UNIVERSITY OF TORONTO
DEPARTMENT OF CIVIL ENGINEERING

FINAL EXAMINATION - DECEMBER 2001

CIV 312H1F - STEEL AND TIMBER DESIGN

Examiner: J.A. Packer

NAME: _____

STUDENT NUMBER: _____

This is a Type D Examination.

The specific aids permitted in the Examination are unmarked copies of the following:

(1) The Canadian Institute of Steel Construction's, "Handbook of Steel Construction".

(2) Canadian Standards Association's, "Engineering Design in Wood (Limit States Design)", O86.1-94, pages 1 to 49.

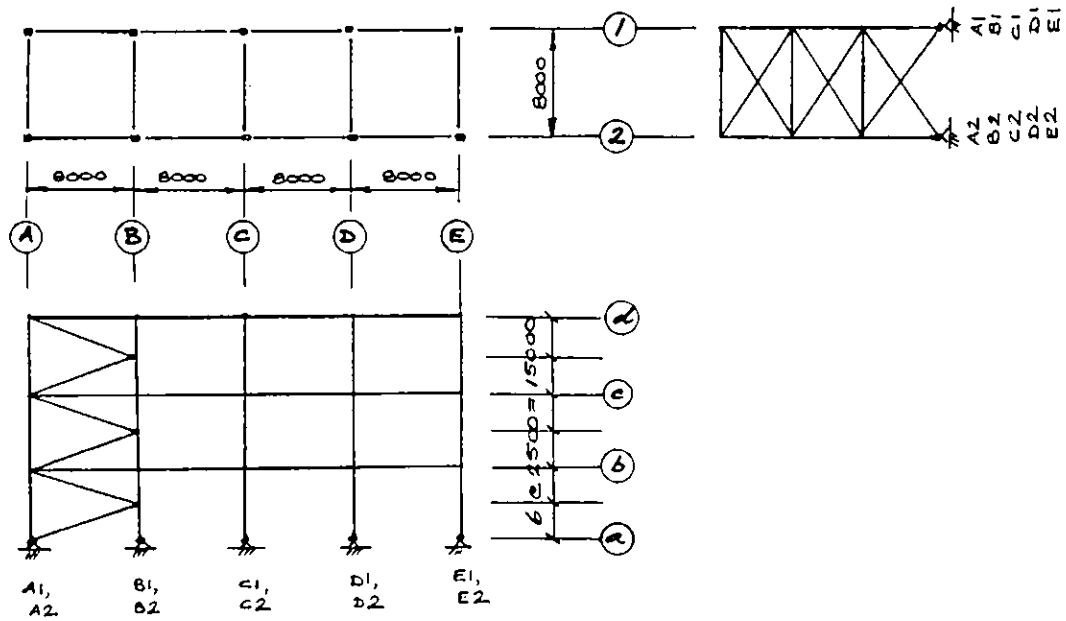
- Answer all FOUR questions in the space provided. If additional work space is required use the back of the preceding page and note appropriately.
- Do not unstaple pages.
- Questions all have the same value, as shown below.

DO NOT WRITE IN THIS SPACE.

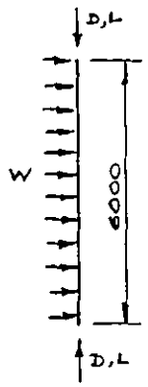
Problem 1	/ 12.5
Problem 2	/ 12.5
Problem 3	/ 12.5
Problem 4	/ 12.5
TOTAL	/ 50

1. A three-storey, four-bay, steel-framed building has all W-section beams pin-jointed to the HSS columns and is braced as shown in the figure below. The bracing members are all pin-jointed at their ends to the columns too. The building is designed as a statically-determinate structure and hence cross-bracings are designed for tension only. The X-bracings are not joined where they cross. A net specified Wind Load of 1.00 kPa acts positively or negatively on any surface of the building (which is covered with cladding and roofing materials). The roof Dead Load (self-weight) is 0.5 kPa and the specified Snow Load is 1.2 kPa.

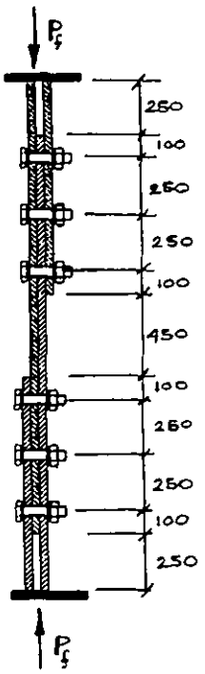
Design optimum (the lightest) bracing members for the frame, using Class C grade 350W square HSS members manufactured to CAN/CSA-G40.20/G40.21-98, but with the constraint that: all K-bracing members are to be one size, and all X-bracing members are to be one size. The member designs must meet the requirements of CAN/CSA-S16.1-94. (Assume that the ends of the bracings are connected without any loss of section capacity). *Cite any CSA Specification clauses or CISC Handbook pages that you use.*



2. A Class H grade 350W HSS 219 x 8.0, manufactured to CAN/CSA-G40.20/G40.21-98, is used as a beam-column in a steel, braced-frame, building. The 6 metre long member is pin-jointed at its ends and supports an axial compression force due to Dead Load (D) of 200 kN (unfactored). In addition to this, two possible loads may act on the member: a specified lateral Wind Load (W) of 2 kN/m (unfactored), and an axial compression force caused by Live Load (L). Determine the maximum possible specified Live Load (L) that the member can support, in accordance with the requirements of CAN/CSA-S16.1-94. *Cite any CSA Specification clauses or CISC Handbook pages that you use.*



3. Four grade 300W steel plates, which are all 6 mm thick and manufactured to CAN/CSA-G40.20/G40.21-98, are bolted together as shown in the cross-section below. Perpendicular to the page the connection is repeated many times, but the tributary plate width for the connection shown is 200 mm. The 6 bolts are ASTM A490 M22, are threaded all along their length, and are placed in punched holes. The connection is loaded in compression and can be assumed to be stable. Determine the maximum factored load, P_f , that can be applied to the connection, in accordance with the requirements of CAN/CSA-S16.1-94. *Cite any CSA Specification clauses or CISC Handbook pages that you use.*



4. An 8 metre span wood roof truss within a covered building is loaded by wood purlins at the panel points, as shown below. All members are made of 140 x 140 mm, No.1 grade (visually stress-graded), D.Fir-L sawn lumber and are coated with a fire retardant. Members are joined using "truss plates", hence there is no loss in sectional area at the connections. Determine the maximum factored panel point load (due to Dead Load and Snow Load), P_f , that can be placed on the truss, based solely on consideration of member resistance, in accordance with O86.1-94. *Cite any Specification clauses that you use.*