Ministry of Higher Education

The Higher Institute of Engineering & Technology

New-Damietta

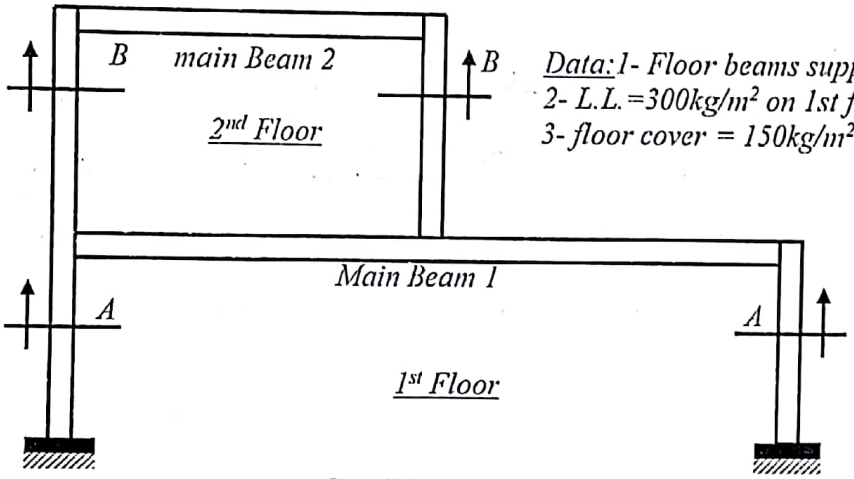
Department: Civil Engineering
Level: Four
Semester: First Semester 2017/2018
Subject: Steel constructions (II)
Subject Code: CIE407

Date: 14-11-2017
Time allowed: 90 Min.
Full marks: 20
No. of pages: one

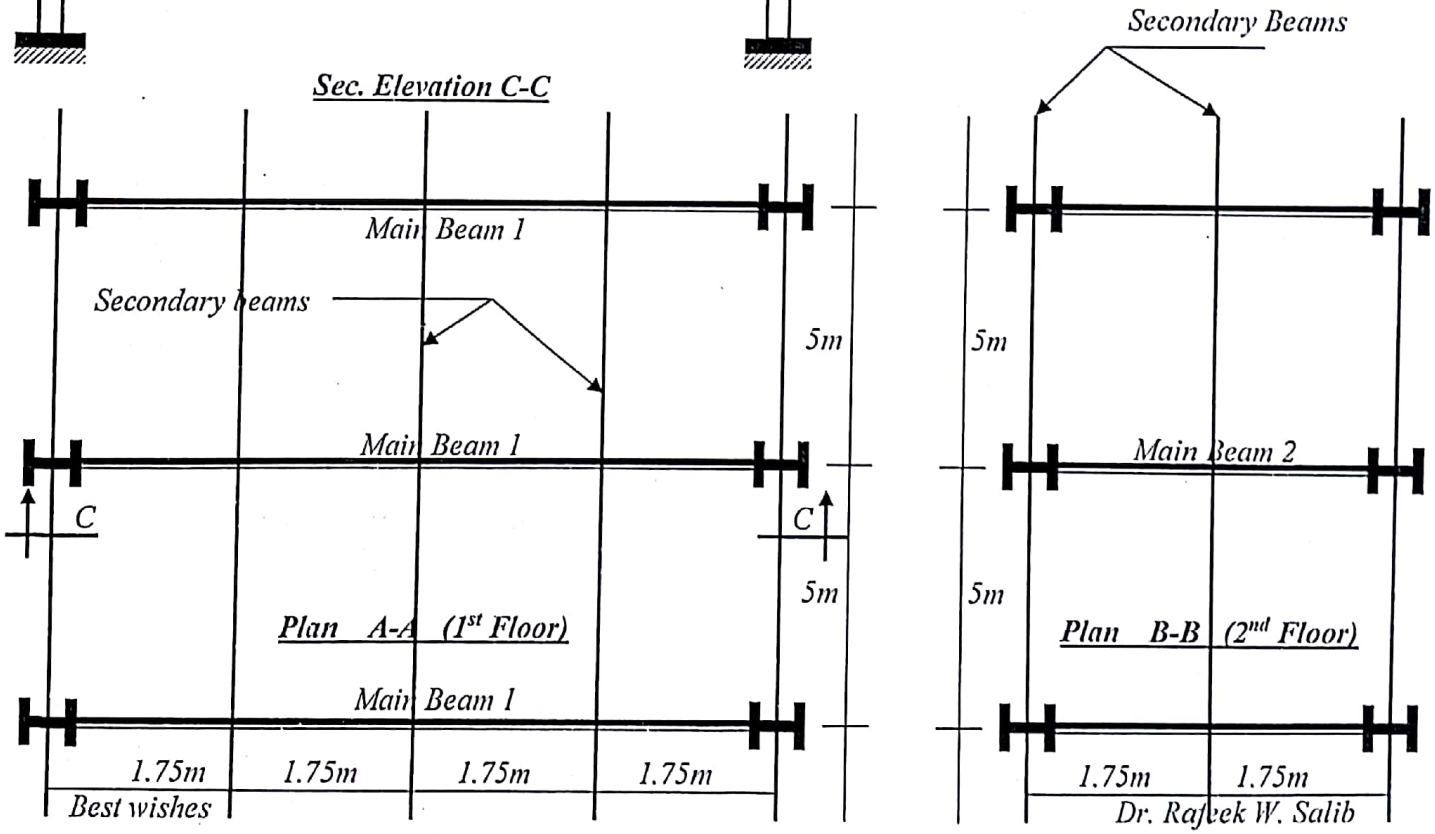
- Any missing data may be reasonably assumed. Any sketch may be neat and drawn to scale.

