UDC 004.045

Zvonov I.A.

Prospects of application of educational–technological task in the formation of information models of university campuses

This paper is a continuation of a series of publications devoted to the intermediate results and prospects of digital and regulatory-technical transformation in the construction industry of our country and its impact on individual tasks of the investment and construction cycle arising from the creation of modern university campuses. The programme of creating a network of university campuses, is one of the main drivers of scientific and technological development and personnel training in the Russian Federation at present. In this regard, in previous publications in the development of this topic, the author proposed and substantiated the need to introduce into the system of construction documentation of the Campus Programme, educational-technological conditions as a new type of engineering parameters-measures of the material-spatial environment and Educational-technological task as a new type of document, which can be part of the design task or an annex to it, as well as part of the subsequent contract for the provision of services for the management or technical operation of the campus. When applied, the Educational-Technological Assignment (hereinafter referred to as ETA) becomes the only available comprehensive tool for forming qualitative and quantitative functional-technological and operational parameters of campus facilities, in accordance with the adopted target model of the educational organization, defined in its development programme. In this paper, the author proposes the algorithms for the formation of ETA, describes the need and possibility of its integration with the technology of information modelling and directly with information models of capital construction objects. This is determined by the fact that in view of the current legal requirements, the information model is designed to cover and unite all stages of the life cycle of a capital construction object.
Keywords: *design task, normative-technical documents, functional-technological requirements, educational-technological task, registers of requirements, parametric normalization, Classifier of construction information*

Zvonov Ilya Alexandrovich,
Senior lecturer of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 6197-7370, Scopus: 57204363101, ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru

INTRODUCTION

In the introduction, let us recall what we managed to establish regarding the ETA in the previous publication. ETA is a document containing a set of basic requirements established by normative documents, certain educational and technological conditions and the target model of the educational organization. The approach to the development of ETA is built from the "realized function", i.e. from the type, scale, features and parameters of educational or research processes. ETA can be oriented to separate buildings and groups with different functional-technological content, within the framework of new construction, reconstruction, major repairs [1]. ETA by the customer's decision can become a part (appendix) of the design task, because it is formed on the basis of synthesis:

- parameters of the material and spatial environment;
- characteristics of the realized educational process or research and scientific-production activity;
- applied educational and research technologies;
- peculiarities of educational and research infrastructure;
- functions necessary for transformation of the educational environment for modern tasks and advanced development [2].

ETA is based on the following principles: increasing the functional flexibility of the university environment; increasing the organizational and technological sustainability of the university during the operation period; increasing integrated security and resource conservation; ensuring the predictability of the personnel policy of the operation system, etc.

REQUIREMENT REGISTRIES AND PARAMETERS IN THE STRUCTURE OF THE ETA

As it has already been mentioned, ETA is formed on the basis of synthesis of the parameters of material and spatial environment, realized educational process, research and production activities, applied educational and research technologies, educational and research infrastructure. In the previous publication, the author gave an approximate structure of the ETA, which, in his opinion, would optimally contribute to the solution of the tasks set before it. Taking into account the fact that in most cases the ETA will be a part of the design task, its structure should reflect mainly those issues that are insufficiently disclosed or absent in the standard version of the task. This refers to the "Form of the developer's or technical customer's task for the design of a capital construction facility, the construction, reconstruction, capital repair of which is carried out with the involvement of funds from the budgetary system of the Russian Federation" [3]. These are the issues of functional zoning of buildings, floors, premises, organization of student flows, safety and comfort issues, created automated and high-tech workplaces, ensuring functional efficiency, requirements for microclimate, requirements determined by the specifics of manufactured products, rendered services, implementation of technological navigation, possible expansion of infrastructure, requirements for microclimate by rooms and zones, formed operational parameters and much more.

