Appendix B-6: Design of Reinforced Concrete Structure Syllabus

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Design of Reinforced Concrete Structure Syllabus

Course title	Design of reinforced concrete Structure					Course number	9031113091
Applicable specialties	Civil Engineering (construction engineering direction ☑ road and bridge direction☐ urban rail transit direction☐)						
Nature of the course	General education courses ☐ subject foundation courses ☐ professional core courses (elective☐ required☑) autonomous development courses (required☐ elective ☐) concentrated practice courses☐						
Unit offering the course	School of Civil Engineering						
total class hours	105	credit	3.5	Contact hours	56	Self-study hours	49
Prerequisite courses	Civil engineering materials, structural mechanics, material mechanics, principles of concrete structure design						
Textbooks and so on teaching materials	Course materials: Shen Puseng. Concrete structure design [M]. Beijing: Higher Education Press, 20 20 Reference: Shi Qingxuan. Design of Concrete Structures [M]. Beijing: China Architecture & Building Press, 2016 Chen Bowang. Concrete structure design [M]. Changsha: Hunan University Press, 2016						

1. Course introduction

"Concrete Structure Design" is an essential core course in the architectural engineering direction of Civil Engineering. It is a follow-up to the principles of concrete structure design and is a required core course that integrates theory with practice in the architectural engineering direction of Civil Engineering. The main content includes the design calculations and construction principles of reinforced concrete beam and slab structures, reinforced concrete portal frame structures, and reinforced concrete frame structures. Through various teaching activities, students will master the basic knowledge of concrete structures, be able to design reinforced concrete structures, and develop their ability to design individual project structures and draw construction plans. This course lays a necessary foundation for future work in designing and researching complex structures, equipping students with the essential qualities and capabilities required for careers related to concrete structures. It is an applied

and practical course that integrates knowledge from mathematics, engineering mechanics, architecture, and civil engineering materials.

2. The graduation requirements supported by this course and the path to achieve them

(1) The graduation requirements that this course can support

Number	Graduation requirement indicators	Specific content of graduation requirement indicators
1	Graduation requirements 1.3	Be able to use civil engineering professional knowledge and other knowledge to analyze, model and solve complex civil engineering problems, and have the ability to compare and synthesize solutions.
2	Graduation requirement 5.2	Be able to use modern tools to analyze, calculate and design complex civil engineering problems, and be able to analyze the effectiveness and limitations of the results.
3	Graduation requirements 6.1	Familiar with the standards, policies and laws and regulations related to civil engineering professions and industries, and understand the impact of different social cultures on engineering activities.
4	Graduation requirements 12.2	Have the ability of independent learning, including the ability to understand technical problems, summarize and summarize, and ask questions, so as to adapt to the new development of civil engineering industry.

(2) The implementation path of graduation requirement indicators in this course

1. Course objectives

Through the theoretical teaching of this course, students will have basic knowledge and ability. The specific course objectives are as follows:

Course objective 1: Master the design knowledge of beam and slab structure, frame structure and row frame structure, be able to use the learned knowledge to analyze, model and solve complex civil engineering problems, and compare and synthesize solutions.

Course objective 2: Be able to use structural software for layout and modeling of structures, calculation and analysis. Be capable of employing modern tools to analyze, calculate, and design complex civil engineering problems, and be able to analyze the validity and limitations of the results.

Course objective 3: Be able to compare design schemes, prepare structural calculation books, master the relevant rules for reading and drawing according to the flat method,

understand the requirements for expressing structural construction drawings, be familiar with standards, policies, and laws and regulations related to civil engineering professions and industries, and understand the impact of different social cultures on engineering activities.

Course objective 4: Master basic knowledge through pre-class preview, be able to discuss difficult problems in the study group, and effectively communicate with group members and teachers, strengthen comprehensive ability training, have the ability of independent learning, including the ability to understand technical problems, summarize and summarize, and put forward questions, and be able to adapt to the new development of civil engineering industry.

