Master's, Doctoral and Post-doctoral Track Program: Urbanism and Civil Engineering

1. Open Doors winner's skill set

To win the Open Doors competition in this track you should have in-depth knowledge and skills in various areas, namely:

- mechanical systems, stresses, strains, forces and displacements of building structures and design solutions for structures, buildings and facilities;
- basics of construction technology;
- basics of highway engineering;
- basics of urban planning, social aspects of urban planning and modern trends in digitalization.

The winner should have a solid command in the following skills:

- calculating stiffness, strength and stability of structural elements, buildings and structures (tension-compression, torsion, shear, bending, combined loading);
- be able to implement a simplified design scheme and analytical dependencies of element operation, design and quality control of construction materials;
- be able to design the main road elements;
- use principles of urban area development and transportation infrastructure design.

2. List of degree programs covered by the subject area

2.1. List of doctoral degree programs

2.1.1 Construction of buildings and facilities
2.1.2 Foundation and underground structures
2.1.5 Civil engineering materials and products
2.1.7 Civil engineering technology and organization
2.1.8 Design and construction of roads, subways, airfields, bridges and transport tunnels
2.1.13 Urban and rural settlement planning
2.1.14 Life cycle management of construction projects

2.2. List of master's degree programs

07.04.04 Urban planning
08.04.01 Civil Engineering
38.04.10 Housing Management and Municipal Infrastructure

3. Content

Field of science 1. Civil Engineering

1. Basis of building structural systems and their structural components
2. Design basis for timber structures
3. Design basis for steel structures
4. Design basis for reinforced concrete structures
5. Buckling of structural components

Field of science 2. Construction Technology

1. Building and structure construction technologies

Monolithic construction
Panel and block construction
Modular and frame construction

2. Methods and technologies for quality control of construction works

Non-destructive and destructive testing methods
Automation of quality control processes
3. Organization of construction production and project management
Planning of construction production
Construction project management
Building information modeling (BIM)
4. Economic efficiency and optimization of construction projects
Cost reduction without compromising quality
Construction logistics optimization
Risk management in construction
5. Sustainable construction and environmental aspects
Energy saving and energy efficiency of buildings and structures
Use of renewable energy sources
Implementation of green building principles

Field of science 3. Mechanics

1. Main types of stress state (tension and compression, bending, torsion, shear)
2. Combined loading
3. Mechanical properties of structural materials
4. Fundamentals of structural mechanics
5. Fundamentals of structural dynamics
6. Buckling

Field of science 4. Highway Engineering

1. Road horizontal alignment design
2. Road vertical alignment design
3. Road cross-section design
4. Subgrade design

Field of science 5. Urbanism

1. History of urban space development. Main schools and theories of urban studies
2. Models of modern cities. Problems and trends in urban environment development
3. Social sphere of the city
4. Pedestrian and transport infrastructure of the city
5. Green spaces in the urban environment
6. Digitalization processes in modern urban studies

4. Preparation materials

4.1 Recommended reading

Field of science 1. Civil Engineering

Reading list in English
1. Lingyu Zhou, Liping Wang, Liqiang Jiang. Design of Steel Structures. Materials, Connections, and Components 1st Edition - August 12, 2022. https://shop.elsevier.com/books/design-of-steel-structures/zhou/978-0-323-91682-0
2. Swedish Wood, Design of Timber Structures, ISBN 978-91-985212-5-2 https://www.swedishwood.com/siteassets/5-publikationer/pdfer/sw-design-of-timber-structures-vol1-2022.pdf https://www.swedishwood.com/siteassets/5-publikationer/pdfer/sw-design-of-timber-structures-vol2-2022.pdf

https://www.svenskttra.se/siteassets/5-publikationer/pdfer/design-of-timber-structures-3-2016.pdf
3. Yining D., Xiliang N. Reinforced Concrete: Basic Theory and Standards. Press and Springer Nature Singapore Pte Ltd. 2023. https://doi.org/10.1007/978-981-19-2920-5