But it is not only inefficient, but sometimes even impossible to enter, correct, or read these data and information in text form or in the form of explications. This means unnecessary processes, additional losses, reduced accuracy, avoidance of automation, etc. The digital and normative-technical transformations developing in the construction industry today equip us with such tools as the information model with its data, digital twins, registers of requirements, parametric method of standardization. These are the tools of tomorrow. In this regard, and based on the developments in the field of integration of registers of requirements and parameters described in previous publications [4], the author proposes to classify and combine all qualitative requirements and calculable parameters that determine functional, architectural, construction, engineering, technical and other properties of capital construction objects of university campuses into a single system with common algorithms of formation and development. In such a system, the parameters should be formed taking into account a variety of flexibly customizable properties and criteria. The formed system in digital format will be able to contain data on functional processes in campus buildings, their parameters and properties, necessary flexibility and so on. As such a digital system, it is proposed to consider the Combinatorial Matrix. The prototype of the Combinatorial Matrix was developed by the author together with N.V. Kashirina.

The approach to the development of ETA based on the application of the Combinatorial Matrix is more universal, because the method of parametric normalization is taken as a basis. This method allows to provide uniform standards and parameters for all participants of the construction process, to guarantee uniformity in the work of all parties, more accurately predict the results and control the construction processes [5]. In this regard, the registers of requirements can include both mandatory requirements of regulatory documents and requirements proposed by developers, which are supposed to be justified. This will ensure the achievement of adaptability and sustainability of ETA.

The application of the register principle and parametric normalization in the basis of the ETA allows it to become a modern, effective tool for describing the complex material and spatial environment of the university. It is equally applicable both at the stage of preparation of the task for the design of a new construction object and in preparation for major repair or reconstruction.

COMBINATORIAL MATRIX

Combinatorial matrix can be defined as a complex integrative tool. When applying the matrix, it is necessary to start from the required function and characteristics of the room, or to be more precise, of the space, because at the pre-project stage “rooms” as an architectural volume do not exist yet, and then adjust its properties to the required tasks. Combinatorial matrix can contain different types of requirements: mandatory, voluntary, recommended from normative and technical documents and regulations, design or operation manuals, as well as appropriate educational and technological conditions. The main criteria for selecting the requirements is compliance with the stated characteristics and functions of spaces and technical equipment of campus facilities. In this respect, the matrix corresponds to the basic provisions of the register principle [6].

The proposed structure of the matrix can have several levels of rationing when using the parametric method. The upper level is the goals of rationing, they are defined by laws and should realize the corresponding socially important tasks. Applied to universities, this is the realization of the Standard of innovative educational environment (campuses) [7]. The next level of the hierarchy is functional requirements. These are architectural and construction, engineering, functional-technical, functional-technological and operational requirements, zoning requirements, selected taking into account the functions of the designed object. In the conditions of creating an innovative educational environment, the goal to be achieved by complying with specific regulatory requirements comes to the fore. Only in this case, instead of the goal there will be functions, because on the campus site it is necessary to create such material and spatial conditions so that they would allow to solve the tasks of another order — the tasks of scientific and technological development. Therefore, variability, flexibility of requirements and parameters depending on the requested functions is necessary. Typical solutions for the construction of buildings of higher education institutions, mostly do not meet the modern demands of the educational environment. This is a consequence of the transition to Education 3.0 [8], the transformation of universities, the introduction of new educational technologies in the educational process, the use of high technologies and so on.

In the hierarchy of the combinatorial matrix the problem of parameter formation for each room is progressively solved. At the beginning, the level of education is determined (bachelor's, specialist, master's, postgraduate). Then, the type of training: frontal, non-frontal, collective, group, individual training. After that, types of classes: coursework, project activities, student research work, startup-incubator, joint projects with industrial partners, advanced training, accelerated professional training [9], etc. For each room, sets of functional requirements are taken into account, provided at the design stage and maintained at the operation stage in connection with the relevant codes of the Classifier of Construction Information (CCI) [10], (if available). The proposed list takes into account new types of training that meet the modern demands of the educational process. For all types of training, the matrix takes into account differences in the scale and number of practical tasks that a student or young scientist performs as part of his/her educational or research activities. This is reflected in the diversity and specific requirements for the spaces of campus facilities (in particular, teaching, research and other specialized laboratories).

