

Student number: _____
Student name: _____

UNIVERSITY OF TWENTE.

Exam Structure Mechanics 2

Bachelor Civil Engineering 1st year

Module code/name: 202000060-2B M4 B-CE Designing Construction
Course code/name: 202400790 Structural Mechanics 2 (Structural Design part)
Date: 20 June 2025
Time: 8.45-10.45 (+25% for students who may use extra time)
Instructors: Floriana Anselmucci

Type of test: Exercises

INSTRUCTIONS & PRACTICALITIES

- All Rules of Order for Testing as established by the examination board apply to this test. In case of inconsistencies with other rules set by the examiner, the Rules of Order for Testing prevail.
- Please read each question carefully before answering the question.
- All paperwork must be handed in at the end of the test, including scrap paper.
- For answering questions, use the working sheets handed to you. If one sheet is not enough, use the sheet with the text "Continuation of ..." in the top right corner.
- The elaboration of the question must be clear. Show what you do, so use a lot of drawings, sketches, or schemas. Make sure to write/draw your answers in a readable form.

ALLOWED RESOURCES

Allowed material to be used during the exam:

- Scientific calculator (not a communication device)
- Formula sheet
- English-Dutch dictionary
- Pen or/and pencil, coloured pens
- Ruler

Attachments: Formula sheet, Materials tables

Exercise 1 (30 points)

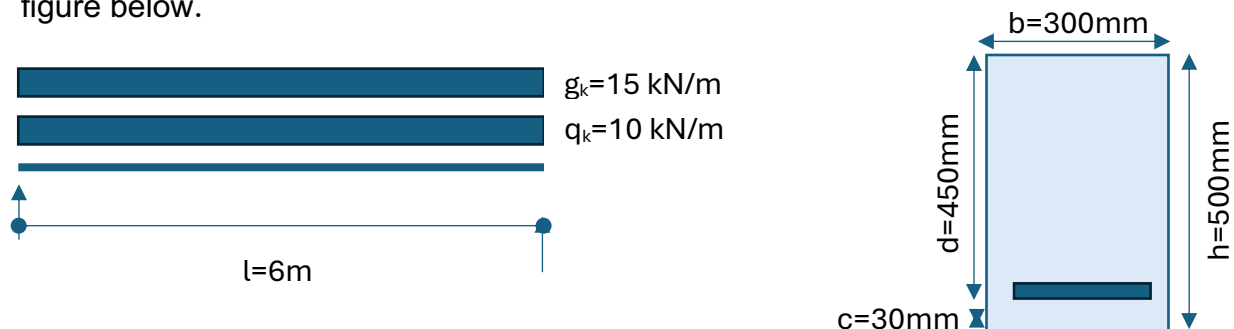
A simply supported beam in S275 steel has a $305 \times 165 \times 40 \text{ kg m}^{-1}$ UB section. The beam is fully laterally restrained and sits on 100 mm bearings at each end. The beam has a span length of 7 m, and it is subjected to a permanent load of 7 kN/m and a variable load of 5 kN/m all over its length. Verify the suitability for bending and deflection under the given loading.

The properties related to the selected sections are:

Depth $d = 307.1 \text{ mm}$, Width $b = 165.1 \text{ mm}$, Flange thickness $t_f = 9.9 \text{ mm}$, Web thickness $t_w = 6.9 \text{ mm}$, Second moment of area: $I_x = 13,900 \times 10^3 \text{ mm}^4$, Plastic modulus $W_{pl,y} = 910 \times 10^3 \text{ mm}^3$, Yield strength $f_y = 275 \text{ N/mm}^2$.

Exercise 2 (45 points)

A simply supported reinforced concrete beam has a span length of 6m, and it is designed with concrete class C25/30 and steel reinforcement B500. The beam is part of a residential building, and it is subjected to a g_k of 15 kN/m and q_k of 10 kN/m. The structure must comply with Eurocode 2. Calculate the needed reinforcement at bending and at shear. The details of the section A-A of the beam are described in the figure below.



Exercise 3 (25 points)

Consider a simply supported reinforced concrete beam in a residential building. The span length of the beam is 8 m and it is subjected to a permanent load estimated to be 12 kN/m, and a combination of variable load of 8 kN/m. The material used for the beam is concrete class C30/37, and steel B500 for the reinforcement. Assume that the beam is cracked and it is subjected to a cracked moment of inertia $I_{cr} = 2.86 \times 10^9 \text{ mm}^4$, and effective Young modulus $E_{eff} = 11000 \text{ N/mm}^2$. After calculating the serviceability load, obtaining the ψ from Table 1, calculate the deflection under quasi-permanent long-term loads of a simply supported reinforced concrete beam and verify if it complies with Eurocode 2 deflection limits.