BACHELOROPPGAVE:

2D and 3D Modeling Comparison

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Summary

Title: 2D and 3D Modeling Comparison

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Abstract:

Many inventors and companies still use 2D drawings and are starting to realize a 3D design because 3D modeling can save time and money.

In this project I am going to compare 2D and 3D drawings and modeling. 2D modeling and 3D modeling have advantages and disadvantages. For this comparison I made 2D and 3D models using AutoCAD, Autodesk Revit Architectural and Revit MEP software. So, I am going to compare CAD (Computer-aided design) and BIM (Building Information Modeling) technologies, because it is related with 2D and 3D modeling.

Preface

This report describes results of the bachelor project from student from Lithuania at Geodesy and Cartography Department at Vilnius Gediminas Technical University which is writing bachelor thesis at Geomatics Department at Gjøvik University College. The project includes 20 ECTS.

The project is carried by one bachelor student from Lithuania Vilnius Gediminas Technical University: Rita Gaidytė. The supervisors of the project are a lecturer at Gjøvik University College, George Preiss and a lecturer at Vilnius Gediminas Technical University, Arminas Stanionis.

This project has started on January in Lithuania where I did measurements of my university for this project. In Gjøvik University College I continued this project from March.

During this project I have made 3D model of one floor of my University in Lithuania. I hope it will be interesting and helpful to the workers of my University.

I would like to thank my supervisor George Preiss and Vilma Zubinaitė, for lots of great ideas and support during my project.

Gjøvik University College, 25 May 2010

Rita Gaidytė

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An overview of all literature researched during the project.

Chapter 8 – Appendixes

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1.2 Project Definition

The main aim of this Project is to sift advantages and disadvantages of 2D and 3D modeling using AutoCAD, Autodesk Revit Architecture and Revit MEP software in CAD and BIM technologies. In this project I used measurements which were made in Lithuania of Vilnius Gediminas Technical University. The measurements I did with laser distance meter Leica D2. Using those measurements I have drawn 2D model with AutoCAD software and 3D model with Autodesk Revit Architecture and Revit MEP software.

A written report will be delivered to the school on 28th of May. Project presentation will be held on 3th June 2010 in Gjøvik University College.

I will try to answer these questions:

- Is 3D modeling better than 2D?

If yes:

- Whom is 3D modeling better?
- What are advantages and disadvantages of CAD and BIM technologies?

1.3 Project Objectives

The main aim of this project is to sift advantages and disadvantages of 2D and 3D modeling using AutoCAD, Autodesk Revit Architecture and Autodesk Revit MEP software, and to compare BIM and CAD technologies.

1.4 Background

A number of decisions have to be made which directly affect the product's overall and total cost. One of the first decisions that has to be made deals with the initial design. The engineering, design and drafting world has been experiencing a shift from 2D to 3D views. Many inventors and companies still use 2D drawings and are starting to realize 3D modeling because it can save time and money.

Making 2D drawings is fast and easy, but the output is still a 2D drawing which does not readily work with downstream systems. In some cases 2D drawings are sufficient but most of the time they are not. In fact, the majority of the buildings need 3D files and it is difficult read 2D drawings because 2D drawings do not contain all information needed to develop a 3D product.

Unlike 2D drafting, parametric 3D modeling is particularly useful at the early stages of design, where engineering skills are required. The main difference between 3D modeling and 2D drafting is that buildings are modeled rather than drawn.

1.5 Project members

1.5.1 Student's background

I, *Rita Gaidytė,* am from Vilnius, Lithuania. I came three months ago as an international student to write bachelor thesis. In Lithuania I am studying in Vilnius Gediminas Technical University, at faculty of Environmental Engineering,at department of Geodesy and Cadastre. Also I have about one year work experience in geodetic company UAB 'Inžineriniai tyrinėjimai' (‚Engineering Researches').

1.5.2 Supervisors background

George Preiss comes from Great Britain. He has a long experience within surveying and GPS system. During his carrier he was a chairman at International Information Sub/Committee of the US Department of transportation Civil GPS Service Interface Committee, for 9 years. He also worked as a GPS consultant for Statens Kartverk for 8 years. Currently he is working as an associated teacher for the Gjøvik University College, Faculty of Technology, and Department of Geomatics.

Arminas Stanionis is from Vilnius, Lithuania. Since 2003 year he is working as a teacher in Vilnius Gediminas Technical University, Faculty of Environmental Engineering, and Department of Geodesy and Cartography.

1.6 Acronyms/Abbreviations

CAD	Computer-aided design
BIM	Building Information Modeling
2D	Two-dimensional
3D	Three-dimensional

2. Background and literature review

2.1 Introduction

Now buildings are more complex than ever before, because today we have more telecom, security, electrical, data and energy requirements. Earlier documentation sets were hundreds of pages long. People who touched these sets of drawings had become huge, because they had to produce them, evaluate them or use them to build the building. But the computer-based technology has replaced pen and paper. Drawing and editing lines is faster and more efficient. But these lines and text are not intelligent lines and text. They are still collections of manually created.

2.2 Computer-aided design (CAD)

Computer-aided design (CAD) is the use of computer technology for the design of real and virtual objects. CAD is 2D technology that outputs a collection of lines and text on a page. These lines have no inherent meaning in the computer or on the printed sheet. Of course, CAD has its advantages over pen and paper, but it is still a digital modeling of the act of drafting. This form of drawing shows us how architects, engineers and designers have worked for the last hundred years. Earlier designers drew plans manually. It was inconvenient, because if any items changed, the designer had to modify each of the other drawings that were affected to take the change into account. In our days we can use *Delete* key, but the goal is the same (figure 1). So, here BIM makes important departure from CAD platforms.

Figure 1. CAD system

2.3 Building Information Modeling (BIM)

BIM is beginning to change buildings: how they look, the way they function, the ways in which they are built. BIM is not a type or a thing of software but a human activity that involves wide process changes in construction. BIM must be: digital, spatial, measurable, comprehensive, accessible and durable. In BIM all elements are loaded with data that describe not only geometry, bur also material, fire rating, cost, manufacturer, count, and just about any other metadata you can imagine.

Now we can have all disciplines involved with a project sharing a single database:

- Architecture, structure, mechanical, infrastructure and construction now can be coordinate in ways, not to be together.
- Models can now be sent directly to fabrication machines.
- Energy analysis can be done at the outset of design.
- Construction costs are becoming more predictable.

BIM regards how designers and constructors look at the all building process: from preliminary design through construction documentation, into actual construction and even into postconstruction building management. With BIM usual 3D model is used to generate traditional building abstractions: plans, sections, details, elevations and schedules. Drawings produced using BIM are not just collections of lines and coordinates but interactive view of a model.

A work with a model-based framework is easier and very convenient because it guarantees that a change in one view will propagate to all other views of the model. If you remove a window from the model, it simultaneously is removed from all views and your window schedule is updated. If you move elements in plan, they change in elevation and section.

2.4 How BIM is different from CAD

The biggest difference between BIM and CAD is that a CAD system, especially 2D, uses many separate documents to explain a building. For example, the wall view is represented with two parallel lines, and we can't understand that those lines represent the same wall in a section. BIM assembles all information into one location. It is a centralized database model. In the BIM all documents are interdependent and share intelligence. (Figures 2 and 3).

