Student ID:		Student Name:	

DIVISION OF
INFORMATION TECHNOLOGY, ENGINEERING & THE ENVIRONMENT

SCHOOL OF NATURAL & BUILT ENVIRONMENTS

Subject Area:	CIVE	Catalogue Number:	2003

STRUCTURAL ENGINEERING 1

Examination Day: Tuesday	Examination Date: 28 June 2005
Examination Time: 9.00 am	Length of Exam: 3 hours

Examination Venue:	Ridley Centre

Instructions to Candidates

a) Attempt ALL questions.

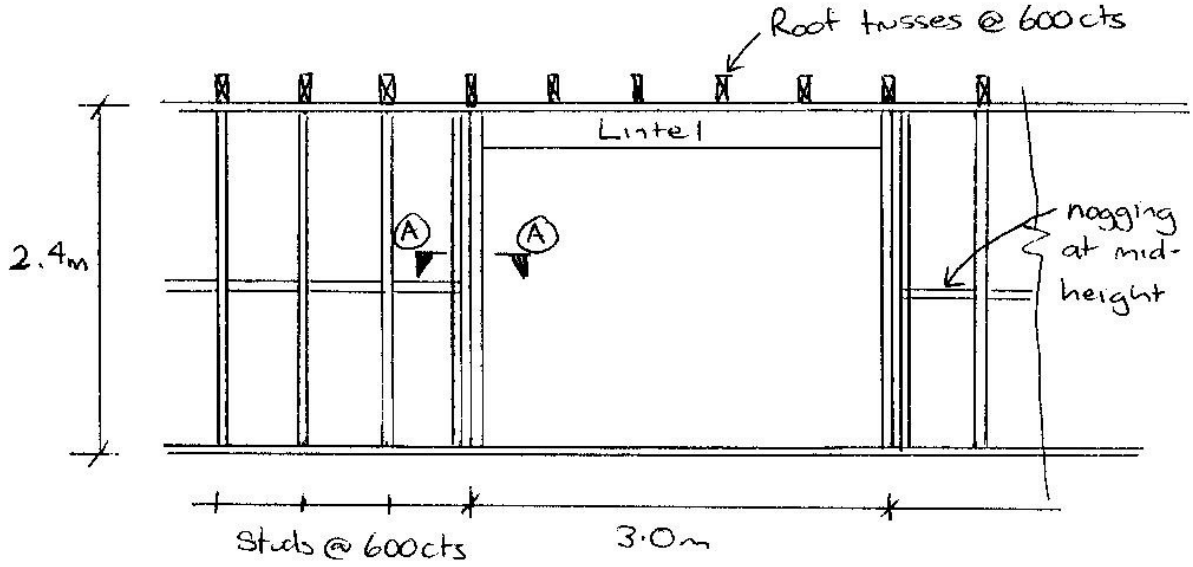
b) Marks for questions are shown in brackets.

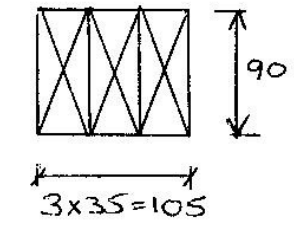
c) You may use the following books/information:
- SAA HB2.2 – Australian Standards for civil engineering students Part 2: Structural Engineering 2003 edition
- Onesteel 300 plus "Hot Rolled and Structural Steel Products", Third edition (photocopy)
- A total of 2 double sided A4 pages with any notes, formulae, information etc you desire to include

PART A: Timber Design

QUESTION 1

The drawing below shows a segment of a residential house frame, in a beachside suburb of Adelaide. You have been asked to check aspects of the design of the triple stud supporting the end of the lintel, as well as checking the lintel deflection.





Section A-A.

Each roof truss puts an **unfactored** load onto the stud or lintel of:

2.7 kN permanent load (dead load, G)
1.3 kN imposed load (live load, Q), from erection and maintenance
4.0 kN wind load uplift (wind load, W_u)

The worst ultimate design wind pressure on the wall is 1.2 kPa outwards.

a) Determine the total design loads or bending moments for ultimate strength design on the triple stud (neglecting self weight of the stud and lintel) for the following:
   - Axial compression load from permanent and imposed loads
   - Axial tension load from permanent and wind loads
   - Bending moment from the outwards wind load

6 marks

b) If the studs are constructed from F5 seasoned pine, check that the triple stud is adequate under axial compression. The nogging at mid-height provides buckling restraint in the plane of the wall. There is no other intermediate restraint to buckling.

