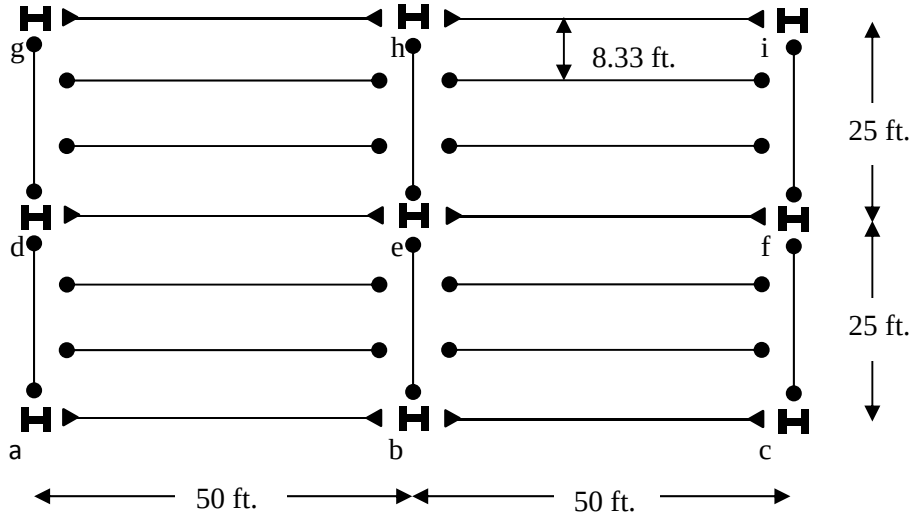
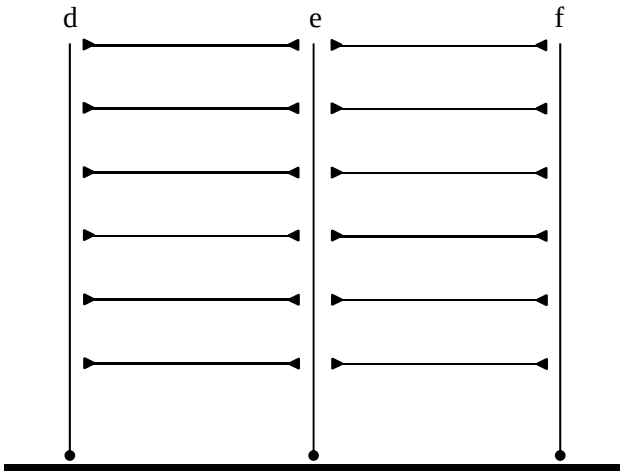
Laboratory - Problem 1

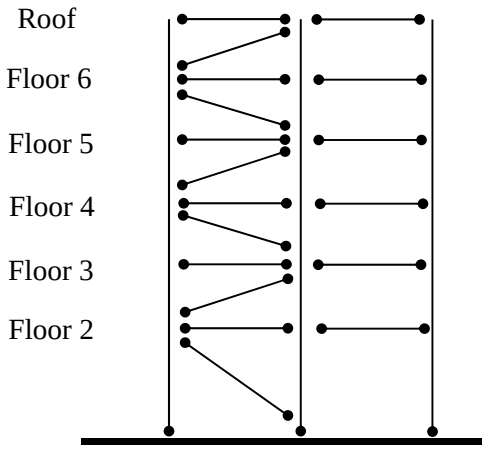
Show all work on separate paper and write answers on the attached pages. Hand in by the end of the lab.



Typical Floor Plan



Elevation (d-e-f) (typ.)



Elevation (h-e-b) (typ.)

First floor height = 15 ft.
All other floor heights = 10 ft.

