

BIM

BIM Civil Engineering Summer School



BIM-Integration in Higher
and Continuing Education



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BIM Civil Engineering Summer School

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Our Staff

Editor In Chief
Lumiere Mwila

Creative Director
Timo Lehtoviita

Authors & Designers
Anastasiia Kumzina
Daria Danilova
Lumiere Mwila
Mariia Koshiaiskaia
Sergei Novishkov

Contributors
Anti Roiha
Borislav Hristov
Ivan Garusov
Jarno Rautiainen
Jouni Könönen

Mauri Huttunen
Mikko Mustonen
Pavel Aksenov
Tuomas Keränen

Photography
Sergei Novishkov

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BIM Civil Engineering Summer School

Lumiere Mwila



This magazine will drive through the BIM Civil Engineering Summer school. Organized in the year 2022 from May 16 to July 31 by **LAB University of Applied Sciences** in collaboration with **BIM-Integration in Higher and Continuing Education**, BIM-ICE development project. BIM-ICE aims to enhance the use of BIM by strengthening BIM competence among future and present professionals.

BIM Civil Engineering Summer School is a substitute working place

for students willing to broaden BIM knowledge. The program gives the opportunity to learn how to use BIM software and get proficiency in it, communicate with companies to get a future job, acquire proficiency in BIM modeling and management, gain a training place with real work experience, and finally, gain credit units.

BIM Civil Engineering Summer School focuses on Building Information Modeling (BIM). Tasks included BIM-modeling training, inventory modeling of private-owned buildings for non-profit organizations, and producing study materials about different BIM software for self-learning purposes.

The Summer School tasks mainly focused on the needs of the partner organizations. The latter enclosed testing implementations of new technologies and working methods: Laser scanning, held in **Imatra**, modeling of actual target buildings, and updating and perfecting education material for various software. The operational language for the Summer School this year was English.

The Summer School 2022 was successful based on the results achieved. Even though the work went mostly online, we had an opportunity to enjoy the process of teamwork and manage our tasks without any limitations. We had a weekly report and check-ups, mostly on Mondays. In these meetings, tasks and results were discussed in detail, and Summer school participants shared results from the given tasks. The activity included four active students from Double Degree Civil and Construction Engineering group.

BIM Civil Engineering Summer School is a great workflow with high student collaboration. In realizing different tasks, summer school students needed to communicate, discuss different questions, and propose solutions. Students could freely share their problems and suggest opinions.

BIM Civil Engineering Summer School is not only about work. It is also about fun, creativity, networking, orientation, and improving time management to work with deadlines. Diving into the results, I hope you will enjoy reading the magazine.

Duplex building

Mariia Koshitskaia



The first task for students in summer school was developing the chosen project into a 3D model using a design software package. The initial data was the computer-aided design (CAD) drawings of floor plans and facades.

The task aimed to allow students to study Revit software independently and more detailedly. One of the projects presented in the article is a duplex building. It was one of the most exciting projects because I have already had some experience with blocks of flats, residential or industrial buildings.

Step 1: Development of a 3D model based on 2D drawings. CAD blueprints were used as the background for the floor plans with the help of the tool Import CAD.

- Wall structure: the main structure of the building is wood, so the walls were made according to Finnish standards as one of the typical wooden wall structures
- Doors and windows were chosen as Revit families from Finnish and other European countries' catalogs
- Panoramic windows were made as glass walls with imposts

Step 2: Visualization

The result was visualized in Twinmotion. For that, the industry foundation classes (IFC) model was exported from Revit. New materials and colors were applied directly in Twinmotion.

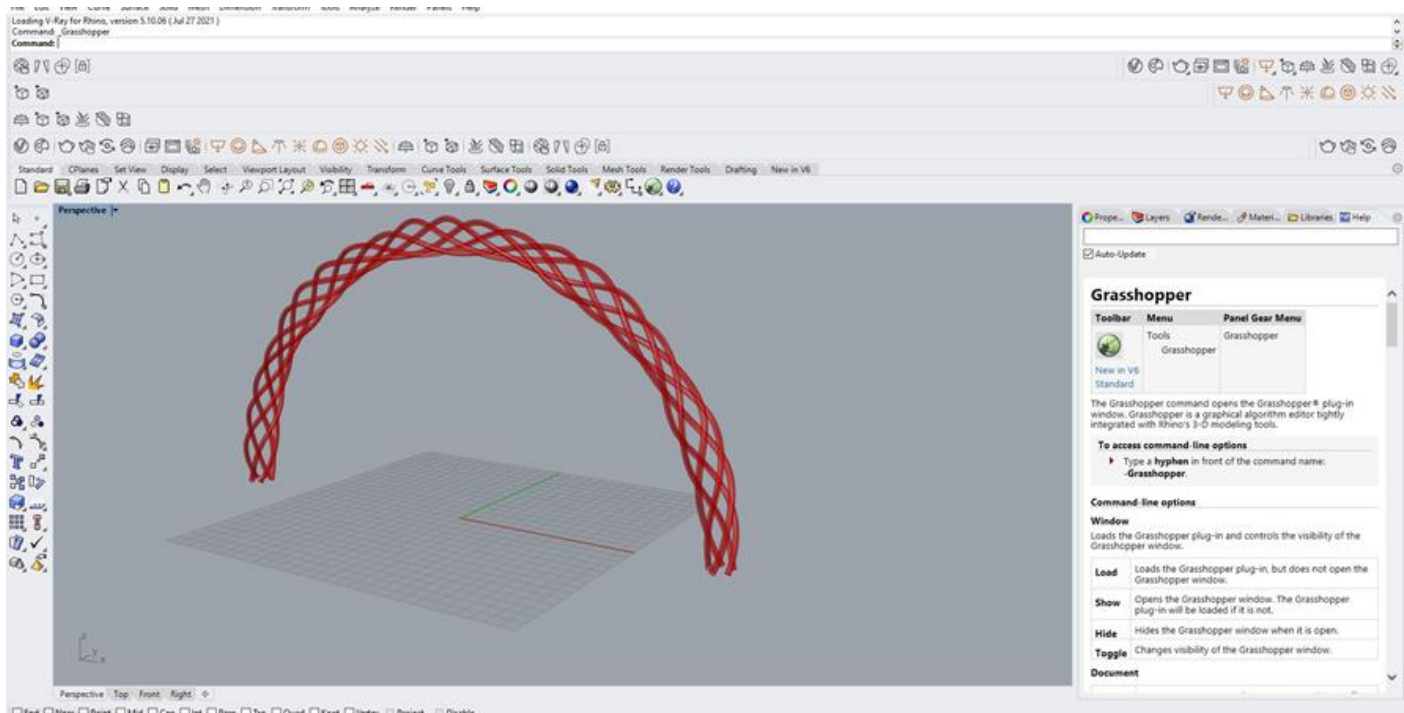
Making a 3D model independently was a great process of self-learning and a significant step in the development of professional skills.



Visualizations in Twinmotion

Parametric modeling course in Grasshopper

Mariia Koshitskaia



Spiral arch in Grasshopper

Parametric modeling is the creation of a digital model based on a series of computer-generated rules or algorithms, known as parameters.

This process is a quantum leap in architecture as it can help resolve visual, perceptive, material, and structural issues.