2. The corresponding relationship between the course teaching objectives and the graduation requirements indicators

Graduation requirement indicators	Course teaching objectives
Graduation requirements 1.3	Course Objective 1
Graduation requirements 5.2	Course objective 2
Graduation requirements 6.1	Course objective 3
Graduation requirements 12.2	Course objective 4

3. Expected learning results and details of teaching links

(1) Intended Learning Outcomes

The intended Learning Outcomes of this course are:

knowledge cell	knowledge point	Initial level	Requirement level	Intended learning outcomes	corresponding program objective
introduction	cognitive construct	L1	L2	1. Correctly state the general procedure and content of concrete structure design and be able to distinguish the applicable scope of concrete structure analysis methods.	Course Objective 1 Course objective 4
Beam and slab structure	Floor structure layout	L2	L3	2. Explain the classification, advantages and disadvantages of concrete floor cover, and the application range. Arrange the floor structure and apply the high span	Course Objective 1 Course objective 4

knowledge cell	knowledge point	Initial level	Requirement level	Intended learning outcomes	corresponding program objective
design				ratio to estimate the section size of beams and slabs.	
	Schematic diagram of one-way plate calculation	L2	L3	3. Correctly divide the calculation unit, calculate the load, and draw the calculation diagram.	Course objectives 1 and 4
	Internal force combination of one-way plate	L2	L3	4. The internal forces of the one-way slab rib beam floor are calculated and analyzed by the application of elastic and plastic theory, and the internal forces are combined according to the load code.	Course Objective 1 Course objective 3 Course objective 4
	Construction drawing of cast-in-place floor slab with single direction	L2	L3	5. Draw the construction drawings of beam and slab structure by applying the flat drawing rules and construction drawing preparation documents.	Course Objective 1 Course objective 3 Course objective 4
	Bidirectional plate design	L1	L2	6. Apply the theory of elasticity and plasticity to calculate and analyze the internal forces of two-way plate ribbed beam floor and carry out the design, and understand the basic principle of plastic cable method.	Course Objective 1 Course objective 4
Framework structure design	Framework structure layout and load calculation	L2	L3	7. Arrange the framework structure according to the basic principles, estimate the section size of beams, slabs and columns, draw the calculation diagram of the framework structure, and correctly calculate the load on the framework structure.	Course Objective 1 Course objective 2 Course objective 4
	Combination of internal forces in frame structure	L1	L2	8. Calculate internal forces, distinguish the advantages and disadvantages of several methods of calculating internal forces and their application range, and apply the load code to combine the most unfavorable internal forces in the control section.	Course objectives 1 and 4
	Adjust the internal force of the frame structure	L1	L2	9. Adjust the internal force in the frame according to the principle and method of internal force adjustment.	Course Objective 1 Course objective 4

knowledge cell	knowledge point	Initial level	Requirement level	Intended learning outcomes	corresponding program objective
	Seismic design of frame structure	L1	L2	10. Apply the principles and specifications of concrete structure design to calculate the reinforcement of frame structure and meet the construction requirements, and apply the basic knowledge of seismic design to design frame structure.	Course Objective 1 Course objective 4
	Framework structure construction drawing	L2	L3	11. Structural software modeling can be used to draw structural construction drawings according to the computer results.	Course Objective 1 Course objective 2 Course objective 4
	Read construction drawings of multi-story and high-rise structures	L1	L2	12. Apply the rules of plane drawing and structural design knowledge to understand the construction drawings of frame structures.	Course Objective 1 Course objective 4
Pile frame structure design	Pile frame selection and structural layout	L1	L 2	13. Correctly understand the structure composition of single-story factory buildings, arrange column grid, deformation joints, supports and enclosure structures, and apply industrial factory standard drawings to select component selection and section size.	Course Objective 1 Course objective 4
	Pile load calculation	L1	L3	14. Understand the load transmission route, calculate the load on the frame, and draw the frame calculation diagram.	Course Objective 1 Course objective 3 Course objective 4
	Combination of internal forces in the frame	L2	L3	15. Calculate the internal force of the frame and apply the principle of internal force combination to combine the internal force of the frame.	Course Objective 1 Course objective 3 Course objective 4
	Cow leg design	L1	L 2	16. Reasonably design the frame columns and bull legs, and meet the relevant construction requirements.	Course Objective 1 Course objective 3

knowledge cell	knowledge point	Initial level	Requirement level	Intended learning outcomes	corresponding program objective
					Course objective 4
	Seismic design of frame structure	L1	L2	17. Design the frame structure with the basic knowledge of seismic design.	Course Objective 1 Course objective 4
	Construction drawing of frame structure	L 1	L 2	18. Draw the construction drawings of the frame structure by applying the flat drawing rules and construction drawing preparation documents.	Course Objective 1 Course objective 3 Course objective 4