14 marks

c) Check that the triple stud is adequate under axial tension.

6 marks

d) Check that the triple stud is adequate under bending about its weak axis due to wind load on the wall.

10 marks

e) Check combined actions for bending and tension

4 marks

f) If the lintel is chosen as 290 x 70 MGP 12, show that its maximum deflection under the long term serviceability load combination will be less than the maximum of 12 mm that is allowed for clearance to the glass window below. The maximum deflection at mid-span of a simply supported beam with 4 equally spaced point loads, P, is given by

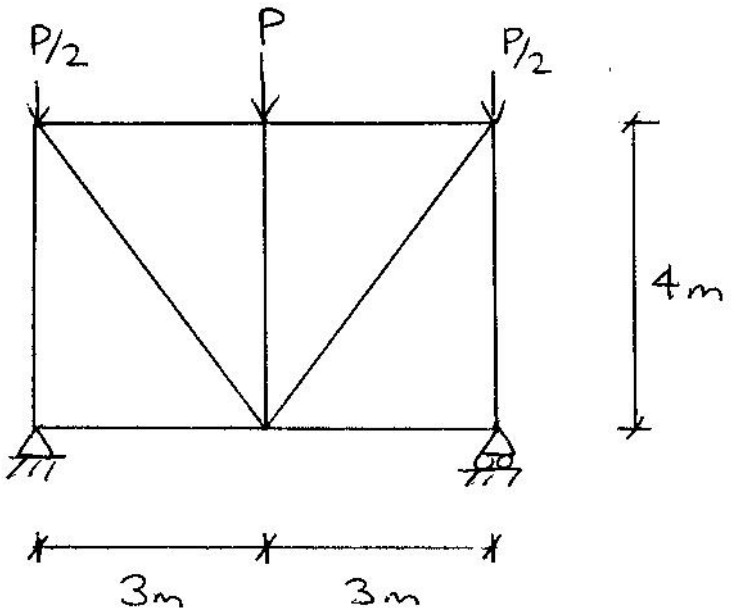
$$\Delta = \frac{63}{1000}\frac{PL^3}{EI}$$

10 marks

Total = 50 marks

PART B: Steel Design

QUESTION 2



The truss pictured is a roof-bracing truss carrying ultimate wind loads, P = 20 kN. The truss members are all equal angles, Grade 300 Plus. Assume all connections will be pin-ended, using a single line of M20 bolts (you do not need to design the connections).

a) Determine the tension and compression forces in the truss. (Hint: look at the triangle dimensions)

6 marks

b) Design the critical tension member, allowing adequate edge distance for the bolts.

10 marks

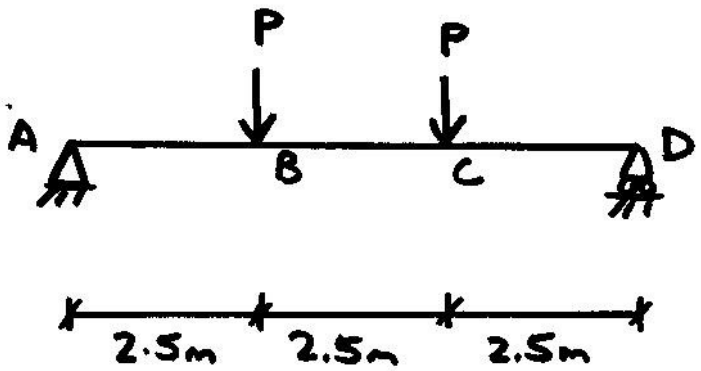
c) Design the critical compression member (do a maximum of 2 trial sizes, even if your last one isn't big enough).

9 marks

Total = 25 marks

QUESTION 3

An existing 460UB67.1 beam must be checked to see if it is adequate to support a new machine load that will be installed for the long term. The proposed loads and load positions are:



P = 50 kN permanent load (unfactored)
and 20 kN imposed load due to machine operation (unfactored)

Ignore the beam self weight

a) For satisfactory operation of the machine, the deflection must be limited to a maximum of 20 mm when the machine is operating. Check whether this can be achieved.
Note: The maximum deflection at mid-span due to both point loads, P, acting together is given by:

$$\Delta = \frac{1}{25}\frac{PL^3}{EI}$$

5 marks

b) Also check whether the beam is satisfactory for bending. Assume that the beam is laterally restrained at A, B, C and D. Only check the critical segment. Do not check for shear, or combined bending and shear.

20 marks

Total = 25 marks