

Identification	Subject	ARCH 311, Architectural Construction 3, 6 AKTS
	Department	Architecture and Design Department
	Program (Undergraduate, Graduate)	Bachelors
	Term	Fall 2027.
	Instructor	Sevinj Hasanova
	Email:	hasanova.sevinj@khazar.org
	Classroom/hours	Khazar University, Neftchilar campus
Prerequisites	-	
Language	English	
Compulsory/Elective	Compulsory	
Textbooks and course materials	1. “Structure As Architecture” A Source Book For Architects And Structural Engineers /Andrew W. Charleson/2nd Edition / 2014 2. “The Function of Form” Farshid Moussavi /2009 3. “From Concepts to Desig” (2nd Edition) Malcolm Millais, Building Structures: 2005 4. “Structural Systems” (Reprint, 2007 / 2013) Heino Engel	
Course description	This course explores the complex relationship between large-scale structural typologies and the quality of architectural space, focusing specifically on long-span, large-volume, and heavy industrial facilities. Moving away from abstract mathematical stress analysis, the curriculum aims to foster a practical, three-dimensional understanding of tectonic systems and their spatial implications. Throughout the semester, architectural form is analyzed not as an isolated aesthetic shell, but as a direct outcome of structural logic and static equilibrium. The course systematically explains the engineering principles, material behaviors, and load dynamics associated with portal frames, planar trusses, double-layer space structures, folded-plate systems, and lightweight tensile membranes.	
Course objectives	The primary objective of this course is to foster a comprehensive understanding of advanced structural systems and their direct integration into contemporary architectural practice, with a particular focus on long-span, large-volume, and industrial-type structural systems. The key goals of the curriculum are defined as follows: 1. Integration of Form and Structure: Understanding structural systems not merely as technical load-bearing mechanisms, but as fundamental architectural elements that define, shape, and enclose vast spatial volumes. 2. Intuitive Understanding of Structural Logic: Developing a deep graphic and visual understanding of load paths, spatial equilibrium, and the behavior of forces (tension, compression, bending, and shear) within expansive,	

	column-free spaces, without relying on complex mathematical calculations. Typological Analysis of Large-Scale Spaces: The strategic formulation, zoning, and optimization of complex functional layouts, structural grids, circulation flows, fire safety parameters, and acoustic requirements for highly specialized facilities, including transport hubs, automated factories, and sports arenas. 3. Historical Evolution and Computation-Based Adaptation: A systematic analysis of form-active structures, tracing the path from historical construction methods to modern practices; specifically focusing on how parametric design tools transform rigid engineering schemes into fluid, organic, and kinetic architectural envelopes. 4. Material Ecology and Sustainability Assessment: A comparison of high-carbon traditional steel elements against modern, sustainable mass timber solutions (Glulam and CLT) within the context of large-scale construction and material selection.		
Learning Outcomes	Academic skills acquired upon completion of this curriculum: 1. Ability to immediately classify long-span and industrial building systems based on structural solutions, materials, and construction typologies. 2. Ability to independently draft clean, professional-grade 2D plan layouts, sections, and connection details in an AutoCAD environment, while demonstrating proper architectural graphic standards. 3. Developing structural and architectural solutions for shell structures in long-span architectural buildings by mastering the skill of graphically analyzing and tracing force vectors. 4. Application of optimal circulation and functional zoning parameters for large-scale public and industrial interiors. 5. Ability to compare heavy structural steel elements with modern mass timber solutions (Glulam/CLT) and select materials based on criteria such as lower carbon footprint and spatial efficiency. 6. Application of practical skills in creating scaled models, structural origami geometries, and spatial meshes to visually observe elastic deformation, torsion (or bending) vectors, and material stiffness derived from form.		
Teaching methods	Lecture	A lecture is given to the students about the topic.	
	Group discussion	For students to better understand and remember the topics covered, discussions are held regularly.	
	Practical exercises	Practical exercises are done to improve the knowledge and skills students have learned during lectures.	
	Analysis of a practical issue	Discussions are held periodically based on question-and-answer, quick-solve small-scale tasks to understand the extent to which students have mastered the topics theoretically and at what level they can practically perform the task given by thinking like an architect.	
Evaluation Criteria	Components	Date/deadline	Components
	Assignment 1		10
	Assignment 2		10
	Attendance		5
	Activity		10
	Midterm exam		30
	Final exam		35
	Conclusion		100

