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**MUHAMMADAMIN KABULOVICH TOHIROVNING TAVALLUDINING
80 YILLIGIGA BAG'ISHLANGAN
“SAMARALI QURILISH MATERIALLARI, KONSTRUKSIYALARI VA
TEXNOLOGIYALARI”
MAVZUSIDAGI XALQARO ILMIY-AMALIY KONFERENSIYASI
ILMIY ISHLARI TO'PLAMI**

Toshkent davlat transport universiteti Rossiya Arxitektura va qurilish fanlari akademiyasining akademigi, O'zbekiston Respublikasida xizmat ko'rsatgan yoshlar murabbiysi, texnika fanlari doktori, professor **Muhammadamin Kabulovich Tohirovning tavalludining 80 yilligiga bag'ishlangan “Samarali qurilish materiallari, konstruksiyalari va texnologiyalari”** mavzusidagi xalqaro ilmiy-amaliy konferensiya ilmiy ishlari to'plami chop etildi.

Muhammadamin Kabulovich kompozitsion qurilish materiallarining polistrukturaviy nazariyasini rivojlantirishga ulkan hissa qo'shgan olimdir. 1995-yilda Muhammadamin Kabulovich Rossiya Arxitektura va qurilish fanlari akademiyasining (RAASN) xorijiy a'zosi etib saylangan, bu esa ularning qurilish materialshunosligi sohasiga qo'shgan ilmiy hissasining xalqaro miqyosdagi e'tirofi bo'ldi. Ular o'z ilmiy faoliyati davomida 6 ta monografiya, 200 dan ortiq ilmiy maqola va 25 ta ixtiroga mualliflik guvohnomasi yaratganlar.

Ushbu konferensiyaning asosiy maqsadi – qurilish materialshunosligi, bino va inshootlarni loyihalash hamda qurilish sohasidagi zamonaviy ilmiy tadqiqotlar natijalarini muhokama qilish, shuningdek, muhandislik ta'limini takomillashtirish yo'llarini aniqlashdir.

Konferensiyada O'zbekiston Respublikasi hamda xorijiy mamlakatlarning oliy o'quv yurtlari va ilmiy-tadqiqot institutlari olimlari, shuningdek, muhim ilmiy tadqiqot natijalariga ega bo'lgan ishlab chiqarish vakillari o'z ilmiy ishlari bilan ishtirok etdilar.

“Samarali qurilish materiallari, konstruksiyalari va texnologiyalari” mavzusidagi xalqaro ilmiy-amaliy konferensiyaning asosiy yo'nalishlari quyidagilardan iborat:

1. **Resurs va quvvatni tejaydigan qurilish materiallari va texnologiyalari** – zamonaviy ekologik va iqtisodiy talablarni qondirishga qaratilgan innovatsion yechimlar.
2. **Bino va inshootlarning qurilish konstruksiyalari, zamonaviy hisoblash va loyihalash usullari - muhandislik** va texnologik yechimlarni takomillashtirish yo'nalishlari.
3. **Arxitektura va shaharsozlik** – estetik va funksional jihatlarni uyg'unlashtirgan zamonaviy loyihalar yaratish.
4. **Zamonaviy muhandislik ta'limi tizimini takomillashtirish** – kelajak mutaxassislarini yuqori malakali darajada tayyorlash uchun ta'lim jarayonini modernizatsiya qilish.

Mazkur konferensiya ilmiy hamjamiyatning turli vakillarini bir joyga jamlab, qurilish materialshunosligi sohasidagi zamonaviy muammolar va istiqbollarni muhokama qilish uchun qulay platforma vazifasini bajardi.

Innovative approaches to teaching the “geotechnics” course for future civil engineers

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Abstract:

The rapid evolution of digital technologies is revolutionizing the educational landscape, particularly in technical disciplines such as geotechnics. This study explores how digital tools, virtual and augmented reality, project-based learning, interactive teaching, gamification, and case studies enhance the quality of education in construction engineering. These approaches not only bridge the gap between theory and practice but also foster a deeper engagement, interdisciplinary collaboration, and practical skill development among students.

