

The University of Architecture, Civil Engineering and Geodesy, in Sofia incorporates five Faculties – Architecture, Structural Engineering, Hydrotechnics, Geodesy and Transportation Engineering with thirty three departments. The following degree programmes are offered: Architecture, Structural Engineering, Transportation Engineering, Water Supply and Sewerage, Hydraulic Engineering and Geodesy.

UACEG is till now the only civil institution in the country offering higher education for architects, civil engineers and surveyors.

The duration of Architecture study, including the time for preparation and defence of diploma thesis, is eleven semesters. The number of students is approximately 750 – about 120 for each academic year.

### What and Why

Actually these are the two main questions which determine the place and the content of the Construction education of the future architects. In the curriculum at our Faculty this is divided in two general groups of topics with different aims.

In **the first group** are the topics that give general information about the structure and the function of the building elements, and also about the construction systems as a whole.

#### Housing Construction

The subjects of the discipline include architectural structures, elements and details of the building. Their structural, insulation and art functions, materials, structures, ways for performance and their relation with the architectural composition are studied. The course covers the classic and the most widely spread modern structures, elements and details and offers the most general principles for their design.

#### Architectural Structures

This discipline covers the following areas - Structure and architectural form, Structural and construction systems; Buildings with bearing walls – masonry walls, monolithic and prefabricated reinforced concrete walls; Skeleton-structure buildings – monolithic reinforced concrete skeleton, prefabricated reinforced concrete skeleton, steel skeleton; Roof structures of wide-span buildings – beam structures, frames, arches, thin-wall shell and folded structures, lattice structures, suspended and cable structures, pneumatic structures.

**The second group** incorporates the pure engineering topics as follows:

#### Structural Mechanics - Part I

Includes the disciplines Theoretical Mechanics, in which the types of systems of forces are discussed and the support reactions of the most frequently

met loads in cantilever and simple beams. The methods for determining normal forces in plane trusses are discussed. In the discipline Strength of Materials the methods for determination of generalised forces in cantilever beams and systems of the simple beams type are examined. The state of stress and the methods for dimensioning of the above-mentioned structures, corresponding to pure tension (compression), pure shearing, bending, etc. are studied.

### **Structural Mechanics - Part II**

The course covers the discipline Static of Structures. Students are introduced to statically determinate and statically indeterminate structures, met in the architectural and the engineering practice. The determination of the generalised forces in hinged girders and three-hinged frames is shown. The methods for solving statically indeterminate systems (frames and continuous beams) are discussed.

### **Reinforced Concrete Structures**

The course discusses the basic physics, mechanical and deformation properties of reinforced concrete, the methods for determining the bearing capacity of reinforced concrete elements under characteristic loads and their construction as a part of the overall bearing structure. The types of reinforced concrete structures and the rational field of their application are covered. The foundations of antiearthquake design and construction are discussed. The different types of inter-floor structures and their basic elements are classified in detail.

### **Steel and Timber Structures**

The discipline covers the basic concepts, connected with the design of steel and timber structures. Special attention is paid to the structural composition, morphology and realisation of the different parts in the structural complex. The foundations of calculation and dimensioning of steel and timber elements and structural parts are discussed. The aim of the discipline is to develop knowledge for assessment of the abilities of the structures and to realise efficient co-operation with engineers-designers.

The main question about the content of all engineering topics is the general use of this detailed knowledge. Is it necessary for further architects to learn how to calculate constructions if they won't do this in their professional practice?

In the fifth year of study architecture students can choose a specialisation pathway by the different departments of the Faculty. One of them - **"Architectural Structures and Details"** - is by the Department Housing Construction. Future architects are educated to estimate and choose adequate structural alternatives, to design architectural objects in close consideration with structure. The pathway further extends students' knowledge about structures, architectural detail and computer-aided design methods. Studio work - design of important architectural projects, the relationship between structure and architectural form being accentuated.

As a rule the organisation of the education in the different topics follows

**How**

the same scheme – theoretical lectures and smaller or bigger projects made parallel during the seminars. The volume and the objectives for the seminars are different by the various disciplines.

**Housing Construction - Project I** - Small two-storey building is developed in three variants by using different bearing structures (monolithic reinforced concrete skeleton; bearing walls; timber or steel skeleton), with the help of which architectural form is put in the context of the structural decision. Characteristic features and details of the bearing structure, floors, roof, facade and internal walls are elucidated.

**Housing Construction - Project II** - Projects of roof structures, staircases, walls, doors and windows are developed. Specific knowledge about architectural structures and methods about designing architectural details are mastered as well.