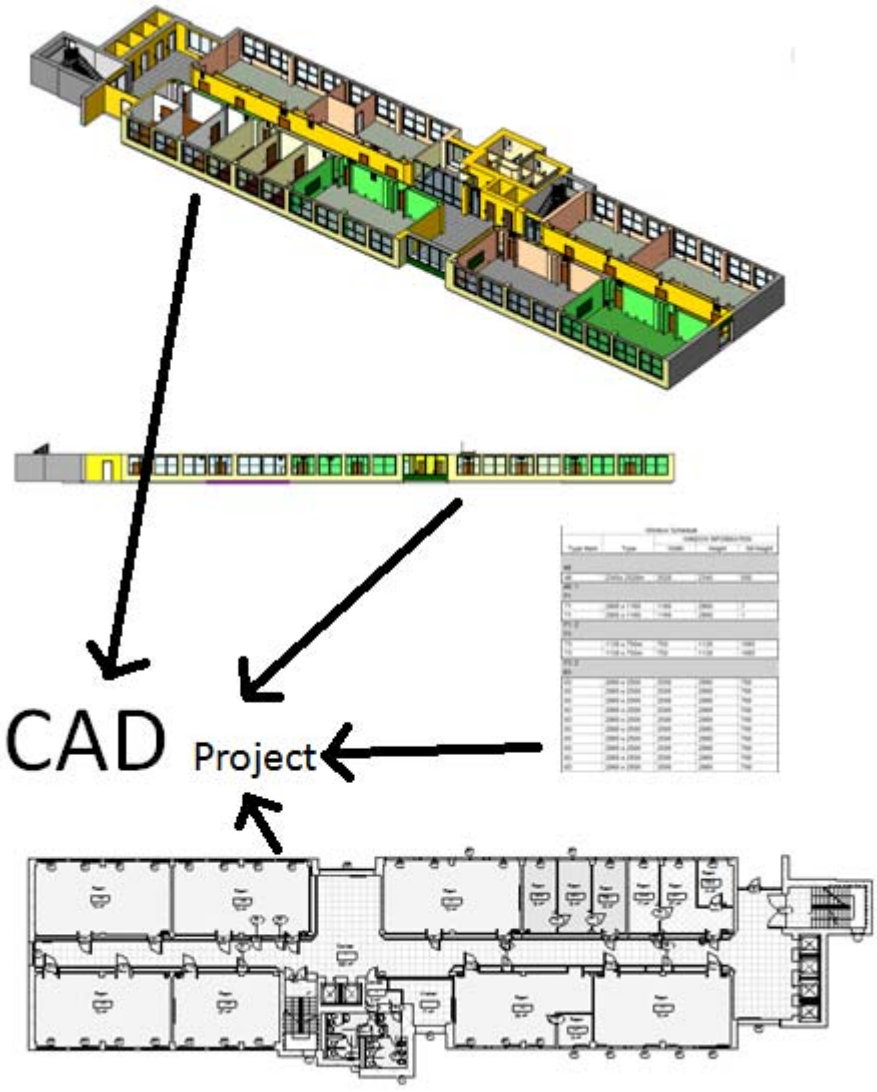

Figure 2. A CAD project consists of many uncorrelated, independently created files.

The best thing in BIM is that it manages changes for you. If we do change in the project in one place, the system will change all relevant views and documents of the project. If we change size of a window opening in elevation, this change is made throughout sections, floor plans and schedule tables.

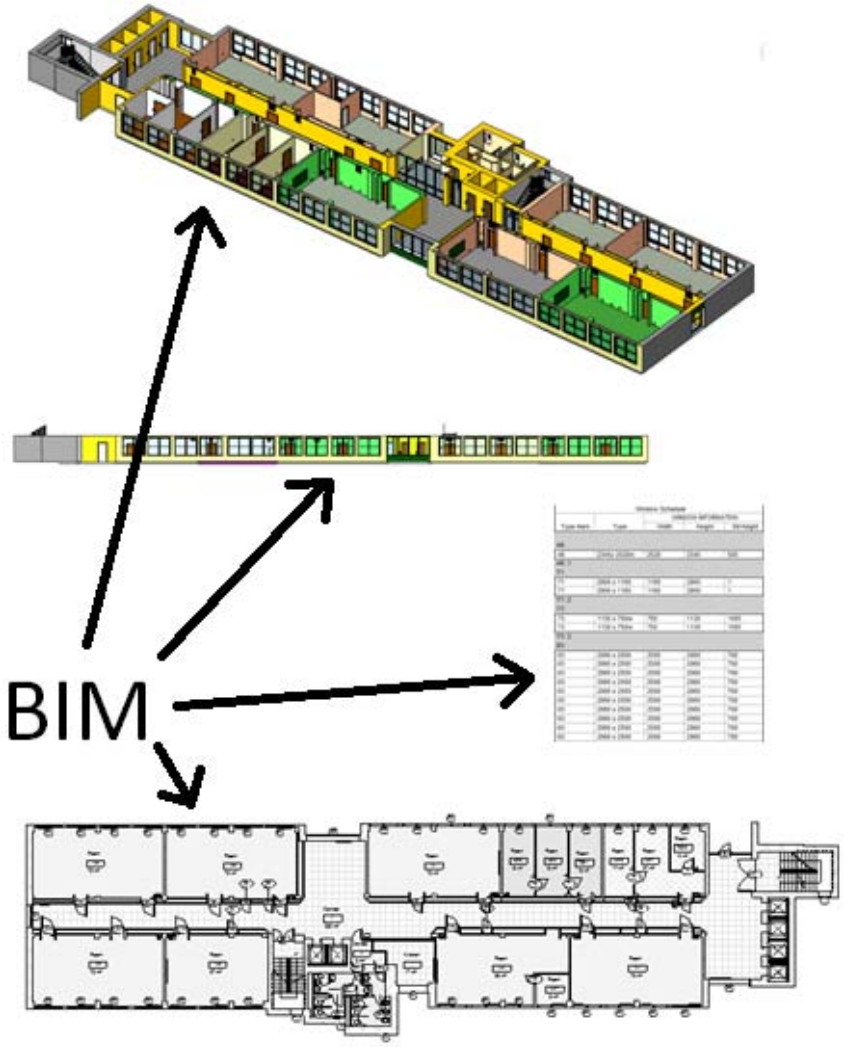

Figure 3. The BIM model is a centralized data-base in which all documents are independent.

Here are five big differences between BIM and CAD:

- ***BIM adopts a task-oriented more quickly than an object-oriented methodology.*** In 2D drafting the wall we draw with two lines. In BIM, a wall is presented like a tool named *Wall.* This wall has height, width, bearing or nonbearing, interior or exterior, materials, fire rating, demolished or new. If we add a door, in BIM it's more than four lines like in 2D drafting. Adding doors to wall automatically creates an opening in the wall in all views where are the doors.

- ***BIM keeps us honest.*** One of BIM advantage is that we can't cheat design, because the elements have properties based on real-life properties. If we have a window in plan, it automatically appears in the other associated views, such as elevation or section. In a CAD system it can be easy to overlook because we can forget to draw a window in the place or can draw it at a wrong location.
- ***BIM is more than a 3D modeler.*** Usual modeling doesn't have the ability to document a design for construction or to be leveraged. But it is possible to bring a model into a BIM application and progressed through design, analysis and documentation.
- ***BIM is a data-driven design tool.*** BIM lets you create custom content and libraries. This content contains a rich amount of data that will inform schedules, quantity take-offs, and analysis. So, it is not also just 3D – it is 3D with intelligent information.
- ***BIM is based on an architectural classification system, not „layers".*** In CAD every line belongs to a layer. It is a reason that we can to place, for example a window, into not correct layer. For example, in Revit, there is no way to accidentally place a window into 'wall' layer.

In the table 1 we can see more differences between CAD and BIM:

Table 1. CAD and BIM technologies comparison.

PROPERTIES	CAD	BIM
Views which have communications	-	✓
Parametric solutions	-	✓
Automated tables	-	✓
Drawing 2D	✓	✓
DWG compatibility	✓	✓
Supplementary drawings support	✓	✓
Lines thicknesses, types and patterns	✓	✓
Visibility management	✓	✓
Auto zoom control	-	✓
One of the project database in a file	-	✓

3. Equipment

3.1 Leica DISTO D2

The measurements I did with laser distance meter Leica DISTO D2 (figure 4).

The Leica DISTO D2 has a versatile measuring range of 0.05 meters to 60 meters, which lets you use it for almost any task you can think of. The accuracy is ± 1.5 mm. With Leica DISTO D2 to measure is not difficult: measure distances at the touch of the button and calculate areas and volumes, with the flip-out end-piece you are equipped for any measuring situation, the results are shown on a 3-line display, minimum / maximum measurements, tracking and storage of results (figure 5).

