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CONCEPTUAL BIM MODELING IN IMMERSIVE VIRTUAL REALITY

Abstract: *The article describes the problem of clarity in the design of today's architectural typology complexes, the analysis of the studies of foreign and domestic scientists. The general definition of BIM systems (Building Information Model) through the analysis of its components and hierarchy was made. The review of the leading engineering graphics packages was performed. Possibilities of this structure in conceptual creative plane, the purpose, boundaries and research methodology were highlighted. A list of software used in the study was given. It was concluded that virtual reality is a tool of research and education. The article proves the prospects of using CIM model (Concept Information Model), which is described in the research stages as part of the reconstruction of historic BIM modeling. In this paper the fact of evolution of the architect's thinking is ascertained.*

Keywords: conceptual BIM modeling, immersive virtual reality model of the architectural space, the architectural composition.

Problem statement. For architect key task is to combine harmonious architectural composition with a good functional solution. The modern architecture complex differs typology that always enters into an argument with the results of searching perfect lines of art. The link between ideas of abstract visualization and analysis is a difficult part of professional work, especially given the need to harmonize policy decisions with a third party – the customer. The problem of visibility comes to the fore not only for already formed specialists, but also at the stage of education of architects. A large degree of abstraction in the study of architectural composition,

interaction of parametric models in generative shaping cause difficulties of perception.

Analysis of the recent researches. Knowledge of architectural composition in the works of art criticism Doctor, Professor Titz A. A. [2], architect, theorist of architecture and urban planning Robert Krier [5], and other power scientists from different countries are covering the fundamental concepts of communication form-features, proportions and techniques of artistic expressiveness. These principles are still in the precomputer era. The authors traditionally based on 2D graphic symbols and spatial representation of an artist.

Until recently, the concept of architectural space had not a single interpretation and was used by different authors in the sense of design or ties, determine the ratio of architectural parts. In theory, there was no method by which might have been presented its structure [1]. However, this problem was considered in theoretical investigation of modern Ukrainian scientists on which basis this research. For selection of the main elements of toolbar software platform, developed in this study, the proposed by Sivko L. [1] method of formal theoretical structuring architectural space was analyzed.

Her research examines the overall methodological approach to architectural composition that includes a portfolio of recent decades. This is the formal structure as well as the scientific method theory of architecture which defines the most general principles of knowledge in the real creativity. Theoretical researches in architecture to some extent are related to the formal and structural methods or results obtained from their use. In domestic science the results from the use of these methods can be considered as the creation of architectural composition course [1].

Article purposes. The aim of this article is to fill the gap LOD 0 – LOD100 within the BIM modeling. Another purpose of research is the developing tools for the visualization of architectural space. The article should provide general definition of BIM.

The main part. The rapid development technology of immersive virtual reality (VR) gives hope to solve many problems associated with a high degree of abstraction initial stages of

planning, conceptual searching for the best ideas. A wide choice of software such as Revit Autodesk, Trimble, Archicad Grafisoft and others allows visualizing the BIM model in VR and even editing them in real time according to the built – in plugin from the scope of the gaming industry. It should be noted the lack of professional tools for the conceptual design of pre-stage. In fact, the opportunity to generate volumes in 3D sketching techniques is given that really is replaced the handmade sketching. However, there is no conceptual virtual environment where ideas can reproduce the structure of architectural space and simulate the real-time correlation between its elements, impact factors and their interaction and so on.

Today, system of BIM modeling has clear guidelines and classification level of detail that developed the American Institute of Architects in 2013 [4]. This document of classification LOD (The Level of Development) is the stages of creating a model (Fig.1). Determination of the extent of the original model is LOD 100, which is provided in the LOD Spec 2016 part1 formulated very generally:

"…LOD 100 elements are not geometric representations. Examples are information attached to other model elements or symbols showing the existence of a component but not its shape, size, or precise location. Any information derived from LOD 100 elements must be considered as approximate".

