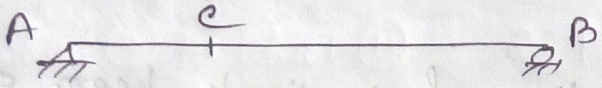
CT ⇒ Sunday (Assgn II to today's class)

31·10·15

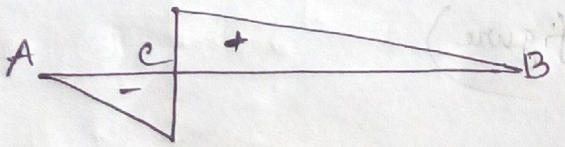
Art 62 & 64

Position of wheel to produce max^m shear at a section.

যে side টা বড় সেদিকে পিছে movement হবে।



IL diagram for shear at C



Change in shear for a movement d_1 of a series Loads is given by—

$$\Delta V = \frac{\Sigma P d_1}{L} - P_1 + \frac{P' e}{L} + \frac{P_2 e'}{L}$$

where, ΣP = wheel load that stay on the span before and after movement

P_1 = the wheel that crossed point C (section C)

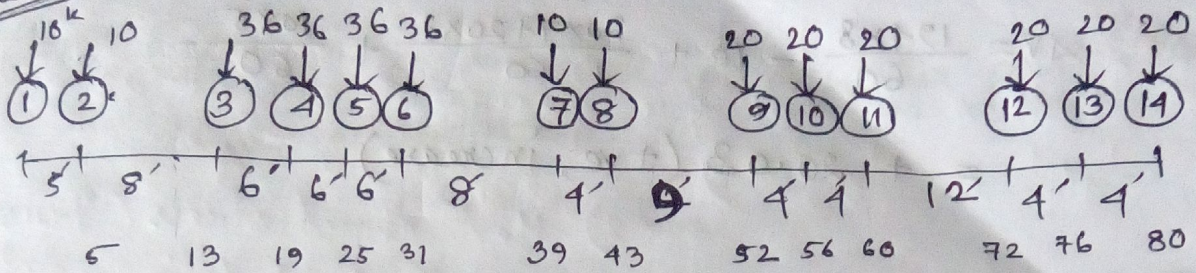
P' = wheel that comes on the span during movement

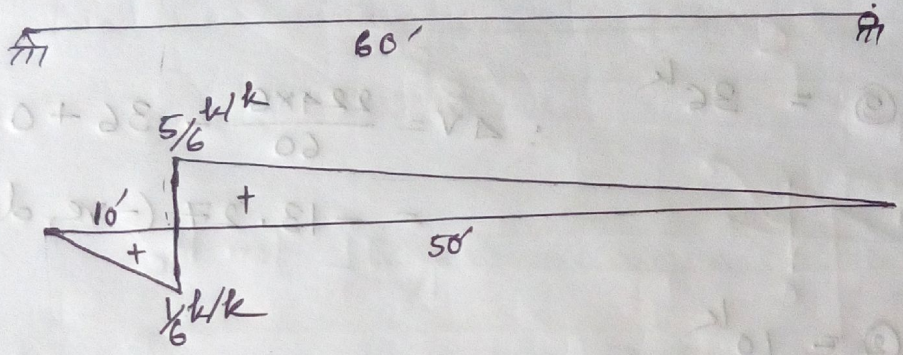
e = distance travelled by P' on the span

P_2 = wheel that moves off the span during movement.

e' = distance travelled by P_2 on the span before moving of the span.

Example-1





Find max^m shear at distance 10' from left support of a 60' simple span

Trial-1 wheel ① at C to wheel ② at C.

ΣP = wheel ② to wheel ⑧ = 184^k

$d_1 = 5'$

P_1 = wheel ① = 10^k

P' = wheel ⑨ = 20^k

$e = 3'$

$P_2 = 0$

$e' = 0$

$$\Delta V = \frac{\Sigma P d_1}{L} - P_1 + \frac{P' e}{L} + \frac{P_2 e'}{L}$$

$$= \frac{184 \times 5}{60} - 10 + \frac{20 \times 3}{60}$$

$$= +6.33^k \text{ (+ve, increasing)}$$

Trial-2 wheel ② at C to wheel ③ at C

ΣP = wheel ② to wheel ⑨ = 194^k

$d_1 = 8'$

P_1 = wheel ②

P_2 = wheel ① = 10^k

$e' = 5'$

P' = ~~wheel ⑩ &~~ wheel ⑫ = ~~20^k + 20^k~~ wheel ⑩ = 20^k

e = ~~7' + 3'~~ 7' for wheel ⑩, 3' for wheel ⑪.

$$\Delta V = \frac{194\times 8}{60} - 10 + \frac{20\times 7 + 20\times 3}{60} + \frac{10\times 5}{60}$$

$$= +20.03 \text{ (+ve, increase)}$$

Trial-3

ΣP = wheel ③ to wheel ⑪ = 224^k

$d_1 = 6'$

P_1 = wheel ③ = 36^k

$P' = 0$

$e = 0$

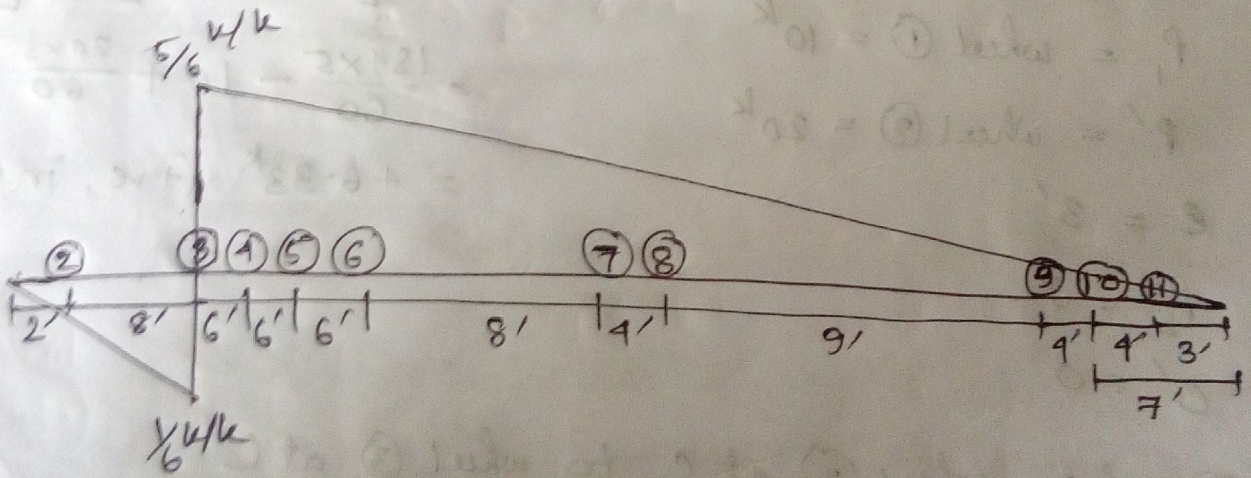
P_2 = wheel ② = 10^k

$e' = 2'$

$$\therefore \Delta V = \frac{224\times 6}{60} - 36 + 0 + \frac{10\times 2}{60}$$

$$= -13.27 \text{ (-ve, decrease)}$$

∴ wheel ③ at C gives the max^m shear.