Figure 4. Leica DISTO D2.

Figure 5. Minimum/maximum measurements, tracking and storage of results.

3.2 Software

3.2.1 AutoCAD

AutoCAD - a universal Autodesk company created and developed computer-aided design system. AutoCAD purpose is to draw drawings, to simulate the complex flat and dimensional constructions, which are using in construction, controversy, electrical engineering, maps and furniture design and etc.

In AutoCAD system are basis more than 2000 specialized software products for houses, cities, robot, machines, building construction, utility and communication, roads and streets, maps and for other objects design.

3.2.2 Autodesk Revit

There are a lot of software based on BIM technologies (table 2):

Table 2.Software based on BIM technologies.

SOFTWARE	PRODUCER
Revit	Autodesk
Navit Works JetStream	Autodesk
ArchiCAD	Graphisoft
Constructor	Graphisoft
Bentley Architecture	Bentley Systems
Digital Project	Gehry Technologies LLC
Vector Works Architect	Nemetschek N.A
Tekla Structures	Tekla Corporation
SPIRIT	SOFTTECH GmbH
StruCAD	AceCAD Software Inc
IFC Engine Series	TNO

For 3D modeling I chose Revit Architecture and Revit MEP software, because Revit is the most technologically BIM application. The name Revit comes from ,,Revise Instantly". Revit is built for managing change. This software was designed from the ground up as a BIM platform to specifically address problem areas of the architecture, engineering and construction industry: communication, coordination and change management. In CAD users have to do a lot of manual updating, but Revit understands when a change happens and does it automatically.

Revit has a lot of advantages, but sometimes, if we are not careful, this can also be disadvantages, especially for users who may be quick to make changes. Revit creates relationships between building elements in order to streamline the design process. For example, if we will delete a wall, all windows, doors and other elements will be deleted. But beauty of Revit is that it will not let you leave elements floating around.

3.2.4 Other software

3.2.4.1 Microsoft Office Word

Microsoft Office word was used to write all draft documents and the final report.

3.2.4.2 Paint

Paint was used for modeling of figures.

4. Processing and Analysis

4.1 Measurements in Lithuania

In January I started my Project from measurements of Vilnius Gediminas Technical University, faculty of Environmental Engineering in Lithuania. I measured second floor. These measurements were not like usual cadastral measurements, because I had to measure this floor for 3D model. It means that I had to measure not only length of walls but every detail in all rooms: sockets, switches, lamps, all cords which we see and other things. Also I had to know all materials of walls, floors, ceilings. This information I have got from my university (figure 6). Also I have got a plan of second floor (figure 7). I had to gather all information what needs Building Information Modeling.

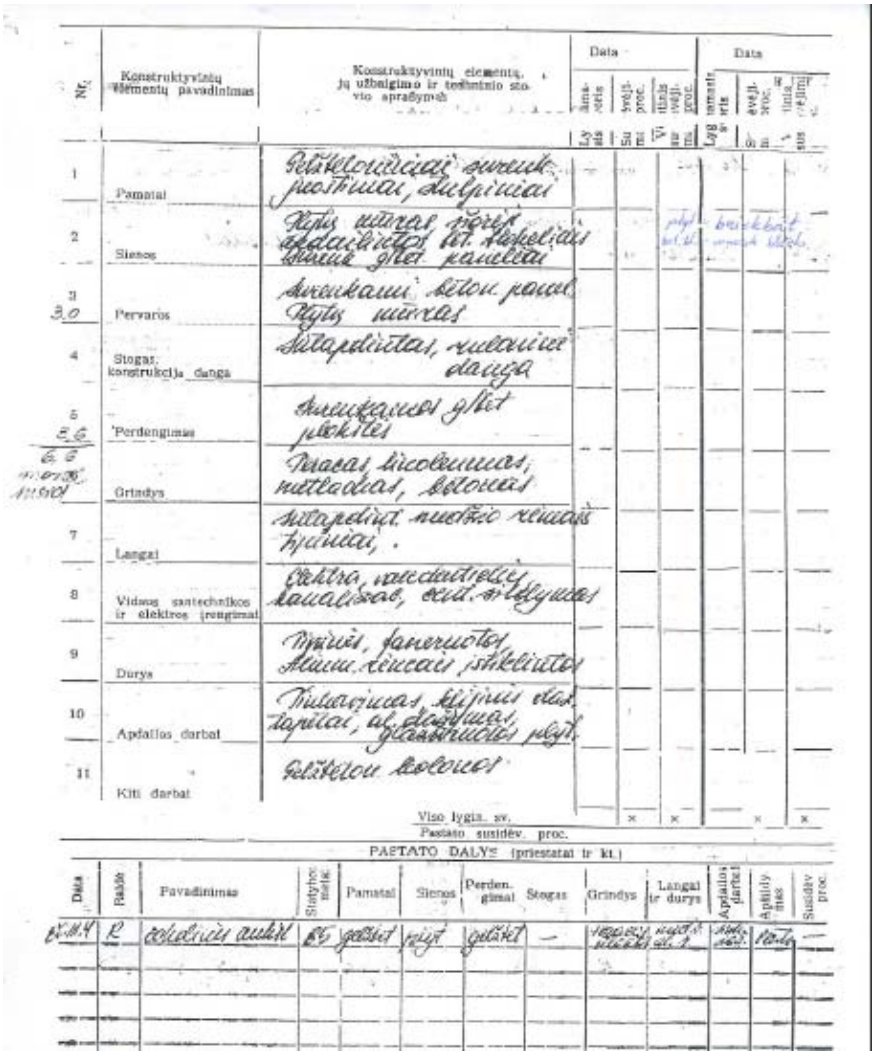

Figure 6. Materials of constructions.

Figure 7. A plan of the second floor.

For measurements I didn't use any coordinate system. I used laser distance meter (Leica DISTO D2) and a roulette if wasn't possibilities to measure with laser distance meter. All measurements I wrote on the paper (figure 8 and 9).

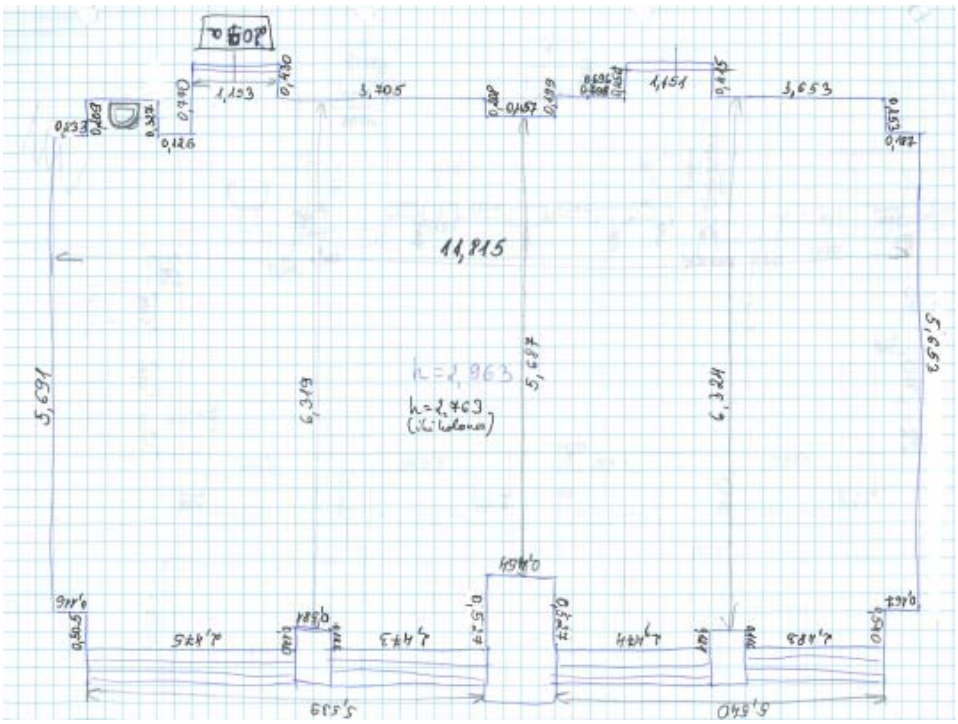

Figure 8. Results of measurements.