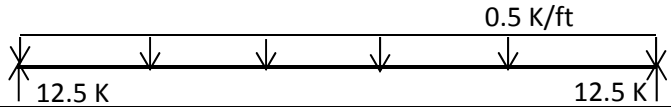
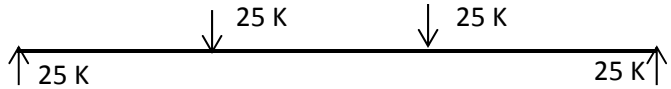
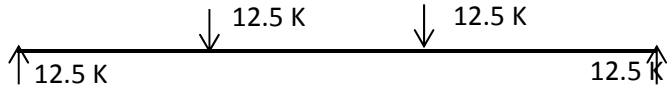
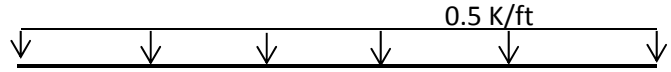
Roof Live Load = 20 PSF	(Roof)
Live Load = 50 PSF	(Floors 2-6)
Dead Load = 60 PSF	(All Floors)

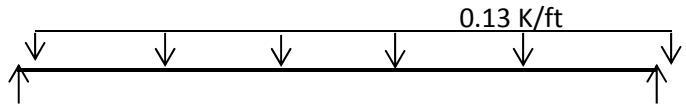
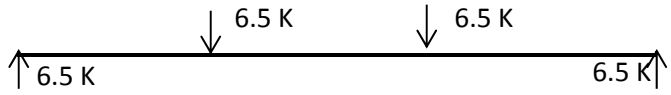
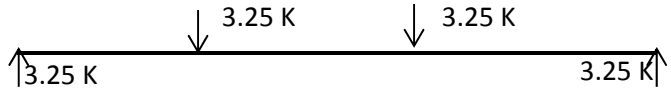
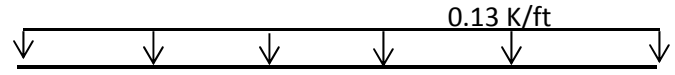
For Frame d-e-f, find:

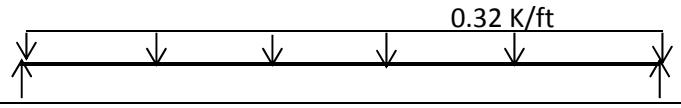
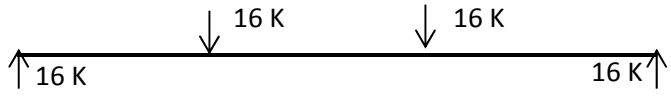
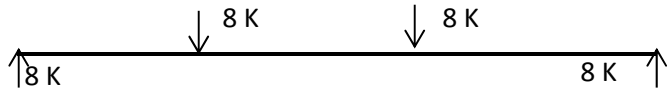
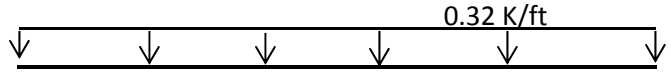
1.) Dead loads to be applied on the frame (group similar members).
2.) Roof live loads to be applied on the frame (group similar members).
3.) Live loads to be applied on the frame for floors 1-5 (group similar members).

For Frames d-e-f and h-e-b, find:

1.) Wind loads to be applied on the exterior nodes.

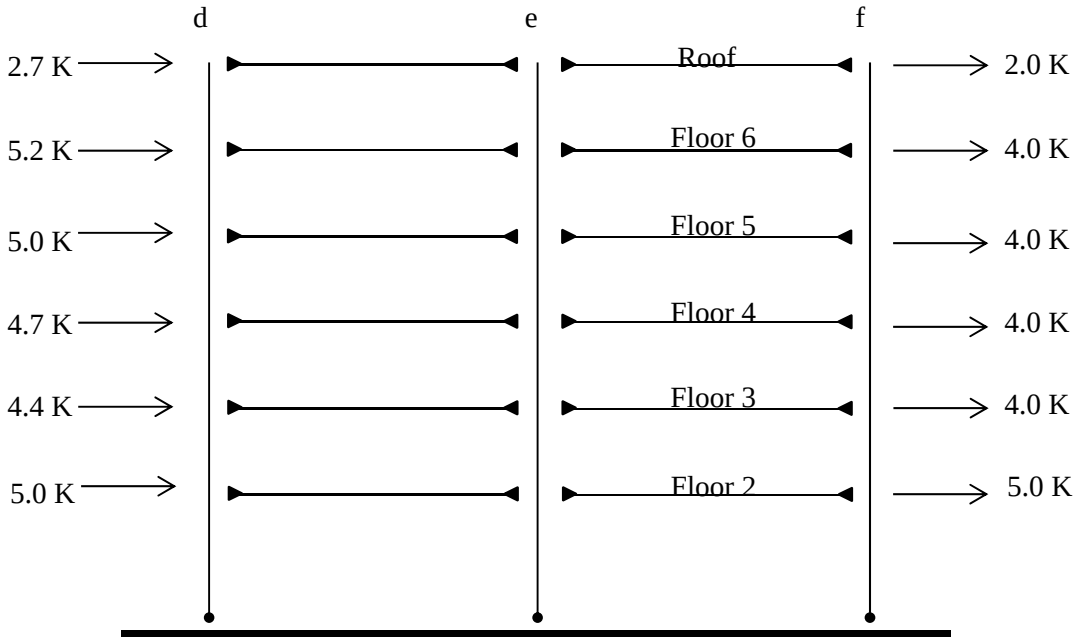
Frame Members	**Dead Load Distribution (All Floors)** (include distribution, load magnitudes, and reactions)
Stringer	
b-e e-h	
a-d d-g c-f f-i	
d-e e-f (reactions not required)	

