$

$$\frac{p}{f_c} = \frac{\frac{5p(l+7.5z)}{3l^2 d}}{\frac{25p(l+1.5z)}{2l^2 d}}$$

$$= \frac{5\cancel{p}(l+7.5z)}{3\cancel{l^2}\cancel{d}} \times \frac{2\cancel{l^2}\cancel{d}}{\cancel{25}_{5}\cancel{p}\,\cancel{(l+1.5z)}}$$

$$= \frac{2}{\cancel{10}\,15} \times \frac{(l+7.5z)}{(l+1.5z)}$$

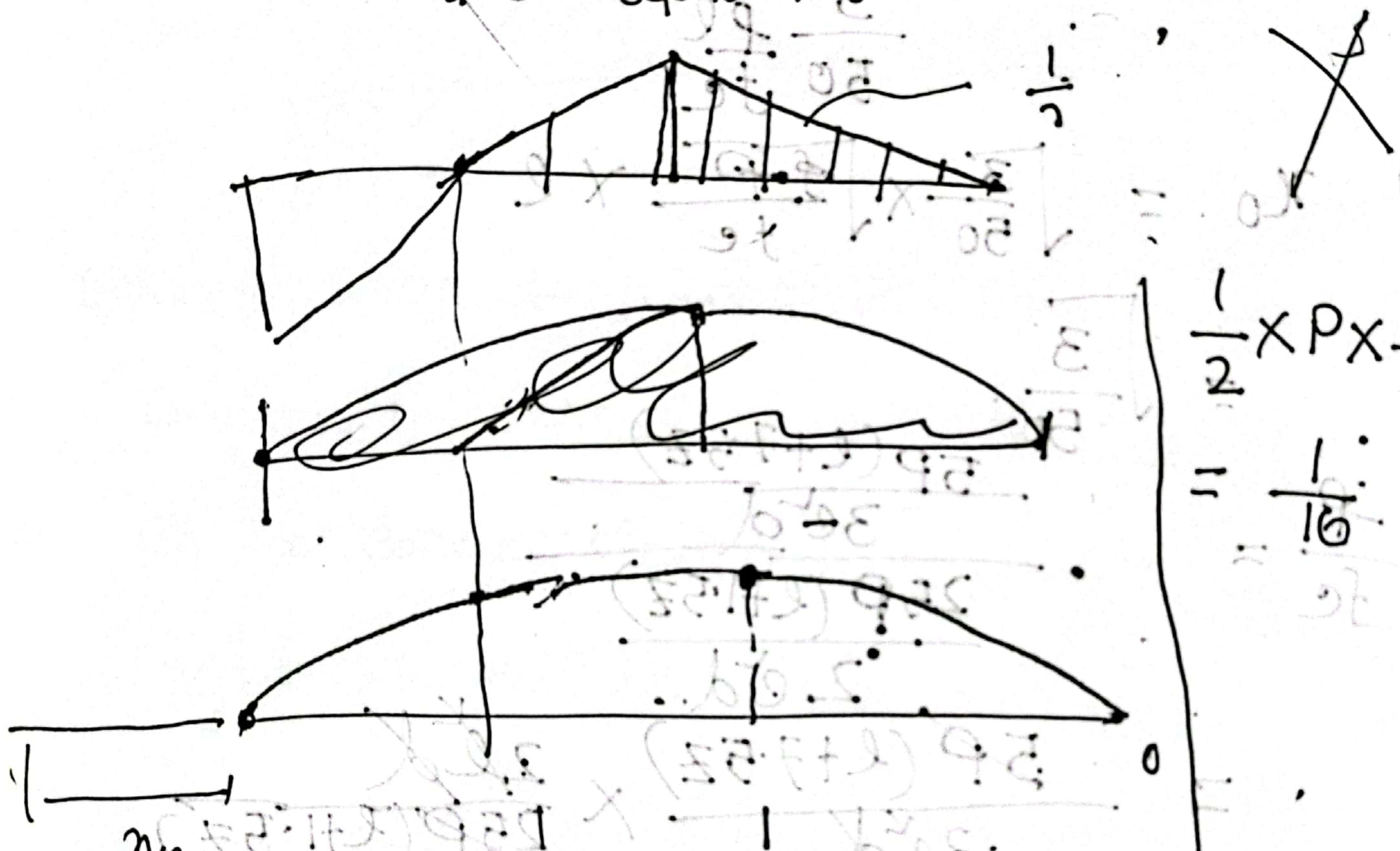
$$\Rightarrow \sqrt{\frac{p}{f_c}} = \sqrt{\frac{2}{15}} \times \sqrt{\frac{l+7.5z}{l+1.5z}}$$

