Утверждено приказом ФГАОУ ВО СПбПУ № 71 от 19.01.2026 г.

Name of the entrance exam

Civil Engineering

Field/fields of study

08.04.01 Construction

Educational program/programs

08.04.01_12 Civil engineering (International Educational Program)

Abstract

The program contains a list of topics (questions) on the disciplines of the core professional cycle of the bachelor's degree curriculum in the field of 08.03.01 Construction, which are included in the content of the questions (test assignments) for the master's degree entrance examinations.
The entrance examination is graded on a 100-point scale and consists of an interdisciplinary exam covering the requirements set by state educational standards for higher education for the level of bachelor's degree preparation in the field corresponding to the master's degree program. The exam is administered in person in written form or remotely (maximum score: 100). The minimum score for successful completion is established by the Admission Rules approved for the current academic year.
The duration of the exam is 90 minutes.
The use of writing utensils, a draft, and a calculator is permitted during the entrance examination.

Disciplines included in the program of entrance examinations for the Master's degree program

1.1. Construction materials
1.2. Building structures
1.3. Construction technology
1.4. Project management

Content of academic disciplines

2.1. Construction materials
1. Classification of construction materials.
2. Basic terms and definitions.
3. Basic properties of construction materials.
3.1 Relationship between the composition and structure of materials and their properties.
3.2 General patterns of formation of properties.
3.3 Basic properties of construction materials and methods of their assessment.
4. Raw material base for the production of construction materials.
4.1 Natural stone building materials.
4.2 Rocks as the main base for the production of building materials.
4.3 Igneous, sedimentary and metamorphic rocks.
5. Metals and metal alloys used in construction.
5.1 Carbon and alloy steels and cast irons.
5.2 Non-ferrous metals and alloys.
5.3 Steel reinforcement for reinforced concrete structures.
6. Ceramic materials and products.
6.1 Classification of ceramic materials.
6.2 Raw materials. Production of ceramic products.
7. Wood-based materials.
7.1 Features of the structure and properties of wood.
7.2 Properties of wood.
8. Organic binders and materials based on them.
8.1 Bitumen and tars.
8.2 Asphalt concretes and mortars.
8.3 Polymer-based materials.
8.4 Plastics.
9. Mineral binders and materials based on them.
9.1 Classification.
9.2 Air binders (gypsum binders, air lime, magnesia binders, liquid glass, hydraulic lime, Roman cement).
9.3 Hydraulic binders.
9.4 Portland cement and its varieties. Chemical and mineral composition of Portland cement. Types of cements.
9.5 Active mineral additives and cements based on them.
10. Concretes and mortars.
10.1 Materials for the preparation of concrete and mortar.
10.2 Concrete mix.
10.3 Types of heavy concretes and mortars.
10.4 Lightweight concretes on porous fillers.
10.5 Cellular concretes.

10.6 Dry construction mixes.

Reference:
1. BAE 639-Construction Materials.pdf http://iqytechnicalcollege.com›BAE 639-Construction
2. «Construction Materials: Their Nature and Behaviour, Fifth Edition» Marios Soutsos и Peter Domone. https://books.google.ru/books?id=vpdRAAAAMAAJ&hl=ru&source=gbs_navlinks_s
3. «Construction Materials: Their Nature and Behaviour, Fifth Edition» Marios Soutsos и Peter Domone. https://doi.org/10.1201/9781315164595
4. Construction Materials And Equipment 2nd Edition https://engineerrefe.com/book/construction-materials-and-equipment/

2.2. Building structures
2.2.1. Reinforced Concrete Structures
1. Advantages and disadvantages of reinforced concrete structures.
2. Mechanical properties of concrete under compression, tension, and shear. Grades of concrete.
3. Deformational properties of concrete, stress-strain curve, influence of loading conditions, deformation modules.
4. Creep of concrete and its influence on the performance of reinforced concrete structures.
5. Types of reinforcement, stress-strain curve, factors ensuring the bond between reinforcement and concrete.
6. Reinforced concrete beam behavior (without pre-stressing).
7. Flexure theory of reinforced concrete.
8. Basics of the limit state method: groups of limit states, loads and load combinations, normative and design resistances, safety factors.
9. Limit states design method.
10. Doubly reinforcement Beams. Strength verification and reinforcement selection.
11. Calculation of T and I-beams.
12. Causes of inclined crack formation. Influence of shear and principal stresses. Shear stresses in reinforced beams.
13. Critical sections for shear. Shear strength provided by concrete and shear reinforcement.
14. Calculation for crack formation.
15. Opening of normal cracks, influence of various factors, methods to reduce crack opening.
16. compression plus bending of reinforced concrete elements with rectangular cross-section; influence of flexibility, calculation based on deformed state; cases of small and large eccentricities; equilibrium equations.

