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BIM EDUCATION IN RIGA TECHNICAL UNIVERSITY

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Abstract. Building Information Modelling (BIM) is a complex process of managing not only design documentation in 3D form but it also includes all the consecutive stages of the design analysis, followed by construction management, and including facility management after the site completion. The success in the collaboration to unite common efforts of architects, constructors and HVAC engineers would make the work of all involved stakeholders more productive because the existing information technologies provide this option already for a long time. The training for effective use of this relatively new and very complex approach from the very beginning of the building lifecycle in the construction industry is even a more complex task. Universities have to join the promotion of BIM ideas not only to the designers and engineers, but to a much wider public than at present. The history of BIM teaching and the approaches used at Riga Technical University (RTU) are outlined in this paper. RTU along with several other universities from Lithuania have joined the EU sponsored Leonardo da Vinci project BIMTRAIN initiated by regional software distributer and developer AGA-CAD which facilitates the BIM implementation through the training.

Keywords: BIM, BIM Teaching, BIM Curriculum, CAD, Engineering Graphics, Engineering Education

Introduction

Over the past decade the emerging benefits of BIM application have been recognized by many governments worldwide. The UK Government has mandated that all public building projects will have to be using BIM design processes at ‘level 2’, fully collaborative 3D BIM, or higher by 2016 (McGough, D.; Ahmed, A. *et al.* 2013). The ‘level 2’ is defined as file-based collaboration and library management. However in majority of countries the BIM implementation in practice has caused considerable resistance from many stakeholders, involved because of its complexity. There are several reasons for this, but the most important one is the misunderstanding about what the BIM process is in general. Some will compare the BIM with just the 3D modeling and visualization tools, followed by structural analysis at best. The first two options nowadays are integrated into numerous CAD software packages. The teaching of the use of different CAD software in the university courses over the past three decades has gone through the everchanging issues due to enourmous increase in both the PC hardware performance and the software potentials. It all started with computer aided drafting software like AutoCAD when the former classic manual engineering graphics drafting skills had to be reoriented towards PC usage, which was problematic issue especially for elderly specialists. In some cases the CAD software teaching turned into specific keystroke training. As a result the instruction was mainly focused on training the particular special courses with the support of computer aided solutions if at all, but in many cases these courses remained isolated on their own, rather than coordinated between each other. The BIM involves much greater challenges than the pure computer aided drafting and therefore the main concept of BIM is the whole building information coordination and sharing. Without these aspects there will hardly be any effect in the use of the most powerful hardware and the most expensive software. The problem of cooperation between parties involved exists almost at the same scale both in industry while implemementing this concept and in education while training effectively and preparing the future users of this technology.

1. BIM development

It is assumed that the first trace of BIM concept originates from the projects of Professor Charles Eastman at the Georgia Tech School of Architecture. Abbreviation BIM stands for Building Information Modelling (or Model) in early 1970s. The developed Building Description System (BDS) was the first software which manipulated with individual library elements from the database in the model on PDP computers. This idea was developed a long time before the victorious march of personal computers and therefore could not get a wide popularity because not many architects had a chance to get grips on it. Later several similar systems (GDS, EdCAAD, Cedar, RUCAPS, Sonata and Reflex) were developed and tested on practical projects in United Kingdom in 1980s (Bergin, M. 2012). A wider application of this concept into practice became possible only with the development of personal computers, when the ArchiCAD software from Graphisoft Company appeared on the scene, which incorporated the idea of Virtual Building rather than drawing from the very first of its versions - Radar CH (ArchiCAD 1.0) in 1984. The power of software was amplified by flexible built-in programming environment for its parametric library components using GDL (Geometric Description Language).

The Virtual Building concept, realized by Graphisoft in its software ArchiCAD v. 2.0, which debuted in 1982, could be considered as the first broader application of BIM in practice. The representation tool BIM starts as a three-dimensional model

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tied to a database of project information, with this current support tool being the most powerful for Integrated Project Delivery (IPD) projects (Becerik-Gerber, B. 2010, Wright, J. A. 2012). This is because BIM integrates the design, fabrication, assembly instructions, logistics and project management into a database, also providing a platform for collaboration for all the IPD members. This is a tool, not a method; a tool that still is not frequently used in the sector; but it may end up enabling the efficient development in very complicated projects, or projects that are easily understood by all the agents. The project team reaches an understanding regarding how the model will be developed, introduced and used. In order to carry out the introduction of this information modelling, a series of usage protocols must be established in the conceptualization phase within the IPD model by the different agents.

