

SAIMAA UNIVERSITY OF APPLIED SCIENCES  
Technology  
Double Degree Programme in Civil and Construction Engineering

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**MODELING OF INDUSTRIAL BUILDING ACCORDING  
TO COBIM 2012**

Bachelor's thesis 2016

## **ABSTRACT**

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Modeling of industrial building according to COBIM 2012, 26 pages, 4 appendices

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The purpose of the study was to design architectural, structural and merged models of industrial building according to Finnish common BIM requirements 2012 (COBIM 2012). Many companies around the world have started to implement BIM technology in their projects and a lot of them plan to start implementing BIM. It is extremely important to have a system of rules and restrictions that allows using BIM technology properly, provides better design coordination and reduces possibility of inaccuracies or incompletes in the model. COBIM 2012 project provides such vault of requirements.

The study used the publication series of Common BIM requirements 2012 parts one, three and five, Revit architecture 2015 by Autodesk, Tekla Structures 2016 and Tekla BIMsight by Trimble. The study used two-dimensional architectural drawings of industrial building provided by Lengiprotrans JSC as base for modeling.

Implementing BIM technology along with regulations vault COBIM 2012 allows performing a project of high level of customization and flexibility, easing collaboration and coordination, accelerating drafting and drawing processes, detecting and solving conflicts, optimizing costs and scheduling, easing maintenance of building life cycle. Revit Architecture allows creating and maintaining architectural models of high accuracy and quality, Tekla Structures provides fast and high quality structural modeling. Tekla BIMsight allows creating merged models, detecting and solving conflicts between models and solves the problem of interoperability between different BIM-based applications.

Keywords: BIM, Industrial building, Revit, Tekla, Building Information Modeling

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# 1. INTRODUCTION

The digital age has brought many changes into our lives. Almost every activity nowadays corresponds with the computer. Not surprisingly, it effects every existing industry in the world, and engineering is not an exception. For dozens of years computers helped us design structures, make calculations, scheduling, creating two-dimensional drawings. Then the time for revolutionary technology has become and this technology is BIM (Building Information Modeling).

“With BIM technology, one or more accurate virtual models of a building are constructed digitally. They support design through its phases, allowing better analysis and control than manual processes. When completed, these computer-generated models contain precise geometry and data needed to support the construction, fabrication, and procurement activities through which the building is realized”. This definition in the Handbook of BIM (Eastman, Teiholz, Sacks & Liston 2011) describes the meaning of BIM and its advantages completely. (Tekla Website)

BIM spreads its influence to the globe quickly and there are dozens of projects realized using BIM around the world. That is why it is extremely important for an engineer to explore new things in BIM, to stay up to date with the technology and to learn different software provided by different companies.

As every technology or tool, BIM needs a list of rules, requirements and restrictions that helps to use it properly and easily for all project parties. It is important for everyone in the project team to observe requirements for design and modeling. Publication series Common BIM requirements 2012 provides these rules and restrictions and makes the modeling process easier for all parties, well-coordinated and more flexible for possible changes.

This thesis is about creating architectural, structural and merged models using different types of software and in accordance with COBIM 2012. The goal of the study is gaining and performing skills of architectural and structural modeling, discovering benefits of applying COBIM 2012 regulations on the modeling process, studying questions of interoperability between different design applications and gaining skills of creating and analyzing a merged model.

## **2. COMMON BIM REQUIREMENTS 2012**

The publication series Common BIM Requirements 2012 is the result of a broad-based development project entitled COBIM. The need for these requirements arises from the rapidly growing use of building information modeling in the construction industry. During all phases of a construction project, the involved parties have an increasing need to define more precisely what is modeled and how the modeling is done. Finnish BIM Requirements 2012 is based on the previous instructions of the owner organizations and the user experiences derived from them, along with the thorough experience the writers of the instructions possess with model-based operations. (COBIM 2012)

The publication series Common BIM Requirements 2012 consists of the following documents (COBIM 2012):

- 1) General BIM Requirements
- 2) Modeling of the Starting Situation
- 3) Architectural Design
- 4) MEP Design
- 5) Structural Design
- 6) Quality Assurance
- 7) Quantity Take-off
- 8) Use of Models for Visualization
- 9) Use of Models in MEP Analyses
- 10) Energy Analysis
- 11) Management of a BIM Project
- 12) Use of Models in Facility Management
- 13) Use of Models in Construction
- 14) Use of Models in Building Supervision

Each participant in a building information modeling project must be acquainted of a minimum with the parts related to its qualification and specialization.

Part 1 of the COBIM 2012 called General BIM Requirements contains the main objectives of Building Information Modeling, covers general technical requirements for BIM: questions of software used, file formats for publishing and distribution of the

model regulations, rules for tools used, requirements on naming, labelling and dividing of model components. Along with definitions and terminology used for BIM in engineering field, the document specifies rules and restrictions for generation and utilization of models at different project stages for different designers involved in the project. Depending on the project stage, designer profile and utilization of the model, the document clarifies models' contents, parties' functions and responsibilities, the level of accuracy of models created. There are also coordination and cooperation restrictions and requirements presented in this part of COBIM 2012.

Thus, Common BIM Requirements 2012 serves to provide project parties' coordination, to restrict and divide responsibilities of designers and managers, to provide general rules for working with BIM and to allow managing models of content level needed depending on project stage and utilization of BIM.

### **3. BUILDING SUGGESTION**

Working on the study became with building suggestion for further modeling using BIM based software. The main goal was to pick the building, of the structural and architectural design, which contains more commonly used or even typical structures for a regular industrial building. With the help of Leningradprotrans JCS (Saint-Petersburg, Russia), one of the largest design organizations of Russia having 80 years of experience in the field of carrying out engineering surveys and design of the objects of transport infrastructure, different buildings design was provided for comparing analyses and using as base for modeling. After considering several industrial buildings projects, comparing their design concept and drafts architectural drawings, the most suitable and interesting project was chosen. Three two-dimensional drawings (floor plans at levels 0.000, +3.600 and building section) were used as the foundation for modeling.

The building of carriage wheelsets' maintenance workshop is an industrial building that is planned to be constructed as a part of modernization project of one of Saint-Petersburg subway depots. The main functional purpose of the workshop is to maintain subway carriage wheelsets, observe carriages details and define its condition and usefulness for further exploitation.

The building has a rectangular shape in plan with the total dimensions 42x18 meters between edge axes and it is approximately 10.2 meters high. The whole building space can be divided into two spaces considering its functional purpose. The first space is a workshop and it has one storey height. The second is an office and welfare part, which is two-storied. The design concept is presented as a row of composite frames interconnected with steel bracings. Frames are made of precast concrete columns 7.2 meters high and steel trusses 18 meters wide and at maximum 2.1 meters high. External walls are presented as a system of three layers steel sandwich panels, the plinth of the building is made of ordinary bricks with ventilation façade system facing. Internal walls and partitions are of bricks and have different thicknesses. Flooring slabs are of reinforced concrete. Each flooring is supported by a beam system of various types of I section steel beams. The roofing system is a multi-layered structure and is supported by profile decking and girder beams.

All additional information about building properties can be found in the created architectural and structural models.

*Figure 1* presents Autodesk AutoCAD drawing of the floor plan of the building at level 0.000 provided by architects of Lengiprotrans JCS. This drawing gives the idea of general arrangement of spaces, walls and elements.

*Figure 2* presents Autodesk AutoCAD drawing of the floor plan of the building at level +3.600 provided by architects of Lengiprotrans JCS. This drawing shows the general arrangement of spaces, walls and elements.

*Figure 3* presents Autodesk AutoCAD drawing of the transverse section of the building provided by architects of Lengiprotrans JCS. This drawing provides understanding of the structural design concept of the building, levels, walls and structures arrangement.

