DOI 10.15826/rjcst.2020.1.005

УДК 711.113

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BIM IN THE FRAMEWORK OF THE EXISTING REGULATORY-TECHNICAL AND LEGAL FRAMEWORK OF THE RUSSIAN FEDERATION

Abstract. The article presents the problems of introducing information modeling technology in the state of normative and technical documentation in terms of information modeling and the preparation of design and working documentation, highlights the main difficulties and tasks, prerequisites, directions and ways of solving problems.

Keywords: information modeling technology, project documentation, working documentation, design, BIM technology, regulatory and technical documents, Unified System for Design Documentation, System of Design Documentation for Construction

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BIM В РАМКАХ ДЕЙСТВУЮЩЕЙ НОРМАТИВНО-ТЕХНИЧЕСКОЙ И ЗАКОНОДАТЕЛЬНОЙ БАЗЫ РОССИЙСКОЙ ФЕДЕРАЦИИ

Аннотация. В статье представлена проблематика внедрения технологии информационного моделирования при текущем состоянии нормативно-технической документации в части информационного моделирования и оформления проектной и рабочей документации, выделены основные трудности и задачи, предпосылки, направления и способы решения проблем.

Ключевые слова: технология информационного моделирования, проектная документация, рабочая документация, оформление, BIM-технология, нормативно-технические документы, ЕСКД, СПДС

Introduction

An important task of the state is to improve the comfort and quality of life of citizens. One of the promising tools for this is to stimulate the increase in science intensity and innovativeness of industries and enterprises. An important aspect of this process is technical and legislative regulation. For this purpose, dozens and hundreds of legislative acts and normative and technical documents are developed and implemented annually, aimed at ensuring the possibility of introducing and applying new technologies, as well as increasing the requirements for technologies and products already being implemented. BIM technology has become one of these innovative technologies, which are becoming widespread in the design and construction of rear and structures.

Building Information Modeling

BIM (Building Information Modeling) is a building information modeling technology. BIM is the process of creating, modifying and then using a virtual model of a structure containing the necessary information about it, as a result of which an information model of the capital construction object is formed.

Information model is a set of graphical and non-graphical data presented in electronic form, which is a single reliable source of information on an object at all or individual stages of its life cycle. Examples of information models of various civil buildings are shown in Fig. 1. It should be noted that there is a division of information models according to the degree of their development (LOD — Level of Development), which consists of the degree of their detailing (lod — level of detailing) and informatization (loi — level of information). Different stages of design are applied at different stages of a building's life cycle.

Benefits of implementing BIM technologies

Research by the National Association of Designers and Surveyors (NOPRIZ) [1] showed that the introduction of BIM technology reduces the overall design time by 20–30 %, and also, due to the high quality of design documentation, reduces the duration of the process of its

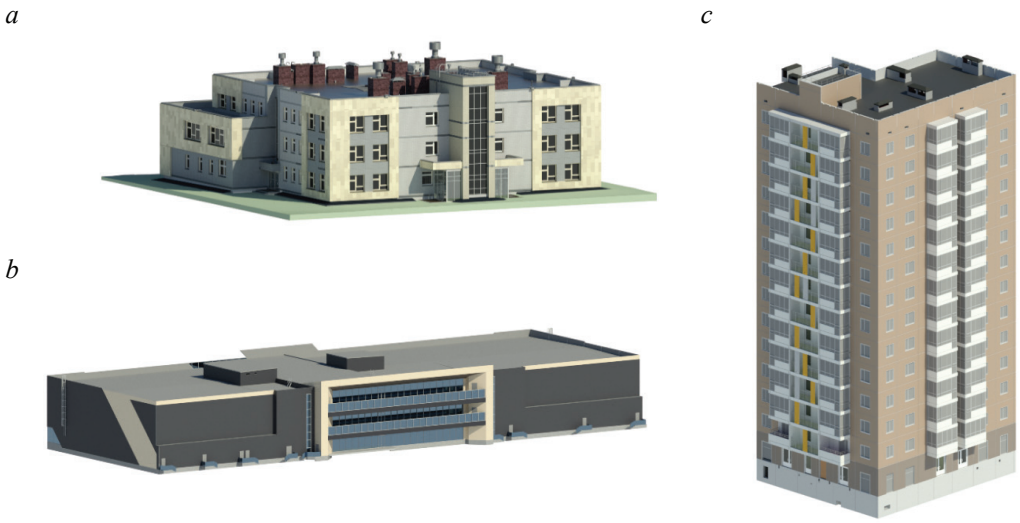

Fig. 1. The examples of information models for civil buildings:

a — the preschool educational institution in Ekaterinburg; *b* — the sports and recreation complex in the cottage village Onegino in the Moscow region; *c* — the large-panel residential building in Rostov-on-Don

formation. A multiple decrease in the number of collisions is recorded. A significant decrease in the number of requests for additional information from builders reduces the likelihood of downtime of labor resources, machines and mechanisms. The time for calculating the volume of construction work and the subsequent adjustment of the estimated calculations is reduced by 2–3 times. Thanks to more accurate procurement planning and organization of construction and installation works, costs during the construction and operation of the facility are reduced by 10–30 %. There has been an increase in labor productivity up to 30 % due to the optimization and automation of a wide range of tasks. It is also important to reduce the duration of the examination procedure, due to the possibility of quickly obtaining additional information by experts by generating additional types and more accurate issuance of comments.

The application of information modeling technology

It is not surprising that the introduction of this technology into the activities of design and construction organizations in our country has become a primary development task in the construction industry. For this purpose, an order was issued on the approval of the Plan for the phased implementation of information modeling technologies in the field of industrial and civil construction dated December 29, 2014 No. 926/pr [2]. This plan establishes a number of measures and deadlines for their implementation for the widespread implementation of BIM technology, in particular: selection and submission to the examination bodies of "pilot" projects, the design of which was carried out using information modeling technologies in the field of industrial and civil construction, examination, making changes in normative, legal and normative technical acts, educational standards, etc. As part of the execution of the order in 2015, PC-5 of the Technical Committee (TC) 465 began work on the first editions of new Russian standards supporting the use of information modeling technology, based on analysis and partial application of a number of ISO standards under the leadership of JSC Research Center Construction. At the moment, in the field of regulation of the application of information modeling technology in the design of buildings and structures, 8 regulatory and technical documents have been published, namely:

- State Standard R 57310–2016 "Information modeling in construction". Leadership in the delivery of information. Methodology and format (entered into force on 01.07.2017) [3];
- State Standard "Information modeling in construction". Requirements for operational documentation of completed construction objects (entered into force on 01.07.2017) [4];
- State Standard R 57563–2017 "Information modeling in construction". Basic provisions for the development of standards for information modeling of buildings and structures (entered into force on 01.10.2017) [5];
- Code of Practice 301.1325800.2017 "Information modeling in construction". Rules for the organization of work by production and technical departments (entered into force on 02.03.2018) [6];
- Code of Practice 328.1325800.2017 "Information modeling in construction". The rules for describing the components of the information model (entered into force on 16.06.2018) [7];
- Code of Practice 331.1325800.2017 "Information modeling in construction". Exchange rules between information models of objects and models used in software systems (entered into force on 19.03.2018) [8];

- Code of Practice 333.1325800.2017 "Information modeling in construction". Rules for the formation of an information model at various stages of the life cycle (entered into force on 03/19/2018) [9];
- Code of Practice 404.1325800.2018 "Information modeling in construction". Rules for the development of project plans implemented using information modeling technologies (will come into force on 06/18/2019) [10].

