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WAYS TO OVERCOME THE IMPLEMENTATION PROBLEMS OF BIM- TECHNOLOGY RELATED TO THE NATIONAL STANDARDS IN THE ARCHITECTURAL AND BUILDING INDUSTRY OF UKRAINE

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Abstract
The paper describes the problems of intentions of the rapid introduction of BIM technologies in the construction industry of Ukraine. The research methodology involves analysis of national building standards, BIM technologies that have already been partially tested and a new logical structure of design processes in the logic of BIM technology in Ukraine. It is proposed to introduce into the design practice a number of actions aimed at harmonizing the key stages of BIM-technologies development with the regulatory framework. The European LOD stages and Ukrainian stages of designing are compared; it is proposed to introduce and gradation enshrine it in state building standards. The correctness problem of competitive tender documentation form for the development of project documentation in Ukraine is highlighted. The issue of the need for a detailed review of European Union standards in terms of national specifics and their gradual implementation in the Ukrainian legal framework was raised. It is proved that the proposed measures will improve the quality of design solutions in terms of economic feasibility and environmental friendliness, and government agencies will be able to qualitatively control all design and construction processes.

Keywords: **Architecture; LOD; BIM-technologies; Ukraine; Ukrainian stages of designing.**

1. INTRODUCTION

The active position of the Ukrainian commercial sector on the use of the best world experience in the construction industry at the local level has accelerated the processes of state perception of BIM as a necessary tool for managing architectural and construction processes. In February 2021 the Cabinet of Ministers of Ukraine has adopted the Concept of Implementation of Building Information Modelling (BIM) Technology in Ukraine [1, 2]. This was the first step towards the formation of information (digital, indexed) architecture of data on the construction environment and the construction industry of Ukraine in general, which will include local architectural and construction processes in global contexts and establish a common European BIM space.

As part of the implementation of the Concept, by 2025 it is planned to regulate the implementation of BIM technologies in the regulatory field; to introduce

methods of effective life cycle management of construction objects; to encourage organizations to use BIM technologies in their activities, in particular through the introduction of free training programs and expert support; to introduce unified system processes of creation and exchange of digital information – from design to operation; ensure integration with existing electronic systems for providing services and information in the construction industry; develop manuals, regulations and protocols on principles and requirements for modeling, data exchange and management, taking into account the best international experience; to gradually introduce pilot construction projects using BIM technology; to create a national infrastructure of geospatial data and urban cadasters, which will facilitate the process of digital transformation of the construction industry, as well as ensure the creation of a state system of data storage and management; review and develop appropriate educational programs in institutions of higher and higher professional education; create mechanisms for retraining and certification of specialists.

The concept is expected to be implemented in stages. At the initial stage, it is envisaged to create appropriate conditions (implementation of regulatory and technical regulation, development of regulatory and technical support), training of architectural entities and implementation of pilot projects in the design and construction of various facilities. After creating the necessary prerequisites, it is planned to carry out BIM technologies in Ukraine and establish criteria for the use of BIM technologies during the construction of individual facilities depending on their cost, complexity, class of consequences (responsibility), in particular during the implementation of construction projects using state support, as well as the spread of the practice of implementing the operation of facilities (including in the implementation of pilot projects) using BIM technologies.

Despite the wide range of objectives set in this Concept, it has a number of shortcomings and does not address national issues in broad contexts, which reduces the real effectiveness of steps towards full implementation of BIM technology. This applies to cultural, financial, management, and security barriers, as well as directly to technology. The concept does not disclose the detailed mechanism by which the technological transition to new principles of design and construction using BIM technology is not clearly indicated, the issue of phased design and compliance of the Ukrainian regulatory framework with the standards of the European Union is not agreed. The proposals to adopt certain ISO documents as Ukrainian state norms in a literal translation are also contradictory – such a method of transferring Western experience will leave unresolved issues of terminological and practical BIM achievements of Western design and construction practice.

