HW wk-03 | due 02.12.2019 | Vertical Load Flow

Complete the two problems below. For each beam, draw the free-body diagram first. Remember to get the units right! Show all your work for full credit.

1. An 15'-long simply-supported beam carries a uniformly distributed load $\omega$ and the point load shown. Calculate the resultant for the distributed load and determine the reaction forces at A and B using the equations of equilibrium. Redraw your final answer.

Resultant
$=50 \text{ lbs/ft (15')}$
Resultant occurs at midspan of beam

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$=50 \text{ lbs/ft (15')}$
Resultant occurs at midspan of beam

$\sum F_x = 0: R_{xa} = 0$
$\sum \tau = 0: R_{ya} = \frac{400 \text{ lbs} \cdot 5' - 750 \text{ lbs} \cdot 7.5' + R_{yb} \cdot 15'}{0'} = 0$

$R_{ya} (0') - 400 \text{ lbs} \cdot 5' - 750 \text{ lbs} \cdot 7.5' + R_{yb} (15') = 0$

$R_{ya} = 642 \text{ lb}$
$R_{yb} = 508 \text{ lb}$

Result is positive. Therefore direction of $R_{ya}$ shown on F.B.D. is correct.

Resultant
$=50 \text{ lbs/ft (15')}$
Resultant occurs at midspan of beam

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$=50 \text{ lbs/ft (15')}$
Resultant occurs at midspan of beam

$\sum F_y = 0: R_{ya} - 400 \text{ lbs} - 750 \text{ lbs} + R_{yb} = 0$

$R_{ya} = 642 \text{ lb}$
$R_{yb} = 508 \text{ lb}$

Result is positive. Therefore direction of $R_{ya}$ shown on F.B.D. is correct.

2. For the floor framing plan shown below, draw and shade the floor areas that are tributary to beam B1, beam B2, and column C2. ALSO, please calculate and list each of those tributary areas, in ft².

Tributary area calculations

B1 (25') (20') = 500 sq ft
B2 (25') (10') = 250 sq ft
C6 (25') (10') + (12.5') (10') = 375 sq ft
3. Indicate the tributary area for B1, G1, and G2 by cross-hatching. Calculate their tributary areas in ft².

Tributary area calculations

B1 (5') (21') = 105 sq ft
G1 (10.5' + 10') (10' + 10') = 410 sq ft
G2 (5') (21') + (10' + 10') (15') = 405 sq ft

4. Draw B1, G1, and G2 with their respective loading. Assume uniform area Dead Load (DL) 75 psf and Live Load (LL) is 50 psf. Boundary conditions should be pin and roller for these members. (Hint: A decking area load becomes a line load on a beam. A supported beam acts as a point load on a girder. It is possible to have both point loads and distributed loads simultaneously, see G2)

B1

\[ \omega_{DL} = (5') (75 \text{ psf}) = 375 \text{ plf} \]
\[ \omega_{LL} = (5') (50 \text{ psf}) = 250 \text{ plf} \]

\[ P_{DL} = (10.5' + 10') (10') (75 \text{ psf}) = 15,375 \text{ lbs} \]
\[ P_{LL} = (10.5' + 10') (10') (50 \text{ psf}) = 10,250 \text{ lbs} \]

G1

\[ \omega_{DL} = (5') (75 \text{ psf}) = 375 \text{ plf} \]
\[ \omega_{LL} = (5') (50 \text{ psf}) = 250 \text{ plf} \]

\[ P_{DL} = (5') (21') = 375 \text{ lbs} \]
\[ P_{LL} = (5') (21') = 250 \text{ lbs} \]

G2

\[ \omega_{DL} = (5') (75 \text{ psf}) = 375 \text{ plf} \]
\[ \omega_{LL} = (5') (50 \text{ psf}) = 250 \text{ plf} \]

\[ P_{DL} = (7') (15') (75 \text{ psf}) = 7875 \text{ lbs} \]
\[ P_{LL} = (7') (15') (50 \text{ psf}) = 5250 \text{ lbs} \]