$$x_0 = \sqrt{\frac{\cancel{3}}{\cancel{50}_{25}} \times \frac{\cancel{2}}{\cancel{15}_{5}}} \times \sqrt{\frac{l+7.5z}{l+1.5z}}\, l = l \times \sqrt{\frac{1}{125}} \times \sqrt{}$$

$$= l\sqrt{\frac{1}{125}} \times \sqrt{\frac{l+7.5z}{l+1.5z}}$$

Find maxim umo bending moment :

Draw SFD upto x_0



$\frac{1}{2} \times P \times \frac{l}{5} \times d$

$= \frac{1}{16}$

$$\frac{1}{5} - \frac{1}{5\sqrt{5}}$$

$$\frac{\sqrt{5}-1}{5\sqrt{5}}$$

$$\frac{(\sqrt{5}-1)(\sqrt{5}+1)}{5\sqrt{5}(\sqrt{5}+1)}$$

$$\frac{4}{5} \times \frac{1}{}$$

$\frac{l}{5} - \frac{1}{11}$

$= \frac{11-5}{55}$

$= \frac{6}{55}$

P-9

$$\cancel{x_0 = l\sqrt{\frac{1}{125}} \times \sqrt{\frac{P+7.5z}{P}}}$$

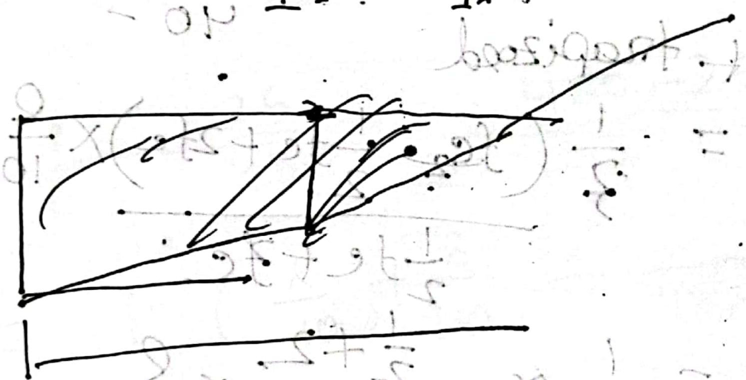
$$x_0 = l\sqrt{\frac{1}{125}} \times \sqrt{\frac{l+7.5z}{l+1.5z}}$$

$l \gg z$

$$\sqrt{\frac{l+7.5z}{l+1.5z}} \approx 1$$

$$x_0 = l\sqrt{\frac{1}{125}}$$

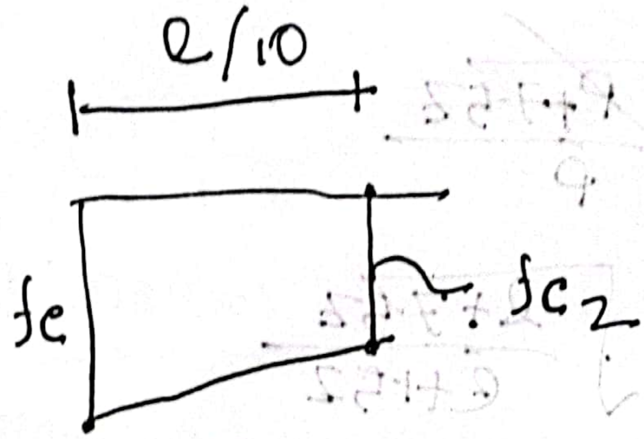
$$x_0 \approx l \times \frac{1}{11} \approx \frac{1}{11} l$$



