

## **Construction Teaching Methods in Architectural Education**

### **Semester I, II**

#### **Exercise 1:**

1. Introductory class 2 h.
  - drawing a simple building with the materials graphically marked
2. Class 1 4 h.
  - drawing a simple, single-floor building,
  - application of the appropriate graphical designations
3. Class 2 8 h.
  - drawing the ground floor of a multi-storey building,
  - principles and application of dimensioning
4. Class 3 4 h.
  - drawing a storey of a repeatable multi-storey building
5. Class 4 8 h.
  - constructing a vertical section based on projections drawn earlier
6. Final test 2 h.
7. Final test re-take 2 h.

#### *Theoretical background for exercise 1*

#### **General Civil Engineering, Lectures 15 h**

1. Introductory lecture, basic concepts used in civil engineering,
2. Basic types of building constructions, classification, definitions,
3. Classification of loads working on buildings, Building ground. Classification,
4. Water in grounds. The effect of atmospheric conditions on a building's foundations,
5. Laying out and fixing the position of a building. Earth works basic principles.
6. Foundations of buildings basic principles, classification,
7. Special cases of foundation engineering, foundation

- work next to a neighbour,
8. Wall constructions basic types and principles of bricklaying,
  9. Chimney ducts basic principles,
  10. Construction elements affecting the shape of walls: cornices, pilasters, pedestals.

#### **Mechanics of Materials**

- State of stresses and strains, Mohr's Circle
- Relationships between internal forces and stresses
- Generalized Hook's law
- Design of a structure: dimensioning conditions, design methods
- Axial loading: compression and tension
- Connections of structural members: technical shearing
- Geometric properties of an area: centroid of an area, moments of inertia
- Bending: pure (straight, skew) and with shearing
- Torsion
- Eccentric compression, core of a cross section
- Bending line of a beam Euler's equation

#### **Theoretical Mechanics**

- Elementary Statics: scalars and vectors, principles of statics, reduction of coplanar force system, equations of equilibrium
- Schemes of beam-column systems, nodes and supports
- Types of structures and loads
- Basic assumptions of structural and material mechanics

#### **Structural Mechanics**

- Statistically determinate structures
- Internal loadings developed in structural members
- Analysis of beams, frames, trusses and arches
- Operational loading - influence lines for beams
- Moment's envelope

- Statistically indeterminate structures
- Static and kinematic analysis of beam-column structures
- Principle of virtual work - displacement calculations
- Force method
- Symmetric structural systems loaded symmetrically and antisymmetrically
  - Buckling of a column
  - Plastic load

### Semester III, IV

#### Exercise 2 (15 h):

- drawing part of a building (fragment of a section) including the foundation, the cellar ceiling, ground floor ceiling and flat roof, details are selected individually, scale 1:20.
- designing a single detail including: insulation of the underground part of the building, cellar and ground floor ceiling, timber roof construction with draining system, scale 1:20.

#### *Theoretical background for exercise 2*

#### General Construction, Lectures 15 h

1. Introductory lecture, presentation of the syllabus. Vaulting, lintels basic constructions,
2. Timber ceilings, steel and ceramic ceilings,
3. Reinforced concrete ceilings rib-and-slab, solid slab,
4. "Green" roofs and deck roofs,
5. Methods and systems of draining rainwater,
6. Steep roofs types. Inclination of the roof slopes. Principles of designing roofs,
7. Timber roofs classification, timber construction elements,
8. Basic types of roofing designing principles.
9. Insulation of the underground parts of buildings types and methods of making,
10. Stairs designing principles and basic constructions,
11. Ramps, lifts. Balconies and loggias.

