LAB University of Applied Sciences

Civil Engineering Summer School

your development platform

#1(2020)

Summer School

Nikifor Sedovin,
2020 LAB Civil Engineering Summer School Foreman

Dear reader,

This magazine is about 2020 LAB Civil Engineering Summer School, its activities, projects, researches and its people. Whether you are interested in civil engineering or just want to know more about activities in LAB University of Applied Sciences, we made it for you. But first let me introduce you to what is called Summer School.

LAB Civil Engineering Summer School - a training place for students who have not gotten a summer internship from companies, and at the same time a great platform for knowledge and skills development.

In 2020 Summer School was held the whole summer. To complete summer training students have to work 7 weeks. But some of our students continued working for even more. As it is a job, salary is in credit units (ECTS). Hopefully in future Summer Schools there will be an opportunity to participate in external projects and pay everyone a normal salary.

All the working process is managed by a Foreman, who creates plans and controls assignments. Also there are teachers who guide the Foreman and give assignments for students. But because almost every teacher has a summer vacation, most of the work is shifted to the Foreman.

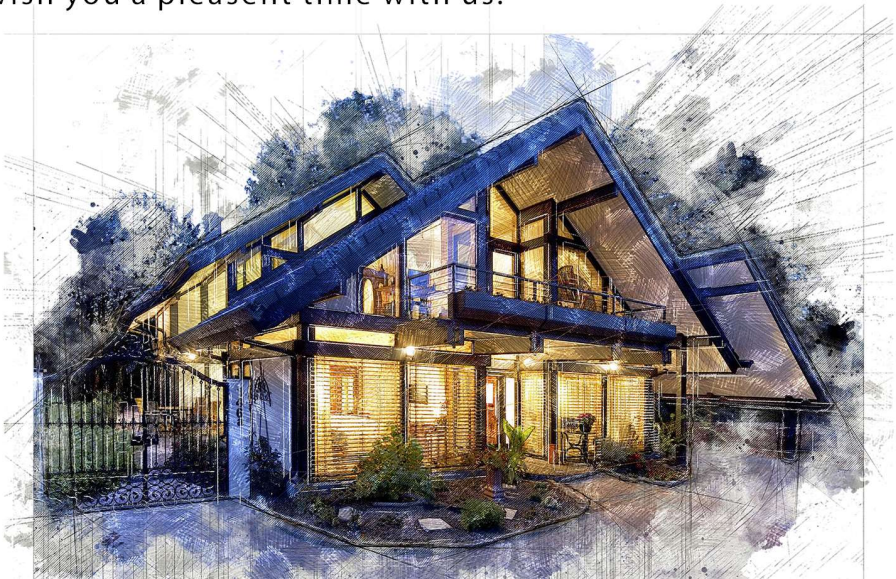
Summer School

The main working topic here is BIM (Building Information Modelling). Students concentrate on 3D modelling in different softwares and on checking their models in special BIM tools. But also thay have an opportunity to make researches and work with laboratory assignments, such as laser scanning and laboratory video tutorials.

This year, despite the pandemic situation, Summer School was held successfully and the results speak for themselves. Even though our work went mostly online, we had an opportunity to enjoy process of teamwork and make our projects without any limitations. We had daily morning meetings called “Morning coffee” and Weekly reports every monday. “Clever constructor” meetings, where student can teach others something, were arranged to exchange knowledge and experience with each other. We had 11 active students overall, all from Double Degree Civil and Construction Engineering group, working in different time of summer.

Workflow of LAB Civil Engineering Summer School is a great example of collaboration among students. During the process of different tasks execution students of Summer School had a lot of online meetings to discuss different questions, results and plans together. A lot of contact, dialogues and cooperation is a straight way for the student to succeed in the future. Students were easy to share their problems or suggest decisions covering somebody`s weakness by own strengths. Summer School lets interns get more familiar with each other and work in the atmosphere of friendship and dedication.

Welcome to the first LAB Civil Engineering Summer School Magazine!
I want to wish you a pleasent time with us.



Content

Pulsa railway station. LAB teachers and students, July, 2020.

Jarno Rautiainen, Leonid Vasiliev, Timo Lehtoviita, Nikifor Sedovin, Nikita Maslov.

Pulsa Station in 3D

Kseniia Kuznetsova

One of the main tasks for students during the summer school was the development of a BIM model using software packages for design. The development was based on a set of plans for each building in PDF format. In this article, one of such projects will be presented - a 3D model of Pulsa railway station in Lappeenranta.

Step 1 – Architecture model development.

The **Revit** software was chosen to develop the architectural model of the building.

The design was carried out in accordance with the **Common BIM Requirements 2012**.

The model creation process was complicated by a large number of intricate architectural details. The station was built in 1869 and has many carved wooden elements.

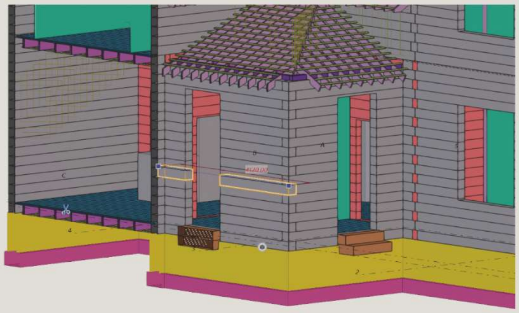
The carved wooden elements were made as the formed walls.The roof safe equipment – Revit families.

To solve this problem, it was required to study the Revit program in more details and learn how to create complex architectural forms.

The final result was visualized using the **Twinmotion** software.

