Entrance tests

Specialty 05.23.01 - Building structures and buildings

1. Typology of architectural structures and the respective requirements.
2. Basic provisions for the layout of load-bearing and enclosing structures of civil and industrial buildings. The modular system. The technological effectiveness of production and installation. Ensuring the rigidity and stability of the building.
3. The basic requirements for the bearing and enclosing structures of industrial and agricultural buildings. The problems of resource saving in construction.
4. Fire safety. Principal provisions. Fire safety requirements in the choice of space-planning, architectural and structural solutions for buildings. The fire-engineering classification of buildings, premises, structures and production processes. The fire resistance rating of building, premises structures and its criteria. The fire resistance requirements for structures.
5. Designing thermal protection of buildings. The basic design concept. The thermal protection rate setting. The calculation of resistance to the heat transfer of enclosing structures. The rules for the rational thermal protective shell design.
6. Construction lighting. The basic concepts and laws of light engineering. The concept of the natural illumination coefficient and the basic principles of its calculation.
7. The sound insulation of enclosing structures and its calculation.
8. The main load-bearing and enclosing structures of buildings, their classification, the relationship of structural solutions with the materials of structures. Advantages and disadvantages of different types of structures. The rational areas of application of structures. The rational areas of application of structures from various materials.
9. The classification of structures by the methods of erection; the influence of methods of erecting buildings on their constructive solutions.
10. Selection of the type and material of structures, depending on the purpose and capital of buildings and structures, the conditions of construction and operation, and their economic efficiency.
11. Description of the requirements for the construction of residential and public buildings as well as the structures of special facilities, e.g. towers, pillars, pipes, silos, tanks etc.
12. Specific requirements and design solutions for buildings and structures erected in seismically hazardous areas, on subsidence grounds, over mine workings, in harsh conditions of the North under permafrost, in dry and hot climates, in remote, undeveloped and hard-to-reach areas.
13. The frameworks of multi-storey civil and one-storey industrial buildings. Ensuring geometric unchangeability and stability of the scheme. The main structural elements. Rules for the rational choice of the framework material.
14. The macro- and microstructure of building materials. Heterogeneity, continuity and anisotropy. Moisture absorption. Thermal conductivity. Temperature-humidity deformations. Frost resistance. Corrosion resistance. Soundproofing. Sound absorption.
15. The strength of materials in tension, compression, shear, transverse bending and torsion; at static short-term and long-term influences, and also at cyclic and dynamic influences. The crack resistance of materials.
16. Diagrams to show the performance of building materials and their main characteristics, i.e. elasticity, creep, relaxation and plasticity. Elasticity modules of. Poisson’s ratio.
17. Statistical processing and evaluation of the results of material testing based on samples. Planning experiments.
18. The basic physical and mechanical properties of concrete and reinforcement; reinforced concrete; the experimental fundamentals of the theory of resistance of reinforced concrete.

19. The main stages in the development of methods for calculating building structures. The calculation methods for allowable stresses, destructive loads and limiting states. Communication and the fundamental difference between these methods.
20. The method of calculation by limiting states. The classification of limit states. Types of loads, load reliability factors and load combination factors. Coefficients of reliability for the material, coefficients of working conditions. Regulatory and design resistance.
21. Loads per unit length. The physical meaning of the load, the definition of the load.
22. The statistical approach to the calculation of building structures. The random nature of the calculated quantities and their distribution. Average dispersion values and standards. The statistical nature of the safety factor. The reliability, durability and economy of structures.
23. Evaluation of the strength of building structures in simple and complex stress states. The strength theory. The plasticity, brittle fracture and fatigue criteria.
24. The constructive and design schemes for frames. The rules for compiling a design scheme based on a structural layout. Methods for calculating frames. The centrally compressed solid and through columns. Eccentrically compressed solid and through elements. The calculation procedure.
25. Limiting states and calculation of the centrally compressed and centrally stretched elements.
26. Truss. Determining the loads on the truss. Methods for determining the forces in the elements of a truss. An approximate method for determining the forces in the belts of a truss. Features of the calculation of trusses when the truss is rigidly interfaced with the pillar.
27. Types of cross sections of elements of light trusses. Advantages of thin-walled bent welded sections in comparison with angular sections, selection of the sections of truss elements.
28. The structural plates. Granite conditions for supporting the contour, determining the forces in the elements of the structure.
29. Steel rope roofs. Determination of the force in the cables, the selection of the cable section.
30. Membrane coatings. Determination of forces in the membrane shell. Calculation of the outer and inner rings.
31. The arched constructions, types of arches. Features of arches calculation.
32. The basics of the computer-aided calculation of building structures. Numerical methods. The matrix form for calculating building structures. The finite element method and its connection with the basic methods of structural mechanics.
33. The optimal design and design criteria.
34. Fundamentals of the plasticity theory and the calculation of building structures beyond the elastic limit. The theories of small elastoplastic deformations. Simple loading. Unloading. The ideal elastoplastic material and yield condition. Extreme variational principles. Bending of beams of elastoplastic material. The limit state of continuous beams and frames. Plasticity hinges. The joint action of several force factors and the external environment.