Frame Members	**Reduced Roof Live Load Distribution (Roof only)** (include distribution, load magnitudes, and reactions)
Stringer	
b-e e-h	
a-d d-g c-f f-i	
d-e e-f (reactions not required)	

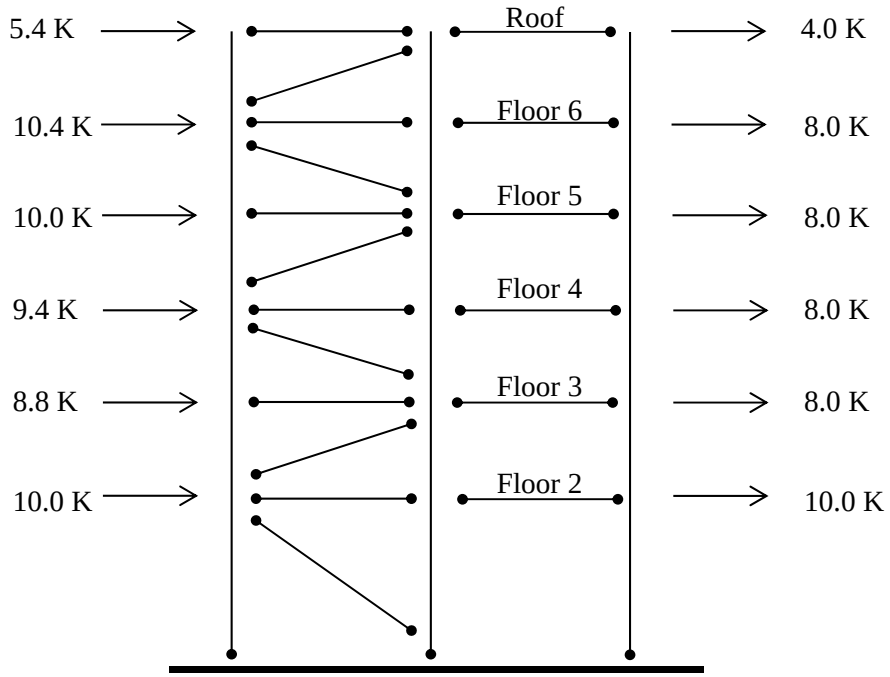
Frame Members	**Reduced Live Load Distribution (Floors 1-5)** (include distribution, load magnitudes, and reactions)
Stringer	
b-e e-h	
a-d d-g c-f f-i	
d-e e-f (reactions not required)	

Wind Loads

Enter all nodal loads next to the arrows for each floor on each side of the building



Elevation (d-e-f) (typ.)



Elevation (h-e-b) (typ.)

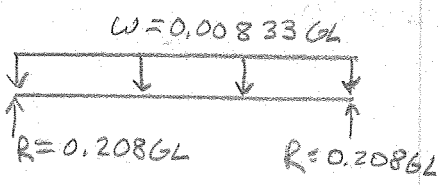
Hint: Figure 14 in example 1.2, explained in lab last week, contains the wind load pressures. You still must show all work for developing wind loads, tributary areas, and nodal loads. Don't forget about the minimum wind design load pressure!