#### Exercise 3:

#### Construction Elements of a Factory Building, Classes 30 h

- Statical and dimensional calculations, scale 1:5, 1:10
- roof slab
  - roof beam

- binding joist
- pillar
- base of foundation

#### *Theoretical background for exercise 3*

#### Reinforced Concrete Constructions, Lectures 15h

- Introductory lecture, basic information, designing methods, definition of near-limit states, the essence of reinforced concrete constructions
- Concrete characteristic features, strength and classes of concrete, advantages and disadvantages of concrete. Reinforcing steel characteristic features strength and classes.
- Designing bending elements the general and simplified method. Principles of constructing reinforcements in bending elements.
- Calculations of elements for shearing.
- Eccentrically compressed elements the general and simplified method.
- Pressure, torsion and tension.
- Cracks in reinforced concrete constructions. The mechanism of cracking.
- Permissible and actual sagging. A simplified method for checking the near-limit state of a sag.
- Requirements and recommendations for concrete reinforcement. Distribution of rods in the section, cleading or rods, anchorage and joining of rods, depth of support for slabs and beams.

### Semester V, VI

#### Exercise 4:

#### General Civil Engineering

Building design of a single family house - 30 h.

Design content:

- two floor plans (i.e. ground floor and first floor) scale 1:50 or 1:100
- selected cross-section scale 1:50
- one selected facade in black and white scale 1:50 and one in colour scale 1:50
- selected building detail scale 1:20, 1:25, 1:10 or 1:5
- project description
- specification of windows and doors

On the basis of the student's own design (concept phase prepared during the III or IV semester) and the

knowledge gained during the preceding semesters I-IV the design documentation of the single family house (or another type of small building) is prepared.

The design should contain:

- structural solutions of the building elements (walls, foundations, roofs, staircases, etc)
- thermal insulations and waterproofing/vapour barriers
- internal finishing
- ducting shafts, gutters, etc.
- building site elements (i.e pavements), drainage, etc.
- design data: building area, usable floor area, total area, volume room specification (number of rooms, function, room)

#### **Exercise 5:**

##### **Pre-fabricated Constructions**

Building design of an apartment building

Design content:

1. Construction drawings scale 1:50,
  - projection of repeatable storey
  - cross section of stairwell
  - projection of foundations
2. Construction drawing of the floor slab scale 1:20,
3. Construction details 4 elements scale 1:20,
4. Statical calculations:
  - bidding rafter, roof beam
  - floor slab
  - continuous footings

#### **Exercise 6:**

##### **Subject of the Class - 30h**

Design of steel structures of factory building

Design content:

- plan of roof 1:100
- plan of ground floor 1:100
- cross and longitudinal section 1:00
- selected details 1:100
- project description

Structural analysis:

- purlin (bidding rafter)

- roof truss
- beam (joist)
- binder (binding joist)

*Theoretical background for exercises 4, 5, 6*

##### **Room Acoustics, 15 hours (1h/week)**

1. Introduction
  - Architect's role in acoustical designing of rooms
2. General information on sound
3. Acoustical phenomena in rooms
4. Methods of acoustical analysis of rooms
5. Acoustical properties of building materials
6. Acoustical parameters of halls
7. Acoustical designing of halls
8. Acoustics of semiclosed spaces
9. Halls of outstanding acoustics
10. Case studies

##### **Building Physics**

The introduction of fundamental theoretical knowledge about thermal energy and vapour processes in the building. Conduction, convection, radiation. Polish regulations concerning protection against heat loss.

Physical properties of building materials. Heat exchange in the building "R" and "U" factor. Moisture. Condensation processes. Vapour barrier. Microclimate and thermal comfort. Building technology for energy saving.

