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HUGE POTENTIAL OF BUILDING INFORMATION MODELING

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Abstract. Information systems capable of managing large parameter objects are being improved and their potential is quickly growing. Parameter modeling was offered as an efficient means of building models expertise. The more powerful the system, the better it understands specific features of designed objects, and it facilitates comprehension of the semantics of that field and information management.
The article analyses peculiarities and needs of building design applying modern automated design systems. The compared information is obtained in software while modeling buildings by means of BIM (Building Information Modeling) and CAD (Computer Aided Design). The system potentialities are demonstrated by creating spatial views for building design customers.

Keywords: Building information modeling, design systems, AutoCAD, CAD Standard.

1. Introduction

Computer programs, capable of creating virtual buildings, help an architect and a customer 'to make oneself clearly understood', i.e. to realize architectural ideas the same. Architects, who use special computer programs, have the possibility to demonstrate a spatial, either internal or external, view of the house to the owners of a future building or flat (Figure 4), spatial view in context with the existing environment or even an animated subject (animated image presentation). Nowadays, it is possible to "build" a house with all future shadings reflected therein, without leaving your home and stepping aside from the computer either. For the said reason, BIM technology is increasingly becoming more and more popular not only in major design enterprise, but among the players of minor construction business.

2. Properties of building design

With increasing development in the globalization of the construction processes, growing market needs the role of architects, constructors and specialists of engineering networks witnesses an extreme change in the whole construction process. The foregoing phenomenon has been influenced by the creation of a new software and development of wide spectrum of application programs: authors of design software are in constant search of new IT (information technologies) solutions, which would facilitate to save a very expensive time of the designers and help them to carry out design works in the most precise and secure manner.

Not so long ago, approximately 25 years before the present days, ordinary working tools of a building designer used to be a pencil, paper rolls, plaster, tracing paper, easel, etc., naturally, they greatly differ from the today's ordinary working devices, such as a computer, plotter, printer, etc. The occurrence of personal computers has globally changed working tools as used in the building design process, however, the essence of the design itself has remained the same as formerly: a designer (today as well) shall be able to collect loads, estimate potential effects, make up an estimating (calculating) scheme and (already today) should know possibilities of computer usage not only in modeling, but in the process of calculating constructions of the buildings. Furthermore, simultaneously with the development of the production of new, strong, resistant and long-lived building materials, constructors

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must be able to create new constructions, applicable in constructing complicated buildings ascribed to modern architecture. Not only a constructor, but an architect as well, willing to have a good sense of the diversity in the field of various constructions, materials and construction systems, shall have not only certain knowledge of the peculiarities in the constructions work, their calculation and designing, but also be well up in information technologies intended for building design. Ability to manage computer-aided design systems assists an architect to properly select constructions and compose them into the structure of the building (Figure 1).

