Faculty of Engineering

CIVE 3205: Steel Design I

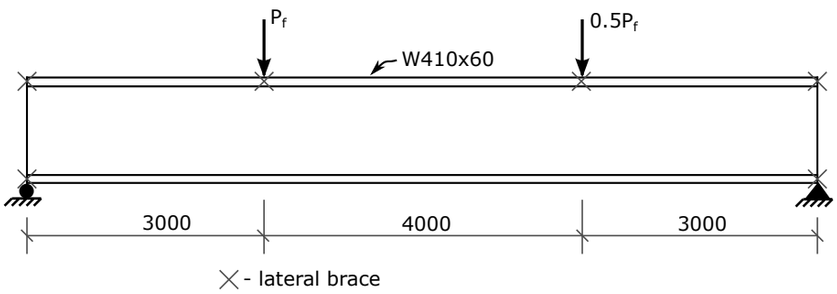
Final Examination, April, 2012

Notes:

1) Time Limit: 3 hours.
2) This exam has 16 pages and 9 questions.
3) Answer all questions. There is no choice.
4) All questions are of equal weight.
5) Unless otherwise indicated, you must show detailed calculations and all necessary steps to support your answers.
6) Incorrect answers with no detailed work shown will be awarded zero (0) marks.
7) Work done for marks must be neat and well organized; marks may be deducted for untidy or disorganized work.
8) If you feel that any information is incorrect or incomplete, make a reasonable assumption, state it clearly, and proceed. **DO NOT ASK QUESTIONS**.

Question 1 (10 marks)

Determine the maximum factored load, P_f for the following beam – a W410x60 of G40.21 350W steel. The compression flange is laterally supported only at the ends and at the points of application of the loads. You need not consider deflection. Show all detailed calculations necessary to support your answer.



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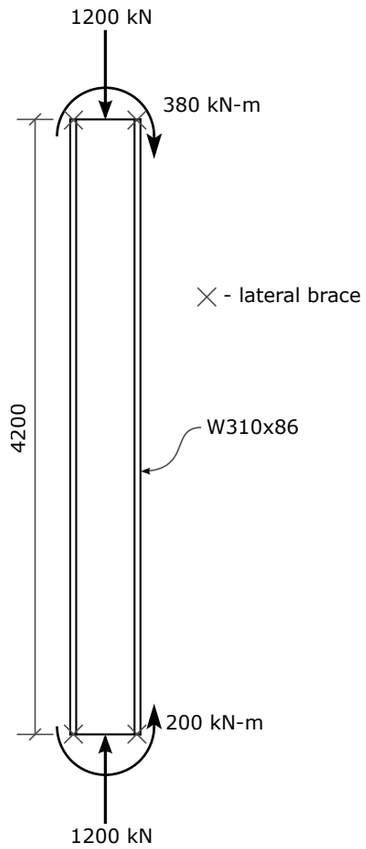
Question 2 (10 marks)

For the beam-column shown in the figure, a W310x86 of G40.21 350W steel is proposed. The column is in a braced frame, and the flanges are braced laterally (perpendicular to the plane of the web) at the ends. Is the proposed section adequate with respect to *cross-sectional strength*? Show all detailed calculations necessary to support your answer.



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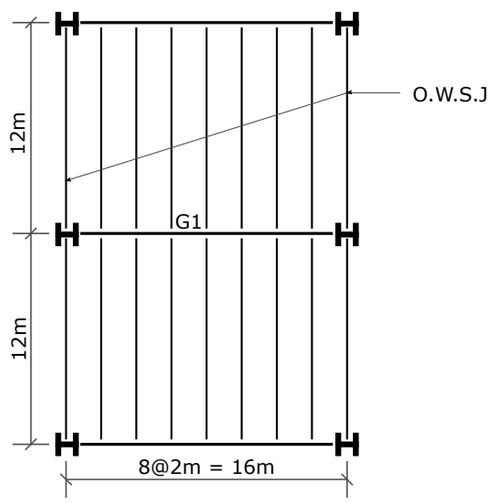
Question 3 (10 marks)

A portion of the a floor plan in a commercial building is shown in the figure. The floor is a concrete slab supported on metal deck on top of open web steel joists (O.W.S.J.). The OWSJ are in supported by girders (G1 and others). Lateral support for the compression flange of the girder is provided by the joists. Specified dead loads are 3.0 kPa and live loads are 2.4 kPa; the dead loads include an allowance for all self-weights. The floor finish is susceptible to cracking. A W1000x222 of 350W steel has been proposed for G1. Is it adequate? Show all relevant checks and justify your answer.