Visualization in Twinmotion

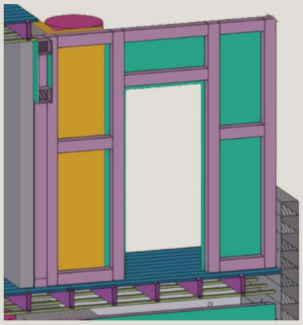
Step 2 – Structural model developing. After creating an architectural model, it became necessary to develop a structural model on its basis. Tekla Structures was chosen for that purpose.



1

Log wall construction

The main bearing elements of the Pulsa station are log walls. In the model, they are represented by a system of beams that are later combined into assemblies.



2

Partition construction

The partitions were made as a wooden frame. The floor structure is presented in a simplified version - of three layers (plank covering, load-bearing beams and lathing).

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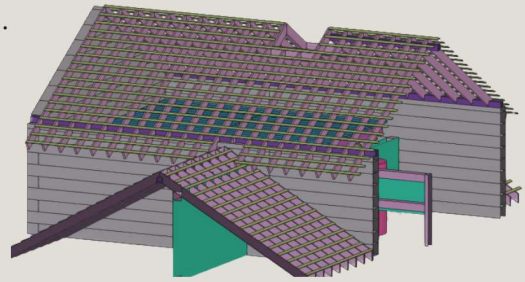


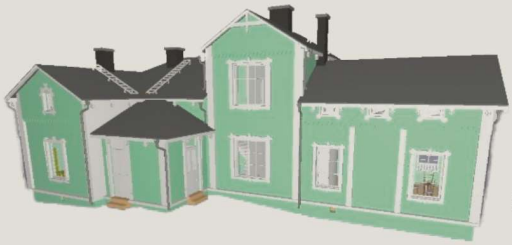
3

Roof construction

The roof structure is also presented in a simplified form - a rafter system and lathing.

4

The structural model was also developed according to the Common BIM Requirements 2012. The structural model visualization is presented in **Twinmotion.**



5

The SMC model

The end result of the work can be considered the production of architectural and structural IFC models, which were subsequently combined into the SMC merged model.

The experience of self-development of a complex building model is a big step in the development of professional skills. Thanks to this project, new design and visualization programs that were studied. But the most important acquisition is the ability to solve problems arising in the design process. Solve not only through self-study, but also through communication with the team.

Solibri
BIM Tool

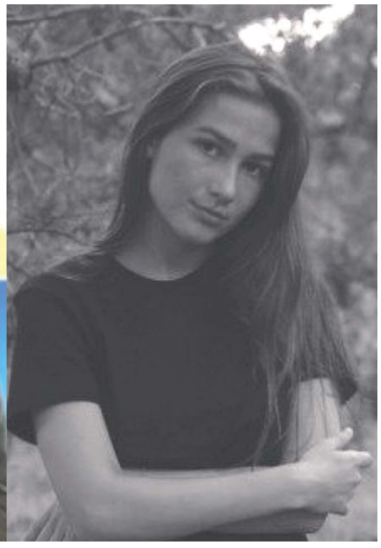
Melnikov Daniil

Federiakina Irina

BIM in construction

BIM – building information model (modelling) – is a relatively new but rapidly developing technology used in modern construction industry. 2D drawings are replaced by 3D digital representation also incorporating information about time. BIM contains specific data about every component, all the data is linked together and can be accessed straight from the model.

The project life cycle becomes accompanied by different softwares, from modelling to analysis providing programs Special place is for collaborating and checking tools since they are utilized throughout the whole process of project development. And Solibri is one of these tools.



A closer look to Solibri

Solibri Office (FKA Model Checker) is a software for viewing, accuracy checking and quality assurance of 3D models. There are separated tools included: Solibri Office, Solibri Site and Solibri Anywhere. Since the first two need to pay for the license students reviewed only Solibri Anywhere which allows model checking and communication for all the involved parties.

What for and why?

In any building project there are those who design and manage and those who actually build – and the relevant information must find its way efficiently from one to another. But it does not stop there.

The daily work at the construction site involves numerous people each focusing on their individual tasks. Therefore, only relevant information should be accessed effortlessly for getting each task done without confusion or delay.