The entry into force of these documents formed a number of conditions and requirements for information models, thereby imposing a number of restrictions and setting a number of serious tasks for the design and production and technical departments, which, as a result, increased the labor intensity of creating and maintaining BIM models. It is also worth noting that in addition to additional time for the execution of these tasks, a significant number of engineering and technical personnel are required, qualified in the field of information modeling and design of buildings and structures, the deficit of which is strongly felt at the present time, due to the lack of a sufficient level of training of these specialists in the existing higher and professional educational institutions. This, in turn, creates favorable conditions for the emergence and development of commercial educational organizations specializing in training and implementation of information modeling technology. The disadvantage of this solution is the complete lack of control over the quality of training and the teaching methodology for solving project problems, as well as short training periods, which do not allow for a sufficient amount of knowledge. As a result, there is a shortage of qualified personnel in the labor market, which leads to the need for design organizations to "entice" qualified employees from other organizations, in view of which there may be inconsistency in the quality level of the information model issued in each particular organization at each stage of the information model life cycle.

Along with the normative and technical documents that have come into force in the field of regulating the use of information modeling technology, a number of existing State Standards are being updated in terms of the Unified System for Design Documentation and the System of Design Documentation for Construction [11–13] that establish requirements for the formation and execution of design and working documentation capital construction objects. Updates to these regulatory and technical documents do not take into account the features of the information modeling approach and the features of complexes implementing this technology, as a result of which, meeting the requirements established by these regulatory and technical documents causes difficulties and creates obstacles for the implementation and distribution of BIM technology, and sometimes even requires an appeal to the toolkit of CAD technology, which negatively affects the entire design process, and also does not allow to fully reveal all the advantages of the actively implemented technology.

The aim of the work is a comprehensive assessment of the current regulatory and technical documentation establishing the requirements for the formation and execution of design and working documentation for capital construction facilities, and the requirements for the creation and maintenance of information models of capital construction facilities, identification of "problematic" requirements for widespread use of BIM technology and the formation of a number proposals aimed at disclosing and disseminating the advantages of the implemented approach, which will increase the innovation and science intensity of design enterprises using information modeling technology.

First of all, we will characterize the problems of implementing the requirements of regulatory and technical documents in terms of the Unified System for Design Documentation and the System of Design Documentation for Construction when using information modeling technology. The main difficulty is the requirements for a high level of conventionality of graphic documents. There is absolutely nothing surprising in the fact that the requirements for the preparation of design and working documentation, drawn up in the middle of the last century, in an age of completely different technologies and, the only possible, manual method for creating graphic documents, establish a significant number of symbols for various elements, structures and equipment, which, in turn, significantly reduces labor costs for the execution of graphic documents, contributed to a high level of standardization of conventional-graphic symbols, increased the speed of formation of design and working documentation and guaranteed unambiguous reading of the drawing at the construction site under conditions of a minimum number of drawings and the absence of other ways of presenting information.

The emergence and distribution of personal computers, printers, plotters and CAD systems made it possible to significantly expand the possibilities of replicating design and working documentation and improve the quality of issued graphic documents. The deadline for completing a new copy of the drawing was reduced from hours and days to seconds, which could not but affect the organization of the entire design production, in particular, the redistribution of the ratio of draftsmen and highly qualified specialists in favor of the latter. Nevertheless, the introduction of CAD did not make any fundamental changes in the approach and methodology for generating graphic documents. The requirements for the minimum number of drawings and a high level of conventionality in order to reduce the amount of labor costs for detailed elaboration of elements, structures and equipment were also optimal. A truly new tool in the hands of CAD professionals is the ability to use color as a way to store and transmit information. A limitation of the widespread use of this information transmission tool was the significant cost of color printing and the low distribution of electronic graphic machines at the construction site. At the moment, the use of color as a tool for transmitting information to a construction site is of a local nature due to the proliferation of portable and compact means of viewing

electronic documents and the absence of such requirements in the current regulatory and technical documents and its distribution is entirely due to the initiative of foremen and foremen in the field.