The next step was when Irwin Jungreis and Leonid Raiz split from Parametric Technology Corporation (PTC) and started their own software company called Charles River Software in Cambridge, MA. They were equipped with the knowledge of working on Pro/ENGINEER software (released 1988) development for mechanical CAD that utilizes a constraint based parametric modelling engine (Bergin, M. 2012). The two wanted to create an architectural version of the software that could handle more complex projects than ArchiCAD. A trained architect David Conan joined the project and designed the initial user interface which lasted for nine releases. By 2000 the company had developed software called Revit, which was written in C++ and utilized a parametric change engine, made possible through object oriented programming.

In 2002 the power and promising future of Revit was noticed by Autodesk which purchased the company and began to heavily promote the software in competition with its own object-based software Architectural Desktop (ADT). This provided a transitional approach to BIM, as an intermediate step from CAD (Howell I.; Batcheler B. 2005). At that time ADT created its building model as a loosely coupled collection of drawings, each representing a portion of the complete BIM.

Approximately at the same time period the concept of BIM was adopted by another two software developers Bentley and Nemetschek in their further products. Bentley Systems interpreted BIM differently as an integrated project model which comprises a family of application modules that include Bentley Architecture (internationally known under Microstation Triforma name), Bentley Structures, Bentley HVAC, etc. Nemetschek provided a fourth alternative with its BIM platform approach. The AllPlan database was “wrapped” by the Nemetschek Object Interface (NOI) layer to allow third-party design and analysis applications to interface with the building objects in the model (Howell I.; Batcheler B. 2005).

2. Most important dimensions of BIM

BIM concept uses parametric object-oriented three dimensional or 3D data in virtual models in contrary to the conventional 2D drawings, a long time used so far by engineers and designers. Instead of drawing just a filled rectangular in plan view which represents a wall of a building in section, in BIM concept supporting software the model is built virtually in 3D space. The relative location of all neighbouring elements is precisely determined and easily observable from arbitrary viewpoint for visualization purposes. The model includes not only the geometric relationships between all building elements, but these elements carry information on many real attributes associated with them, like material, paint, class of fire safety, cost, etc. The drawings – plans, elevations, and sections – are obtained automatically from the unique virtual building model, along with the bills of materials and are updated immediately after any changes are performed in the original building model. Amount of wall material in specifications (schedules) is updated as soon as real virtual building elements like windows and doors are placed in the model. This method highly eliminates the human errors while producing drawing documents, which cannot be avoided using the conventional 2D drafting technique. The synchronization between views, elevations and sections in the manually produced drawing documents is the responsibility of all parties involved, which in the case of large projects and many stakeholders involved could be a serious problem.

The concept of BIM besides the conventional three dimensions of the model and real attributes attached to these elements includes the fourth dimension – time. The so called 4D design approach allows the coordination between parties involved not only during the building construction phase but also during exploitation, reconstruction and finally even utilization. The information is maintained and updated in the common database from the initial stage of the design through the whole lifecycle of the building.

The fifth dimension incorporated in the BIM concept is “money”. One of the most important attributes for elements and processes of the real building included in the virtual model is a cost. In this case the process is described as 5D design approach. The databases may include building elements with their attributes from many vendors and the designers could easily simulate several variants of the design. Numerous design scenarios “what if” could be played to find out the most effective solution.

Besides the five more or less known dimensions the current BIM concept supports also the sixth dimension which are facility management applications like CAFM (Computer-Aided Facility Management) and the seventh dimension with procurement solutions e. g. contracts, purchasing, suppliers, and environmental standards.

In order to support all these dimensions of the BIM concept in the numerous software and applications, it is evident that a common standard has to be used to share the information between so many different “players on the field”. There are many problems which have to be solved before this undoubtedly effective BIM process can be widely used in practice (Eastman C.; Teicholz P. *et al.* 2008). Therefore the core technological and modelling principles of BIM were defined and the IFC (Industry Foundation Classes) and aecXML standards are used. These standards define the data structures for representing the information which is used in BIM. There are a few other data structures developed by commercial vendors in the BIM domain besides the two mentioned.

