Munich University of Applied Sciences	**Faculty 09, Degree Programme WI, LM, AU** **Exam. Engineering Mechanics, SS 2010**	Prof. Dr. Anzinger, Hoffmann, Simon

Time to finish: 90 min., Resources: pocket calculator, formulary Date: 08.07.2010

Family Name (legible!): . . . . . Sem.: . . . . . Seat-Nr.: . . . . . .

First Name: . . . . . Room-Nr.: . . . . . .

The valid Student ID together with a photo ID have to be presented during the examination!

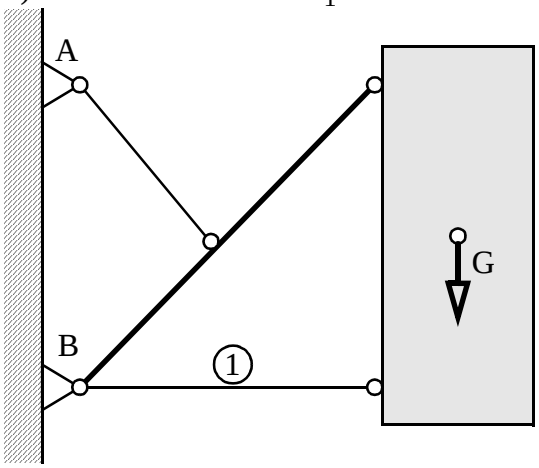
Signature: Supervisor:

Task 1: Graphic Solution (12 points)

A body with the dead weight G=4kN is fixed in the depicted structure.

a) Determine the support reactions in the bearing A and B graphically!

b) Determine the force S_1 in strut 1 !



Plan of forces: scale 1cm = 1 kN

Results: A = . 7.8 kN . . . ; B = . 5.4 kN . . . ; S_1 = . 1.1 kN . . .

Task 2: Rolling resistance (12 points)

A worker moves a wheelbarrow with constant speed.

Given:

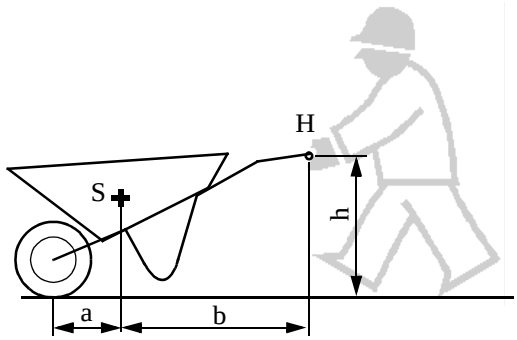
Weight of the wheelbarrow
(in centroid S) G = 1000 N,

Coefficient of rolling resistance μ_R = 0.07,

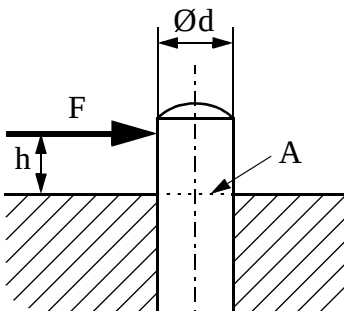
Distances: a = 400 mm; b = 1000 mm; h = 830 mm.

To be determined: Resultant of handforce H.

[H= 260 N]



Task 3: Shear pin (7 points)



A cylindric steel pin is clamped rigidly and subject to a force F as shown.

Given: Ød = 10 mm; h = 4 mm; F = 8 kN;
flexural yield strength: σ_{bF} = 400 N/mm^2.

To be determined for the cross section A at the rigid clamping:

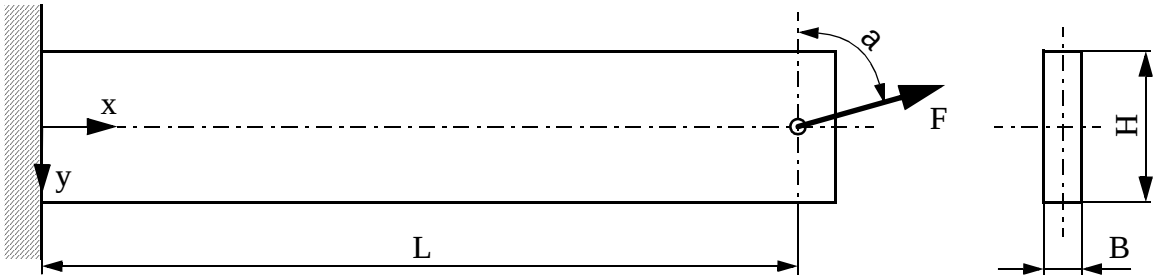
a) Safety factor S_{Fb} against plastic flow due to max. bending stress σ_b ,

b) Safety factor S_{Fq} against plastic flow due to max. shear stress τ_q .