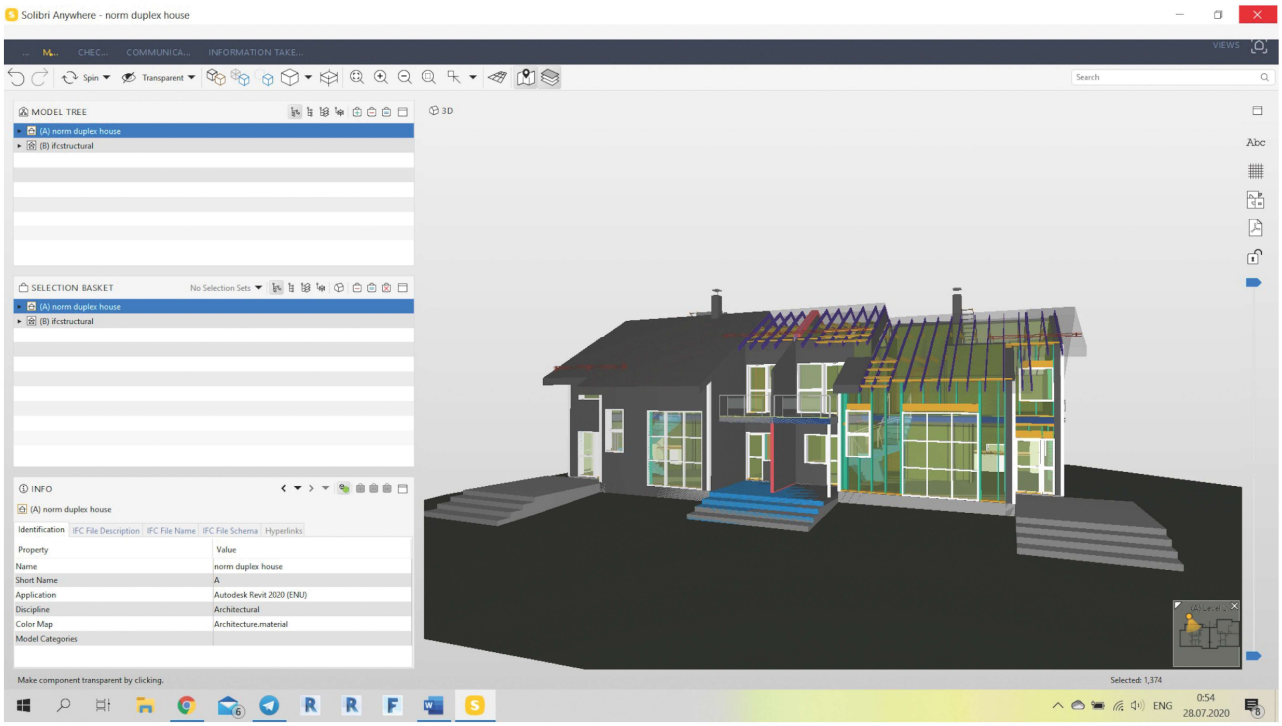
Outside the construction site there are stakeholders like owners who need to see how the models and the project evolves. Solibri is used to validate the design corresponds with the intent of the design providing a representation of what is to be built.

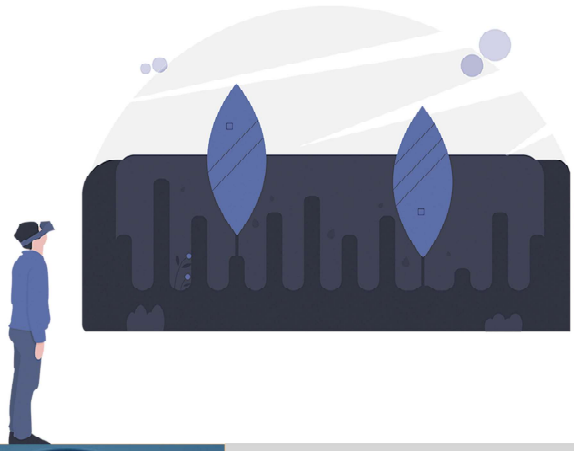
Even after the construction building life-cycle management requires information for further maintenance. And it is already available from once-defined information takeoffs and classifications. With Solibri Anywhere this information is always up-to-date and at the fingertips of the right people, right when they need it.

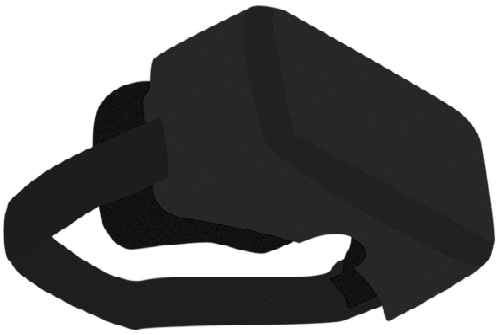
Sum-ups

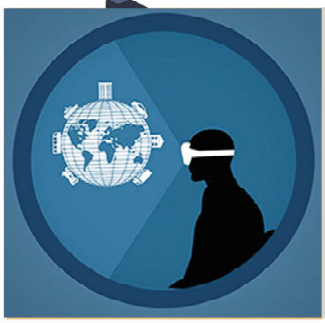
According to Jonathan Widney, president of Solibri US office, in an ideal world the model would be designed to behave in a certain way. If that model represents a building, then information would be included in the model to address not only its components and structure, but also factors such as its environmental impact and its total cost of ownership. This, he said, is where Solibri Model Checker is venturing into the future of BIM.

Finally, after the research that was made during the work in Summer School the conclusion can be made that Solibri is a truly valuable tool for modern construction industry and project development. And later students will be able to apply obtained knowledge and skills in their workplaces.









Virtual Reality

Nikita Ishchenko

Virtual Reality in construction

There are many pro problems in construction associated with the fact that stakeholders and customers don't understand how the finished building will actually be look like. And VR can help in this issue.

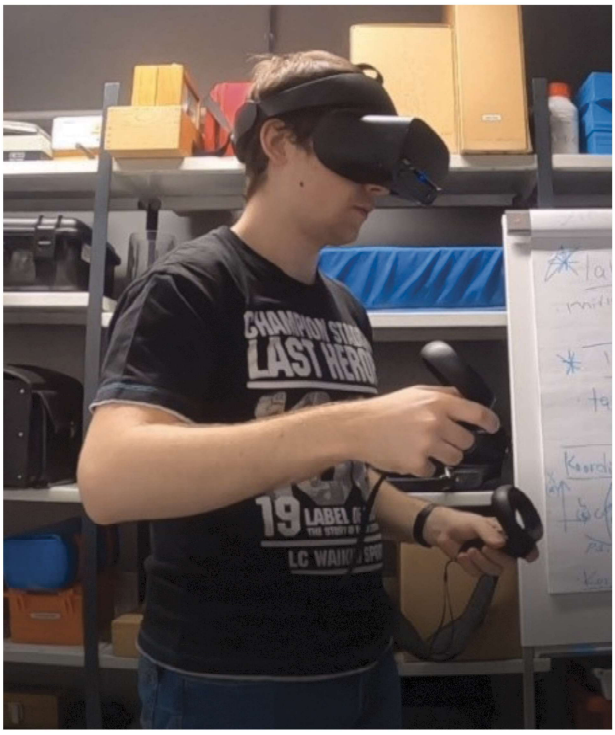
What is Virtual Reality?