Wikipedia describes the technology adoption lifecycle model as the adoption or acceptance of a new product or innovation, according to the demographic and psychological characteristics of defined adopter groups. The process of adoption over time is typically illustrated as a classical normal distribution or "bell curve". The model indicates that the first group of people to use a new product is called "innovators", "followed by early adopters". Next come the early and late majority, and the last group to eventually adopt a product are called "laggards".

Since these BIM tools and techniques have become increasingly complex, architectural and civil engineering schools have been faced with a great challenge not to lie behind and not to become laggards. To train specific software requires first of all mastering itself provided there is a financing for it. In general, industry lies behind and picks up the innovations slowly. A student with knowledge of only one type of software may well be trained to design according to the biases of the programs that they are using to represent their ideas (Bergin, M. 2012). In the case of BIM tools, the building is represented as parametric components including walls, roofs, floors, windows, columns, etc. These components have pre-defined properties, rules or constraints which help them perform collaborative tasks thanks to shared project model data.

In a blog by Shilovitsky, O. 2008, the BIM is characterized as the process of generation and management of the "building data" during its lifecycle. BIM is accepted by major vendors in architecture, engineering and construction industry and is widely used in all building types – from simple warehouses to many of most complex new buildings. BIM covers multiple domains – geometry, spatial relationships, geographical information, quantities and properties of building components. It helps manage a wide scope of works, system assemblies and other related processes. BIM provides potential future as a virtual information model to be handled from design teams to contractors and subcontractors, and then to owners, each adding their own additional discipline-specific knowledge and tracking of changes to the single model.

BIM uses 3D, real-time, dynamic building modelling software to increase productivity both in design and construction. This process successfully coordinates products, project and process information throughout new product introduction, production, service and retirement among the various players, internal and external, who must collaborate to bring the concept to life. OpenBIM is a universal approach to the collaborative design, realization and operation of buildings based on open standards and workflows and it is an initiative of buildingSMART and several leading software vendors using the open buildingSMART data model. Educators have to seek contacts/relationships with a view of developing joint actions with industry and enterprises. Particular attention should be paid to small and medium sized enterprises as they account for an enormous part of economic growth and could be the places where the innovations could be introduced much easier. There is an evident role for universities to play in lifelong learning and continuing education thought them to offer possibilities of companies to increase competitiveness, productivity and efficiency, total costs estimation, and to become concurrent also on the global rather than the local market.

3. Problems in industry

Contemporary hardware and software provides enormous potentials for the nowadays designers. How come that these potentials are not introduced in everyday practice and are not used in full scale? The two main factors that affect this are the expenses and training. The BIM's learning curve could be one of the top barriers of implementation in construction. There is an opinion that wide use of BIM concept mainly fails because of another two much more important factors – people factor and change factor (Shilovitsky, O. 2012). BIM implementation is not really about the software, but it is about organizational change. The experiences of clients have demonstrated that people and processes are far more important than technology.

BIM is an absolutely wonderful tool, and it has great potential to streamline costs and processes, to help different disciplines communicate effectively and to ensure little confusion on a job site. But to get to that promised land of benefits, you have to pass through the wilderness of adoption, which always seems to hinge on organizational change, not technology. This is the inconvenient truth.

People's factor has been acknowledged by many AEC/CAD/CAM analysts (Barison, M. B.; Santos, E. T. 2011, Shilovitsky, O. 2012). The influence of people is significant factor in software product implementation that requires from people to re-think the way they are doing their business. BIM software can eliminate some roles in organizations and change business processes between organizations. It makes the process of software adoption long and complicated. This is a place where failure comes very often.

Changes are another aspect, which very often comes together with data and object and/or process oriented software like BIM and PLM (Product Lifecycle Management). The specific character of almost every enterprise-level data and process management software is to focus on how to change the organization – improve processes, re-organize business relationships, change tools, etc. It is extremely hard to people, since the change is hard, it consequently leads to failures (Shilovitsky, O. 2012).

During all phases of a construction project, the involved parties have an increasing need to define more precisely what is being modelled and how the modelling is done. In Finland as a response to the rapidly growing use of BIM in the construction industry the set of documents "Common BIM Requirements 2012" or COBIM were published in 14 Series (BIM Guide, 2012). COBIM is based on the previous instructions of the owner organizations and the user experiences derived from them, along with the thorough experience the writers of the instructions possess with model-based operations. The project was properly funded by Senate Properties in addition to several other real estate owners and developers, construction companies and software vendors. BuildingSMART Finland also participated in the financing of several projects.