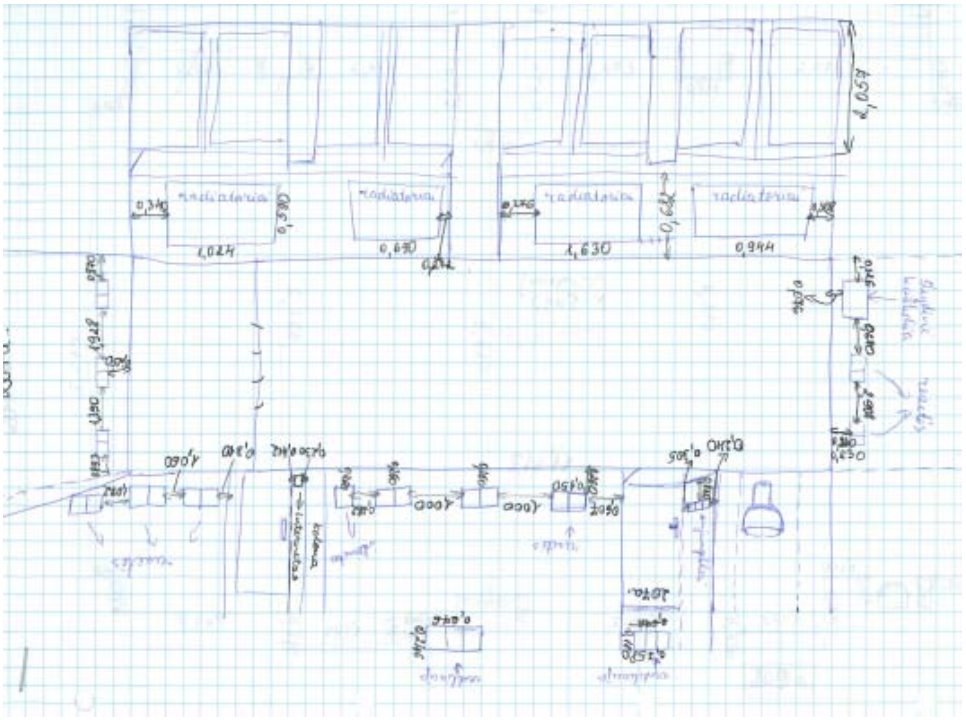

Figure 9. Results of measurements.

When I had results of measurements I drew 2D model with AutoCAD software (figure 10). With AutoCAD software I have more than three years work experience, so to draw 2D model of one floor for me wasn't too difficult.

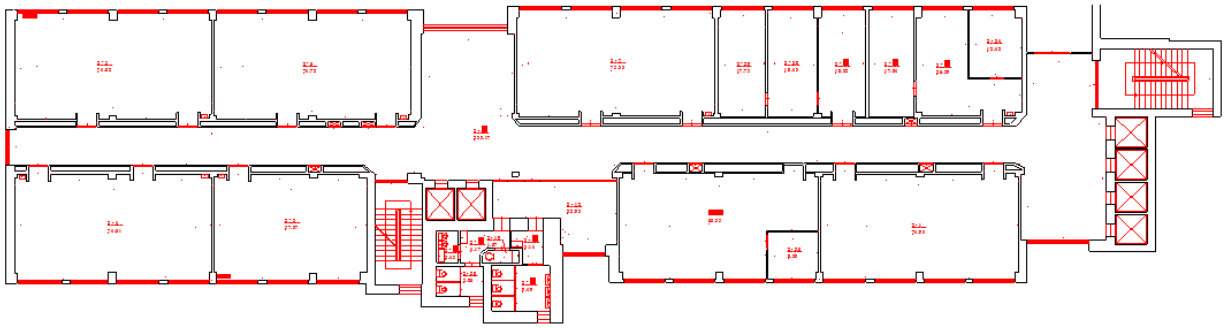

Figure 10. 2D model.

4.2 BIM Modeling

4.2.1 The importing of 2D model to Autodesk Revit Architecture

One more a beauty of Revit is that we can import and export to a predefined set of layers. I have imported my 2D CAD model to Revit very easy and quickly (figure 11).

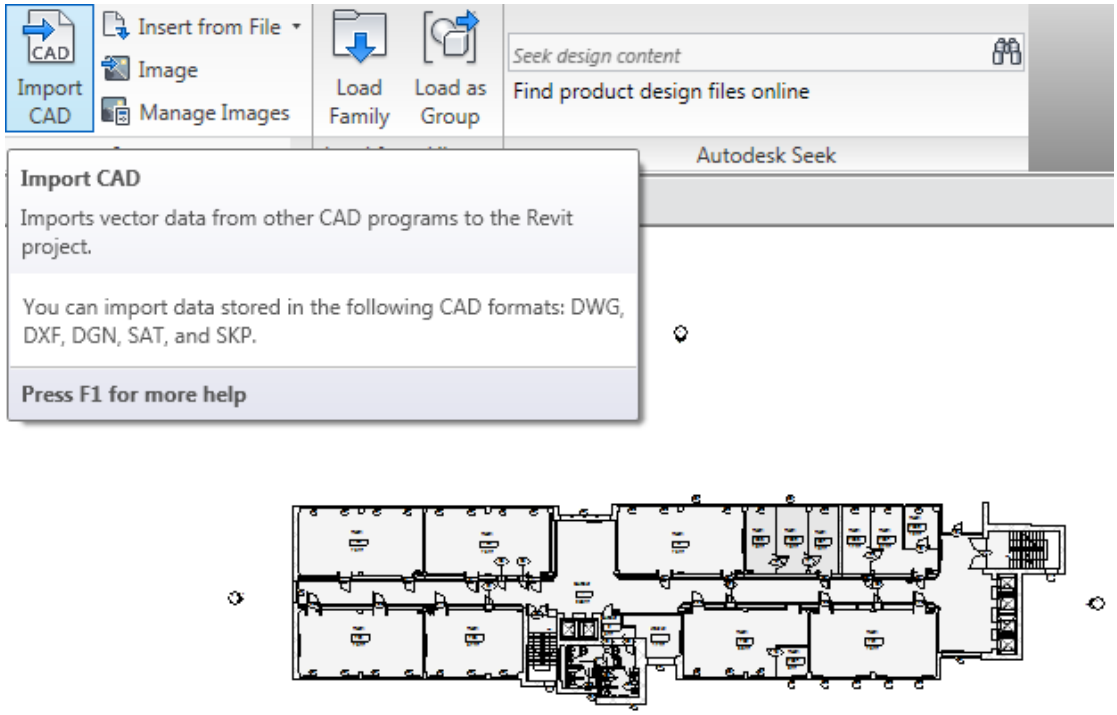

Figure 11. Importing of 2D CAD model to Revit Architecture.

4.2.2 SlimBIM

A 'SlimBIM' is a digital model of the building without intelligence. A 'SlimBIM' consist from walls, floor, doors, stairs, windows, etc. In 'SlimBIM' we don't have any information about building, materials, communications, etc. We have only 3D view (figure 12).

