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Advanced Structural Concrete – Exercise 2

(101-0127-00L)

Topics: In-plane loading beams **Deformation capacity and demand**

Hand out: 26. October 2023, HIL E7

1 Dimensioning bases of the exercise

1.1 Introduction

The goal of this exercise is to learn how to verify the deformation capacity of a reinforced concrete structure by evaluating plastic redistributions of internal forces in hyperstatic systems based on the tension chord model and calculating the deformation demand.

An existing building is re-used and needs to be assessed for new additional live load. In this exercise a part of this building needs to be verified. The structure is composed of a clamped beam and a tension member (see Figure 1). A particular focus lies on its deformation demand and deformation capacity.

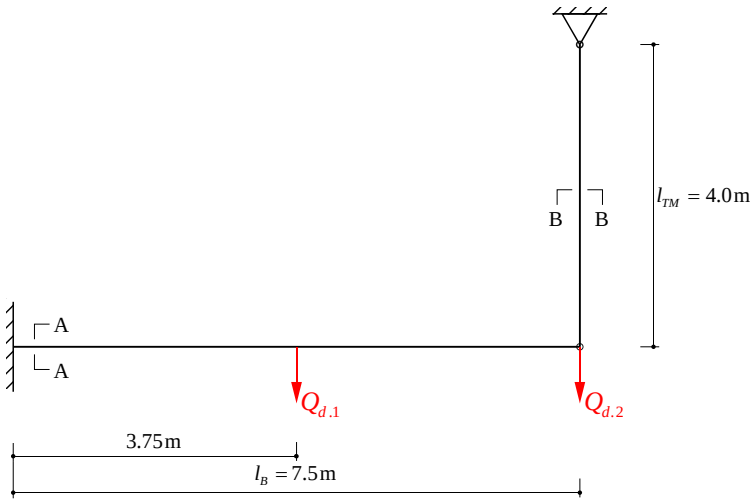

Figure 1: Static system and loads.

1.2 Geometry and material

The dimensions can be taken from Figure 1 and Figure 2. The bending stiffness of the beam and the tensile stiffness of the tension member can be assumed constant over their length and height. Furthermore, the whole structure is expected to be cracked. Concrete C25/30 and reinforcing steel B500B were used for the structure.

1.3 Loads

Two different load scenarios are investigated:

- Load scenario 1: $Q_{d.1} = 300\,\text{kN},\ Q_{d.2} = 0\,\text{kN}$
- Load scenario 2: $Q_{d.1} = 0\,\text{kN},\ Q_{d.2} = 300\,\text{kN}$

1.4 Reinforcement

Figure 2 shows the reinforcement of the structure (c_{nom} = 25 mm). Constructive reinforcement and reinforcement in the compression zone can be neglected. The reinforcement is not curtailed, and sufficient anchorage can be assumed.

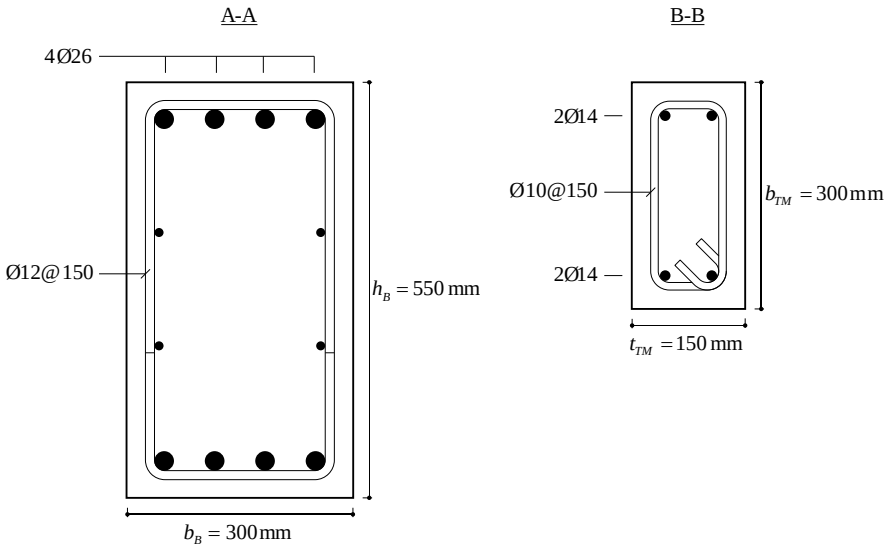

Figure 2: Reinforcement layout and cross-section geometries.

2 Tasks

Verify the bearing capacity of the structure considering the deformation demand and the deformation capacity for:

a) Load scenario 1
b) Load scenario 2

In order to determine the deformation capacity, characteristic material parameters are used for the yield and ultimate reinforcement strength. However, according to SIA 262 (2013) 4.2.2.6 the design strain to rupture should be used, which is more conservative. The rotation capacity is to be analysed according to the detailed investigation method, whereas the strain distribution of the reinforcement can be assumed linear within regime 2 and regime 3. The bearing capacity of a member is determined using a linear elastic – perfectly plastic material model for the reinforcement.

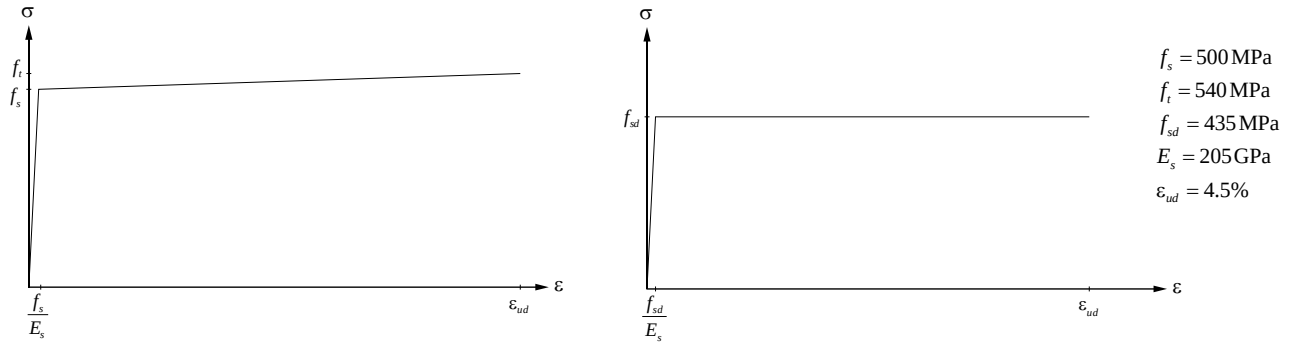

Figure 3: Material models of the reinforcement for deformation capacity (left) and bearing capacity (right).