**Architectural Structures - Project I** - Project on an architectural and structural decision of a detached residential building with monolithic skeleton reinforced concrete structure. Actually these are the working drawings of a project made in one of the previous terms but in some other department.

**Architectural Structures - Project II** - Project on an architectural and structural decision of a multi-storey building using a structural system, chosen by the student.

**Structural Mechanics, Seminars** - Students solve small tasks for calculating loads and forces in different type of structures.-

**Reinforced Concrete Structures – Project** - During the seminars students are introduced to the calculation methods and drawing of the main parts of a project of a small house.

**Steel and Timber Structures – Project** - The project consists of a structural composition of a single-span steel-structure building, calculation of main structural parts and elaboration of details.

As a common disadvantage of the education in this field is the absence of cooperation and some times of coordination between the topics.

Only in the Specialisation pathway there are some elements of the design studio atmosphere. Here the students work under the supervision of a team of teachers with some consultation from teachers from engineering departments. In their projects developed during the seminars students must show and develop the construction of the building as a whole and of its different subsystems (curtain walls, roof constructions etc.) in greater detail. If the students decide to do their diploma project in the same department they have to choose an interesting and innovative structure for their building, that has to be studied in a greater detail.

## Who

Professors-architects from a specialised Department Housing Construction at the Faculty of Architecture teach the disciplines **Housing Construction** and **Architectural Structures**. Representative of different firms developing and distributing building products or subsystems -cladding systems, curtain walls roof constructions etc. are also invited to give some of the lectures.

Practising architects are involved in the education as tutors for the projects. The principal lecturers and tutors for the seminars in **Structural Mechanics**, **Reinforced Concrete Structures** and **Steel and Timber Structures** are from different specialised departments at the engineering faculties of the University. So the content and the volume of these topics could be different from the main objectives in the education of future architects. Although the curriculum and the content of the topics are assessed from the ruling body of the Faculty of Architecture, there are almost no possibilities to supervise regularly this part of the education.

The place of these topics in the curriculum is as follows:

**The first group** topics - general information

**Housing Construction** (2 - 4 term with 6 hours Lectures+8 hours Seminars)

**Architectural Structures** (5 - 6 term with 4 L + 8 S)

**The second group** - engineering topics

**Structural Mechanics** in two parts (3 - 4 term with 4 L + 4 S)

**Reinforced Concrete Structures** (4 - 5 term with 4 L + 2 S)

**Steel and Timber Structures** (6 term with 3 L + 2 S)

As complementary, but important for the knowledge, taught in the engineering subjects, two other disciplines have to be mentioned:

**Building Materials** (2 term - 2 L + 1 S) and **Building Physics** (3 term - 2 L)

The **Specialisation pathway** by the Department Housing Construction during terms 9 and 10 is represented with 6 hours of lectures and 32 hours of seminars.

In the development of our curriculum during the years many changes have been made without touching the main point – who and to what extend has to teach the architects in construction. We are faced with some general changes in the curriculum of the architectural education. So workshops like this will help us to acquire more information and exchange experience for this development.

## When and to What Extent

## Virtual Reforms



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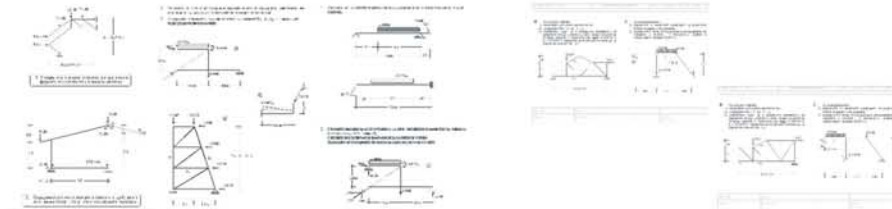


### THE PURE ENGINEERING TOPICS

#### Structural Mechanics - Part I

Theoretical Mechanics - types of systems of forces and support reactions of the most frequently met loads in cantilever and simple beams; Methods for determining normal forces in plane trusses. Strength of Materials - methods for determination of generalised forces. State of stress and methods for dimensioning, corresponding to pure tension, pure shearing, bending, etc.

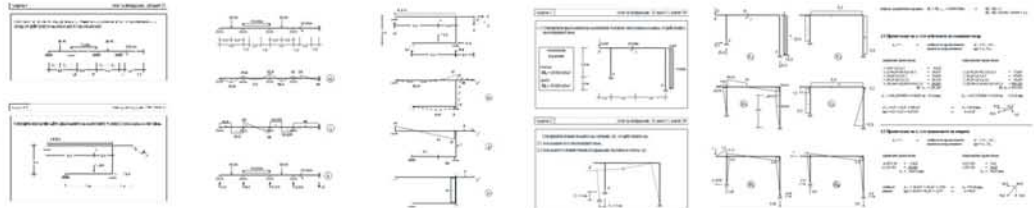
SEMINARS - Students solve small tasks for calculating loads and forces in different type of structures.