Field of science 2. Construction Technology

Reading list in English
1. Abe Kruger, Carl Seville. Green building: principles and practices in residential construction (Go green with renewable energy resources), 2012. 608 p. https://www.amazon.com/Green-Building-Principles-Practices-Residential/dp/1111135959
2. Adrienne Watt. Project Management. 2nd Edition", 2014. 200 p. https://opentextbc.ca/projectmanagement/
3. Alan Griffith and Paul Watson. Construction Management: Principles and Practice, 2004. 508 p. https://link.springer.com/book/10.1007/978-0-230-50021-1
4. Amitava Mitra. Fundamentals of Quality Control and Improvement, 2008. 700 p. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118491645
5. Donald Towey. Cost Management of Construction Projects, 2013. 336 p. https://www.amazon.com/Management-Construction-Projects-Donald-Towey/dp/1118473779
6. E. Keith Blankenbaker. Construction and Building Technology, 2013. 608 p. https://www.g-w.com/construction-building-technology-2013
7. How to Enhance Quality Control in Construction Management, 2024 https://www.constructionplacements.com/enhancing-quality-control-construction-management/
8. Introduction to Construction Management, Routledge. 2022, 138 p. https://www.routledge.com/rsc/downloads/An_Introduction_to_Construction_Management.pdf#:~:text=URL%3A%20https%3A%2F%2Fwww.routledge.com%2Frsc%2Fdownloads%2FAn_Introduction_to_Construction_Management.pdf%0AVisible%3A%200%25%20
9. James J. O'Brien. Construction Inspection Handbook: Quality Assurance/ Quality Control, 1989. 773 p. https://link.springer.com/book/10.1007/978-1-4757-1191-2?page=2#toc
10. Joseph Iano, Edward. Allen Fundamentals of Building Construction: Materials and Methods, 7th Edition, 2019. 944 p. https://www.wiley.com/en-us/Fundamentals+of+Building+Construction%3A+Materials+and+Methods%2C+7th+Edition-p-9781119446194
11. J Zhou, X Wang, K L Teo & Z Irani. A review of methods and algorithms for optimizing construction scheduling, 2013. Volume 64, pages 1091–1105 https://link.springer.com/article/10.1057/jors.2012.174
12. Madan L. Mehta, Walter Scarborough, and Diane Armpriest. Building Construction: Principles, Materials, and Systems, 3rd edition, 2018. 300 p. https://www.pearson.com/en-us/subject-catalog/p/building-construction-principles-materials-and-systems/P200000001496/9780137402793
13. Mehrdad Ghahramani, Daryoush Habibi, Mehran Ghahramani, Morteza Nazari-Heris & Asma Aziz. Sustainable Buildings: A Comprehensive Review and Classification of Challenges and Issues, Benefits, and Future Directions, 2023. 28 p. https://link.springer.com/chapter/10.1007/978-3-031-41148-9_1
14. Xiaoming Wang, Sayanthan Ramakrishnan. Environmental Sustainability in Building Design and Construction, 2021. 175 p.

https://link.springer.com/book/10.1007/978-3-030-76231-5

Field of science 3. Mechanics

Reading list in English
1. Beer F.P., Johnston E. R., DeWolf J.T., Mazurek D.F. Mechanics of Materials. McGraw Hill, 2020. 896 p. https://www.mheducation.com/highered/product/Mechanics-of-Materials-Beer.html (limited access).
2. Hibbeler R.C. Mechanics of Materials, 10th Global Edition. Pearson, 2018. 885 p. https://www.pearson.com/se/Nordics-Higher-Education/subject-catalogue/engineering/mechanics-of-material-hibbeler.html (limited access).
3. Hučko B., Jančo R. Introduction to Mechanics of Materials: Part I, Bookboon, 2013. 160 p. https://bookboon.com/en/introduction-to-mechanics-of-materials-part-i-ebook (free access)
4. Hučko B., Jančo R. Introduction to Mechanics of Materials: Part II, Bookboon, 2013. 234 p. https://bookboon.com/en/introduction-to-mechanics-of-materials-part-ii-ebook (free access)
5. Keith D. Hjelmstad Fundamentals of Structural Dynamics. Springer Cham. 2022. 552 p. https://link.springer.com/book/10.1007/978-3-030-89944-8 (limited access).
6. Strømmen E.N. Structural mechanics. Springer Cham. 2020. 354 p. https://link.springer.com/book/10.1007/978-3-030-44318-4 (limited access).

