Undergraduate track program: Urbanism and civil engineering

1. Olympiad winner's skill set

To win the Olympiad, you should have a comprehensive understanding of history, geography, and social science that encompasses:

- The humanitarian aspects of urbanism and civil engineering;
- The basic principles of physics, chemistry, mathematics, and computer science for presenting the natural structure of urban design objects;
- A clear understanding of the urban environment, infrastructure elements, and the processes involved in construction and design;
- Knowledge of urban planning objects, including architectural, historical, and cultural elements.

You should also have a solid command of the following skills:

- Understanding the history of architecture and construction, identifying building types, and comprehending the main structural elements of architectural space;
- Navigating cartography and topography with ease, and being aware of environmental control measures and the transport and planning structure of the city;
- Grasping the basic physical and mechanical properties of building materials and their operational requirements;
- Introducing the design of urban objects and spaces that meet the needs of modern society.

2. List of degree programs covered by the subject area

2.1 List of master's programs

08.03.01 Construction
07.03.01 Architecture
07.03.04 Urban planning
07.03.02 Reconstruction and restoration of architectural heritage
07.03.03 Architectural environment design
38.03.10ousing and communal infrastructure

3. Content

Civil engineering and construction
History of architecture and construction. Urbanism and urban environment. Classification of buildings. Structural elements of buildings. Architectural shapes. Thermal engineering in construction

Construction technology
Basics of technological processes in construction. Basic technologies for building construction. Modern technologies in the construction industry.

Road Construction

Transport system and its modern structure. Cartography and topography. Environmental protection and transport. Transport and planning structure of the city. Mathematical ratios in transport problems. Graph theory.

Mechanics
Kinematics. Dynamics. Statics. Oscillations and waves

Materials Science – assessment and testing
Physical and mechanical properties of building materials. Assessment of the technical condition of building elements and testing methods. Operational requirements for materials, buildings and elements of capital construction objects. Technology for assessing completed construction works

4 Recommended sources

4.1. Reading list

Civil engineering and construction

Sources in English	Topic
Kostof Spiro. A history of architecture / SpiroKostof. New York : Oxford University Press, 1985. - 788 p.: URL://https://archive.org/details/historyofarchite0000unse_u4t3 (free access).	History of architecture and construction
Macionis, John J. Cities and urban life. Pearson education, Inc., 2010 . p 456. URL: . https://books.google.ru/books/about/Cities_and_Urban_Life.html?id=5aKRPwAACAAJ&redir_esc=y (free access).	Urban studies and urban environment.
Moughtin J. C. Urban Design: Street and Square / J. C. Moughtin, Cliff Moughtin. - Architectural Press, 2003..320 p. URL: .https://www.academia.edu/12652620/URBAN_DESIGN_STREET_AND_SQUARE (free access).	Urban studies and urban environment.
Sudzic Dejan. B as Bauhaus: The ABC of the modern world. - Moscow, 2017.- Publishing house Strelka Press. 400 p. URL: https://archi.ru/lib/book.html?id=2146113557&fl=2&sl=2 (free access).	Urban studies and urban environment.

Sources in Russian	Corresponding topic

Ананьин М. Ю. Основы архитектуры и строительных конструкций: термины и определения : учебное пособие. Уральский федеральный университет им. первого Президента России Б. Н. Ельцина .— Екатеринбург : Издательство Уральского университета, 2016 . 134 с. URL://https://biblioclub.ru/index.php?page=book&id=688975 (free access).	Classification of buildings Structural elements of buildings
Глазычев В. Л. Урбанистика: монография. М. : Европа, 2008 . 220 с. URL://https://biblioclub.ru/index.php?page=book&id=44909 (free access).	Urban studies and urban environment.
Куликов А. С. История архитектуры: учебное пособие. 1. Всеобщая история архитектуры. Тамбов: Тамбовский государственный технический университет (ТГТУ), 2017 . 108 с. : URL://https://biblioclub.ru/index.php?page=book&id=499405 (free access).	Classification of buildings Structural elements of buildings
Скрябин В.И. Курс лекций по теплотехнике. URL://https://www.c-o-k.ru/library/document/597/13612.pdf?ysclid=lyx521mkl0498702597 (free access).	History of architecture and construction
Стецкий, С. В. Архитектура и строительство. Вводный курс: учебное пособие. М,: Директ-Медиа, 2021 . 308 с. URL://https://biblioclub.ru/index.php?page=book&id=613834 (free access).	Thermal engineering in construction
Фролов, А. А. Строительные конструкции : учебное пособие. Минск : РИПО, 2021 . 284 с. URL://https://biblioclub.ru/index.php?page=book&id=697186 (free access).	Classification of buildings. Structural elements of buildings. Architectural shaping