~~from left~~

From support distance of zero shear

$$= \frac{l}{5} - \frac{l}{11} = \frac{11-5}{55} = \frac{6}{55} l \approx \frac{l}{10}$$



$$f_{c_2} = f_c - \frac{\cancel{5} f_c}{l} \times \frac{l}{\cancel{10}_{\,2}}$$

$$= \frac{1}{2} f_c$$

Area of the trapizoid $= \frac{1}{2}\left(1 + \frac{1}{2}\right) f_c \times \frac{l}{10} \times d$

$$= \frac{1}{2} \times \frac{3}{2} \times \frac{l}{10}\ \mathrm{nd}$$

$$= \frac{3}{40} f_c l d$$

centroid of trapizoid

$$= \frac{\frac{1}{3}\left(\cancel{f_{c_2}}\ \frac{1}{2} f_c + 2 f_c\right) \times \frac{l}{10}}{\frac{1}{2} f_c + f_c}$$

$$= \frac{1}{3} \times \frac{\frac{1}{2} + 2}{\frac{1}{2} + 1} \times \frac{l}{10}$$

$$= \frac{1}{3} \times \frac{\frac{5}{2}}{\frac{3}{2}} \times \frac{l}{10}$$

$$= \frac{1}{3} \times \frac{5}{\cancel{2}} \times \frac{\cancel{2}}{3} \times \frac{l}{\cancel{10}_{\,2}}$$

$$= \frac{l}{18}$$

taking moment cont. zero ... $\frac{l}{2}$

$$\frac{Pl}{10} + \frac{Pz}{2} - \frac{\cancel{3}}{4\cancel{0}} f_e l d \times \frac{l}{\cancel{18}_{6}}$$

$$= \frac{Pl}{10} + \frac{Pz}{2} - \frac{f_e l d}{2400}$$

$$= \frac{Pl}{10} + \frac{Pz}{2} - \frac{l^2 d}{2400} \times \frac{25P(l+1.5z)}{2l^2 d}$$

$$= P\left(\frac{l}{10} + \frac{z}{2} - \left(\frac{25l}{4800} - \frac{1.5\times25}{4800}\right)\right)$$

$$= P($$

$$\frac{1}{10} - \frac{25}{480} = \frac{480-25}{4800} = \frac{455}{4800}$$

$$= P\left(\frac{l}{10} + \frac{z}{10} - \frac{}{48\times9}\right)$$

$P \cdot 12$

taking moment cont zero of $\frac{l}{2}$

$$\frac{Pl}{10} + \frac{Pz}{2} - \frac{\cancel{3}}{\cancel{40}} f_c l d \times \frac{l}{\cancel{18}_{6}}$$

$$= \frac{Pl}{10} + \frac{Pz}{2} - \frac{f_c l^2 d}{2400}$$

$$= \frac{Pl}{10} + \frac{Pz}{2} - \frac{\cancel{l^2 d}}{2400} \times \frac{25P(l+1.5z)}{2\cancel{l^2 d}}$$

$$= P\left(\frac{l}{10} + \frac{z}{2} - \left(\frac{25l}{4800} - \frac{1.5\times 25}{4800}\right)\right)$$

$$= P\left(\right.$$

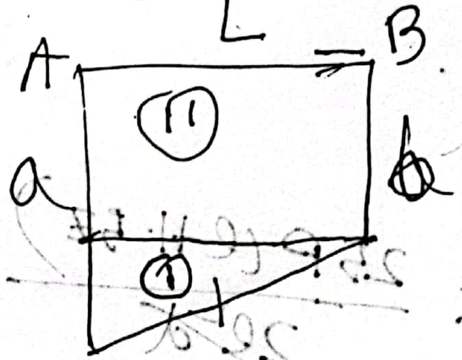
$$\frac{1}{10} - \frac{25}{4800} = \frac{480-25}{4800} = \frac{455}{4800}$$

