Course Specifications
Valid as from the academic year 2020-2021

Structural Analysis Calculation Techniques II (E711028)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size (nominal values; actual values may depend on programme)
Credits 6.0 Study time 180 h Contact hrs 60.0 h

Course offerings and teaching methods in academic year 2020-2021
A (semester 2) Dutch Gent lecture 36.0 h

Lecturers in academic year 2020-2021
Vandedrinck, Frank TW14 lecturer-in-charge

Offered in the following programmes in 2020-2021

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<th>Programme</th>
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<td>Bachelor of Science in Engineering Technology (main subject Civil Engineering Technology)</td>
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<td>Linking Course Master of Science in Civil Engineering Technology</td>
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Teaching languages
Dutch

Keywords
Statically determinate and indeterminate structures; lines of bending moments, shear forces,..., stress and strength; theorems of Mohr and Greene; virtual work; Clapeyron; Transference Method, Displacement Method.

Position of the course

PART 1:
This course is intended to provide the student with the theory and application of structural analysis as it applies to beams and frames for also dead and live loads (calculate influence lines).
Analysis of indeterminate structures under dead loads.
Developing the students ability to both model and analyze a structure and to provide realistic applications encountered in professional practice.

PART 2:
Translation of structural analysis problems into mathematical models, to be programmed easily and allowing the design of complex structures.
The study of the mathematical analysis of the calculation techniques leads to the acquisition of new insights.
The student will understand
- how to select the (most) suitable calculation technique;
- the applicability, effectiveness and restrictions of the treated calculation techniques;
- how to implement the advanced calculation techniques in an appropriate way, in order to determine the behaviour of the structure as a whole, as well as the interaction between the structural components and elements.

Contents

PART 1:
Study of calculation techniques for statically definite and indefinite load bearing structures.
Virtual work as a displacement method of analysis:
Calculation of the displacements of nodes for statically definite and indefinite linear structures and frames, by using the load-displacement relations and (in case of indefinite) the compatibility equations.

(Approved)
The analogies of Mohr and the theorems of Greene as displacement calculation techniques available for linear structures and frames.
Method of Clapeyron, a calculating technique for analyzing the forces in structural members of static non determinate constructions (linear structures and frames) due to dead or fixed loads. The method is used for non-displaced joints.
General methods for the analysis of indeterminate structures. Practical exercises based on the calculation techniques from above. Indications to determine and apply the calculation method that is best suited for a given load bearing system.

PART 2:
1. Introduction
   Summary of analytical and numerical calculation methods available to determine the internal distribution of stresses and the deformation of hyperstatic structural frames; Adjustment techniques; Gehler’s Method; Equilibrium of a deformable structure and its components; Virtual work; Theorems of Mohr, Greene and Betti-Maxwell.
2. Transference method
   Single and continuous beams;
   Vector of state; matrices for zones, nodes, fields and girders;
   Enveloped lines for bending moments, shear forces, linear and angular displacement in hyperstatic systems; Boundary conditions; Hinge points; Rigid vs. elastic supports; Curvilinear girders.
3. Displacement method
   Frameworks, plane frames and 3D-frames, grid structures;
   Degrees of freedom;
   Displacement vector and bar force vector;
   Matrices for transformation, rigidity and equilibrium;
   Principal equation; Arithmetical processes; Nodal numbering; Load application outside the nodes.

Initial competences
   The student must have basic knowledge and insight into the general principles of equilibrium of structures.
   He/she must be able to determine and interpret the internal forces - i.e. bending moments, shear forces and normal forces - in beams and columns, and the related stresses and deflections caused by dead loads in static determinate and a few indeterminate structures.
   He/she must have developed skills with respect to the calculation of the internal forces of simple loadbearing structures or structure components.
   See the final competences of STERKTELEER and BOUWKUNDIGE REKENTECHNIEKEN I.

Final competences
   1 The student implements the Displacement Method in a correct and efficient way on 2D- and 3D-frame structures on rigid and/or elastic supports, under different kinds of loads;
   2 The student determines the reactions and internal forces in and the deformations and displacements of continuous beams under well defined load combinations, by applying the Transference Method;
   3 The student has full comprehension of the building stones of the calculation techniques: Transference matrices for zones, nodes, fields and beams; Vector of state; matrices simulating the behaviour of elastic supports; Kinematic degree of freedom of a structure; Displacement vector and bar force vector; Matrices for transformation, stiffness and equilibrium.
   4 The student can implement Mohr’s and Greene’s Theorem to determine the deformation and nodal displacements of continuous beams and hyperstatic frames under simple loads;
   5 The student has good insight in the relation between Virtual Work and the Theorems of Mohr, Greene and Betti-Maxwell, both methods to calculate displacements.
   6 The student knows how to select the (most) suitable calculation technique;
   7 The student has insight in the applicability, the effectiveness and the restrictions of the treated calculation techniques for the structural analysis of more complex loadbearing structures;
   8 Mathematical analysis of the calculation technique of the Transference Method, applied on both straight and curvilinear continuous beams on rigid or elastic supports.
   9 The student implements the advanced calculation technique in an appropriate way, in order to determine the behaviour of the structure as a whole, as well as the interaction between the structural components and elements.

Conditions for credit contract
   Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

(Approved)
This course unit cannot be taken via an exam contract

Teaching methods
Lecture, seminar, online lecture, online lecture: plenary exercises, online seminar, online seminar: coached exercises

Extra information on the teaching methods
Classroom and online lectures: 36h
Online problem solving sessions, interactive facilities: 24h
Next to the classical lecture and exercises, the following active learning methods are used: flipped classroom: students are expected to self-study parts of the course and make some initial exercises, selftests via the digital learning environment of UGent

Learning materials and price
Teacher's course (Dutch language): digitally available for free; Supplementary courseware, calculation examples and exercises are also available for free on the e-learning platform

References
See references teacher's course and supplementary courseware

Course content-related study coaching
1. Guidance and coaching bij lecturer and assistant: Possibility to obtain individual explanation in case of any problem;
2. E-learning platform: Students can visit an electronic workspace for supplementary courseware and exercises and possible examination questions.

Evaluation methods
end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period
Written examination with open questions

Examination methods in case of periodic evaluation during the second examination period
Written examination with open questions

Examination methods in case of permanent evaluation
Participation, skills test

Possibilities of retake in case of permanent evaluation
examination during the second examination period is possible

Extra information on the examination methods
End-of-term evaluation (theory): written examination;
Continuous assessment (practice): 2 or 3 written skill tests.

Calculation of the examination mark
Theory (oral exam): 67%
Practice (written skill tests): 33%
The assessment and the final assignment of quotas of course components happens by means of the mathematical average according to the apportioned coefficients.
When the student does not participate in the evaluation of one or more components or the student scores less than 8/20 for one of the components, he/she can no longer pass the entire course unit. If the total score is a mark of ten or more out of twenty, then this is reduced to the highest failing mark.

(Approved)