[a) S_{Fb} = 1.23 b) S_{Fq} = 1.70]

Task 4: Combined normal stress (16 points)

The sketched cantilever is subject to a force F as shown.
Given: L = 1 m; B = 50 mm; H = 200 mm; α = 80.54°; σ_{allow} = 100 N/mm^2.



a) Sketch in into the drawing at any position x:
the distribution of the total normal stress over the height of the beam qualitatively.

b) Calculate the location x0 at which compressive stress begins to occur.

[x_0 = 800 mm]

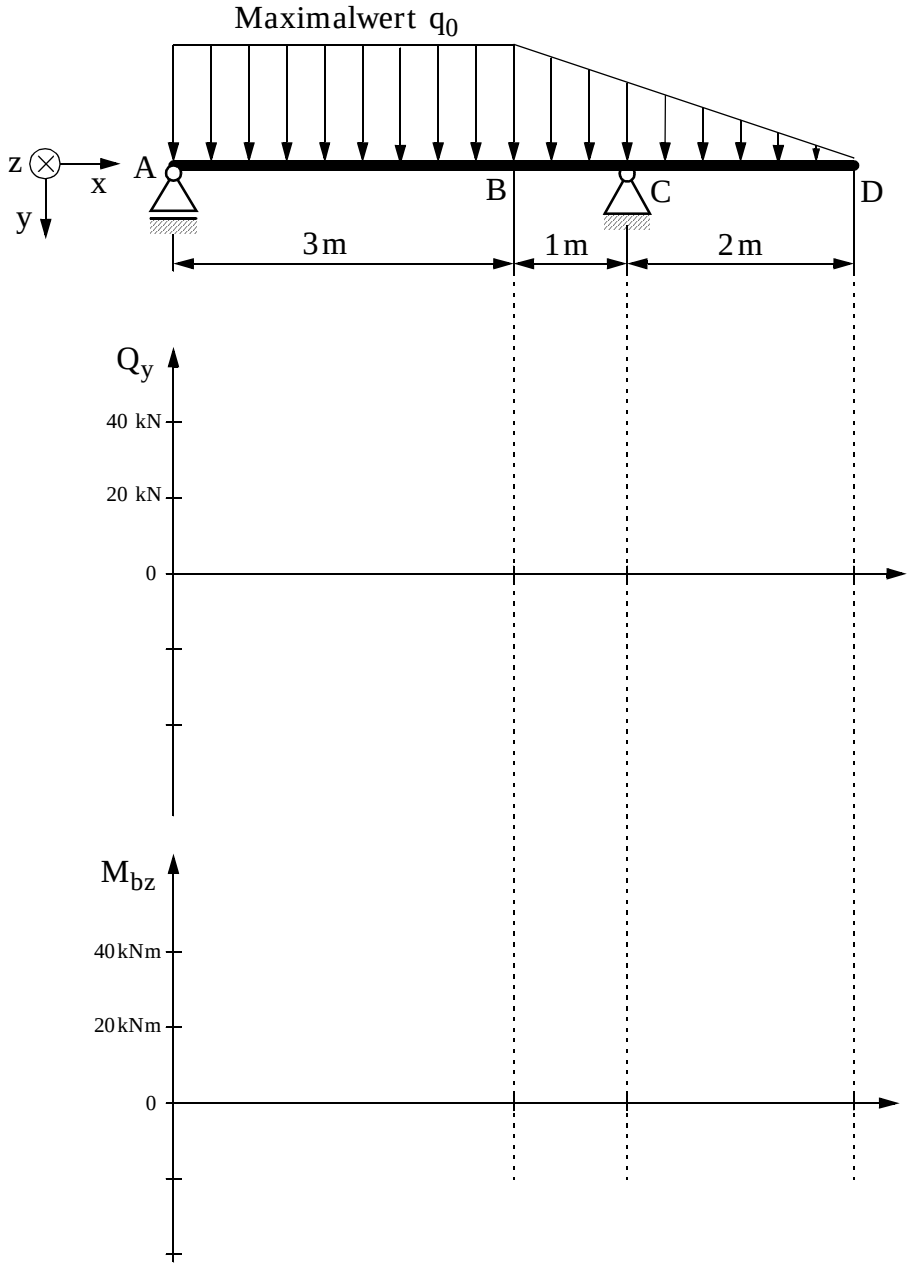
c) Calculate the maximum of the force F so that the allowable total normal stress σ_{allow} is not exceeded.

