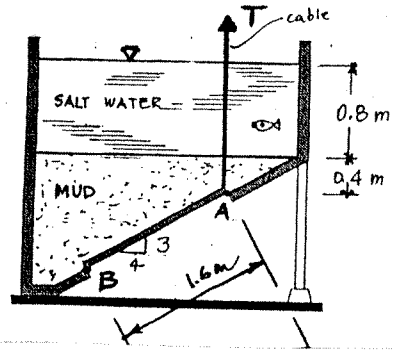
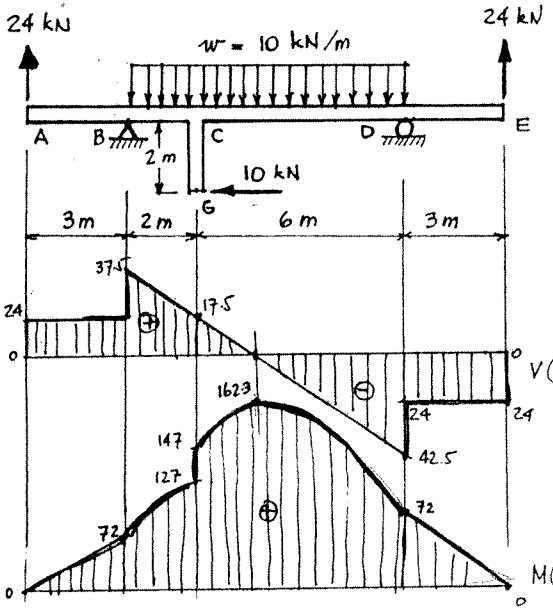
CIV100 MECHANICS - FINAL EXAM 2010

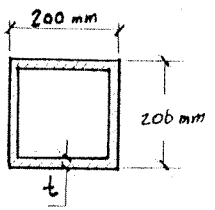
1. The cross section of a tank with an inclined bottom is shown below. The tank is filled with mud and water as shown. In this inclined bottom there is a uniformly thick gate (1.6 m x 2.2 m) which is hinged at B and rests at the bottom of the tank at A. The gate which has a weight of 12 kN can be opened by means of the cable at A. The density of the salt-water is 1040 kg/m^3 and of mud is 1760 kg/m^3. Determine the tension in the cable just as the gate opens. Show all forces on a separate free body diagram.



Answer: T = 51.5 kN (T)

3. The beam shown below is supported by a pin at **B** and roller at **D**. For the given loading determine:
   a) In the space provided draw the bending moment and shear force diagrams for the horizontal part of the beam.
   b) If the cross section is a hollow square as shown in the figure determine the minimum wall thickness (t) if the material is steel with the yield stress of 400 MPa in both tension and compression and with the load/safety factor of 1.6.

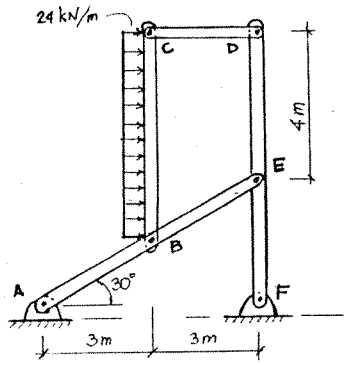


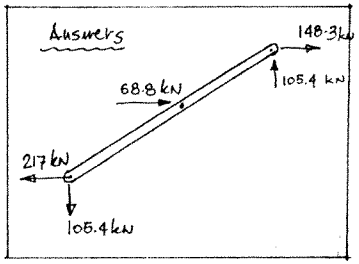


enlarged cross section

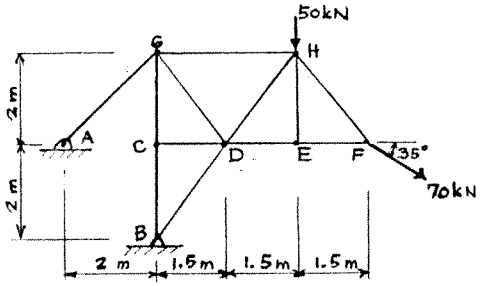
Answer: t = 16 mm

2. Given below is a pin connected and pin supported frame with loading as shown.
   Determine the reaction components at supports **A** and **F** and all force components acting on member **ABE**.
   Show your answers on a separate diagram of **ABE**.