$$= P\left(\frac{l}{10} + \frac{z}{10} - \frac{}{48\times 9}\right.$$

$P \cdot 12$

Calculation of Maximum

Bending Moment



$$A = \frac{1}{2}(a+b)L$$

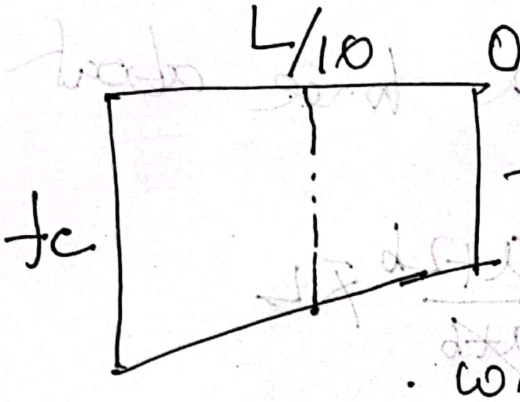
	Area	C.g wrt A	Moment
I	$\frac{1}{2}(a-b)L$	$\frac{1}{3}L$	$= \frac{1}{6}(a-b)L^2$
II	bL	$\frac{L}{2}$	$\frac{1}{2}bL^2$
	$\{\frac{1}{2}(a-b)+b\}L$ $= \frac{1}{2}(a-b+2b)L$ $= \frac{1}{2}(a+b)L$		$\frac{1}{6}(a-b+3b)L^2$
			$\frac{1}{6}(a+2b)L^2$

$$\text{C.g wrt } A = \frac{\frac{1}{6}(a+2b)L^2}{\frac{1}{2}(a+b)L}$$

$$= \frac{\frac{1}{6}}{\frac{1}{2}} \times \frac{a+2b}{a+b} \times L$$

$$= \left(\frac{1}{6} \times \frac{2}{1}\right) \times \frac{a+2b}{a+b} L = \frac{1}{3}\frac{a+2b}{a+b} L$$

P-13



$\frac{1}{2}fc$

wrt ~~zero~~

c.g wrt 0 $= \frac{1}{3} \times \left(\frac{\frac{1}{2}fc + 2fc}{\frac{1}{2}fc + fc} \right) \frac{L}{10}$

$= \frac{1}{3} \left(\frac{\frac{1}{2}+2}{\frac{1}{2}+1} \right) \frac{L}{10}$

$= \frac{1}{3} \times \frac{5/2}{3/2} \times \frac{L}{10}$

$= \frac{1}{3} \times \frac{5}{\cancel{2}} \times \frac{\cancel{2}}{3} \times \frac{L}{10}$

$= \frac{\cancel{5}}{9} \times \frac{L}{\cancel{10}_{2}} = \frac{1}{18} L$

Force $= \frac{1}{2}$

Moment

$= \frac{1}{6} \left(\frac{1}{2}fc + 2fc \right) \times \frac{l^2}{10^2}$

$= \frac{1}{6} \times \frac{5}{2} fc \times \frac{l^2}{100}$

$= \frac{5fc\, l^2 d}{1200}$

P-14

Moment of Trapezoidal force about ~~Free~~ end

$$M_A = \frac{1}{2}(\cancel{a+b})L \times \frac{1}{3} \times \frac{a+2b}{\cancel{a+b}} \times L$$

$$= \frac{1}{6}(a+2b)L^2$$

So Maximum moment:

$$M_0 = \frac{Pl}{10} + \frac{Pz}{2} - \frac{5f_e l^2 d}{1200}.$$

$$\frac{5l^2d}{1200} \times f_e = \frac{5\cancel{l^2d}}{\cancel{1200}_{48}} \times \frac{\cancel{25}P(l+1.5z)}{2\cancel{l^2d}}$$