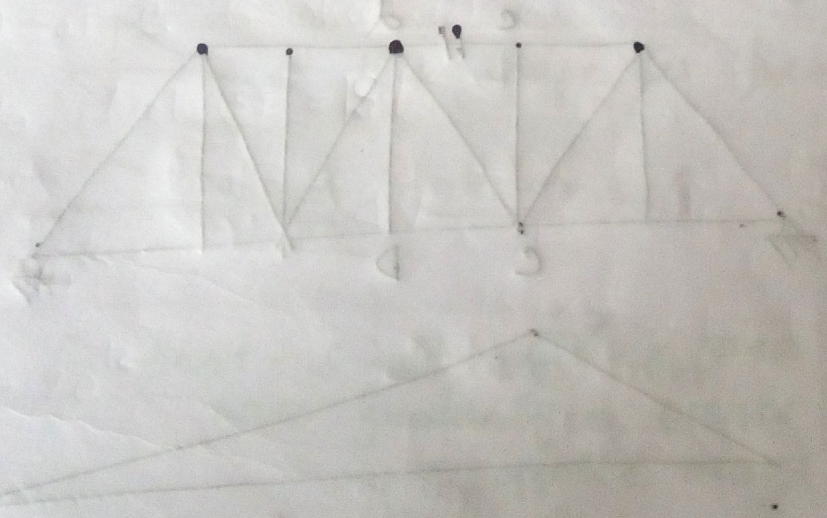


$$\therefore \text{Max}^m \text{ shear} = +\frac{5/6}{50}\left[50\times 36 + 44\times 36 + 38\times 36 + \cdots + 7\times 20 + 3\times 20\right] - \frac{1/6}{10}\left[2\times 10 + 3\times 20\right]$$

$$= \underline{112.4^k}$$

Assgn-24

Span = 80' Max^{m} shear at quarter point. Loading same as before.

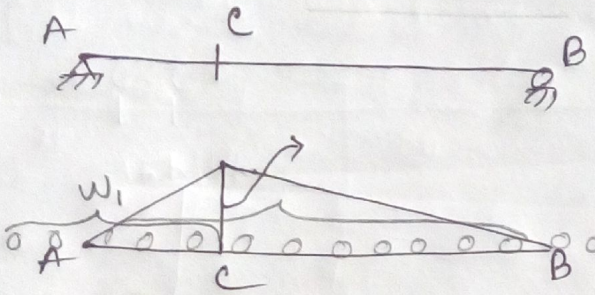


01.11.15

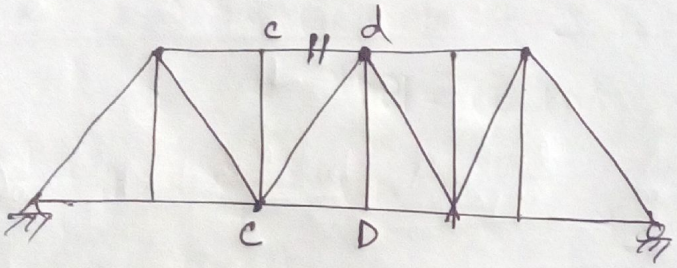
Art 65

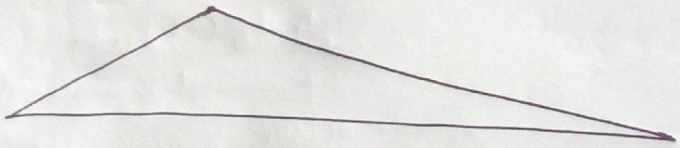
Position of wheel for 1) maximum moment at a section (Beam)

2) Max^m chord stress (Truss)
(max^m chord force member)



IL for M_C





IL for member cd

(cz এই cd ⇐ chord মেম্বার bottom chord → C point → moment নিলে force পাব।)

⇓

Top & bottom chord → almost same

⇓

symmetric truss, so, half side বললেই হবে

⇓

(load left support থেকে দূরত্ব হবে right support পর্যন্ত থাকবে।)

Assignment 25 I line force ⇒

① top chord members
② bottom " "
③ diagonal " "
④ verticle " "

• Criterion for maximum moment at a section —

$$\frac{W}{L} = \frac{W_1}{a}$$

এটার diff করবে যে C-এর বামে/ডানে বসাবে।

W = wheels on the span

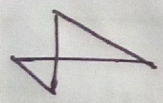
W_1 = wheels at the left side of the ~~span~~ control point

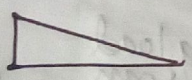
L = total span

a = span of the left of the section.

∴ Avg load on the span = avg load of the left of the section

This criterion are valid for only this shape of IL dia

Similarly,  ⇒ this shape is fixed for shear

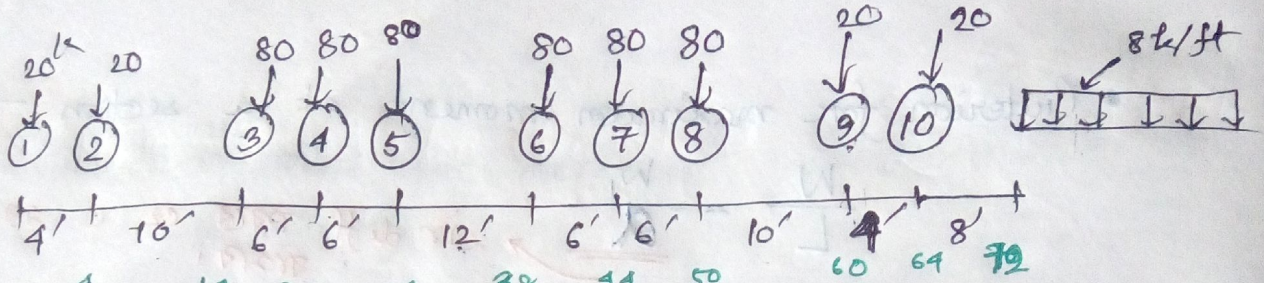
&  ⇒ " " " " " reactions.

Prob-120

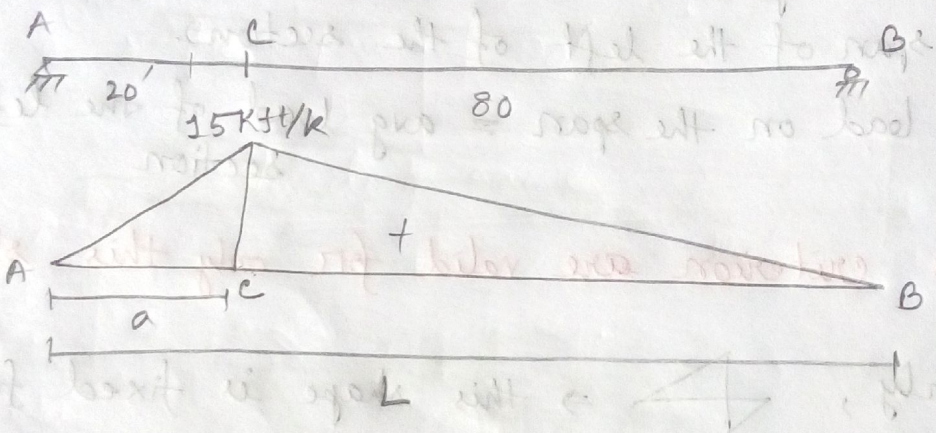
(*) first - এ just right - এ বসাবে then ~~slowly~~ left - এ বসাবে gradually ⇒ যেভাবে right - এ and left > or < opposite ভাবে যে স্থান stop.

⇓

stop - এর পর যে wheel control point - এ ছোঁয় সে load দিবে তা Max^m moment.



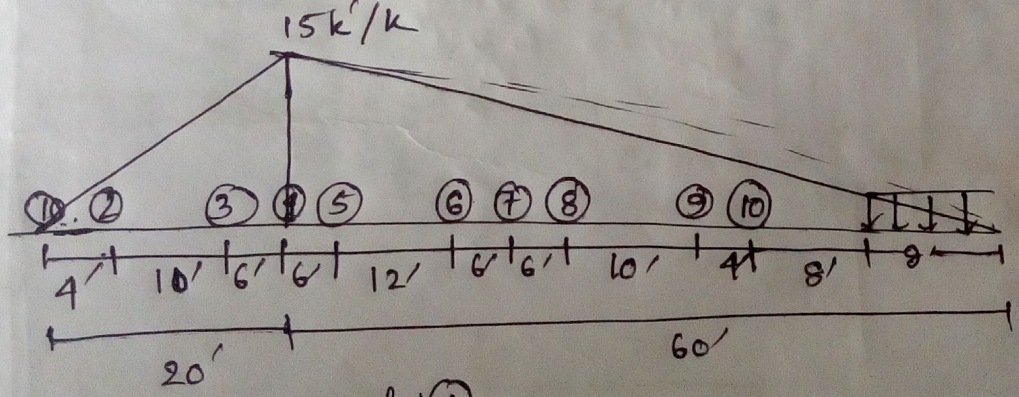
Dul to the Axle load shown, Find max^m moment at quarter point of a simple span of 80'.