Virtual reality (VR) is a technology which allows a user to interact with a computer-simulated environment, be it a real or imagined one. Most current virtual reality environments are primarily visual experiences, displayed either on a computer screen or through special stereoscopic displays, but some simulations include additional sensory information, such as sound through speakers or headphones.Some advanced, haptic systems now include tactile information, generally known as force feedback, in medical and gaming applicationsand also in construction field.The equipmentfor Virtual Reality consist of computer, VR glasses, controllers and sometimes special sensors.

In recent times VR became popular in construction field. Now, BIM models and VR technologies can merge into a more interactive, immersive, and detailed virtual representation of aconstruction project. You can literally walk into a building that is yet to be erected.

What does using VR mean for the construction company?

1. Cost-efficiency. Any party that is involved in the building process can spot potential problems (or identify any changes that have to be made) at the initial design phase. Any alteration needs that are detected during the construction phase usually prove to be quite pricey and time-consuming when done at the site.



Nikita Maslov in VR bundle

2. No more “it does not look like I imagined” phrases.A client can easily access their object using a VR headset and explore every nook and cranny to see whether everything matches their expectations and provide feedback. For example, they can check if there’s enough room for all the things they want to place inside and make the necessary adjustments in virtual reality. With that, any miscommunication simply becomes impossible.

LAB Summer School experience

During thesummer school course Me and Nikita Maslov did a video about compatibility VR and 3D model.Ourlaboratory is equipped with all required staffincluded Oculus Rift and Oculus Rift Sglasses.We used a model made in Revit and rendered in Twin Motion. We uploaded model to Twin Motion and view it with VR.VR technology is a new wave in construction,but it needs to be developed and it will bring a lot of benefits to all members of construction projects.

true interview

TIMO LEHTOVIITA

Senior lecturer, Member of BIM-ICE project group and LAB Civil Engineering Summer School project group.

How did you start summer school?

The university has had this kind of activities for years. At first it was computer science department. Some students had lack of training places especially in computer science field in summer and also because of situation in 2008 civil engineering field had the same problem. The Summer school was not active every year when students didn't have problems with training places. In recent years we have had different kinds of tasks that have mostly been modelling-related, and clients for these tasks.

What are the main benefits for students from Summer School?

Students have plenty of new knowledge about modelling. You can even call it BIM Summer School, because building information modelling is the main topic. I know a lot of students from our previous Summer Schools who now work as BIM specialists at companies.

What are the main benefits for the University from Summer School?

Students have developed a lot of learning materials for the University. Also students have worked in some University development projects, and it was useful.

When did you start working with BIM and what is your background in Engineering?

About 30 years ago before teacher's work I also worked in Engineering office. In 1993 I recognized the idea of 3D Models. In the beginning of 2000's we recognized the idea of Open BIM with IFC models as the main tool for that. That time I was also participating different courses and activities and I wanted to know more about BIM. I realized that it is a huge step; We took it into account in teaching process since then and began BIM-related projects. LAB University of Applied Sciences is a part of buildingSMART Finland organization. I realized that if we don't have BIM we don't have digitalization in construction field.

What will be with BIM in 5 years?

My opinion is that we need to think about not only how to make models, but also how to use them. Design is the same as modelling. But we need models not only for drawings, that is old fashioned. We need more and more use cases. For example, if we talk about fire safety, how can we use models to ensure that the fire safety is good? Model is much more valuable if it has correct information inside.

I know that you are developing an international BIM-ICE project. What is the main idea of it?

The idea of BIM-ICE is that after and during the project both Universities, LAB University of Applied Sciences and Saint Petersburg GASU, are much better in BIM education. And all the companies that will

Jarno Rautiainen, Timo Lehtoviita. Pulsa Railway Station, July, 2020.

participate also will have a lot of benefits. The main thing is to develop BIM field in our neighbor countries. It is good that we have cooperation with Russian engineers, who are very clever people, and also they will learn something from us. We have been working only for two months on this project, but the full project is going to last two and a half years.

What do you like most about teaching and working with students?

It is very interesting to work with young people. And I am happy to see when students have a good development. It is interesting to follow the full process. First they start studying and in four years they become engineers.

I know that you are a good sportsman. What are your favourite sports and why?

It is easy to answer. Cross country skiing in winter and golf in summer. With skiing you keep yourself in a good shape. Of course I can skate and play other different sports, but these two I like most. And golf is an exceptional sport, because you don't understand it if you don't play it.

As I know people play golf not for golf, but for new contacts.

Yes, it is a very social game and I don't usually play alone. You need to try that.

Blitz:

Online or live meeting ?

Live. But online also works.

Autodesk or Nemetschek?

I like philosophy of Open BIM at Nemetschek. But Autodesk is also good.

Wood or reinforced concrete?

Both are needed. But I like wood more

City center or countryside?

Countryside.

Car or bicycle?