Construction technology

Sources in English	**Corresponding topic**
Construction: Building the Future URL: https://www.spotblue.com/wiki/construction/ (free access)	Fundamentals of technological processes in construction

CivilJungle. URL: https://civiljungles.com/construction-technology/ (free access).	Modern technologies in the construction industry
Technology Education. URL:// https://technologyeducation.org/building-2024-exploring-new-technology-in-construction/ (free access).	Basic technologies for building construction

Sources in Russian	**Corresponding topic**
Иванчук Е.В. Технологические процессы и механизация в строительстве. Ростов н/Д: Рост. Гос. Строит. Ун-т, 2022. 175 с. URL://https://de.donstu.ru/CDOCourses/structure/_new_/2026272/6116.pdf (free access).	Fundamentals of technological processes in construction
Рыжевская, М. П. Технология строительного производства : учеб. Минск : РИПО, 2019. 495 с., [24] л. URL:// https://studylib.ru/doc/6426259/ryzhevskaya-m.p.-tehnologiya-stroitel._nogo-proizvodstva (free access).	Modern technologies in the construction industry
Современные технологии производства. Портао о строительных технологиях. URL:// https://extxe.com/13342/osnovy-tehnologii-stroitelnogo-proizvodstva/ (free access).	Modern technologies in the construction industry
Технология и организация строительного производства: учебно-методическое пособие. Воронеж : Издательско-полиграфический центр «Научная книга», 2021. 76 с/ URL:// https://cchgeu.ru/upload/iblock/30f/nkeej1ty3l2ye2o7w100kpezxat889ug/Tekhnologiya-i-organizatsiya-stroitelnogo-proizvodstva.pdf?ysclid=m08191w3cf73778142 (free access).	Basic technologies for building construction

Construction technology

Sources in English	**Corresponding topic**
Construction: Building the Future URL: https://www.spotblue.com/wiki/construction/ (free access)	Fundamentals of technological processes in construction
CivilJungle. URL: https://civiljungles.com/construction-technology/ (free access)	Modern technologies in the construction industry

Technology Education. URL:// https://technologyeducation.org/building-2024-exploring-new-technology-in-construction/ (free access).	Basic technologies for building construction

Sources in Russian	**Corresponding topic**
Иванчук Е.В. Технологические процессы и механизация в строительстве. Ростов н/Д: Рост. Гос. Строит. Ун-т, 2022. 175 с. URL://https://de.donstu.ru/CDOCourses/structure/_new_/2026272/6116.pdf (free access).	Fundamentals of technological processes in construction
Рыжевская, М. П. Технология строительного производства : учеб. Минск : РИПО, 2019. 495 с., [24] л. URL:// https://studylib.ru/doc/6426259/ryzhevskaya-m.p.-tehnologiya-stroitel._nogo-proizvodstva (free access).	Basic technologies for building construction
Современные технологии производства. Портао о строительных технологиях. URL:// https://extxe.com/13342/osnovy-tehnologii-stroitelnogo-proizvodstva/ (free access).	Modern technologies in the construction industry

Road Construction

Sources in English	**Corresponding topic**
Hutchinson, B. G. Principles of urban transport systems planning Washington, Scripta Book Co. 1974. 474 p. URL://https://www.civil.iitb.ac.in/~dhingra/ce751/hutchinson.pdf (free access).	Transport and planning structure of the city
Dr. Jean-Paul Rodrigue . Climate Change and the Adaptation of Transport Infrastructure. In: The Geography of Transport Systems. 2024. URL://https://transportgeography.org (free access).	Environmental protection and transport
Harata, N. Fundamentals of “Transportation-Oriented Urban Planning”. In: Horita, M., Koizumi, H. (eds) Innovations in Collaborative Urban Regeneration. C SUR-UT Series: Library for Sustainable Urban Regeneration, vol 6. Springer, Tokyo. 2014. https://doi.org/10.1007/978-4-431-99264-6_3 (free access).	Transport and planning structure of the city

Sources in Russian	**Corresponding topic**
Градостроительное проектирование: Учебник для вузов. Л.Н. Авдотьин, И.Г. Лежава, И.М. Смоляр. М. Стройиздат. 1990 г.	Transport system and its modern structure