Furthermore, this research highlights the pivotal role of modern pedagogical techniques in addressing contemporary challenges in engineering education. By integrating real-world applications and industry-driven methodologies, students acquire the analytical, problem-solving, and technical competencies necessary for a highly competitive professional environment. The findings of this study demonstrate that innovative teaching strategies significantly contribute to the preparation of well-rounded construction engineers, capable of meeting industry demands with confidence and expertise.

Keywords:

geotechnics, ground and foundations, digital technology, virtual and completed realism, project-based teaching, gamification, interactive teaching, case-examples, interdisciplinary education

1. Introduction

The science of "geotechnics" is considered one of the main disciplines in the process of training qualified builders and is associated with ensuring the strength and stability of structures, and with the correct design and construction of foundations. However, when teaching this subject, there are often a number of problems, including the difficulty in understanding theoretical material, the need for modern methods and technical means of teaching due to the lack of practical skills in students. This science requires in-depth knowledge of engineering disciplines such as the mechanics of grunts, strength theory and methods for calculating foundations. In this, students may have difficulty understanding complex concepts of mathematics and physics. Also, situations such as a lack of practical skills, limited access to specific projects, such as ham cause some problems[4].

Also, the existence of a discrepancy between theoretical knowledge and their application to practice plays an important role in the teaching of "Geotechnical" Science. Students often have difficulty applying abstract concepts and mathematical models to practice. This situation affects the development and implementation of effective engineering solutions by students. Accordingly, one of the improvement solutions of teaching is the question of real projects of foundations and the integration of Applied Research. In this case, it is possible to eliminate the discrepancy between theory and practice by introducing real projects and applied research into the curriculum. Working on engineering problems related to the mudflating of foundations or collaborating with mudflats and construction enterprises to master practical examples will help students to deeper understand the subject and its application in practice.

The ground grunts, which are expected to spend a lot of time and funds, can be studied using virtual laboratories and simulation programs for laboratory work and field research

on the physical and mechanical properties. These tools help students to form practical persuasions when learning variable grunt properties and foundation sludge.

Integrated processes with engineering disciplines such as geology, hydrology and geodesy are important in mastering the science of "geotechnics". Such an approach allows students to understand in more detail the complex features of the grunt and the factors that affect the operation of the foundation.

In recent years, the emergence of complex modeling programs and digital modeling tools in the educational process has created a wide range of opportunities to teach students the effects of the changing physical and mechanical properties, tension and subsidence of grunts on the blurring of foundations by marginal states. In particular, tools such as PLAXIS, GeoStudio, LIRA and ABAQUS allow students to visualize and analyze the interconnections of the grunts that make up the building and its floor in a managed virtual environment [2,3,5]. Practical experiments carried out using software at the Professional level prepare students to solve real engineering problems and help them to more quickly master the concepts that are abstract. In this regard, it is good to discuss our calculation results with the help of LIRA software, taking into account the variable strength and volatility (such as E , s , ϕ , m_0 , m_v) Hoss Of Grunts in the structure-floor system of multi-story Residential buildings with the participation of students divided into groups in advance.

The degree of student satisfaction after the introduction of new teaching methods (survey):

- The percentage of students who began using BIM, VR/AR or simulations in their educational projects;
- Comparing academic performance between students who studied using traditional methods and those who used digital technologies;

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- Employment of graduates (for example, the growing demand for engineers with skills in working with digital tools);

- The level of students' independence, determined by the number of completed individual projects or work performed outside of classroom activities.

2. Research methodology

Currently, innovative approaches such as the use of digital technologies, virtual and completed realism, project-based teaching are being implemented in order to improve the effectiveness of the educational process and improve the quality of education for construction students. Including:

1. To realistically simulate projects of foundations of buildings and structures, it can be effective to introduce vokhelik-filled (VR and AR) technologies that reflect a virtual and a real state of the art into the educational process. With them, students will be able to see how the foundations are built, observe changes in structures in Real time. For example, our electronic developments such as "study of grunt properties", "design and installation of foundations", "deeply located foundations", "central and non-central compressed foundations" are of great interest to students. In this regard, developments related to the application of pile foundations in the construction of agricultural buildings and structures in the nearby and saline soils of groundwater, which are common in our mamalakat, will help students and Masters to conduct independent studies [6,7,8,9].

2. Building information modeling-Building Information Modeling(BIM) technology allows you to create digital models of buildings that reflect all aspects of the layout, including geotechnics. Accordingly, students can study the actual structure of buildings in a three-dimensional environment, simulate loads and analyze the movements of grunts under load.