Trial No.	Position of wheel	Avg load on span	Avg load on left of sect^n	Remark	Calculation.
I	wheel ② at C				
	just to right	$\frac{540}{60}$	$\frac{20}{20}$	Criterion not satisfied	W = ① to ⑤ W = ① to ⑥ W = ① & ②
	just to left	$\frac{560}{60}$	$\frac{40}{20}$		

Trial No	Position of wheel	Avg. load on the span	Avg load on the left	Remark	Calculation
2	wheel ④ — right	$\frac{624}{80}$	$>$ $\frac{120}{20}$	satisfied	W = ① to ⑩ + 8×8 = 624 W_1 = ①, ②, ③ = 120
	wheel ④ — left	$\frac{604}{80}$	$<$ $\frac{180}{20}$		W = ② to ⑩ + 8×8 = 604 W_1 = ② to ④ = 180
2	wheel ③ — right	$\frac{576}{80}$	$>$ $\frac{40}{20}$	Not sat	W = ① to ⑩ + 8×2 = 576 W_1 = ① & ② = 40 k
	wheel ③ — left	$\frac{576}{80}$	$>$ $\frac{120}{20}$		W = ① to ⑩ + 8×2 = 576 W_1 = ①, ②, ③ = 120

Hence wheel ④ at c (quarter point) give maximum moment for Axle load.



$$\therefore \text{Max}^m M \text{ for Axle load} = \frac{15}{60}\Big[60\times 80 + 54\times 80 + 42\times 80 + \cdots + \cdots \times 20\Big] + \Big[\Big(\tfrac{1}{2}\times 8\times \tfrac{15}{60}\times 8\Big)\times 8 \text{ k/ft}\Big] + \frac{15}{20}\Big[14\times 80 + 4\times 20\Big]$$

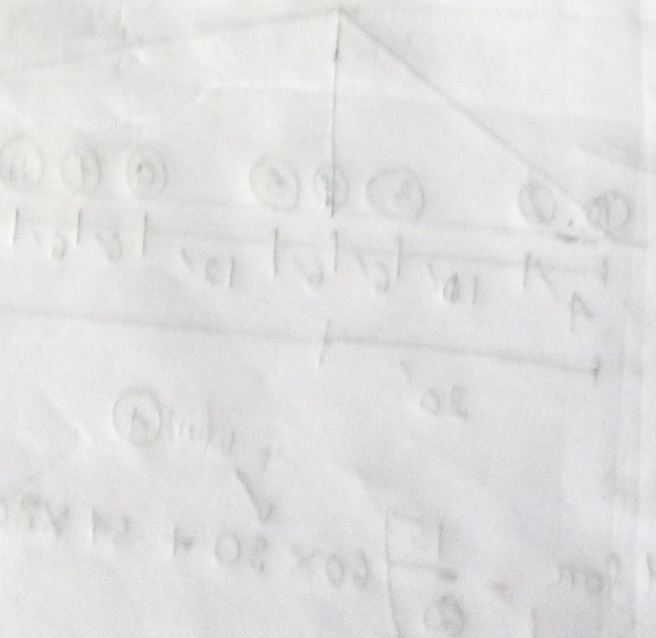
(wheel ④ at the first term; wheel ⑩ at the last term; wheel ③ at the last term; the bracketed area is the area of the IL dia of that portion of UDL.)

$$= 5584 \text{ k-ft}$$

∴ Max^m moment for wheel load = $\frac{5581}{2}$ = 2792 kft.

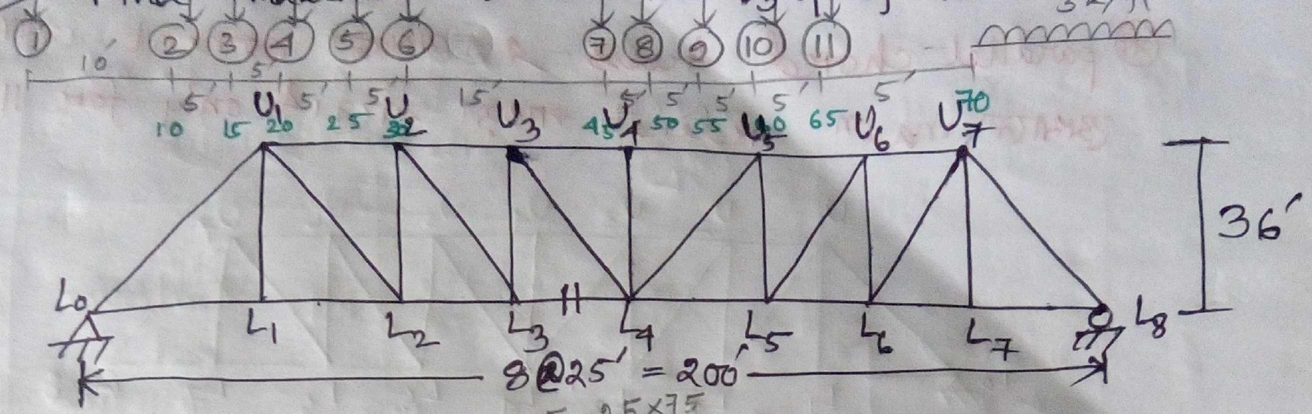
Assgn-2.6

Find max^m moment at ~~quarter~~ one third point of a simple span of 90' if loading same

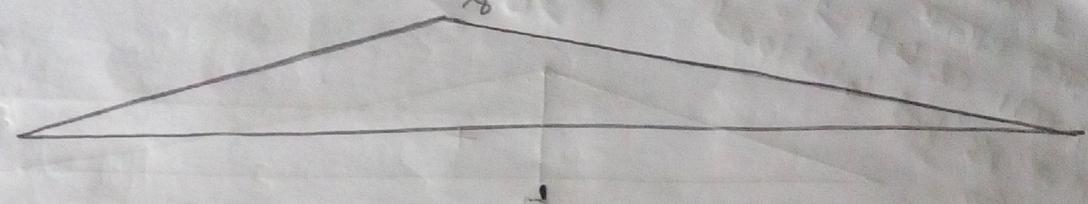


Problem # 221

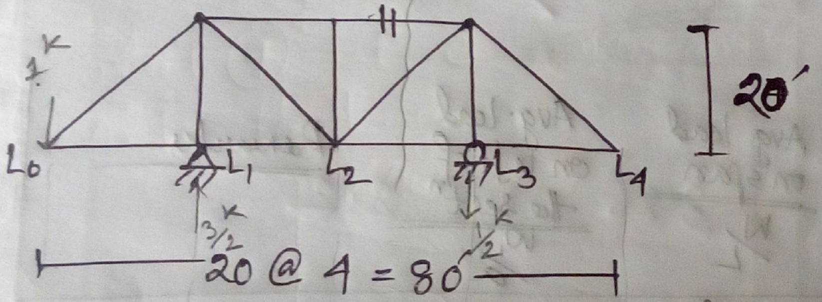
Find maximum stress in L_3L_4 of the truss shown.