In the Combinatorial Matrix, each level of education corresponds to the type of learning and function to be realized in the material-spatial environment. The rooms are labeled by type in accordance with CP 118.13330.2022. “Code of Rules. Public buildings and structures” [11] and in accordance with the codes of CCI.

A fragment of the matrix considering the type of training and function can look as follows:

1. Function: EDUCATION:

1.1. Level: Bachelor's degree/specialization.

1.1.1. Type: Basic disciplines.

1.1.1.1. CSI code.

1.1.1.1.1. Room type.

An excerpt of a transcript of the CII codes, linked to room types, is as follows:

IBAEI Teaching spaceI

IBAE010I Lecture hallI

IBAE020IUniversal classroomsI

IBAE030IUniversal classroomI

IBAE040ISpecialized training roomI

IBAE060IComputer labI

A selection of normative and individual requirements to ensure the effective implementation of the educational or scientific process are attached to the rooms in the matrix. The requirements are selected in such a way that the room can become multifunctional and modelable for changing tasks of the scientific and educational process [12]. For example, in order to take into account, the modern demands of distance and combined education, the combinatorial matrix takes into account the functions of the educational process, which involve live broadcasts of laboratory experiments, the possibility of conducting webinars and classes in AR, VR environments.

Thus, the combinatorial matrix allows to establish, assign and bind the necessary register of requirements and parameters-measures to each space or room of each campus object. The formed requirements and parameters are to be systematized and placed in the ETA, which in turn can reasonably become an annex to the design task.

INTEGRATION OF ETA WITH THE INFORMATION MODEL

Information model (IM) is a set of electronically presented documents, graphical and textual data on the construction object, placed in the common data environment and representing a reliable source of information on the object at all or some stages of its life cycle [13]. The listed materials and data begin to be formed at the very initial stages of the life cycle, in particular, while identifying functional and technological requirements, which then become the basis for design solutions. In the process of digital transformation of the construction industry, there is a need to supplement the information model with new, additional data and information. For example, about construction manufacturing technologies, material properties, and performance characteristics. In the last two years, the task of creating digital registers of requirements and their integration with the information model has become more and more frequent.

While researching this task, the author, together with the student of NRU MGSU A.T. Asanova, conducted a selective comparison of digital tools open for use, with the help of which this integration can be realized to a greater or lesser extent. For this purpose, normative-technical, functional, operational and other requirements to the building, its elements, structures, engineering systems were systematized and analyzed, as well as parameters that are usually present in design solutions and materials in text, graphic or explication format.

The study of the possibility of integrating these requirements and parameters into the information model was carried out by the example of Revit Autodesk and Microsoft Excel programmes. Excel