As can be seen, the initial stage of birth architectural composition based on finding the solutions and harmonious artistic sketch functional structure is not taken into account and all geometric representation does not provide.

The implementation of the research results is in the form of educational software platform where students of professional direction in real-time in immersive virtual reality will perform tasks of conceptual architectural design course.

According to the defined limits, the problem of research carries out in conjunction graphical multilevel modeling and tools for building architectural composition and for creation of CIM (Concept Information Model) as the first element in the hierarchy of levels of BIM modeling.

The research of first stage aims to visualize theoretical concepts and primary structural unit of architectural space.

Furthermore, interface for modeling dynamic changes of volumes in real-time, connections in time and abstract relationships is developing. This level is where the volumetric abstract factors become graphic form is defined as the LOD 0 and is a model of concept.

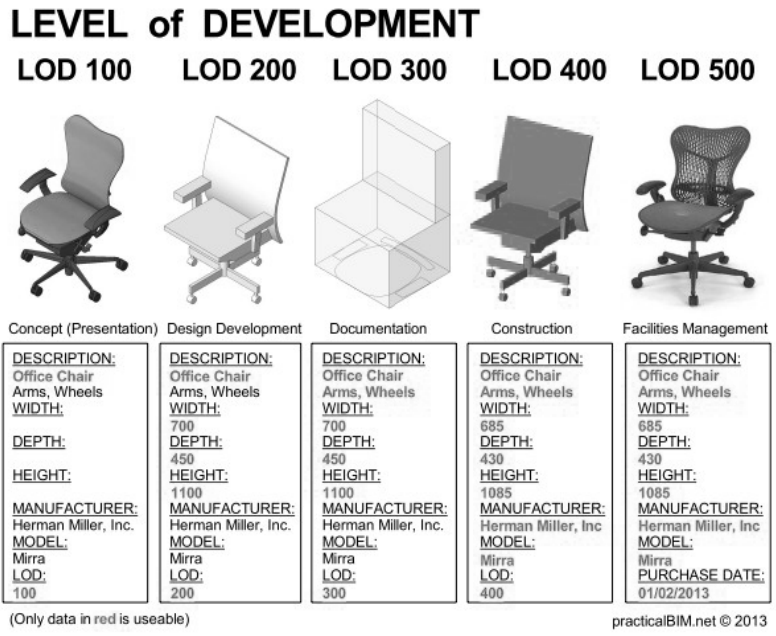

Fig.1. Level of development of BIM model according to "Guide, Instructions and Commentary to the 2013 AIA Digital Practice Documents".

The second stage of the research based on historical analysis, synthesis and abstraction method creates an educational environment for further development of the concept model LOD 0 in a conceptual information model CIM (LOD 50). The source data file is one of the formats that uses advanced integrated engineering platform – ArhiCad, AutoCad, Revit, and others can be edited and supplemented in the future.

The results obtained in step LOD 50 can be specified in the above mentioned programs, adding graphic elements walling, ceilings and coatings specified size, estimates of the total area and the approximate cost for $1m^2$. This will improve the model to the next level of detail.

For mentioned tasks are used the free license software version of Unity 3D Engine Personal Edition, Visual Studio 2015, 3D Studio Max (student version), free VR asset for Unity.

Adaptation of educational software module for VR is required for entry maximize visibility of the subject. Relevance of using of virtual reality in research and teaching experience is confirmed by the world's leading scientific communities and institutions of secondary and higher education. It creates a computer environment that is characterized by a high degree of credibility, full immersion and interactivity in order to give to user the feeling of being in the scene. In ideally, users of virtual world will be unable to determine whether the real thing in front of him or virtual [3]. In analyzing of the perspective of the impact feeling of this level is determined that VR improves understanding of many complex scientific concepts. For example, while teaching students mathematical formulas topics that have complex of curved graphics, VR only allows “walk” on the peaks and troughs, feel how the variables are related. The same effect is a graphical representation of a mathematical function that is used for shaping parametric architecture [6].