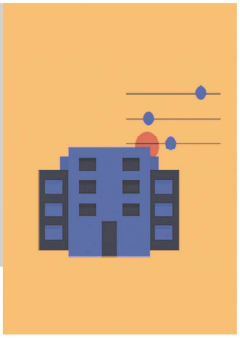
Both are nice, but in Finland you need a car.

What would you like to change in Summer School?

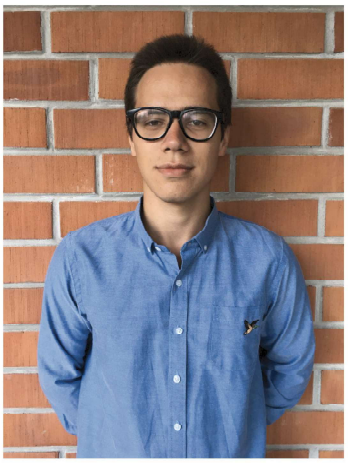
One problem is that teachers are on holidays. It would be better if they have been more involved in the process. But at the same time it is a good case, because students need to make their own decisions, especially foreman must be very active like yourself.

It would be also good if students can get money for their work. I hope that in future we will have connection with different projects and everyone will have normal salary.

Parametric Modeling



Leonid Vasiliev



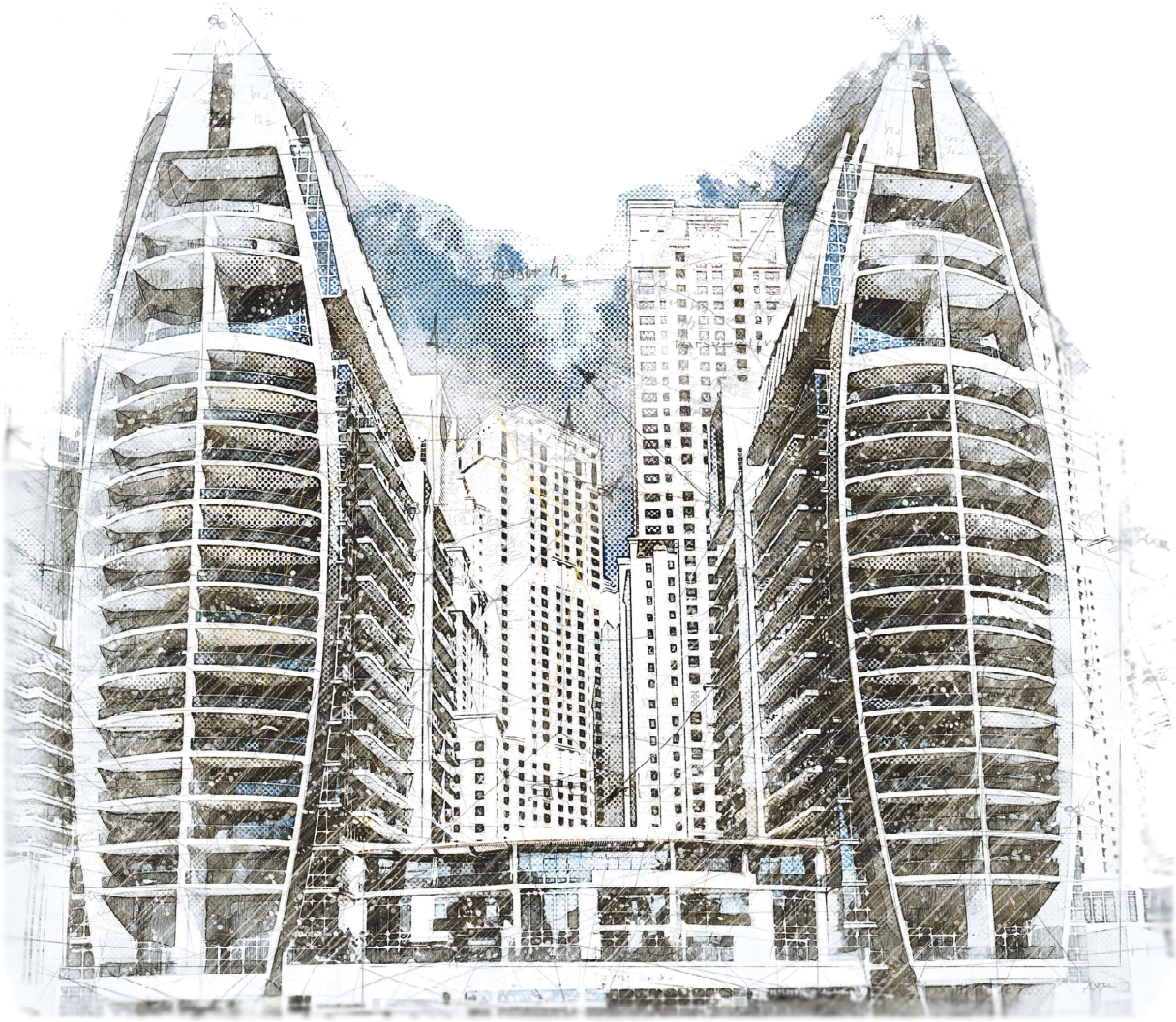
What is parametric modeling?

Parametric modeling is modeling using the parameters of the model elements and the relationships between these parameters. Parameterization allows for a short time to "play" (by changing parameters or geometric relationships) with various design schemes and avoid fundamental errors.

Parametric modeling or Direct modeling?

Designers have been arguing long about what is better: direct or parametric modeling? Some like the freedom and flexibility of direct modeling, while others like feature definition and dimensional control using parametric systems.