Hint: For deflection, moment and shear, in this case the load on the girder may be approximated by a uniformly distributed load no significant error. **You may use the beam selection and other tables in place of all detailed calculations; i.e., you need not show detailed strength calculations**.



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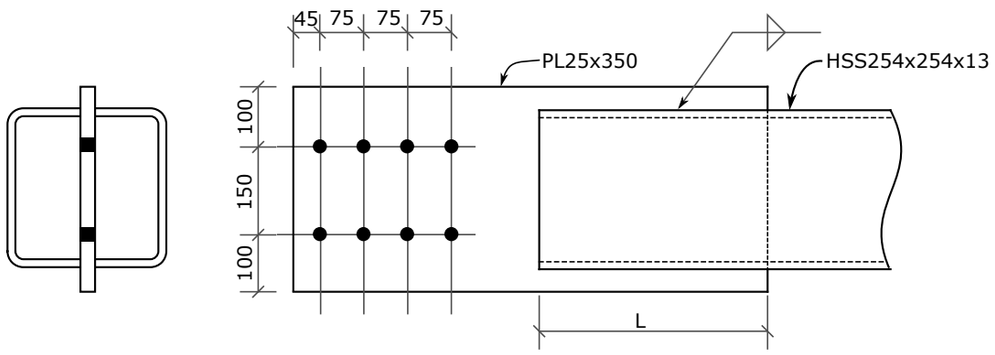
Question 4 (10 marks)

A CSA G40.20 HSS254x254x13 tension member of 350W steel has two sides cut to fit over a 25mm plate to use as one of its end connections. The HSS will be fillet welded to the plate along the cut, as shown. Determine how long the cut should be, L, in order to achieve 80% efficiency in the tensile capacity of the HSS (i.e, $T_r = 0.8\phi A_g F_y$). **Note:** this does *not* depend on the weld leg size, only its length.



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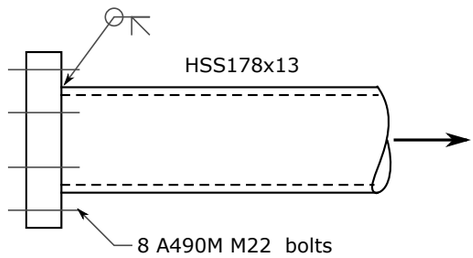
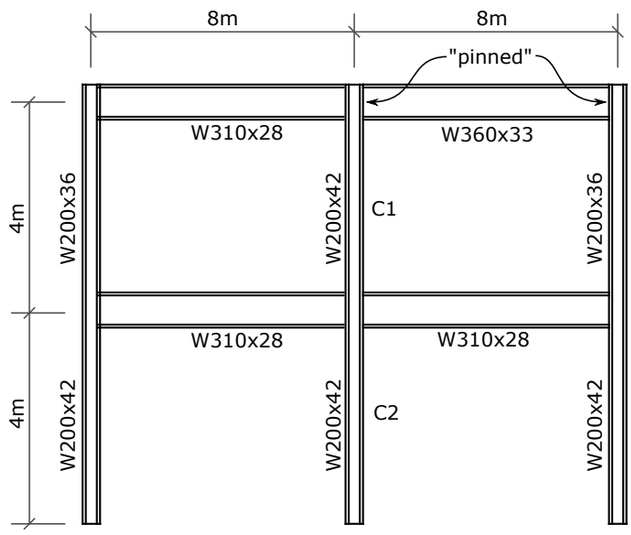
Question 5 (10 marks)

A CSA G40.20 HSS178x13 tension member of 350W steel is welded with a full strength groove weld to a plate. The plate is bolted to its support with 8 pretensioned M22 bolts of ASTM A490M material. The bolts are stressed in tension. Determine the factored tension capacity of the component. You may ignore prying action and may assume that neither the plate nor the welds govern.