（2）Detailed rules for teaching

content of courses (blocks of knowledge)	teach school class hour	Expected Learning Outcomes (ILO)	Implementation link	Instructional strategies
introduction	2	1. Correctly state the general procedure and content of concrete structure design and be able to distinguish the applicable scope of concrete structure analysis methods.	Study outside of class In-class instruction/testing	lecture Problem-oriented guidance practise
Beam and slab structure design	16	2、This paper describes the classification, advantages and disadvantages of concrete floor, application scope, layout of floor structure and application of high span ratio to estimate the section size of beam and slab. 3、Correctly divide the calculation unit, calculate the load, draw the calculation diagram. 4、The internal forces of the one-way slab rib beam floor are calculated and analyzed by using the theory of elasticity and plasticity, and the internal forces are combined according to the load code. 5、The construction drawing of beam and slab structure is drawn by applying the flat mapping rules and construction drawing preparation documents. 6、The elastic and plastic theory is applied	Study outside of class In-class lectures/practice/test after-class assignments	lecture autonomic learning flipped classroom Task-driven

content of courses (blocks of knowledge)	teach school class hour	Expected Learning Outcomes (ILO)	Implementation link	Instructional strategies
		to calculate and analyze the internal forces of two-way slab rib beam floor and design, so as to understand the basic principle of plastic twisting method.		
Design of multi-layer and high-rise frame structures	20	7、The framework structure will be arranged according to the basic principles, the section size of beams, slabs and columns will be estimated, the calculation diagram of the framework structure will be drawn, and the load on the framework structure will be correctly calculated. 8、The internal forces in the calculation frame are calculated, and the advantages and disadvantages and application scope of several internal force calculation methods are distinguished. The most unfavorable internal forces in the control section are combined according to the load code. 9、The internal force of the frame is adjusted according to the principle and method of internal force adjustment. 10、The reinforcement of frame structure is calculated according to the principles and specifications of concrete structure design, and the basic knowledge of seismic design is applied to design frame structure. 11、Using structural software modeling, it can draw structural construction drawings according to the computer results. 12、Understand the structural construction drawing by applying the rules of flat mapping and structural design knowledge.	Study outside of class In-class lectures/practice/test after-class assignments	lecture autonomic learning flipped classroom Task-driven
Design of single-storey factory structure	18	13、Correct understanding of the structure composition of single-story factory buildings will enable the arrangement of column grid, deformation joints, supports and enclosure structures, and the application of industrial factory standard drawings to select component selection and section size. 14、Understand the load transmission route, calculate the load on the frame, and draw the frame calculation diagram. 15、Calculate the internal force of the frame	Study outside of class In-class lectures/practice/test after-class assignments	lecture autonomic learning flipped classroom Task-driven

content of courses (blocks of knowledge)	teach school class hour	Expected Learning Outcomes (ILO)	Implementation link	Instructional strategies
		and apply the principle of internal force combination to combine the internal force of the frame. 16、The frame columns and bull legs should be reasonably designed to meet the relevant construction requirements. 17、The basic knowledge of seismic design is applied to design the frame structure. 18、The construction drawing of the frame structure is drawn by applying the flat drawing rules and construction drawing preparation documents.		

4. Course assessment (Assessment Scheme)

(1) Course assessment structure

Examination items		Scale	Content of examination	Evaluation mode
usual performance	process control	10%	Teachers evaluate 70% Students evaluate each other 30%	The evaluation of students participation in the learning of teaching resources, discussion, classroom performance and so on; students evaluation of group members learning attitude and learning effect.
	In-class test	20%	All the knowledge points	The test is mainly based on objective questions, using the Blue Ink Cloud platform or other ways for online classroom testing.
	cooperative project	30%	Hand calculation book of beam and slab structure, computer modeling of frame structure Hand calculation book of frame structure	In combination with the course design task, compile the calculation book of beam and slab structure course design, one person one problem; use modern tools such as Yingjianke or PKPM to complete the computer model of frame structure; in combination with the course design task, compile the calculation book of frame structure course design, one person one problem.
final		40%	Core knowledge points	The test is mainly based on registered engineers, focusing on assessing students comprehensive analytical ability to meet industry needs.