The purpose of this study is a proposal to harmonize the key stages of development of BIM technologies with the regulatory framework of the construction industry of Ukraine for their rapid implementation in the structuring of BIM models in accordance with current Ukrainian design standards and develop recommendations for adopting agreed standards with ISO standards.

The implementation of the European experience should be consistent with the restructuring of the technological process in both design and real construction. The sequence of the process of design and approval of project documentation also requires a rethinking of the plan of design and construction works.

2. LITERATURE REVIEW

The development of research on BIM technologies in the scientific community of Ukraine began with the emergence of appropriate applications that allow you to form objects as virtual models. But a qualitative shift began at the end of the last century.

Historically, the practice of implementing BIM at the research level is concentrated in the technical fields of research, the calculation of building structures in Yevhen Surzhan, Kostyantin Rapina and Tetyana Rapina from O.M. Beketov National University of Urban Economy, Kharkiv where it is mentioned about the use of BIM as a process that will strengthen the rationalization of the STISK system and open the way for new designs based on this structure [3].

Separate researches are devoted to technological features of use of separate BIM-applications as the tool of BIM-designing in research of Victor Shpagin, Taras Shevchenko National University, Kyiv. It is claimed that the decision to create a program for BIM is possible only by the world's leading developers of software products for the construction industry, such as Autodesk, Nemetschek and Trimble. Analysis of the use of specialized tools does not yet allow the full use of a single platform and requires the exchange of information [4].

Certain features are highlighted in the use of BIM for infrastructure projects, the calculation and construction of structural elements of such structures requires

constant monitoring of their condition and reflects the nature of the information content of the model in the study of Alexey Lobiak, Andrii Plugin, Larisa Kravtsiv and Oksana Kovalova, Ukrainian State University of Railway Transport, Kharkiv. Performance control was implemented using new structural coefficients, which are implemented in the software package "LIRA-SAPR" based on BIM and FEM (finite element method) [5].

There are also examples of emergency use of BIM, as in the study of A. Kravchenko and M. Hryhorenko, "Building Information Modeling (BIM) of Coke-Plant Components in Giprokoks Designs" Giprokoks, Kharkiv, Ukraine [6]. That is, the system component of BIM as a theory of coordination of components and processes allows the use of general technological principles for many construction-related technological solutions.

The general goal of streamlining the industry is aimed at setting up information support for all processes and stages of both design and construction; much attention is paid to environmental issues and sustainable construction in society. Supporting innovation in construction is one of the main ways to implement, manage and operate the life cycle of a building. Particular attention is paid to the technology of building information modeling, especially its benefits and tools. The essence of this direction is set out by Peter Mesaros, Jana Smetankova and Katarina Krajnikova in the paper "Proceedings of advances in resource-saving technologies and materials in civil and environmental engineering (CEE 2019)" [7].

A perspective direction is the introduction of BIM to the objects of renovation, revitalization and reconstruction of real estate in the publication "Implementing Building Information Modelling for the Reconstruction Process of Unfinished Building Projects" at the Conference "2020 IEEE EUROPEAN TECHNOLOGY AND ENGINEERING MANAGEMENT SUMMIT (E-TEMS 2020)" by authors from Ukraine and Belgium (Tetiana Lukianova, Vasyl Donenko and Ralf Klein) [8].

A special link in the implementation of BIM are business representatives and colleagues from the Ukrainian BIM Community, who spoke in 2020 at the conference KNUBA, Department of Information Technology in Architecture, presented the "Concept of BIM technology in Ukraine" [9] and made a report: "International experience in the implementation of BIM technologies" There are Andre Poddubny (EU project "Assistance to the authorities of Ukraine in improving the management of the infrastructure project cycle"), Dmytro Afanasyev (NTUU "KPI"), Oleg Blonsky, Yuriy Podolchuk, Investment Projects Bureau – Oleksandr Kanivets (ASKansulting), Mykola Kolomoyets (STEM Engineering), Yuriy Krivokhatko (Graphisoft Center Ukraine), Yuriy Smirnov (Allbau Software Ukraine), Oleksiy Sokolovsky (AVG Group), Igor Yurasov (Archimatics). The developed "Concept of introduction of BIM-technologies in Ukraine" [9] is the basis for the development of a roadmap and adoption of the concept of introduction of BIM in Ukraine at the state level – "Concept of introduction of BIM technologies in construction" [1, 2].