References:
1. Arthur H. Nilson, David Darwin, Charles William Dolan. Design of Concrete Structures McGraw-Hill Education, 2010. https://construccion.uv.cl/docs/textos/coleccion03/TEXTO.12.DesingofConcreteStructures.pdf
2. Mashhour Ghoneim, Mahmoud El-Mihilmy. Design Of Reinforced Concrete Structure, 2008. https://civiltechnocrats.wordpress.com/wp-content/uploads/2013/11/24317264-24158249-design-of-reinforced-concrete-structure-volume-1-dr-mashhour-a-ghoneim.pdf

2.2.2. Metal Structures
1. Concept of Metal Structures (MS). Advantages and Disadvantages of MS
2. Algorithm for Designing MS. Design Brief and Its Components
3. Structural Scheme of a Single-Story Industrial Building with a Steel Frame. Influence of Thermal Stresses and Displacements on the Structural Scheme
4. Concept of Material Bearing Capacity, Design and Normative Resistance Values. Limit State Method
5. Loads and Effects. Load Combinations
6. Types of Wind Loads
7. Procedure for Selecting Enclosure Structures of MS: Roof, Walls, and Half-Timbered Frames
8. Design Lengths of Structural Elements
9. Truss Calculation in SCAD Software
10. Checks for Truss Elements
11. Global and Local Stability
12. Behavior of Metal Structures Under Load. MS Check According to Limit State Criteria
13. Connection of Metal Structures. Welding. Types of Welds. Advantages and Disadvantages of Welded Connections
14. Connection of Metal Structures. Bolted Connections. Advantages and Disadvantages of Bolted Connections
15. Calculation of Nodes in Metal Constructions. Local Stability Checks
16. Calculation and Design of Intermediate Truss Nodes
17. Calculation and Design of Support Truss Nodes
18. Calculation and Design of Truss Assembly Nodes
19. Analytical Calculation of Roof Truss Elements. Upper Chord
20. Analytical Calculation of Roof Truss Elements. Lower Chord
21. Analytical Calculation of Roof Truss Elements. Braces and Assembly Stand

References:

1. Design of steel structures. Eurocode 3: Part 1-1 – General rules and rules for building/ Luís Simões da Silva, Rui Simões and Helena Gervásio – 2013 – 456 p.
2. Design of steel structures/ S. K. Duggal – 2010 – 181 p.
3. Handbook of structural steelwork. Eurocode edition/ Publication No. 55/13 , BSCA and SCI – 2013 – 454 p.

2.3. Construction technologies

2.3.1 Construction equipment

1.1. Construction machines: basic concepts and structural elements.
1.2. Construction machines for earthworks: bulldozer, scraper, grader. Purpose and scope.
1.3. Single-bucket excavators: "forward shovel", "reverse shovel", "dragline", "grab". Purpose and scope.
1.4. Multi-bucket excavators. Types and purpose.
1.5. Machines for piling. Types and purpose.
1.6. Machines for earthworks in winter conditions. Design features.
1.7. Basic construction cranes, technical specifications, selection methods.
1.8. What is excavation sheeting used for?

2.3.2 Construction methods in Site Works and Foundations

1. What is the nature of the most common type of foundation failure? What are its causes?
2. Explain the differences among sand, silt, and clay, both in their physical characteristics and their behavior in relation to building foundations.
3. Explain the difference between cohesionless soil and a cohesive soil. Give one example of each soil type.
4. Explain the difference between well graded and poorly graded soil. How does their behavior differ?
5. What is a test soil boring and why is it performed?
6. What is excavation sheeting used for? List three different types of excavation sheeting.
7. Under what conditions would you use a watertight barrier instead of well points when digging below the water table?
8. In cold climates, how does the frost line affect the placement of shallow footings?
9. What footing type is an exception to this general principle?
10. What conditions might lead to the choice of a mat foundation for a building?
11. If shallow foundations are substantially less costly than deep foundations, why do we use deep foundations?
12. What soil conditions favor piles over caissons? What type of pile is especially well suited to repair or improvement of existing foundations and why?
13. List and explain some cost thresholds frequently encountered in foundation design.
14. Explain the difference between waterproofing and dampproofing. When is one or the other an appropriate choice for protecting a foundation from moisture?
15. List two types of waterproofing and describe one possible advantage of each.
16. List the components of a typical foundation drainage system and their functions.
17. What is filling? Why is fill placed in lifts?