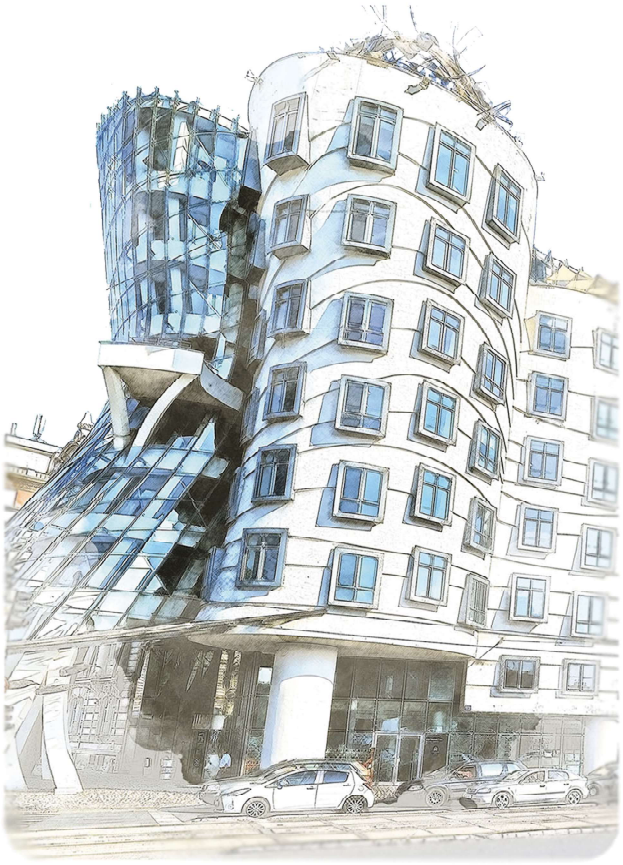
Direct modeling allows you to quickly



define geometry without wasting time on features, constraints, and initial design intent. With parametric modeling, you can track design intent with features and constraints, allowing users to automatically make recurring changes, for example, to product families of parts.

Building parametric modeling

In my opinion, parametric modeling of a building is the most important and necessary tool in creating beautiful and non-standard architecture. The use of standard direct modeling methods does not allow achieving the flexibility and versatility that parameterization gives.



But Parametric modeling are used not only in some non-standard geometric project, but also it is allowed to optimize a process of modeling by creating full parametric families, parts of a model and even full models of building.

How to make a parametric building model

In my own experience of work with parametric modeling, I can say that almost all famous BIM programs as Tekla and Revit somehow make parametric models, but they don't allow to make your parameters and you can use only prepared, also it doesn't allow you to make full parametric model. But fortunately, it has some extra tools as Dynamo for Revit and Grasshopper extend for RhinoCeros that are usually used for structure modeling in Tekla. To be short these are special expansions for visual programming where you can code using Python and make your functions for a model without any knowledge at coding. These programs are more complex and require knowledge of mathematical functions and logical connections. But it opens almost limitless scope for modeling possibilities.

Summer school experience

Summer school gave all students a lot of different work experience. An opportunity to work on projects in various fields from modeling to creating educational videos. As a person interested in parametric modeling, I managed to program scripts in Dynamo, make a training presentation for other students about this topic and create parametric sketches of furniture in Formit Autodesk.

So do we need it?

Modern architecture does not stand still and every day is becoming more daring and individual and production is only increasing. In my opinion mowadays there is almost nowhere to go without BIM modeling, soon it will be usual to create a mathematical parametric model of a building.

Main software:
Dynamo for Revit Autodesk
Grasshopper extend for RhinoCeros

The Heydar Aliyev Center is a 57,500 m2 (619,000 sq ft) building complex in Baku, Azerbaijan designed by Iraqi-British architect **Zaha Hadid**

Drone and laser scanner - that's all you need

Laser technology *was born more than 60 years ago, but who could expect the wideness of its usage? Nowadays, in civil engineering sphere lasers are part of laser scanning process. Laser scanning provides better measurements and accuracy in modelling compare to traditional ways. Laser scanners are mostly used for making a model of an existing structure or building for renovation and city design.*

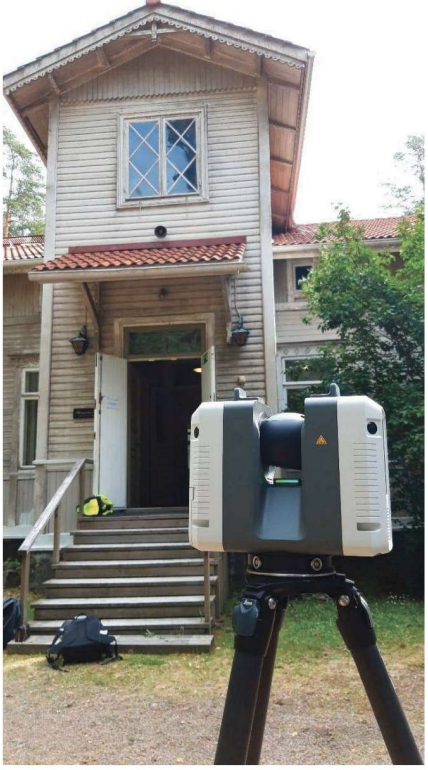
Nikita Maslov

Core idea of this process is special laser rangefinder sending millions of rays per second through the special rotating mirror. With help of rays laser rangefinder can track the distance to any point that is visible. The general system of those points is called **point cloud**. Together these points can form a surfaces and elements of a building, that you need to model. The more points you have – the more accuracy of your point cloud would be.

Postproduction process is also important. If you need to connect multiple point clouds with coordinate system you need special common points to work with. The postproduction may take some time, depending on software you use.