The authors of the study and colleagues from the Ukrainian BIM Community support the philosophy of open BIM environment to solve specialized problems of design and development of OpenBIM on the basis of free and public access to data [10–12]. Such structured data storage centers for architectural, construction, industrial and infrastructure projects will allow Ukraine to make a rapid step towards BIM not only at the level of design and construction, but also the same BIM life cycle level, the so-called BIM 6D and beyond.

3. MATERIALS AND METHODS OF RESEARCH

The research methodology involves analysis of national building standards, BIM technologies that have already been partially tested and a new logical structure of design processes in the logic of BIM technology in Ukraine. The materials of the study are ISO standards and Ukrainian state building codes, which regulate the stages of design, design documentation and implementation and implementation of BIM-technologies, as well as inquiries and interviews of leading Ukrainian architectural and construction companies on BIM-standards and procedures they implement in their practice.

4. RESULTS

The desire to quickly implement BIM technologies has its drawbacks, which are related to the local characteristics of the design and construction activities. Thus, in his work, the Ukrainian designer (architect or engineer) focuses on the final result, design documentation, prepared in accordance with DBN A.2.2-3-2014 "Composition and content of design documentation for construction" [13], meanwhile, modern tender proposals, especially in international projects, indicate the level of BIM project development according to LOD

(Level of Development – Level of detail of both graphic and information component [14]). Thus, in the scientific field there is a need to develop methodological applications or adopt new standards, which will develop and describe in detail the comparison of design stages according to DBN A.2.2-3-2014 (Draft Project (DP), Project (P), Working Project (WP), Working Documentation (WD), and according to certain requirements to the level of the design object - preliminary developments of Feasibility Study (FS) or Feasibility Calculation (TER) with LOD levels (100–500). The degree of development of the model and its saturation with information should correspond to the specified LOD levels [12, 14–18], and the complete set of drawings is unified.

As part of the research, the authors proposed their method of comparing the requirements of detail of development according to the Ukrainian stages of design with the gradation of stages of development of BIM models, taken as a model in developed countries for the formation of local LOD requirements.

In order to correlate the differences between the division system at the LOD level and the design stages enshrined in the Ukrainian regulatory framework, within the developed methodology, the degree of development of project documentation was considered from three positions: 1) comparison of descriptions of criteria, which are prescribed in the main normative documents (as a material for analysis were taken Ukrainian DBN A.2.2.2-3: 2014 [13] and distributed in the space of European countries Level of Development (LOD) Specification [19, 20]; 2) the level of scale of the project work that carried out: site, object, floor; 3) the level of structural elements that compose the design object.

In addition, it was determined that in the process of correlation it makes sense to pay attention to the logic and tools of specialized software for BIM design, which is most common in Ukraine: Allplan, ArchiCAD, Revit, etc., because the presence or absence of display or designation of a certain properties in the program can affect the content component of the detail. In addition, when approving certain regulations that will regulate the procedures for determining the optimal composition and content of project documentation, the temporality of the process of developing specialized software should be taken into account, especially given the preservation of the project in the general state base. The developers are constantly making changes to the programs, updated versions are released every year, adding additional features and improving "usability". This means that the completeness of the information in the project documentation should not be a permanent form, and in the regulatory documentation should be fixed the deadline after which, this completeness should be reviewed and updated.