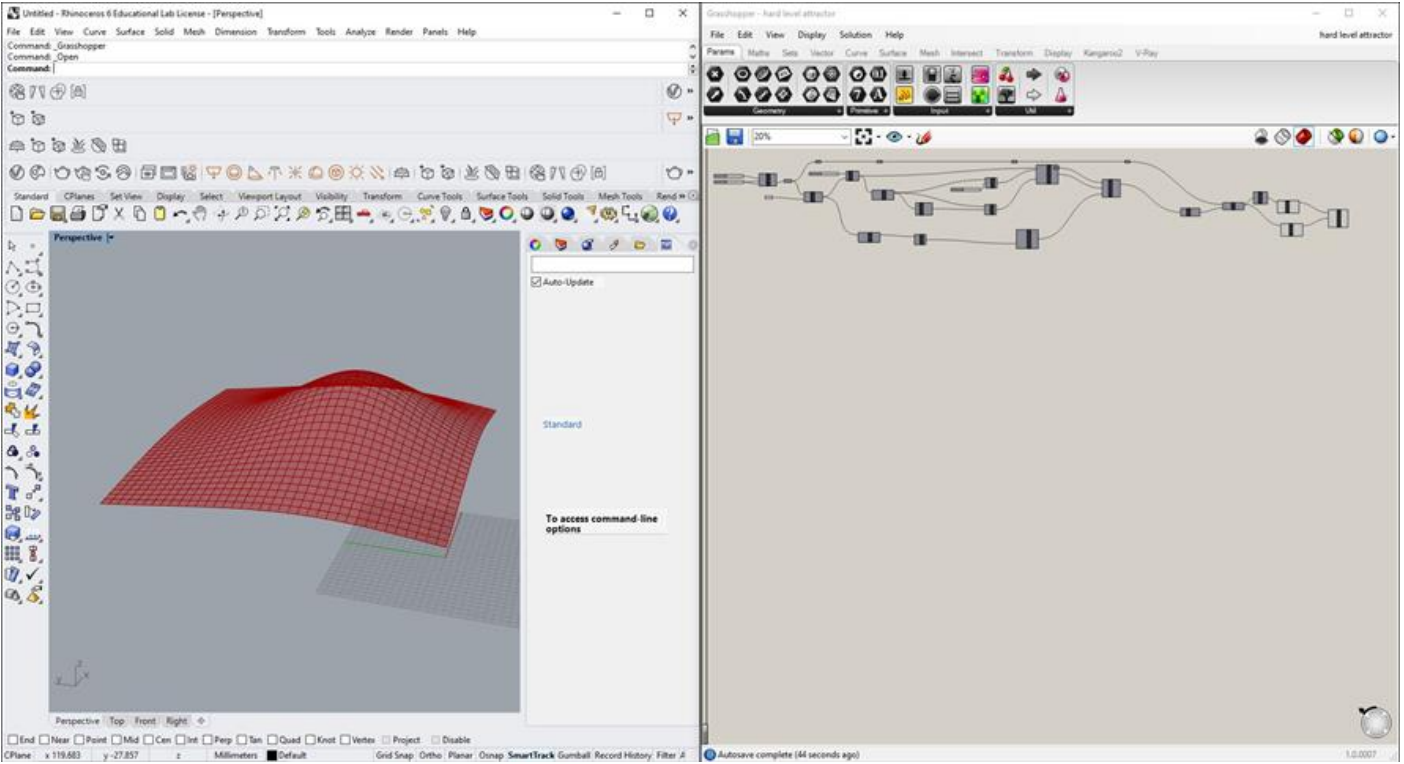
The course was created by Pavel Aksenov and led by Antti Roiha.

This was my first time being introduced to parametric modeling, and I learned the use of such software as Rhino, Tekla, and Revit.

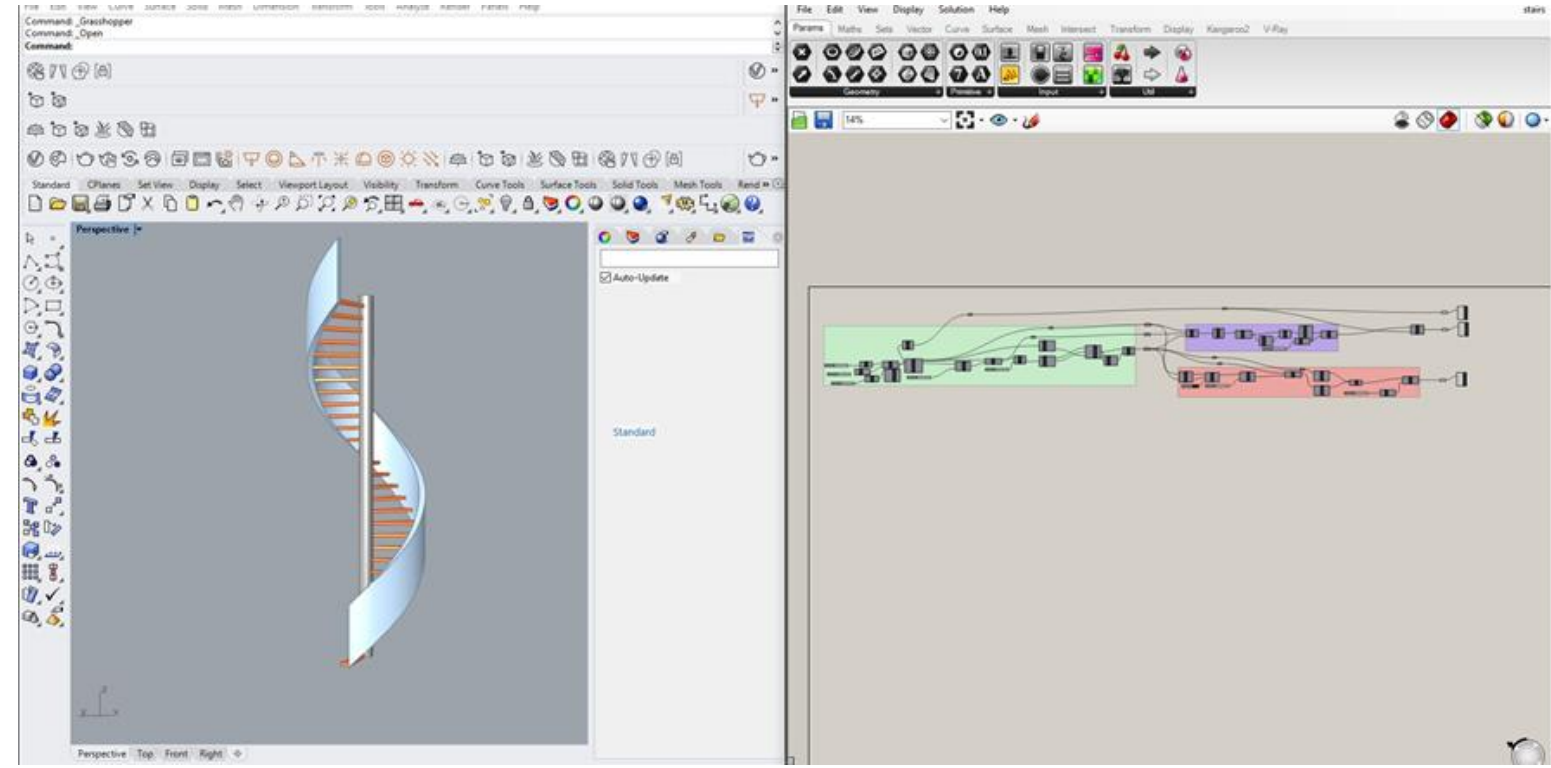
How does it work?

Mentioned software does not allow the creation of complete parametric models, but they have extra plugins such as Dynamo for Revit and Grasshopper for Rhino and Tekla. These plugins contain a special tool called nodes which can help with the creation of an algorithm.

With grasshopper, we created several sophisticated surfaces and structures such as spiral arch and staircases and surfaces with an attractor (Bottom left). The programming was based on basic mathematical and logical rules, so the process was great brainstorming.



