CIV-E4050 Prestressed and Precast Concrete Structures

Examination 21.12.2021 (remote examination using My Course)

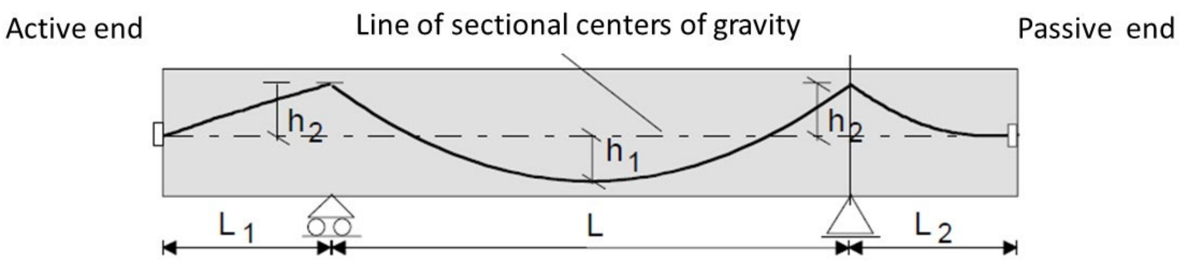
A precondition for the participation in the examination is the fulfilment of compulsory parts of the course in the autumn 2021 or earlier.

Question 1 (altogether 8 p)

Scan your handwritten answers and upload the scanned document as a pdf-file within the period given for this task

Remember to validate your answers. Illustrate your answers with drawings if needed.

1. The figure below represents a prestressed beam. The height of the beam is small compared to its length. The tendon force F can be assumed to constant along the beam axis. The tendon geometry comprises one linear part and two parabolic parts.



Post-tensioned beam

1) $y_1-y_0=a(x_1-x_0)^2$ or $a=(y_1-y_0)/(x_1-x_0)^2$
2) $y=a(x-x_0)^2+y_o$

$$y''(x) \approx q/F$$

a) Using the measurements given in the figure, express the forces that the tendon exerts on the concrete (**3p**). Desribe the forces also by a drawing (**1p**)

b) Define the support reactions caused by the tendon force F (**1p**)

c) Draw the shear force, normal force, and moment diagrams caused by the tendon force F (**2p**)?

d) The tendon geometry is theoretical. How should it be modified at the supports? (**1p**)

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Question 2

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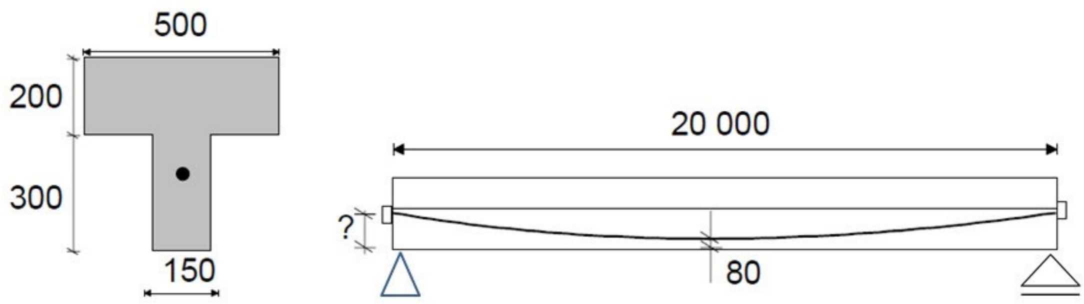
The figure below represents a post-tensioned concrete beam. The dead weight of the beam 3.625 kN/m. The tendon will be designed for balancing the dead weight of the beam assuming that the prestressing losses are 18% in total.



1) $y_1-y_0=a(x_1-x_0)^2$ or $a=(y_1-y_0)/(x_1-x_0)^2$
2) $y=a(x-x_0)^2+y_o$

$$y''(x) \approx q/F$$

a) Determine the tendon geometry and height of the achoring points. (**3p**)

b) Determine the tendon force needed before anchoring the tendon. (**3p**)

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Question 3

Scan your handwritten answers and upload the scanned document as a pdf-file within the period given for this task. (**Althogether 10 p**)

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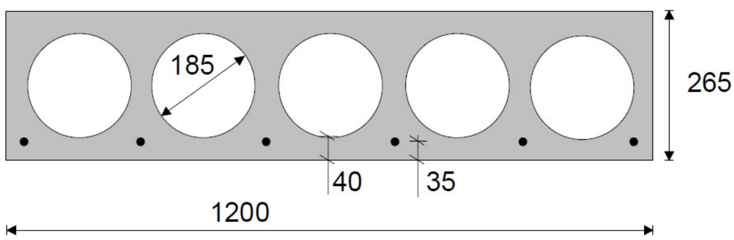
The figure represents a section of a hollow core concrete slab. which has six tendons. Each tendon has a sectional area of 93 mm^2, initial prestressing 1000 MPa, and the modulus of elasticity of 198000 MPa. At the release of the tendon, the design strength of the concrete and the modulus of elasticity of the concrete are 25.5 MPa and 33000 MPa, respectively. The dead weight of concrete is 25 kN/m^3, which includes the mass of the tendons.



Moment of inertia of a circular section is $I=\pi d^4/64$

a) Assuming that prestressing losses are 2%, calculate the effect of the release of the tendons on the stresses on the bottom and top fibers of the section. Consider in the calculation that the values of the modulus of elasticity are different for concrete and tendons (e.g., the method of transformed section). (**4p**)

b) Shortly after the release, the slab will be supported at its ends in a way that its span length is 10 m. Calculate the maximum bending stresses at the middle of the span caused by the dead weight of the slab. (**2p**)

c) Based on the resuls of the items a and b, discuss if the slab is at the risk of bending cracks after the release of tendos. (**2p**)

d) The concrete composite members can be constructed either by using a shored or unshored method. How does the method used influence the response of composite section to the shrinkage of topping layer? (**2p**)