In summer school students made a laser scanning of Skinnarilan Hovi – old wooden mansion. There were a lot of rooms, so scanning process took much effort to plan the common points in every room before starting the scanning.

Actually, over 80% of laser scanning process is preparing and planning the points to keep your fresh-made point cloud in correct coordinate system and connect it with other point clouds.



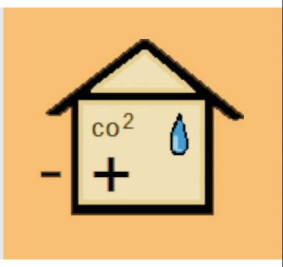
Drone is a modern invention. Small, lightweight and fast flying machine, that can be controlled with a program or an operator on the ground. Drone can make photos of huge areas below the aircraft. Such complication of photos can be transformed into 3d view with the same algorithm as human eyes make people able to see 3d size of objects. This 3d view is also a point cloud, but this one is not so accurate as the point cloud made by stationary scanner.

Combining laser scanning and drone scanning you can achieve an amazing result. In the summer school students took part in drone and laser scanning with city of Lappeenranta.

The drone made dozens of photos of the area from the air. Later on, drone photos were transformed into point cloud using Pix4D program, but there were no information about tunnel, because it was closed for drone sight.

So, summer school students made a scanning of small tunnel under the main road with help of stationary scanner. In this way, two point clouds were combined into one, more accurate cloud. This point cloud will help to update information of city model and improve city planning solutions in future.

IOT
IN CONSTRUCTION



OVERVIEW FOR SUMMER SCHOOL

Aleksandar Mladenov

This overview contains the general information about IOT in the construction industry from a study that was carried out as a part of the LAB university Summer School on a request from the university laboratory to provide insight for future possibilities of acquiring IOT systems for use in terms of building physics. The study included gathering information about the IOT market, providers of such services, and cases of implementations in Finland and other countries.

What is IOT?

IOT stands for "Internet Of Things", which describes a concept of gadget-to-gadget communication without the human intervention. It is a system of electronic computing devices able to transfer data over a network without requiring human-human or human-computer interaction. IOT opens virtually endless possibilities for automated data analysis, monitoring and management and it is rapidly making its way into the construction industry as well as other parts of our lives.

Basically any smart device you can imagine uses IOT technology in some way or another, the most obvious example would be your smartphone, automatically checking the weather on web resources, connecting to your Bluetooth headphones, communicating with hundreds of app's servers – it's all usually done without you even knowing and it is the IOT.

Of what use is IOT in civil engineering?

IOT can be benefitial in both existing buildings, for instance by acquiring and processing data for achieving peak energy efficiency, and also on the construction sites, for example by allowing for a decrease in number of paper reports by presenting a real-time graphics for more transparency and easier management.

Benefits of using IOT in construction:

- Increased safety;
- Real-time observation;
- Improved construction management;
- Predictive maintenance possibilities;
- Reduction of manual reporting;
- Improved energy efficiency.

Today an ever-increasing number of building sector companies is using IOT technologies to capitalize on its advantages.

IOT implementations today:

- Sensors on machines (fuel economy, brakes, GPS tracking);
- Smart work wear (health monitors on helmets, tracking devices);
- Physical condition sensors (temperature, humidity sensors for concrete in cold weather);
- Remote help systems (tracking performance of equipment and remote help on site);
- Asset tracking platforms (monitors effectiveness of material usage);

Is there a market for IOT in Finland?

Finland already has quite a big market for IOT ready solutions and IOT platforms in construction. Ready solutions provide fully-fledged services, they can be quickly installed wherever needed and start functioning from the get-go. On the other hand IOT platforms provide tailor-made systems, where the final product is customly assembled and is bound only by the customer's imagination.

What is the future of IOT in civil engineering?

The demand for IOT in construction and building maintenance is only going to grow, so it is safe to say that this technology will be the staple of civil engineering in the near future. More than 2000 universities in Finland are supplied with IOT maintenance support and more and more companies turn to smart systems to control the construction workflow on their sites.

PROJECT WORK TEAM WORK

Richard Kurilov

Summer School **project work** is a cooperative work of civil engineering students on the assignment to become familiar with different modern engineering collaboration methods and deliver the project. One of the project assignments was designing of an industrial building information model. This project is a part of **BIM – ICE** project. BIM-ICE project is a cooperative work of the LAB University of Applied Sciences and Saint Petersburg State University of Architecture and Civil Engineering on Open BIM development in the North-East region. As a part of BIM-ICE project the industrial project work team consisted from the students of two universities and different specializations.

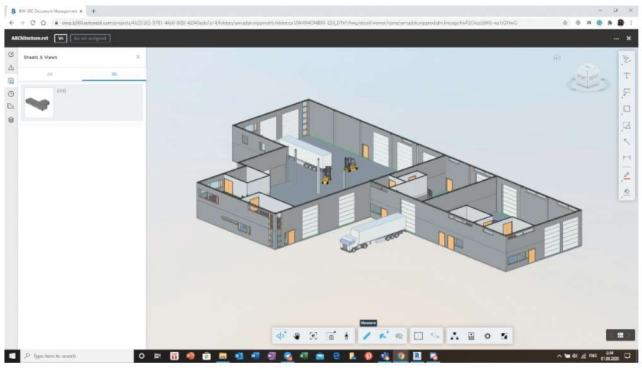
Working on a **real project** everyone notices how different specialists of different categories work together on the same project in the conditions where the work of one engineer fully depends on the work of engineer with another specialization.