Surface in Grasshopper

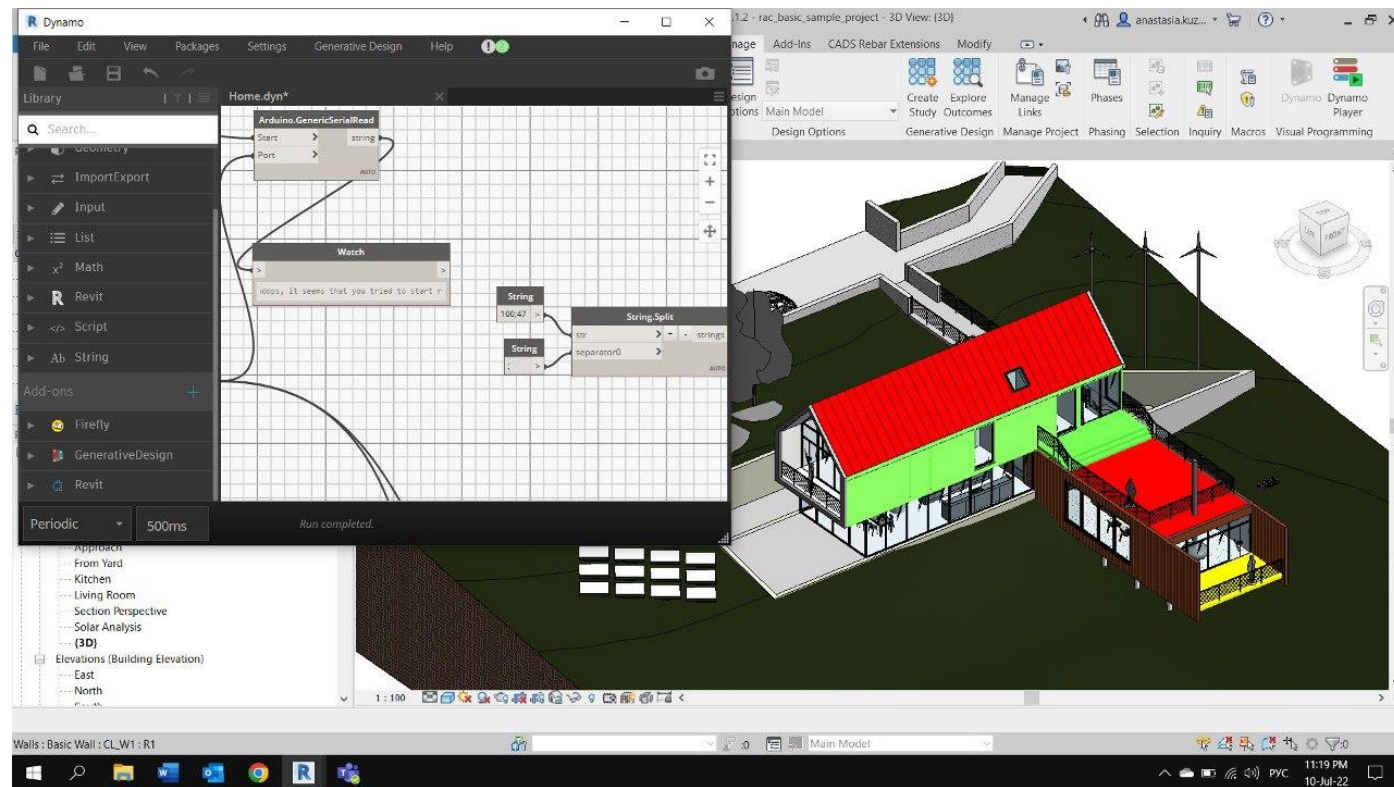


Spiral staircases in Grasshopper

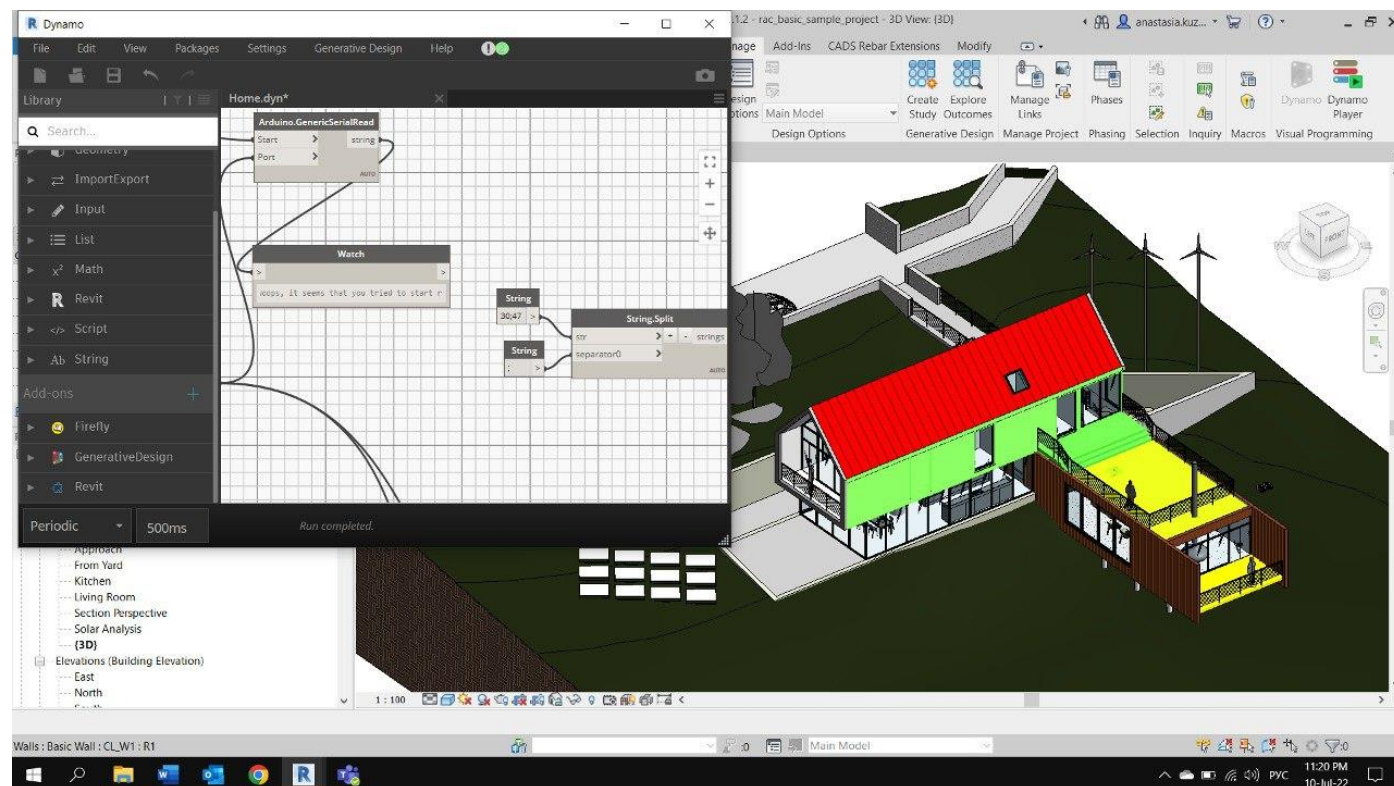
Parametric modeling sensor into Revit

Mariia Koshitskaia

Today's high-performance buildings are outfitted with sophisticated monitoring systems and sensors that collect massive amounts of data about the indoor environmental quality and energy consumption of the buildings. Facility managers and decision-makers typically use text or spreadsheets to visualize, interpret, and use the collected data, making it difficult to understand and track the real-time performance of the building. Building information modeling is the process of creating a virtual replica of a physical building that supports data exchange, management, and communication throughout the building's life cycle.



Color changing tool in Dynamo, Revit



Color changing tool in Dynamo, Revit

However, the BIM model cannot show real-time information related to the performance of the building in the operational stage.

The parametric modeling course which included Sensor into Revit was led by **Ivan Garusov**, one of the summer school participants from the Mechanical department. The course was based on Dynamo script together with the Arduino tool. Sensors into Revit were used for temperature measurement. The pictures at the left show temperature change in real-time in three different colors. The roof of the entrance changes from yellow to red as the temperature increases. The opportunity of implementing sensors in the construction sector was demonstrated to the student, and it deepened their knowledge on the modeling of monitoring systems.

Industrial building

Anastasiia Kuzmina



One of the major tasks was the development of BIM models of different buildings according to common Finnish BIM requirements during BIM summer school. A set of CAD drawings was used as initial data for models.

One of the offered assignments is a 3D model of an Industrial building. This building was chosen as an introduction to modeling in Revit software to recall Revit features and use previous skills.