Field of science 4. Highway Engineering

Reading list in English
1. Martin Rogers. Highway Engineering. I. Title.TE145.R65 2003. 625.7 – dc21. 277 p. eopcw.com›find/downloadFiles/161 (PDF) HIGHWAY ENGINEERING
2. Mannering, Fred L. Principles of Highway Engineering and Traffic Analysis / Fred L. Mannering, Scott S. Washburn. -- 5th ed.p. Wiley. 2012. 336 p. http://yandex.ru Principles of highway engineering and traffic analysis : Mannering, Fred L : Free Download, Borrow, and Streaming : Internet Archive https://studylib.net/doc/27001085/principles-of-highway-engineering-and-traffic-analysis--f...?ysclid=mc8rjy1mmn638262171
3. Magdi Zumrawi. Highway Engineering. 2020. 110 p. PDF) https://www.researchgate.net/publication/385701473_HIGHWAY_ENGINEERING

Field of science 5. Urbanism

Reading list in English
1. Colin Ellard. Places of The Heart: The Psychogeography of Everyday Life. Kindle Edition. 257 p. https://www.amazon.com/Places-Heart-Psychogeography-Everyday-Life-ebook/dp/B011H510K0 (limited access)

2. Encyclopedia of Urban Studies. 1st Edition. SAGE Publications. 2006. 1080 p. https://www.amazon.com/Encyclopedia-Urban-Studies-Earl-Hutchison-ebook/dp/B00YFRCST0 (limited access)
3. History of Urban Planning and Design. Cognella Academic Publishing. 2012. 358 p. https://www.amazon.com/History-Planning-Design-Rabinowitz-Bussell/dp/1621310523 (limited access)
4. Rob Kitchin. The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences. 1st Edition. SAGE Publications Ltd. 2014. 240 p. https://se.moevm.info/lib/exe/fetch.php/courses:smart_data:the_data_revolution_big_data_open_data_data_infrastructures_and_their_consequences_by_rob_kitchin_z-lib.org_.pdf (free access)
5. Vukan Vuchic. Transportation For Livable Cities. Routledge; 1st edition. 378 p. https://www.amazon.com/Transportation-Livable-Cities-Vukan-Vuchic/dp/0882851616 (limited access)
6. William J Mitchell ME++: The Cyborg Self and the Networked City. Massachusetts Institute of Technology. 2003. 269 p. https://www.researchgate.net/publication/246788407_Me_The_Cyborg_Self_and_the_Networked_City (free access)

4.2 Recommended online courses

Field of science 1. Civil Engineering

Online courses in English	Link	Course description
1. Purdue University: Fundamentals of Prestressed Concrete	CE 597 - Fundamentals of Prestressed Concrete - Lyles School of Civil and Construction Engineering - Purdue University	The course provides an introduction to the fundamentals of prestressed concrete design. The course consists of three modules, each of which lasts for one session. Upon completion of the course, students will gain an understanding of key theoretical frameworks and practical approaches in prestressed concrete design.
2. Purdue University: Steel Beam and Plate Girder Design	CE 597 - Design of Plate Girders - Lyles School of Civil and Construction Engineering - Purdue University	The course provides an introduction to the fundamentals of steel structure design. The course materials are delivered through video lectures, texts, and interactive components. The course introduces the fundamental principles and

		design methodologies of steel structural systems.
3. Fundamentals of Structural Analysis	https://www.udemy.com/course/statics-for-engineering-undergrads/?utm_medium=website&utm_source=archdaily.com	The course provides an introduction to the fundamentals of analysis of building structures. The course materials are delivered through video lectures. Students will gain a solid grounding in the theoretical foundations and practical techniques for the structural analysis of buildings.

Field of science 2. Construction Technology

Online courses in English	**Link**	**Course description**
1. Concrete Multi Storey Building - System Design (Coursera)	https://www.coursera.org/specializations/concrete-multi-storey-building-system-design	The course enables students to apply acquired knowledge to real-world scenarios and includes the basic topics of building design principles taking into account the requirements of modern technologies. The course uses discipline-specific methods and tools to investigate complex issues, to construct logical and evidence-based conclusions. Course materials are presented in text format, training is organized in stages, from basic concepts to more complex topics. Upon completion of the course, the applicant will know the basic theories and concepts in the field of fundamentals concrete Multi Storey Building - System Design.
2. Construction Project Management (classclasscentral)	https://www.classcentral.com/course/construction-project-management-7105	The course enables students to apply acquired knowledge to real-world scenarios in construction project management. It introduces the processes of project initiation and