##### **Steel Structures, Subject of Lectures - 15 h**

- Introduction. Characterisation and history of steel structures
- Steel - building material
- Production technology
- Mechanical properties
- Grade of steel
- Products (shapes, rolled, flat - rolled)
- Analysis and structural design general rules: tension, bending, compression
- Steel connectors (rivet, bolt, weld)
- Analysis and design: flanged beam, plain girder, truss girder, column
- Bracing of steel structures
- Protection of steel structures - fire, corrosion

## Semester VII, VIII

### Exercise 7:

#### Design content

1. Extracts from literature illustrations (drawings, sketches, photographs) of five roof solutions for using special constructions (including domes, hyperbolic paraboloids, and space trusses) with specification of basic data:
  - spatial (projection and section with main dimensions specified);
  - constructional (presentation of the main construction principle);
  - material (short description);
  - bibliographical (author, date, place and type of publication);
2. Approximate statical calculations for one of the described solution.

*Theoretical background for exercise 7*

#### Building Acoustics, 15 hours (1h/week)

1. Introduction
  - Architect's role in improving acoustical properties of buildings
2. General information on noise and vibration
3. Acoustical properties of partitions
4. Acoustical properties of windows and doors
5. Vibration isolation
6. Protection of buildings against noise and vibrations
7. Protection of buildings and rooms of special destination
8. Case studies

#### Urban Acoustics, 15 hours (1h/week)

1. Introduction - Town planner and problem of noise in town.
2. General information on sound propagation in open space
3. Transportation noise in urban areas
4. Law regulations referring to urban acoustics
5. Noise control by urban solutions
6. Acoustical plan of a city
7. The use of scale and computer modeling in urban acoustics

#### Special Constructions, Lectures 15 h, Project classes 15 h.

Presentation of basic concepts, classification and general analysis of large-dimension constructions. Discussion of selected existing constructions of this kind.

- solid-web girders,
- shells: single-curve, double-curve,
- domes: membrane theory of rotary shells determining the internal forces; dimensioning and constructing domes and their support elements,
- hyperbolic paraboloid-shaped shells: general principles of statical work directions of principal stresses, work of edge beams, transmission of loads to the support elements; analysis of roofs composed of compiled sections of hyperbolic paraboloid areas; dimensioning and constructing shells and edge beams,
- conoids,
- space trusses: solution of joints; approximate determining of internal forces;
- cylindrical shells: long and short shells, component elements and their role in transmission of loads; abutment beams, cut-off walls; cloister vaults, cross vaults,
- folded plate structures,
- pneumatic constructions: general characteristic, advantages and disadvantages, types of roof, statical work,
- suspension roofs: types of suspension roofs; operation of tension members, free and coupled structures; methods of transmission of forces from the tension members to the support elements; types of tension members and anchorage,

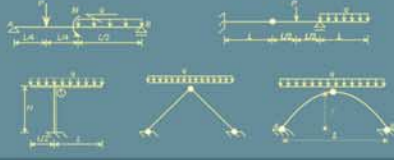


# Construction Teaching Methods in Architectural Education

## DEPARTMENT OF BUILDING TECHNOLOGY

### MECHANICS OF MATERIALS

- Rule of stress and strain, Mohr's Circle
- Relationships between internal forces and stresses
- Generalized Hooke's law
- Design of a structure: dimensioning conditions, design methods
- Axial loading: compression and tension
- Connections of structural members: technical shearing
- Geometric properties of an area: centroid of an area, moments of inertia
- Bending: pure (straight, skew) and with shearing
- Torsion
- Eccentric compression, core of a cross section
- Bending line of a beam: Euler's equation



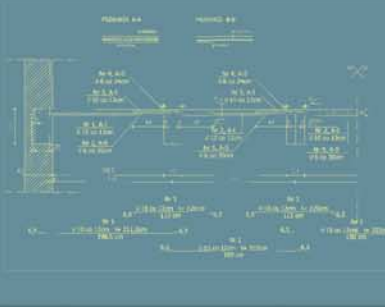
### THEORETICAL MECHANICS

- Elementary Statics: scalars and vectors, principles of statics, reduction of coplanar force systems, equations of equilibrium
- Schemes of beam-column systems, nodes and supports
- Types of structures and loads
- Basic assumptions of structural and material mechanics
- STRUCTURAL MECHANICS
- Statically determinate structures
- Internal loadings developed in structural members
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- Static and kinematic analysis of beam-column structures
- Principle of virtual work - displacement calculations
- Force method
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- Buckling of a column
- Plastic load