Students of LAB summer school went through the same feeling where you are not only the person who can do and cover everyone`s job, so you have to delegate the parts of the job that you cannot implement to other specialists and share the updated project files, markups and the newest results of your work with them to let everyone be updated with the new changes. All these difficulties occur in the collaborative work of an architect, structural engineer, MEP engineer and HVAC engineer; all students of summer school had a one of these roles and were working sticking to it. The decision how to minimize collaboration issues that can potentially slow down the project deliverance like: requests for information, timely file sharing and updating, was BIM Coordination.

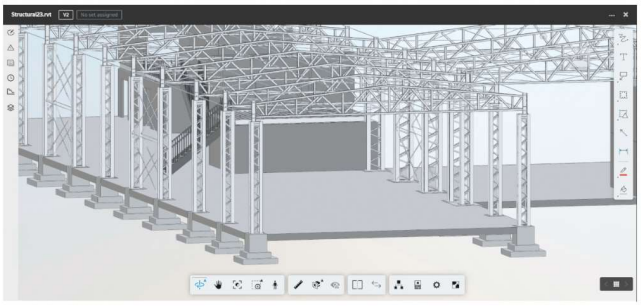
Since the BIM-ICE project goal is to underpin the future development of Open BIM in Finland and Russia, the same Open BIM standards were used in project work. That was one of the main project deliverance condition. To fulfil this demand interns created an execution plan and picked roles that they will implement across the project. One of the roles that provide coordination among the engineers and following up the project execution is BIM Coordinator. This role is one of the most important roles in today's civil engineering field. This role was also implemented in LAB summer school project work. I was responsible for the collaboration methods, platform as well as the results.

AUTODESK®
BIM 360® DESIGN

The BIM Coordination platform (Common BIM Environment) Autodesk BIM 360 is a cloud-based worksharing tool that allows you easily and successfully follow up the project execution, detect changes, send RFAs, adding markups and marking different issues. Since Autodesk softwares are fully integrated to each other the Autodesk Revit was chosen as a main designing tool.



The core of collaboration between engineers is a minimum of useless information. BIM 360 platform allows you to divide project files and duties among the engineers. In this case the HVAC engineer have an access only for the files he needed to calculate and model HVAC system and nothing more. This is possible due to BIM 360 folder system. Every team of engineers has the access only to their special folders without an opportunity to watch files of other teams and disciplines. In case when one team needs files of the other – BIM 360 automatically creates the folder called "Shared"

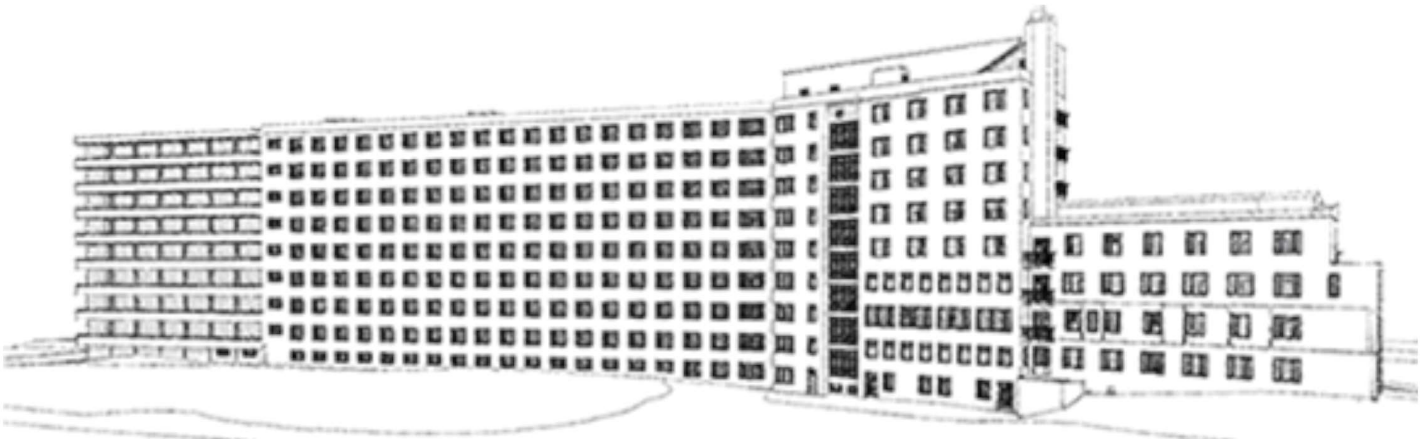


All these technologies are created to help the engineers to understand each other as we could experience by ourselves during the project work. We had 4 teams and 4 models: Architectural, Structural, HVAC and MEP. As a guideline here COBIM Requirements was used. In process of the creation we had several model checkings, and clash detections that helped us to make the model right and find a suitable place for every structure and system.

As a result we get a combined model in Solibri Model Checker that contains the models of different disciplines.

The goal was to learn how to implement Common BIM Requirements in software, test one of the collaboration platforms and get the result - combined model. We have achieved the certain level of usage and collaboration skills and I am sure that this kind of experience will be more than demanded for our future engineers.

DDCIV20 group, LAB and GASU teachers, February, 2020.



Thanks to

Summer School 2020 workers: Aleksandar Mladenov, Artur Tugushev, Andrei Tkachenko, Daniil Melnikov, Daria Kravtcova, Irina Federiakina, Kseniia Kuznetsova, Leonid Vasiliev, Nikita Maslov, Nikita Ischenko, Richard Kurilov

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