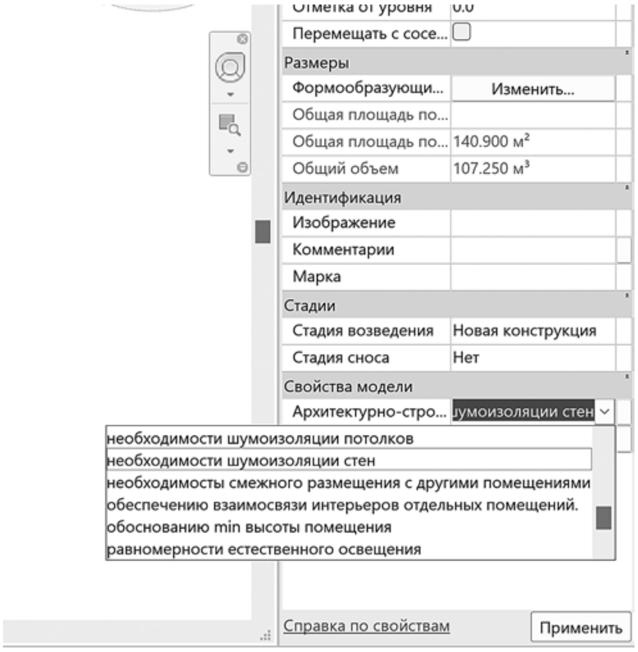

Fig. 1. Requirement formulations placed in the information model materials

contained a list of architectural and construction requirements for structures that needed to be entered into the information model in the Revit programme. Several auxiliary programmes with which this could be accomplished were also examined. The first was Speckle, which is an open platform for data exchange between different programmes, design and collaboration in a 3D environment; the second was DiRoots, which is a less popular programme, but has more agile options for importing data from Excel to Revit. DiRoots is a utility programme for Revit; the third — Dynamo extension, built into Revit environment, allows adding lists, for example, to model properties (Fig. 1).

By applying the Dynamo extension, the model can be a representation of even the smallest volume, such as a single room. In this way, certain requirements will be linked to a specific element, structure or equipment. This solution has the greatest development prospects,

