UNIVERSITY OF TORONTO

Faculty of Applied Science and Engineering

FINAL EXAMINATION, APRIL, 2001

First Year - Programs 1,2,3,4,6,7,8 and 9

# CIV 101S - STRUCTURES, MATERIALS, AND DESIGN

Examiner: Peter M. Wright

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NAME: _____

(Please **print clearly** and underline family name)

STUDENT NUMBER: _____

CIRCLE MODEL NUMBER OF CALCULATOR

CASIO 991 SHARP 520 TI 30

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NOTES:

1. Be sure you have all 7 sheets of this examination paper. Page 7 is blank.
2. Answer all 5 (five) equal-valued questions.
3. No other paper will be accepted for marking nor allowed on the desk.
4. The permissible calculators are listed above.

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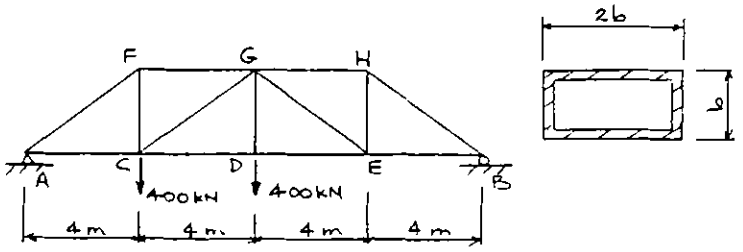
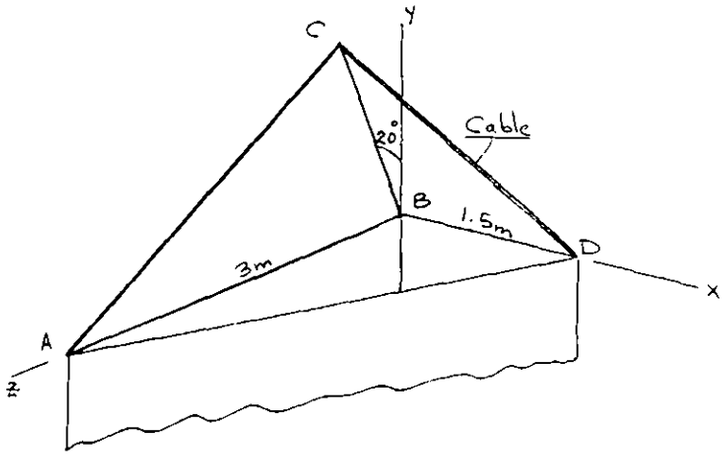
DO NOT WRITE IN THIS SPACE.

| | |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| TOTAL | |

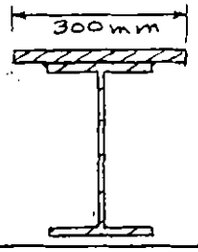
1. The members of the steel truss shown are rectangular hollow structural steel sections with outside cross-sectional dimensions of b and 2b, and inside ones of 0.8b and 1.6b.
   (a) Determine the internal actions in members GH and GE
   (b) Determine the minimum value of b for member GH. The modulus of elasticity $E = 200 \times 10^3$ MPa and the yield stress for the material is 380 MPa. The factor of safety (load factor) for yielding is to be 1.8 and for buckling it is to be 2.5.

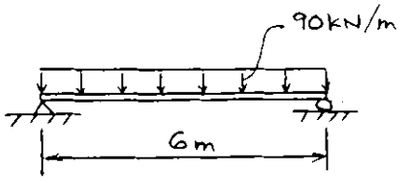


2. The uniformly-thick plate ABC which is the lid for the triangular container shown has a weight of 600 N/m$^2$. It is supported by a cable CD, a ring at A which can not support a force in the z-direction, and a ball-and-socket at B.
   (a) Sketch the free body of the lid
   (b) Determine the tension in the cable
   (c) Determine the reaction components at A.

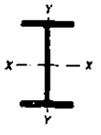


3. A steel beam is fabricated from a W356 x 64, and a plate 10 mm x 300 mm welded together as shown. The loading on the beam is also shown, as are the properties of the W356 x 64. Assuming linearly elastic material, determine the maximum tension and compression stresses due to bending moment.

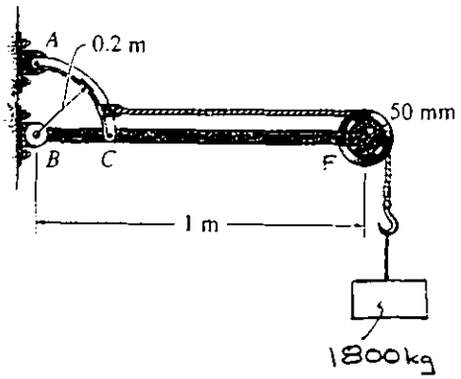



| Designation* | Area ($mm^2$) | Depth (mm) | FLANGE Width (mm) | FLANGE Thickness (mm) | Web Thickness (mm) | AXIS X-X $I$ ($10^6$ $mm^4$) | AXIS X-X $S$ ($10^3$ $mm^3$) | AXIS X-X $r$ (mm) | AXIS Y-Y $I$ ($10^6$ $mm^4$) | AXIS Y-Y $S$ ($10^3$ $mm^3$) | AXIS Y-Y $r$ (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| W356 × 179 | 22775 | 368 | 373 | 23.9 | 15.0 | 574 | 3115 | 158 | 206 | 1105 | 95.0 |
| × 122 | 15550 | 363 | 257 | 21.7 | 13.0 | 367 | 2015 | 154 | 61.6 | 480 | 63.0 |
| × 64 | 8130 | 347 | 203 | 13.5 | 7.7 | 178 | 1025 | 148 | 18.8 | 185 | 48.0 |
| × 45 | 5710 | 352 | 171 | 9.8 | 6.9 | 121 | 688 | 146 | 8.76 | 95.4 | 37.8 |



4. The frame shown is supported by pins at A and B. Determine:
   (a) the reaction components at A and B
   (b) the force components acting on member BCF



5. A beam has the cross-section shown. At a particular location along the beam the stresses due to a bending moment M are as shown in sideview.
   (a) Determine the value of the maximum compression stress $\sigma_{max}$
   (b) Determine the value of the bending moment M