Sources in Russian	Corresponding topic
URL://https://books.totalarch.com/n/0838 (free access).	
Картография с основами топографии: учебно-методическое пособие. Кызыл: Изд-во ТувГУ, 2020. 92 с. URL:// https://tuvgurep.elpub.ru/xmlui/bitstream/handle/123456789/420/картография%20с%20основами%20топографии.pdf?sequence=1&isAllowed=y (free access).	Cartography and topography
Курант Р., Роббинс Г. Что такое математика? — 7-е изд., стереотипное. М.: МЦНМО, 2015. 568 с. URL: https://azbyka.ru/deti/wp-content/uploads/2021/09/chto-takoe-matematika.-kurrant-robbins.pdf (free access).	Cartography and topography
Основы QGIS для градостроителей : практикум / А.Г. Бурцев; М-во науки и высшего образования РФ. Екатеринбург : Изд-во Урал. ун-та, 2021. 185, [1] с. URL:// https://elar.urfu.ru/handle/10995/105750 (free access).	Environmental protection and transport
Омельченко А. В. Теория графов. М.: МЦНМО, 2018. 416 с. URL: https://publ.lib.ru/ARCHIVES/O/OMEL'CHENKO_Aleksandr_Vladimirovich/%CE%EC%E5%EB%FC%F7%E5%ED%EA%EE%20%C0.%C2._%20%D2%E5%EE%F0%E8%FF%20%E3%F0%E0%F4%EE%E2.(2018).pdf (free access).	Transport and planning structureof the city

Mechanics

Sources in English	Corresponding topic
Online Textbook | Classical Mechanics - MIT OpenCourseWare. URL://https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/pages/online-textbook	Kinematics Dynamics Statics Oscillations and waves
Physics: Principles with Applications. Global Edition by Douglas C. Giancoli. URL://https://people.vts.su.ac.rs/~ognjen/Inz_fizika2/Physics%20Principles%20with%20Applications,%20Global%20Edition%20(Douglas%20Giancoli)%20(z-lib.org).pdf	Kinematics Dynamics Statics Oscillations and waves
Schaum's Outline of Theory and Problems of Applied Physics. URL://https://kishorekaruppaswamy.wordpress.com/wp-content/uploads/2011/10/applied-physics.pdf	Kinematics Dynamics Statics Oscillations and waves

Sources in Russian	Corresponding topic
Механика : учебное пособие для студентов высш их. учебных заведений, обучающихся по техническим направлениям подготовки и специальностям. Тамбов : Изд-во ФГБОУ ВПО «ТГТУ», 2015. 248 с. URL:	Kinematics Dynamics Statics Oscillations and waves

Sources in Russian	Corresponding topic
https://tstu.ru/book/elib/pdf/2015/bars-t.pdf?ysclid=m0832t801x998972482 (free access).	
Савельев И. В. Курс общей физики. В 3 томах. Том 1. Механика. Молекулярная физика. Санкт-Петербург: Лань, 2023. 436 с. . URL: http://www.physics.gov.az/book_K/SAVELEV_I.pdf (free access).	Kinematics Dynamics Statics Oscillations and waves
Яковлев И.В. «ФИЗИКА. Полный курс подготовки к ЕГЭ» М. 2016.- 509 стр. ЦНМО. URL: https://mathus.ru/phys/book.pdf (free access).	Kinematics Dynamics Statics Oscillations and waves

Characterization & testing

Sources in English	Corresponding topic
Borodov, V. E. Fundamentals of reconstruction and restoration: reconstruction of buildings and structures: textbook. 1. Assessment of the technical condition of buildings and structures . Yoshkar-Ola: Volga State Technological University, 2017. - 199 p. URL:https://biblioclub.ru/index.php?page=book&id=483722 (free access).	Physical and mechanical properties of building materials
Materials Science: textbook on materials science in English Collection of texts and exercises in English on the topic “Materials Science”. Moscow: 2018. 213 pp. URL:https://infourok.ru/materials-science-sbornik-tekstov-i-uprazhneniy-na-angliyskom-yazike-po-teme-materialovedenie-2848558.html (free access).	Technology for assessing completed construction works
Methodology for Assessing the Technical Condition of Buildings and Structures Using the Reliability Criterion. 2022. 129 p. DOI: 10.11648/j.ajce.20221006.13. https://doi.org/10.4028/p-mbgy1w (free access).	Assessment of the technical condition of building elements and testing methods

Sources in Russian	Corresponding topic
Калинин В. М. Оценка технического состояния. М.: Инфра-М, 2016. 267 с. URL://https://znanium.ru/catalog/document?id=415590 (free access).	Physical and mechanical properties of building materials
Соколов Г.К. Технология и организация строительства: учебник для студ. СПО. – М.: Академия, 2008 - М.:528 с. Режим доступа: электронная библиотечная система «Университетская библиотека ONLINE», требуется авторизация ISBN 978-5-7695-8. URL://https://obuchalka.org/2015032483537/tehnologiya-stroitelnogo-proizvodstva-sokolov-g-k-2008.htm (free access).	Assessment of the technical condition of building elements and testing methods
Строительные материалы (Материаловедение и технология) : учеб. для студентов вузов ... по строительным специальностям. М: Изд-во АСВ, 2002.	Operational requirements for materials, buildings and elements of capital construction objects

Sources in Russian	Corresponding topic
536 с. URL://https://bigenc.ru/b/stroitel-nye-materialy-048737 (free access).	