In applications DBN A.2.2.2-3:2014 "Structure and content of the project documentation for construction" [13] identified, which requires the presentation of information of every stage of design.

Feasibility study (FS), feasibility calculation (TER) contains initial provisions, which indicate the technical feasibility and economic feasibility of construction of the object; justification of the design capacity of the construction object; justification of the number of new or additional jobs; data on the availability of raw materials, on the provision of basic materials; data on engineering surveys; environmental impact assessment; schemes of general plans and transport, scheme of the consolidated plan of engineering networks; basic decisions on engineering preparation of the territory and protection of the object from dangerous natural or man-caused factors; basic technological, construction and architectural planning solutions; basic solutions and indicators of energy efficiency, comparison of options; basic provisions for the organization of construction; measures for technical protection of information; basic decisions on sanitary and household services, explosion and fire safety, implementation of engineering and technical measures of civil protection; accessibility of the object territory for less mobile groups of the population; substantiation of investment efficiency; design duration of construction; technical and economic indicators; estimate documentation; calculation of the class of consequences and the category of complexity. The main characteristic of all the information presented at this stage of design is its approximation. The level of development of the LOD 100, which is proposed by leading European developers of BIM models, assumes the same approximation, but it states that the information shows the existence of the component, but not its shape, size or exact location. However, Ukrainian practice shows that at the stages of feasibility study and TER a certain amount of design and drawing documentation is already attached.

In our opinion, there is no reason to abandon the established practice over the years, most likely this stage needs to be reconsidered in terms of formalizing the information required, and can be presented as a geometrically modeled object. Non-graphical information can also be added to a model element. In terms of the level of scale of the ongoing design work,

at the level of the construction site BIM model of the design stage of the feasibility study (TER) will include a simple topographic surface; at the object level – general parameters of approximate dimensions, shape and location; at the floor level – general zoning. In terms of the level of structural elements - they will not be geometrically represented, but will be described in text applications.

The composition of the design documentation of the Draft Project (DP), according to DBN A.2.2.2-3: 2014 [13] includes initial data for design, a brief description of the object, data from engineering surveys, information on the order of construction and start-up complexes, determination of requirements for urban planning decisions, accessibility of the object for low mobility groups, basic technical and economic indicators, cost documentation, calculation of the class of consequences and contains the following mandatory drawings: situational plan, scheme of the master plan, scheme of transport and pedestrian connections, floor plans, facades, sections of buildings and structures, schematic diagrams of engineering equipment, technological layouts and design solutions. This level of detail of the design solution can be compared with the level of development of LOD 200, which describes: that the elements of the model are presented as a general system or assembly with approximate quantities, sizes, shapes, locations and orientations. Non-graphical information can also be added to the BIM model.

The information presented at the stage of the Draft Project (DP) should provide a complete picture of the object, sufficient to obtain realistic technical and economic calculations and to make an approximate estimate. BIM model of the design stage, the sketch at the level of the design site includes the topographic surface, roadways, parking spaces, parking curbs and gutters, walkways and sidewalks, sports, recreational and playgrounds, site lighting, utilities, tunnels, trenches; objects are modeled with limiting elements - walls, columns, floors, the exact dimensions, number of floors, the status of reconstruction, service life are determined; at the floor level – defined grids (building axes) and level heights (floor marks), areas and volumes of buildings. From the point of view of the level of structural elements – modeling will include the approximate size and shape of foundation elements, utilities and additional structures, approximate code and requirements for free space, approximate pipe material, building envelopes (vertical limiting elements, spatial objects must be connected among themselves), load-bearing structures, wall thicknesses (there is an idea of materials of enclosing structures), their slopes are defined.