GRAVITY LOADS (GL)

STRINGER
d-e
e-f

TRIB WIDTH $= \left(\frac{8.33'}{2}\right)2 = 8.33'$

$w = \frac{(GL)(8.33')}{1000} = 0.00833\ GL$

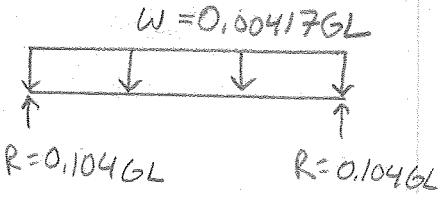


REACTION $= \frac{(0.00833GL)(50')}{2} = 0.208\ GL$

g-h
h-i
a-b
b-c

TRIB WIDTH $= \frac{(8.33')}{2} = 4.17'$

$w = \frac{(GL)(4.17')}{1000} = 0.00417\ GL$

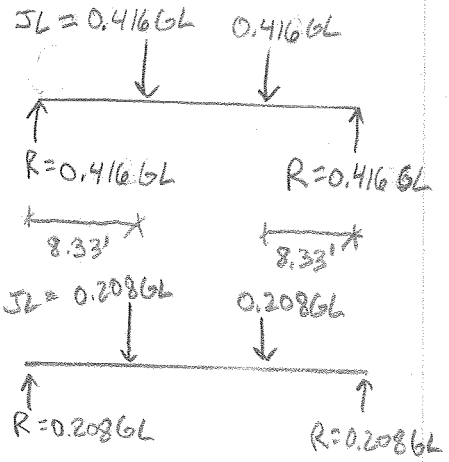


REACTION $= \frac{(0.00417GL)(50')}{2} = 0.104\ GL$

h-e
e-b

JOINT LOAD = JL = STRINGER REACT
$= 0.208\ GL \times 2 = 0.416\ GL$

REACTION $= 0.416\ GL$



g-d
d-a
i-f
f-c

JL = 0.208 GL

REACTION = 0.208 GL

DEAD LOAD

GL = 60 PSF

STRINGER
d-e
e-f → W = 0.00833 (60 PSF) = 0.5 K/FT
R = 0.208 (60 PSF) = 12.5K

g-h
h-i
a-b → W = 0.00417 (60 PSF) = 0.25 K/ft
b-c R = 0.104 (60 PSF) = 6.25 K

h-e → JL = 0.416 (60 PSF) = 25K
e-b R = 0.416 (60 PSF) = 25K

g-d
d-a → JL = 0.208 (60 PSF) = 12.5K
i-f R = 0.208 (60 PSF) = 12.5K
f-c

LIVE LOAD

$$\frac{L}{L_o} = 0.25 + \frac{15}{(K_{LL} A_T)^{0.5}}$$

STRINGER	TRIB AREA	K_{LL}	L/L_o		(50PSF)(L/L_o) GL
d-e e-F	→ $A_T = (8.33')(50') = 416.5\ ft^2$	2.0	0.77	>0.5	38.5 PSF
g-h h-i a-b b-c	→ $A_T = \left(\frac{8.33'}{2}\right)(50') = 208.25\ ft^2$	2.0	0.98	>0.5	49.0 PSF

STRINGER
d-e
e-f → $W = 0.00833(38.5\ PSF) = 0.32\ K/Ft$
$R = 0.208(38.5\ PSF) = 8.0K$

g-h
h-i
a-b
b-c → $W = 0.00833(49\ PSF) = 0.41\ K/ft$
$R = 0.208\ (49\ PSF) = 10.2\ K$

h-e
e-b → $JL = 0.416(38.5\ PSF) = 16K$
$R = 0.416\ (38.5\ PSF) = 16K$

g-d
d-a
i-f
f-c → $JL = 0.208(38.5\ PSF) = 8K$
$R = 0.208\ (38.5\ PSF) = 8K$

ROOF LIVE LOAD

$L_r = 20 F_1 R_2$

$R_2 = 1.0$

	A_T	R_1	L_r
STRINGER d-e, e-f	416.5 ft²	0.78	15.6 PSF
g-h, h-i, a-b, b-c	208.25 ft²	0.99	19.8 PSF