$$= \frac{5P}{96}(l+1.5z)$$

$$M_0 = \frac{Pl}{10} + \frac{Pz}{2} - \frac{5P}{96}(l+1.5z)$$

P-13

$$= \frac{\cancel{P}}{\cancel{10}} \frac{P}{960}\left[96l + 480z - 50l - 75z\right]$$

$$= \frac{P}{960}\left[46l + 405z\right]$$

$$= \frac{P \times \cancel{46}^{23}}{\cancel{960}_{480}}\left[l + 8.8z\right) \qquad \frac{7}{146} = 0.0479$$

$$= \frac{23P}{480}\left(l + 8.8z\right) \Big\} = \text{Bradbury Gives It as } \frac{7P\left(l+8.8z\right)}{146}$$

dowel is a Circular Section :

Moment of Inertia $= \frac{\pi}{64} d^4$

$$c = \frac{d}{2}$$

$$Z = \frac{I}{c} = \frac{\frac{\pi d^4}{64}}{d/2} = \frac{\pi d^{\cancel{4}\,3}}{\cancel{64}_{32}} \times \frac{\cancel{2}}{\cancel{d}} = \frac{\pi d^3}{32}$$

Maxim moment That cand nanted by a dowel section

$$f_s = \frac{M_{max}}{Z}$$

$$\Rightarrow M_{max} = f_s Z = f_s \times \frac{\pi d^3}{32}$$

equating ~~this~~ to M_0 we get

$$\frac{7P}{146}(l + 8.8Z) = f_s \frac{\pi d^3}{32}$$

$$\Rightarrow P = \frac{146}{7} \times f_s \times \frac{\pi d^3}{32} \times \frac{1}{l + 8.8Z}$$

$$= \underbrace{\left\{\frac{146 \times \pi}{7 \times 32}\right\}}_{2.04} \times \frac{d^3 f_s}{l + 8.8Z}$$

(Brad bracy approximate it as 2.0)

$$P = \frac{2d^3 f_s}{l + 8.8Z} \quad \text{(8)}$$

Maximum shear stress of a circular bar

$$= \frac{\pi}{4} d^2 f_s'$$

$$P = 0.785 d^2 f_s' \quad \text{--- (7)}$$

From Bearing concrete:

$$f_c = \frac{25P(\ell + 1.5z)}{2\ell^2 d}$$

$$\Rightarrow P = f_c \times 2\ell^2 d \times \frac{1}{25} \times \frac{1}{\ell + 1.5z}$$

$$= \left(\frac{2}{25}\right) \times \frac{f_c \ell^2 d}{\ell + 1.5z}$$

$$= \frac{1}{12.5} \times \frac{f_c \ell^2 d}{\ell + 1.5z} \quad \text{--- (9)}$$

eq (9) says increasing dowel length increases capacity in concreate bearing parabolically while (8) tell for ~~that~~ bending capacity of dowel decreases ~~linearly~~ hyperbolically.

P-18

We need to combine these two formulas

$$\frac{2d^3 f_s}{l+8.8z} = \frac{1}{12.5} \times \frac{f_e l^2 d}{l+1.5z}$$

$$\Rightarrow \frac{4d^3 f_s}{l+8.8z} = \frac{1}{\cancel{25}}$$

$$\Rightarrow \frac{d^3 f_s}{l+8.8z} = \frac{1}{25} \times \frac{f_e l^2 d}{l+1.5z}$$

$$\Rightarrow 25 \times \frac{f_s}{f_e} \times \frac{d^3}{d} \times \frac{l+1.5z}{l+8.8z} = l^2$$

$$\Rightarrow l = 5 \times \sqrt{\frac{f_s}{f_e}} \times \sqrt{\frac{l+1.5z}{l+8.8z}}\, d$$

$$= 5d \times \sqrt{\frac{f_s}{f_e}} \times \sqrt{\frac{l+1.5z}{l+8.8z}}$$

Limiting dowel length for equal capacity in both

$$l = 5d \times \sqrt{\frac{f_s}{f_e}} \times \sqrt{\frac{l+1.5z}{l+8.8z}}$$

P-17

If $l \gg Z$ $\sqrt{\frac{l+1.5Z}{l+8.8Z}} \approx 1$

$l = d\sqrt{2}$

$= 5d\sqrt{\frac{fs}{fc}}$

Actual length of dowel bar:

$l+Z$

Proper dowelling means each slab end will carry $\frac{1}{2}$ of the total system load at joint.