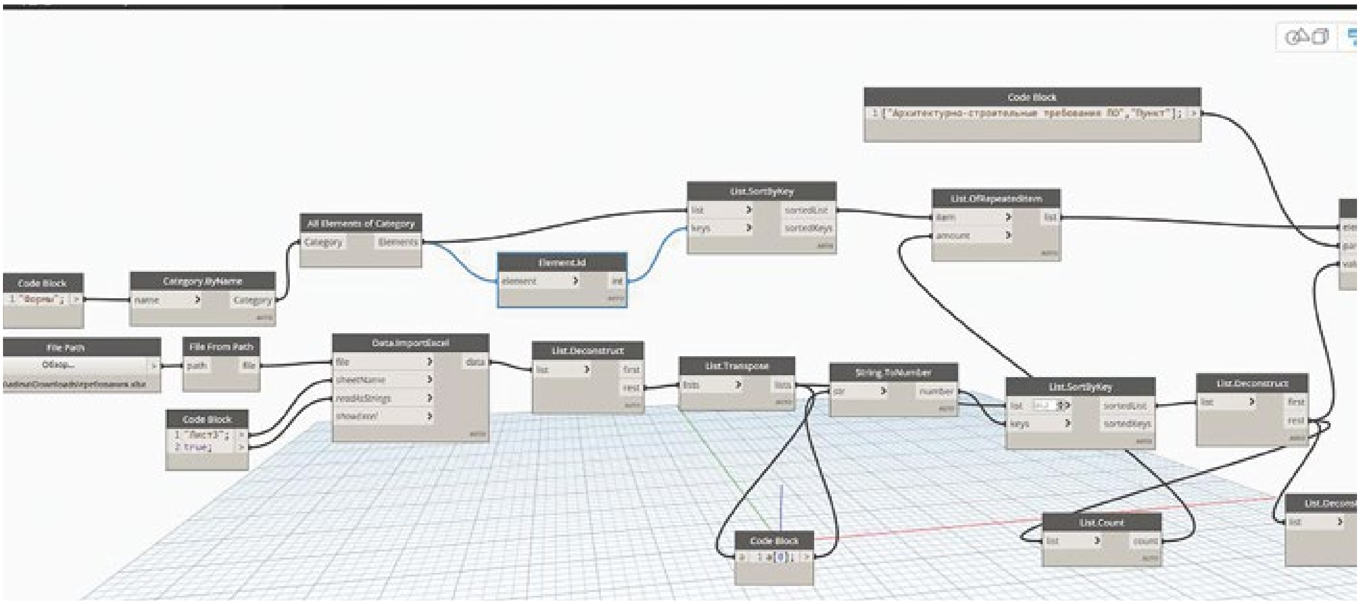

Fig. 2. Code fragment for Dynamo

because in this case, the requirements from Excel can be integrated with various elements of the information model, guided by the Rules of formation and maintenance of the information model of the capital construction object [14]. Initially setting the necessary settings and conditions implemented in the information model, it is possible to significantly simplify the design tasks. It should be noted that in Speckle and DiRoots, importing data from Excel is almost automatic. Whereas Dynamo is an application for visual programming, therefore, it is necessary to generate programme code in it first. The code fragment is shown in Fig. 2. It shows the programme code for importing lists from Excel to the properties of elements, structures, equipment.

The logic of the Dynamo programme implies the use of id [15] for the elements to be changed. These id's need to be uploaded from Revit to Excel before starting to write programme code. This preparation is necessary so that the row ids from the Excel spreadsheet data match the element ids from Revit and integrate in the right order. This task is to establish a match between the element id and the Excel spreadsheet data. This condition imposes certain inconveniences in writing code for Dynamo. From the above analysis results we can conclude that with the help of ETA, it is possible not only to realize the pre-design and design stage of the life cycle of university facilities at a more modern, efficient and safe level, but also to significantly improve the formation and maintenance of their information models.

CONCLUSIONS

University campuses, by definition, should have unique characteristics that differ significantly from standard requirements. They represent an organized set of multifunctional objects performing educational, research, innovation, social, and service functions, united by infrastructural issues of development. The ETA proposed for consideration is one of the few tools with the help of which the formation of a system of initial data for design and operation can be carried out. The educational and technological conditions contained in it reflect the system of interrelationships between the characteristics of various types of educational, scientific or auxiliary activities and the corresponding or required parameters of the created or preserved material and spatial environment of campus facilities. The author reasonably assumes that the ETA tool can be further developed through the creation of a register of requirements in the form of data cards in *xml, as well as combining the requirements tied to the relevant spaces and technical equipment of the campus to determine the functional zones of premises or cross classification.

REFERENCES

1. Zvonov I.A. Conditions and prospects for the application of Educational and Technological tasks at the pre-project stages. Real Estate: Economics, Management. 2024; 3:60-64. DOI: 10.22337/2073-8412-2024-3-60-64 URL: https://n-eu.iasv.ru/index.php/neu/article/view/218 (rus.).

2. University campuses and the city: cooperation for the sake of competitiveness, August 2021. VEB RF University 20.35. CSR. URL: https://www.csr.ru/upload/iblock/3f0/kbpm276p3tau6knlzdla3d6ozz0fve0e.pdf (rus.).

3. Approval of the Form of the Developer's or Technical Customer's Assignment Form for the Design of a Capital Construction Project, the Construction, Reconstruction, Major Repair of which is carried out with the involvement of funds from the budgetary system of the Russian Federation : Order of the Ministry of Construction and Housing and Communal Services of the Russian Federation of April 21, 2022 N 307/pr (as amended and supplemented). URL: https://base.garant.ru/404808053/ (rus.).

4. Zvonov I.A., Kashirina N.V. Prospects of application of parametric method of standardization in conditions of the registry principle of technical requirements development. Real Estate: Economics, Management. 2024; 2:73-74. DOI: 10.22337/2073-8412-2024-2-73-77 URL:https://n-eu.iasv.ru/index.php/neu/article/view/203 (rus.).

5. Pustovgar A.P. Prospects of transition of the construction industry to the norms based on the parametric method of norming. URL: https://smeta-na.ru/tehnologii/perspektivy-perehoda-stroitelnoj-otrasli-na-normy-osnovannye-na-parametricheskom-metode-ormirovaniya/?ysclid=luzr8cngf3408612912 (rus.).

6. Approval of the Rules for Forming, Maintaining and Updating the Register of Mandatory Requirements : Resolution of the Government of the Russian Federation No. 128 dated 06.02.2021 (as amended and supplemented) (rus.).