4.2. Recommended online-courses
Civil engineering and construction

Online-courses in English	Link	Summary
Historical Monuments in the World	https://stepik.org/course/181095/promo?search=5050198854	This course explores significant historical monuments across the globe, examining their cultural, architectural, and historical importance. By studying various landmarks, students gain a deeper understanding of global heritage and the impact of historical preservation.
BIM: from sketch to digital twin	URL://https://openedu.ru/course/spbstu/BIM/	This course is designed to provide participants with fundamental skills in Building Information Modeling (BIM). It offers comprehensive training in the creation of architectural and construction projects, the development of detailed architectural and construction drawings, and the formulation of construction schedules. Participants will gain proficiency in utilizing advanced software systems such as Autodesk Revit and Navisworks, equipping them with the necessary tools to efficiently manage and optimize the design and construction processes in a professional setting.
City Design	URL://https://stepik.org/course/43/promo?search=4777805584	The course introduces the basics of urban systems

Online-courses in Russian	Link	Summary
Guide to the History of Architecture	https://online.synchronize.ru/architecture/architectureguide?sysclid=m09t3kp9av577653731	The course covers various architectural styles and studies the history of architectural development from ancient Greek temples to modern high-rise buildings. The goal of the course is to teach how to distinguish architectural styles and navigate the most important names in the world of architecture; highlight the main structural elements of

		buildings; determine the time when a particular building was built, and understand the patterns of architectural development.
Fundamentals of architecture and building structures	URL://https://openedu.ru/course/urfu/ARCHC/?session=spring_2024	This course is designed to provide participants with basic skills in Building Information Modeling (BIM). It offers comprehensive training in the creation of architectural and construction projects, the development of detailed architectural and construction drawings, and the formulation of construction schedules. Participants will gain proficiency in utilizing advanced software systems such as Autodesk Revit and Navisworks, equipping them with the necessary tools to efficiently manage and optimize the design and construction processes in a professional setting.
Fundamentals of architecture and building structures": electronic course / I.N. Maltseva [et al.]; UrFU, Yekaterinburg; 2021; (Electronic edition)	URL://https://openedu.ru/course/urfu/ARCHC/	The content introduces solutions for various aspects related to the use of innovative building materials and technologies aimed at enhancing building comfort and saving energy resources for heating and air conditioning. The course is focused on addressing professionally significant tasks, fostering the development of students' design thinking, and forming users' architectural and construction knowledge and skills necessary for their further professional activities, as well as for improving overall competence in the architectural and construction field.
Heat engineering	https://openedu.ru/course/urfu/TEPL/?ysclid=m09rrkeoyd220361634	This course covers the basics of technical thermodynamics and the theory of heat transfer and heat exchange.

Construction technology

Online-courses in English	**Link**	**Summary**
City Design	URL://https://stepik.org/course/43/promo?search=4777805584	The course is devoted to digital methods of studying the object of civil engineering. The theoretical

		aspects of building information modeling (BIM) technology, architectural design technologies, and how they have replaced each other in recent years are considered
Civil 3D Mastery: Comprehensive Guide from Basics to Advance	https://stepik.org/course/200974/promo?search=5050071018	The aim of the course is to provide a broad understanding of the phenomena affecting the resistance of structures to damage and collapse caused by earthquakes. The scientific methods underlying the analysis of the behavior of structures under seismic loads are based on first principles.
Structural Dynamics	URL://https://stepik.org/course/172763	The course introduces the basics of the structure of urban systems.

Online-courses in Russian	**Link**	**Summary**
Basics of Building Design FREE	URL:// https://stepik.org/course/91085/promo	A course on the construction of buildings and structures.
Construction for beginners in 3 days.	URL:// https://intensive.skillbox.ru/construction/	A brief introduction to construction technologies.
Construction process technologies	https://stepik.org/course/132341/promo?search=5050046146	The course introduces the basics of technological design and construction processes.