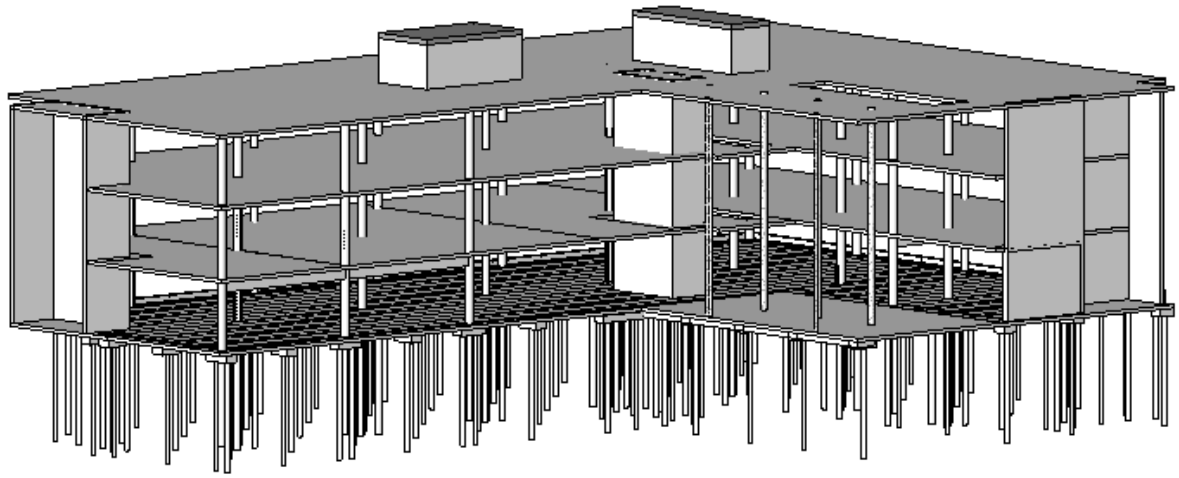

Fig. 1: Retaining elements of the framework public-purpose building

Modern computer-aided design systems should have an integrated link with technological requirements, most important from the constructional point of view: durability of the building, its stability, security in case of fire, requirements raised for thermal safety and hygiene. In BIM type systems, a model of the building is revised, therefore the integrity of the semantics of the building model might be regarded as the described geometrical restrictions and appropriate rules [1].

Quite a number of researches state that modern construction modeling systems should use not only precise geometry or perform routine operations exactly, but also have an integrated (either centralized or local) data store [2-5].

Today, Lithuania is witnessing a decreasing number of building design enterprises, still creating projects for buildings by applying CAD systems. In pursuance of saving time intended for design, increasing the precision of projects performance, reducing the possibility of potential mistakes, enterprises prefer to choose IT products created on the basis of BIM technology.

3. CAD platform

AutoCAD is a universal design program, which might be applied in creating the architecture of buildings, mechanical details, landscapes or maps. It was introduced to the global market twenty years ago, however, appeared in Lithuania sixteen years ago. Its popularity might account for its long existence in the market, low price. Two simplest parallel lines, drawn by using *AutoCAD* system, may represent a wall, and a rafter, and a balk, and a water sewage pipe, etc. The concept of layers and styles has been introduced in *AutoCAD* in pursuance of the said graphic elements to acquire a certain meaning (Figure 2). Names of the foregoing layers or styles are being created by the user himself, furthermore, in the absence of *AutoCAD* layers standard, designers create them by using different names.

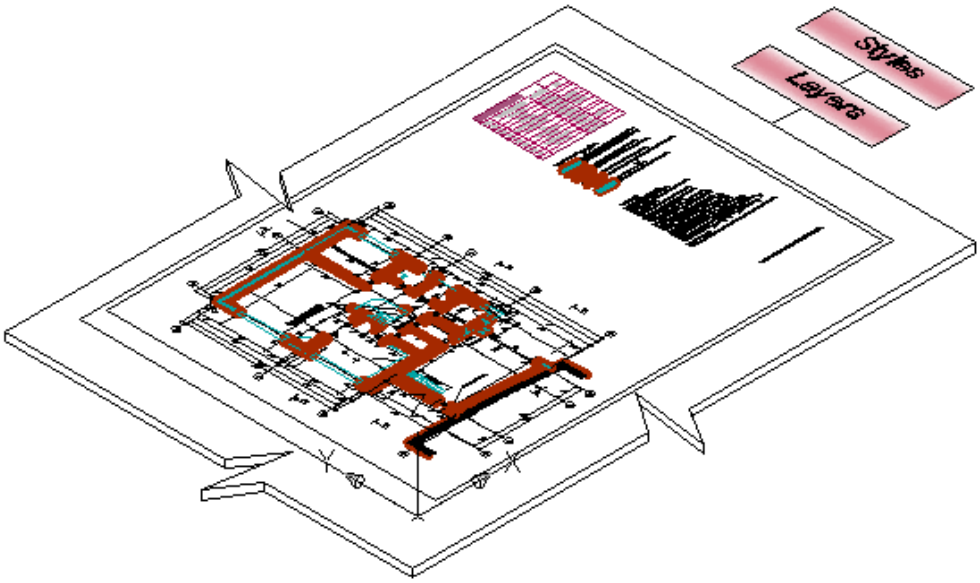

Fig. 2: Comparative separation of *AutoCAD* objects

Despite the importance of standardization in the everyday life, in particular, in the IT usage, in the process of investigation how appropriate standards are being created, what is their structure and how they are used, it has become clear that in scientific literature no considerable attention has been paid to this issue [6]. One of the possible reasons is the following: absence of any scientific discipline in this sphere, standardization has not been explained as a phenomenon since standardization needs conceptions and methods in various scientific subjects [7]. In separate cases, standardization is being examined in general terms only, and only certain individual cases are being offered [8].