A vague attempt has been initiated by a group of enthusiasts from private companies to embrace similar documents in Latvia. No support or any funding has been provided from the governmental agencies side. This initiative has resulted in some documents translated in Latvian – BIM Handbook (BIM Rokasgrāmata, 2013) and first two COBIM series (COBIM v. 1.0a 2013; COBIM v. 1.0b 2013) with adjustments for the peculiarities of local industry. Local BIM compatible software distributors are active promoters of this initiative as well. They actively organize information seminars on BIM issues.

4. Problems in education

Innovative companies nowadays require professional employees who are able to work effectively on projects undertaken with BIM. Several universities throughout the world have been running a wide range of courses to meet this demand and provide students with experience on this new paradigm. However, this learning experience is relatively new and based on a pedagogical system that has not yet been consolidated. In a recent analysis (Barison, M. B.; Santos, E. T. 2011) an attempt was made to address the main obstacles encountered with BIM teaching, as well as to give examples of how to overcome them and introduce new strategies at introductory, intermediary and advanced levels.

The programs that are planning to introduce BIM into the curriculum face a number of obstacles that can be grouped into three types: academic circumstances, misunderstanding of the BIM concepts and difficulties in learning/using the BIM tools (Kymmell, W. 2008). In an academic environment a wide range of problems occur, just to name the topics: time, motivation, resources, accreditation, and curriculum. Misunderstanding of BIM concepts is associated with individualized instruction, traditional teaching, little teamwork and week collaboration or lack of collaboration between courses or curricula at all. The weakness of BIM tools is associated with creativity, learning, teaching, and knowledge aspects.

An extensive survey on 119 building construction schools in the United States found that only 9% of them teach BIM at a degree level (Sabongi, F. J. 2009). The main problems named by the respondents are as follows: lack of time or resources to prepare a new curriculum, lack of space in the curriculum to include new courses and a lack of suitable materials to teach BIM. Another survey (Becerik-Gerber, B.; Gerber D. J. *et al.* 2011) involving 101 Architecture, Civil Engineering and Construction Management programs in the U.S. found that, apart from these obstacles, there is a shortage of trained personnel in BIM, that the curriculum is not focused on BIM, that its implementation takes time and that the accrediting bodies for the construction programs have not drawn up clear guidelines for BIM.

The summary on BIM education analysis (Barison, M. B.; Santos, E. T. 2011) showed that only a few engineering schools have been teaching BIM since 2000, e.g. Georgia Institute of Technology, which has carried out research on BIM since the early 1990s. Several international schools have begun teaching BIM tools around 2003, but the vast majority introduced BIM between 2006 and 2009. In exceptional cases, the architecture programs were those that first showed interest in this area. Rapid advances were made and today there are a large number of BIM courses developed around the world and their number is constantly growing (Barison, M. B.; Santos E. T. 2010, Becerik-Gerber, B.; Gerber D. J. *et al.* 2011, Pavelko, C.; Chasey, A. D. 2010).

5. Teaching approaches

UK is one of the BIM concept support and implementation leaders in Europe and has developed well-structured approach. In late 2011 BIM Academic Forum UK (BAF) was established to respond to the growing needs in education area (Embedding, 2013). The BAF is a group of representatives from a large number of UK universities formed to promote the academic aspects of BIM. In particular, BAF is focused on the development of a ‘BIM academic framework’, the aim of which is to propose a roadmap towards a longer-term vision of embedding BIM learning at the appropriate levels within ‘discipline-specific’ undergraduate and postgraduate education. This would facilitate the development of professionals with the relevant BIM knowledge considered necessary. Professor David Philp, Head of BIM at consultancy firm Mace and head of BIM implementation at the UK Government’s Cabinet Office has pointed out: “At this point in the evolution of the UK BIM strategy it is of increasing importance that our teaching institutions are equally well informed of the progress that is being made across those Government departments which are spearheading implementation on projects and across its asset base. The BAF has taken great steps by bringing together and providing a focus for UK academia. The agenda supports that of the BIM task group in promoting UK BIM adoption and leadership both home and abroad to ensure that the UK is at the vanguard on new, more efficient ways of working”.

Using the surveys the current educational programs throughout the world were reviewed and recommendations developed to assist universities with curriculum development. Based on an extensive research on BIM teaching experience (Barison, M. B.; Santos E. T. 2010) three skill levels are given which define the BIM learning and teaching strategies. These skill levels include: introductory, intermediary and advanced. At introductory level BIM usually is taught in typical engineering design graphics courses including courses like Computer Aided Design.

