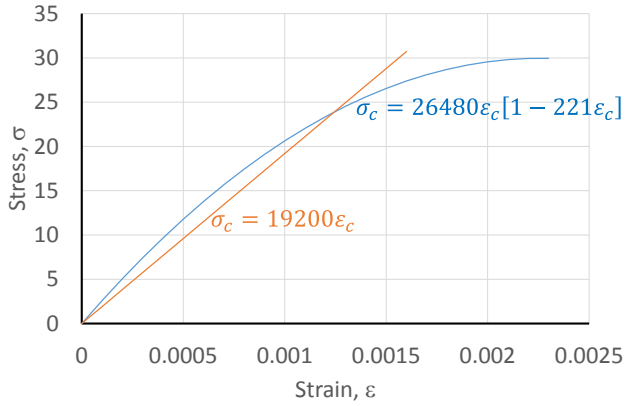
CE 382 HOMEWORK 2

Due Date & Time: April 3, 2015 @ 17.00

Q1. A short concrete column, reinforced with 4ϕ20 steel bars is subjected to a uniaxial load of 1300 kN. The square column has 250×250 mm dimensions. Concrete and steel strengths are $f_c = 30$ MPa and $f_y = 420$ MPa, respectively. $E_s = 200000$ MPa.

a. Assuming linear elastic behavior both for concrete (as given in the figure, $\sigma_c = 19200\varepsilon_c$) and steel, calculate the stress in concrete and steel.
b. Assume steel to be a linearly elastic material and concrete to be a non-linear material with a σ–ε curve as shown below ($\sigma_c = 26480\varepsilon_c[1 - 221\varepsilon_c]$). Compute the stresses in steel and concrete.

Comment on the results.

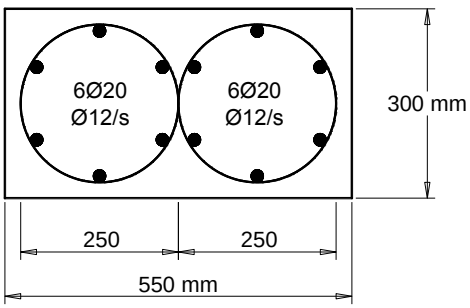


Q2. Calculate the maximum axial load that can be carried by the tied columns given below. All columns have 300×300 mm cross-section.

a. $f_c = 20$ MPa, $f_y = 420$ MPa, longitudinal steel $8\phi12$.
b. $f_c = 40$ MPa, $f_y = 420$ MPa, longitudinal steel $8\phi12$.
c. $f_c = 20$ MPa, $f_y = 420$ MPa, longitudinal steel $8\phi24$.
d. $f_c = 40$ MPa, $f_y = 420$ MPa, longitudinal steel $8\phi24$.
e. Based on the results obtained above, discuss the influence of ratio of longitudinal reinforcement and concrete strength on ultimate load capacity.

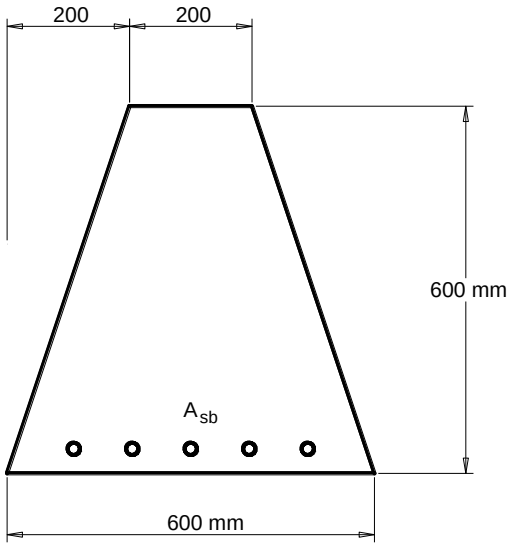
Q3. The uniaxially loaded rectangular spiral column is reinforced with 12ϕ20 longitudinal bars and two ϕ12 mm spirals as shown. Determine,

a. The spiral pitch (spacing) "s" which makes the second peak equal to the first peak using
$f_{cc} = 0.85f_c + 6\sigma_2$ (for actual columns)
where $\sigma_2 = 2f_{yw}A_0/Ds$
b. The uniaxial load capacities N_{01} & N_{02} to verify their equality.

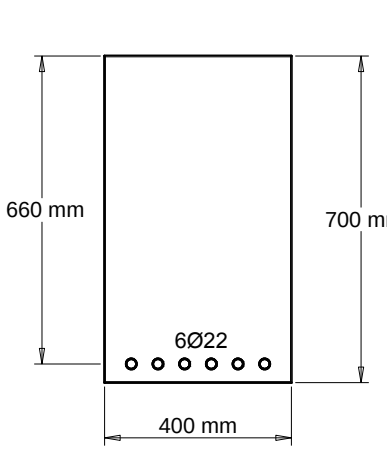


f_c = 25 MPa & f_y = 420 MPa & f_{yw} = 220 MPa

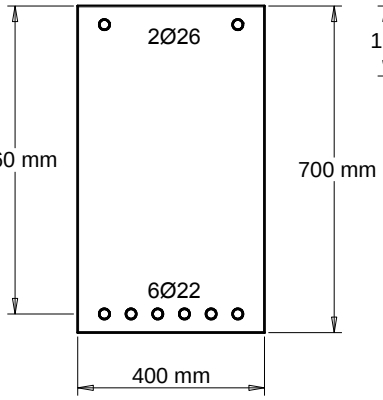
Q4. Calculate the balanced steel area, A_{sb}, of the beam given. Materials are given as $f_c = 35$ MPa and $f_y = 500$ MPa.



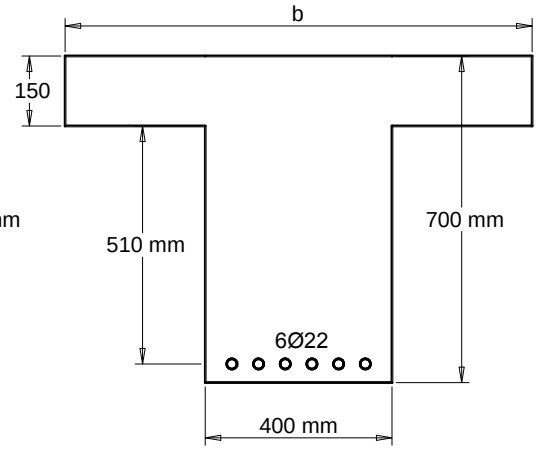
For the following 3 questions, materials are given as as $f_c = 30$ MPa and $f_y = 520$ MPa.



Question 5



Question 6



Question 7

Q5. Calculate the moment capacity and curvature of the rectangular single reinforced beam given above.

Q6. Calculate the moment capacity and curvature of the rectangular double reinforced beam given above.

Q7. Calculate the flange width, b, to make equal the moment capacity of the flanged single reinforced beam given above to the moment capacity of the double reinforced rectangular beam of Question 6.