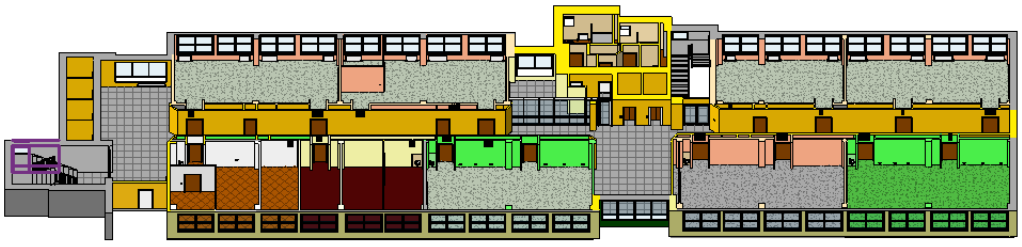

Figure 12. SlimBIM

4.2.3. BuildingSMART

BuildingSMART is a digital model with intelligence. If we want to get a full BIM model, we have to put in all information about building, constructions, communications and other details. Type of information depends from drawer, because he can put, create all information which he needs and thinks that it is important.

For example, I tried to put and to create all information that everybody could find information which is required them. For example: electrician - about electricity, plumber - about heaters, communications.

All information in Revit is in schedules (table 3). To create schedules is very easy and quickly. We can choose fields and create new fields if we think that they are required.

Table 3. Door Schedule.

Door Schedule										
DOOR INFORMATION			FLOOR	DOOR		FRAME		Model	Company	Comments
Mark	Height	Width		Door Finish	Door Hardware Group	Frame Finish	Frame Jamb Type			
Level 1										
1	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
2	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
3	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
4	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
9	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
10	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
11	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
12	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
13	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
14	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
15	2025	799	Level 1	WD	Lever	WD	WD	D66	DECOR	
16	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
17	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
18	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
19	1993	1100	Level 1	WD	Lock	WD	WD	D60	DECOR	
20	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	
21	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	
22	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	
23	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	
24	2000	800	Level 1	WD	Lever	WD	WD	D74	DECOR	
25	2000	800	Level 1	WD	Lever	WD	WD	D74	DECOR	
26	2000	800	Level 1	WD	Lever	WD	WD	D74	DECOR	
27	2000	800	Level 1	WD	Lever	WD	WD	D74	DECOR	
28	2000	800	Level 1	WD	Lever	WD	WD	D74	DECOR	
31	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	
32	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	
33	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	
34	2020	900	Level 1	WD	Lever	WD	WD	D71	DECOR	

One more power of Revit is, when we place a door in the model it is automatically tagging with a sequential door number. The same is with windows. In table 3 we can see door schedule. The dimensions of the doors are creating automatically, so I hadn't to write one by one. But, for example, model, company, I had to write in. But it is obviously, because software can't know these things. This schedule can help for

everybody. For example, if we broke door, we can open door schedule and see model of the door and company which produce those doors. So, we just go to the shop and say that we need this door, with this dimensions, etc.

But schedules do not stop just at doors and windows. We can schedule almost any item that goes into the model. (Appendixes).

Next step of creating buildingSMART is creating material takeoffs. It is similar to creating a schedule. The only difference is that we are now breaking components down and scheduling the smaller pieces (table 4). For example, we could get a schedule of the all o the doors. But with material takeoff, we can quantify the glass within the doors, the square footage of door panels.

Table 4. Door Material Takeoff.

Door Material Takeoff						
Mark	Material: Area	Type	Width	Height	Door Finish	Family
4 m²: 1 5 m²						
1	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
2	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
3	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
4	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
9	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
10	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
11	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
12	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
13	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
14	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
16	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
17	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
18	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
19	5 m²	1100 x 1993m	1100	1993	WD	M_Single-Flush
5 m²: 14 6 m²						
36	6 m²	2400 x 1900m	1900	2400	PL	M_Double-Glass
6 m²: 1 7 m²						
36	7 m²	2400 x 1900m	1900	2400	PL	M_Double-Glass
7 m²: 1 7 m²						
41	7 m²	2400 x 2900m	2900	2400	PL	M_Double-Glass
7 m²: 1 11 m²						
41	11 m²	2400 x 2900m	2900	2400	PL	M_Double-Glass
11 m²: 1 Grand total: 71						

One more thing in Revit which I like very much is that we can create room areas plans. There we can write names of rooms. And later we can create Room Schedule (table 5). In Room Schedule we can create all information about each room. We can see floor finish, wall finish, ceiling finish and other information which is required for us. It is very easy, quickly and informative.

Table 5. Room Schedule.

Room Schedule

Number	Name	Base Finish	Floor Finish	Wall Finish	Ceiling Finish	Area	Perimeter	Level
Corridor								
1	Corridor	WD	CL	PT	ACT	230 m²	165932	Level 1
2	Corridor	WD	CL	PT	ACT	5 m²	10575	Level 1
Corridor: 2								
Kitchen								
	Kitchen	WD	CL	PT	ACT	17 m²	18936	Level 1
Kitchen: 1								
Room								
705	Room	WD	LA	PT	ACT	75 m²	41047	Level 1
701	Room	WD	LA	PT	ACT	75 m²	42336	Level 1
702	Room	WD	LA	PT	ACT	66 m²	41339	Level 1
704	Room	WD	LA	PT	ACT	75 m²	42498	Level 1
706	Room	WD	LA	PT	ACT	75 m²	41672	Level 1
707	Room	WD	LA	PT	ACT	75 m²	42272	Level 1
708-3	Room	WD	LA	PT	ACT	18 m²	18316	Level 1
708-2	Room	WD	LA	PT	ACT	18 m²	18536	Level 1
708-1	Room	WD	LA	PT	ACT	18 m²	20620	Level 1
709-3	Room	WD	LA	PT	ACT	17 m²	18165	Level 1
709-1	Room	WD	LA	PT	ACT	27 m²	27619	Level 1
709-2	Room	WD	LA	PT	ACT	12 m²	14336	Level 1
702-1	Room	WD	LA	PT	ACT	8 m²	11583	Level 1
703	Room	WD	LA	PT	ACT	57 m²	35705	Level 1
Room: 14								
Toilet-gentelmens								
2	Toilet-gentelmens	WD	LA	CL	ACT	9 m²	12410	Level 1
1	Toilet-gentelmens	WD	LA	CL	ACT	3 m²	7907	Level 1
Toilet-gentelmens: 2								
Toilet-ladies								
2	Toilet-ladies	WD	LA	CL	ACT	5 m²	9177	Level 1
3	Toilet-ladies	WD	LA	CL	ACT	2 m²	6361	Level 1
1	Toilet-ladies	WD	LA	CL	ACT	4 m²	9587	Level 1
Toilet-ladies: 3								

So, I can say that all information in buildingSMART can be classified to: ‘must have’, ‘ought to have’, or just ‘nice to have’.

In smart model we also must have energy. For energy and communications I used Revit MEP software, because in Revit Architecture wasn’t switches, sockets, cables, ducts, etc (figure 13).

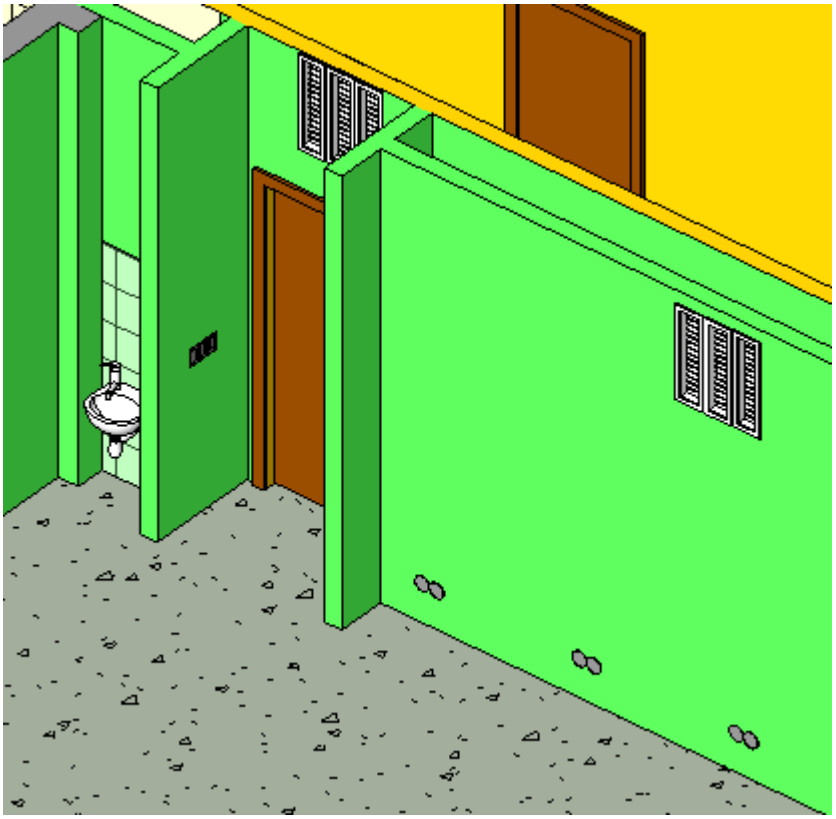

Figure 13. 3D view with switches, sockets and ventilation.