Approximately 8-9 years ago, the first specialized programs intended for specific design works appeared: *ADT (Autodesk Architectural Desktop), ArchiCAD* and etc. As *CAD* systems have started to be widely put in practice in the construction industry, and it has become possible to divide data according to the layers, the users have started creating layers distribution systems so that to limit their accessibility, and what is much more important – in order to switch off data (for example, those of shading or text) in order to speed up the opening of files of the earlier CAD systems [9]. Simultaneously, space and automobile companies were using much more complicated CAD systems, and the need to change in the structural data form aroused the necessity to create the first standard IGES (the Initial Graphics Exchange Specification), which later became ANSI standard. European CAD users and traders, which examined it, have decided that it was not fully suitable for construction since forms of components as used in airplanes and automobiles are much more complicated.

Today, not only *CAD*, but also these specialized programs already fail to reflect modern computer design, entirety of possibilities to manage engineering systems and production processes, and one of the reasons is the following - they have not got any link with the data bases.

4. BIM platform

Modern computer design could be identified as a scientific field, based on the technology of building modeling. The above-mentioned technology should encompass everything: starting with a certain idea and ending not only with a real building, but its demolition process as well.

Term '*building information modeling*' (BIM) occurred not so long ago, by aiming to separate information technologies and computer-aided design from the traditional CADD (computer-aided drafting and design), which some time ago dominated while issuing project/design graphic documentation. At present, Lithuanian construction industry has been witnessing major changes, related to the occurrence of BIM technology in the computer-aided design systems intended for design works.

While creating walls of the building, a designer has already been using not Line, but Wall command and, appropriately, for creation of other elements - Floor, Roof, Stairs and other building modeling commands. Graphic packages, created on BIM basis, contain rich libraries, intended for creating building elements (Figure 3), furthermore, BIM systems allow to connect on the Internet to other firms' libraries and use necessary elements of the building.