Class Policy

Lecture, seminar, presentation

- This curriculum is based not only on theory but also on collaborative research, as well as the investigation, development, and presentation of projects. The course instruction is divided into three main components:
- **Interactive lectures:** Weekly classes are dedicated to studying and comparing advanced, traditional, and innovative structural systems, as well as various types of long-span structures and materials. The lectures prioritize real-world structural examples and visual diagnostic analyses. They focus on analyzing structural logic, load-transfer vectors, and how architectural form organically responds to physical forces, without relying on complex mathematical formulas.
- **Analytical seminars and workshop sessions:** Seminar hours function as an active design laboratory. These sessions include hands-on structural experiments (e.g., physical exercises in paper folding/origami), group brainstorming, and direct project discussions within the AutoCAD environment. Students actively discuss the differences and selection criteria among various structural solutions (e.g., space frames versus tensile structures), taking into account specific factors such as column-free long-span requirements, the environmental performance of materials, and interior acoustics.
Students are required to deliver agile and effective presentations throughout the semester.

Detailed Project Assignment Requirements

- **Assignment 1: AutoCAD Structural Drawing Package & Portfolio.** This assignment focuses entirely on the precise technical execution of architectural and structural components using AutoCAD. Students are required to draft comprehensive plans, cross-sections, elevations, and structural connection nodes according to specific industry-standard scales assigned in class.
 - **Phase A - Presentation (5 Points):** The digital drawings and preliminary layouts must be presented and defended orally during the class session immediately preceding the Midterm Examination week.
 - **Phase B - Hardcopy Submission (5 Points):** The finalized, fully formatted, and printed version (plots) of this structural drawing package must be submitted physically on the absolute final day of the semester classes.
- **Assignment 2: Constructive Scale Model (Structural Mockup).** This core assignment requires students to translate their entire semester-long research and individual design geometry into a physical reality. Students must fabricate a highly accurate, scaled structural mockup/model showcasing the core load-bearing behavior, columns, and roof framework of their project. **Submission Details (10 Points):** The final physical model must be presented and handed over on the absolute final day of the semester classes.

Strict Deadline and Late Submission Policy

- **No-Extension Policy:** The field of architecture demands rigorous time management at a professional level. Therefore, no additional time or second chances will be granted for assignments not submitted by the officially established deadlines.

- Immediate Zero Grade: Failure to submit Assignment 1 (Phase A) by the midterm exam, or failure to present final drawings and the physical model on the last day of class, will result in an immediate score of zero (0) for that assessment component.

Midterm Exam

Test questions and graphic assignments based on topics covered during the semester.

Exception:

- A student may be granted the opportunity to retake the exam only if they notify the Faculty Dean in advance regarding their inability to attend due to valid reasons (such as family circumstances or health issues) and submit the appropriate documentation (a formal request or medical certificate).

Attendance

- The maximum score for class attendance is 5 points. The number of points is based on: if the student attends all classes in the subject during the semester, he is given 5 points. If the total number of lessons missed during the semester for the subject exceeds the prescribed limit of 25% (illness, family situation, etc.), the student is not admitted to the exam session and a certain decision is made about it.

The procedure for completing the course

- The student's knowledge is evaluated with a maximum of 100 points. an overall success rate of 60% and above is considered to complete the course. A student with a deficit can take this subject again in the next semester or the next year.

Violations of examination rules

- During mid-term and final exams, students are prohibited from disrupting the course of the exam and making transfers. The exam work of the student who does not follow this rule will be canceled and the student will be excluded from the exam with a grade of 0 (zero).

Rules of conduct of the student

- It is not allowed to disrupt the learning process or engage in unethical actions, as well as students' unauthorized discussions and use of mobile phones.