#### Structural Mechanics - Part II

Static Structures - statically determinate and statically indeterminate structures, met in the architectural and the engineering practice. The determination of the generalised forces in hinged girders and three-hinged frames is shown. The methods for solving statically indeterminate systems (frames and continuous beams) are discussed.

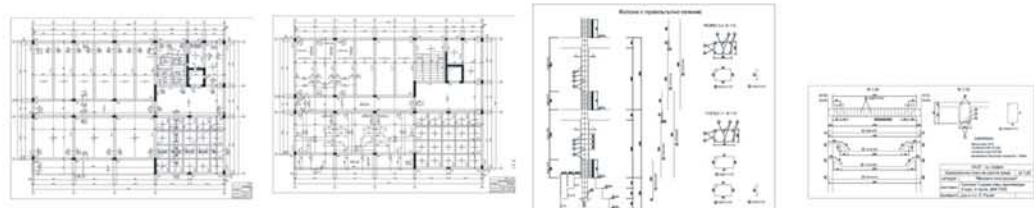
SEMINARS - Students solve small tasks for calculating loads and forces in different type of structures.



#### Reinforced Concrete Structures

Basic physics, mechanical and deformation properties of reinforced concrete, methods for determining the bearing capacity of reinforced concrete elements and their construction. Types of reinforced concrete structures and the rational field of their application. Foundations of anti-earthquake design. Detailed classification of different types of inter-floor structures and their basic elements.

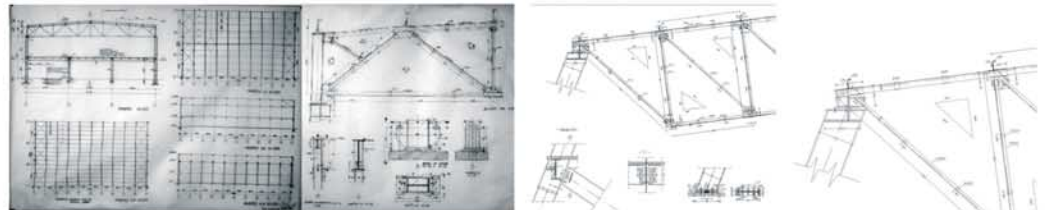
PROJECT - During the seminars students are introduced to the calculation methods and drawing of the main parts of a project of a small house.



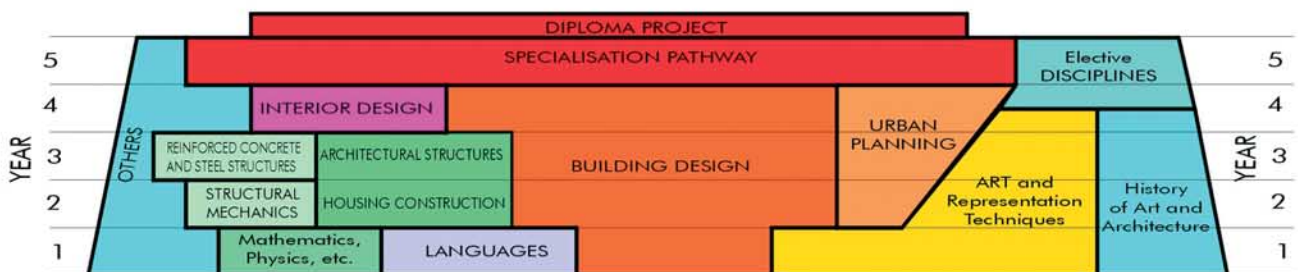
#### Steel and Timber Structures

Basic concepts, connected with the design of steel and timber structures. Structural composition, morphology and realisation of the different parts in the structural complex. Foundations of calculation and dimensioning of steel and timber elements and structural parts. Knowledge for assessment of the abilities of the structures for efficient co-operation with engineers-designers.

PROJECT - The project consists of a structural composition of a single-span steel-structure building, calculation of main structural parts and elaboration of details.



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As complementary, but important for the knowledge, taught in the engineering subjects, two other discipline has to be mentioned:  
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 The SPECIALISATION PATHWAY by the Department Housing Construction during terms 9 and 10 is represented with 6 hours of lectures and 32 hours of seminars.