The Project (P) stage, according to DBN A.2.2.2-3:2014 [13], requires the presentation of the following information: initial data for design, a brief description of the object of the design capacity, data from engineering surveys, information on fuel, water, thermal energy, energy saving measures, information on the order of construction and start-up complexes, materials for environmental impact assessment, decisions on engineering protection of territories and objects, accessibility of the object territory for low mobility groups, section of engineering and technical measures of civil protection, ensuring reliability and safety, basic technical and economic indicators, economic calculation of investment efficiency, section on scientific and technical support, information on the scope of work and calculation of the class of consequences. Thus, in architectural and construction decisions and the basic indicators of the general plan, improvement and gardening should be presented; brief description and substantiation of architectural decisions, decisions on exterior and interior decoration. Developed technological solutions and solutions for engineering equipment – heating, ventilation, air conditioning, gas supply, water supply and sewerage, electrical equipment, electric lighting, lightning protection, television, automation, fire safety measures. Thus, in the operating DBN there is a requirement concerning the following drawings: the situational plan, the general plan, basic decisions on vertical planning, the scheme of transport and pedestrian communications, the plan of external engineering networks and communications, plans of routes of internal platform networks and constructions, schemes of arrangement of the bases, plans floors, facades, sections of buildings and structures, main components of structural elements, reinforcement schemes of monolithic reinforced concrete structures, interiors of main premises, catalog sheets, floor plans, facades, sections, schematic diagrams of engineering equipment, technological layouts with plans for the location of basic equipment, documentation on the organization of construction and estimate documentation. These requirements of the Project (P) stage meet the established levels of development LOD 300-350, in which the elements of the model are graphically represented in the form of specific systems, objects, assemblies in terms of quantity, size, shape, location and orientation; the details necessary for coordination with the next or connected elements are modeled. These parts include elements such as

supports and connections. The number, size, shape, location and orientation of the element can be measured directly from the model.

From the point of view of the scale of project work at the construction site level, the BIM model of the Project (P) stage will include a complete and accurate reflection of the earth's surface, created on the basis of site topography, with borders, slopes and "red lines", with curbs, complex landscapes, buildings, ditches, utilities, landscaping, detailed planning of the territory. At the level of the object – the spaces of the building are modeled or placed in connection with the limiting elements, the volume of internal spaces is calculated to the nearest horizontal surface of the finish; at the floor level – grids of axes and levels of levels are specified in relation to the content of the model; defined position and dimensions of holes; the area, entrance levels, construction status are specified. From the point of view of the level of detail of constructive elements – presented by concrete elements, with in detail developed constructive decisions, layers of materials; spatial objects are automatically associated with vertical, horizontal and inclined limiting elements, the following characteristics of structural elements are defined: degree of fire resistance, flammability, smoke formation, toxicity, thermal conductivity, moisture resistance, frost resistance, service life (main indicator for BIM 6D).

The composition of the Working Documentation (WD) in DBN A.2.2.2-3:2014 [13] is written in general terms, it is indicated that it should contain working drawings, passport of finishing works, estimate documentation, specifications of equipment, products and materials; questionnaires and dimensional drawings for the relevant types of equipment and products, working documentation for construction products, sketch drawings of general types of atypical products. This generalized presentation places the responsibility for the chief engineers and chief architects of design organizations to decide which parts of the project should be elaborated in detail and which should not. This leads to an imbalance in the construction industry - the construction site receives different in form, information and quality design solutions, which inhibits the involvement of the construction stage in full-fledged BIM processes. At the same time, equating the stage of Working Documentation (WD) to the generally accepted level of development of LOD 400 could unify design solutions and improve the quality of the organization, construction work in general. The LOD 400 design level assumes that model elements are graphically represented within the model as a specific system, object, or assembly in terms of size, shape, location, number, and orientation. The elements are modeled with sufficient detail and precision to allow each element of the model to be manufactured, assembled and installed.