$\frac{5}{8} \times 25 \times 75$



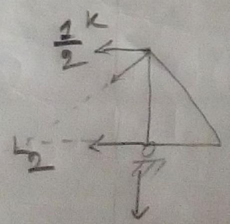
Assignmnt-27



Draw IL dia for U_2U_3 and L_1L_2 and U_1L_2

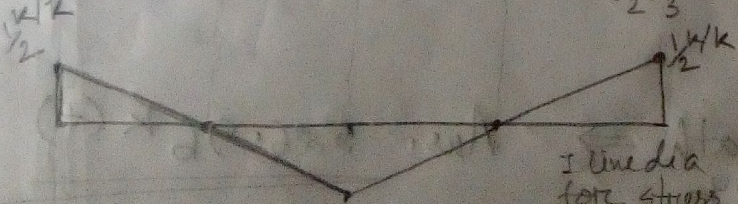
only member এর মানে stress/ bar force-এর জন্য cz এখানে moment/shear নাই

(*) first-এ 1^k L_0-এ then gradically L_1, L_2, L_3, ... -এ বসাব।



$\Sigma H_{L_2} = 0 \Rightarrow$ $F_{U_2U_3} \times 20 - \frac{1}{2} \times 20 = 0$ —— (1)

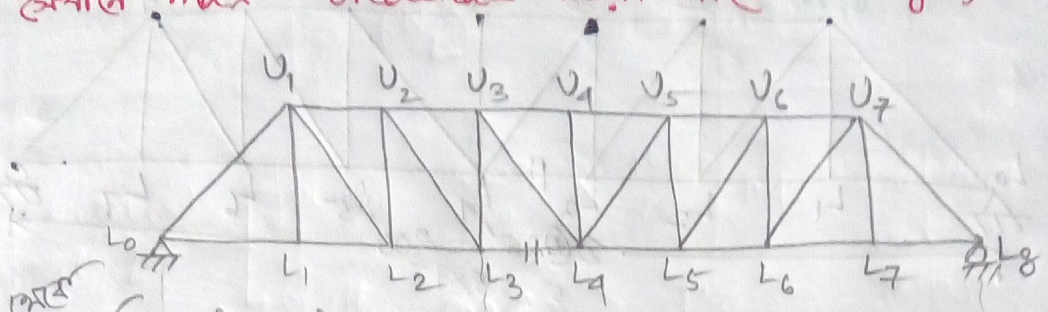
$\Rightarrow F_{U_2U_3} = \frac{1}{2}$ (+)



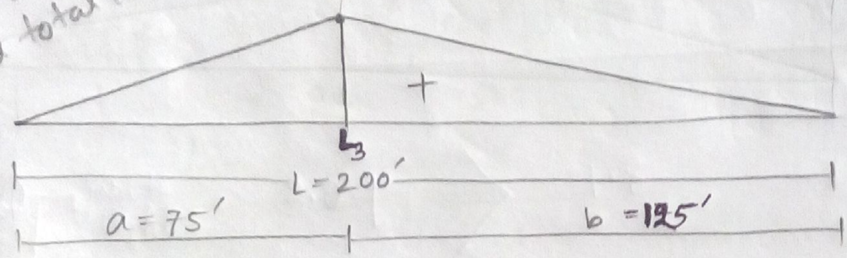
I Line dia for stress in member U_2U_3

(*) force বের করে then first-এ 1^k যেখানে বসালাম ওখানেই বসাব।

⊛ parallel chord truss - এ এখানে moment বেশি হবে এখানে max^m ordinate পাওয়া যাবে। & only for || members.



⊛ এখানে 1 থেকে start করলে অনেক time লাগবে। cz left-এ total span হলো 75' but total load length 70'. 50 load গুলোকে মোটামুটি middle-এ আনতে হবে for max^m.



* যেদিক থেকে move করালে load বেশি আনতে পারব ওদিক থেকে move করাব। for this problem B থেকে move করাব।

always a < b ⇒ most imp.

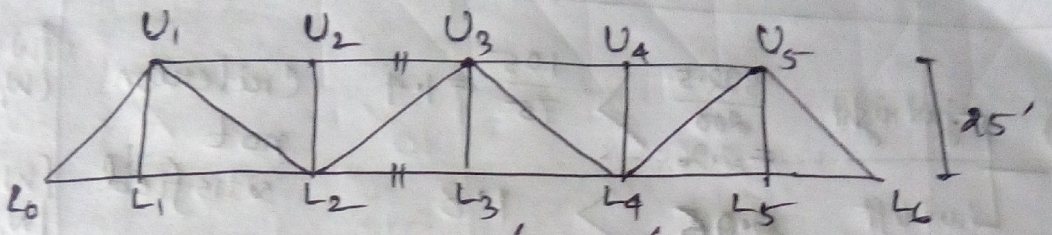
Trial No

No	Position of wheel	Avg load on span W/L	Avg. load on left of the sect^n W_1/a	Remarks
1	wheel ⑤ at L_3	[		

W = wheel ① to wheel ⑪ + 80' of UDL =

Complete the math in CW copy ⇒ Ans. 526.96^k (+)

Assignment-28



6 @ 20' = 120'

Find max^m stress in member-

a) U_2U_3

b) L_2L_3

Loading (same as before)

$\Sigma M_{U_3} = 0$

$\rightarrow \frac{85}{8} \times 75 = F_{L_3L_4} \times 36$

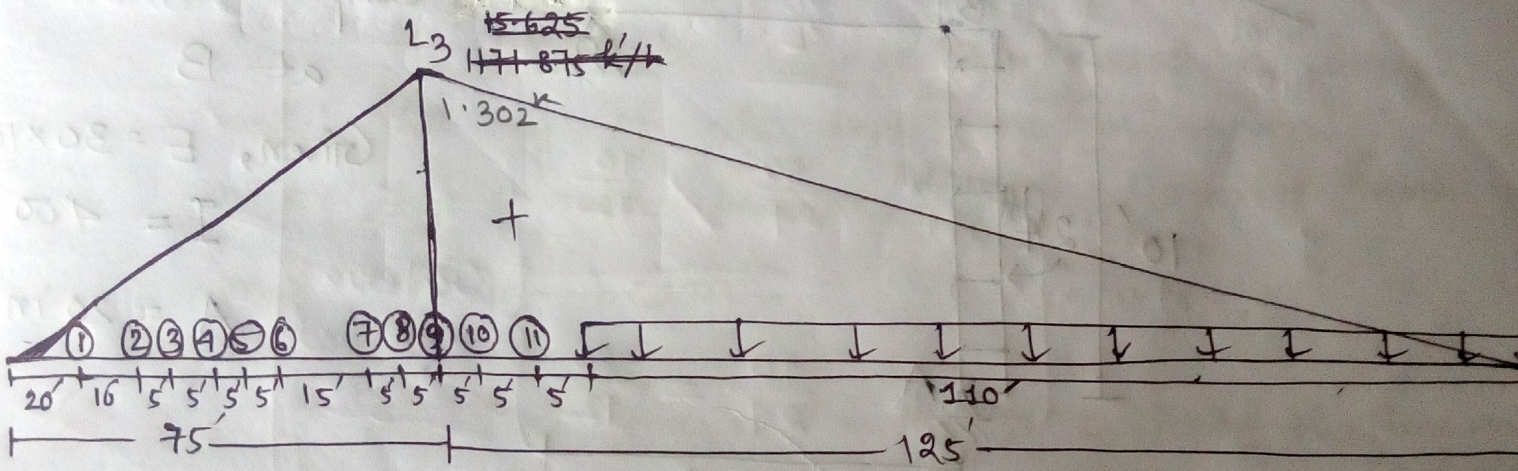
$\Rightarrow F_{L_3L_4} = 1.302^{k}$

352.5

Trial No	Position of wheel	Avg load on span (W/L)	Avg load on left of the seat (W_1/a)	Remarks	Calculation
1	wheel ⑤ at L_3 — just right	$\frac{592.5}{200} = 2.96$	$> \frac{105}{75} = 1.4$	Criterion not satisfied	W = wheel ① to ⑪ + 3 × 80 = 592.5 W_1 = ① to ④ = 105
	just left	2.96	> 1.8		W = ① to ⑪ + 3 × 80 = 592.5 W_1 = ① to ⑤ = 135
2	wheel ⑥ at L_3 — just to right	3.04	> 1.8		W = ① to ⑪ + 3 × 85 = 607.5 W_1 = ① to ⑤ = 135
	just to left	3.04	> 2.2		W = ① to ⑪ + 3 × 85 = 607.5 W_1 = ① to ⑥ = 165
3	wheel ⑦ at L_3 — just to right	3.26	> 2.2		W = ① to ⑪ + 3 × 100 = 652.5 W_1 = ① to ⑥ = 165
	just to left	3.26	> 2.7		W = ⑥ to ⑪ + 3 × 100 = 652.5 W_1 = ① to ⑦ = 202.5
4	wheel ⑧ at L_3 — just to right	3.3	> 2.7		W = ① to ⑪ + 3 × 105 = 667.5 W_1 = ① to ⑦ = 202.5
	just to left	3.3	> 3.2		W = 667.5 W_1 = ① to ⑧ = 240

Trial No	Position of wheel	Avg load on span $\frac{W}{L}$		Avg load on left of the sect^n $\frac{W_1}{a}$	Remarks	Calculation
5	wheel ⑨ at L_3 — just to right	3.4	>	3.2		W = ① to ⑪ + 110 = 682.5 W_1 = ① to ⑧ = 210
	just to left	3.4	<	3.7		W = 682.5 W_1 = ① to ⑨ = 277

∴ wheel ⑨ at L_3 gives max^m moment.