Road Construction

Online-courses in English	**Link**	**Summary**
Fundamentals of Earth Remote Sensing and Geographic Information Systems	URL://https://stepik.org/course/170081/promo	The course is aimed at studying methods of mapping and data analysis.
Geography of Russia (Online School by European Gymnasium)	URL://https://stepik.org/course/82658/promo?search=4777815738	The course is aimed at developing an understanding of the federal structure of the Russian Federation, and its geographical and natural features.
Modeling Urban Ecosystems	URL://https://stepik.org/course/172614	The course aims to improve the understanding of the properties, processes, functions, and services of urban ecosystems. During the course, students will examine existing approaches to ecological modeling in terms of their applicability to urban ecosystems. Theory and practice of statistical,

		GIS, and process modeling will be presented through case studies of ecological processes and risks, e.g. air and soil pollution or climate change. The goal of the course is to provide a better understanding of the interactions between urban residents and the urban environment and to provide a relevant tool for analyzing and modeling these interactions and their consequences.

Online-courses in Russian	**Link**	**Summary**
Basic engineering training	https://stepik.org/course/103610/promo?search=5050222689	The course is aimed at the formation and development of spatial geometric thinking, an ability essential for design and technological activities
"Ecological monitoring of the urban environment"	URL://https://openedu.ru/course/msu/ECOMONITORING/?session=spring_2024	The course is aimed at mastering a system of knowledge about environmental monitoring of the urban environment, focusing on assessing and controlling the state of the environment to ensure its quality
Online school for TSU applicants: Geography	URL://https://ido.skills.tsu.ru/course/view.php?id=129	The course is designed to present the structure of the Earth, including topographic maps of the terrain.

Mechanics

Online-courses in English	**Link**	**Summary**
Introduction to middleschool physics	URL://https://www.khanacademy.org/science/ms-physics/x1baed5db7c1bb50b:movement-and-forces/x1baed5db7c1bb50b:representing-motion/v/introduction-to-middle-school-physics	This course will provide the student with a basic understanding of the physical laws, covering topics from forces and motion to energy and waves.
Mostly Physics	URL://https://www.youtube.com/@mostlyphysics	A series of videos for students studying general physics.
Physics 1 Course - Algebra Based - Unit 1 Displacement, Velocity, Vectors & Scalars	https://www.mathtutordvd.com/public/Physics-1-Course-Unit-1Displacement-Velocity-Vectors-Scalars.cfm	A series of videos for students studying general physics.

Online-courses in Russian	Link	Summary
Unified State Exam Physics 2025 "Mechanics"	https://stepik.org/course/100318	The course is dedicated to preparation for the Unified State Exam in Physics.
Preparation for the Unified State Exam in Physics (intensive course)	https://stepik.org/course/672/promo?search=5050257072	This course is designed for intensive preparation for the Unified State Exam in Physics.
Advanced and Olympiad Physics	https://stepik.org/course/3594/promo?search=5050248316	The practical course is aimed at expanding, deepening and systematizing knowledge and skills in solving physics problems, ranging from basic tasks to Olympiad-level challenges.

Characterization & testing

Online-courses in English	Link	Summary
Advanced Composite Materials: Chemistry and Applications	URL://https://stepik.org/course/107500	This course explores advanced composite materials, focusing on their chemistry and practical applications.
Application of magnetic materials	URL://https://stepik.org/course/50377/promo?search=4777775605	The course covers the full range of topics related to magnetocaloric phenomena, associated materials, and device prototypes.
Multiferroic and ME composite materials	https://stepik.org/course/50378/promo?search=4983076389	This course provides an in-depth exploration of multiferroic and magnetoelectric (ME) composite (smart) materials. It covers their key characteristics, production technologies, research methods, and mechanisms for property formation, as well as the physical principles involved in their creation.

Online-courses in Russian	Link	Summary
General chemistry	URL://https://openedu.ru/course/misis/CHM/?session=spring_2024	The course provides modern ideas about the structure of matter, the relationship between the structure and properties of inorganic compounds, and the regularities of property changes based on the position of the

		constituent elements in the Periodic Table and the nature of the chemical bonding. The course also covers the application of the kinetic and thermodynamic approaches to describe processes used in practice.
Fundamentals of calculation of building structures	URL://https://openedu.ru/course/spbstu/BASBUILD/?session=spring_2024	The course provides an understanding of the diversity of building structures, both in terms of materials and construction schemes.
General Chemistry: Demonstration Experiments (Appendix to the online course "General Chemistry")	https://openedu.ru/course/misis/DEM/?session=fall_2024	The course provides modern ideas about the course of chemical reactions.