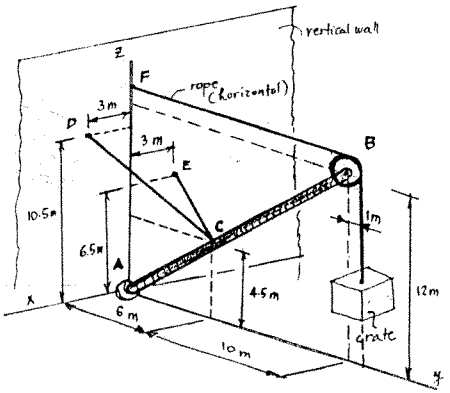
4. The steel truss shown is supported by a pin at **A** and a pin at **B**. The yield stress for the steel is 380 MPa, and the load/safety factor is 1.9.
   a) determine the forces in members **GH, DH** and **BC** and indicate if in tension (T) or compression (C).
   b) determine the required cross section for members **GH** and **BC** assuming that they have to have the same cross-section. All cross-sections are square steel bars and the sides are available in increments of 5 mm.



Answers: HG = 97.7 kN (T)
HD = 112.7 kN (C)
BC = 129.5 kN (T)

Cross section for BC & BD: 30 x 30 mm

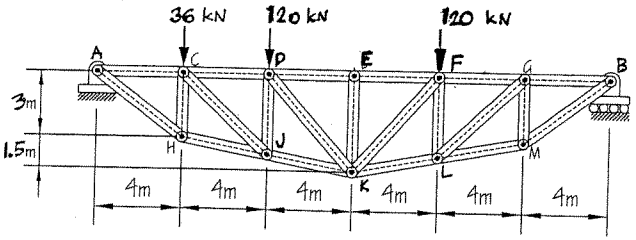
5. The 20 m long straight, light boom **AB** is supported by ball and a socket joint at **A** and by two cables **CD** and **CE**. A 2 m diameter frictionless pulley is pinned to the boom at **B** and supports 5100 N crate. The boom is in the y-z plane and points **D, E** and **F** are in a vertical wall coinciding with the x-z plane (y = 0). The pulley and rope combination lie in the vertical y-z plane. Neglecting the weight of the boom determine the magnitude of tension in cable **CD** and **CE**.

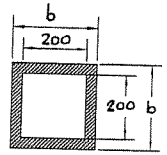


Answers:
T_{CD} = 1800 N (T)
T_{CE} = 1400 N (T)

CIV 100 MECHANICS - FINAL EXAM 2009

3. The steel truss below is supported by a pin at A and a roller at B. For the given truss determine:
   a. The forces in members DK, JK and EF.
   b. Assuming that the force in member KL is 175 kN in tension calculate the minimum overall width b for member KL knowing that the cross section is a hollow square as shown. The maximum yield stress for steel is 300 MPa.
   c. Calculate the elongation of member KL if the modulus of elasticity (Young's modulus) is 200 000 MPa.

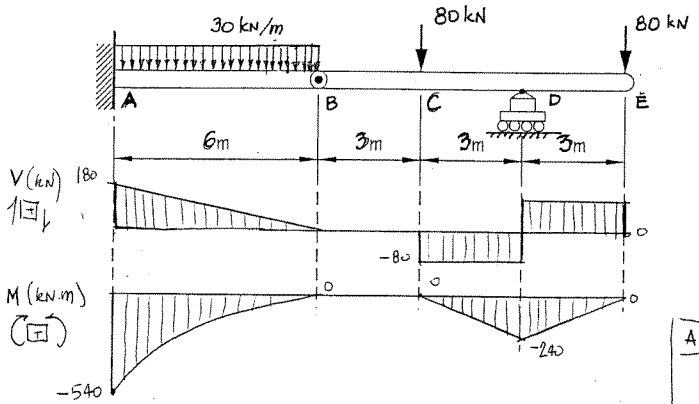


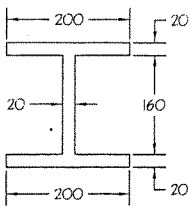


Cross Section Dimensions are in millimeters

Answers : EF = 229 kN (C) b = 24 mm
JK = 286.5 kN (T) ΔL = 6.1 mm
DK = 78.4 kN (C)

4. The given I-beam shown below is supported by a fixed connection (built in) at A, internal pin at B and a roller at D.
   For the given loading:
   a. Draw neatly the shear and bending moment diagrams in the space provided below the given beam.
   b. If the maximum allowable (yield) stress of the material is 300 MPa determine if the beam is adequate for the loads shown.