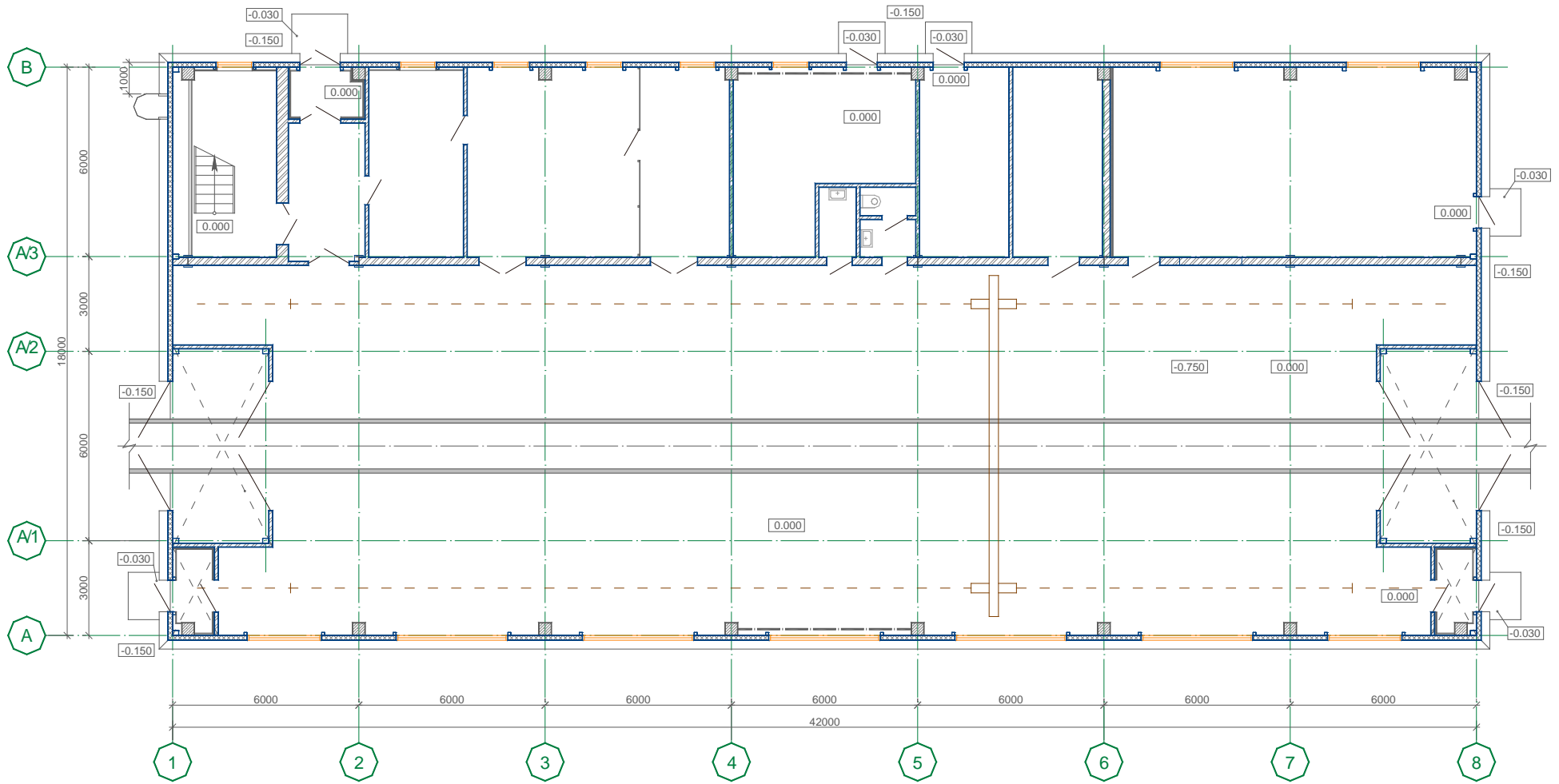


Figure 1. Autodesk AutoCAD drawing. Floor plan at level 0.000



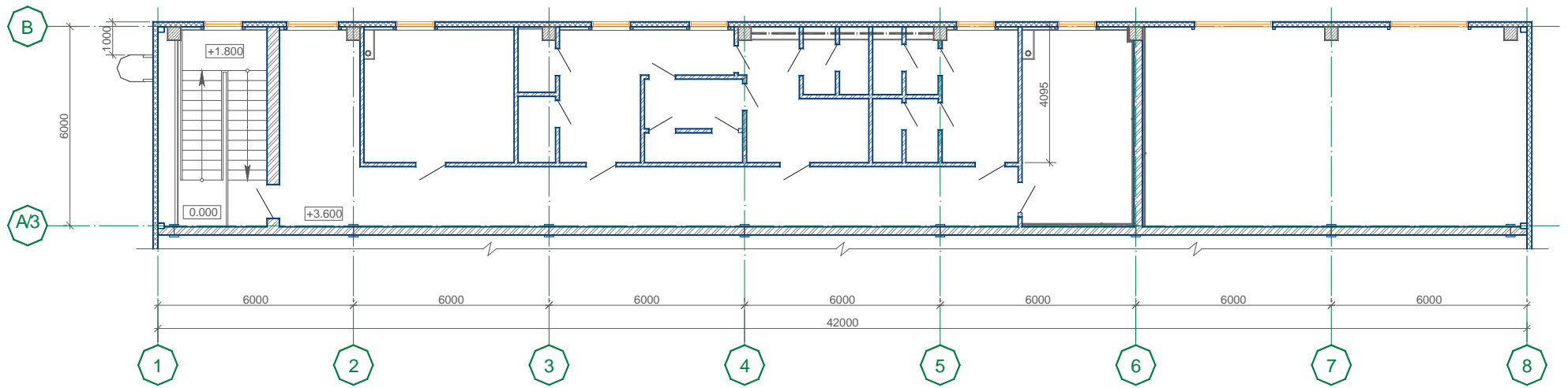


Figure 2. Autodesk AutoCAD drawing. Floor plan at level +3.600

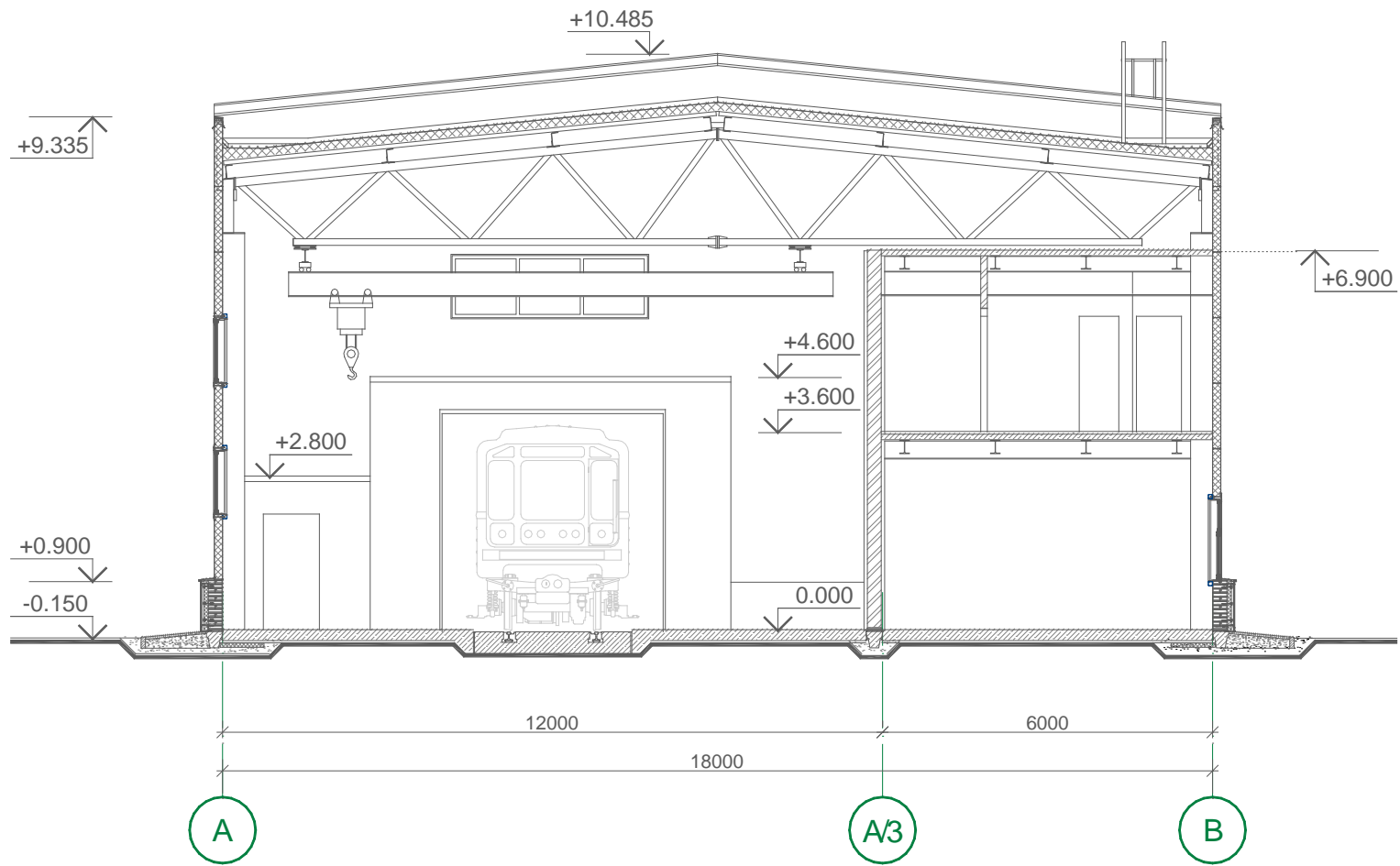


Figure 3. Autodesk AutoCAD drawing. Building section.

## **4. ARCHITECTURAL MODEL**

Architectural model presents the architectural concept of the building. The modeling is done using Revit Architecture version 2015 by Autodesk and corresponding to modeling principles in architectural design provided by COBIM 2012.

### **4.1. Revit review**

Autodesk Revit is a multifunctional BIM based software, which presents a wide spectrum of abilities for architectural design, mechanical engineering design, structural design, building parts design, modeling of construction, documentation, visualization and calculations. It provides models of high quality and accuracy, teamwork of high level, reduces errors in design and allows creating models of different levels of complexity. (Autodesk Website)

One of the main features of the program is every Revit project consists of families - groups of elements with a common set of properties. Families' concept allows you to load or create an element with parameters needed and pack your model of them. Revit Architecture is a part of complex Revit software that is used by architects worldwide to create projects and bring the design to life. As far as this particular part of the Revit software was used for architectural modeling in the study it is essential to go on details focusing on Revit Architecture.

#### **4.1.1. Main functions**

The main functions of Autodesk Revit Architecture are (Autodesk Website):

- BIM based modeling of the project;
- Parametric modeling: all links between objects and elements are described as a set of different parameters, which can be changed easily;
- Modeling of different concept versions of the same project;
- Modeling building parts and elements on different phases of construction (for instance, in renovation projects);
- Creating of different views of the project;
- Creating and placing of parametric components (families);

- Bidirectional associativity: ability to collect and store the information in the project within the ability to show any changes made from one view at all views at once;
- Creating and manipulating of drafts, models and surfaces of free forms and geometry of high flexibility and accuracy;
- Providing colour schemes and scheduling of designer thoughts;
- Providing high quality visualisation of design;
- Creating elements using many varieties of structural materials;
- Documentation of project concept including automatically created specifications;
- Providing material scheduling;
- Providing quantity take-offs;
- Creating detailing drawings;
- Securing collaboration work with other designers or adjacent specialists at the same time and in one common file (using wide spectrum of working sets for each party);
- Making possible to export model information at varies of electronic file formats;
- Exporting and importing IFC-files;
- Collision check.

#### **4.1.2. Advantages and disadvantages**

Revit Architecture is a very powerful tool for incarnation of any kind of architectural design or thought. It is almost in all cases so that the project team in charge of architectural design needs to introduce several design concepts of one project at the same time. It is known that the customer or the owner often insists on shorting of the design scheduling also. Revit architecture allows to create many different alternative designs of the project in a very short period of time by the great tools of co-operational work and concept versions creation. It also makes it possible to gain the desirable or required visualisation of the project, provides colour schemes and legends and the vast commonly used documentation views and formats. Using Revit Architecture, you can also easily create material scheduling, specifications, quantity take-offs and transfer all kinds of information contained in the model at the desirable file-format. It is noteworthy that the Revit license price is considerably low so that

many companies not depending on their income or project scopes can afford it and design buildings using modern BIM based software.

Being a versatile software Revit has complexities and inconveniences when applying for very specified and precise specializations, for instance, finishing modeling.

Although some companies producing building parts and materials provide Revit families for using in projects by designers nowadays, the vast part of those parts and materials families should be done and uploaded to the project by the project team or a BIM manager. Roughly saying in other words, when using Revit, architects should supplement the software. In addition, Revit abilities for Architecture are not at the highest level in comparison with other software products that serve architects' needs only.

## **4.2. COBIM architectural design requirements**

Part 3 of the COBIM 2012 called Architectural Design explains the main objectives of BIM, contains the minimum requirements for modeling, restrictions on the use of the model, guidelines for modeling processes, definitions and classifications that are corresponded to architectural design process.

As far as the architects' model is the base for every participant of the project and many analyses and simulations are considered to be done using it, it is obligatory to have an architecture model in all of the design phases.

Two main factors define the requirements, geometry accuracy and content level for the architect's model:

- ✓ Project phase the model is done for;
- ✓ The use of the model.

All the modeling principles in architectural design along with terminology and definitions are documented depending on these factors.

*Figure 4* presents the use of BIM in different project phases.