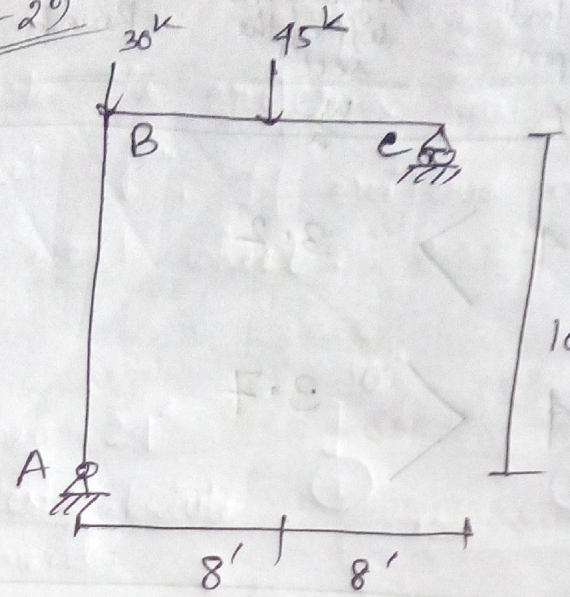
Max^m bar force moment = $\frac{171.875}{125}$ [1.302 (125 × 37.5 + 120 × 37.5 + 115 × 37.5)] + $\left(\frac{1}{2} \times \frac{171.875}{125} \times 110 \times 110\right) \times 3$

+ $\frac{171.875}{75}$ [1.302 (70 × 37.5 + 65 × 37.5 + 50 × 30 + 45 × 30 + 40 × 30 + 35 × 30 + 30 × + 20 × 15)]

= 252773.44 + 1101.56 + 1636 + 90.75 + 94.69

= 5737.56 k 526.92 k (+)

Assignment-29



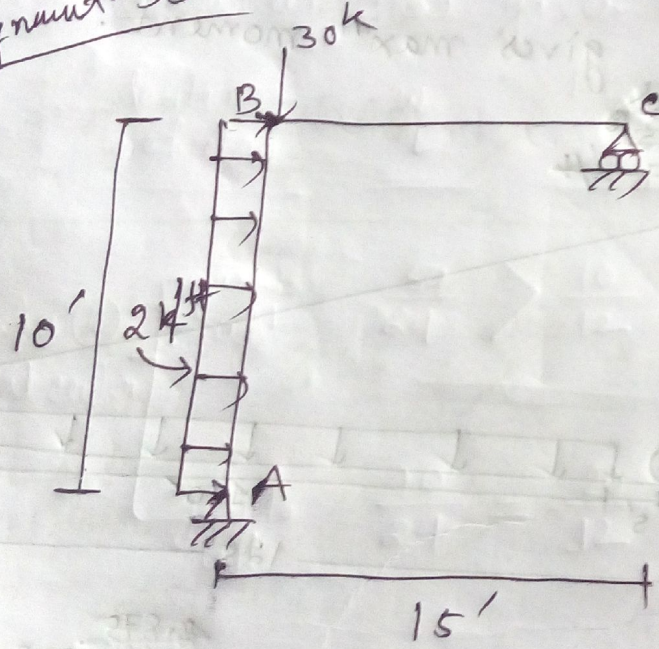
Compute rotation at C

Given, $E = 30,000$ ksi

$I = 400\ in^4$

$A = 20\ in^2$

Assignment-30



Compute hor. deflection at B

Given, $E = 30 \times 10^3$ ksi

$I = 400\ in^4$

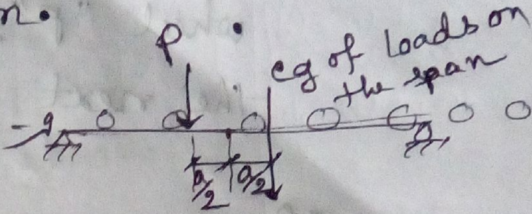
$A = 20\ in^2$

14.11.15

Art # 67 : Greatest Moment or Absolute Moment —

• আগের ক্ষেত্রে নির্দিষ্ট ছিল, but এখানে the point/section is unknown.

• আমরা জানি এই beam-এ middle-এ BM max^m. But practically exact middle-এ হয় না



⇓

So first-এ identify which load on middle point gives max^m moment, P ??

⇓

• Then P should be changed in such a way that the cg of the loads on the span and ~~dist~~ P will be at equal distance from mid point of beam.

(*) P = The wheel that gives max^m moment at center of the beam (mid $sect^n$)

a = distance bet^n P and cg of the loads on the span.

(*) Procedure —

1. Find the wheel that gives max^m moment at midspan
2. Place this wheel and c.G. of the loads on the span such that they are equidistant from the center line (mid $sect^n$)

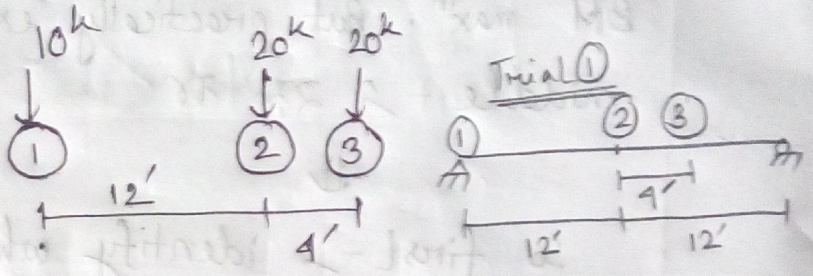
$\frac{W}{L} > \frac{W_1}{a}$ and $\frac{W}{L} < \frac{W_1}{a}$ → a is same as before.

3. Check the criteria for max^m moment under wheel "p". If criteria not OK then try with the next wheel.

Prob #130

Span = 24′

Find greatest / absolute moment.



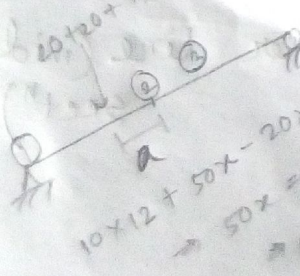
Sol^n :

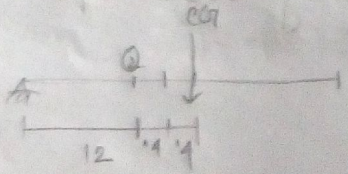
① Find the wheel that gives max^m moment at mid-span.

Trial No.	Position of wheel	$\frac{W}{L}$	$\frac{W_1}{a}$	Remarks	Calculation
1	wheel ② at center, just to right	$\frac{50}{24}$	$> \frac{10}{12}$	Criteria Satisfied	
	just to left	$\frac{40}{24}$	$= \frac{20}{12}$		

∴ p = wheel ②

(*) এখানে $\frac{W}{L}$ এর মান probability ② & ③ i.e. mid point এর right এ বেশি। So we will move P to the left. Then ① will be out of the span.