[F = 169 kN]

Task 5: Stress resultants (25 points)

Given: A girder with both a constant and a linear decreasing line load q(x);
q_0 = 24 kN/m; Distances as shown.

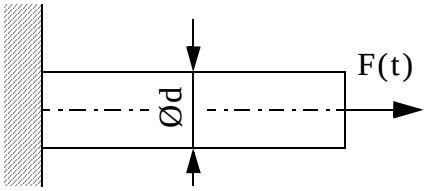
To be determined: a) the support reactions in the bearings A and C,
b) Profile of both transverse force Q_y and bending moment M_{bz} including the numerical values in B and C
c) exact position and numerical value of the maximum bending moment M_{bz}.

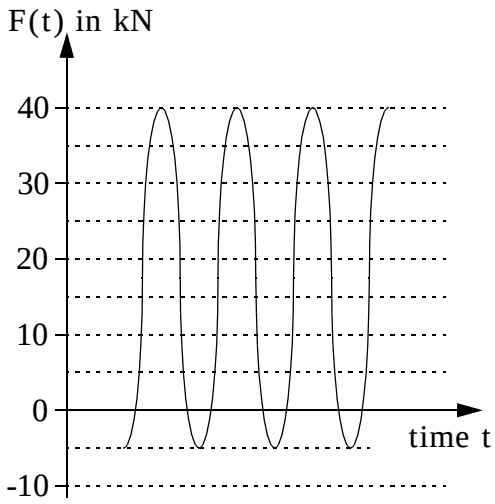


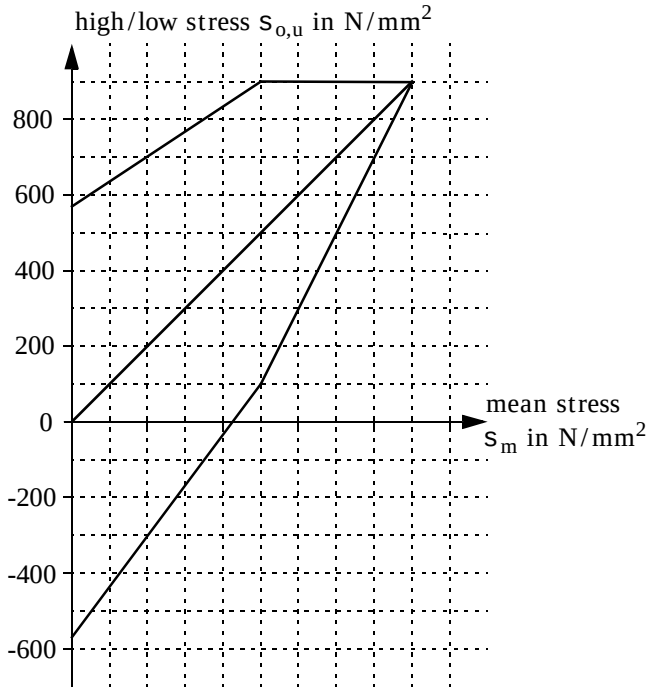
[a) A=45kN C=63kN c) M_{bzmax}=42.2kNm at x=1.875m]

Task 6: Long life fatigue strength (11 points)

A girder (diameter d=10.55mm) is subject to a dynamic compressive-/tensile-force F(t) (with constant mean load). Furthermore the Smith-diagram of the used material is given.







a) Calculate the safety factor S_D against endurance failure.

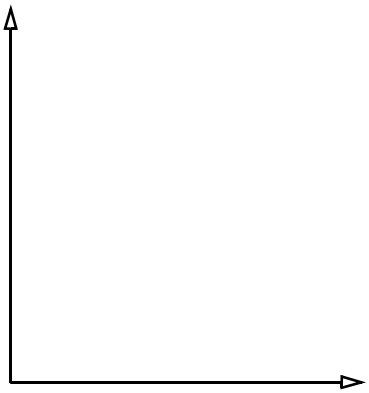
[S_D=1.94]

b) Calculate the safety factor S_F against plastic flow.

[S_F = 1,97]

Task 7: Tensile Test (8 points)

A rubber cord (length l=200mm; quadratic cross section with edge length a_0=2mm) is stretched by a tensile force linear-elasticly.



a) Plot the curve of this tensile test in a stress-strain diagram (into the depicted coordinate system)! Show how to find Young's modulus with the help of the diagram (sketch it in!)

b) Calculate Young's modulus for this rubber material.

[E = 25 N/mm²]

c) Poisson's ratio for rubber material is n=0.5. To which value a_1 will the edge length change while carrying out this tensile test.

[a_1 = 1.9 mm]