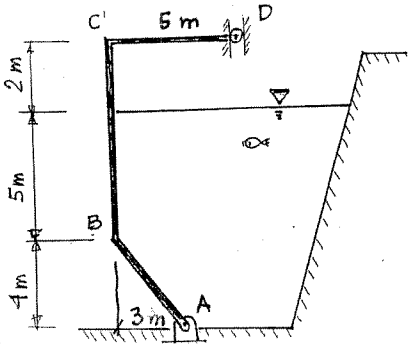




Cross Section dimensions are in millimeters

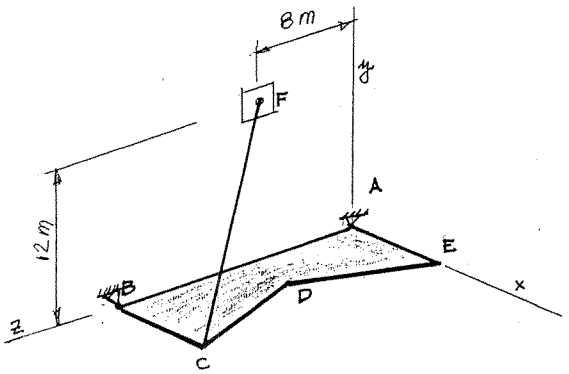
Answers
σ_{max} at A = 751.1 MPa
σ_{max} at D = 334 MPa
σ_{allow} = 300 MPa = not adequate

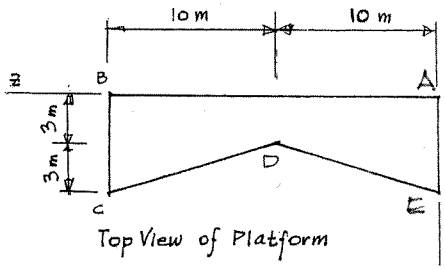
5. The gate ABCD retains water as shown. The gate is 6 m wide (perpendicular to the page). The gate is supported by a roller at D and a pin at A.
   Neglecting the weight of the gate determine the reactions at A and D.



Answers : Dx = 802.6 kN →
Ax = 1580 kN →
Ay = 1236 kN

1. The horizontal, homogeneous platform ABCDE of uniform thickness, weighs 1500 kN. The platform is supported by the cable CF, a ball and socket at A and by a connection at B that provides support in the x and y direction only.
   Determine the force in the cable and the reaction components at B.

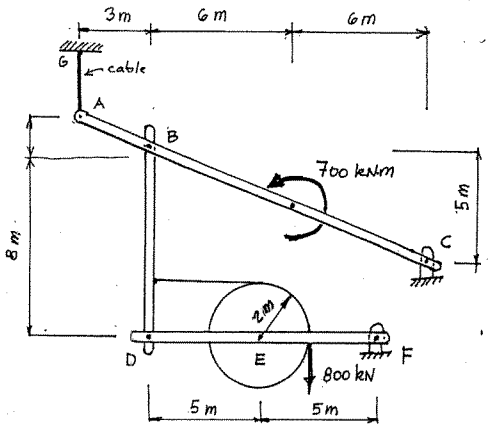




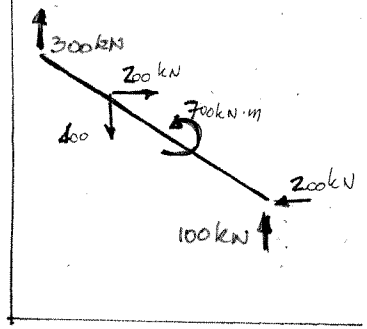
Top View of Platform

Answers : T_{CF} = 875 kN (T)
B_x = 116.7 kN →
B_y = 166.7 kN ↑

2. The pin connected frame is supported by the cable AG and by a pin at C and F. Neglecting the weight of all members determine the force in cable AG and force components at B and C.
   Show your final answer on a **new** free body diagram sketch of ABC .