Stage 1 - Development of Architectural model

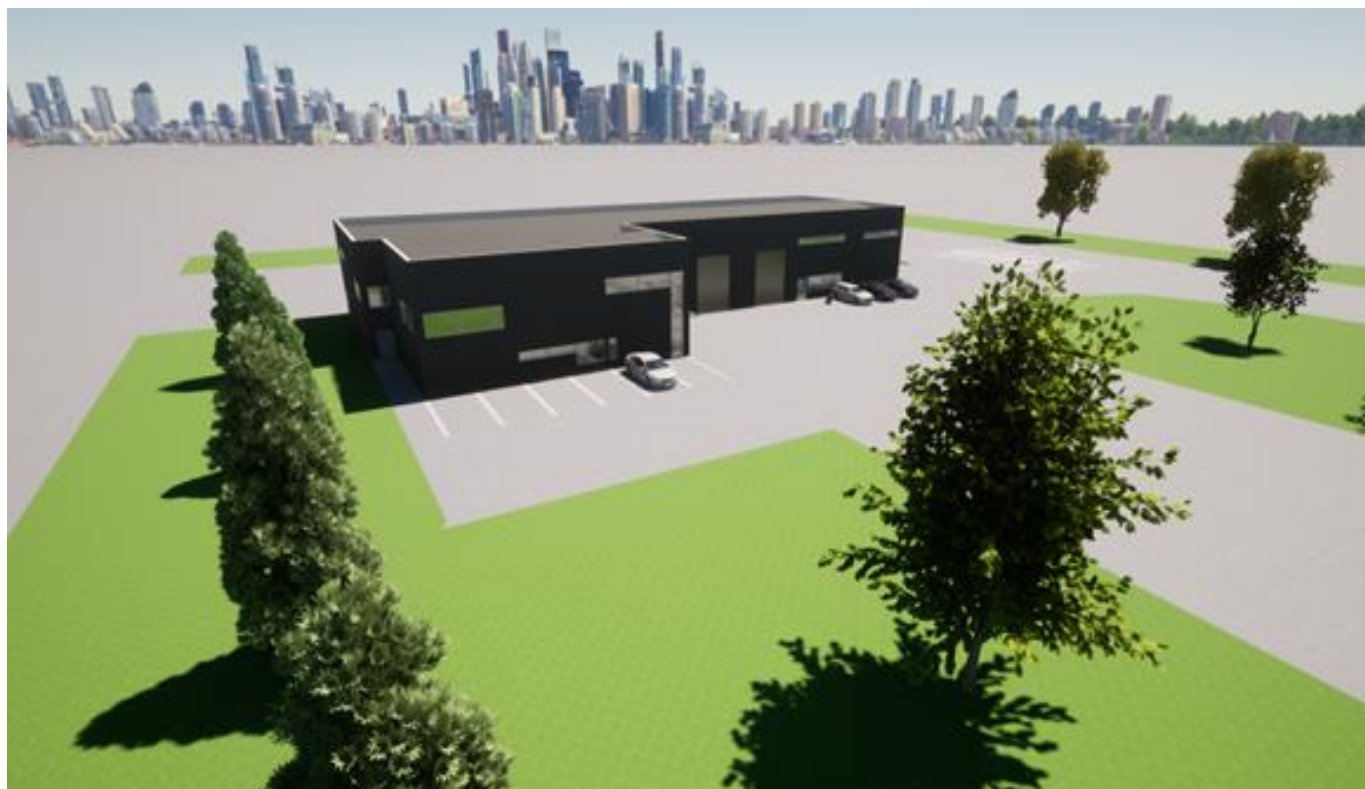
For the development architectural model of the building, Revit software was chosen. The model was performed in accordance with Common BIM Requirements 2012.

The model of the industrial building was not so complicated in shape or elements. Basic Revit families possess almost all the elements of the building.

The exception was garage gates. Revit does not possess gates of these sizes. To handle this obstacle, it was needed to find an RTE format which is the file extension given to files created in Revit gate to be imported to the project.

Stage 2 - Visualization

The Twinmotion software tool was chosen to handle this assignment, It was used to improve the visualization of the Revit model to make results more appealing.



Visualizations in Twinmotion



Revit workflow with Blender, Unity, Twinmotion

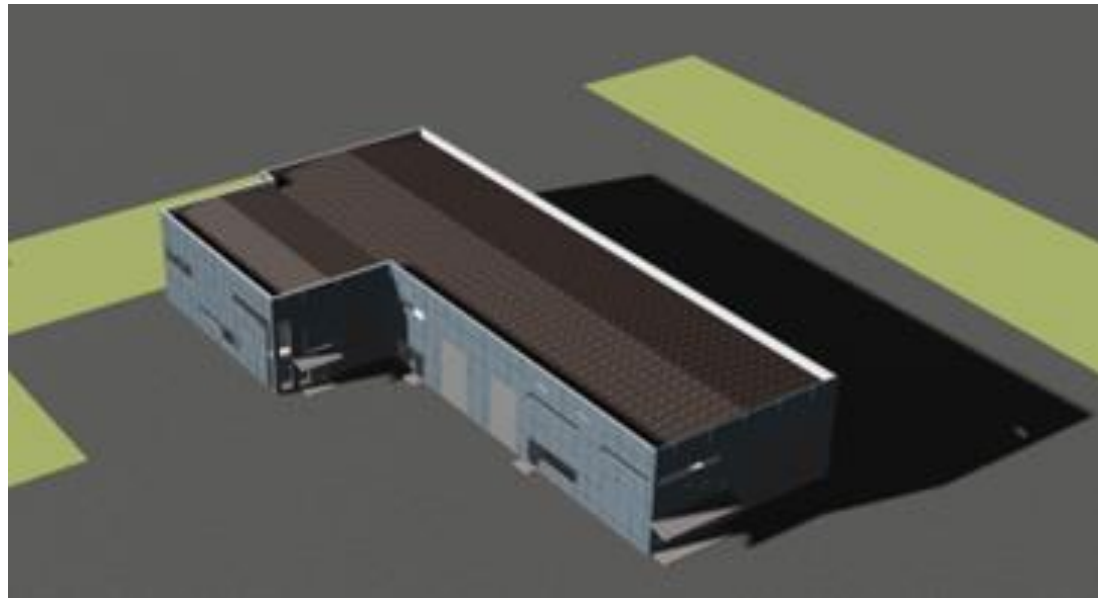
Anastasiia Kuzmina

Another assignment during summer school activity was to work on new software such as Blender and Unity. This task aimed to compare these three visualization tools: Blender, Unity, and Twinmotion.

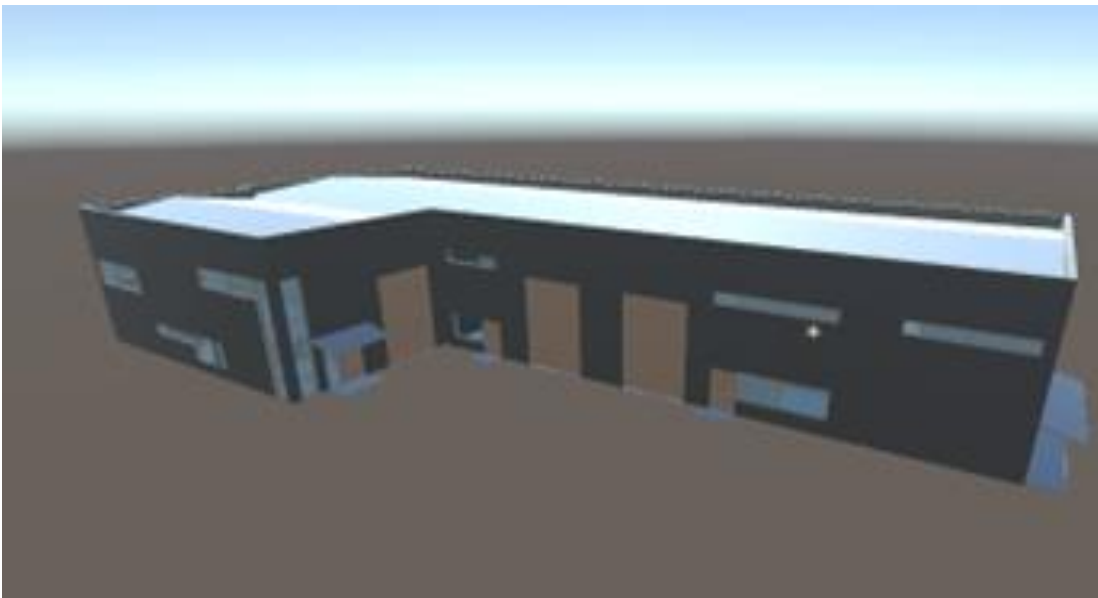
As a result of this practice, it has been concluded that to rapidly view IFC files with no textures, and it is convenient to use dedicated software such as Dalux BIM Viewer. If prompt, high-quality previzualization images are needed, it is more efficient to use FBX format and Twinmotion. In order to render a photorealistic image, FBX, Blender, or Unreal Engine could be used. The Unity game engine can be brought into play to insert a model into a Unity game.