Tentative Schedule			
Week	Date/Day (tentative)	Topics	Textbook/Assignments
1.	---,--, ----	<u>Structural Expressionism & Form-Finding Methods</u> - Visual exploration of structural expressionism in 21st-century architecture. - Case analysis of Santiago Calatrava, Zaha Hadid, and Pier Luigi Nervi. Structural form as a design generator. Structural Decoding Workshop. Diagnostic sketching and analytical breakdown of form-to-structure vectors on select contemporary reference buildings.	1. Andrew Charleson, “Structure as Architecture:” A Source Book for Architects and Structural Engineers (2014) – Chapter 1, "Introduction," pp. 1–15. 2. Malcolm Millais, “Building Structures: From Concepts to Design” (2005) – Chapter 1, "The Integration of Structure," pp. 3–22.
2.		<u>Industrial Typologies & Logistical Spatial Zoning</u> - Morphological classification of transport hubs and industrial plants. - Layout optimization for automated workflows, pedestrian logistics, and equipment corridors. Bubble Diagramming Studio. Developing functional adjacencies and structural module layout charts for a regional logistics terminal.	1. Malcolm Millais, “Building Structures: From Concepts to Design” (2005) – Chapter 8, "Structural Planning for Large Spaces," pp. 185–205. 2. Farshid Moussavi, “The Function of Form” (2009) – Section on "Grid Modulations in Industrial Layouts," pp. 42–61..
3.		<u>Portal Frames: Mechanics, Materials & Force Paths</u> - Physics of rigid portal frames under lateral wind loads and gravity. - Material shifts: Structural Steel vs. Mass Timber (Glulam/CLT). Rigid connection details. Load Path Tracking. Drafting cross-sections to trace gravitational force transfer from cladding elements down to foundation anchors.	1. Heino Engel, “Structural Systems” (2007) – Section 1, "Section-Active Structural Systems: Portal Frames," pp. 55–78. 2. Malcolm Millais, 2Building Structures: From Concepts to Design” (2005) – Chapter 5, "Rigid Frames and Bending Response," pp. 112–134.

4.		<u>Multi-Span Frame Layouts & Case Defenses</u> Design parameters for multi-span frames, tapered structural steel columns, and knee-bracing requirements in manufacturing facilities. Student Case Presentations. Rapid 3-minute critical reviews of a chosen international portal frame factory site.	1. Andrew Charleson, “Structure as Architecture:” A Source Book for Architects and Structural Engineers (2014) – Chapter 3, "Building Exterior Structures (Portal & Braced Frameworks)," pp. 52–71.
5.		<u>Long-Span Roof Enclosures & Truss Typologies.</u> - Structural vulnerabilities in column-free layouts: buckling risks and thermal movement. - Evolution of planar trusses (Pratt, Warren, Vierendeel models). Graphic Statics Studio. Direct vector marking to visually isolate tension paths (Red) from compression paths (Blue) on custom truss forms.	1. Heino Engel, “Structural Systems” (2007) – Section 2, "Vector-Active Structural Systems: Flat Trusses," pp. 102–129. 2. Malcolm Millais, “Building Structures: From Concepts to Design” (2005) – Chapter 4, "The Mechanics of Trusses," pp. 85–109.
6.		<u>Space Frames: Three-Dimensional Spatial Modules</u> - Mechanics of multi-layered space frames. - Node mechanisms (Mero system components) and spatial layout distribution criteria. Node System Dissection. Geometrical breakdown of the structural envelope used at Kansai Airport or the Beijing Olympic Stadium.	1. Heino Engel, “Structural Systems” (2007) – Section 2, "Vector-Active Systems: Space Trusses & Polyhedral Grids," pp. 130–155. 2. Farshid Moussavi, “The Function of Form” (2009) – Section on "Tessellated Three-Dimensional Space Grids," pp. 114–138.
7.		<u>Parametric Space Frames & Non-Standard Forms</u> Implementation of computational design algorithms (Rhino/Grasshopper environment) to manipulate structural modules over free-form, fluid surfaces. Free-Form Canopy Lab. Setting up a conceptual 3D structural wireframe layout for an organic pavilion form.	1. Farshid Moussavi, “The Function of Form” (2009) – Section on "Parametric Modulations and Non-Standard Structures," pp. 182–210. 2. Andrew Charleson, “Structure as Architecture: A Source Book for Architects and Structural Engineers” (2014) – Chapter 8, "Structural