When using information modeling technology, first of all, the information model of the required level of development is performed and all the necessary attributes of the information model elements are filled. Then the required drawings are generated by projecting the model elements onto the view plane and placing annotation symbols (dimensions, tags, leaders, elevations, etc.), as well as automatically generated lists and specifications. High detail of model elements, which serves to improve the quality of design, leads to high labor costs in the preparation of design and working documentation in view of the need to bring the automatically generated view to the requirements of the current State Standard and the Unified System for Design Documentation in terms of symbols and simplifications, which reduces its clarity, and, as a result, eliminates the advantages of using information modeling technology in the formation of design and working documentation. It is also worth noting that the presence of these difficulties, in contrast to CAD, pushes the specialists of design departments to abandon the implementation and use of information modeling technology as much as possible. Thus, the totality of the current requirements and the absence of a number of new requirements of the current the Unified System for Design Documentation and the System of Design Documentation for Construction documents prevent the introduction and widespread dissemination of information modeling technology in the design and construction departments.

The main directions for the development of documents that establish requirements for design and working documentation in order to create conditions for the spread of the use of information modeling technology in the design and engineering departments of the country is to change the requirements towards increasing the detail of drawings in general, their number, and variety. Expansion of methods of transferring and presenting graphic information, in particular, stimulating the use of color as a tool for transmitting information and axonometric projections as a visual way of presenting information. And also the creation of conditions for the replacement of working documentation with a highly detailed and well-developed information model in the event of a technical feasibility of its use at the construction site as agreed with the customer. Examples of the use of color and axonometric projections in the formation of drawings and views are shown in Fig. 2.

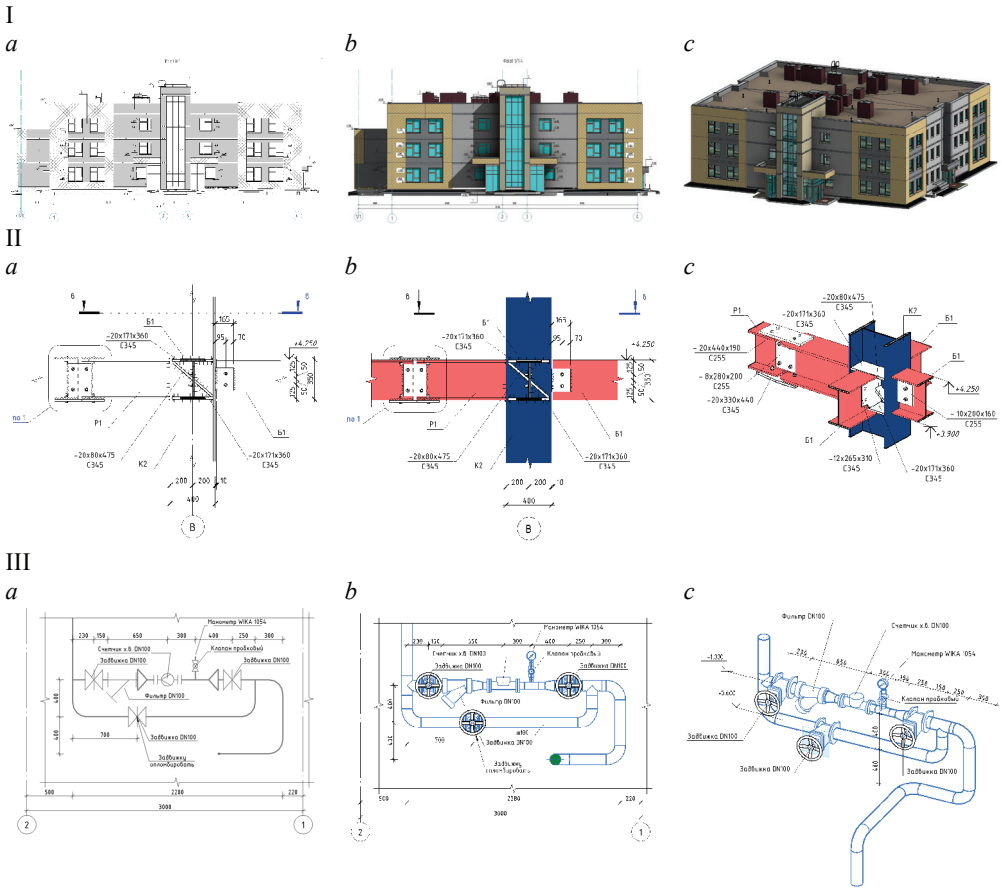

Fig. 2. Demonstration of the advantages of using BIM technology in the formation of graphic documents:

I — the main facade, II — the junction of metal structures, III — the water meter unit;
a — presentation in b/w with the use of conventional graphic symbols; *b* — representation in color and high detail; *c* — axonometric representation

It is also worth highlighting the issue of revising the type of a number of statements and specifications established by State Standard in view of the impossibility or high complexity of implementing the established forms with currently available software systems that implement information modeling technology while maintaining the BIM approach. The BIM approach implies the automatic generation of statements and specifications and their constant automated updating, thanks to the automatic updating of the data specified in them when changes are made to the model elements. The "problematic" lists and specifications include: a list of finishing of premises in accordance with Appendix A of Interstate Standard 21.501–2011, a list of jumpers in accordance with Appendix A of Interstate Standard 21.501–2011, a list of steel consumption in accordance with Form 5 in accordance with Appendix A of Interstate Standard 21.501–2011, a list of facade finishing in form 9 in accordance with Appendix A Interstate Standard 21.501–2011, a list of elements in form 1 in accordance with Appendix E Interstate Standard 21.502–2016, specification of rolled metal in form 2 in accordance with Appendix L Interstate Standard 21.502–2016, etc. type of sheets or specifications with the customer, use tools or solutions that neutralize the advantages of the BIM approach, and sometimes even form sheets and specifications using text and lines. Also, the possibility of using color in the formation of lists and specifications remains unrealized. An example of applying color is shown in Fig. 3.

Another problem in the implementation of BIM technology is the normative and technical documentation that sets recommendations for information models and their components. In particular, the recommendations of Code of Practice 301.1325800.2017 in terms of requirements for design and construction information models; and recommendations of Code of Practice 328.1325800.2017 in terms of requirements for the description and naming of components of information models. The most problematic is the implementation of the recommendations set out in sections 8 and 9 Code of Practice 301.1325800.2017 in view of the significant amount of information that needs to be entered into the information model as construction progresses and the almost complete absence of specialists from the VET departments qualified in the field of information modeling.

Clauses 5.10.10–5.10.12 deserve special attention:

5.10.10. As the work is completed and accepted, the executing organizations carry out the transfer of data to the construction model in accordance with section 9 of this set of rules.