Imported an FBX file to Blender



Rendered picture from Blender



Rendered picture from Unity

Blender

Pros: hundreds of plugins, offers many features, frequent updates

Cons: very steep learning curve, no asset or material libraries, viewport not built for walking around the model, takes lots of effort to get good renders, needs a powerful computer, some plugins don't work.

Unity

Pros: well optimized, versatile (lots of features and customizations)

Cons: very steep learning curve, no asset or material libraries, takes effort to get good renders (setting up lighting), needs a powerful computer, and no support for IFC.

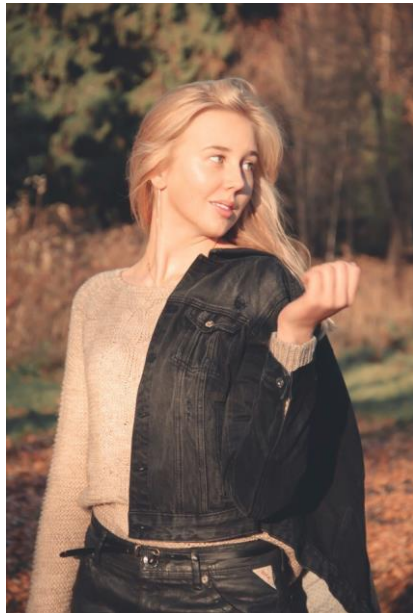
Twinmotion

Pros: intuitive viewport, fast export times, very well optimized, real-time rendering, preinstalled asset, and material libraries

Cons: no support for custom plugins, does not export to 3D formats including IFC.

Row house

Daria Danilova



One of the most interesting tasks was the creation of a BIM model for different types of buildings. In the realization, the following were used: CAD drawings such as floor drawings, sections, and facades.

The main targets of the assignment were the development of a 3D model and the visualization in Twinmotion. I chose to work with the row house, the realization process and results are presented below.

First step.

Initially, the floor plan was imported to Autodesk Revit and created a 3D building model according to Common BIM Requirements 2012.

Second step.

Import the resulting model into the IFC file and choose materials and exteriors in Twinmotion. Respectively, renders were obtained.

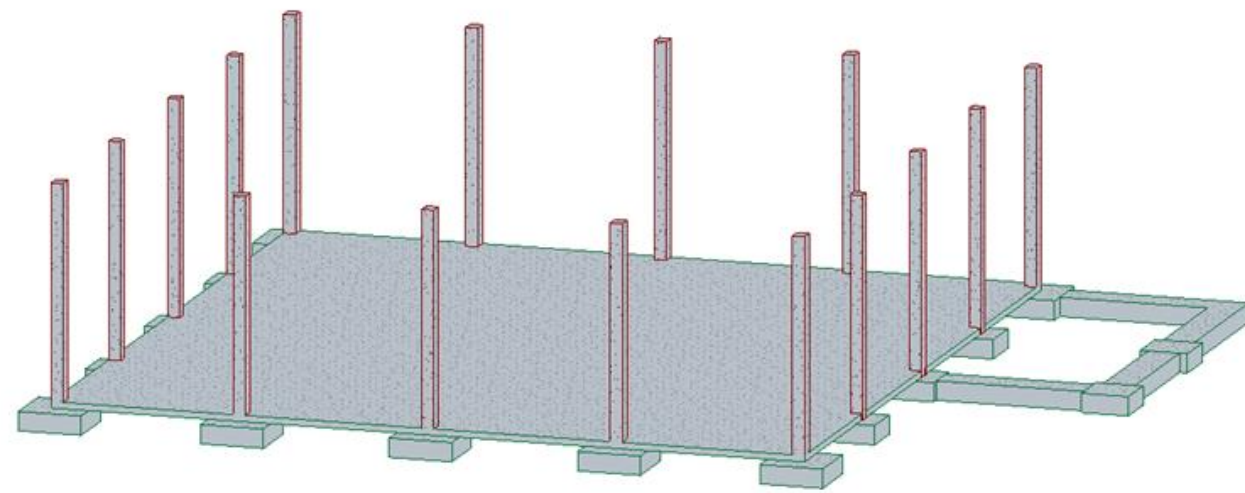
The students carried out a lot of work from the construction of 3d models to ready-made renderers. The given task was very creative, and participants got valuable experience.



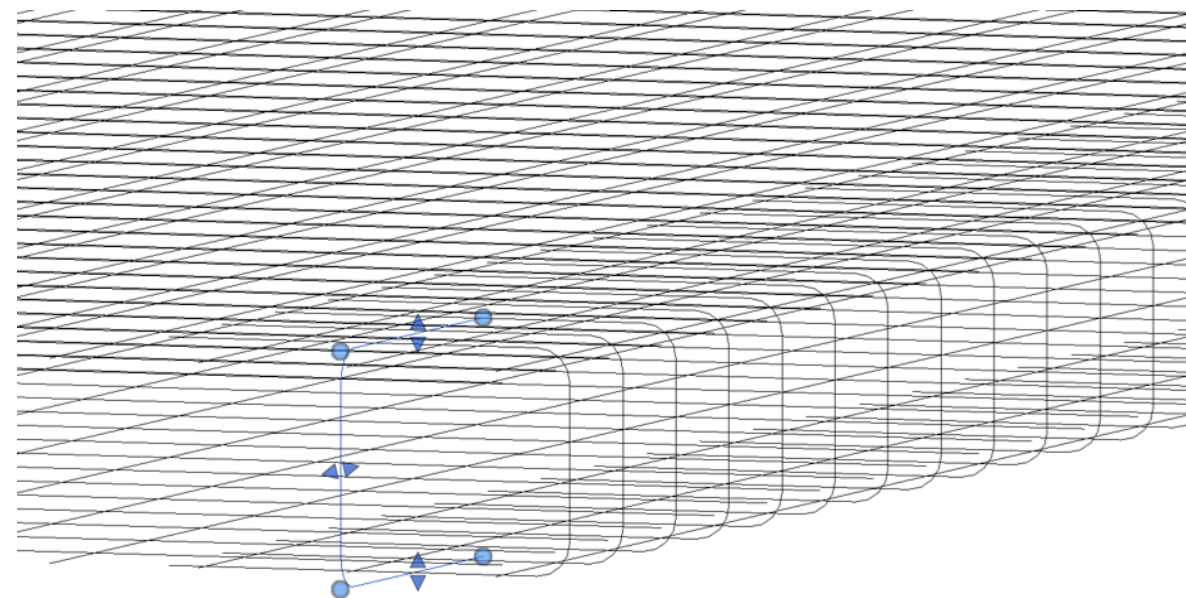
Row house in Revit



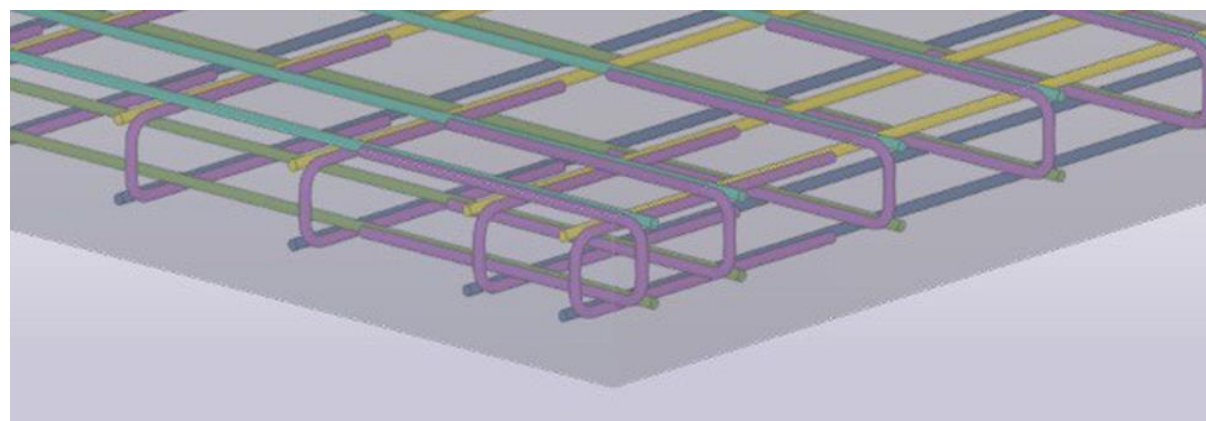
Visualizations in Twinmotion



Structure of the building



Reinforcement in Revit



Reinforcement in Tekla

Reinforcement in Revit & Tekla

Daria Danilova

The main idea of this task was to compare methods of reinforcement by using Tekla Structures and Revit. Primarily, the task of reinforcement in Tekla was completed; analogically, a complete instruction on reinforcement in Revit was made. To complete the reinforcement task in Tekla, students used a guideline made by **Andrey Golishev**, a Double Degree student in the Civil and Construction Engineering field.