		planning, and employs discipline-specific methods and tools to investigate complex issues and formulate logical, evidence-based conclusions. The course materials are presented in text format, with training organized progressively from basic concepts to more complex topics. Upon completion of the course, participants will have acquired foundational knowledge of key theories and concepts in construction project management.
3. Sustainable construction and environmental aspects (classclasscentral)	https://www.classcentral.com/course/construction-the-university-of-maryland-college-p-46427	The course enables students to apply acquired knowledge to real-world scenarios, covering sustainable construction management from concept development to project completion. It employs discipline-specific methods and tools to analyze complex issues and develop logical, evidence-based conclusions. The course materials are presented in text format, with training organized progressively from basic concepts to more advanced topics. Upon completion, participants will have a solid understanding of the fundamental theories and concepts related to sustainable construction and its environmental aspects..

Field of science 3. Mechanics

Online courses in English	Link	Course description
1. Mechanics of Materials I: Fundamentals of Stress & Strain and Axial Loading (Coursera)	https://www.coursera.org/learn/mechanics-1	The course consists of several thematic modules such as axial loading, mechanical properties of materials, stress-strain

		behavior of structural material, statically determinate and indeterminate axially loaded systems. The course is structured progressively, from basic concepts to more advanced topics. Upon completion of the course, students will demonstrate knowledge of theoretical foundations and methodological approaches to solving practical problems within the specified subject areas.
2. Mechanics of Materials III: Beam Bending (Coursera)	https://www.coursera.org/learn/beam-bending	The course aims to build foundational knowledge in beam bending. The course introduces methodological tools essential for plotting the shear and moment diagram. The course materials are delivered through video lectures, texts, and interactive components. By the end of the course, students will have acquired a sound understanding of the theoretical principles and practical methods relevant to the specified topics.
3. Mechanics of Materials IV: Deflections, Buckling, Combined Loading & Failure Theories (Coursera)	https://www.coursera.org/learn/materials-structures	The course promotes a deeper understanding of the complexities involved in deflections, buckling, and combined loading. The course equips students with theoretical and practical tools for structural analysis. Each module focuses on a specific aspect of the subject. Upon completion of the course, students will understand the theoretical foundations and methodological approaches required to solve practical problems within the specified topics.

4. Strength of materials (tension, compression, bending)	https://openedu.ru/course/mephi/mephi_strength/?session=fall_2025	The course provides an introduction to the mechanics of materials and structures. The course aims to build foundational knowledge in tension, compression, and bending. The course is structured progressively, from basic concepts to more advanced topics. Upon completion of the course, students will understand the theoretical foundations and methodological approaches required to solve practical problems within the specified topics.
5. Structural Mechanics	https://ep.jhu.edu/courses/565604-structural-mechanics/	The course provides an introduction to structural mechanics. The course includes stress, strain, and constitutive laws; introduction to nonlinear mechanics; static, dynamic; specialization of theory to one- and two-dimensional cases; plane stress and plane strain, rods, and beams;; and variational formulations.

Field of science 4. Highway Engineering

Online courses in English	Link	Course description
1. Construction management: Road construction (Udemy)	https://www.classcentral.com/course/udemy-construction-management-road-construction-399493	This course focuses on road construction and is designed to enhance students' knowledge and skills in construction management. It covers the key stages of road development, including the protection of existing infrastructure, site clearance, planning for future utilities, preparation of the road subgrade, and the sequential placement of pavement layers such as sub-base, base course, and asphaltic courses. Upon completion of the course, students will be familiar with current trends, techniques, and best practices in the

		professional field of road construction.
2. Gravel Roads Construction and Maintenance (www.cedengineering.com)	https://www.cedengineering.com/courses/gravel-roads-construction-and-maintenance-R1	This online engineering course provides clear and practice-oriented instruction in the construction and maintenance of gravel roads. Upon completion, students will possess a solid understanding of the fundamental theories and design principles underpinning effective gravel road maintenance.
3. Highway Engineering (www.youtube.com)	https://www.youtube.com/playlist?list=PLZmv_MNQCMBjOX9qChv1LCNfqHyFP_4fU	This course in Highway and Transportation Engineering, delivered through video lectures, covers key topics in the field of road construction. It addresses the geometric design of highways, including vertical and horizontal alignment, and introduces essential formulas for the design of flexible pavements, among other core subjects. Upon completion, students will acquire a solid understanding of the fundamental theories and principles underlying road design and maintenance.