Maximum load due to concentrated load is maxm at point of application. According to W Westergaard theory moment is approximately $\frac{1}{2}$ at a distance 9 to 15 inch from load.

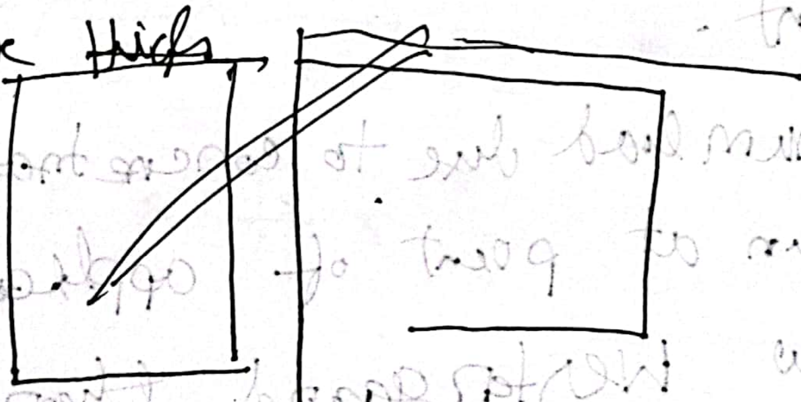
Reasonably close spacings of dowels not more than 24 inch any case

Total no of dowels >> All loads applied at Joints

Maximum Load Transfer capacity of a single Dowel

Maximum Wheel Load:

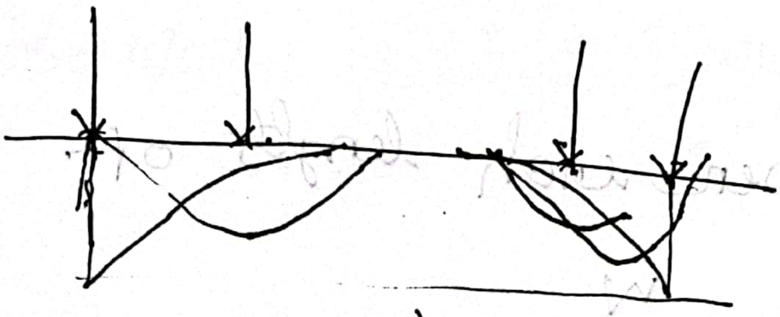
Towlox thick



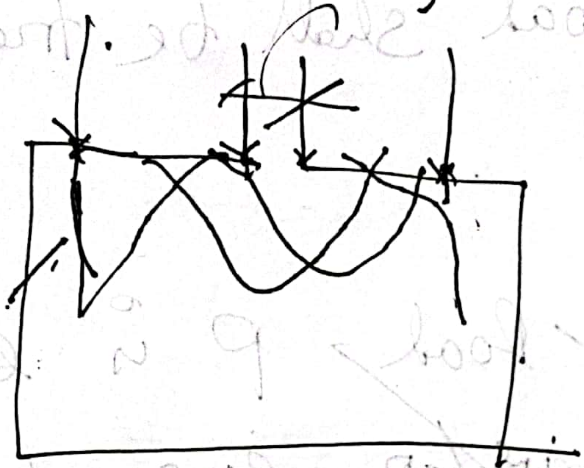
Two lane:

• Two passing vehicle [2 axle Load]

P-21



(a)



a) Case a

Vertex or Edge:

fairly uniform distribution of load over a width of 8 feet (two-wheel loads)

Uniform distribution of load over Case: b A fairly of 16 feet of 4 wheel loads:

So It is reasonable to assume

So Two wheel load uniformily distributed over a lane width shall be a reasonable estimate.