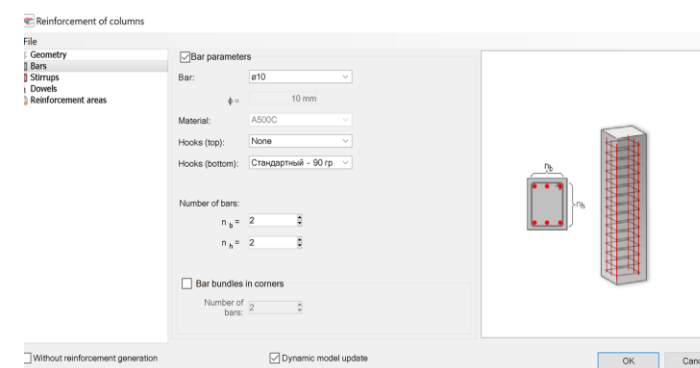
The following materials were used for the task: a reinforcement template in Revit and a plugin. Students were introduced to various reinforcement methods, from the simplest to the most complex. Reinforcement methods were compared in different software. As a result, Tekla is the most convenient reinforcement program considering its automatized processes and great functionality.

Revit

First step: Create a structure model of the building (only columns, slabs, footings, and load-bearing walls).
Second step: Reinforcement of slab with the template. (using area tool)
Third step: Reinforcement of footing. (using an array of reinforcement)
Fourth step: Reinforcement of column using plugin. (considered as an easy way for reinforcement)

Tekla

First step: Floor slab reinforcement
Second step: Reinforcement column
Third step: Reinforcement of footing.
Fourth step: Reinforcement of custom component footing
 Reinforcement in Tekla is an easy way for using rebars without any additional materials (for example, plugins, templates, etc.)



Reinforcement with plugin

Apartment complex

Sergei Novichkov



The task was to show the workflow from 2D CAD drawings to final realistic images.

There are three main stages to the process. Creation of the 3D model from the CAD files, the creation of context around the model, and preparation of the model for VR use or for image/video export.

Twinmotion has great compatibility with Revit using the Data smith plugin, which allows for changes in the model to be translated to twinmotion, which makes it easy for quick project previews.

Stage 1 - Development of Architectural model

The goal of this stage is to create a 3d model out of AutoCAD drawings. That is done by importing the CAD drawing into Revit and drawing over the existing drawing

Stage 2 – Material application, context creation.

The goal of this stage is to make the building look as close to real life as possible. That can be achieved by setting up lighting and adding surrounding buildings, roads, terrain, and vegetation.

Stage 3 – VR preparation/camera setup and export.

The goal of this stage is to set up camera views for image/video export by moving around the world and setting up photo points.

VR preparation consists of cleaning up the model and making sure there are no blockages in pathways. It is important to check that all doors can be opened within the world. Collisions are turned on and it is not possible to walk through walls or other subjects.



Visualizations in Twinmotion



Uses of AR and VR

Sergei Novichkov

Virtual reality (VR)

AR has many more applicable uses in construction in comparison to VR, but VR also has its niche.

VR can be used for personnel training, client previz of the project, and improved quality control.

VR models must be thoroughly prepared for viewing as the highly intensive real-time rendering process. Having unseen elements in the model may cause an unneeded strain on the operating system and cause heavy lag while viewing the model.

Augmented reality (AR)

The AR Model can be used to locate hidden wiring, piping, and other communications.

This technology, in terms of hardware and software, is yet to be improved, as the positioning and the mapping of a model could be much more accurate. The most prominent AR vendors recognize the potential of this tech and keep investing to make improvements.

An auditorium model was created and exported to IFC to be imported into GAMMA AR for viewing.

For more details, a demonstration video is linked via the Qr code.



AR demonstration

3D printing

Lumiere Mwila



3D printing uses computer-aided design to create three-dimensional objects through a layering method. Sometimes referred to as additive manufacturing, 3D printing involves layering materials, like plastics, composites, or bio-materials, to create objects that range in shape, size, rigidity, and color, as shown in the picture below.

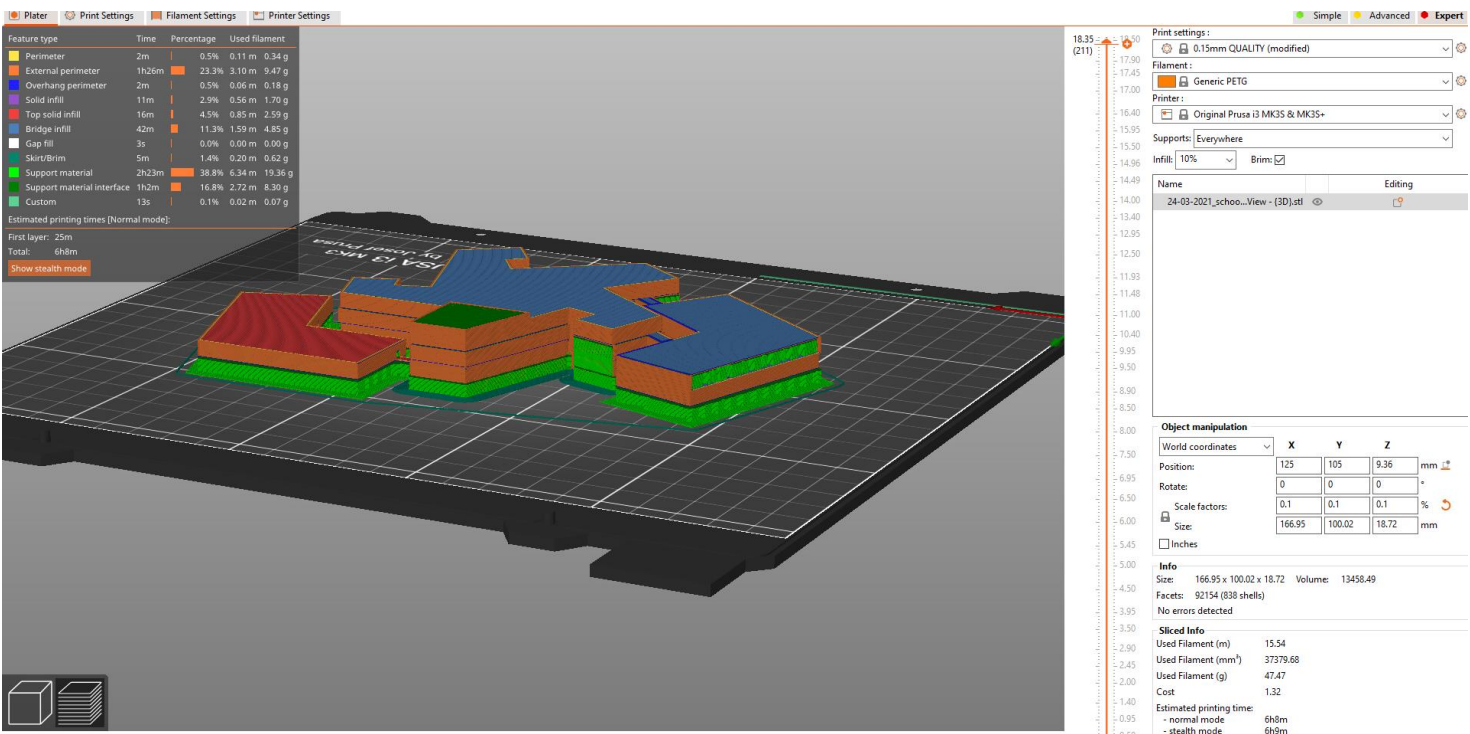
3D printing involves the following actions:

- Create or Find a Design
- Export the STL File
- Choose Your Materials
- Choose Your Parameters
- Create the Gcode
- Print

This year summer school participants produced models in Revit, and from the Revit file, IFC (industry foundation classes) was exported into STL (Standard Triangle Language). Many other software packages support this file format. It is widely used for rapid prototyping and 3D printing computer-aided manufacturing. Participants got their 3D models printed as gifts from the LAB University of Applied Sciences.