			Expressivism in Free-Form Roofs," pp. 195–212.
8.		<u>Midterm exam</u> • Midterm Examination & Final Project Briefing: Midterm Exam : • Evaluation of theoretical, material, and graphical concepts covered from Weeks 1 to 7. Launching the Final Term Assignment. Defining project briefs (e.g., airport terminal, Olympic arena, exhibition hall) and assigning individual sites.	1. Review of all previous readings by Andrew Charleson, Malcolm Millais, and Heino Engel for exam preparation.
9.		<u>Folded Plate Structures: Geometry-Induced Stiffness</u> • Architectural history of thin-shell folding. • Using spatial pleating to create high bending resistance out of concrete, cross-laminated timber, or sheet metal. Origami Structural Workshop. Direct physical folding of V-shape and W-shape paper patterns. Incremental weight testing to observe shape stiffness.	1. Heino Engel, “Structural Systems” (2007) – Section 3, "Surface-Active Structural Systems: Folded Plates," pp. 202–225. 2. Farshid Moussavi, “The Function of Form” (2009) – Section on "Folded Surfaces and Dihedral Angles," pp. 240–258.
10.		<u>Structural Detail Integration in Folded Layouts</u> • Technical reviews of landmark folded systems (UNESCO Paris). • Resolving structural joint execution, roof drainage paths, and thermal barrier lines. Concept Elevation Pitches. Drafting a schematic A3 folder layout followed by a 60-second structural pitch to peers.	1. Andrew Charleson, “Structure as Architecture” : A Source Book for Architects and Structural Engineers (2014) – Chapter 4, "Interior Structural Architecture (Folded Plates Case Studies)," pp. 88–105.
11.		<u>Compression Archetypes: Arches, Vaults & Thrust Control</u> • Physics of pure compression lines from Roman infrastructure to steel parabolic arches. • Structural detailing for horizontal thrust: ties, buttresses, and mass footings.	1. Heino Engel, “Structural Systems” (2007) – Section 1, "Section-Active Systems: Arches and Vaults," pp. 24–54. 2. Malcolm Millais, “Building Structures: From Concepts to

		Arch Interface Comparison. Comparative analytical sketching of stress pathways in Romanesque vs. Gothic profiles. Section review of a contemporary terminal arch.	Design” (2005) – Chapter 6, "Arches and Overcoming Thrust," pp. 140–162
12.		Cable-Stayed, Suspended & Tensile Enclosures - Form-active tension mechanics. Cable-net networks, suspension geometries, and membrane fabrics (Frei Otto design paradigms). - Anchor layouts and mast details. Tensile Field Mapping. Drafting structural layouts for a membrane stadium roof. Locating mast points and tie-down vector clusters.	1. Heino Engel, “Structural Systems” (2007) – Section 4, "Flexible-Active Structural Systems: Cable Nets & Tents," pp. 272–305. 2. Malcolm Millais, “Building Structures: From Concepts to Design” (2005) – Chapter 7, "Suspension Systems and Pure Tension," pp. 165–184.
13.		<u>Biomimetic Form-Finding & Kinetic Enclosures</u> - Structural patterns in biological systems (eggshell metrics, leaf veining, bone load distribution). - Retractable roof structures and automated moving envelopes. Biomimetic Ideation Studio. Adapting structural layout strategies found in nature into a schematic long-span project layout.	1. “Farshid Moussavi, “The Function of Form” (2009) – Section on "Biomimetic Membranes and Kinetic Formations," pp. 310–335. 2. Andrew Charleson, “Structure as Architecture:” A Source Book for Architects and Structural Engineers (2014) – Chapter 9, "Structural Innovation via Natural Analogies," pp. 220–242.
14.		<u>Material Lifecycle & Structural Matrix Comparisons</u> - Comparative grouping of mega-structures. - Embodied energy assessments of massive steel frames vs. sustainable heavy timber structures in large exhibition halls. Matrix Assembly Workshop. Group dynamic to map Trusses, Space Frames, Folded Shells, and Tensile Skins by span caps, costs, and spatial footprint.	1. Malcolm Millais, “Building Structures: From Concepts to Design” (2005) – Chapter 11, "Material Selection and Structural Sustainability," pp. 320–345.
15.		<u>Final Project Defense</u> Formal submission and exhibition of the final semester assignments. Students present their comprehensive long-span	

		architectural projects (technical drawings, digital BIM models, or physical structural mockups) .	
Final exam			