a *b* *c*

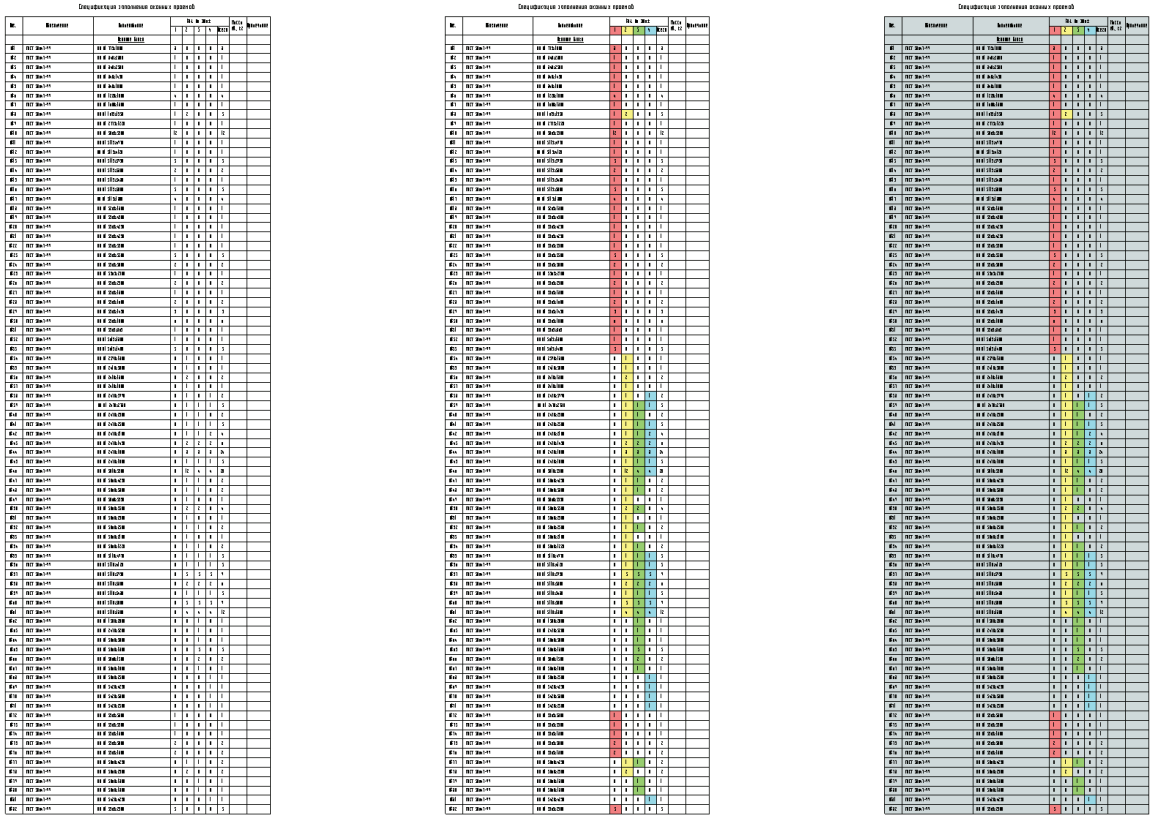

Fig. 3. An example of applying color when generating a specification for filling window openings:

a — b/w option; *b* — filling cells with a non-zero value; *c* — full color fill

5.10.11. The data transferred to the construction model by the organizations executing the work is stored in the working version of the construction model until the PTO control is passed for compliance with 9.4.

5.10.12. After passing the VET control, the data transferred to the construction model by the organizations executing the work is transferred to the current version of the construction model.

Thus, the initial input of data into the construction model should be carried out by employees of the organization-executor of work qualified in the field of information modeling, the acute shortage of which is observed in the labor market; and the transfer of data into an actual building information model, which indicates the need to maintain and control two parallel building information models, which unnecessarily complicates the workflow of VET specialists.

Confusion is caused by the recommendations for the formation of names of materials, attributes and files established by Code of Practice 328.1325800.2017, in particular: recommendations for indicating the "author's code" at the beginning of the name of attributes, materials and files, due to the lack of practical application of this information, as well as any rules formation of this "author's code"; and the requirement for continuous spelling of words when forming names; as well as a number of implicit requirements for the components of the model, an example of which is clause 8.1 and a number of others:

8.1. A component shall "behave" in a manner that reflects its functionality and relationships with other components.

It is also worth noting the disagreement of the recommendations established by the various sets of rules in the field of information modeling.

Conclusions

Thus, the current regulatory and technical documentation in the field of information modeling in construction does not contribute to the introduction and dissemination of BIM technology in the design and construction organizations of the country, but only establishes a number of requirements and recommendations that complicate the process of implementation and transition to a new technology.

The main direction of development of normative and technical documentation in the field of information modeling in construction is taking into account the shortage of specialists qualified in this area at all stages of information modeling and canceling a number of recommendations, the implementation of which has no practical application and is unjustified.

Thus, it can be argued about the insufficient orientation of the regulatory and technical documents establishing the requirements for the design and working documentation for the implementation of BIM technology, and the high complexity of implementing the requirements of regulatory and technical documents establishing recommendations for information modeling in view of not taking into account the current situation in terms of the availability of a sufficient number qualified personnel in the field of information modeling at various stages of construction production, which together leads to a slow implementation of BIM technologies and an incomplete use of its potential. The main direction of development is to stimulate the use of new tools for storing and transmitting information, expanding the mandatory forms of information presentation.

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