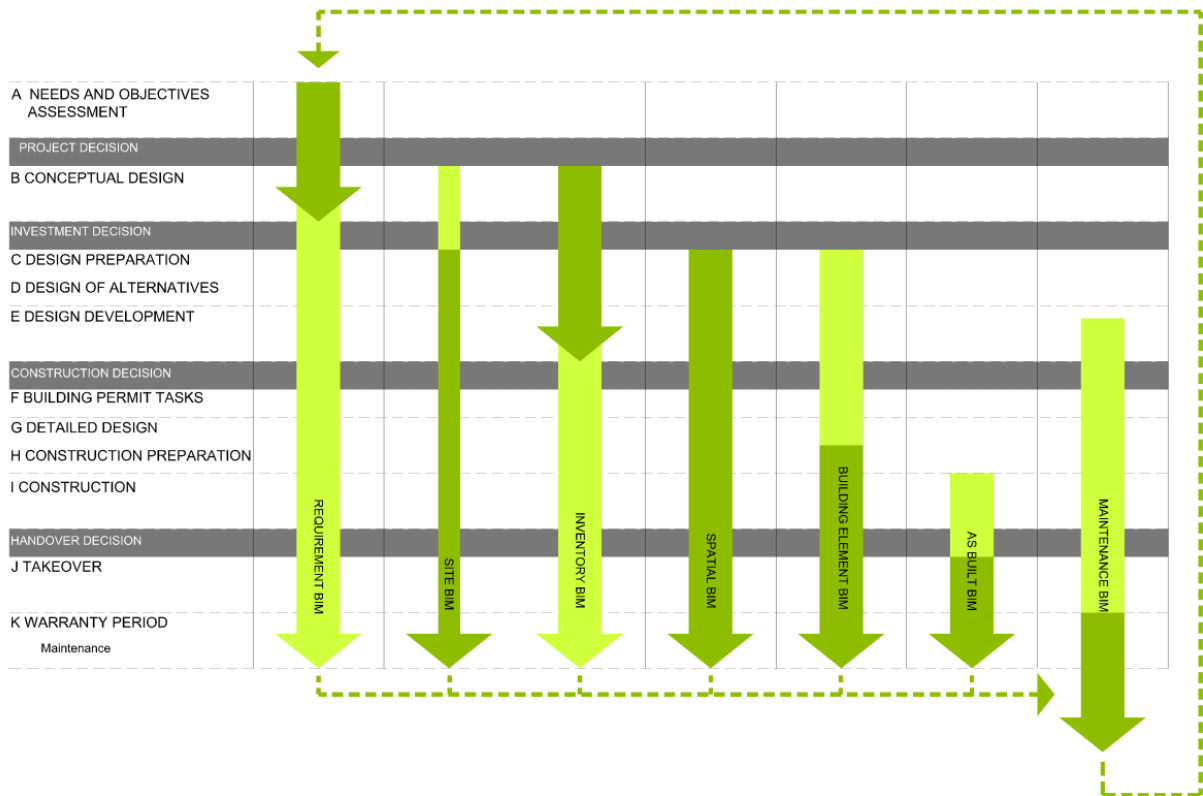


Figure 4. COBIM part 3 (COBIM 2012). The use of BIM in different phases of the project.

There are also some separated requirements for BIM in renovation projects that are described in the document.

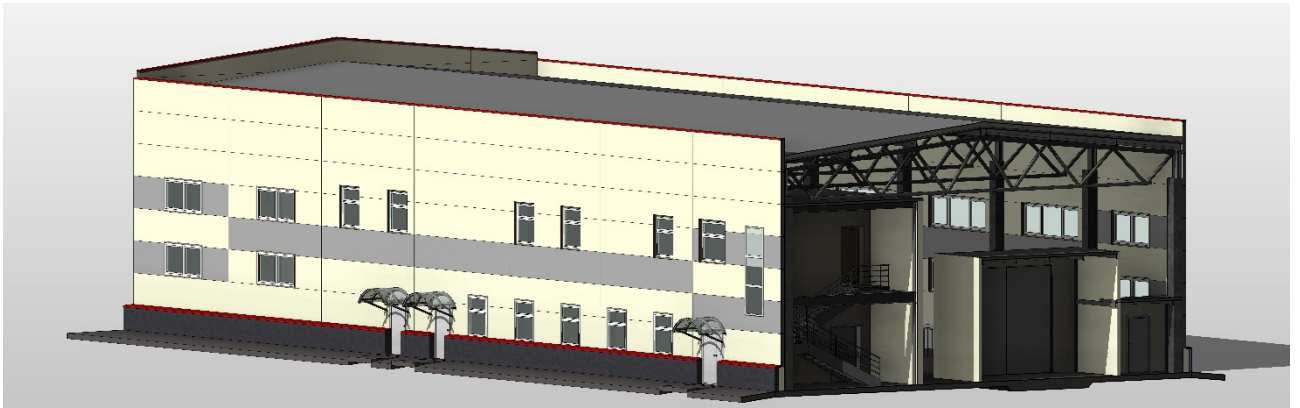
The aim of such a detailed system of requirements is to have an architectural model done according to what it is done to and how it will be used in the project. It defines the required informational level of the model and serves to the effective and efficient use of the model and resources needed to create it.

### 4.3. Model review

As mentioned previously, architectural model presents the architectural concept of the building. Using standard tools and catalogues of Revit Architecture 2015 an architectural model is created. All load-bearing structures are modelled simply for visualization and understanding of the structural design concept of the building.

Figure 5 presents visualization of the project provided by Revit Architecture 2015.

Modeling algorithm and additional information can be found below.



*Figure 5. Revit Architecture 2015. Project visualization.*

Modeling algorithm:

- 1) Setting up architectural template when starting new project file;
- 2) Uploading AutoCAD plan drawing on the plan view at 0.000 level;
- 3) Creating desired gridlines on the plan view;
- 4) Creating facade view and setting up desired levels;
- 5) Modeling on-ground floor modifying flooring default family at level 0.000;
- 6) Modeling concrete columns for visualization and using structural column tool;
- 7) Modeling steel columns for visualization and using structural column tool;
- 8) Creating plinth wall uploading and modifying default multilayered family;
- 9) Creating beam systems for visualization using structural beam tool;
- 10) Creating flooring using structural flooring tool;
- 11) Creating internal walls using and modifying default wall families;
- 12) Modeling internal doors and garage doors uploading families from default catalogue;
- 13) Modeling staircase using default stair and barrier tools;
- 14) Uploading AutoCAD section drawing into the section view;
- 15) Creating truss for visualization using structural beam tool and 3D snaps;
- 16) Copying trusses onto grids;
- 17) Creating roofing system using default multilayered roofing family;
- 18) Creating external walls using a curtain wall tool;
- 19) Separating external walls into panels by using specified tool;
- 20) Creating two panel types of different facing color and arranging them on facade views;
- 21) Uploading and placing external doors and all windows;

- 22) Creating entrance peaks using structural beam and roofing tools;
- 23) Coping peaks to entrances;
- 24) Creating, modifying and annotating views for documentation;
- 25) Deleting uploaded CAD drawings, purging the model of not using families and elements;
- 26) Creating drawings (see appendix 1);
- 27) Creating an IFC-file;

Industry Foundation Classes (IFC) is an open file format specification that is not controlled by a single vendor or group of vendors. Using IFC files eases interoperability between different BIM based design applications (Autodesk Website).

Model description document is a description of the contents of the model and it explains the purpose for which the model has been published and what the degree of precision is. The description document contains information about the modeling software used, the different versions created from the original model, and exceptions to these requirements. In addition, all used naming conventions, the maturity of the content and any restrictions on its use are documented in the description. (COBIM 2012)

A model description document is required by COBIM 2012 requirements for architectural models and can be found in appendix 3.

## **5. STRUCTURAL MODEL**

Structural model presents the arrangement of load-bearing and non-load-bearing concrete structures of the building along with connections between them. In addition, it includes the information about structural materials quantities, may comprise the information about loads imposed to the structures and boundary conditions.

Analytical model that is for using in calculation and analyses software is usually created along with the structural model. The modeling is done using Tekla Structures Learning version 2016 by Trimble and corresponding to modeling principles in structural design provided by COBIM 2012.



## **5.1. Tekla review**

Tekla Structures is a BIM-based application for structural design needs. It allows to create a full digital both physical and analytical model of the building structure. There are abilities to use the application by different types of structural engineers such as a reinforced concrete structures specialist, a steel structures specialists and even geotechnical engineers. Tekla Structures provides realistic visualisation of the structural model including detailing and has a variety of tools to create the construction documentation of all kinds for the construction phase of the project automatically.

### **5.1.1. Main functions**

The main functions of Tekla Structures are:

- BIM based modeling of the project;
- Parametric modeling: all links between objects and elements are described as a set of different parameters, which can be changed easily;
- Bidirectional associativity: ability to collect and store the information in the project within the ability to show any changes made from one view at all views at once;
- Creating of different views of the project and managing them concurrently;
- Providing different configurations depending on the role of the user in the project (Standard Design, Steel Detailing, Precast Concrete Detailing, Reinforced Concrete Detailing, and Full Detailing);
- Providing an extensive catalogue of profile sections and structural materials;
- Placing components and modifying their properties;
- Automatic creation of drawings, detailing, scheduling and specifications;
- Providing quantity take-offs;
- Making possible to export model information at varies of electronic file formats;
- Exporting and importing IFC-files;
- Collision check;
- Automatic creation of analytical model from the physical structural model, modifying the merged model, imposing loads and creating boundary conditions;

- To maintain the entire structural design process from structural design to implementing on the building site.

### **5.1.2. Advantages and disadvantages**

Tekla Structures provides high quality structural design at any part of structural engineering field. Its extensive catalogues of components, materials and building elements' sections along with abilities to modify component provides incarnation of any type of structures in compliance with the engineers' thoughts. In comparison with other structural design applications, Tekla allows designers to work faster and more efficient by means of wide spectrum of automatic operations from placing joints and connections components to creating sets of drawings of different purpose. Automatic users' feedback system provided by Tekla Structures ensures constantly developing software. In addition, Trimble corporation concentrates on creating high quality software for each party of the project team separately along with creating specified tools for high performance interoperability between every existing BIM based software. This is far more reasonable and effective than producing one big versatile application that needs preparation and additional work before or concurrently with the modeling.

There are also some disadvantages of Tekla Structures. The application license price is relatively high so that not much of companies can afford it. The lack of modeling tools can be listed to the disadvantages list too, but high performance interoperability instruments can help in modeling of structures of complicated forms.

## **5.2. COBIM structural design requirements**

As mentioned in paragraph 2 General BIM requirements, the publication series Common BIM Requirements 2012 presents a set of documents divided into terms of covering targets.

Part 5 of the COBIM 2012 called Structural Design covers structural BIM modeling and defines information containing in BIM models produced by structural designers. As every document in the series, part 5 contains the main objectives of building information modeling. There are general definitions, terminology and conditions containing in the document. This particular part of the document presents the vault of

rules and requirements for structures to be modeled and modeling itself, structure types modeling, sections and stories in the model. In addition, numbering and labeling rules, readiness degree requirements and guideline, required quality assurance are presented and specified.

The document also presents separated requirements for BIM in renovation projects. Similar to architectural design requirements part 3 of the publication, the document contains requirements and definitions for structural model depending on the project phase and use of the model.

The document is very detailed, it provides model pictures, drawing examples illustrating requirements and guidelines. Commissioning and facility management guidelines for use of the structural model are considered too.

### **5.3. Model review**

As mentioned previously, the structural model presents the arrangement of load-bearing and non-load-bearing concrete structures of the building along with connections between them. Using standard tools and catalogues of Tekla Structures 2016 a structural model is created. *Figure 6* presents a 3D view of the assembled model provided by Tekla Structures 2016.