Applied load per inch length of Joint would be $\frac{W}{66}$

$\frac{1}{2}$ of Joint load shall be tranfered by dowels.

~~If W is wheel load~~, P is ~~the~~ ~~single~~ ~~load transfer capacity of single dowel bar~~

~~S =~~

~~Stresses~~

Allowable Stresses:

f_e = allowable elastic stress of concrete
$= 0.4 f'_c$

f_s = allowable tensile stress of steel.

P.29

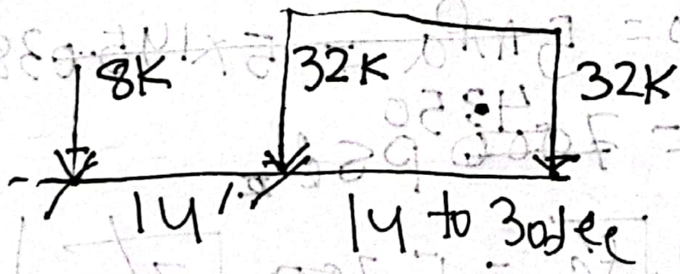
$f_s = \cancel{0.75 f_y}\ 0.75 f_y$ [working stress of steel]

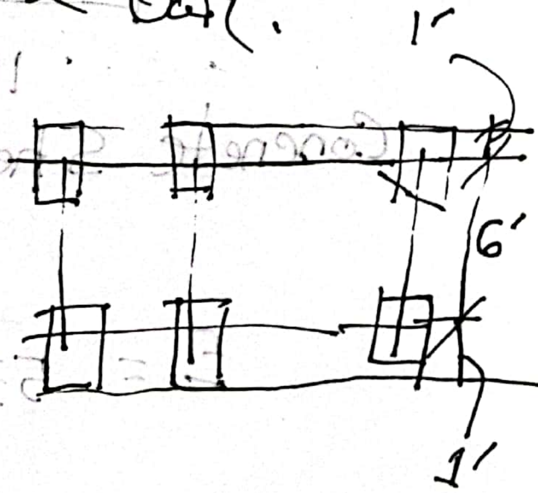
Required Minimum concrete cover for Dowel bar: $D = 3d$

D = distance of nearest concrete face from center of dowel bar.

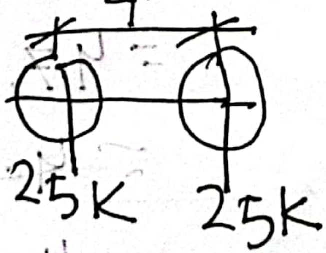
d = diameter of dowel bar.

Loads HL-93





Tandem

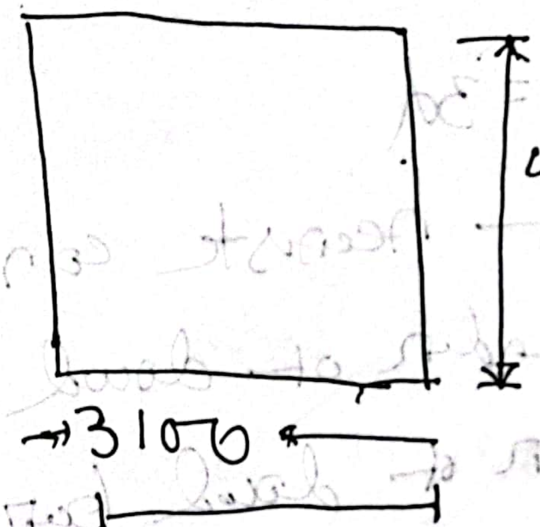


P-24

Lane load 0.64 klf

Design Problems :

Maximum Load



10' 2"

thickness h
= 30cm
= 12 inch

Concrete Strength = ~~5 MPa = 5×145.038~~ =
= ~~7000~~ 4350 psi

$E = 57000\sqrt{f'_c} = 57000\sqrt{7000}$
$= 47,68,962$
$= \cancel{4.8}\ 4$
$= 4.76 \times 10^6$ psi
$= 3.76 \times 10^6$ psi