4.2.4 The Final Result

My friend from my University in Lithuania is doing similar project like me. She did measurements of the third floor of our University. We decided to do one test: to connect our two floors.

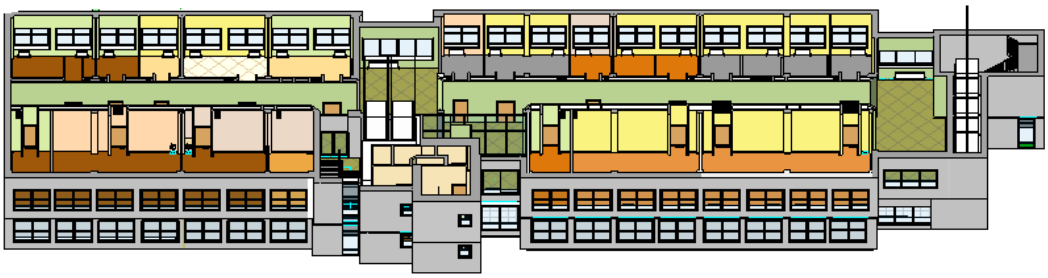

Figure 14. Connected second and third floors.

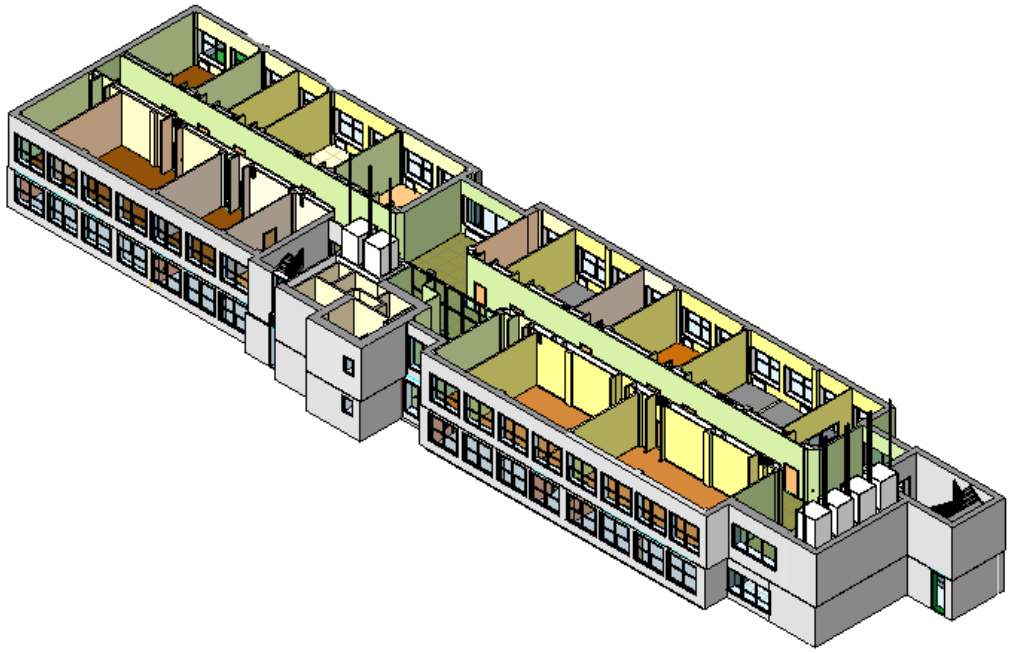

Figure 15. 3D view of connected floors

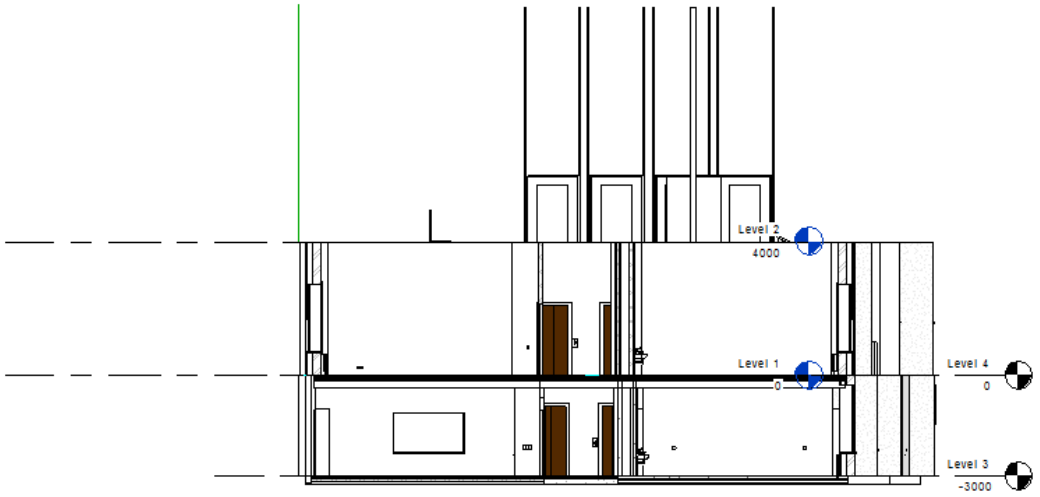

Figure 16. Elevations of connected floors.

This two floors connection shows for us that with Revit we can connect the works of different persons. It lets for us to make projects faster.

4.3 Other BIM possibilities

Building Intelligent Modeling can be used not only for buildingSmart. With BIM we can designed, for example, an intelligent 'industry park model' which can be used for planning and to have information about size, main dimensions and number of rooms, floor bearing weight restrictions, driving route to the building from the main gates, driving route to come out again, which services are available – power, gas, water, remote heating, telephone, etc. It means that we can create not only building, but also the area near the building.

I created buildingSMART for existing building. But we also can create buildingSMART for new buildings which are not built. For existing buildings to create a buildingSMART model is difficult, because we have to measure a building, to know, for example, all cables of telephone, internet and other communications. It needs a lot of time and expenditure before we start to create a BIM model. In my opinion, for not existing buildings is easier to create BIM model, because we need only drawing, project whereby we can create buildingSMART.

5. Difficulties

During this project I had some difficulties:

- The first difficulty was that I didn't measure lamps. But later I understood that I can draw lamps from the pictures and when I will back to Lithuania I can measure and correct lamps by precisely measurements, because Revit let for us to do it quickly and easy.
- First weeks were very difficult to understand the new software and how to work with it, because before I hadn't experience with buildingSMART software.
- Next difficulty was that I couldn't draw sockets, switches, cables, because Revit Architecture hadn't, so I had to fix Revit MEP software and through very short time to learn how to use this software.
- Revit is American software, so there are some words from American English language.
- The most difficult was to connect two floors, because measurements and drawing were did by two different students (me and my friend).

6. Conclusions and Recommendations

This project is based on comparing 2D and 3D modeling by of BIM and CAD technologies. The aim of this analysis was to find out the merits and demerits of these two presented technologies. Nowadays it is very important to save the resources of time and to make the best result which could be used from various companies of industry to the users.