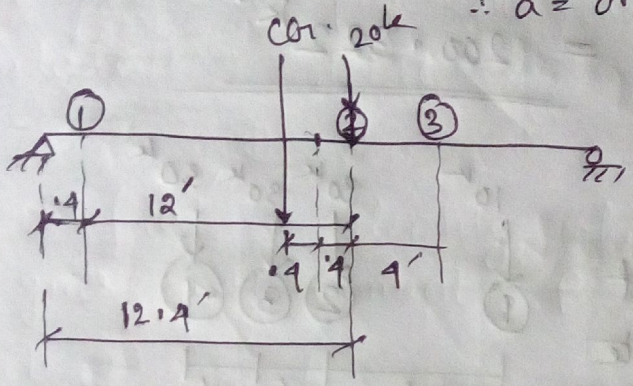


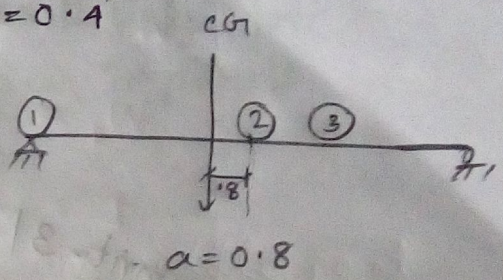
2. Locate cg of loads on the span.

From wheel ③

$$X = \frac{20\times0 + 20\times4 + 10\times16}{20+20+10} = 4.8 \text{ ft.}$$

$\therefore a = 0.8'$ and $a/2 = 0.4'$



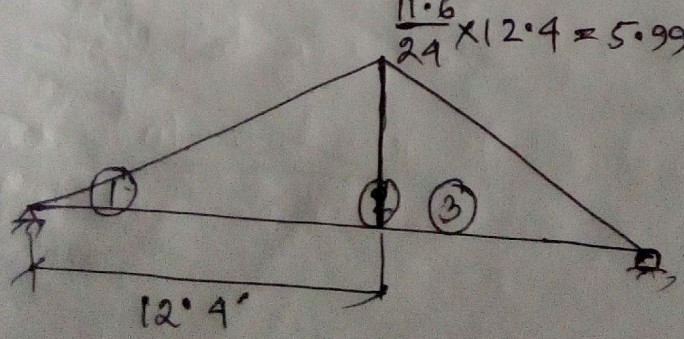


$a = 0.8$

3. $\frac{W}{L} = \frac{50}{24}$

For W_1/a

	W/L	W_1/a	Remarks
wheel ② at 12.4' from the left support; just to right	$\frac{50}{24}$	$\frac{10}{12.4}$	criteria under wheel ② satisfied
just to left	$\frac{50}{24}$	$\frac{30}{12.4}$	



$\therefore$ Greatest moment $= \frac{5.993}{11.6}\left[11.6 \times 20 + 7.6 \times 20\right]$

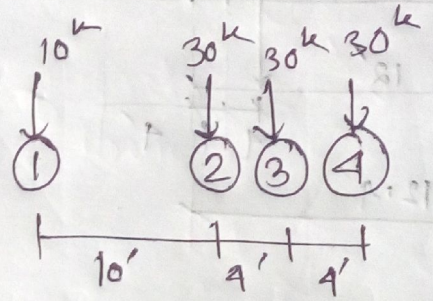
$+ \frac{5.993}{12.4}(10 \times .4)$

$= 200.322^{k'}$

Assignment-3|

Span = 40 ft

Find greatest / absolute moment.

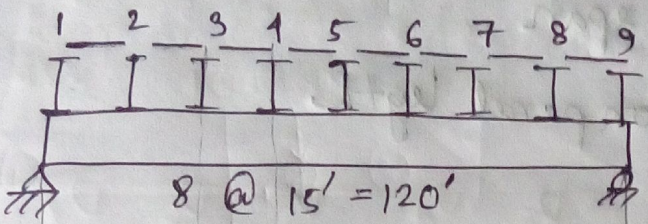


15.11.15

• Art 69

1. Panel shear in Span with floor beams —
2. Max^m Web / Diagonal stress in Truss

(1)



Span with floor beams

Draw I lines for shear in panels 4-5, 2-3,

I line for shear in 3rd panel

V_{3-4}

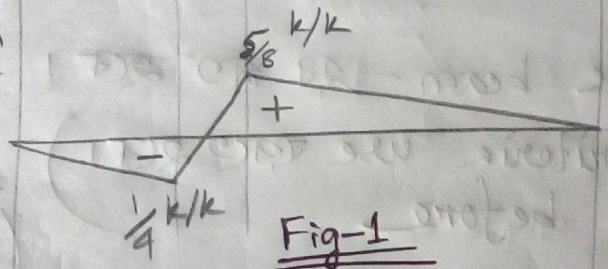
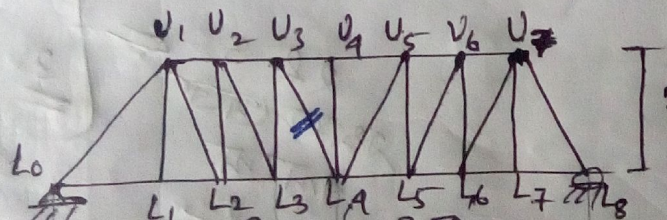


Fig-1

1^k 3 no ∧ वरून left reaction 1/4 k

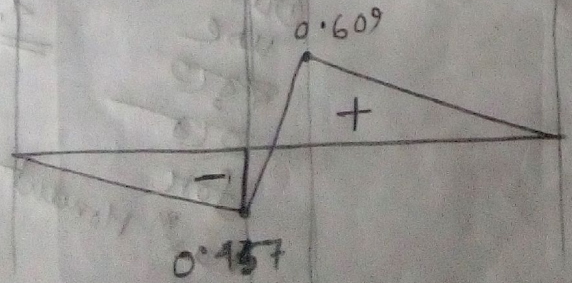
& 1^k 4 no ∧ वरून left reaction is 5/8 k

(2)



Draw I lines for U_2L_3, U_1L_2

⇒ for U_3L_4 ⇒ section → left part & $\Sigma V = 0$



1^k load at L_3

Reactⁿ = 5/8 k

$\Sigma V = 0 \Rightarrow \frac{5}{8}\uparrow - 1\downarrow + F_{U_3L_4} = 0$

$\Rightarrow F_{U_3L_4} = \frac{3/8}{36} \times \sqrt{36^2+25^2}$

$= -0.457$ k/k

1^k load at L_4

$F_{U_3L_4} = .609$ (+) (tension)

- Criteria for max^m panel shear/web stress — (floor beam) (truss)

$$\frac{W}{L} = \frac{W_1}{P}$$ ⇒ just to the right & just " " left

W = loads in span

W_1 = loads on panel length

L = Span

P = panel length.

- At panel point 4 ⇒ Max^m moment = ?

⇓

Moment shape beam — এর মত হবে।

(So ↗ criteria use করতে হবে। as before)

1. Beam Moment
2. Floor Beam reaction in span in floor beam
3. Panel point moment in girder with floor beam
4. Truss chord member

2 & 3. এখান থেকে বলতে same criteria use করতে হবে for Max^m Moment

Problem

Find max^m panel shear in 3rd panel of the span with floor beams (in previous fig - 1)

