Course description

Department/Unit /	KME / TFA1			**Academic Year**	2023/2024
Title	Technic. and Physic. Analys. of Struc. 1			**Type of completion**	Exam
Long Title	Technical and Physical Analysis of Structures 1				
Accredited/Credits	Yes, 5 Cred.			**Type of completion**	Combined
Number of hours	Lecture 3 [Hours/Week] Tutorial 2 [Hours/Week]				
Occ/max	Status A	Status B	Status C	**Course credit prior to**	YES
Summer semester	18 / -	0 / -	1 / -	**Counted into average**	YES
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	10
Timetable	Yes			**Repeated registration**	NO
Language of instruction	Czech			**Semester taught**	Summer semester
Optional course	Yes			**Internship duration**	0
Evaluation scale	1|2|3|4			**Ev. sc. – cred.**	S|N
No. of hours of on-premise					
Auto acc. of credit	Yes in the case of a previous evaluation 4 nebo nic.				
Periodicity	K				
Substituted course	None				
Preclusive courses	N/A				
Prerequisite courses	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	N/A				

Course objectives:

Student will be acquainted with the principles of design of structures according to ČSN EN 1990, limit states of bearing capacity and usability, load combinations, reliability management, application of load of building structures according to ČSN EN 1991, application of principles of design of geotechnical structures according to EN 1997 and principles of design of earthquake resistant structures, finite method. elements, principles and basic types of finite elements.

Requirements on student

Requirements for credit:
Student will create semester task in a satisfactory quality and successfully pass the written test.

Requirements for exam:
Student will demonstrate adequate knowledge of semester subject and skills of its application in context.

Content

1. Principles of structural design. Development of design methods. Eurocode system. Validity and binding nature of standards. Principles of structural design according to ČSN EN 1990. Basic requirements. Lifespan. Design situations. Basic quantities. Limit states. Partial factor method. Combination of loads for ultimate limit states and serviceability. Applicability criteria. Reliability differentiation.

2. Constant and payload loads. Self weight, permanent and payloads. Examples of determining the effects of loads on basic load-bearing elements. Load due to snow, icing, temperature. Water load. Wind load. Other types of loads. Loads during execution, loads on cranes, loads on traffic.

3. Temperature loading of buildings, temperature field, stationary and non-stationary temperature profiles in structures, stress of building structures by temperature changes. Interaction of load-bearing structure and thermal insulation in conditions of cyclic temperature changes. Thermal expansion of materials, sandwich constructions in conditions of cyclic temperature changes.

4. Principles of designing geotechnical structures. Basic quantities. Load combinations. Determination of load and resistance effects.

5. Influence of structural stiffness on its stress by temperature changes. Stressing of structural elements and their joints by non-force effects. Building physical and fire safety of sandwich building structures. Influence of uneven settlement of buildings on the stress of building structures. Analysis of the interaction structure - foundations - subsoil. Influence of material strength, modulus of elasticity of material, stiffness of structure and coefficients of longitudinal expansion of material on the reliability of building structures.

6. Extra loads. Strategies for emergency design situations. Categorization of structures into reliability classes. Principles of structural robustness. Load due to vehicle impact, gas explosion, charge explosion. Principles of calculating the response of building structures. Dynamic loads. Equivalent static loads. Load combinations.

7. Seismic loads. Seismic regions, classification of earthquakes according to macroseismic scales, Richter scale, design acceleration, elastic response spectra. Simplified and 3D computational procedures, dissipative properties and their use, damping of the structure, combination of seismic load cases.

8. Introduction to the calculation of building structures by the finite element method, basic types of finite elements, design principles, bar structures, lattice structures, frame structures, the effect of joint stiffness on internal forces, density of division.

9. Stability of bar structures, spatial stiffening, stiffening elements, division density, grate modeling, internal forces, modeling of planar structures - walls, internal forces, dimensional internal forces of the singularity of an elastic solution.

10. Modeling of planar structures - slabs, internal forces, dimensional internal forces, boundary phenomena, singularities of elastic solutions, modeling of reinforcements of planar structures.

11. Modeling of column supports, evaluation of internal forces, dimensioning internal forces, modeling of the interaction of foundation structures with the subsoil, soft and rigid subsoil, types of subsoil.