7. Standard of Innovative Educational Environment (Campuses) (approved by the Ministry of Science and Higher Education of the Russian Federation on February 28, 2024) (rus.).

8. Education 3.0. URL: https://translated.turbopages.org/proxy_u/en-ru.ru.1d5b66eb-67459f51-f8ef95c2-74722d776562/https/en.wikipedia.org/wiki/Education_3.0 (rus.).

9. Blinov V.I., Satdykov A.I., Osadcheva S.A., Krasovsky N.A. Advanced vocational training: formation of system-forming components. Educational policy. DOI: 10.22394/2078-838X–2020–4–84–93 URL:https://edpolicy.ranepa.ru/core-components (rus.).

10. Classifier of construction information. URL: Stroycomplex.RF /ksi/99 (rus.).

11. CP 118.13330.2022. Code of rules. Public buildings and structures. SNiP 31-06–2009 (approved and enacted by Order of the Ministry of Construction of Russia from 19.05.2022 No. 389/pr). (rus.).

12. Register of requirements in the field of engineering surveys, design, construction and demolition. URL: Stroycomplex.RF/rntd (rus.).

13. CP 333.1325800.2017. Information modelling in construction. Rules for the formation of an information model of objects at various stages of the life cycle. URL: docs.cntd.ru (rus.).

14. Government of the Russian Federation. On approval of the Rules for the formation and maintenance of an information model of a capital construction project, the composition of information, documents and materials included in the information model of a capital construction project and submitted in the form of electronic documents, and requirements for the formats of the said electronic documents : Resolution No. 614 of May 17, 2024. URL: docs.cntd.ru (rus.).

15. Guide to IDs for JPA entities. Part 1: IDs generated on the server. URL: https://habr.com/ru/companies/haulmont/articles/653843/ (rus.).

Перспективы применения образовательно-технологического задания при формировании информационных моделей университетских кампусов

Данная статья является продолжением серии публикаций, посвященных промежуточным результатам и перспективам цифровой и нормативно-технической трансформации в строительной отрасли нашей страны и ее влиянию на отдельные задачи инвестиционно-строительного цикла, возникающие при создании современных университетских кампусов. Программа создания сети университетских кампусов является одним из основных драйверов научно-технологического развития и подготовки кадров в Российской Федерации в настоящее время. В связи с этим в предыдущих публикациях в развитие данной темы автор предлагал и обосновывал необходимость введения в систему строительной документации Кампусной программы, образовательно-технологических условий как нового типа инженерных параметров-измерителей материально-пространственной среды и образовательно-технологического задания (ОТЗ) как нового типа документа, который может являться частью задания на проектирование или приложением к нему, а также частью последующего договора на оказание услуг по управлению или технической эксплуатации объектов капитального строительства. При применении ОТЗ становится единственным доступным комплексным инструментом формирования качественных и количественных функционально-технологических и эксплуатационных параметров объектов кампуса в соответствии с принимаемой целевой моделью образовательной организации, определенной в ее программе развития. В настоящей статье автор предлагает алгоритмы формирования ОТЗ, описывает необходимость и возможность его интеграции с технологией информационного моделирования и непосредственно информационными моделями объектов капитального строительства. Это определяется тем, что ввиду действующих требований законодательства информационная модель призвана охватывать и объединять все этапы жизненного цикла объекта капитального строительства.