At the level of the construction site, the BIM model stage of the Working Documentation (WD) is a ground surface modeled using robotic profiling and GPS slope control systems, on which all elements of the master plan are developed in detail; at the object level – spaces are modeled or placed with limiting elements, the volume of internal spaces is calculated to the nearest horizontal surface of the finish; at the floor level – grids of axes and levels are specified in relation to the content of the model; defined position and dimensions of holes; indicate the area, entrance levels, construction status. In terms of the level of detail of structural elements – they are represented by specific elements, with detailed design solutions, which include the layout of individual elements (masonry, reinforcement systems); structural joints are elaborated in detail; developed assemblies of individual products; the following characteristics of structural elements are determined: degree of fire resistance, flammability, smoke formation, toxicity, thermal conductivity, moisture resistance, frost resistance, service life. The introduction of such a detailed BIM model at the design stage will almost completely replace the use of paper drawings on construction sites and in production.

The Law of Ukraine "On Public Procurement" from 23.01.2021 [21] and regulations currently do not strictly regulate the format of the description of information on the necessary technical, qualitative and quantitative characteristics of the subject of procurement in the preparation of tender documents. As a result, the design tasks, which are attached to the tender documentation, prescribe only the phasing of the project documentation without specifying the details of its development. Given a very generalized description of the composition of the project in DBN A.2.2.2-3:2014 [13] at each project stage, the customer can't be sure of the quality of the project documentation that will be obtained by him as a result.

According to this, we consider it expedient to propose a revision of the form of the tender documentation. First, the description of the lot for design and construction work should specify at which level the LOD proposals are expected, and secondly, the need of rethinking and requirements, in what form should be presented project items – BIM models with appropriately designed budget documentation should grad-

ually completely replace two-dimensional drawings and manual estimates. In order to accelerate the process of approval and effective implementation of construction for simple technological and structural solutions of facilities there should be given the opportunity to submit tender documents at the level of sketch development. In this case, a sufficient level for submitting a project proposal for the tender can be developed as a draft project, which does not provide for detailed development of external and internal networks of water supply, sewerage, gasification, heating, electricity, etc., but it must be fully developed proposals for design solutions, appropriate calculations primarily according to DBN B.1.2-2:2006 "Loads and impacts" [22], and the use of building materials with the development of basic structural units (at the level of LOD 300-350).

Thus, the main calculation indicators by which choose the proposal can be chosen will be: 1) the cost of construction materials, which are laid down in the project proposal, and which are calculated automatically based on the proposed technology of construction; 2) the level of operating costs, the basic indicators of energy efficiency of the house, in the first place, the annual cost of heating the house, which are also calculated automatically; 3) time, term or term of execution of the order – construction of the object, which is also calculated automatically, based on the proposed construction technology and construction materials.

It should be noted that the Customer will be able to assess the degree of cost of future construction, time to receive the order (ready-to-use building) and the degree of cost of operation of the building in the future for LOD 500 (design period) as well as if there is information on the service life (LOD 500) – plan of the further use or disposal of the construction site.

The proposal for harmonization of ISO and DBN in the transition phase of BIM implementation is shown in Figure 1.

Also, it should be noted that, despite of all advantages of using LOD in design using BIM technologies in each context, it is necessary to define both the general level of LOD – object level, indicating the stages of design, and, if necessary, individual parts or sections of the project. Ideally, all sections of the project should be at the same LOD level, determine the full amount of information saturation of all components of the construction process, material costs and the level of responsibility of both building structures and professionals involved in the construction of this facility.

The second important issue that should be focused on before deploying activities for the direct implementation of actions specified in the Concept is the understanding of the process of harmonization of the Ukrainian national regulatory framework (DBN, DSTU…) with the standards of the European Union [23] (ISO).