STRINGER

d-e
e-f → $W = 0.00833 (15.6\ PSF) = 0.13\ K/FT$
$R = 0.208\ (15.6\ PSF) = 3.25\ K$

g-h
h-i
a-b → $W = 0.00833 (19.8\ PSF) = 0.16\ K/FT$
b-c $R = 0.208 (19.8\ PSF) = 4.12\ K$

h-e → $JL = 0.416 (15.6\ PSF) = 6.5\ K$
e-b → $R = 0.416 (15.6\ PSF) = 6.5\ K$

g-d
d-a → $JL = 0.208 (15.6\ PSF) = 3.25\ K$
i-f $R = 0.208 (15.6\ PSF) = 3.25\ K$
f-c

WIND LOADS

$G = 0.85$
$V = 115\ MPH$
$K_D = 0.85$
$K_{zt} = 1.0$

$p = q_h G C_p - q_i G C_{pi}$
$C_p = 0.8 \rightarrow$ WINDWARD
$C_p = -0.3 \rightarrow$ LEEWARD
$GC_{pi} = \pm 0.18 \rightarrow$ INTERNAL

$P_{MIN} = 16\ PSF$

$q_z = 0.000256\ K_z K_{zt} K_D V^2 = 28.78\ K_z$

$q_h = q_z = 65\ ft$

HEIGHT (ft)	K_z	q_z	WINDWARD $q_z G C_p$	LEEWARD $q_h G C_p$	INTERNAL $q_h (GC_{pi})$	WINWARD P	LEEWARD P
15	0.57	16.40	11.15	-6.39	±4.51	~~15.66~~ → 16	-10.9 → -16
25	0.66	18.99	12.91	-6.39	±4.51	17.42	-10.9
35	0.73	21.00	14.28	-6.39	±4.51	18.79	-10.9
45	0.79	22.74	15.46	-6.39	±4.51	19.97	-10.9
55	0.83	23.89	16.25	-6.39	±4.51	20.96	-10.9
65	0.87	25.04	17.03	-6.39	±4.51	21.54	-10.9
		PSF	PSF	PSF	PSF	PSF	PSF

D-E-F FRAME

HEIGHT (FT)	A_{TRIB} (FT^2)	WINWARD JL (K)	LEEWARD JL (K)
15	312.5	5.0K	5.0K
25	250	4.4K	4.0K
35	250	4.7K	4.0K
45	250	5.0K	4.0K
55	250	5.2K	4.0K
65	125	2.7K	2.0K

H-E-B FRAME

HEIGHT (FT)	A_{TRIB} (FT^2)	WINDWARD JL (K)	LEEWARD JL (K)
15	625	10.0K	10.0K
25	500	8.8K	8.0 K
35	500	9.4K	8.0K
45	500	10.0K	8.0K
55	500	10.4K	8.0K
65	250	5.4K	4.0K

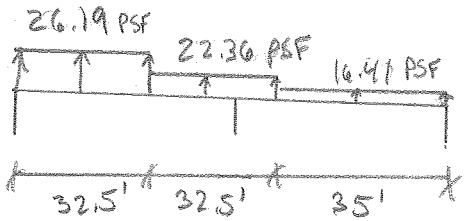
ROOF WIND LOADS

$$p = q_h G C_p - q_h G C_{pi} \quad \pm 4.51 \text{ PSF}$$

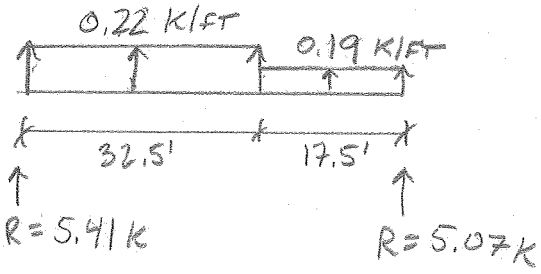
FOR C_p, USE FIGURE 27.4-1 IN ASCE 7-10

D-E-F FRAME (USE INTERPOLATION FOR h/L = 65 FT/100 FT = 0.65)