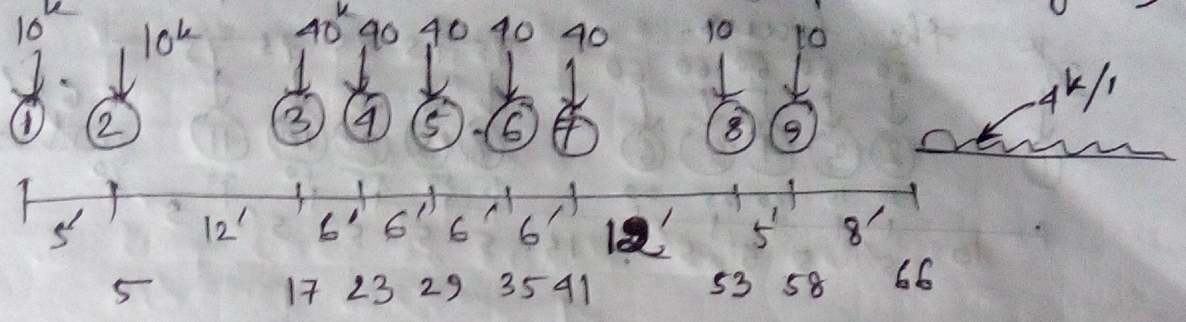
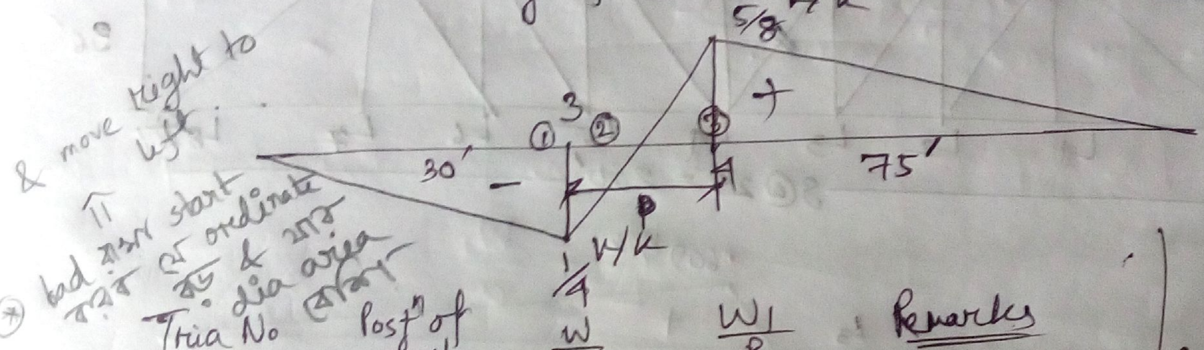


Fig of beam

For this ⇒ Control Point = 4



$\frac{5/8}{5/8 + 1/4} \times 15 = 10.71'$

$15 - x = 4.29$

Tria No	Posn of wheel		$\frac{W}{L}$	$\frac{W_1}{P}$	Remarks
1	wheel ① at 4	right	$\frac{276}{120}$ >	$\frac{0}{15}$	
		left	$\frac{276}{120}$ >	$\frac{10}{15}$	

Calculation

$W = ①$ to $⑨ + 4 \times 9$
$= 276^k$
$W_1 = 0$

$W = 276^k$
$W_1 = ① = 10^k$

(*) wheel ③ at 4 gives max^m shear $= 122.35 - 3.09$
$= 119.26^k$

Ans: Max^m Panel shear $= 119.26^k$

Assignment - 32

Same loading, 10 @ 15 = 150'
Max^m Panel shear in 5th panel.

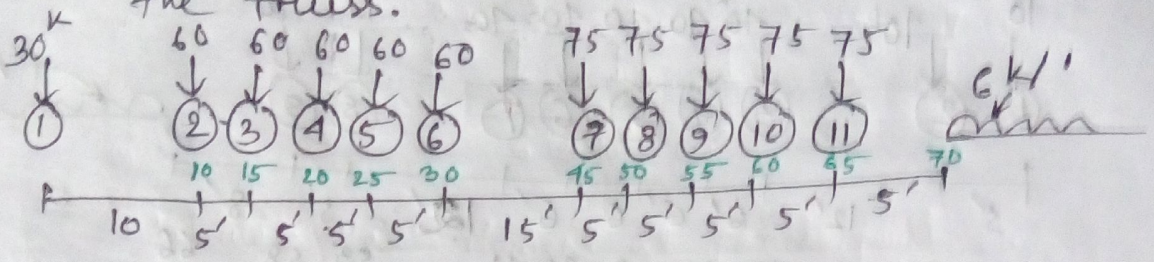
111.08 +
122.35

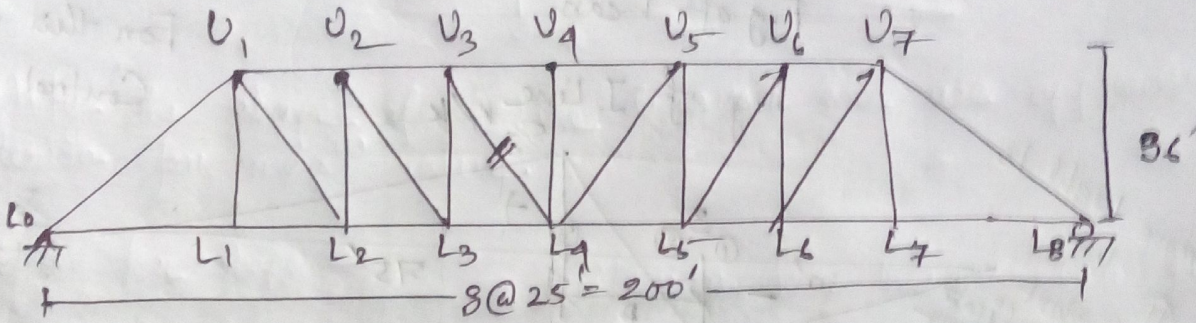
⑤ 38'   ③ 26'
344^k
240^k
50'   2.93
5.8

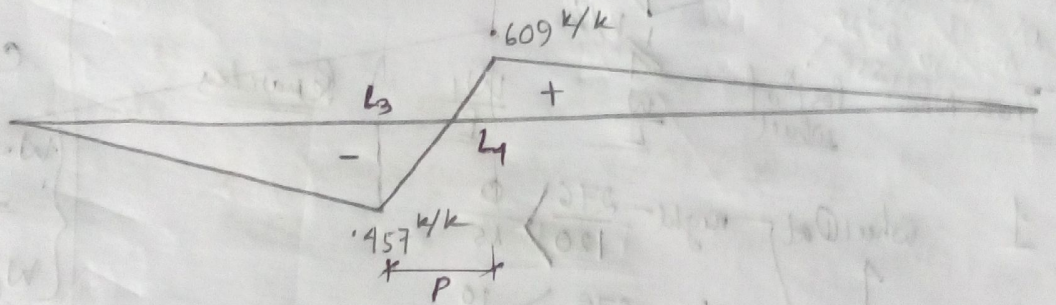
21·11·15

Problem-22

Find ① Max^m tension and ② Max^m Compression in U_3L_4 of the truss.







* For max^m tension, load will start to move through tension dia

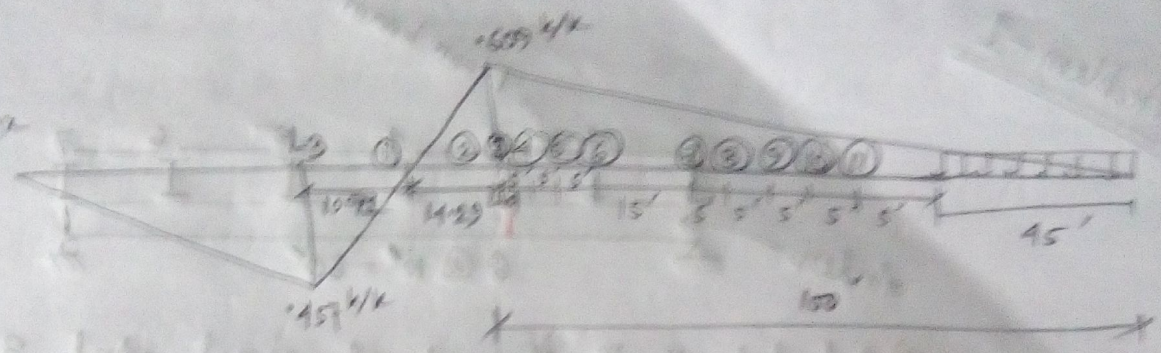
Trial No	Position of wheel	$\frac{W}{L}$	$\frac{W_1}{P}$	Remark
1	wheel ① at L_4	Right $\frac{885}{200} >$	$\frac{0}{25}$	Criteria not satisfied
		Left $\frac{885}{200} >$	$\frac{30}{25}$	
2				
3	wheel ③ at L_4	Right $\frac{975}{200} >$	$\frac{90}{25}$	Satisfied
		Left $\frac{975}{200} <$	$\frac{150}{25}$	