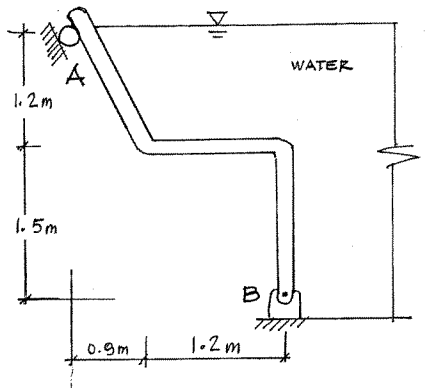
Answers



CIV 100 MECHANICS – FINAL EXAM 2008

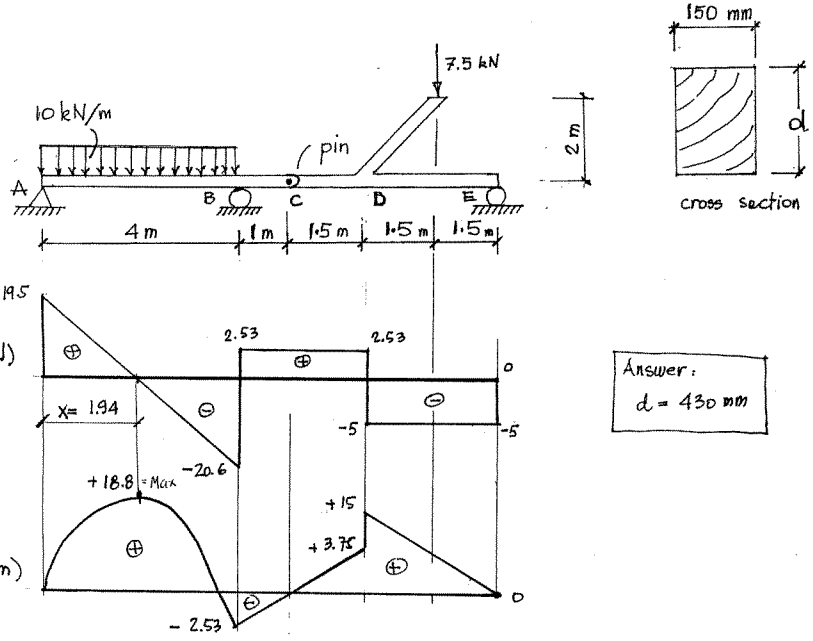
1. **AB** represents the cross section of a 3 m wide dam that has fresh water of depth 2.7 m on one side. Neglecting the weight of the dam calculate the reactions at **A** and **B**.

Draw the free body diagram in the space bellow:



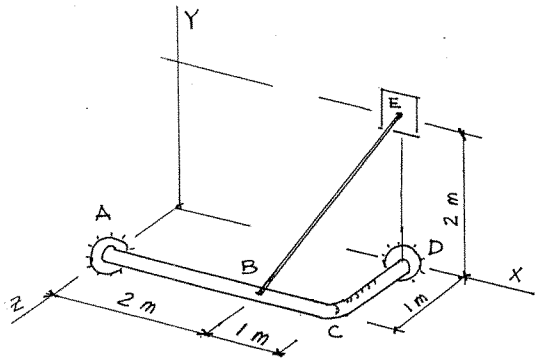
Answers:
$A = 42.6\ kN$ (5, 3)
$B_y = 32.7\ kN \uparrow$
$B_x = 73.2\ kN \rightarrow$

2. In the space provided plot the shear force and bending moment diagrams for the wood beam **ABCDE** and show all key values. The failure stress for the material in compression and tension is 8 MPa and the load (safety) factor is 1.9. Determine the required depth **d** for the rectangular cross section of the beam shown. Depths are available in increments of 10 mm.