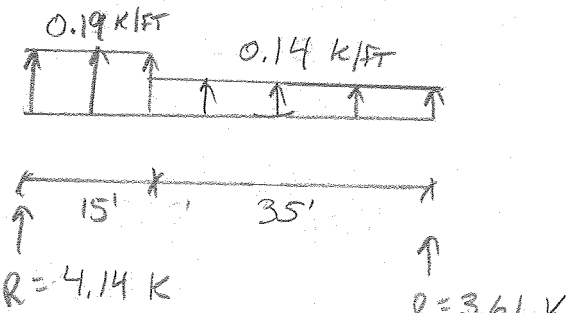
		$q_h G C_p$	p
$0 \leftrightarrow h/2$	$C_p = -1.02$	-21.68	-26.19
$h/2 \leftrightarrow h$	$C_p = -0.84$	-17.85	-22.36
$h \leftrightarrow 2h$	$C_p = -0.56$	-11.90	-16.41
		PSF	PSF



STRINGERS
d-e
e-f
(LEFT SIDE) → TRIB WIDTH = 8.33' →



STRINGERS
d-e
e-f
(RIGHT SIDE) → TRIB WIDTH = 8.33' →

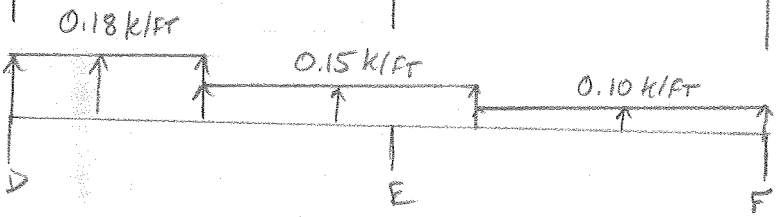


2(5.41 K) = 10.82K

(5.07K + 4.14K) 2 = 18.42K

(3.61K) 2 = 7.22K

FROM STRINGER REACTION TO EXTERIOR BEAM TO COL D

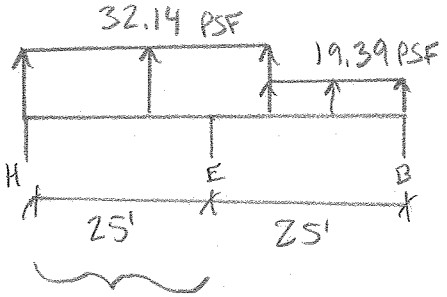


H-E-B FRAME

h/L = 65FT/50FT > 1.0

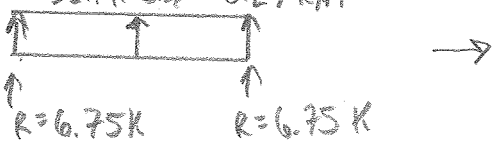
		$q_h GC_p$	P
$0 \leftrightarrow h/2$	$C_p = -1.3$	-27.63	-32.14
$> h/2$	$C_p = -0.7$	-14.88	-19.39

PSF

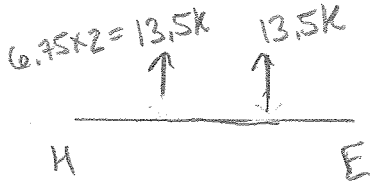


STRINGERS AND D-E AND E-F

32.14 x 8.33' = 0.27 K/FT



→



STRINGERS CONNECTED TO E-B

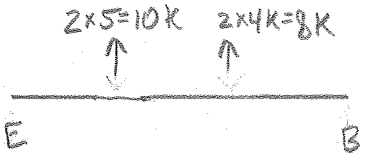
THE ONE STRINGER HAS 3.33' OF 32.14 PSF AND 5.0' OF 19.39 PSF

$(3.33')(32.14\ PSF)+(5.0')(19.39\ PSF) = 0.20\ K/FT$ $\quad R=\frac{(0.2)(50')}{2}=5K$

THE OTHER STRINGER HAS ALL 19.39 PSF OVER 8.33' TRIB WIDTH

$(19.39\ PSF)(8.33') = 0.16\ K/FT$ $\quad R=\frac{(0.16)(50')}{2}=4K$

E-B



g-h
h-i

$REACTIONS = (32.14\ PSF)\left(\frac{8.33'}{2}\right)\left(\frac{50'}{2}\right) = 3.35K$

a-b
b-c

$REACTIONS = (19.39\ PSF)\left(\frac{8.33'}{2}\right)\left(\frac{50'}{2}\right) = 2.02\ K$