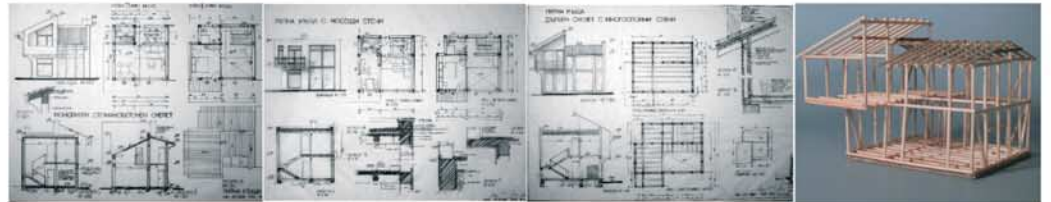
## TOPICS FOR GENERAL INFORMATION ABOUT THE STRUCTURE AND THE FUNCTION OF THE BUILDING ELEMENTS, AND ABOUT THE CONSTRUCTION SYSTEMS AS A WHOLE

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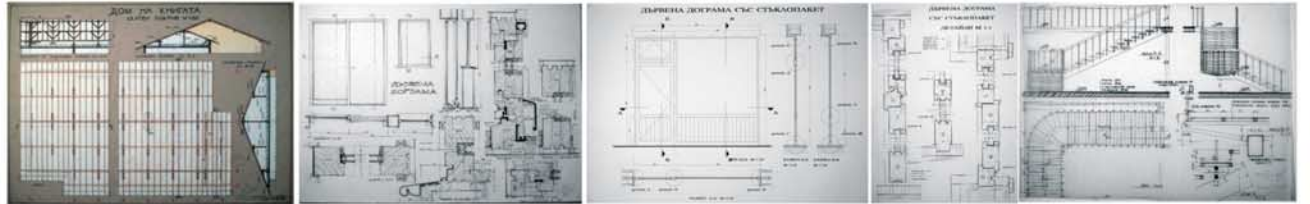
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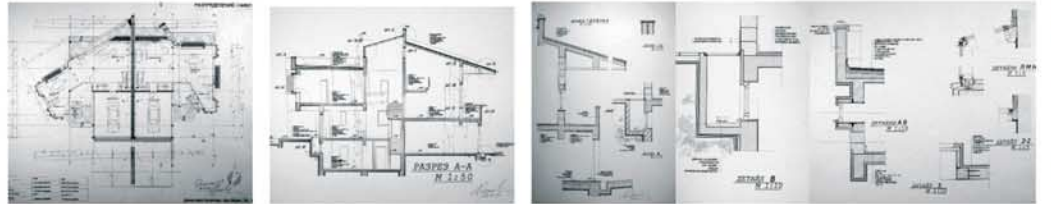
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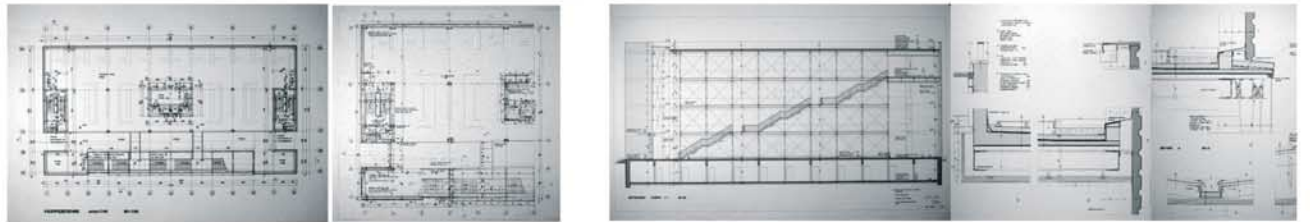
### Architectural Structures

Structure and architectural form, Structural and construction systems; Buildings with bearing walls-masonry walls, monolithic and prefabricated reinforced concrete walls; Skeleton-structure buildings-monolithic concrete skeleton, steel skeleton; Roof structures of wide-span buildings beam structures, frames, arches, thin-wall shell and folded structures, lattice structures, suspended and pneumatic structures.

PROJECT I - Project with working drawings on an architectural and structural decision of a detached residential building with monolithic skeleton reinforced concrete structure.



PROJECT II - Project on an architectural and structural decision of a multi-storey building using a structural system, chosen by the student



### Pathway "ARCHITECTURAL STRUCTURES AND DETAILS"

Future architects are educated to estimate and chose adequate structural alternatives, to design architectural objects in close consideration with structure. The pathway further extends students' knowledge about structures, architectural detail and computer-aided design methods. Studio work - design of important architectural projects, the relationship between structure and architectural form being accentuated.