How fast can a 3D-printed house be built?

In general, 3D printers can print the foundation and walls of a small house in less than 24 hours for a fraction of the cost of traditional construction. This cutting-edge construction technology can potentially change how many people think about homes. The estimated printing time was 6 hours, as shown in the slice information in the second image. It took 5 hours and 10 minutes to print the above miniature building.





Laser Scanning

Sergei Novichkov

During our trip to Imatra on 7th June 2022, we got a great educational experience thanks to **Mikko Mustonen** and **Tuomas Keränen**, who masterfully showed us the setup and operation of a **Leica laser scanner** and have taken us through a tour of the building, its construction and reconstruction history. We got to visit multiple important rooms and see all ins and outs of how a modern reconstructed school works and got to discuss some aspects of building engineering. I admire Finnish efficiency (in material, heat, space, and human resources used for construction). It was greatly educational to walk around the building and discuss these aspects of construction, as, during these discussions, we learned to recognize parts of these aspects and dive deep into the decision-making behind solutions.



Set up and operation of the Leica laser scanner

Rooms visited

- Main hall (high ceilings, tall thermally efficient windows, got to look at material connections.)
- Classrooms (got to see the room layouts, window sizes, and HVAC placements)
- 2 HVAC rooms
- Old-style roof structure tour
- Stage area (got to see the structure underneath the stage)
- Old **kattilahuone** translated Boiler room, underground and its modern equipment

Takeaways

There are many takeaways, but the main one is the enriched "vocabulary" of situations on site. The solutions found by the engineers throughout previous reconstructions who managed to marry old constructions with the new building areas in an efficient way were valuable to discuss.

BIM-IT Event

Lumiere Mwila



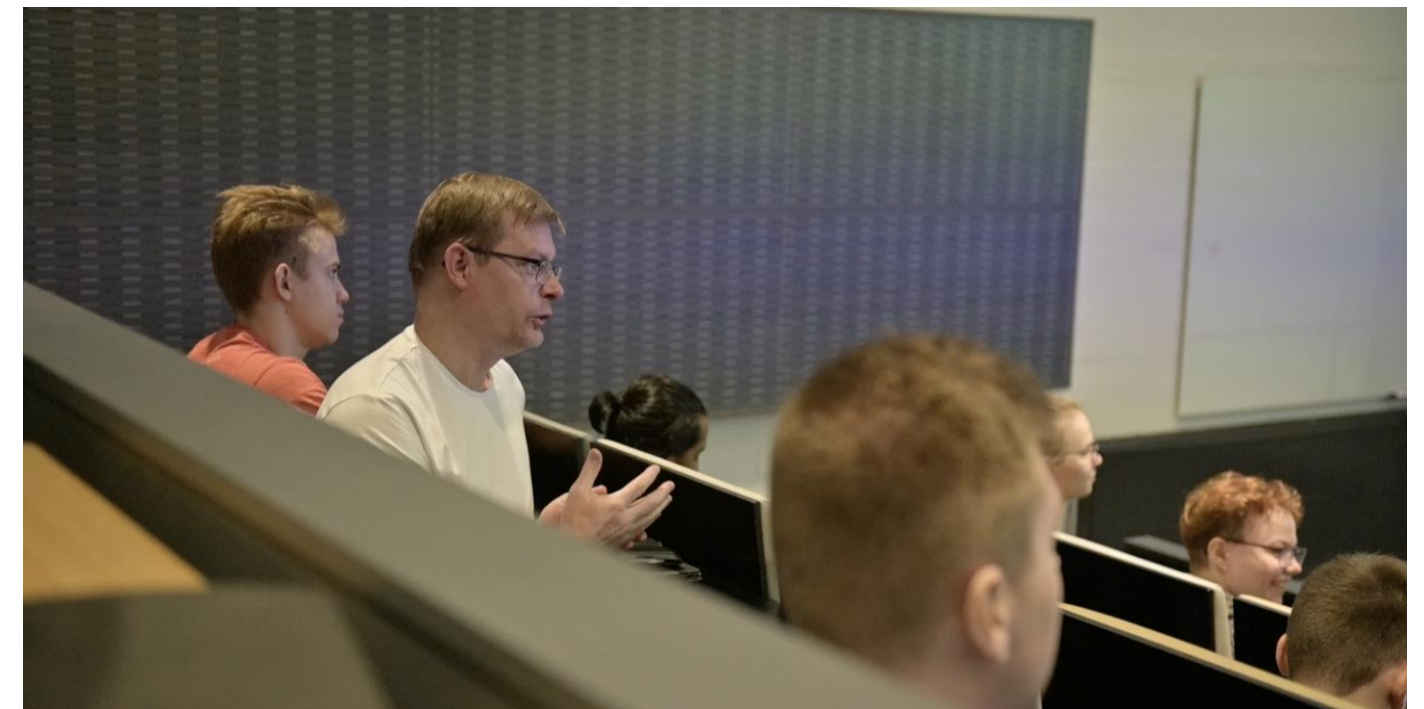
On Friday, 10th of July, in one of the conference rooms, Civil engineers, Mechanical engineers, IT engineers, and staff members joined the event. The following topics were presented: BIM (Open BIM, Workflow), The use of IFC files and how that connects to IoT, the connection between CAD, Revit, Twinmotion, VR and AR demonstration plus explanation, 3D printing, sometimes referred to as Additive manufacturing, and rapid prototyping, Servo-electric grippers, Application for the common BIM terminology which the IT students made.

As a result, the connection between these faculties was remarkable, as shown in the survey and the interview. All participants freshened up, regardless of their differences, based on their domains.

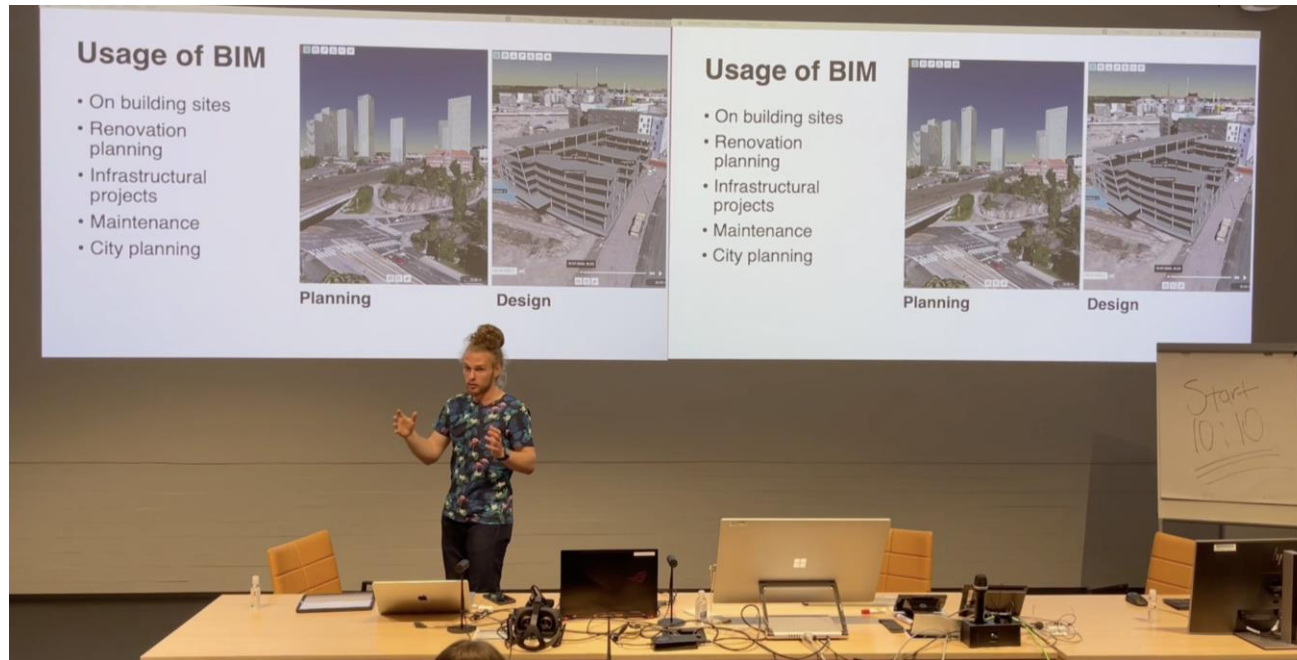
“Are walls getting smarter than us? ”

BIM Civil Engineering Summer School is not designed only for Civil engineers. In collaboration with the IT department of LAB University of Applied Sciences, BIM-IT event was organized. The event was based on how Building Information Modeling is connected to IT (Information Technology) and the Internet Of Things (IoT).