To understand which software is the best, there was made a 2D model by AutoCad and 3D model by Autodesk Revit software. The process of this was to carry out the measurements of already built building, which is Vilnius Gediminas Technical University in Vilnius, Lithuania. There was measured the second floor, and all available information was collected starting from the electricity switches to the material of walls. These data were processed by the software mention above. Conclusions and recommendations are:

- ✓ Both software are applicable for building modeling. They have a lot of properties to create as real a model as possible. They both produce the main objects, as walls, doors, windows and etc. But it was noticed - that using AutoCad there was not the possibility to create families. With the help of families we can easy change various minor details as desired. For example, door hardware and frame jamb.
- ✓ 3D design we can understand easily because we see and know what windows or doors, and other details look like. It is not just lines like in a 2D model. Also, not everyone can understand 2D, because we have to know how we draw windows, doors, and what the symbols mean.
- ✓ 3D design gives for us the ability to show a variety of design options to the team and client. For example, if a client can see a 3D buildingSMART model of his future house, he can change the colors of walls, the style of doors and other things and see what the result look like.
- ✓ In Revit Architecture schedules of building components can be automatically produced, and improve the calculation of costs and quantities.
- ✓ In Revit material quantity take-offs allow for better planning and predictability, because in the table we can see which kind of materials we need, how much materials we need and where we need them.

- ✓ BuildingSMART model we can create for already existing buildings and for yet not existing buildings. For existing buildings we need more work, more time, because we have to measure the building before creating a buildingSMART model. For not existing buildings we need only project of the future building.
- ✓ Popular AutoCAD software with 2D modeling is universal, it is good to learn to draw, to do small-scale projects. But Building Information Modeling lets for us not just to do, but to create and to model projects. The goal of BIM is to control calculations and interaction of elements in software systems, because it is more quick, more accurate and easier for us.
- ✓ 2D modeling has one advantage: to draw 2D model is very quick. Disadvantages are that in 2D model, in CAD technologies we have only drawing (lines and text) without information about building. Of course, in AutoCAD we have layers, for example stairs layer, windows layer, doors layer. But we can't see how they look visually. However in Revit in 3D model we can see every detail of doors or other details.
- ✓ So, 3D modeling needs more time for design than 2D modeling, because there we have to reduce more information. Also 3D modeling costs more than 2D modeling, because with 3D model work more people and longer time, what needs bigger salary.

However, because these both software, are using in these days, and look that more and more architects, and the others companies, which are connecting with it, I recommend in the future the Cadastral measurements have to be in 3D model like the buildingSMART. Of course, for owners, in my opinion, would be better to have a 2D model on the paper, because it is easy to use. But a 3D model, especially buildingSMART, would be useful for electricians, plumbers and other house supervisors, because in buildingSMART model everybody can find the required information. For example, if we have a digital 3D buildingSMART model of our house, when we want to make changes of our house, we can go to architect with a digital model for consultation. It needs less time and money, because the architect hasn't to come to us.

But I understand that the world needs more time for changes. In my opinion a lot of people, companies and institutions still will use 2D modeling some years more, because changes come step by step. I also still will use 2D modeling in the job, in my university, because I can't change software in job or education system in university. But for myself, for my interest and my future projects I will use 3D modeling, because to begin to use 3D modeling now is investment to the future.

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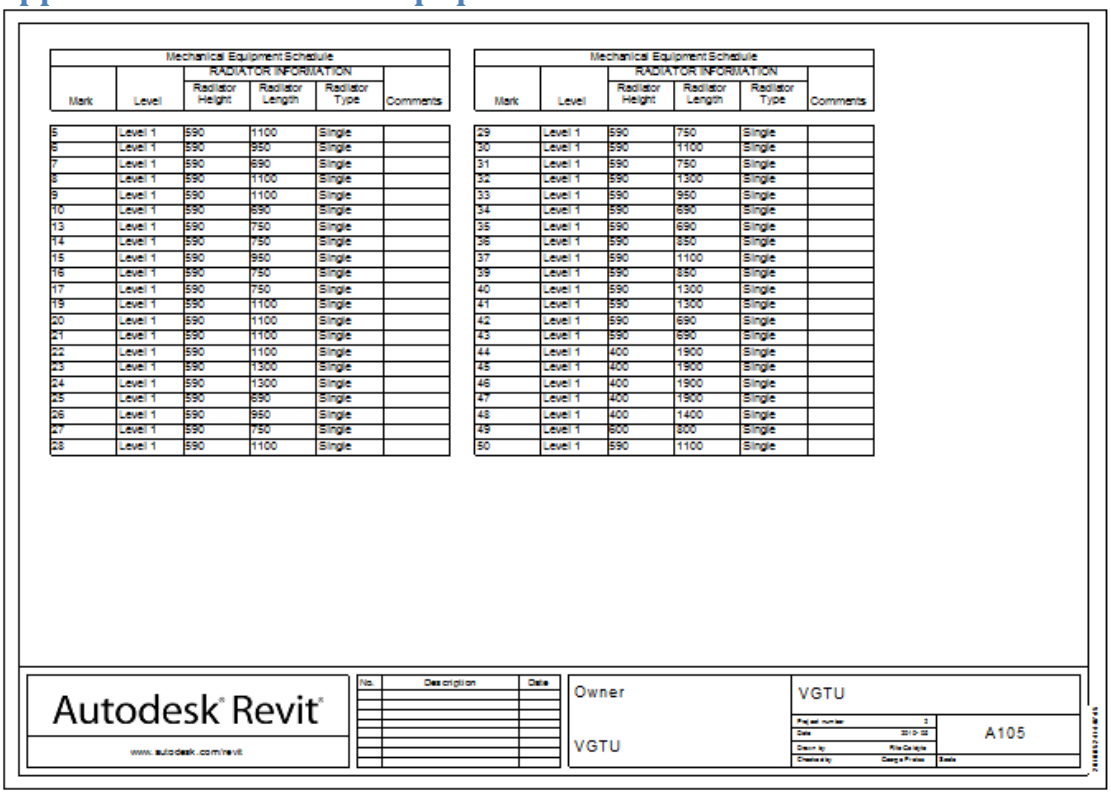
8. Appendixes