Note: When the final grade is lower than 5 0 points, the regular grade composed of process assessment, in-class test and cooperative project shall be calculated at no more than 60 points.

(2) Course assessment details:

Assessment items		Primary coverage	
		Knowledge units/points	**Ability items**
school assignment		All the knowledge points	1. Independent learning ability; 2. Application ability of modern tools; 3. Industry standard reading and application ability; 4. Communication skills.
In-class test		All the knowledge points	This is an objective question, all of which are tested in terms of knowledge
cooperative project	Hand calculation book of beam and slab structure	Beam and slab structure design	To examine students ability to apply concrete structure design knowledge, consult industry standards, policies and laws and regulations, and effectively express the analysis process and conclusions of beam and slab structure.
	Framework structure computer modeling	Design of multi-layer and high-rise frame structures	To examine students ability to use modern tools to model and calculate the framework structure, and to analyze the effectiveness and limitations of the results.
	Hand calculation book of frame structure	Design of single-storey factory structure	To examine students ability to use concrete structure design knowledge, consult industry standards, policies and laws and regulations, and effectively express the analysis process and conclusions of the frame structure.
final		Beam and slab structure design Framework structure design Design of single layer industrial plant Read the map in plan view	The test uses subjective questions with engineering background to focus on assessing students ability to use their knowledge to comprehensively analyze and deal with problems.

5. The tasks undertaken in the cultivation of the ability to solve complex engineering problems

The course covers the basic theories of beam and slab structures, frame structures, and

portal frame structures. Students will master the principles, methods, and steps of structural design. They will be able to construct models, solve problems, and conduct comparative analyses when addressing complex civil engineering issues. They will also be proficient in using structural software for layout and modeling, as well as for calculations and analyses. Additionally, they will understand the requirements for structural construction drawings based on the relevant rules of planar representation and drawing preparation. Familiarity with standards, policies, and laws and regulations related to civil engineering professions and industries is also emphasized.

6. Non-technical ability training and observation

Through pre-class preview to master basic knowledge, discuss difficult problems in the study group, and effectively communicate with group members and teachers to strengthen comprehensive ability training and cultivate students ability to learn independently and adapt to the development needs of the industry.

The scores of teachers evaluation in the process assessment and students self-evaluation, as well as the scores of group self-evaluation and mutual evaluation in the project assignment are the main observation points, supplemented by other methods such as questionnaires.

7. Course ideological and political design

The course on concrete structure design is a core course in the geotechnical engineering major. To better enhance students comprehensive qualities, strengthen their ideals and beliefs, improve their moral cultivation, and further foster their patriotism, scientific spirit, and craftsmanship, the course team has made efforts to explore ideological and political content within the course, develop teaching cases for ideological and political education, innovate teaching methods, and focus on designing an ideological and political education system, building a case library for ideological and political education, and innovating teaching models for ideological and political education.

Course Ideological and Political Design: ① By strictly regulating behavior, preparing

lessons diligently, delivering content proficiently, and grading assignments conscientiously, students are set an example in their conduct, serving as role models for teachers, and conveying the spirit of dedication to ones job; ② Through explaining engineering cases and outstanding figures in Chinas construction sector, students patriotic sentiments are deepened, cultural confidence is enhanced, and a sense of national pride is cultivated; ③ By introducing the development process and typical cases of concrete structure design in China, as well as innovative technologies in scientific research and practical engineering cases related to hollow floor slabs, composite floor slabs, composite floor slabs, and recycled concrete floor slabs; by introducing innovative technologies in scientific research and practical engineering cases related to steel-concrete composite columns, prefabricated modular concrete structures, and prefabricated modular composite structures, students are encouraged to be innovative and strive for excellence, fostering a scientific spirit and an innovative mindset; ④ By introducing teachers work in concrete structure design, concrete structure testing and evaluation, and research on seismic resistance of prefabricated modular structures, students are inspired to have a spirit of hard work and continuous academic advancement, stimulating their interest in scientific research; ⑤ By introducing typical accident cases of beamless floor slabs and industrial buildingsEngineering accident cases and typical engineering accident cases of concrete multi-story and high-rise structures are introduced to improve students sense of responsibility and strengthen their engineering ethics quality.