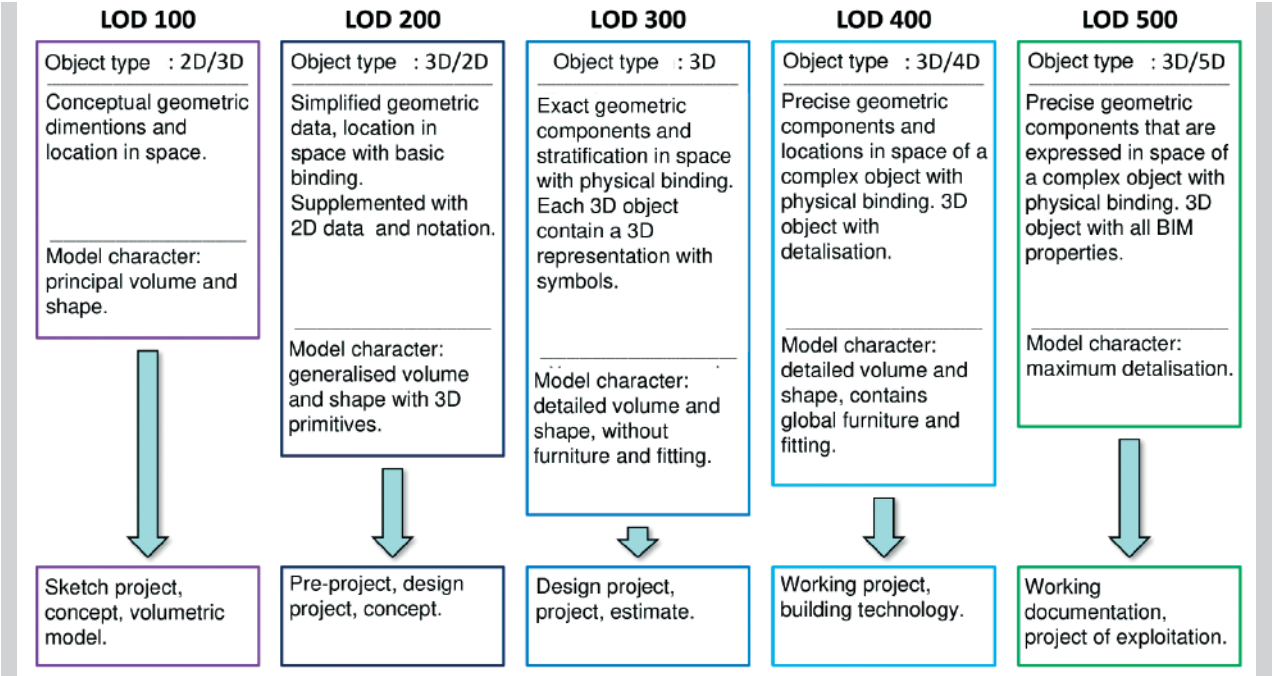

Figure 1.
Comparison of the levels of project development according to LOD and the principle of phased design according to DBN

Since 2020 work has begun on the formation of the Ukrainian base of standards, which are regulators of design and construction activities, taking into account BIM technologies. However, this work is implemented by direct translation of certain international standards into Ukrainian. This method of implementing foreign normative experience, which does not provide for detailed consideration and adaptation of certain provisions in accordance with established local norms of construction process management, raises doubts about its effectiveness and concern – the inclusion of inconsistent norms in the normative field may cause contradictions in their implementation and create unexpected obstacles to construction activities.

As you know, the standardization organization itself – ISO (International Organization for Standardization) is a global association of national standardization (ISO members) and it is a complex international structure that does not just formulate common European standards, which are taken directly, but also develops recommendations according to which local state organizations make changes, additions and clarifications to their national norms, making sure that they do not conflict with state standards governing the construction industry at the local level. Work on the preparation of international standards is usually carried out with the involvement of ISO technical committees. Every ISO member is interested in the subject matter of the technical committee, Governmental and non-governmental international organizations have the right to be represented on these committees.

The methodology of estimating project proposals – the resource method – needs special attention. The method determines the statistical accumulation of data and the transparent use of pricing of both material resources and the salary fund of all participants in the design and construction process.