The main purpose in an introductory level of curricula courses is to develop the skills of geometric modelling using BIM supporting software. These courses do not require the essentials of classic 2D CAD skills like AutoCAD, which are still considered as a compulsory knowledge for architectural and civil engineering graduates. The objective is to preferably learn those BIM tools that are most commonly used in the field in order to obtain a good background of BIM concepts. The BIM tools can be taught through lectures, workshops and labs. The students do problem-solving exercises and carry out small individual tasks to practice the BIM tool. Some university researchers found that it is recommended that before the students start the modelling they make modifications to an existing model (Barison, M. B.; Santos E. T. 2010, Brown, N. C.; Peña, R. B et al. 2009, Taiebat, M.; Ku K. et al. 2010). This allows an exploration of the basic concepts of geometric modelling and provides understanding how to communicate different type of information.

BIM software could be successfully used also in numerous other applications. One of the most interesting seems to be in the area of digital heritage, for example, a digital preservation of historical architectural sites (Boeykens, S. 2011). Another promising area is game industry, especially the aspects which concern the use of games in contemporary engineering education (Jurāne, I. 2013).

The students create their own model of a small building (or parts of it), usually with an area of or less than 600 square meters to extract quantities from it, and learn how to manipulate the model, types of basic components and their behaviour. It is recommended that a modern single family residence is used as a project. The modelling can be accompanied by analogue methods, sketches and axonometric views, which allow the students to perform suitable adjustments to the physical proportions (Barison, M. B.; Santos E. T. 2010, Brown, N. C.; Peña, R. B *et al*. 2009, McGough, D.; Ahmed, A. *et al.* 2013).

The architecture student can make a volume/mass representation of the house, carry out an investigation of primary components (doors, windows, panels and furniture) and, based on his/her research, develop and refine a new component. The engineering student can do the following: identify a construction component of his/her choice in the structural and/or mechanical, electrical and plumbing (MEP) areas, make a list of the necessary information required for the construction of that component, categorize this information throughout the life cycle to show how it can be linked and managed from a life cycle perspective and decide how they should be shared with the other subject-areas (Brown, N. C.; Peña, R. B et al. 2009, Koch, D.; Hazar D. 2010). Barison, M. B.; Santos E. T. 2010 suggested that the assessment of the students' performance can be conducted through individual exercises (components or simple models), written exams about BIM concepts and their presentation of models.

BIM could be introduced in different courses of the curriculum and the study (Barison, M. B.; Santos E. T. 2010) grouped them into eight categories: Digital Graphic Representation (DGR); Workshop; Design Studio; BIM Course; Building Technology; Construction Management; Thesis Project and Internship.

This approach is used at RTU in programs Architecture and Civil Engineering. ArchiCAD software at first was introduced in RTU Architectural programs back in 1997, when Graphisoft Company granted free licences for university. In 2002 the elements of 3D modelling using ArchiCAD were introduced also in Civil Engineering program. Extensive support materials both theoretical and practical tutorials are available for both the educators and the students (Learning, 2015). Further practical training with an alternative BIM concept supporting Revit Architecture software was possible only in 2006 after acquiring a new lab with powerful CAD workstations. Permanently growing requirement for hardware performance from the software developers' side has always been and still is one of the main drawbacks of much wider application of new technologies in engineering education not only in our region but many other countries worldwide.

Introductory information about BIM at Riga Technical University is delivered to the students of Architecture program in a separate compulsory course in the fall semester in the third year. The program administrators have an opinion that it is crucially important to train to the students the skills of manual drafting and sketching the concept ideas. Just a few years ago it was even restricted the submission of computer generated and printed projects. Lately this restriction has become moderate. The students of Civil Engineering program get introduced to BIM in the compulsory course which is designed as a course combining the classical manual engineering drafting practices with computer aided applications. The students have to apply the knowledge about the basics of architectural design practices both ways – manually and by use of PC. Four formal lectures are accompanied with the training exercises on 3D modelling using ArchiCAD software. Advanced skills may be later trained in a free choice subject Computer Aided Design where the students have to virtually build their own „dream residential house" which was analysed and designed before in a separate compulsory course Architectural Design using the classical manual drafting technique. In this course even AutoCAD drafting technique was not allowed to prevent the submission of Copy&Paste home assignments.

