

Student number: _____
Student name: _____

UNIVERSITY OF TWENTE.

Exam Structural 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: 19 June 2026
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 (45 points)

A simply supported reinforced concrete beam with a span of 7.0 m is designed using concrete class C30/37 and reinforcement steel B500. The beam is part of an underground parking garage and is subjected to a uniformly distributed permanent load of 20 kN/m and a uniformly distributed variable load of 25.32 kN/m. The self-weight of the beam is negligible.

The beam has a rectangular cross-section with a width b of 350 mm, a height h of 500 mm, and a nominal concrete cover c of 30 mm.

1. Design the required bending reinforcement according to Eurocode 2.
2. Design the required shear reinforcement according to Eurocode 2.
3. Sketch the beam cross-section showing the arrangement of the longitudinal reinforcement bars.
4. Sketch the beam cross-section showing the arrangement of the stirrups, clearly indicating the position of all reinforcement.

Exercise 2 (30 points)

A simply supported steel beam with brittle finish, UB 533x210x101 kg/m (steel grade S275), has a span of 10 m, and a flexural rigidity EI_x equal to $1.29 \times 10^5 \text{ kNm}^2$. The beam is subjected to the following uniformly distributed loads: g_k of 10 kN/m, q_k of 7 kN/m, and a self-weight of 1 kN/m. Assume that the beam is fully restrained against lateral-torsional buckling.

After verifying the beam's bending resistance, calculate the maximum vertical deflection and check whether it complies with the serviceability requirements of Eurocode 3.

Exercise 3 (25 points)

Design a simply supported plastered timber beam with a rectangular cross-section for a roof with a plastered ceiling. The beam is made of C24 solid timber in Service Class 2, with a span of 7.0 m, a permanent load (including the beam self-load) of 10.0 kN/m, and a variable long-term load of 1.5 kN/m. The beam dimensions are: width $b = 40$ mm, height $h = 150$ mm. Consider for a C24 timber a $E_{0,\text{mean}} = 11 \text{ kN/mm}^2$. Check the beam for deflection according to Eurocode 5, considering if needed a $\psi_2 = 0.6$.