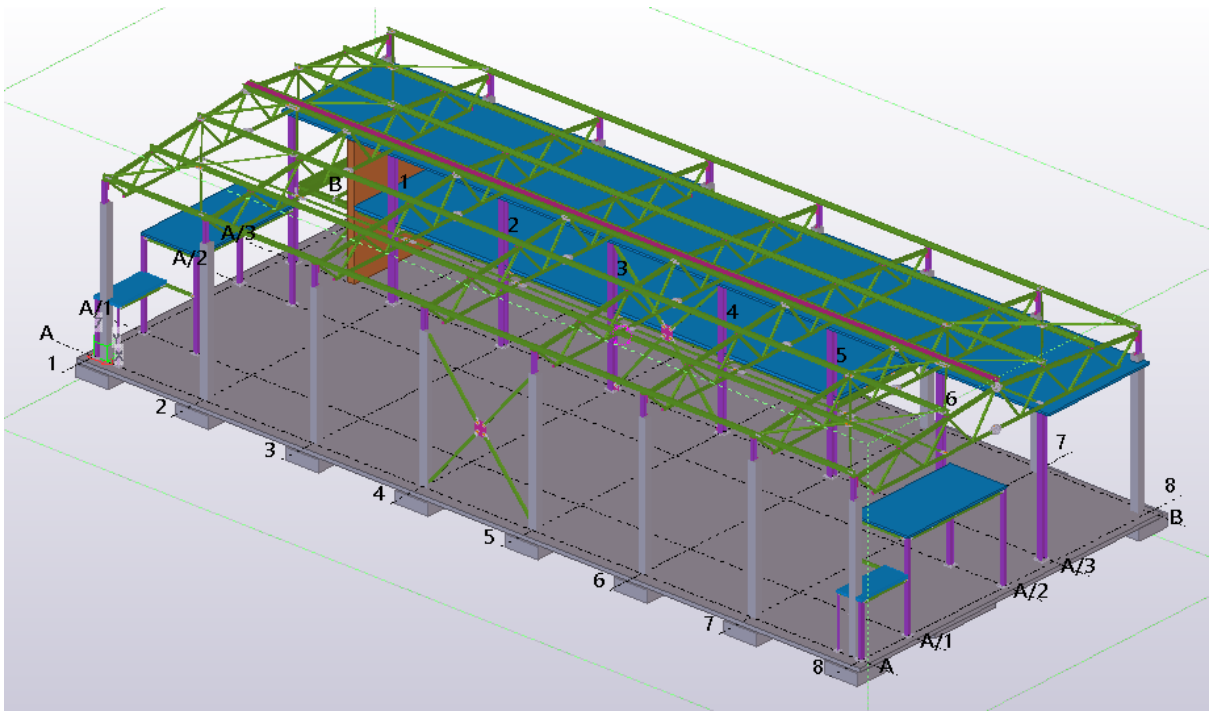


Figure 6. Tekla Structures 2016. A 3D view.

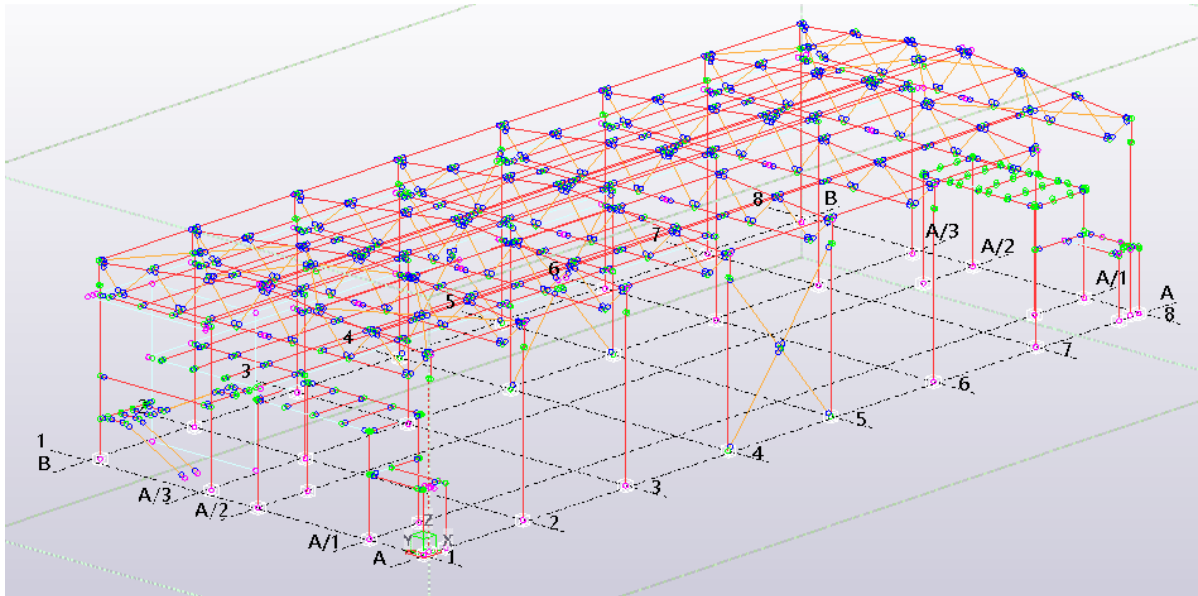
Modeling algorithm:

- 1) Setting up standard design configuration when starting new project file;
- 2) Uploading AutoCAD plan drawing;
- 3) Modifying grids at X,Y,Z axes;
- 4) Creating footing using pad footing tool;
- 5) Modeling concrete columns and using concrete column tool;
- 6) Modeling steel columns and using steel column tool;
- 7) Creating beam systems using steel beam tool;
- 8) Creating floorings using concrete panel tool;
- 9) Modeling staircase steel structure using steel beam tool;
- 10) Creating truss using steel beam tool;
- 11) Copying trusses onto grids;
- 12) Creating girder beams system using steel beam tool;
- 13) Creating bracings using steel beam tool;
- 14) Highlighting automatically created analytical model;

As described previously, Tekla Structures allows creating an analytical model concurrently with creating a physical model. Analytical models of elements are created automatically along with creating their physical prototypes. It is possible to

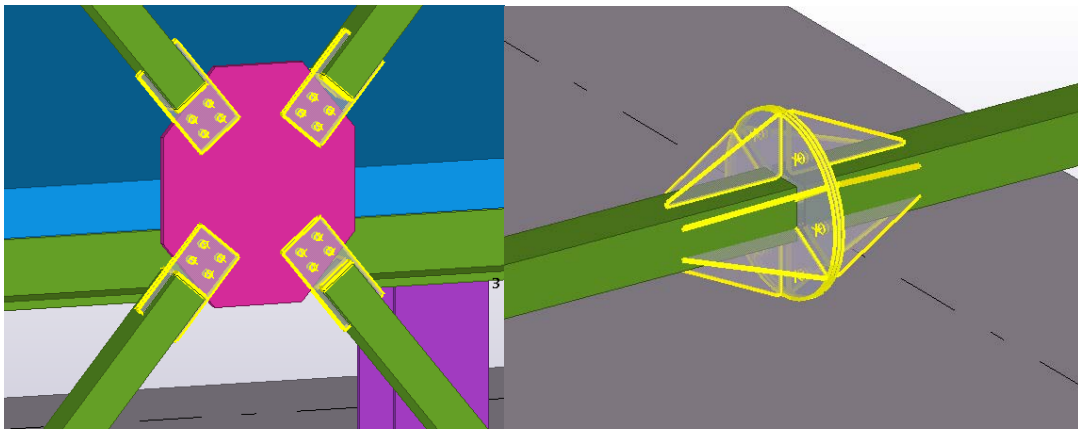
highlight an analytical model by changing view properties. *Figure 7* presents a 3D view of a highlighted analytical model of the building.

When this is done, the designer is able to correct (to merge nodes, to extend or cut elements) the model and use it for analyses.



*Figure 7.* Tekla Structures 2016. 3D view. An analytical model.

It is recommended to assemble the model first, then impose loads and allocate boundary conditions and transfer analytical model into specified application (Tekla Structural Analysis, for example) for analyses and calculations. After analyses are done, you should bring the model back into Tekla Structures. If needed, the application automatically corrects sections of elements and then you can detail your model and place connection components. *Figure 8* presents the placing connection components to connect structure elements.



*Figure 8. Tekla Structures 2016. Connection components.*

- 15) Placing and modifying components – steel structure bolt and welded joints;
- 16) Creating drawings (see appendix 2);
- 17) Creating an IFC-file;

A model description document can be found in appendix 4.

## **6. MERGED MODEL**

Merged models are created from the models of individual designers during the project, and they can be used for visualizing the designs and assessing their compatibility. (COBIM 2012)

A merged model can be created by exporting different designers' models to IFC format files and assembling IFC files in a specified application. Trimble Corporation provides such an application called Tekla BIMsight.

### **6.1. Tekla BIMsight review**

Tekla BIMsight is a professional software created for both design and construction collaboration. It allows combining models provided by different designers in one called merged model. Thus, it gives designers opportunity to make automatic collision check of the model at the design stage and fix clashes when needed. It also allows project parties to communicate in terms of fixing final model clashes easily. Along with all those benefits, Tekla BIMsight is very mobile; it can be used both in designers' offices and on construction site. It is noteworthy, providing high quality

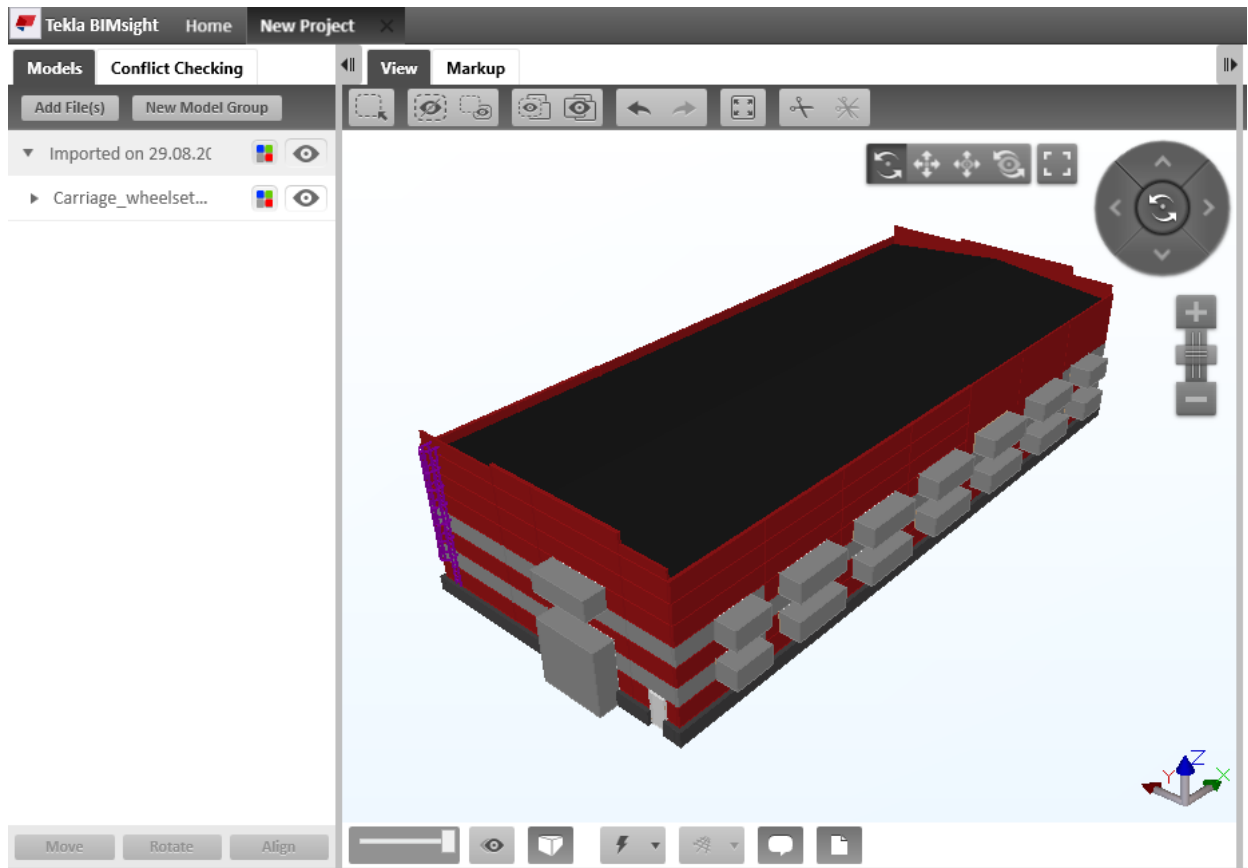
interoperability between different BIM based applications, Tekla BIMsight is completely free of charge that eases its implementation in many projects throughout the world. (Tekla BIMsight Website)

## **6.2. Model review**

Before assembling the final model using Tekla BIMsight it is needed to check the starting points of coordination bases of each project. It is essential to create different models of the building using the same coordinate bases for modeling areas in each of them.

