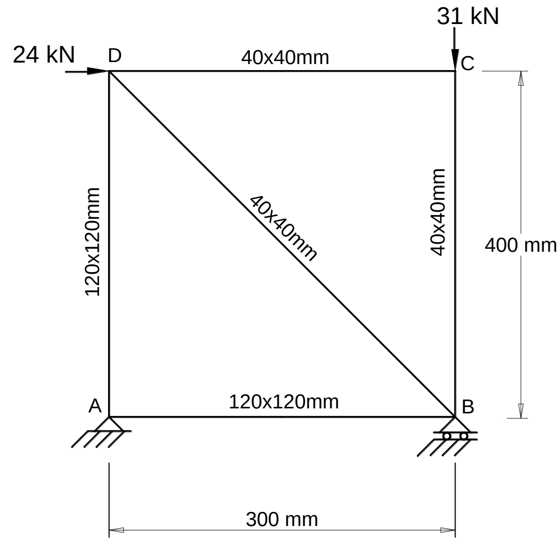
CE 382 HOMEWORK 1

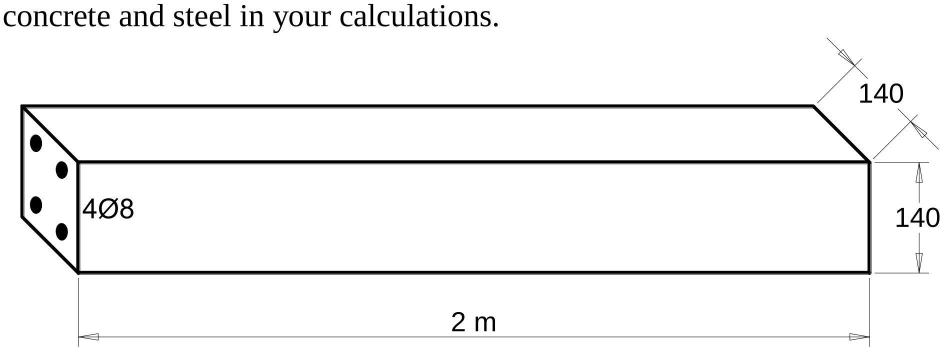
Due Date & Time: March 20, 2015 @ 17.00

Q1. Draw the stress-strain curve of normal density concrete with a compressive strength of 40 MPa by using the Hognestad mathematical model.
Additionally, show on the same curve the loading and unloading path for concrete tested from zero to 30 MPa and reduced to 15 MPa. In your calculations, assume linear elastic unloading rule with initial elastic stiffness before peak strength.

Q2. The members of the truss shown below are of plain concrete. The compressive cylinder strength of concrete is 30 MPa. Determine whether the structure can carry the applied load.



Q3. A reinforced concrete member has 140×140 mm square cross-section and 2 m length as shown below. It is reinforced with $4\phi8$ rebars with a yield strength of $f_y = 450$ MPa. The concrete compressive strength is $f_c = 25$ MPa. The reinforced concrete member is freely laying down without any restraint at the ends. Consider linearly elastic behavior both for concrete and steel in your calculations.



a. Calculate the stresses developed on concrete and steel due to a temperature drop of 20°C.
b. Calculate the stresses developed on concrete and steel due to long term shrinkage. Assume humid environment and adequate curing. Bear in mind that all four faces of the member are in contact with the environment. Also determine whether concrete has cracked or not.

c. Solve the same question asked in part “b” for dry environment along with inadequate curing.
d. Consider the reinforced concrete member given above with uniaxial compressive load of 196 kN. Under this sustained compressive load calculate the stresses developed on concrete and steel first for elastic initial case, and also for long term creep. Assume humid environment and the loading is applied at 28 day.

Q4. The standard cylinder test results of two different ready-mix concrete companies are provided below. Calculate the mean strength, standard deviation, coefficient of variation, characteristic strength, and class of concrete for both companies. Draw the concrete strength distribution curves and comment on your results.

Company I: 16.2, 18.0, 18.9, 20.4, 20.8, 21.2, 22.4, 22.6, 23.7, 24.1, 24.6, 24.9, 25.2, 25.5, 25.8, 26.2, 26.6, 27.0, 27.4, 27.5, 27.9, 28.0, 28.2, 28.8, 29.1, 29.4, 29.7, 30.3, 30.4, 30.8, 31.0, 31.6, 32.2, 32.4, 32.7, 33.3, 33.9, 34.5, 34.7, 35.1, 36.1, 36.6, 37.0, 37.9, 39.2, 41.4 MPa

Company II: 17.7, 18.1, 18.8, 19.6, 20.0, 20.2, 20.7, 20.9, 21.1, 21.3, 21.8, 22.2, 22.4, 22.4, 22.6, 22.7, 22.8, 22.9, 23.1, 23.3, 23.4, 23.8, 23.9, 24.0, 24.2, 24.5, 24.6, 24.7, 24.8, 24.9, 25.3, 25.4, 25.8, 26.0, 26.2, 26.5, 26.8, 26.9, 27.1, 27.2, 27.4, 27.5, 27.9, 28.3, 28.9, 29.5 MPa

Q5. A simple supported one bay - one story frame is given in the figure below. The uniformly distributed dead and live loads on the beam and overhang are g = 18 kN/m and q = 10 kN/m, respectively. There is a point live load of Q = 20 kN at the tip of the overhang. Additionally, a lateral earthquake loading of E = 50 kN hits on to the structure as shown. Considering all possible load combinations and live load arrangements, calculate the design moments and design shear forces of all columns and beams at their critical sections.