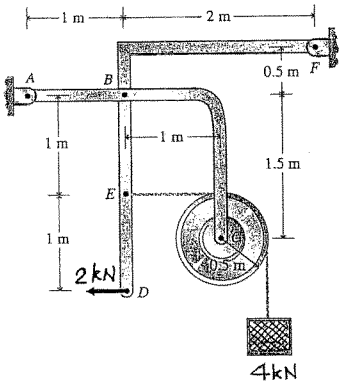
Answer:
$d = 430\ mm$

3. An L-shaped pipe bracket is supported by a ball-and socket at **A**, by a ball-and socket at **D** which has been modified to permit movement in the **z** direction, and by cable **BE**. The mass of the pipe segment **AC** is 2 kg/m whereas the mass of segment **CD** can be neglected. Determine the tension in cable **BE** and the components of the reaction at **D**.



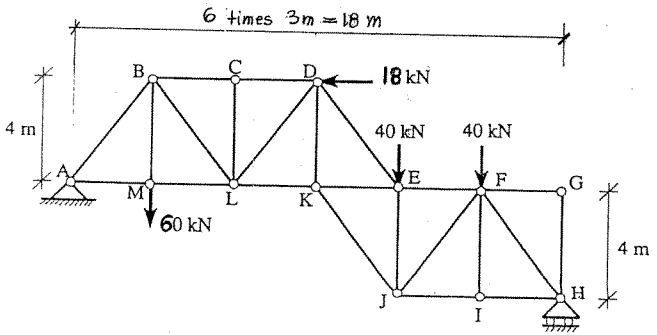
Answers:
$T_{BE} = 54.1\ kN\ (T)$
$D_x = 44.2\ kN \leftarrow$
$D_y = 0$
$D_z = 0$

4. The pulley on the pin-connected frame has a radius of 0.5 m.
a) Determine the components of the forces at the three pins on member **ABC**. Show your answers on a separate the sketch of **ABC**.
b) Determine the reaction components at **F**.



Answers
(a)
A 54 kN
14 kN
B 58 kN
10 kN
(b)
$F_x = 56\ kN \rightarrow$
$F_y = 14\ kN \uparrow$
4kN
C
4kN

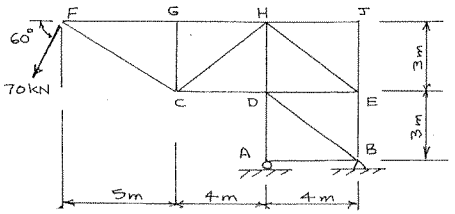
5. For the given truss shown supported by a pin at **A** and a roller at **H**,
a) determine the forces in members **EJ**, **LK** and **IF**,
b) determine the cross section of member **LK** if the failure stress for the material is 100 MPa and the load (safety) factor is 1.8. Assume a square cross section,
c) calculate the elongation of member **BM**. The modulus of elasticity **E**, of the material is 200 000 MPa.



Answers
a) EJ = 118 kN (C)
LK = 58.5 kN (T)
IF = 0 (zero force member)
b) for LK the cross section:
(32.4 x 32.4) mm
c) for LK: $\Delta L = 0.833\ mm$

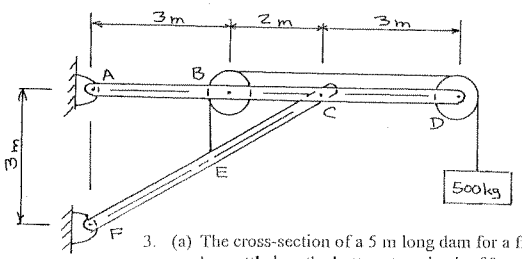
CIV 101 STRUCTURES, MATERIALS, DESIGN FINAL EXAM 2007

1. The truss shown which is supported by a roller at A and a pin at B is loaded as shown..
   (a) Determine the reaction components at A and B
   (b) Determine the forces in members CD and EH
   (c) Determine the stress in member CD and its elongation. E = 12 x 10^3 MPa and the cross-sectional area is 500 mm^2.