$57000\sqrt{4350}$
$= 3.76 \times 10^6$ psi

$\mu = 0.15$

p-25

CBR value = 25

$K = 28.6926\, CBR^{0.7288}$

$= 34350 psi/in^3$

Radius of relative stiffness

$$= \sqrt[4]{\frac{4.76 \times 10^6 \times 12^3}{12 \times 350 \times (1-\mu^2)}}$$

$$= \sqrt[4]{\frac{8225.28 \times 10^6}{12 \times 350 \times 0.9775}}$$

$$= \sqrt[4]{\frac{8225.28 \times 10^6}{4105.5}}$$

$$= \sqrt[4]{2.0035 \times 10^6}$$

= 37.63 inch

= Say 36 inch

$f_s = 0.45 f_y = 0.45 \times 60000 = 27,000$ psi

$f_s = 0.75 \times 60000 = 42,000$ psi

$f_c = 0.4 f'_c = 0.4 \times 4350 = 1740$ psi

For 13'5"

For 4100 mm (13'5") Lane width = 161 inch lane width

~~For~~ One Axle may be considered

A ~~axle~~ load UDL = $\frac{32 \times 1000}{161 \text{ in}}$ = 200 #/inch

Tandem load = $\frac{25 \times 1000}{4 \times 12}$ = $\frac{25000}{48}$ = 520 #/inch

Lane Load = 0.64 klf

= $\frac{0.64 \times 1000}{12}$ = 53 #/inch

Design ~~An~~ Live load = 520 #/inch

Considering Impact for 25%

Design Live load = 1.25 × 520 = 650 #/inch

Dowel Capacity:

φ 3.2 cm dowel = 1.26 inch = d

P-28

$$L_D = 5d\sqrt{\frac{fs}{fc}} \times \sqrt{\frac{Ld+1.5\delta}{Ld+8.8\delta}}$$

$\delta = 2.0\,cm \approx 1$ inch

$$L_D = \cancel{1.25}\ 5 \times 1.25\sqrt{\frac{42000}{1740}} \times \sqrt{\frac{Ld+1.5}{Ld+8.8}}$$

$$= 6.25 \times 4.91\sqrt{\frac{Ld+1.5}{Ld+8.8}}$$

$$= 30.68\sqrt{\frac{Ld+1.5}{Ld+8.8}}$$

needs trial

~~cons~~ use approximate equation

$$L_D = 5d\sqrt{\frac{fs}{fc}}$$

$$= 5d \times \sqrt{\frac{42000}{1740}} = 5d \times 4.91 = 24.56d$$

$$= 26d = 32.76 = 33 \text{ inch}$$

$Ld = 33 + 1 = 34$ inch. (1 inch for Joint)

Dowel capacity in shear

$$P_s = 0.785d^2 fs'$$

$$= 0.785 \times 1.26^2 \times 27000$$

$$= 33650\ \#$$

P-28

Dowel Capacity in Bending

$$P_f = \frac{2d^3 f_s}{L + 8.8Z} = \frac{2 \times 1.26^3 \times 42000}{34 + 8.8}$$

$$= \frac{}{} = 3926\ \#$$

Dowel Spacings = $\frac{\text{Maximum live Load}}{\text{Maximum dowel capacity}}$

$$S = \frac{\text{Minimum } \cancel{\text{Maximum}} \text{ Dowel Capacity}}{\text{Maximum live Load}}$$

$$= \frac{3926}{650} = 6.04$$

= 6 inch

So use 1.26 inch dowel @ 6 in c/c

3.2 cm dowel @ 15 cm c/c

t-29

Redining

2 tandem over 13'

$$\frac{2 \times 25 \times 2}{161} = 621 \text{ \#/inch}$$

50% shall be transfer by dowel

So design tandem load

$= 312$ #/inch

Maximum dowel spacing

$$= \frac{3926}{401} = 9.79 \text{ inch c/c}$$

$$= \frac{3926}{312} = 12.58 \text{ inc c/c}$$