### REINFORCED CONCRETE CONSTRUCTIONS, SYLLABUS OF THE LECTURES 15h

- Introductory lecture, basic information, designing methods, definition of near-limit states, the essence of reinforced concrete constructions
- Concrete characteristic features, strength and classes of concrete, advantages and disadvantages of concrete, reinforcing steel characteristic features strength and classes
- Designing bending elements: the general and simplified method, Principles of constructing measurements in bending elements
- Calculations of elements for shearing
- Eccentrically compressed elements: the general and simplified method
- Prestress, tension and torsion
- Cracks in reinforced concrete constructions, The mechanism of cracking
- Permissible and actual sagging, A simplified method for checking the near limit state of a sag
- Requirements and recommendations for concrete reinforcement, Distribution of rods in the section, cladding or rods, anchorage and joining of rods, depth of support for slabs and beams



### SUBJECT: CONSTRUCTION ELEMENTS OF A FACTORY BUILDING, SYLLABUS OF THE CLASSES 30 h

Structural and dimensional calculations, scale 1:5, 1:10

- roof slab
- roof beam
- binding joist
- pillar
- base of foundation



### PRE-FABRICATED CONSTRUCTIONS

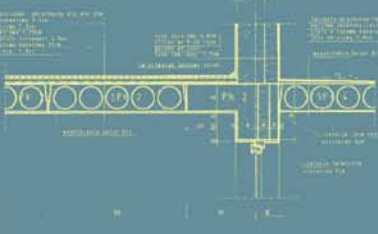
Building design of an apartment building

- Design content:
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    - projection of recognizable sloped cross section of stairwell
    - projection of foundations
  2. Construction drawing of the floor slab scale 1:20,
  3. Construction details 4 elements scale 1:20,
  4. Structural calculations:
    - blinding rafters, roof beam
    - floor slab
    - continuous footings



### BUILDING PHYSICS

The production of fundamental theoretical knowledge about thermal energy and vapour processes in the building. Conduction, convection, radiation. Polish regulations concerning protection against heat loss. Physical properties of building materials. Heat exchange in the building "R" and "U" factor. Moisture, Condensation processes. Vapour barrier, Microclimate and thermal comfort. Building technology for energy saving.



### STEEL STRUCTURES, SUBJECT OF LECTURES - 15 h

- Introduction: Characterisation and history of steel structures
- Steel - building material
- Production technology
- Mechanical properties
- Grade of steel
- Products (shapes, rolled, flat - rolled)
- Analysis and structural design general rules: tension, bending, compression
- Steel connectors (weld, bolt, weld)
- Analysis and design: fringed beam, plain girder, truss girder, column
- Bracing of steel structures
- Protection of steel structures - fire, corrosion

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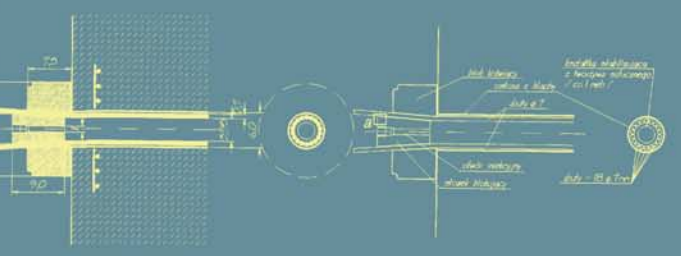
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    - spatial (projection and section with main dimensions specified);
    - constructional (presentation of the main construction principle);
    - material (short description);
    - bibliographical (bibliotic data, place and type of publication);
  2. Approximate structural calculations for one of the described solutions.

### Centrum Techniki i Komunikacji Wizualnej w Gdyni