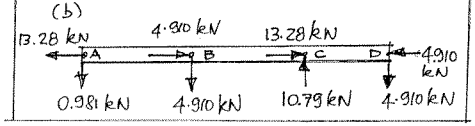


Answers:
a) A = 250kN ↑
By = 188.9 kN ↓
Bx = 35 kN →
b) CD = 181.9kN(C)
EH = 271 kN(T)
(c) σ = 364 MPa
ΔL = 121.3 mm

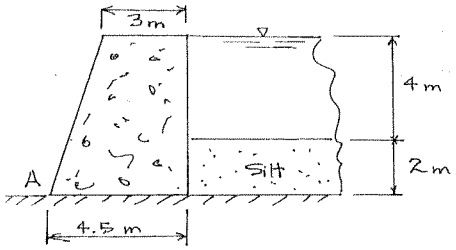
2. The pulleys in the pin-connected frame shown have a radius of 125 mm. Determine:
   (a) the reaction components at A and F
   (b) the components of the forces at the four pins on member ABCD. Show your answers on a sketch of ABCD.



Answers:
(a) Ax = 13.28 kN ← Fx = 13.28 kN →
Ay = 0.981 kN ↓ Fy = 5.89kN ↑

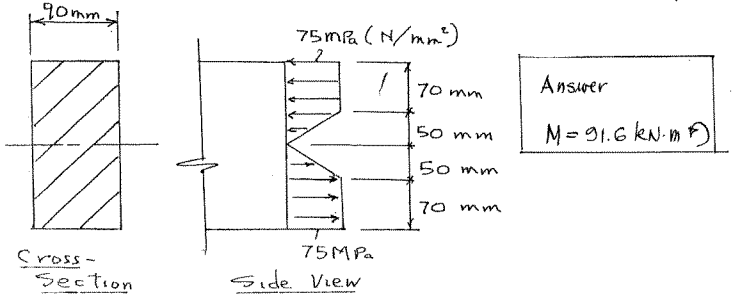


3. (a) The cross-section of a 5 m long dam for a fresh water lake is shown. Over a period of time a layer of silt has settled on the bottom to a depth of 2 m. Assuming that silt is equivalent to a liquid having a density of 1760 kg/m^3 determine the overturning moment of the silt and water about point A.



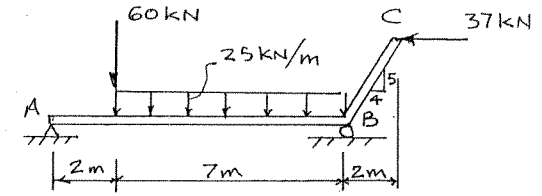
Answer:
M_A = 1815 kN·m ↺

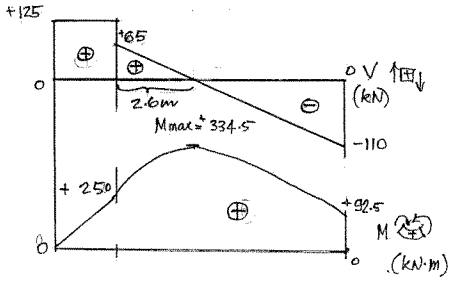
(b) A beam with a rectangular cross-section is subjected to a bending moment M which produces the stresses shown in side view. Determine the bending moment M.

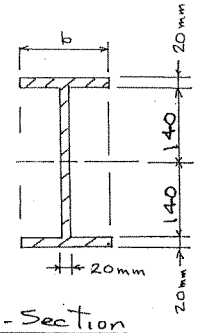


Answer
M = 91.6 kN·m (F)

4. The welded steel beam ABC which has the wide- flanged shape shown is supported by a pin at A and a roller at B. The yield stress for the steel is 380 MPa, and the plate is only available in width increments of 10 mm.
   (a) Sketch the shear and moment diagrams for AB in the space provided. Show all key values.
   (b) For the beam segment AB, determine the minimum flange width, b, assuming a load factor of 1.8.







Cross-Section

Answer:
b = 250 mm

5. A uniformly thick steel plate is supported by a ball-and-socket at B, two pin-connected bars CE and CF located at C, and the cable AD. The plate which weighs 20 kN supports a vertical force of 40 kN located at Q.
   (a) Sketch a free body of the plate in the space provided; show the x and y coordinates of the 20 kN self-weight
   (b) Determine the force in the cable.

Answer : T_D = 37.5 kN (T)