In the free choice subject Computer Aided Design the students can choose between ArchiCAD or Revit software. In the final project the students have to provide all the required basic supporting architectural documentation – plans, elevations, sections, detail drawings, room inventory, exterior and interior renderings both in structured manner in computer and on a single sheet of A1 or A0 format paper for presentation. A standard or self-created zone lists for room inventory have to be used. Standard or modified door and window schedules have to be used to see the power of built-in features in the BIM supporting software. Figures 1-2 demonstrate the complexity of individual projects used in the introductory level of BIM concept study.

At the end of the course only one informative lecture is provided on the possibility to streamline the prepared IFC compliant project for further energy analysis or structural analysis on compatible software like Axis VM, Tekla Structures, and Revit Structure which are typically used by local companies. Educators can receive well prepared presentation materials and support from some BIM software developers (Learning, 2015). Unfortunately, the practice in the classroom reveals that our students are quite reserved when they are offered just the theoretical lectures about global issues. Practical training exercises during the class hours are more appreciated, but the contact hours for the last two decades for classical engineering design graphics subjects have decreased more than twice (Dobelis, M. 2007). Further development of civil engineering curricula is possible through the interaction between different courses based on BIM collaboration. This would highly benefit the preparation of graduates for the next BIM challenges.

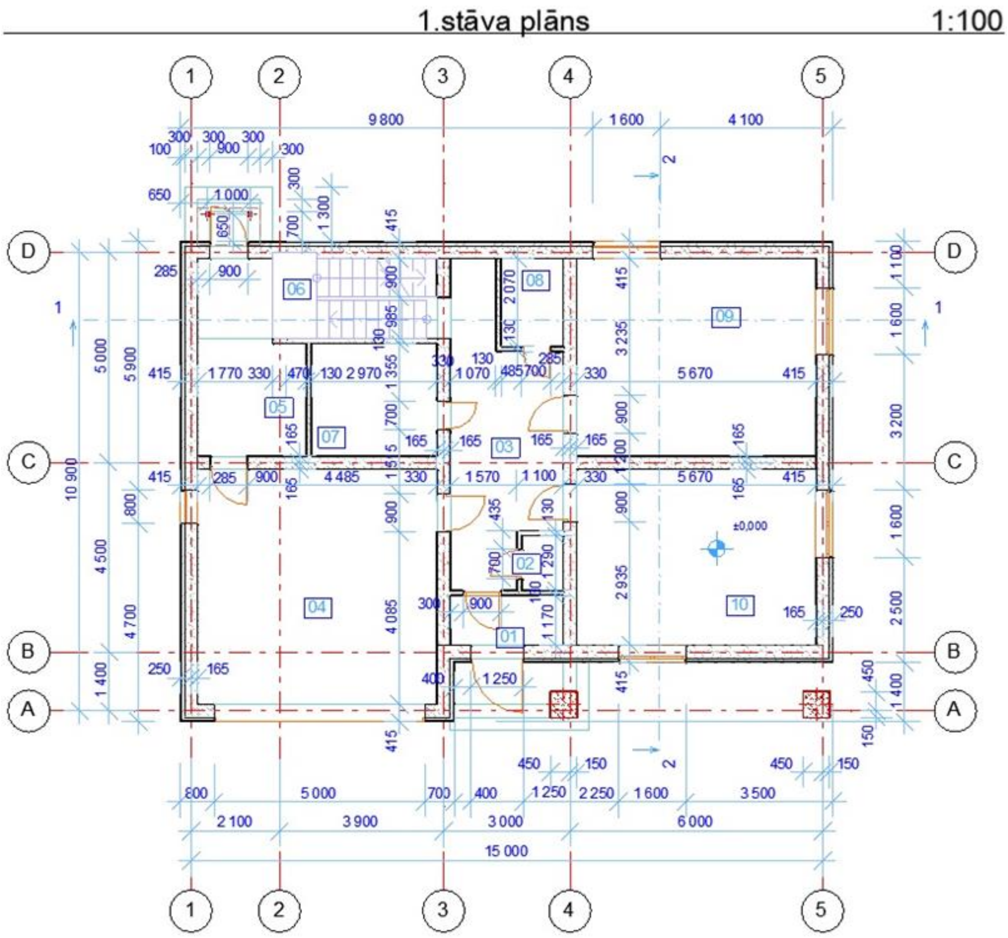

Fig. 1. A plan view of a two story building: An example showing the complexity of project in the course „Computer Aided Design" for undergraduate students in civil engineering program.