Field of science 5. Urbanism

Online courses in English	**Link**	**Course description**
1. An Introduction to Urban Planning and Design (Udemy)	https://www.udemy.com/course/an-introduction-to-urban-planning-and-design/	This course introduces key concepts and approaches in contemporary Urbanism and Urban Design through a series of thematic modules. Topics include the fundamentals of urban planning and urban design, the role of urban planners and designers in neighborhood development, frameworks for sustainable development and urban renewal, recent trends in New Urbanism, and the overall role and impact of urban planning and design. Upon completion of the course, students will be

		able to critically evaluate and interpret contemporary theories and methodologies in urban planning.
2. City Planning from Ancient Times to Today (Udemy)	https://www.udemy.com/course/city-planning/	This course provides an introduction to the history of urban planning through a series of progressively structured thematic modules, moving from foundational concepts to more advanced topics. It covers the history and theory of city planning from ancient times to the present day, explores key innovations and debates in the field, and analyzes the major challenges facing contemporary urban planners along with potential solutions. Each module addresses a specific aspect of the subject. Upon completion of the course, students will be familiar with the historical development and current state of the discipline of urban planning.
3. Learn Urban Planning Concepts (Udemy)	https://www.udemy.com/course/urban-planning-concepts/	This course aims to build foundational knowledge of modern concepts in urban planning through a series of thematic modules. It offers an in-depth examination of successful urban planning concepts, an overview of livable, future, and smart cities, insights into neighborhood planning approaches, and a case study illustrating various planning concepts in practice. The course is designed to provide both theoretical grounding and practical understanding of contemporary urban planning. Upon completion of the course, students will be able to analyze major academic schools, current debates, and methodological approaches in

		the field of modern urban planning.
4. Modeling Urban Ecosystems (Stepik)	Modeling urban ecosystems – Stepik	This course is designed to cultivate strategic thinking about the functions and services of urban ecosystems by deepening the understanding of the complex interactions between citizens and their urban environment. It equips students with analytical and modeling tools to systematically examine these interactions and assess their environmental and social consequences. Upon completion, students will be able to draw logical, evidence-based conclusions regarding the reciprocal influence between natural and urban systems and effectively apply their knowledge to solve both practical and research challenges.
5. Regional Planning: Basic Concepts and Its Contextualization (Udemy)	https://www.udemy.com/course/regional-planning/	This course equips students with the skills to identify and critically evaluate key issues in regional planning. It comprises several thematic modules, including an exploration of fundamental concepts and principles of regional planning, a review of major theoretical frameworks, a case study focused on regional and urban challenges, and an assessment of the current conditions and future outlook of cities from a regional perspective. Upon completion, students will be able to recognize central problems and themes within regional planning and apply theoretical models to effectively analyze regional and urban issues.
6. Shaping Urban Futures (Coursera)	https://www.coursera.org/learn/shaping-urban-futures	The course is designed to develop students' understanding of contemporary

		urban development trends. The course introduces key concepts and approaches to solving the problems of global urbanization. This course explores how an interdisciplinary approach reveals the complex interconnections between health, climate change, migration, and informality in regions most vulnerable to the impacts of rapid, unplanned urbanization .It introduces students to the theoretical and analytical tools needed to examine these challenges in an integrated manner. Upon completion of the course, students will possess knowledge of core theories and concepts in urban planning and will understand scientific methods for analyzing contemporary issues and trends in urban development.
7. The MIT Media Lab: Beyond Smart Cities: Emerging Design and Technology (edX)	The MIT Media Lab: Beyond Smart Cities: Emerging Design and Technology | edX	This course is designed to develop students' understanding of digitalization processes in contemporary urban studies. It consists of several thematic modules, including: design and technology for people-centric cities; the mobility revolution and urban robotics; the live-work transformation through robotics, prefabrication, and IoT technologies; networks of neighborhoods supported by AI, real-time simulation, and emerging systems; sustainable communities based on local production and reduced consumption; and governance innovations such as token economies and algorithmic zoning aimed at fostering prosocial behavior. Upon completion of the course,

		students will be able to effectively apply digital methods of data collection, analysis, and systematization, and to competently utilize digital technologies in both educational and research contexts.