Calculation

$W = ① \text{ to } ⑪ + 30 \times 6 = 885'$

$W_1 = 0$

$W = 885'$, $W_1 = 30^k$ (wheel ①)



$$\therefore \text{Max}^m \text{ tension} = \frac{.609}{100}\left[60\times100 + 93\times60 + 90\times60 + \cdots + 50\times75\right]$$

$$+\left(\frac{1}{2}\times45\times\frac{.609}{100}\times45\right)\times6^{k/'} + \frac{.609}{14.29}\left[60\times9.29\right]$$

$$-\frac{.457}{10.71}\times30\times.71$$

$$= 332.07^k \text{ for axle load}$$

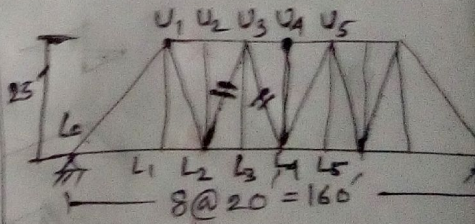
$$= \frac{332.07}{2} \text{ for wheel load}$$

② → Include in class note

Max^m Comp $= 195^k$ for axle load

& $\frac{195^k}{2}$ " wheel "

Assignment - 33



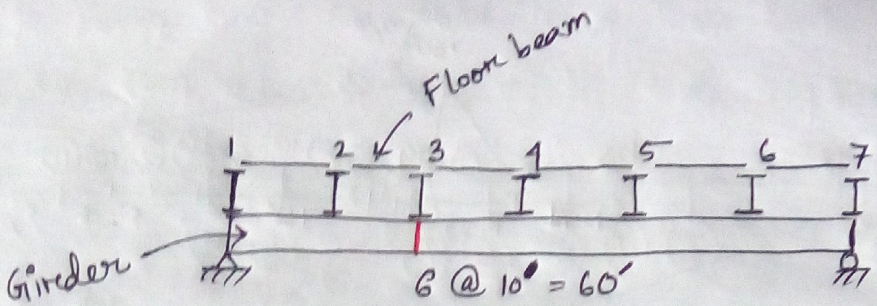
① Max^m Comp U_3L_4

② Max^m Ten. in L_2U_3.

CT
29.11.15 ⇒ 1 to Assignment 33

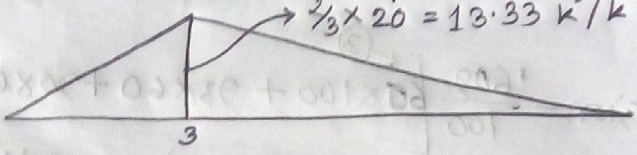
28.11.15

Problem-1



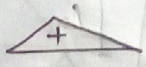
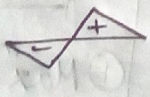
a) Calculate Max^m Moment at panel point 3.

① Draw I.Line diagram



② Identify the shape of I Line diagram and use approximate criterion for max^m value.

Criteria for shapes —

1. 
2. 
3. 
4. 

So criterion for this problem is—

$$\frac{W}{L} = \frac{W_1}{a}$$

b) Calculate max^m floor beam reaction at "3"

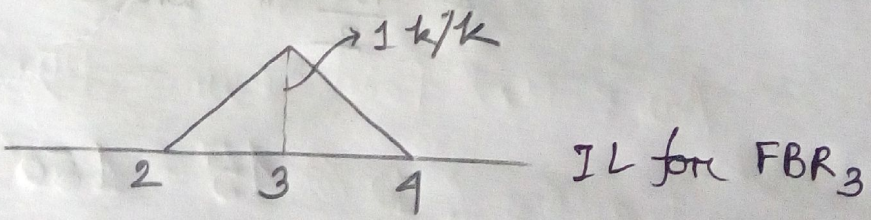


Fig-1

c) Calculate Max^m stress in U_3L_3

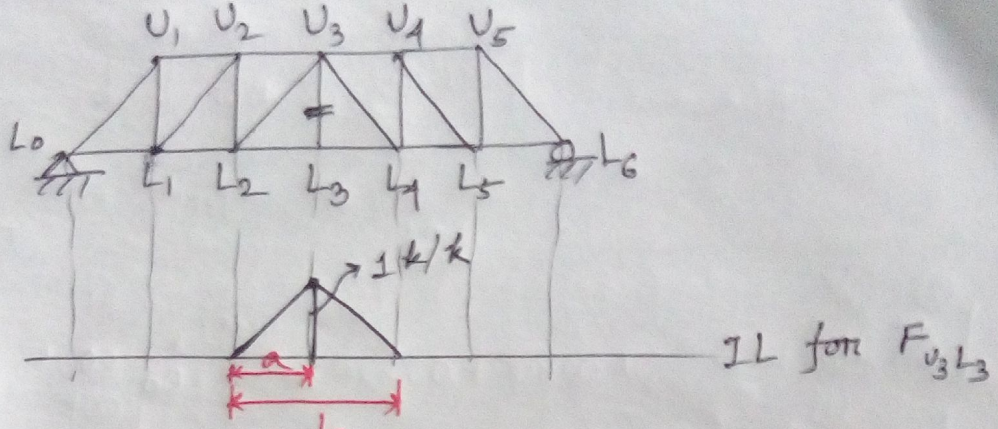
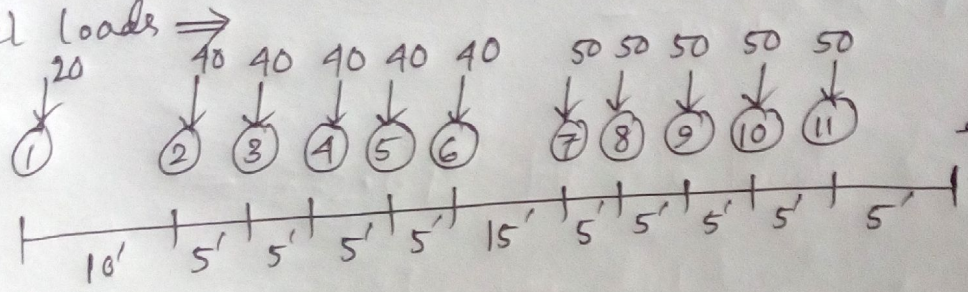
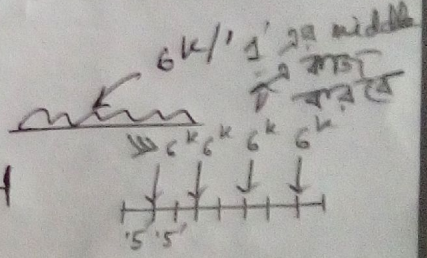


Fig-2

So criteria will be same $\Rightarrow \frac{W}{L} = \frac{W_1}{a}$

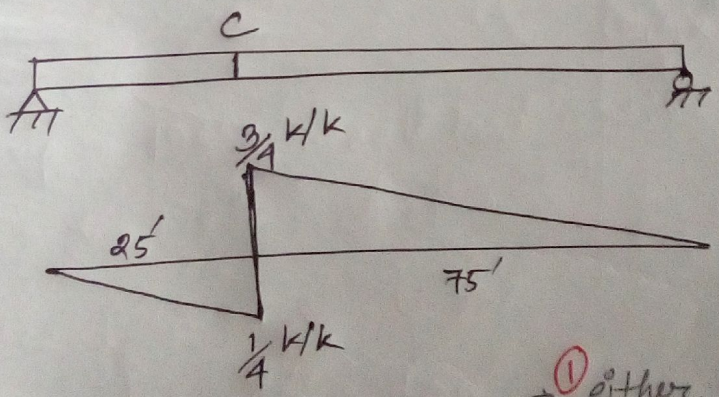
Wheel loads $\Rightarrow$





Assgn-34

Q-2 Calculate max^m shear at ~~dis~~ quarter point of 100' simple span ~~of floor beam with girder~~



for UDL

$$\Delta V = \frac{\Sigma Pd}{L} - P_1 + \frac{P'e}{L} + \frac{P_2 e'}{L}$$

$\Rightarrow$ ① either প্রতিটা 6k, 1' এর middle এ থাকা অবস্থায় বসিয়ে হিসাব করব।

② Suppose 6' UDL travel করল So total load = 36k acts at 3' (middle)

$\Downarrow$

i.e. 3' $\Leftarrow$ So actually এর total 36k load এটা travel করল