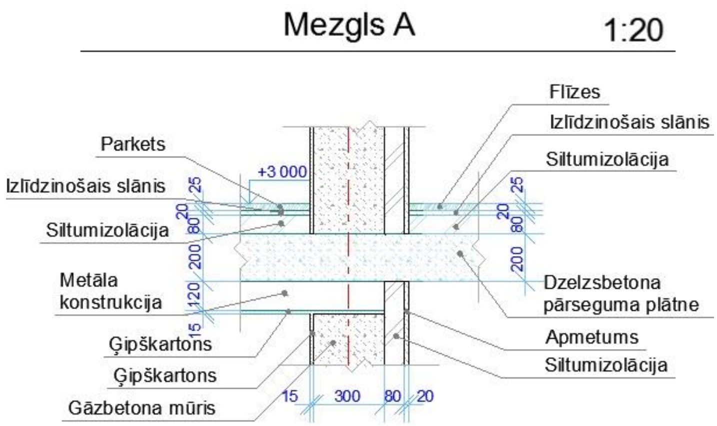

Fig. 2. A detail view of a two story building: An example showing the complexity of project in the course "Computer Aided Design" for undergraduate students in civil engineering program.

The coordination of mechanical, electrical, and plumbing (MEP) systems has become a major challenge for project delivery teams especially when the project size exceeds the size of individual residential buildings. The MEP coordination process involves locating equipment and routing heating, ventilating, and air-conditioning (HVAC) duct, pipe, electrical raceway, and fire protection systems in a manner that satisfies many different types of constraints (Korman, T. M.; Simonian, L. et al. 2008). For the past several years MEP coordination has involved sequentially comparing and overlaying drawings from multiple trades, in which representatives from each MEP trade work together to detect, and eliminate spatial and functional interferences between MEP systems. This multi-discipline effort is time-consuming and expensive. With the recent development of BIM this process has been able to evolve with the software technology thus enabling new teaching methods. The first attempt to teach the students how to perform the MEP coordination with BIM technology utilizing MagiCAD on AutoCAD and Revit platforms was performed in Fall semester 2014 for Heat, Gas and Water Technology program at RTU. The absence of individual student licenses for MagiCAD restricts more advanced training outside the CAD lab.

Further boost in BIM concept study at RTU was possible thanks to the initiative of AGA-CAD Company from Lithuania. Three higher educational institutions from Lithuania and Latvia joined EU sponsored project "Transfer of Building Information Modelling Training Tool for the Increasing Competencies of Building Sector Specialist". Web-based video instruction materials about BIM concept itself and the practical training with Revit software will be available for the students and industry representatives in the Fall semester in 2015.

Conclusions

The development of a well structured and properly balanced BIM course content is critical in sucsessful preparation of future specialists for the new contemporary engineering environment. The ideal course content should sattisfy both the general understanding about the fundamentals of BIM content and the skills of practical mastering CAD applications. Most of the courses struggle with the time deficit for in depth coverage of both focus areas. Implemention of continuos sessions in CAD lab at RTU have proved the effectiveness of blended study of theory and practical training in the same class. A split sessions between lecture, demonstration and lab-tutorial has been found to be less effective and requiring a slowerlearning curve has been found by some other researchers. The nature of engineering graphics course objectives with CAD as a tool calls for a different method of assessment. Instead of the exam in the subject it was found that a project based BIM software training approach is more interesting and entertaning to the students and facilitates more in depth individual studies. Instead of trying to force through changes in the curriculum, the academic world could join together with industry to promote BIM or collaborative thinking and setting up a research, teaching and consultancy projects. A closer partnership is expected between universities and industry. Unfortunately the local building industry has faced well-known global issues and seems that the current period is not yet the right time for changes. In fact, industry must be willing to provide funding for the academic world. Besides this the government should realize the acute need of funding for engineering education in practice not only in their slogans before regular elections over decades. The advanced IT technologies used in contemporary engineering are not cheap and require regular investments. The industry representatives must spend their time to visit universities and be prepared to discuss the current trends and scenarios with educators and students, share generic models from the local industry and provide current materials for students to enable them to practice the knowledge they have learned theoretically. However, the biggest obstacle to the progressive changes will be a human factor.

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