Specialty 05.23.17-Construction mechanics

1. The concept of the design scheme of structures. The classification of design schemes of structures. The kinematic and static analysis of design schemes. The geometrically unchangeable system formation principles.
2. The calculation of composite beams for a fixed load. The scheme of interaction between parts of beams. The calculation method. The rational placement of hinges.
3. The concept of moving loads. The lines of influence of reactions and efforts. Determination of the forces in the beams along the lines of influence from the stationary and mobile loads.
4. The calculation of flat trusses. The formation of trusses. The calculation schemes for trusses. Determination of forces in the rods of trusses at fixed loads.
5. The construction of the lines of influence of forces in the rods of trusses. Determination of effort along the lines of influence.
6. The formation of three-hinged systems. The calculation of the simplest three-hinged frames. The formation and calculation of composite frames.

7. The calculation of three-hinged arches. A rational outline of the arch axis. Features of calculating tied arches.
8. Displacements and their notation. The action of external and internal forces. The potential energy of the elastic system. The principle of possible displacements. The theorems on reciprocity of work and reciprocity of displacements.
9. The general method for determining the displacements. Methods for calculating the Mohr integral. Determination of movements from temperature changes and movement of supports. The matrix form of the definition of displacements.
10. The properties of statically indeterminate systems. The redundancy degree. The essence of the force method. The basic system. The canonical equations of the force method.
11. The calculation of continuous beams with the force method. The rational basic system. The construction of M and Q diagrams. Calculation checks.
12. The procedure for calculation of statically indeterminate frames with the force method. The construction of diagrams M, Q, N. Deformation and static checks. Determination of displacements in statically indeterminate systems.
13. The matrix form of the force method. The calculation of workshop frames with a computer.
14. The calculation of statically indeterminate planar trusses with the force method in ordinary and matrix forms.
15. The calculation of statically indeterminate truss beams with the force method in ordinary and matrix forms.
16. The calculation of two-hinged arches with the force method in the usual form. The role of tightening in the distribution of effort in the arch.
17. The calculation of hingeless arches with the force method in the usual form. The use of symmetry.
18. The essence of the displacement method and the main assumptions. Unknown and the degree of kinematic uncertainty. The basic system. The canonical equations of the displacement method.
19. The features of the calculation of frames with inclined pillars and broken bolts. The diagram of movements of the frame units.
20. The determination of reactions in bonds by multiplying the diagrams.
21. The use of symmetry in the calculation of beams and frames with the displacement method.
22. The matrix form of the displacement method.
23. The calculation of beams and frames on the movement of supports and temperature effects. Uniform and uneven heating of elements of planar rod systems.
24. The out-of-balance moment distribution method.
25. The essence of the mixed method. The main system, unknown and canonical equations. The theorem on the reciprocity of reactions and displacements.
26. The essence of the finite element method. Basic concepts and notation. The stiffness matrix of the finite element.
27. The vector of reactions from external loads. The transformation of vectors and matrices into a common coordinate system.
28. Implementation of the finite elements method on a computer in the calculation of flat frames.
29. The calculation of rectangular plates by the finite elements method. The matrix of moments. The stiffness matrix. The vector of reactions from loads.
30. The stability concept of buildings. Methods for studying stability. The critical force. The stability of systems with one and several degrees of freedom. The stability of straight rods.
31. Solving the problem of a squeezed-bent rod.
32. The stability of flat frames. The method of solving problems by the displacement method.
33. The stability of complex frames with linearly fixed knots. An approximate solution of problems.
34. The stability of complex frames with linearly movable knots. An approximate solution of problems.

35. Dynamic loads. The degree of freedom of structures. Types of oscillations. Methods for solving dynamic problems.
36. Free and forced oscillations of systems with one degree of freedom. Dynamic coefficient. The resonance phenomenon.
37. Free and forced oscillations of systems with a finite number of degrees of freedom. The spectrum of frequencies and the main forms of free oscillations. Constructing dynamic epures.
38. Free oscillations of beams and frames with distributed mass. Differential equation of motion and its integration. Application of special functions. The method of initial parameters.
39. Forced oscillations of beams and frames with a distributed mass of rods. The calculation by the displacement method. Tables of special functions. Calculation checks.
40. Experimental methods of construction mechanics. The tensometry method.
41. Experimental methods of construction mechanics.
The polarization and optical method.
42. Experimental methods of construction mechanics. Application of photoelastic coatings, the moire-fringe technique. The holographic interferometry method.