Conclusions. Synthesis of conceptual modeling, BIM modeling and VR technology synergistically enhances not only the possibility of studying the theory of architecture and design, but in further development of a basis of science in this field. Fundamentally a new visual approach to learning the basics of composition by architects generates new forms of resolution of tasks and new solutions.

VR technology has good prospects in the research as well as in the lessons of history. Basic principle of BIM modeling can well illustrate the different construction technologies and compositional techniques. In historical reconstruction model of the architectural heritage of any historical period can be graphically represented by principle of three-dimensional circuit CIM, described above, types of

finishing materials at that time. Researcher creates a project that reflects the past. This allows studying of the thinking step by step, for examples, architects of the Middle Ages. A student, who joined the study in this way, would never forget this experience.

Algorithmic and systematization thinking by imaging approach offers an interesting look at a new angle architectural creativity. Computerization of this process does not make it mechanically, only helps to design any fantasy objects without error and make them functionally rational.

Architect of XXI century uses the modern scientific achievements and technologies. There is a gradual evolution of artistic thinking, it is in the initial stages of the project abstract mathematical, often with a look in bionics, because nature is the most rational and inspired creator of beauty. For the implementation of ideas where all these factors are woven, VR goggles are new sheet and pencil of artist.

Research perspectives. This investigation provides an opportunity for architects to create new virtual architectural measurements, experiment with algorithmic shaping in the absence of the usual gravity force and explore multidimensional mathematical spaces. One of the hypotheses of this study understands the virtual environment not as simulation of real environment, but as a new real architectural space. Architects create virtual offices for business meetings of various experts, virtual stores and 3D social networks pages' interior with the same importance of representative value as an own home décor. These spaces can be radically different in structure, but open and bring unexpected compositional novelty in to the real physical world. This will contribute to "go beyond" the standard of the imagination – one of the main principles of gamification, which immersive virtual reality is providing.

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Transliteration

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Аннотация:

Кисель О. В. Концептуальный BIM моделинг в иммерсивной виртуальной реальности. *В статье описана проблема наглядности при проектировании типологически сложных современных архитектурных комплексов. Проведен анализ исследований зарубежных и отечественных ученых. Сделано общее определение системы BIM (Building Information Model) с помощью анализа ее иерархии и составляющих. Сделан обзор ведущих инженерных графических пакетов. Определены возможности развития этой структуры в плоскости концептуального творчества, цель, границы и методология исследования. Дан перечень программного обеспечения, используемого в исследовании. Сделан вывод о виртуальной реальности – как инструменте научных исследований и образования. Статья доказывает перспективы использования CIM модели (Concept Information Model), которая описана в этапах исследования, как составляющей реконструктивного исторического BIM моделинга. В работе констатирован факт эволюции мышления архитектора.*

Ключевые слова: концептуальный BIM моделинг, виртуальная иммерсивная реальность, модель структуры архитектурного пространства, архитектурная композиция.

Анотація:

Кисіль О. В. Концептуальний вім моделінг в імерсивній віртуальній реальності. *У статті описано проблема наочності при проектуванні типологічно складних сучасних архітектурних комплексів. Проведен аналіз досліджень закордонних та вітчизняних науковців. Зроблено загальне визначення системи BIM (Building Information Model) за допомогоюаналізу її ієрархії та складових. Зроблено огляд провідних інженерних графічних пакетів. Окреслено можливість розвитку цієї структури у площині концептуальної творчості, мета, межі та методологія дослідження. Надано перелік програмного забезпечення, що використовується у дослідженні. Зроблено висновок що до віртуальної реальності – як інструменту наукових досліджень та освіти. Стаття доводить перспективи використання CIM моделі (Concept Information Model), що описана у етапах дослідження, як складової реконструктивного історичного BIM моделінгу. У праці констатовано факт еволюції мислення архітектора.*

Ключові слова: концептуальний BIM моделінг, віртуальна імерсивна реальність (VR), модель структури архітектурного простору, архітектурна композиція.

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