Appendix A. Mechanical Equipment Schedule



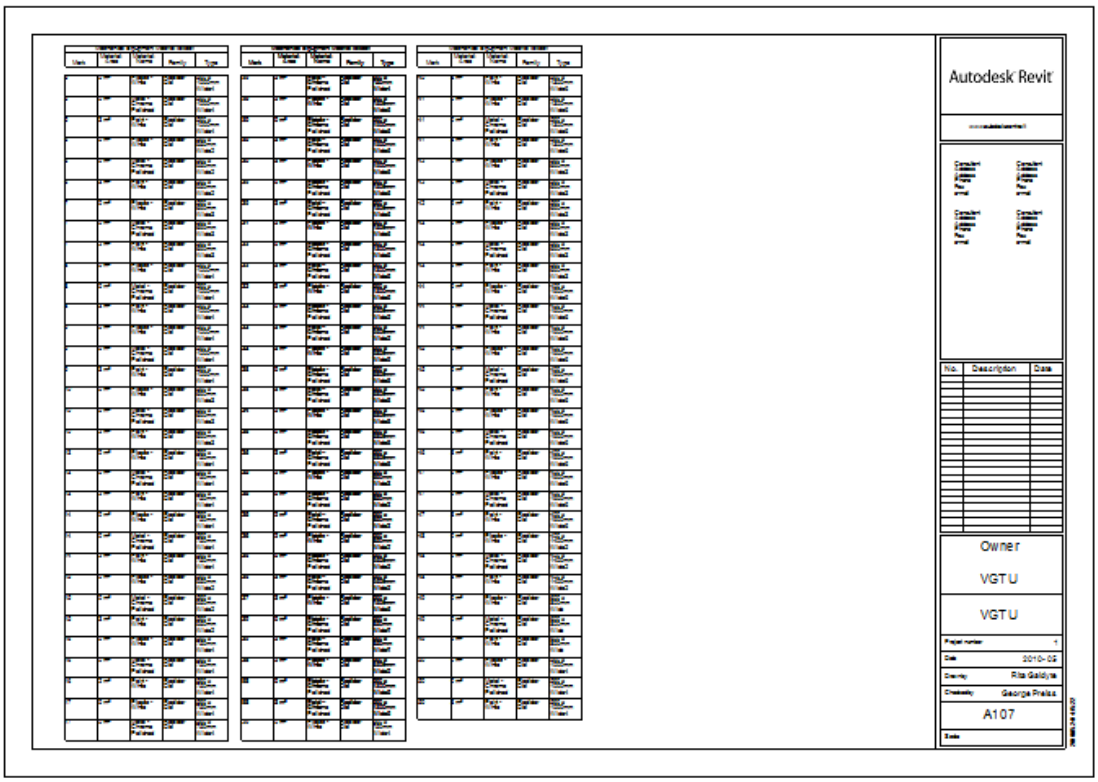
Mechanical Equipment Schedule

Mark	Level	RADIATOR INFORMATION			Comments
		Radiator Height	Radiator Length	Radiator Type	
5	Level 1	590	1100	Single	
6	Level 1	590	950	Single	
7	Level 1	590	890	Single	
8	Level 1	590	1100	Single	
9	Level 1	590	1100	Single	
10	Level 1	590	890	Single	
13	Level 1	590	750	Single	
14	Level 1	590	750	Single	
15	Level 1	590	950	Single	
16	Level 1	590	750	Single	
17	Level 1	590	750	Single	
19	Level 1	590	1100	Single	
20	Level 1	590	1100	Single	
21	Level 1	590	1100	Single	
22	Level 1	590	1100	Single	
23	Level 1	590	1300	Single	
24	Level 1	590	1300	Single	
25	Level 1	590	590	Single	
26	Level 1	590	950	Single	
27	Level 1	590	750	Single	
28	Level 1	590	1100	Single	

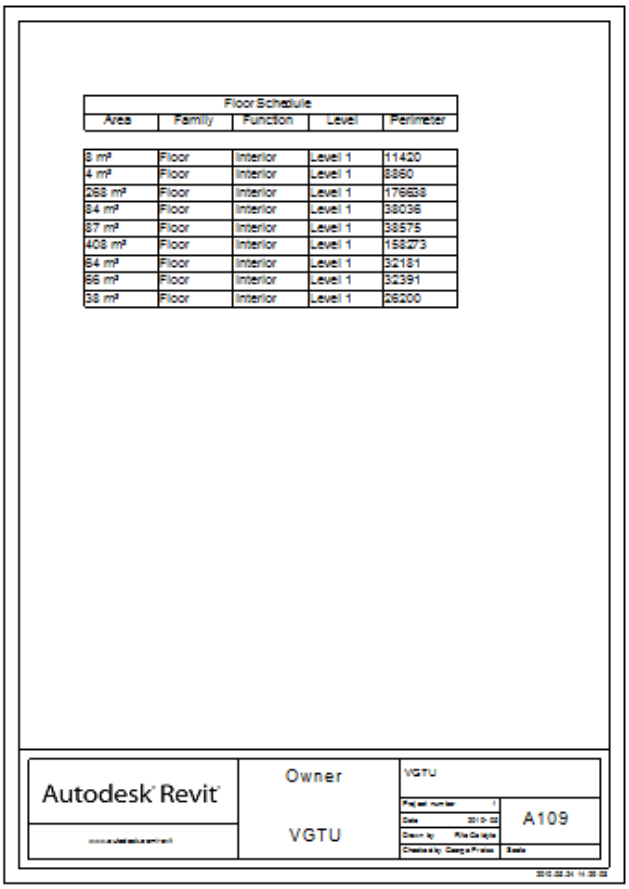
Mechanical Equipment Schedule

Mark	Level	RADIATOR INFORMATION			Comments
		Radiator Height	Radiator Length	Radiator Type	
29	Level 1	590	750	Single	
30	Level 1	590	1100	Single	
31	Level 1	590	750	Single	
32	Level 1	590	1300	Single	
33	Level 1	590	950	Single	
34	Level 1	590	890	Single	
35	Level 1	590	690	Single	
36	Level 1	590	850	Single	
37	Level 1	590	1100	Single	
39	Level 1	590	850	Single	
40	Level 1	590	1300	Single	
41	Level 1	590	1300	Single	
42	Level 1	590	690	Single	
43	Level 1	590	690	Single	
44	Level 1	400	1900	Single	
45	Level 1	400	1900	Single	
46	Level 1	400	1900	Single	
47	Level 1	400	1900	Single	
48	Level 1	400	1400	Single	
49	Level 1	600	600	Single	
50	Level 1	590	1100	Single	

Appendix B. Mechanical Equipment Material Takeoff.



Appendix C. Floor Schedule



Floor Schedule

Area	Family	Function	Level	Perimeter
8 m²	Floor	Interior	Level 1	11420
4 m²	Floor	Interior	Level 1	8360
268 m²	Floor	Interior	Level 1	176833
84 m²	Floor	Interior	Level 1	38036
87 m²	Floor	Interior	Level 1	38575
408 m²	Floor	Interior	Level 1	158273
84 m²	Floor	Interior	Level 1	32181
86 m²	Floor	Interior	Level 1	32391
38 m²	Floor	Interior	Level 1	26200

Autodesk Revit

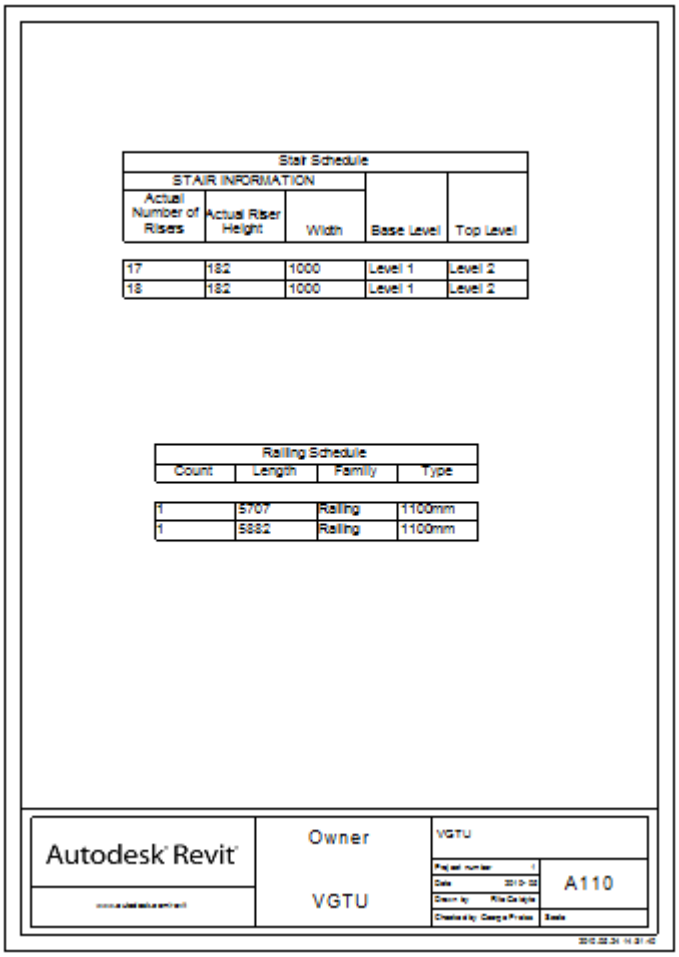
Owner

VGTU

VGTU

A109

Appendix D. Stair and Railing Schedules.



Stair Schedule

STAIR INFORMATION				
Actual Number of Risers	Actual Riser Height	Width	Base Level	Top Level
17	182	1000	Level 1	Level 2
18	182	1000	Level 1	Level 2

Railing Schedule

Count	Length	Family	Type
1	5707	Railing	1100mm
1	5882	Railing	1100mm

Autodesk Revit

Owner

VGTU

VGTU

A110

Appendix E. Window Schedule.