UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION - DECEMBER 2001

Third Year Civil Engineering

CIV352F – Bridge Design

Exam Type: X

Examiner – E.C. Bentz

Ensure that you have all the pages.
There are blank pages at the end if you need extra space
Stiffness matrices will be handed out during the exam.

NAME: _____

ID Number: _____

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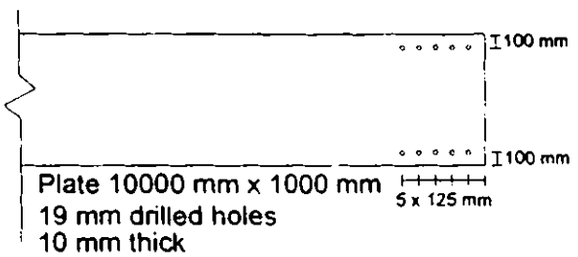
Total	

1: Short answers. (5 marks each)

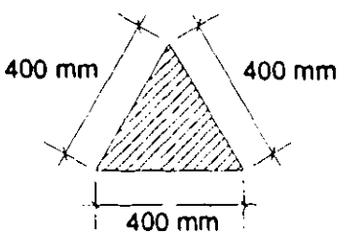
a) How do partial safety factors differ from regular safety factors and what do they allow? Give an example to demonstrate.

b) It is said that arches are just suspension bridges upside-down. Comment on how suspension bridges and arches are similar and how they are different.

b) Calculate the strength of this tension connection (F_y = 300 MPa, F_u = 450 MPa)



d) Calculate the plastic neutral axis location and plastic section modulus of this section:



2) Definitions: (2 marks each)

a) Distribution factor

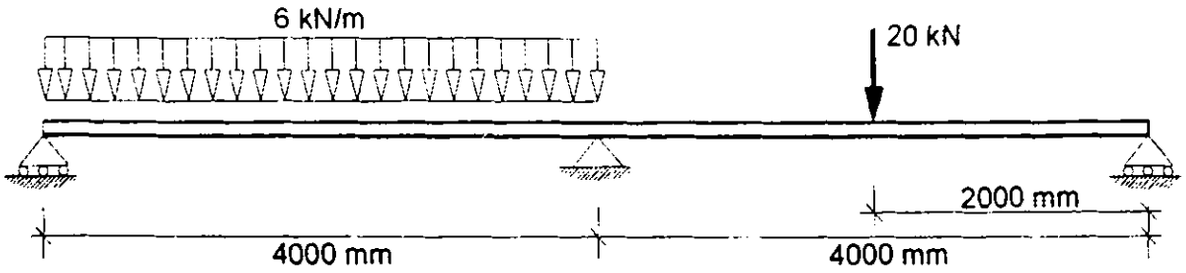
b) Tension field theory

c) Fatigue failure

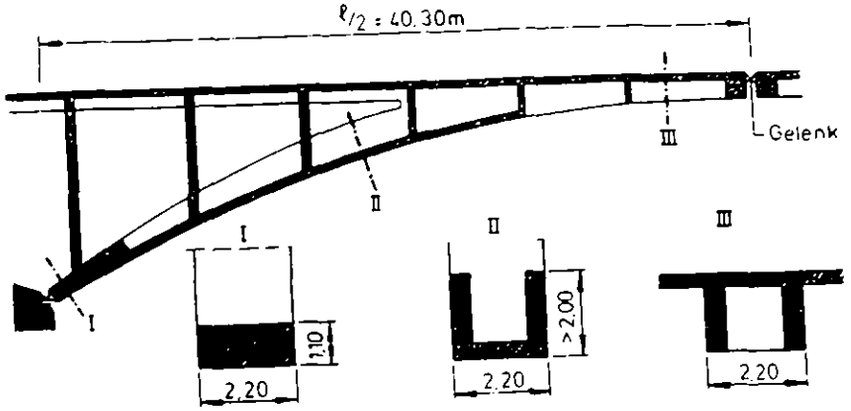
d) Composite section

e) P-Delta Effect

3) Solve for the moment diagram of this structure using the force method. Confirm your answer with moment distribution. (20 marks)



4) The picture shows the left half of a three-hinged arch structure as designed by Maillart some 70 years ago. If the total load (including dead weight) is 80 kN/m, determine a) the reactions of the structure, b) the forces acting in the main arch element at sections I, II, and III in the drawing, c) the variation of longitudinal stress through the thickness of the arch at each location. If the concrete has a safe compressive strength of 15 MPa, and a safe tensile strength of 1 MPa, comment on the safety of the structure. (The drawing is to scale.) (20 marks)



5) Due to a strange geometrical requirement, a structure similar to that shown in the picture is needed to span 40 metres with a pair of trusses on the right hand side and a single steel girder on the left hand side. The loads shown are factored dead + live loads, and the point load cannot move. Design the structure using the CHBDC. Steps: a) calculate reactions, BMD for girder and forces in truss. b) design girder checking all relevant code provisions c) design truss considering all relevant provisions. d) calculate or comment (as appropriate) on connection design. e) Draw a sketch of your completed design. Note that the depth of truss and number of bays can be changed so long as the overall height is less than 3.14 metres deep overall. (F_y = 350 MPa) (30 marks)