An additional criterion, according to the study of the experience of the construction industry of the EU countries is equipment supporting documentation to executed orders – which is the national practice but almost never performed, housing cooperatives receive the executive documentation, mostly, from the developer by the decision of court, and unfortunately, it is not rare phenomena.

At the end of the definition of problems it should be noted that the problem of correct and unambiguous interpretation of terms related to BIM technology acquires special significance in the formation and completion of the database of standards that will regulate the Ukrainian design and construction industry [11, 24]. This work, which has already begun with the participation of the authors, should precede the publication of normative documents, the interpretation of each term should be revised and finally enshrined in the normative field in the state language. But since BIM is seen as a process, as a technology, as a result – it is necessary to expand the usual translation and identify common with established concepts and record them in the construction dictionary for all areas of the construction industry. Thus, the terminological and legal field will be created and agreed upon, and the main provisions on the implementation of BIM in national norms and standards will be fixed.

Examples of domestic companies that already use BIM technologies in design and construction show the accumulated experience, but the technological chain of design follows the principle of creating a ready-made BIM model based on solutions from architects, and then refinement of building structures and design of engineering networks. Sometimes this process, on the contrary, complicates the organization of design in the BIM environment. The authors see the need not only to make changes in DBN A.2.2.2-3:2014 [13], but also the paradigm of the process of architectural and construction design, which will directly lead to a qualitative movement towards improving the interaction of all participants in the construction process.

Examples of domestic companies that already use BIM technologies in design and construction show the accumulation of practical experience in their implementation in Ukraine. However, the technological chain of design is based on the following principle: 1) creation of a ready-made BIM model based on drawings from architects (Fig. 2), 2) refinement of building structures 3) design of engineering networks (Fig. 3). Such a consistent process complicates and slows down the organization of design in the BIM environment. According to the regulations, the detail of the working documentation of the Architecture section submitted for examination corresponds to the LOD 500 level (Fig. 2), while the detail of the documentation of designers and engineering design networks is LOD 300. Many additions are unforeseen by architecture, and sometimes there those that force a radical rethinking of architectural solutions. Based on this, the authors see the need not only to make changes in DBN A.2.2.2-3: 2014 [13], but also to reconsider the paradigm of the process of architectural and construction design in general, which will directly lead to qualitative movement towards improving the interaction of all participants.

Figure 2.
Architectural solutions. Stage of working documentation (approving part) (LOD 500)

Figure 3.
Construction solutions. Stage of working documentation (approving part) (LOD 300)

5. CONCLUSION

At the stage of pre-project development, a technical task for design should be formed, which includes the development of alternative solutions, the formulation of consolidated technical and economic indicators for each of them, and the selection of the optimal design solution. Such a procedure within the pre-design stage will allow fixing a specific design solution, on the basis of which the work on the preliminary design will be started, and will reduce investment risks and unpredictable delays and, consequently, cheaper design work.

The authors propose to open a discussion on the transition to the design stage at the LOD levels [12, 14, 24, 25], which will help to qualitatively compare project proposals, reuse the developed solutions as approved template models and help the construction industry move directly to the European level – get albums of drawings in electronic form, which are directly related to the 3D model. Thus, using additional 3D (BIM) model on the construction site will be able to focus not only on flat representations of the object on the basis of drawings, but also to obtain additional sections and views of the BIM model at any stage of work [24, 26, 27].

Construction and environmental solutions will receive the greatest benefits from the introduction of LOD [14, 24, 28, 29], and government agencies will be able to qualitatively control the design [27] and construction processes on the construction site, monitor the feasibility of investment in construction, especially in public order, conduct environmental monitoring and certify buildings according to EU standards [29] (LEED and BREEAM).

Accumulated International and Ukrainian experience in implementing BIM allows to specify the main duties and functions of BIM managers [27].

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Revit AUTODESK – https://muk.ua/company/vendors/autodesk/, MUK authorized distributor, Dmitry Makarov.

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