3. Project-oriented education allows students to participate in real projects at all stages of their development - from the analysis of grunt characteristics to the design of the foundation. This is applicable to students in developing teamwork skills, project management, and learning to solve engineering problems in Real-world environments.

Opportunities are created for students to carry out research projects such as familiarizing themselves with new foundation materials in the context of various moisture or changing properties of the grunt, analyzing the grunt in difficult natural conditions, or studying methods of strengthening the foundation in the repair of buildings. Such research develops analytical thinking skills in educators and provides the opportunity to develop new approaches in the field of engineering.

4. Mobile applications and online platforms for Independent Education allows students to study materials and solve problems on time. Such training involves using mobile technologies alone or in conjunction with other information and communication technologies (ICT) to learn at any time and anywhere. Education can develop in a variety of forms: students can use mobile devices to access educational resources, interact with others, or create content inside and outside the audience. Mobile education may also include efforts to support broad educational goals, such as effective management of higher education systems, improving the communication between OTM and student's parents [1].

5. Gamification (incorporating game elements into the educational process) makes learning more effective and fun. On the example of virtual tasks for the special science "geotechnics", simulations and games have been developed that help to study construction processes. For example, students may be asked to create a stable foundation for a virtual building, taking into account certain conditions – the type of grunt, load, available materials and costs. It helps to understand the real relationship between theory and practice and to understand the consequences of various engineering decisions.

6. With the help of data collected in the process of building foundations and keys-examples, evidence-based education makes the educational process relevant and practical for students. Working with real-world projects provides students with the opportunity to make sustainable and reliable decisions by correctly assessing possible risks. This develops the ability to think analytically in students. As a result, they study in depth the factors that need to be taken into account when laying and building foundations.

3. Results and discussion

The development of digital technologies has a significant impact on the educational process, especially in technical universities. The introduction of digital technologies, virtual and augmented reality, as well as interactive teaching methods can improve the quality of the educational process, reduce the gap between theory and practice, and increase the competitiveness of graduates. This article examines the application of these methods in teaching the discipline "Geotechnics" to students of the Faculty of Civil Engineering of the Fergana Polytechnic Institute (Fergana State Technical University), especially up to the 3rd year of study.

Table 1

The first results show that the introduction of digital and interactive technologies in the teaching of geotechnics

Indicator	Before the implementation of the methodology	After the implementation of the methodology
The average level of student engagement (%)	60	85
The success rate of practical tasks (%)	55	80
The level of mastery of the material (by testing)	65	90
Percentage of students involved in project work (%)	50	75

For students under the 3rd year of the Faculty of Civil Engineering of Ferghana Polytechnic Institute, the proposed methodology allows them to quickly adapt to professional tasks, develop digital and engineering skills, and effectively

combine theory and practice. In the future, it is planned to expand the use of artificial intelligence and cloud technologies in geotechnical education.

Above, the possibilities of applying innovative methods



in the teaching of "Geotechnical" Science in the field of construction were shown. Accordingly, the use of digital technologies prepares students to work in a realistic environment where BIM and other technologies are becoming standard. Simulations and project-oriented assignments provide the opportunity to apply knowledge in practice, generating the right decision-making skills in the educational process. Interactive teaching methods help to increase interest and motivation and to study science more deeply by students. In some cases, directed pedagogical methods (YPBS) are used, in which students use the experience of solving a problem related to a previously proposed topic in training. In "ground and Foundation" science, ypb scenarios can include real engineering calculations such as designing foundations for a particular type of grunt or solving the problem of slope stagnation. This approach serves to solve problems in practical training in critical thinking, teamwork and theoretical knowledge.

4. Conclusion

Modern problems in the field of construction require the training of engineers who not only understand the theory, but also have the skills to apply knowledge in life. Innovative approaches to teaching "Geotechnical" Science i, such as VR, BIM, and the use of project-based education, improve the quality of education and prepare students for the practical challenges they face in real work.

The quality of education can be further improved by the use of digital technologies in teaching "geotechnics", encouraging practical participation of students and the development of interdisciplinary education. Overcoming the gap between theory and practice, the formation of practical experience skills, the improvement of training programs based on the traditions and needs of the development of the construction industry are important in the training of competitive Civil Engineers. By constantly improving teaching methods and introducing innovations, students can be armed with the knowledge, skills and critical thinking techniques necessary to solve the problems of the mechanics of grunts and the design of foundations.