The BIM-IT event was suggested by **Timo Lehtoviita**, the Creator Director of BIM Civil Engineering Summer School. As mentioned earlier, a collaboration between two departments was established. In order to materialize the event, BIM Civil Engineer Summer School forewoman **Lumiere Mwila** worked in collaboration with the IT & Mechanical engineer foreman **Borislav Hristov**.



Civil engineers



“Are walls getting smarter than us?”

BIM Civil Engineering Summer School introduced the following topics to IT and Mechanical engineers: Building information workflow and the use of IFC connected to IoT. As a result, IT and mechanical students are acquainted with BIM and depend on their knowledge.

What role does IoT play in construction?

Internet of Things (IoT) -enabled devices to monitor concrete maturity using temperature probes and then transmit real-time data to the cloud. The sensors must be embedded during the casting process to track concrete curing. The latter enables managers to plan future construction work accurately.

IT, Mechanical engineers

IT, Mechanical engineers introduced Civil engineers to IT and IoT in BIM. Building Information Modeling and the Internet of Things are two popular technologies that have changed or are set to change the architecture and construction industries profoundly.

IoT devices were integrated with BIM tools to achieve real-time data query, risk identification, visualization, and notification over BIM models.





Entertainment

In addition to educational aspects, summer school provided entertainment and fun for the students. On the 09th of Jun, the sauna summer school was organized by Jouni Könönen, and summer school students came together and had fun, as shown in the pictures. The event included a sauna, traditional Finnish activities Called **Mörkky**, and free pizza for students.

Summer school is a networking place where it is possible to meet new friends, exchange, express ideas, and build one's passion.



Interviews

LAB staff members



Timo Lehtoviita creator director

“BIM Summer School is very useful in two ways: Our students will get more BIM- competencies and our university with co-operative enterprises will get new learning materials and development results. This year we got good results because of fruitful cooperation with mechanical and IT engineering students. I am impressed with summer school students’ know-how and activity in the field of BIM ”



Mauri Huttunen project manager

“The level of co-operation between the students in the field of construction and information technology was very good, and this seemingly self-motivated co-operation materialized in a joint seminar. The seminar was professionally organized, and all the presenters were very prepared and professional in their presentations. I am impressed with summer school students’ know-how and enthusiasm.”

Interviews

What is summer school for students?



Anastasia Kuzmina, Civil engineering field

The BIM Summer School is a place where like-minded people and friends gather to acquire new skills and discuss new ideas. We developed in the field of BIM and created models of various buildings, tried to master new software, and learned a lot of new things by attending BIM-related webinars. I think it is great that the University organizes such a program for students who want to delve into the BIM sphere. It was nice to be in this friendly community, to receive tasks and help from them. I am delighted that I took part!



Alexandra Sennikova, Mechanical engineering field

It is a friendly environment where you can explore your ideas and expand your knowledge about your field-related skills. For example, my area is Mechanical engineering. Therefore, I could create components. I think it is very generous of the University to offer a chance to get some components. Creativity, communication, making friends, and extending knowledge is my way of defining the activity.

Interviews

What is summer school for students?



Ivan Garusov, Mechanical engineering

Summer school has allowed the development of skills that are not directly related to mechanical engineering. For instance, Arduino programming and different electrical engineering applications are precious when trying to make practical prototyping. In addition to that, the program allowed getting into prototyping and find ways to do projects and add features.

The starting period helped build confidence and brought the necessary information for practice. At first, I needed more credits, but then I got very interested in the program. Summer school gave me an experience I will probably not get anywhere else. In other words, summer school is a development mania.



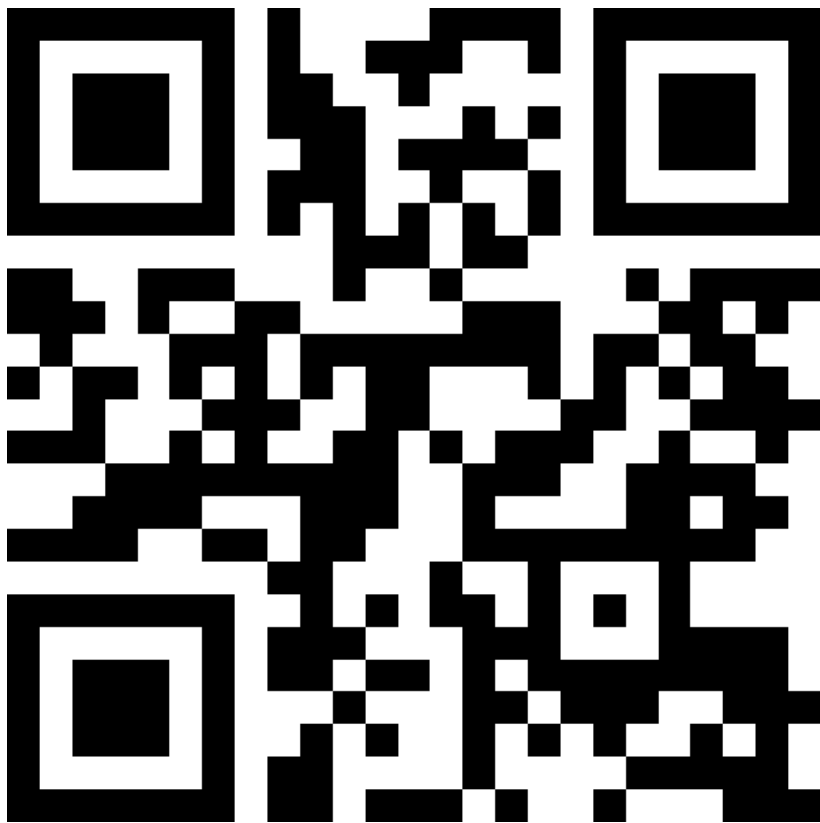
Juuso Miettinen, Mechanical engineering

Summer school is quite a surprising place. I am the only Finnish guy, and it was not my all-time greatest. I know how to speak English very well, but I never got to give in the actual terms of environment development and try to describe things. It has been a good exercise for me, especially as a mechanical engineer for the first year. I expect to use my English skills frequently in the future.

I was also surprised that everyone is also nice and friendly, and I have also met an old friend from behind like 20 years and realized that you get to meet people from around the world and see all the faces, which is fun. I was glad and surprised when told I would build and design a robot from the first day. Also, as I took part in the BIM-IT event and got to try VR, this was my first time. It can be easily missed that we have these tools in the construction industry.



BIM-IT feedback survey



BIM Civil Engineering Summer School video report

BIM-IT feedback survey & video

For more details, I invite you to watch the video, which encloses the BIM Civil Engineering Summer School. In addition, the Qr code and link to the BIM-IT feedback survey are attached.

Looking forward to hearing from you next year!

BIM Civil Engineering Summer School

If you are looking for a training place with real work experience in Building Information Modeling (BIM), then summer school is a great option. The activity gives you the opportunity to work on different tasks and subjects to deepen your knowledge and bring out results such as acquiring proficiency in BIM modeling and management, communicating with companies to get a future job, and finally gaining credit units.



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