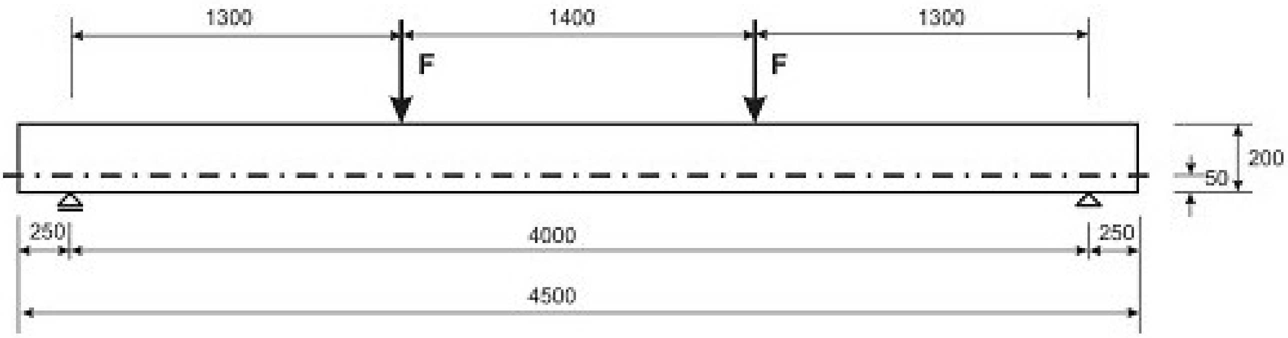
CALCULATIONS 2

Strength

P2.1 Dural rod with regular octagon cross section with side length 5 mm has 60 cm in length and weight 195.6g. During the flexural strength test the rod was broken with the force 58.7 kN. Determine tensile strength of the tested material.

P2.2 We want to do splitting tensile strength test of granite. We use cylindrical testing specimen with diameter 40 mm and height 30mm. The expected strength of granite is cca 10 MPa.
We use testing machine with adjustable force range 10 kN, 30kN and 50kN. Which force range we should set in order that the force would not exceed 75% of the range?

P2.3 Determine maximal forces applied on concrete beam with flexural strength 5.62 MPa. Beam has 4.5 m in length, 0.2 m in width and was loaded with symmetrical four-point-load shown in picture.



P2.4 How long must be vertically hanged steel cable with tensile strength 1800 MPa that it breaks by its own weight?

P2.5 Determine minimal diameter of a lift steel cable, which is placed in the world highest building (Burj Chalifa – 828 m). The lift cabin bearing capacity is 300 kg and weight 500 kg. Use the length of the cable as 800 m and involve the weight of the cable. Tensile strength of the cable is 2000 MPa.

Modulus of elasticity

P2.6 Bar from unknown metal with length 45 cm and diameter 10 mm elongated by loading force 20 kN to the length 47.41 cm and after unloading shortened to 47.25 cm. Determine the modulus of elasticity and try to find out which kind of metal is it.

P2.7 HDPE strap (= high density polyethylene) with cross section 5 mm x 20mm and length 80 cm was tested in tension. Tensile strength of the material is 23 MPa and modulus of elasticity is 1.35 GPa.

a) Determine the elastic deformation of the strap at the moment of break.
b) Determine the total elongation of the strap at the moment of break, if the ductility of the material is 120%

P2.8 Steel bar with length 60 cm and diameter 12 mm was tested in tension. Bar broke by loading 66 kN. Measuring machine scale shown maximal elongation at the moment of break 68.6 cm. Determine the ductility of the steel.

P2.9 The 50 m long steel rope has diameter 6 mm, tensile strength 1620 MPa, yield limit 1285 MPa and elasticity limit 1190 MPa. Determine maximal tensile force, such that after loading the rope returns to its original length and determine the length of the rope at that loading.

Concrete mix design.

Basic principles for ordinary concrete:

- Bulk density of fresh concrete is around 2400 – 2500 kg/m^3
- Minimal amount of cement for unreinforced concrete is 200 kg/m^3 and 240 kg/m^3 for reinforced concrete
- Cement is the most expensive component in concrete, that is why it is dosed in the minimal allowed amount. Maximal amount of the cement is 450 kg/m^3
- Concrete must include at least one fraction of coarse and one fraction of fine aggregate in ratio F : C = 1:1 up to 1:2
- Minimal w/c (= water-cement ratio) is 0.23 (necessary for hydration), in practice is the ratio always higher because of workability: cca 0.35 - 0.8 (maximal values according to ČNS EN 206: 0.45 – 0.7 according to the ambient, where will be the concrete placed)
- If the aggregate is wet, we must reduce amount of added water by corresponding value

Methods of detailed design of concrete mixture will not be solved during practical seminars. During lecture is described the method by empirical amount of water in more details. Kennedy's method or Bollomey's method are solved during the practical seminars of Concrete structures.

P2.10 <u>Determine the amount of mixing water,</u> which is necessary to add to product 1 m^3 of concrete to achieve w/c = 0.7. The amount of cement is 400 kg, amount of fine aggregate with moisture content 5% (of mass) is 800 kg and coarse aggregate with moisture content 3.2% (of mass) is 1000 kg ?

P2.11 For production of the reinforced concrete is available fine aggregate with moisture content 4.5 % (of mass) and coarse aggregate with moisture content 3.4 % (of mass). <u>Determine the amounts of fine and coarse aggregate and mixing water</u> for 1m^3 of high-class concrete, such that the resultant w/c is 0.6.