12. Introduction to nonlinear calculations using the finite element method, types of nonlinearities.

13. Introduction to dynamic calculations using the finite element method, basic problems of dynamics.

Fields of study

Guarantors and lecturers

- **Guarantors:** Ing. Luděk Vejvara, Ph.D.
- **Lecturer:** Ing. Jan Kubát, Ph.D. (15%), Ing. Libor Kubina, CSc. (15%), Ing. Michal Novák, Ph.D. (15%), Ing. Luděk Vejvara, Ph.D. (55%)
- **Tutorial lecturer:** Ing. Jan Kubát, Ph.D. (50%), Ing. Michal Novák, Ph.D. (50%)

Literature

- **Basic:** *ČSN EN 1990. Zásady navrhování konstrukcí.*.
- **Basic:** *ČSN EN 1991.Zatížení konstrukcí (část 1-1, 1-2,1-3,1-4)*.
- **Basic:** Holický, Milan; Marková, Jana. *Zásady navrhování stavebních konstrukcí : příručka k ČSN EN 1990*. 1. vyd. Praha : Informační centrum ČKAIT, 2007. ISBN 978-80-87093-27-6.
- **Recommended:** *ČSN EN 1994. Navrhování spřažených ocelobetonových konstrukcí*.
- **Recommended:** *ČSN EN 1997. NAvrhování geotechnických konstrukcí.*.
- **Recommended:** *ČSN EN 1998. Navrhování konstrukcí odolných proti zemětřesení*.
- **Recommended:** Z.Bittnar,J.Šejnoha. *Numerické metody v mechanice I.*
- **Recommended:** Šejnoha. *Numerické metody v mechanice I.*.
- **Recommended:** V. Kolář. *Principy a praxe metody konečných prvků.*.
- **Recommended:** Černín, Milan; Makovička, D.; Janovský, D. *Příručka protivýbuchové ochrany staveb*. V Praze : Česká technika - nakladatelství ČVUT, 2008. ISBN 978-80-01-04090-4.
- **Recommended:** Procházka J. *Technická pravidla ČBS 01 Statické výpočty*. ČBS Servis, s. r.o., 2006.
- **Recommended:** Technicko-fyzikální analýza staveb. *Technicko-fyzikální analýza staveb*. ČVUT Praha, 1990.
- **Recommended:** Krňanský J. a kol. *Technicko-fyzikální analýza staveb ? pomůcka pro cvičení*. ČVUT Praha, 1991.
- **Recommended:** Studnička J., Holický M., Marková J. *Zatížení*. ČVUT, 2010. ISBN 978-80-01-03768-3.

- **Recommended:** Holický M., Marková J., Sýkora M. *Zatížení stavebních konstrukcí*. Příručka k ČSN EN 1991. 258. publikace ČKAIT Praha 2010, 1991. ISBN 978-80-87093-89-4.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Contact hours	65
Preparation for comprehensive test (10-40)	12
Preparation for an examination (30-60)	32
Undergraduate study programme term essay (20-40)	20
Total:	**129**

assessment methods

Knowledge - knowledge achieved by taking this course are verified by the following means:

Seminar work

Combined exam

Test

Skills - skills achieved by taking this course are verified by the following means:

Written exam

Seminar work

Skills demonstration during practicum

Competences - competence achieved by taking this course are verified by the following means:

Written exam

Seminar work

prerequisite

Knowledge - students are expected to possess the following knowledge before the course commences to finish it successfully:

be familiar with building structures

to know the basics of structural mechanics and the theory of elasticity

to know the terminology of load-bearing and non-load-bearing structures of buildings

to know mathematical functions and operations, trigonometric and exponential functions

to know the structural systems of buildings

Skills - students are expected to possess the following skills before the course commences to finish it successfully:

to determine the internal forces arising in the elements of building structures with regard to the character of the loadings effects

to understand construction drawings - layouts, sections, technical views

to characterize the structural system of the building

Competences - students are expected to possess the following competences before the course commences to finish it successfully:

N/A

N/A

N/A

N/A

teaching methods

Knowledge - the following training methods are used to achieve the required knowledge:

Lecture

Practicum

Individual study

Self-study of literature

Discussion

Skills - the following training methods are used to achieve the required skills:

Lecture

Practicum

Self-study of literature

Individual study

Discussion

Competences - the following training methods are used to achieve the required competences:

Lecture

Practicum

Individual study

Self-study of literature

Discussion

learning outcomes

Knowledge - knowledge resulting from the course:

be familiar with the load types of buildings

to know the types of random, climatic and extraordinary loads

to know the procedures for determining the self-weight of the building and their structures

to know the procedures for determining of combinations of loads types

to know the effects of different types of loads on building structures

Skills - skills resulting from the course:

to create a computational model of the building structure

to analyze and evaluate the consequences of the interaction of the system "structure - foundations - subsoil"

to determine the load combinations for the limit state of ultimate and serviceability

to determine the load combinations of extraordinary effects (e.g. fire, impact of vehicle etc.)

to apply the finite element method in simulating the behaviour of building structures

to analyze the consequences of the effects of loads on the buildings structures

Competences - competences resulting from the course:

N/A

N/A

N/A

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Stavební inženýrství - Pozemní stavby	Bachelor	Full-time	Stavební inženýrství - Pozemní stavby	1	2023	2023	Povinné předměty	A	2	LS
Stavební inženýrství - Pozemní stavby	Bachelor	Full-time	Stavební inženýrství - Pozemní stavby	1	2021 akr	2023	Povinné předměty	A	2	LS