Question No. One (20marks) : For the shown steel structure illustrated in figure, it is required to:

1. Calculate D.L. and L.L. on the secondary and main beams of the second floor. Calculate also the maximum shear and bending for each. (7 marks)
2. Design the suitable cross section of the main beam 1 of the 1st floor roof. Check all kinds of stresses and deflection. (13marks)



Data: 1- Floor beams support 10cm R.C. slab,
2- L.L.=300kg/m² on 1st floor roof and 100kg/m² on 2nd floor roof,
3- floor cover = 150kg/m² and steel used is 37.



Best wishes

Dr. Rafeek W. Salib

Model Answer

For the secondary beam (Second Floor):

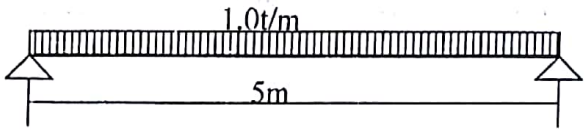
$W_{D.L.}$=0.10x2.5x1.75+0.15x1.75+0.05=0.8 t/m

$W_{L.L.}$=0.1x1.75=0.175 t/m

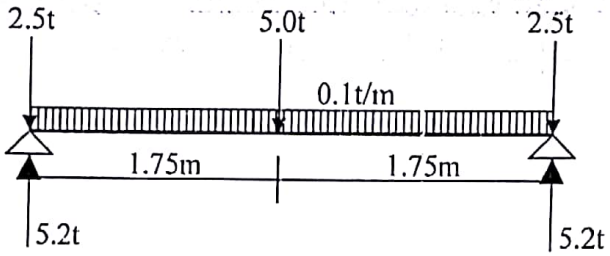
W_T=0.84+0.175=1.0 t/m

Mmax.=3.13mt

Qmax.=2.5t



For the Main beam (Second Floor):



Mmax. = 4.6mt

Qmax. = 2.7t

R=5.2t

For the secondary beam (First Floor):

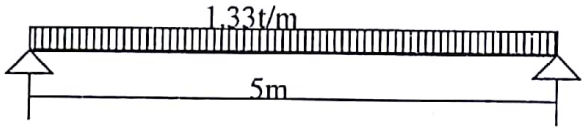
$W_{D.L.}$=0.1x2.5x1.75+0.15x1.75+0.05=0.8 t/m

$W_{L.L.}$=0.3x1.75=0.525 t/m

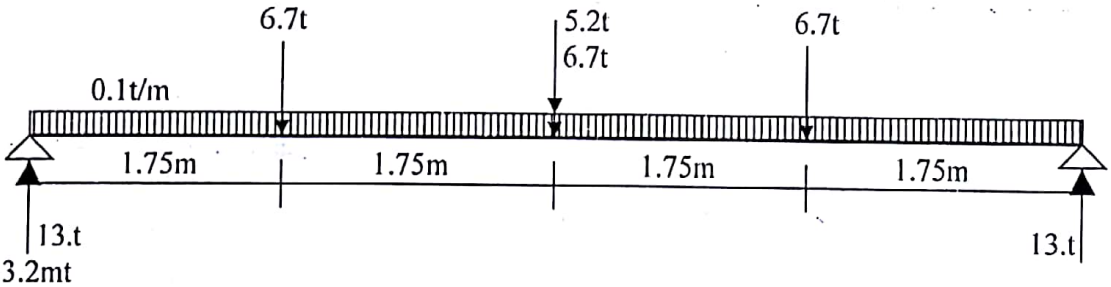
W_T=0.84+0.525=1.33 t/m

Mmax.=4.2mt

Qmax.=3.33t



For the Main beam (First Floor):