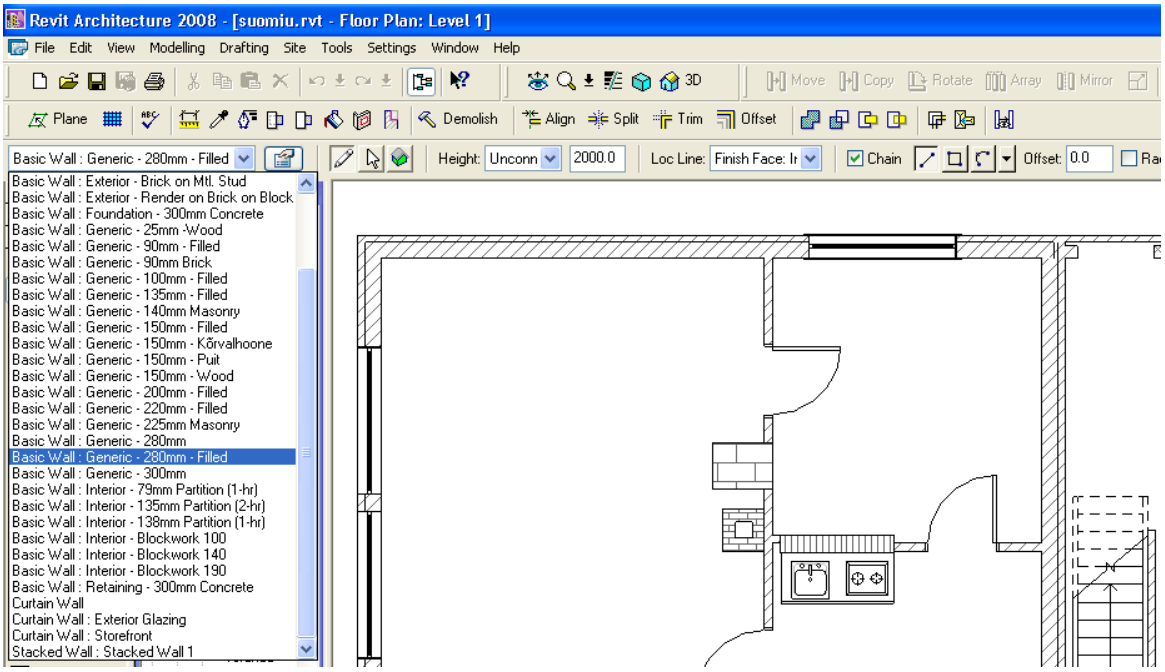

Fig. 3: List of different walls types

Virtual computer model is particular and special for the following reason: a building is being designed practically as an entire object. And even upon changing any of its parameters, the other ones change automatically too; which also encompasses sections, specifications and calendar diagrams.

In comparison with usual computer-aided design systems (CAD), it is possible not only to save the time intended for design, but also to eliminate internal contradictions in design documentation, thus, markedly reducing the possibility of potential mistakes.

Today, a single-purpose, parametric software Autodesk Revit for building creation, grounded on the building information modeling (BIM), is predominating in the construction design. It offers physical and analytical modeling for design, coordination and document creation as well as a bi-directional link with computation programs. A designer, while working with Autodesk Revit programme, becomes a creator of the model of the whole construction, but not of separate drawings. It is of particular importance in the creation of drawings for a multi-storeyed building. When an engineer of the internal system project moves a wall on one level (floor), the said push shall equally reflect on the other levels (floors), while in case of widening the wall due to mounting ventilation channels, it should

become wider on the other levels (floors) as well. Namely at that time a bi-directional link of different program elements is required. In the program Autodesk Revit, all views of the building model (plans, sections, tables) are being stored in one data base, which grants the possibility to simply coordinate variations from any view into the data base and vice versa. Consequently, in the program Autodesk Revit, one model is employed in the work, while all other views (plans, sections, 3D views, etc.) are being generated by the program itself, and the user himself might resolve, which views of the building are needed while creating documentation and which information about the model is required. It is always possible to demonstrate to the customer not only a spatial view of the building (Figure 4 a), but also the view upon changing the decoration materials of the façade or in the context of the surrounding environment in any season of the year (Figure 4 b).

a) 3D view

b) perspective view during the summer season

Fig. 4: Virtual model of the building

5. Conclusions

We can call systems created on the basis of BIM platform intellectual because modern building information modeling technology BIM markedly facilitates conditions for software to carry out all building creation stages in the easiest possible way.

BIM modeling elements should occur in the modules of the construction specialities because parameter modeling might be identified as the design future, and appropriate skilful specialists, capable of efficient work with an intellectual building model, need to be prepared and trained already now. Experienced and proficient engineers-constructors should independently or in the courses learn to work with BIM systems, as already tomorrow it will be necessary in the designer's everyday work.

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POTENCJAŁ PROGRAMÓW OPARTYCH NA TECHNOLOGII BIM

Programy komputerowe wspomagające proces projektowania i oparte na technologii BIM (Building Information Modeling), czyli na parametrycznym modelowaniu informacji o budynku stają się nowoczesnymi narzędziami w ręku inżyniera czy architekta i zastępują tradycyjne metody projektowania, które stosowano przez dziesiątki lat. Tworzenie modelu wirtualnego projektowanego budynku, dla którego znajduje zastosowanie modelowanie parametryczne obiektów (istnieją biblioteki obiektów zdefiniowanych parametrycznie) pozwala „zautomatyzować" generowanie nie tylko odpowiednich rzutów, przekrojów i widoków, ale też dokumentacji technicznej oraz pozwala generować bazy danych dla dalszej analizy. Co więcej, zmiany wprowadzane w modelu trójwymiarowym obiektu, znajdują natychmiast odzwierciedlenie w związanych rysunkach oraz w bazie danych. Pionierami programów grupy BIM były takie programy jak ArchiCAD czy Autodesk Architectural Desktop. W obecnej dobie coraz szersze zastosowanie na Litwie znajduje program Autodesk Revit. W pracy pokazano przykłady obiektów skonstruowanych w środowisku programu Revit oraz opisano możliwości projektowania w tym programie. Dokonano również analizy porównawczej z programami grupy CAD, takimi jak AutoCAD.