In the teaching approach, a blended online and offline method is adopted, with students at the center. The "Cloud Classroom" intelligent mobile teaching platform is used to control the teaching process. Before class, study groups are formed → learning requirements are set, specifying the background knowledge to be familiarized and the skill objectives to be achieved → fragmented low-level learning resources are released for students to reference → group tasks are assigned, urging group members to assist in their studies → pre-class Q&A sessions address issues encountered during self-study, leading to corresponding adjustments in offline teaching. During class, the teaching is meticulously organized, with lectures focusing on "solving engineering problems," logically reconstructing fragmented knowledge to apply it in engineering practice and subtly training students engineering thinking. At the same time,

through classroom tests, brainstorming, group competitions, flipped classrooms, and active participation in answering questions, cooperation and interaction are promoted, fostering mutual competition and enhancing students communication skills. After class, online discussions continue, and comprehensive assignments are given, completed by groups, which not only helps students consolidate and improve existing learning outcomes but also enhances their ability to analyze and solve problems as they work on them.

Construction of teaching case library for ideological and political education in courses: In the teaching process, the course team collects teaching cases in concrete structure construction, such as outstanding figures, major projects, typical accidents, classic theories, scientific research innovation and technological innovation, etc., according to the ideological and political education goals of the course, and always integrates ideological and political education throughout the whole teaching process.

8. Course evaluation and continuous improvement mechanism

(1) Course evaluation

The course evaluation cycle is set to evaluate once per teaching cycle, and the achievement of course objectives is evaluated.

The achievement of course objective 1 is evaluated by in-class test, final exam and major assignment.

The achievement of Course Objective 2 will be comprehensively evaluated by the cooperative project 2 (Framework Structure Computer Modeling). The task requires students to complete the specified building structure layout, component section size estimation, load input, internal force calculation, and analysis of structural computer results using structural calculation software such as Revit, Yinguankai, and PKPM.

The achievement of Course Objective 3 is comprehensively evaluated through Cooperative Project 1 (Hand Calculation Book for Beam and Slab Structures) and Cooperative Project 3 (Hand Calculation Book for Space Frame Structures). The task requires students to consult various standards, manually calculate loads, internal forces, and their combinations, and analyze the results to complete the hand calculation books for beam and

slab structures as well as space frame structures.

The achievement of Course Objective 4 is evaluated through process control, which includes both teacher grading and student self-assessment. Teacher grading is based on classroom performance, communication with the teacher, questions raised during Q&A discussions, answering other students questions, and homework assignments. Student evaluation focuses on their learning attitude, level of knowledge mastery, teacher-student interaction, and group collaboration.

The course evaluation is carried out as follows:

Program objective	Corresponding graduation requirements	Evaluation methodology	Remarks
Course objective 1	1.3	The scoring method	Comprehensive evaluation is adopted by in-class test, final exam and major assignment.
Course objective 2	5.2	Project scoring method	The form of large assignment is divided into tasks, and the group self-evaluation, mutual evaluation and teachers score are combined.
Course objective 3	6.1	Project scoring method	The form of large assignment is divided into tasks, and group self-evaluation, mutual evaluation and teachers score are combined.
Course objective 4	12.2	Scoring sheet method	Student self-evaluation combined with teacher scoring.

(2) Continuous improvement mechanism

(a) Establish a continuous improvement system

① Establish a continuous improvement group for this course.

② The head of the course continuous improvement group is responsible for organizing and supervising the continuous improvement process.

③ Develop continuous improvement measures.

(b) Establish a continuous improvement group for this course: the leader of the group is the person in charge of the course, and the members of the group are the teaching members of the

team.

(c) Continuous improvement method of this course

① Regular grade assessment mechanism: According to each class, the course team teachers must summarize and calculate all indicators of students regular grade assessment every 4 weeks, adjust students status in time, and make corresponding records.

② Final examination assessment mechanism: analyze the final examination paper, count the score of each part of the test, use the statistical results to conduct overall analysis and research on the course, and make improvements for students who take the make-up exam and students in the next class.

(d) Continuous improvement measures for this course

① For the assessment of regular grades, measures such as symposiums, discussion groups, the establishment of study groups and individual exchanges with students are adopted to improve.

② For the final examination, according to the problems in the students examination and the key content of the course, unified guidance and other measures are taken to improve the students who take the make-up examination.

Formulator (signature):

Director of department (office) review (signature):

Professional person in charge (signature and seal):