Ключевые слова: *задание на проектирование, нормативно-технические документы, функционально-технологические требования, образовательно-технологическое задание, реестры требований, параметрическое нормирование, Классификатор строительной информации*

СПИСОК ИСТОЧНИКОВ

1. Звонов И.А. Conditions and prospects for the application of Educational and Technological tasks at the pre-project stages // Недвижимость: экономика, управление. 2024. № 3. С. 60–64. DOI: 10.22337/2073-8412-2024-3-60-64URL:https://n-eu.iasv.ru/index.php/neu/article/view/218

2. Университетские кампусы и город: кооперация ради конкурентоспособности, август 2021. ВЭБ РФ. Университет 20.35 ЦСР. URL: https://www.csr.ru/upload/iblock/3f0/kbpm276p3tau6knlzdla3d6ozz0fve0e.pdf

3. Об утверждении Формы задания застройщика или технического заказчика на проектирование объекта капитального строительства, строительство, реконструкция, капитальный ремонт которого осуществляются с привлечением средств бюджетной системы Российской Федерации : Приказ Министерства строительства и жилищно-коммунального хозяйства РФ от 21.04.2022 № 307/пр (с изменениями и дополнениями). URL: https://base.garant.ru/404808053/

4. Звонов И.А., Каширина Н.В. Prospects of application of parametric method of standardization in conditions of the registry principle of technical requirements development // Недвижимость: экономика, управление. 2024. № 2. С. 73–77. DOI: 10.22337/2073-8412-2024-2-73-77 URL:https://n-eu.iasv.ru/index.php/neu/article/view/203

5. Пустовгар А.П. Перспективы перехода строительной отрасли на нормы, основанные на параметрическом методе нормирования. URL: https://smeta-na.ru/tehnologii/perspektivy-perehoda-stroitelnoj-otr. asli-na-normy-osnovannye-na-parametricheskom-metode-ormirovaniya/?ysclid=luzr8cngf3408612912

6. Об утверждении Правил формирования, ведения и актуализации реестра обязательных требований : Постановление Правительства РФ от 06.02.2021 № 128 (с изменениями и дополнениями).

7. Стандарт инновационной образовательной среды (кампусов) (утв. Министерством науки и высшего образования Российской Федерации 28 февраля 2024 г.).

8. Образование 3.0. URL: https://translated.turbopages.org/proxy_u/en-ru.ru.1d5b66eb-67459f51-f8ef95c2-74722d776562/https/en.wikipedia.org/wiki/Education_3.0

9. Блинов В.И., Сатдыков А.И., Осадчева С.А., Красовский Н.А. Опережающая профподготовка: формирование системообразующих компонентов // Образовательная политика. DOI: 10.22394/2078-838X-2020-4-84-93 URL:https://edpolicy.ranepa.ru/core-components

10. Классификатор строительной информации. URL: Стройкомплекс.РФ /ksi/99

11. СП 118.13330.2022. Свод правил. Общественные здания и сооружения. СНиП 31-06–2009 (утв. и введ. в действие Приказом Минстроя России от 19.05.2022 № 389/пр).

12. Реестр требований в области инженерных изысканий, проектирования, строительства и сноса . URL: Стройкомплекс.РФ/rntd

13. СП 333.1325800.2017. Информационное моделирование в строительстве. Правила формирования информационной модели объектов на различных стадиях жизненного цикла. URL: docs.cntd.ru

14. Правительство Российской Федерации. Об утверждении Правил формирования и ведения информационной модели объекта капитального строительства, состава сведений, документов и материалов, включаемых в информационную модель объекта капитального строительства и представляемых в форме электронных документов, и требований к форматам указанных электронных документов : Постановление от 17 мая 2024 года № 614. URL: docs.cntd.ru

15. Путеводитель по ID для JPA сущностей. Часть 1: ID, генерируемые на сервере. URL: https://habr.com/ru/companies/haulmont/articles/653843/

Об авторе: **Звонов Илья Александрович** — старший преподаватель кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 6197-7370, Scopus: 57204363101, ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru.

For citation: Zvonov I.A. Prospects of application of educational-technological task in the formation of information models of university campuses. *Real Estate: Economics, Management.* 2024; 4:43-47.

Для цитирования: *Звонов И.А.* Prospects of application of educational-technological task in the formation of information models of university campuses // Недвижимость: экономика, управление. 2024. № 4. С. 43–47.