The next step is exporting the architectural and structural model into IFC format files. Initial preparation is needed before exporting the architectural model into IFC file: all load-bearing structures modelled simply for visualization need to be hidden not to cause clashes with the current structural model.

After preparation is done Tekla BIMsight new project can be created and IFC files can be uploaded to the project. *Figure 9* presents uploading an IFC file created from the architectural model of the building.



*Figure 9.* Tekla BIMsight. Uploading an IFC file derived from the architectural model.

*Figure 10* presents uploading an IFC file created from the structural model of the building to Tekla BIMsight project contained IFC file derived from the architectural model of the building. The architectural model is hidden and shown as "ghost".

*Figure 11* presents checking models' arrangement by creating cut planes and zooming the final model.



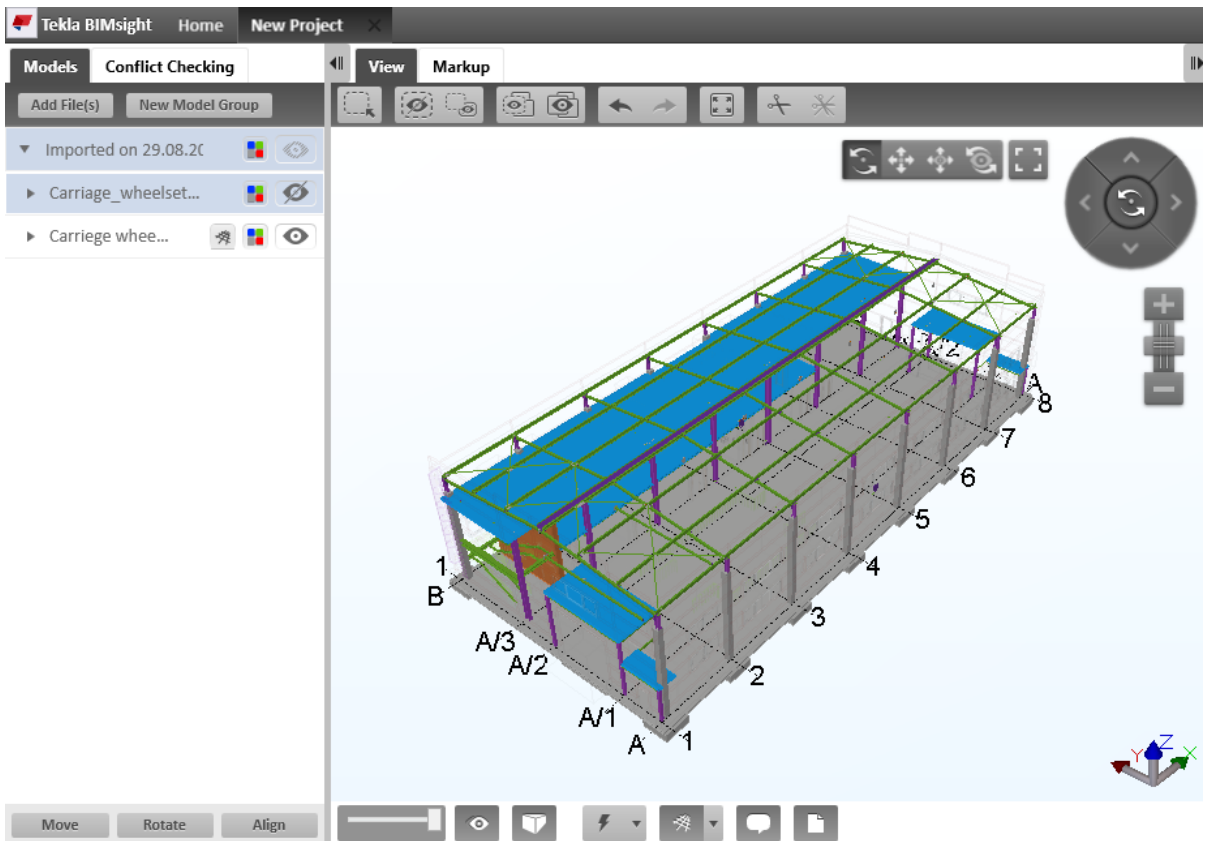


Figure 10. Tekla BIMsight. Uploading an IFC file derived from the structural model.



Figure 11. Tekla BIMsight. Checking models' arrangement.

## 7. Conclusions

Revit Architecture and Tekla Structures software's potentials, advantages and disadvantages are discovered. Architectural and structural models of industrial building along with drawings and IFC format files are created using these applications. Tekla BIMsight potential is discovered too, the merged model of the building is assembled. COBIM 2012 parts one, three and five are studied and implemented to the modeling process.

There are still a lot of things to be considered and done to help designers create and incarnate their thoughts using software. The problem of interoperability of different applications used in one project appears to be the most acute nowadays.

Building Information Modeling technology is a very powerful tool created to solve problems at engineering field. It is becoming faster and easier to model, transfer, share and publish information and design solutions, work in co-operation with adjacent designers, prepare structures for calculation and analyses, maintain the whole lifecycle of the project. Nevertheless, BIM needs a vault of rules and restrictions on its use to perform at the highest level of effectiveness and efficiency. The COBIM project provided a thoughtful and flexible support information base for using BIM properly and adequately.

BIM itself is not a panacea in terms of solving engineering problems, but a team of thoughtful and sensible engineers that will use the tool properly might aspire to this rank.

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5. <http://www.tekla.com/>
6. <http://www.teklabimsight.com/>



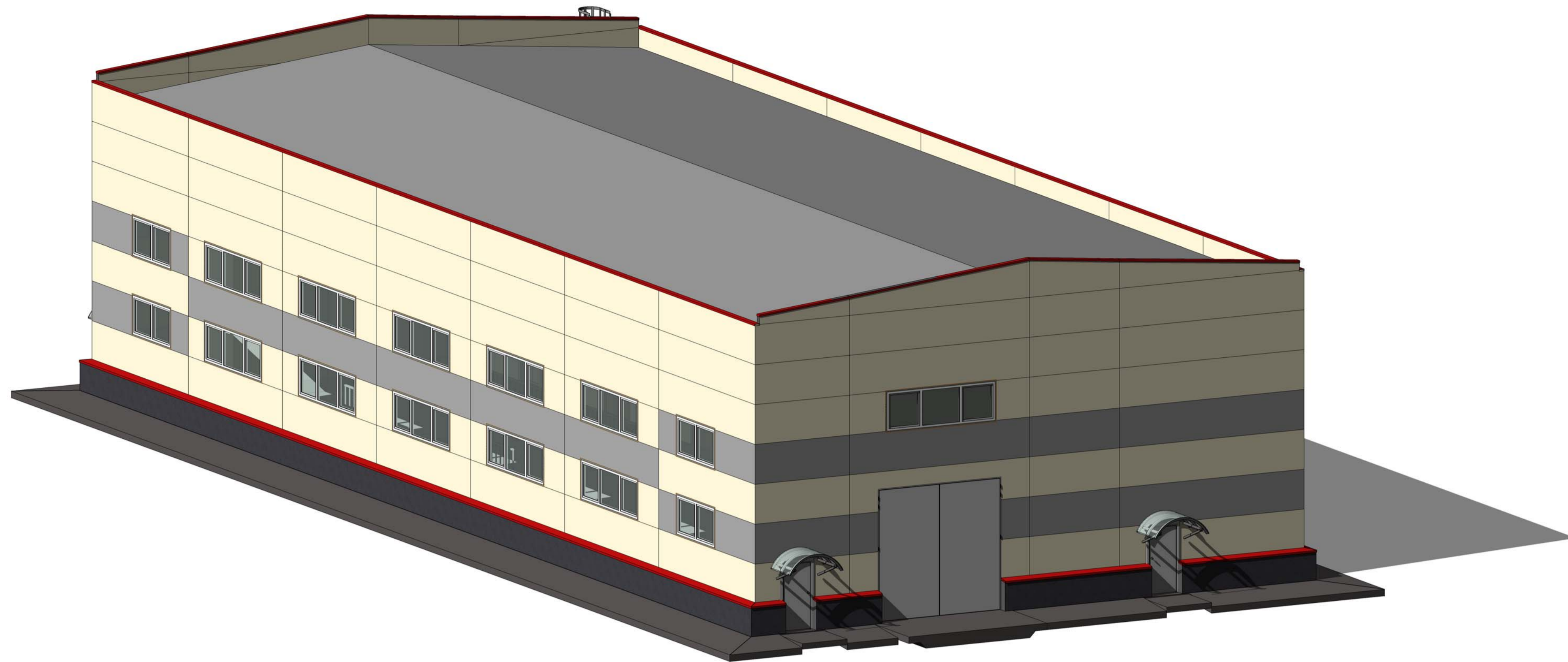
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1 Visualization\_3D\_1  
1:1