References

- [1] Шевякин В.Н., Руковыцина А.А. Новые подходы и инновационные технологии преподавания технологических дисциплин. В НТЖ "Образование и проблемы развития общества" Курск, Россия, ЮЗГУ, №3(12), 2020 г.
- [2] Усманов Б.Ш., Жўраева Г.Х. Инновационные методы обучения в преподавании технических дисциплин. В журн. Техника, Технология, Инженерия. №2(4), 2017г.

[3] Алипатов Г.В., Черкасов Г.В. Специализированные программные технологии как средство повышения качества образования. Материалы 4-Международной НПК, Воронеж, 2019г., с.11-19

[4] Maxsimov Q.I., Ne'matov X. Gruntlar mexanikasi fanini o'qitish metodologiyalarini zamonaviy uslublari yana takomillashtirish to'g'risida. Xalqaro ilmiy texnikaviy anjuman materiallari t'plami, 4-tom. Farfona, 26-27 aprel 2023y. 450-453 b.

[5] Maxsimov Q., Xolmirzaev Q., Ibroximov M. Texnika fanlarini o'qitish metodologiyalarini zamonaviy uslublari to'g'risida. "Fan va innovatsiya-2023: Rivojlantirish va ustivor y'налишlar" xalqaro NPK materiallari, Namangan, 22-23 oktyabr. 2023 y.

[6] Yunusaliyev E. M., Maxsimov K. Q., Sarsenbayev N. B., Auyesbek S. Features of calculation reinforcement concrete piles of agricultural buildings in aggressive ground conditions. Международная конференция «Промышленная технология и инженеринг- ICITE-2023», Чимкент, 2023 18 ноябр, Материалы конференции с .399-303

[7] Maxsimov Q. Design of bases and foundation on salinized soils. Germania Web of Science SJIF (23) Spectrum Journal of Innovation, Reforms and Development. <https://sjird.Journalspark.org/index.php/sjird/article/download>

[8] Maxsimov Q. Durability of reinforced concrete piles in aggressive soil conditions. Germania Web of Science SJIF (23) Spectrum Journal of Innovation, Reforms and Development <https://sjird.journalspark.org/index.php/sjird/article/download/849/815>

[9] Marupov, A., Turdikulov, K., Khakimova, K., & Abdulkadirova, M. (2024, November). Methods for researching the influence of electromagnetic waves of power transmission lines on soil properties. In E3S Web of Conferences (Vol. 508, p. 07002). EDP Sciences.

[10] Maxsimov Q. Design of foundations in extremely solid soils. Web of Science Texas Texas journal of Agriculture and Biological Sciences ISSN NO; 2771-8840 <https://zienjournals.com>.

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G. Khalfin

A method for calculating the stability of a jointless track using the compression ratio of intermediate rail fasteners Pandrol Fastclip..159

A. Bondarenko, K. Lesov, T. Salakhov, M. Kenjaliev

Modelling of longitudinal forces in a rail track to assess the stability of a track without joints.....162

B. Rakhmanov, S. Razzakov

Deformation characteristics of polypropylene thread (p-1) for synthetic slings.....166

D. Sharipova, N. Rakhimova

Modeling of unsteady heat transfer processes in combined coatings.....171

3 section. Architecture and Urban Planning**E. Shchipacheva, N. Umarova**

Innovative approaches to architectural design of youth centers in the era of information society.....177

S. Shaumarov, D. Nurmukhamedova

Modern approaches to designing student dormitories: energy efficiency, functionality, and social environment.....185

K. Markabaeva

Digital technologies in urban planning: a development vector for Uzbekistan.....192

E. Urazkhanova

Energy efficiency of buildings: world experience and prospects for Uzbekistan.....196

Y. Turdibekov

Smart city: problems and solutions.....201

N. Yuling, G. Liubou

Transport route efficiency optimization: a new perspective integrating sustainable development and economic benefits.....206

4 section. Improvement of modern engineering education system**K. Makhsimov, A. Marupov**

Innovative approaches to teaching the “geotechnics” course for future civil engineers.....211