Mmax. = 33.2mt

Qmax. = 13.0t

Design of section of the main beam-first floor:

$F = M / S_x$

Assume compact section therefore, $F=0.64Fy=1.54t/cm^2$ & Mmax. = 33.2mt,

Thus $S_x = 2156cm^3$ Choose I.P.E. 550

Check of section class:

$c/t_f = 4.39$ less than $16.9/\sqrt{2.4}$

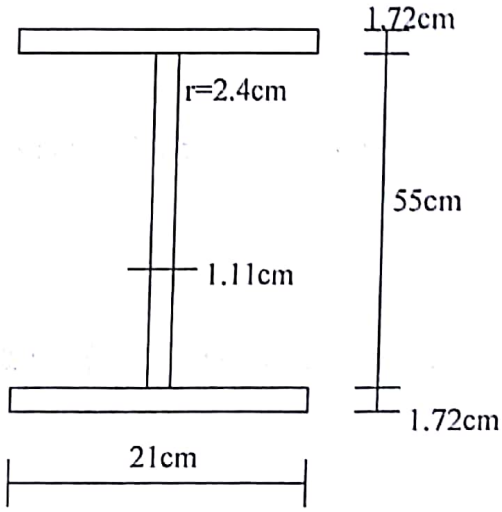
Therefore, the flange is compact.

$d/t_w = 42.13$ less than $127/\sqrt{2.4}$

Therefore, the web is compact.

The section is fully compact.

Lumax. is zero.



Check of stresses:

Check of normal stress:

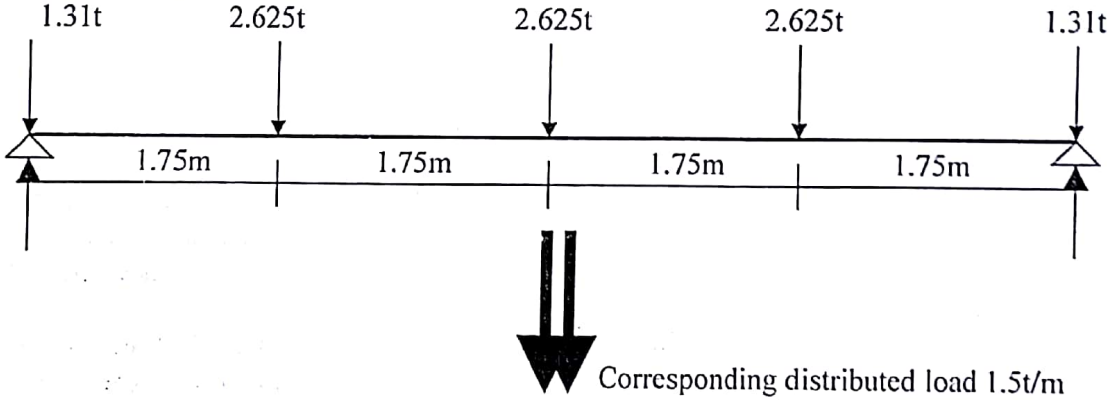
Fact= $M / S_x = (33.2x100) / 2440 = 1.36t/cm^2$ **Safe O.K.**

Check of shear stress:

$q = 13.0/(55x1.11) = 0.21\ t/cm^2$ less than $0.84\ t/cm^2$ **Safe O.K.**

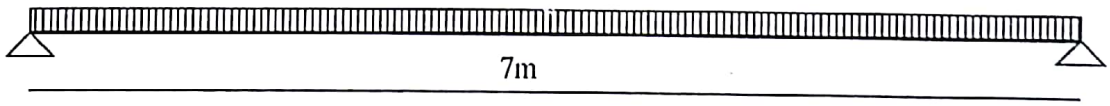
Check of deflection:

Due to L.L. on the main beam only is:



Corresponding distributed load 1.5t/m

≈ 1.5t/m



$$\delta_{L.L.1} = \frac{5}{384} \times \frac{w \times L^4}{EI} = \frac{5}{384} \times \frac{1.5 \times 7^4 \times 10^6}{2100 \times 67120} = 0.33cm$$

Reaction of live load from the second floor =0.88t

$$\delta_{L.L.2} = \frac{1}{48} \times \frac{P \times L^3}{EI} = \frac{1}{48} \times \frac{0.88 \times 7^3 \times 10^6}{2100 \times 67120} = 0.045cm$$

Therefore, $\delta_{L.L.T} = 0.33 + 0.045 = 0.375cm < 700/300 = 2.33cm$ **Safe O.K.**