No.	Description	Date



2 Visualization\_3D\_2  
1:1

SUAS

Carriage wheelsets  
maintenance workshop

Title Sheet

Project number 001

Date 04.08.2016

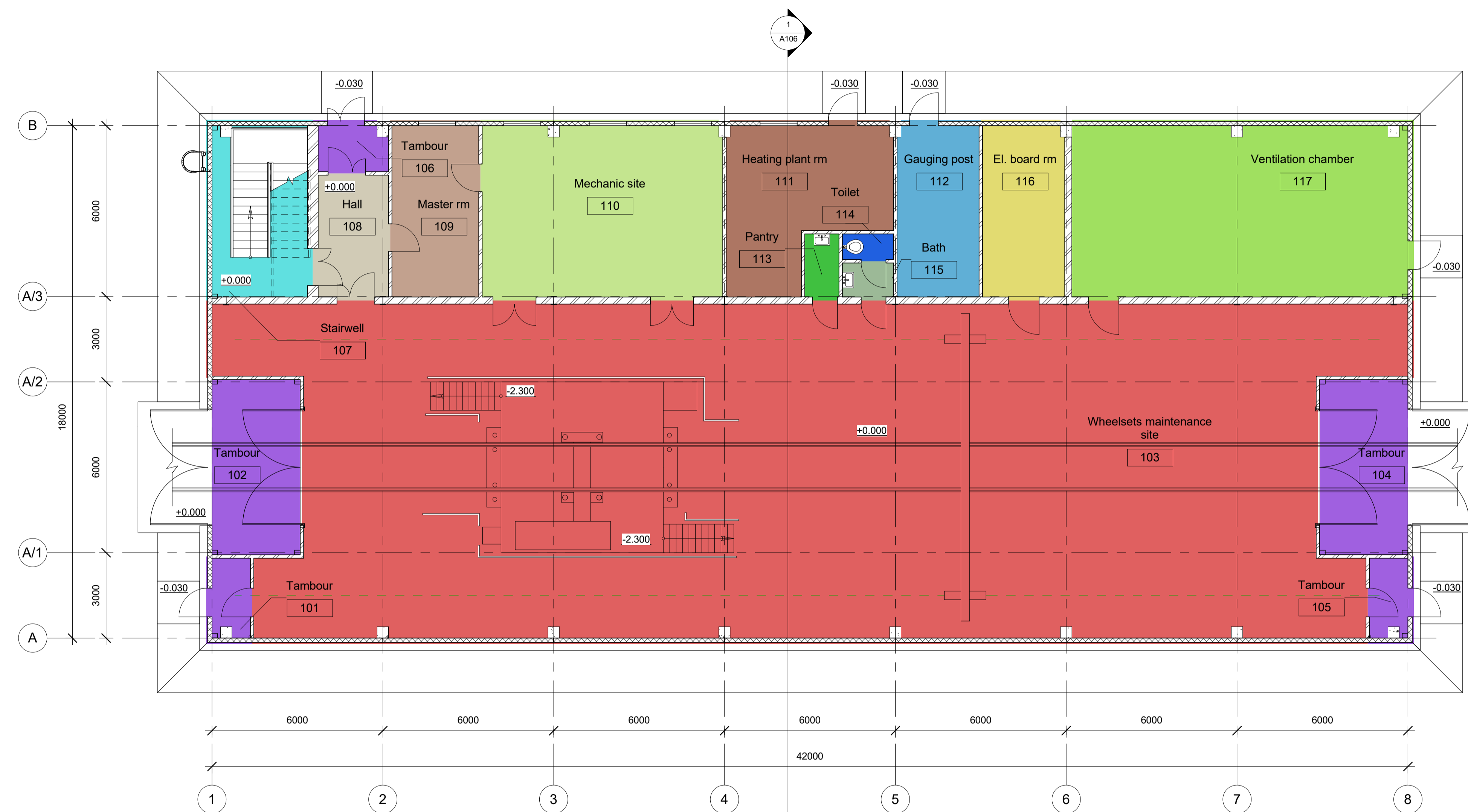
Drawn by Shafranov

Checked by Lehtoviita

A101

Scale 1 : 1





### Rooms legend

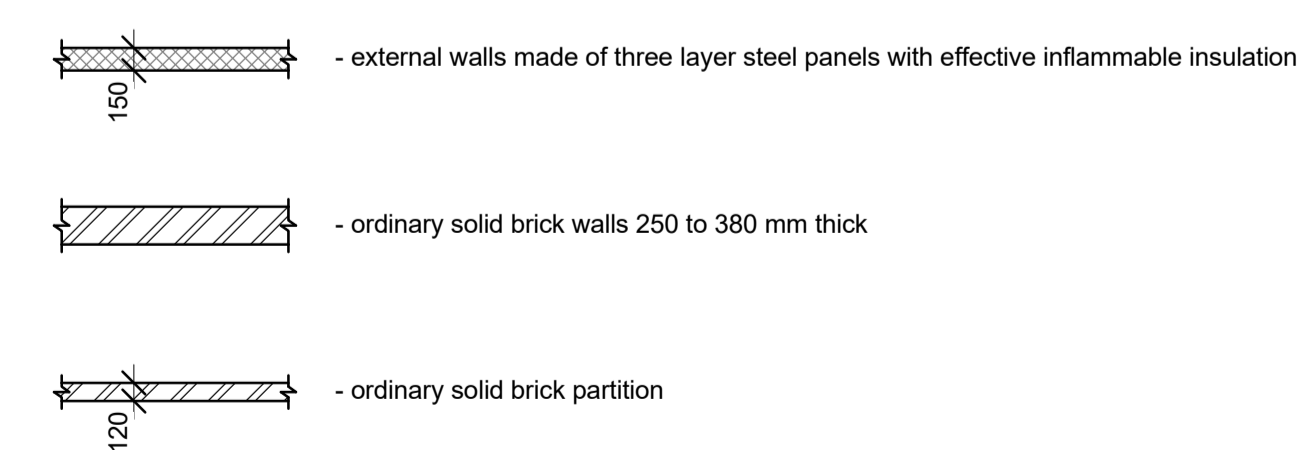
- Bath
- El. board rm
- Gauging post
- Hall
- Heating plant rm
- Master rm
- Mechanic site
- Pantry
- Stairwell
- Tambour
- Toilet
- Ventilation chamber
- Wheelsets maintenance site

Consultant  
Address  
Address  
Phone  
Fax  
e-mail

Consultant  
Address  
Address  
Phone  
Fax  
e-mail

No.	Description	Date

**1 Floor plan. Level 0.000**  
1: 100



### SUAS

Carriage wheelsets  
maintenance workshop

Floor plan. Level 0.000

Project number 001

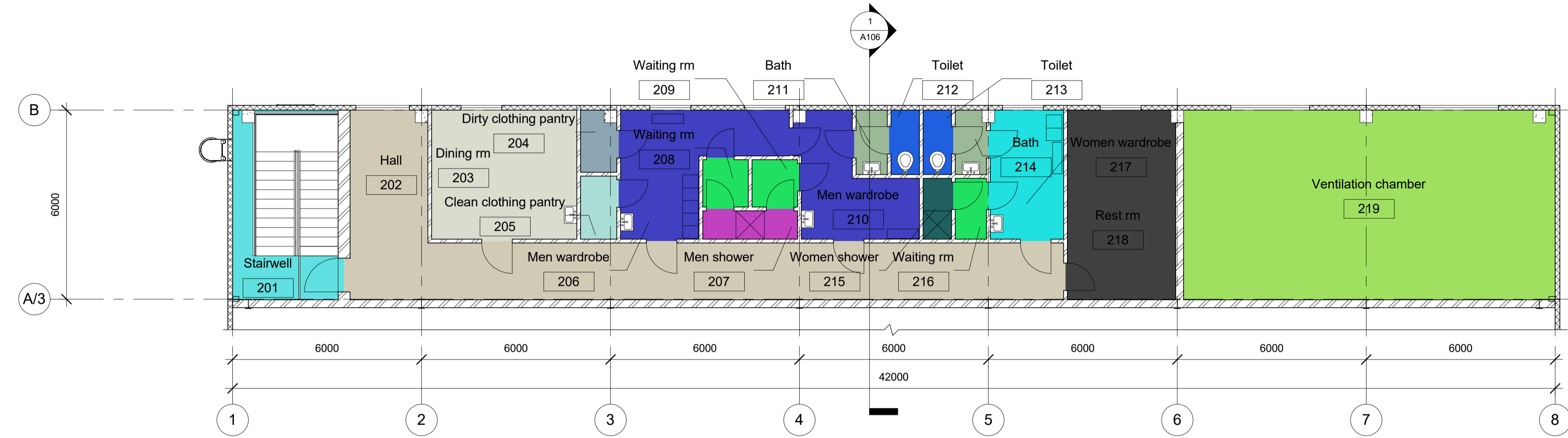
Date 04.08.2016

Drawn by Shafranov

Checked by Lehtoviita

## A102

Scale Как указано



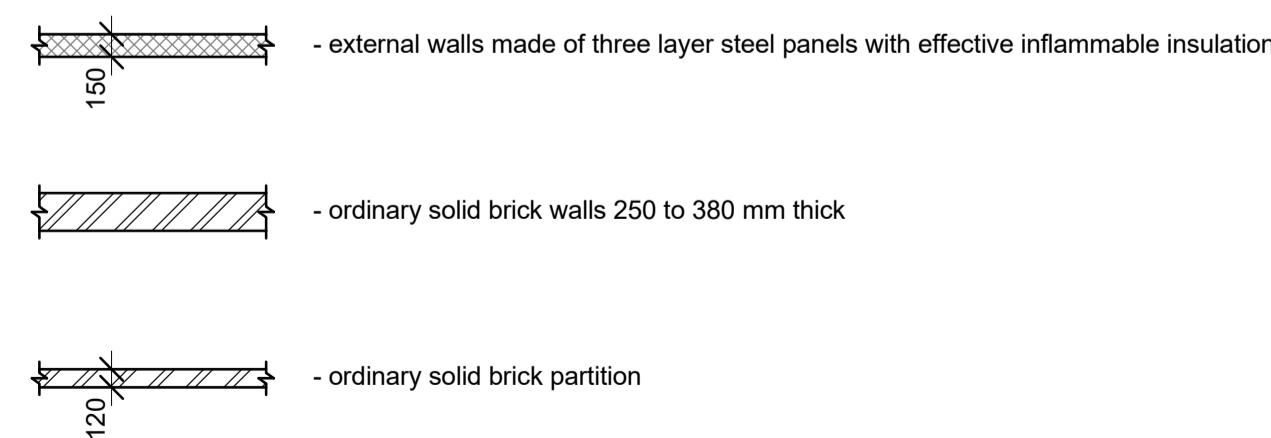
1 Floor plan. Level +3.600  
1 : 100

Rooms specification			
Floor/Level	Amount	Name	Square
Floor plan. Level 0.000	1	Tambour	4 M <sup>2</sup>
Floor plan. Level 0.000	1	Tambour	19 M <sup>2</sup>
Floor plan. Level 0.000	1	Wheelsets maintenance site	442 M <sup>2</sup>
Floor plan. Level 0.000	1	Tambour	19 M <sup>2</sup>
Floor plan. Level 0.000	1	Tambour	4 M <sup>2</sup>
Floor plan. Level 0.000	1	Tambour	4 M <sup>2</sup>
Floor plan. Level 0.000	1	Stairwell	20 M <sup>2</sup>
Floor plan. Level 0.000	1	Hall	11 M <sup>2</sup>
Floor plan. Level 0.000	1	Master rm	18 M <sup>2</sup>
Floor plan. Level 0.000	1	Mechanic site	51 M <sup>2</sup>
Floor plan. Level 0.000	1	Heating plant rm	28 M <sup>2</sup>
Floor plan. Level 0.000	1	Gauging post	17 M <sup>2</sup>
Floor plan. Level 0.000	1	Pantry	3 M <sup>2</sup>
Floor plan. Level 0.000	1	Toilet	2 M <sup>2</sup>
Floor plan. Level 0.000	1	Bath	2 M <sup>2</sup>
Floor plan. Level 0.000	1	El. board rm	17 M <sup>2</sup>
Floor plan. Level 0.000	1	Ventilation chamber	71 M <sup>2</sup>
Floor plan. Level +3.600	1	Stairwell	21 M <sup>2</sup>