3. Concrete work technologies

1. What is the difference between cement and concrete?
2. List the conditions that must be met to make a satisfactory concrete mix.
3. List the precautions that should be taken to cure concrete properly. How do these change in very hot, very windy, and very cold weather?
4. What problems are likely to occur if concrete has too low a slump? Too high a slump? How can the slump be increased without increasing the water content of the concrete mixture?
5. Explain how steel reinforcing bars work in concrete.
6. Explain the role of stirrups in beams.
7. Explain the role of ties in columns.
8. What does shrinkage temperature steel do? Where is it used?
9. Explain the differences between reinforcing and prestressing and the relative advantages and disadvantages of each.
10. Under what circumstances would you use pretensioning, and under what circumstances would you use posttensioning?
11. Explain the advantages of using higher-strength reinforcing bars in concrete that requires very heavy reinforcing

References:

1. Fundamentals of Building Construction Edward Allen and Joseph Iano Materials and Methods
2. Construction Methods and Management Stephens W. Nunnally
3. Bryan, Tony Construction technology : analysis and choice / Tony Bryan. – 2nd ed. p. cmc.
4. Fundamentals of Building Construction Edward Allen and Joseph Iano Materials and Methods
5. Concrete Sustainability Hub: web.mit.edu/cshub/ Portland Cement Association: www.cement.org
6. Concrete Reinforcing Steel Institute. Manual of Standard Practice. Schaumburg, IL, Mehta, P. Kumar, and J. M. Monteiro Paulo.
7. Fundamentals of Building Construction Edward Allen and Joseph Iano Materials and Methods

4. Project management

1. Regulation Support for Construction Management.
2. Classification of Construction Facilities.
3. Stakeholders in Construction Field;
4. Management Structures in Construction;
5. Construction Scheduling and Timeline Planning;
6. Labor Management in Construction;
7. Quality Assurance in Construction;
8. Commissioning in Construction;
9. Construction Management Plan (CMP);
10. Economic Efficiency Evaluation of New Energy Vehicle Investment Projects in SAIC
11. Discount factor
12. Static investment payback period
13. Return on Investment
14. Net present value (NPV)
15. Net Present Value Rate
16. Internal Rate of Return (IRR)
17. Break-even Point (BEP)
18. Suggestion
19. Who are the three principal team members involved in the creation of a new building? What are their respective roles?
20. What are construction documents? What two items are they comprised of?
21. What types of subjects are covered by zoning ordinances? By building codes?
22. Compare and contrast design/bid/build and design/build construction.
23. What is the difference between lump-sum and cost plus a fee compensation?
24. What is the critical path? Why is it important to construction scheduling?

References:

1. Kumar Neeraj Jha Construction Project Management: Theory and Practices, 2015. – 219 pp.
2. Gary L. Richardson and Brad M. Jackson Project Management Theory and Practice, CRC Press, 2019. – 637 pp.
3. Mohamed A. El-Reedy Construction Management for Industrial Projects, 2011. – 414 pp.
4. Alberto De Marco Project Management for Facility Constructions, A Guide for Engineers and Architects, 2018. – 203 pp.
5. Fundamentals of Building Construction Edward Allen and Joseph Iano Materials and Methods

Entrance exam assessment criteria

The entrance test is assessed on a 100-point scale and consists of an interdisciplinary exam in the volume of requirements imposed by the state educational standards of the higher education for the level of preparation of a bachelor in a direction corresponding to the direction of a magistracy.
The entrance test is a set of test tasks reflecting questions on the main sections of four disciplines:
Construction materials (25 points);
Building structures (25 points);
Construction technology (25 points);
Project management (25 points).

Types of test tasks
By the method of answering, test tasks can be of the following main types: - closed test questions, in which the applicant must choose one correct answer from the proposed options;
The test questions are divided into four blocks:

Block 1. Construction materials (25 points).

Number of test tasks– 5, including:
- closed test questions – 5.

Block 2. Building structures (25 points).
Number of test tasks– 5, including:
- closed test questions – 5.

Block 3. Construction technology (25 points).
Number of test tasks– 5, including:
- closed test questions – 5.

Block 4. Project management (25 points).
Number of test tasks– 5, including:
- closed test questions – 5.

Total points - 100 points.
Evaluation criteria
For each correctly solved closed test task, 5 points are awarded. If all answer options in the test task are marked as correct, points for the test task are not awarded.

Assigned group

Chair of the Subject Examination Board:
Director of ICE M.V. Petrochenko
Authors:
Ph.D., Associate Professor HSIC&RC Strelets K.I.
Ph.D., Associate Professor HSIC&RC Ptukhina I.S.
Senior Lecturer HSIC&RC Belyaeva S.V.
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