Assignment # 2

3 Problems, 60 marks Total

Problem 1 (20 marks)

The beam in **Figure 1** with *b = 300 mm*, *h = 700 mm* and *L = 5 m* is subjected to a specified dead load of *30 kN/m* (includes self-weight) and specified live load of *45 kN/m*:

[note: specified or service = unfactored load]

a. Calculate the beam's moment resistance, Mr in accordance with CSA A23.3 standard, and verify that Mr ≥ Mf (use the equations to calculate Mr, and check the beam under 1.25D + 1.5L)

b. Repeat part "b", however this time use the CDH tables (Table 2-1)

c. Verify that the minimum reinforcement requirement in CSA A23.3 is met

d. Verify the bar spacing requirements in the CSA A23.3 standard.

e. Verify the crack control (z-factor) requirement in the CSA A23.3 standard.

f. Calculate the balanced area of steel (Asb); based on this calculation is the beam properly reinforced ?

NOTE:

- Use: f'c = 35 MPa, fy = 400 MPa
- Steel reinforcement: As = 4-25M bars
- Maximum aggregate size (a_{max})= 20mm
- Sheltered (not exposed) conditions

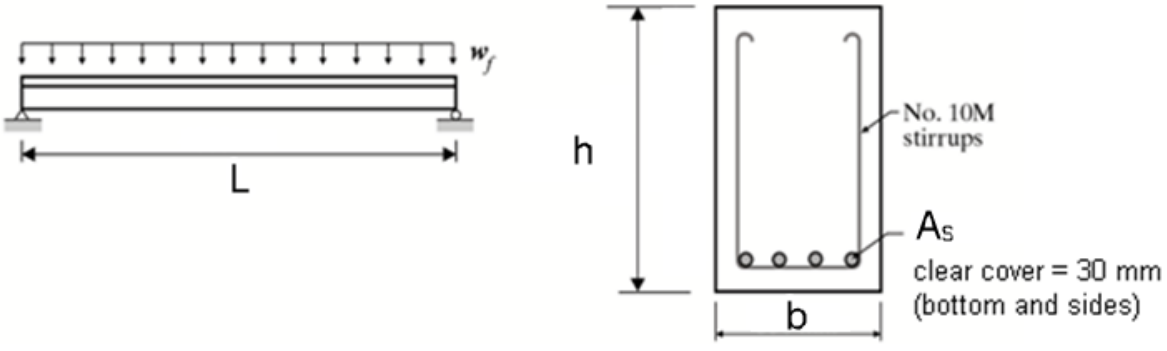

Figure 1

Problem 2 (20 marks)

For the beam having the non-rectangular box-girder cross-section shown in **Figure 2**:

a) determine the moment resistance in accordance with the CSA A23.3 standard for the case of t = 150 mm (where t = wall thickness at the top, sides and bottom)

b) determine the moment resistance, however this time use t = 100 mm

c) for the case of t=150 mm

1) verify the minimum reinforcement requirement
2) verify the bar spacing requirement
3) verify the crack control requirement (z-factor)

NOTE:

Important, read this !

- Use: f'c = 40 MPa, fy = 400 MPa
- Steel reinforcement: As = 8-25M bars
- Beam properties: b = 600 mm, h = 1000 mm
- Clear cover = 30 mm (bottom and side cover)
- Maximum aggregate size (a_{max})= 20mm
- Exposed conditions

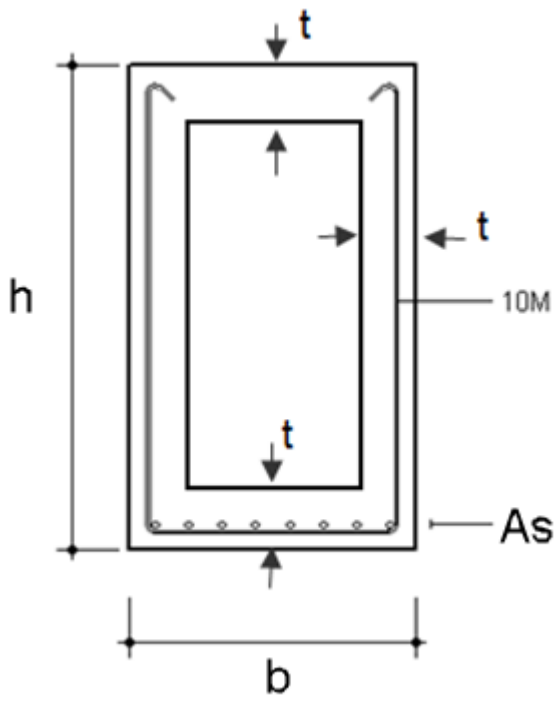

Figure 2

Problem 3 (20 marks)

Consider the beam cross-section shown in **Figure 3** with fixed dimensions *b* and *h* and span *L* as indicated in the "**NOTE**" section next to the figure. The beam is subjected to a specified **superimposed** dead load (does not include self-weight) of ***10 KN/m*** and a specified live load of ***40 KN/m***.

Considering the load case 1.25D + 1.5L :

a) Use the iterative procedure to determine the required number of **25M** bars. (Note: check that Mr ≥ Mf and ensure your design satisfies the Asmin and bar spacing requirements). Show a sketch of your beam design

b) Repeat, but use the quadratic equation to determine the required number of 25M bars.

c) Repeat, but the CDH tables to determine the required number of 25M bars.

[**Note**: If you find the same number of bars in "b" and "c", you don't need to redo the Asmin and bar spacing checks again]

Important, read this !

NOTE:

- Beam span, L = 5 m
- Beam dimensions are fixed: b = 300 mm, h = 600 mm
- Use: f'c = 30 MPa, 25M bars and 10M stirrups
- Density of concrete for self-weight calculation: 24 KN/m^3
- Clear cover = 30 mm (bottom and side cover)
- Maximum aggregate size (a_{max})= 20mm

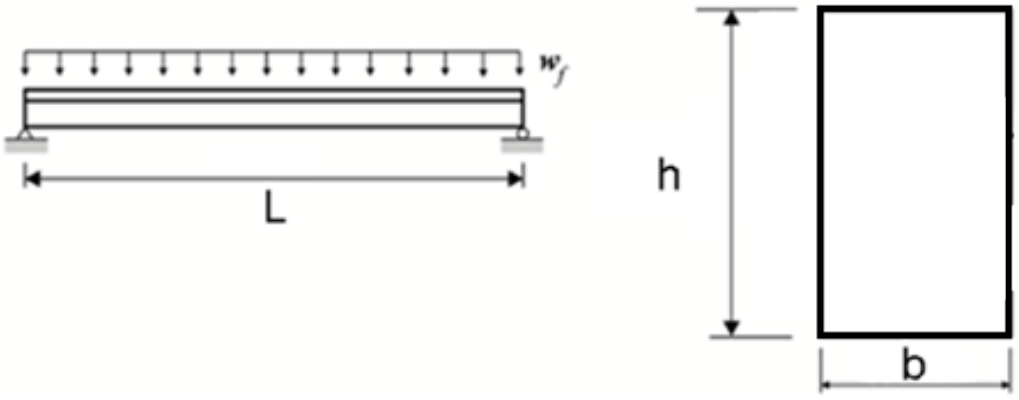

Figure 3