Rooms specification			
Floor/Level	Amount	Name	Square
Floor plan. Level +3.600	1	Hall	51 M <sup>2</sup>
Floor plan. Level +3.600	1	Dining rm	19 M <sup>2</sup>
Floor plan. Level +3.600	1	Dirty clothing pantry	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Clean clothing pantry	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Men wardrobe	15 M <sup>2</sup>
Floor plan. Level +3.600	1	Men shower	3 M <sup>2</sup>
Floor plan. Level +3.600	1	Waiting rm	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Waiting rm	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Men wardrobe	11 M <sup>2</sup>
Floor plan. Level +3.600	1	Bath	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Toilet	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Toilet	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Bath	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Women shower	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Waiting rm	2 M <sup>2</sup>
Floor plan. Level +3.600	1	Women wardrobe	10 M <sup>2</sup>
Floor plan. Level +3.600	1	Rest rm	21 M <sup>2</sup>
Floor plan. Level +3.600	1	Ventilation chamber	72 M <sup>2</sup>

Rooms legend

- Bath
- Clean clothing pantry
- Dining rm
- Dirty clothing pantry
- Hall
- Men shower
- Men wardrobe
- Rest rm
- Stairwell
- Toilet
- Ventilation chamber
- Waiting rm
- Women shower
- Women wardrobe



No.	Description	Date

**SUAS**

Carriage wheelsets  
maintenance workshop

Floor plan. Level +3.600

Project number 001

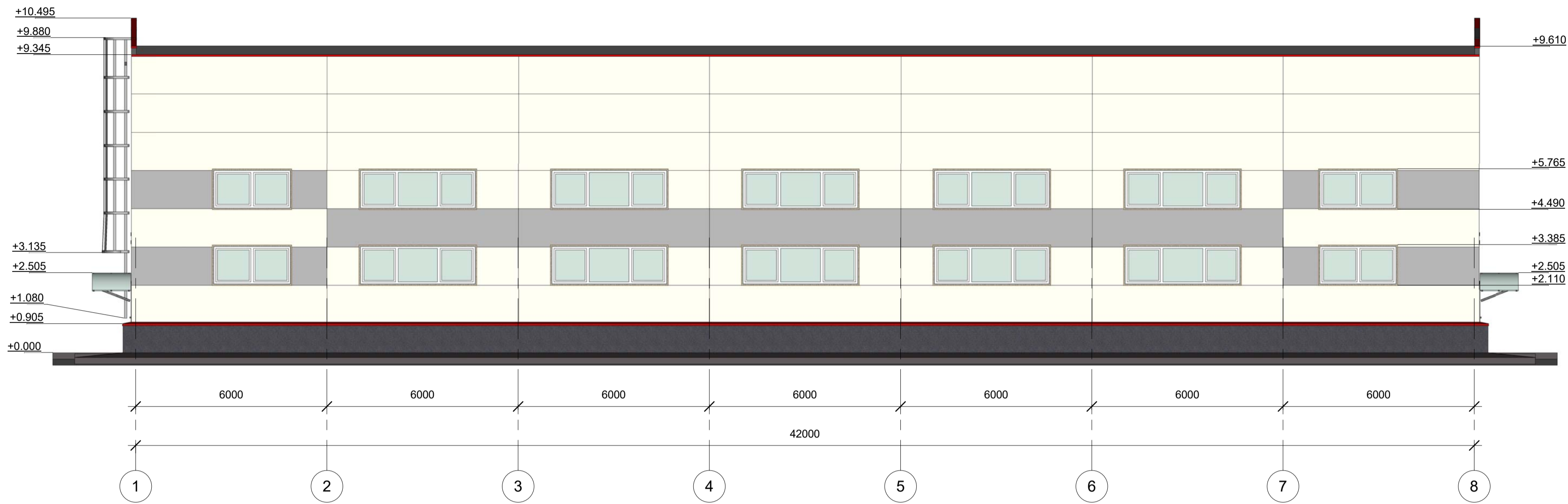
Date 04.08.2016

Drawn by Shafranov

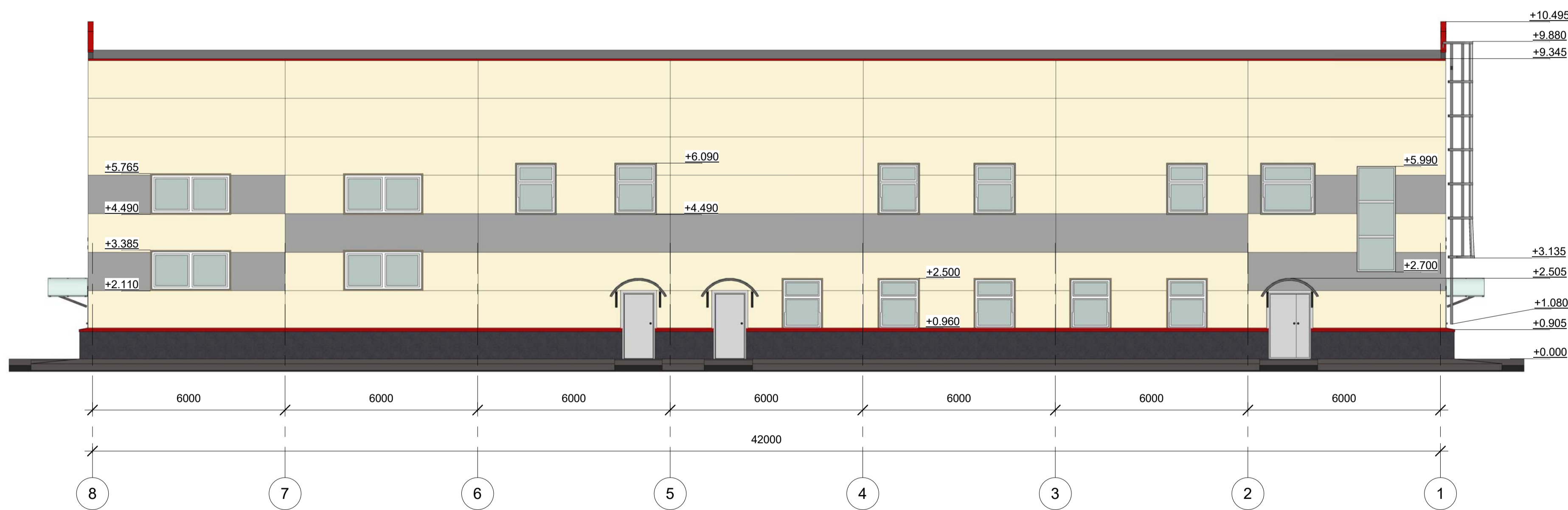
Checked by Lehtoviita

**A103**

Scale Как указано



1 Southern  
1 : 100



2 Northern  
1 : 100

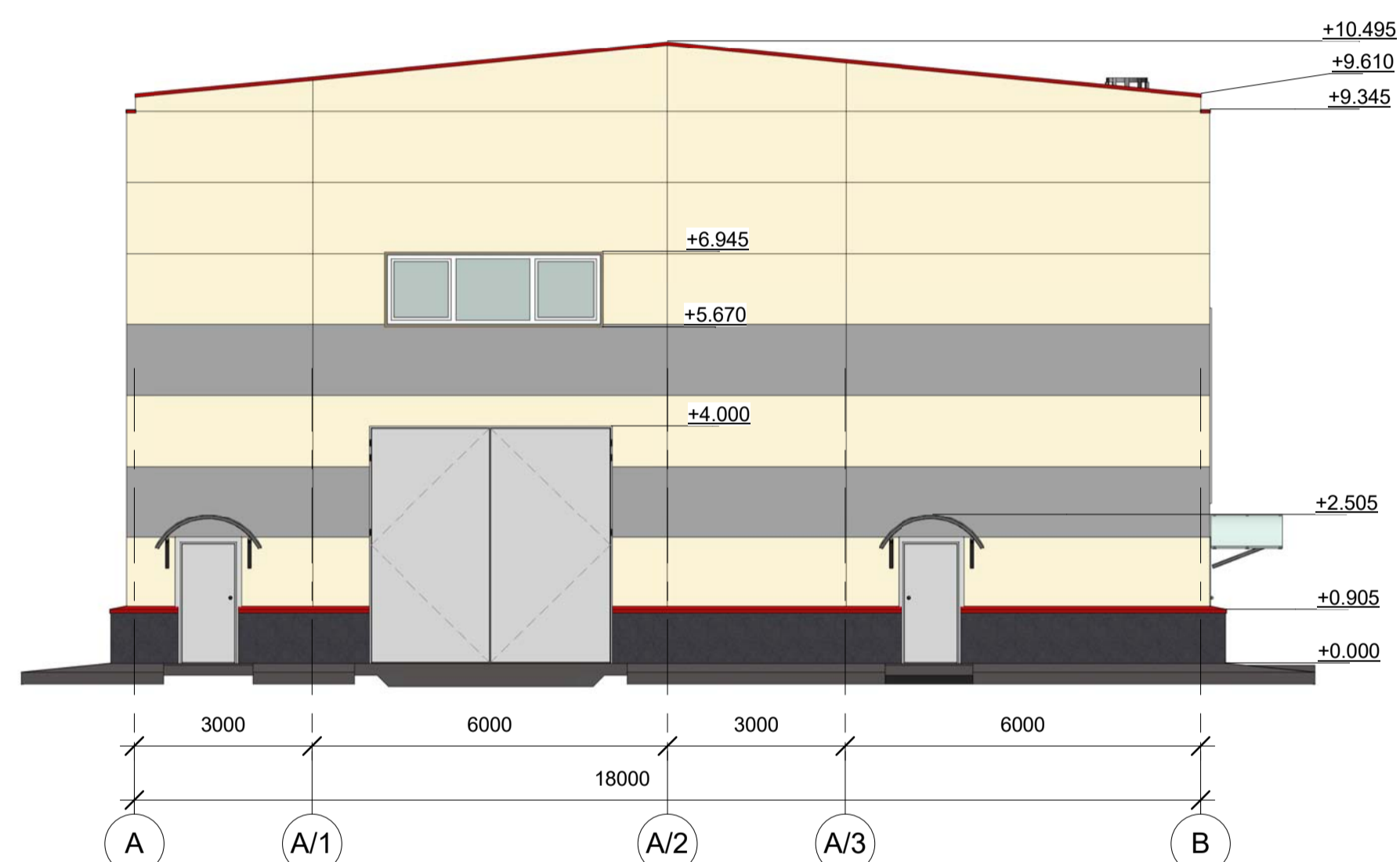
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No.	Description	Date