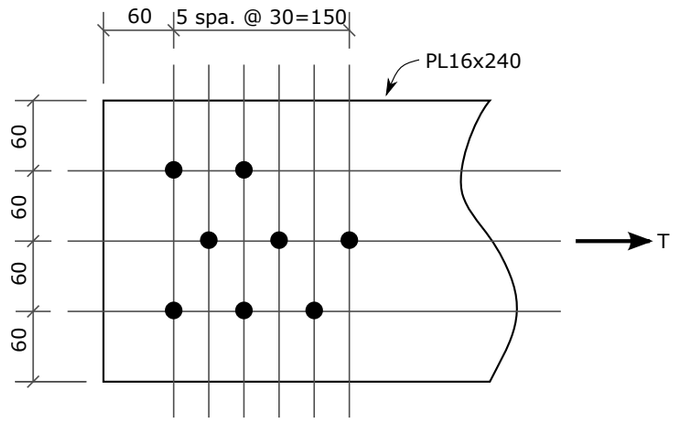
Question 6 (10 marks)

Determine the effective length, KL, of column **C1** with respect to buckling parallel the plane of the figure. All beams and columns will be bent about their strong axis for this mode of buckling; for all, the strong axis is perpendicular to the page. All of the beam-column connections are fully moment resistant, *except* for the W360x33 at the top right, which is pinned (no moment resistance) at both ends.



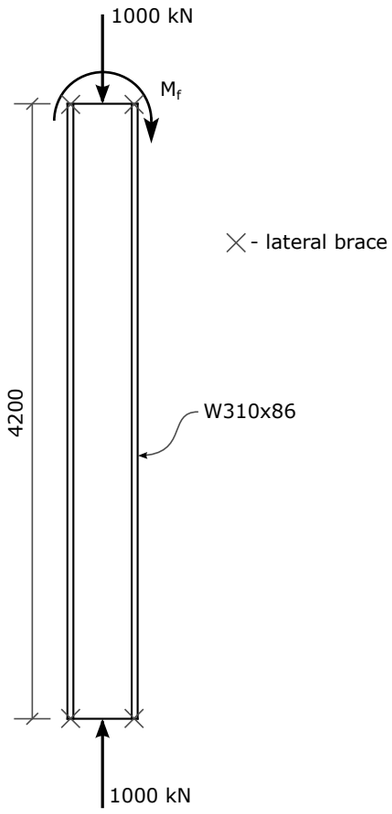
Question 7 (10 marks)

Determine the net area, A_n for the plate tension member. Holes are punched for M20 bolts.



Question 8 (10 marks)

Considering only *overall member strength*, determine the maximum factored moment, M_f, that may be applied to the top of the column in the figure. The column is a W310x86 of G40.21 350W steel and is in a braced frame and you may assume pin ends. The flanges are braced laterally (perpendicular to the plane of the web) only at the ends of the column.



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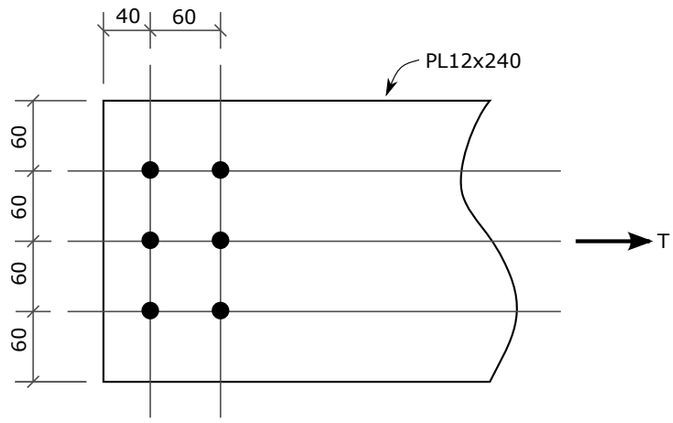
Question 9 (10 marks)

Considering only *block shear* failure, determine the factored tension resistance of the plate tension member. Material is G40.21 300W steel and holes are punched for M20 bolts. Clearly show each possible failure pattern and the resistance associated with each.



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