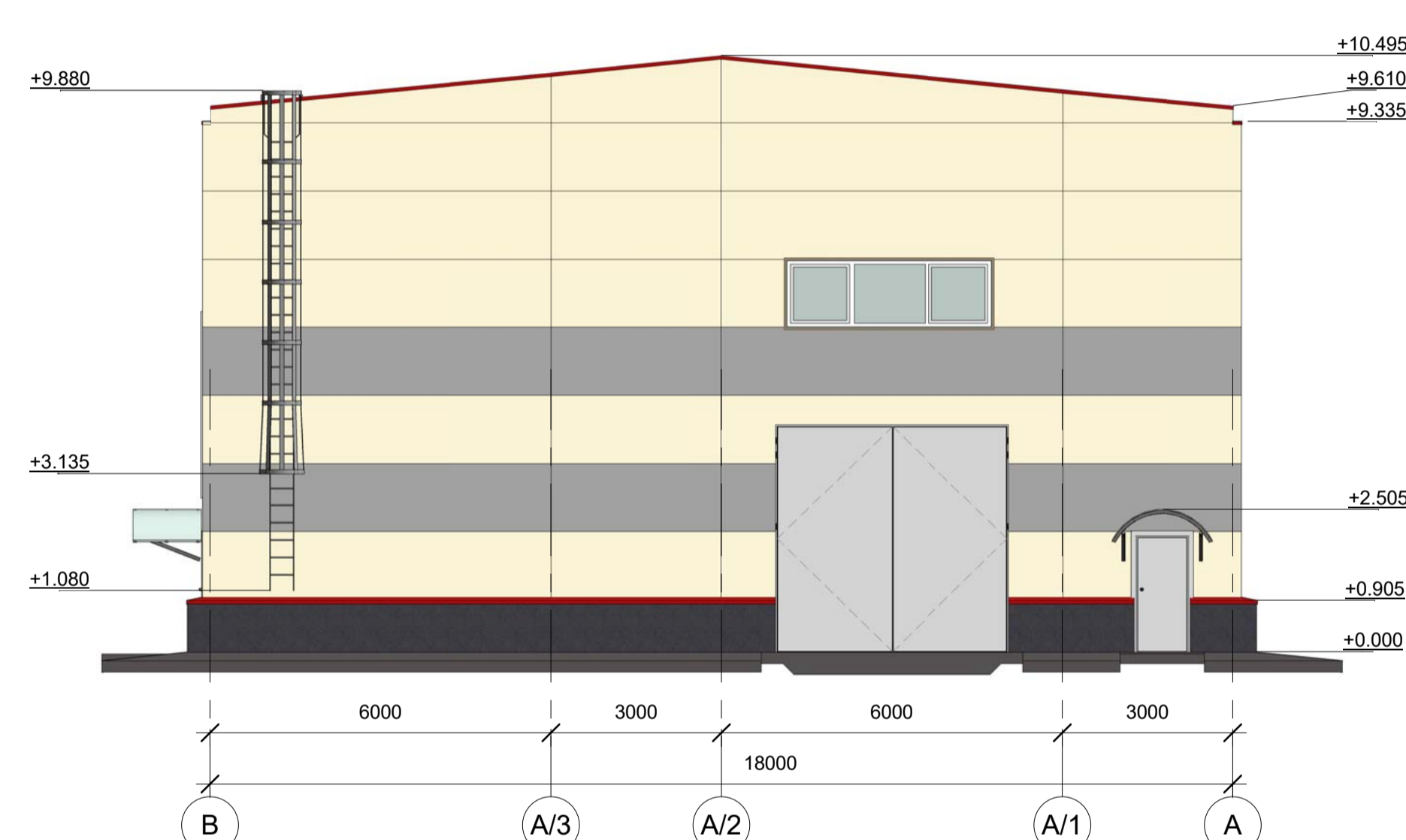
<b>SUAS</b>	
Carriage wheelsets maintenance workshop	
Northern and Southern Facades	
Project number	001
Date	04.08.2016
Drawn by	Shafranov
Checked by	Lehtoviita
<b>A104</b>	
Scale	1 : 100



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Consultant Address Address Phone Fax e-mail	Consultant Address Address Phone Fax e-mail



1 Eastern  
1 : 100



2 Western  
1 : 100

No.	Description	Date

**SUAS**  
Carriage wheelsets  
maintenance workshop

Eastern and Western  
Facades

Project number 001

Date 04.08.2016

Drawn by Shafranov

Checked by Lehtoviita

**A105**

Scale 1 : 100

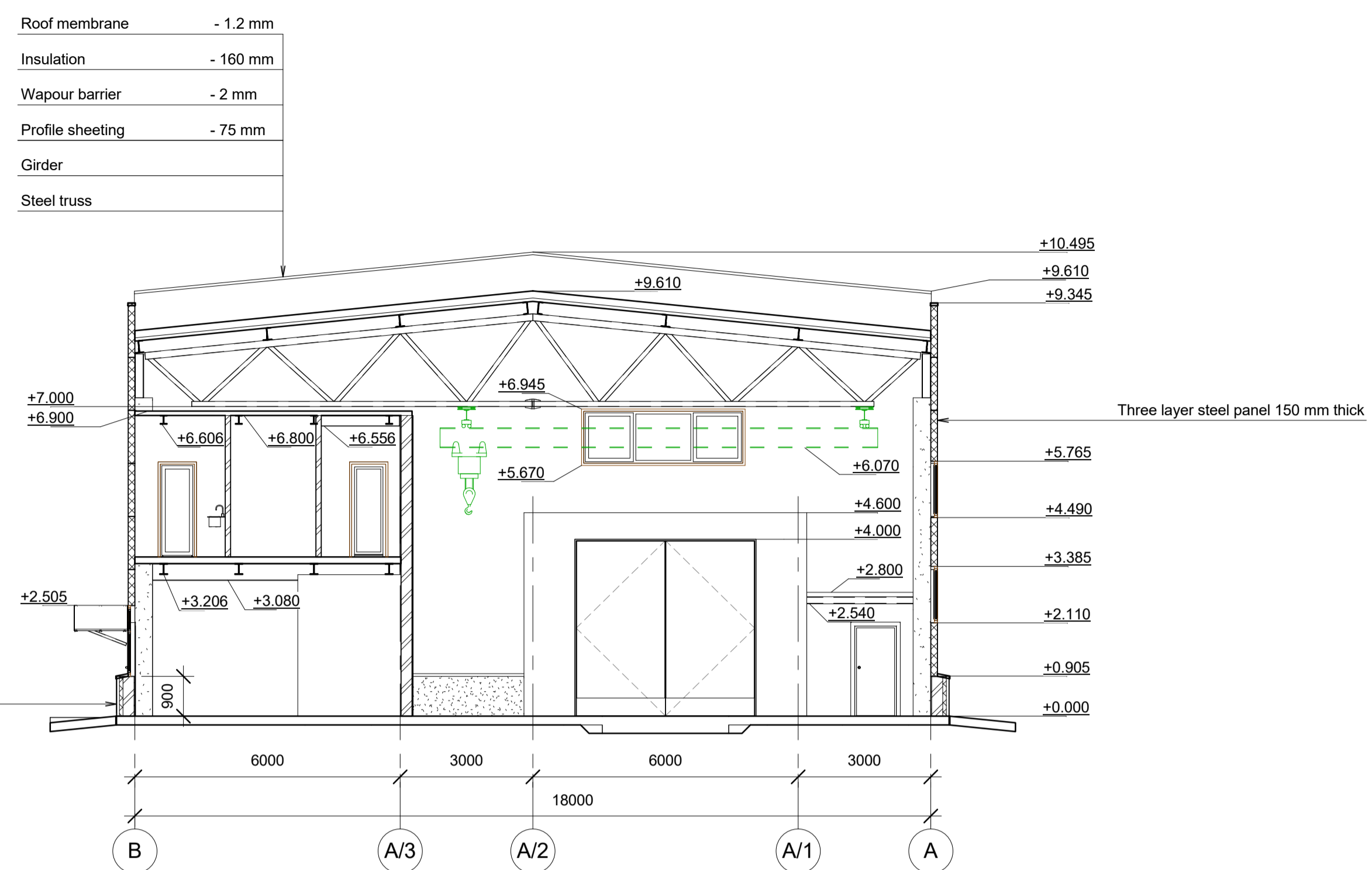


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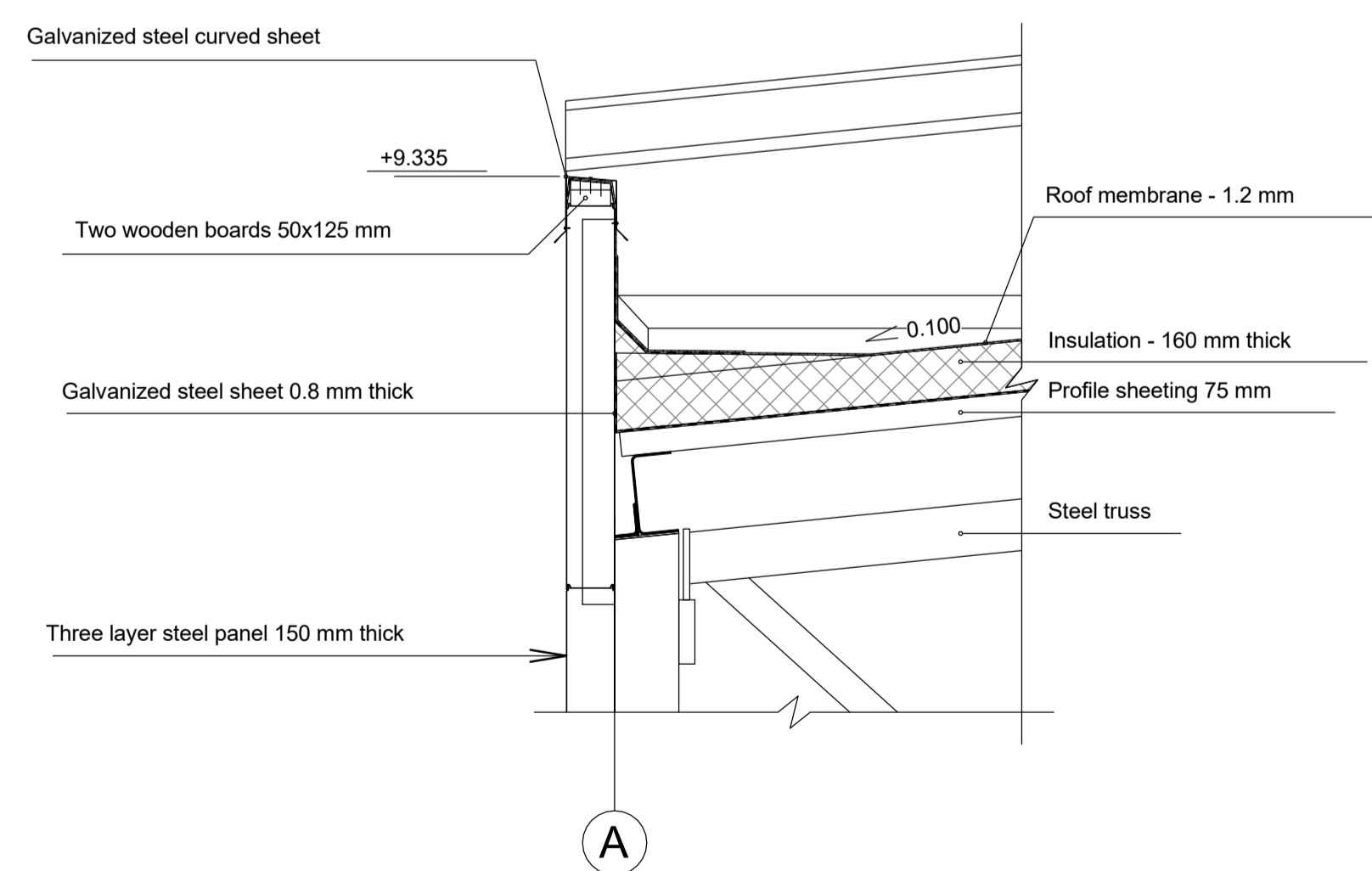
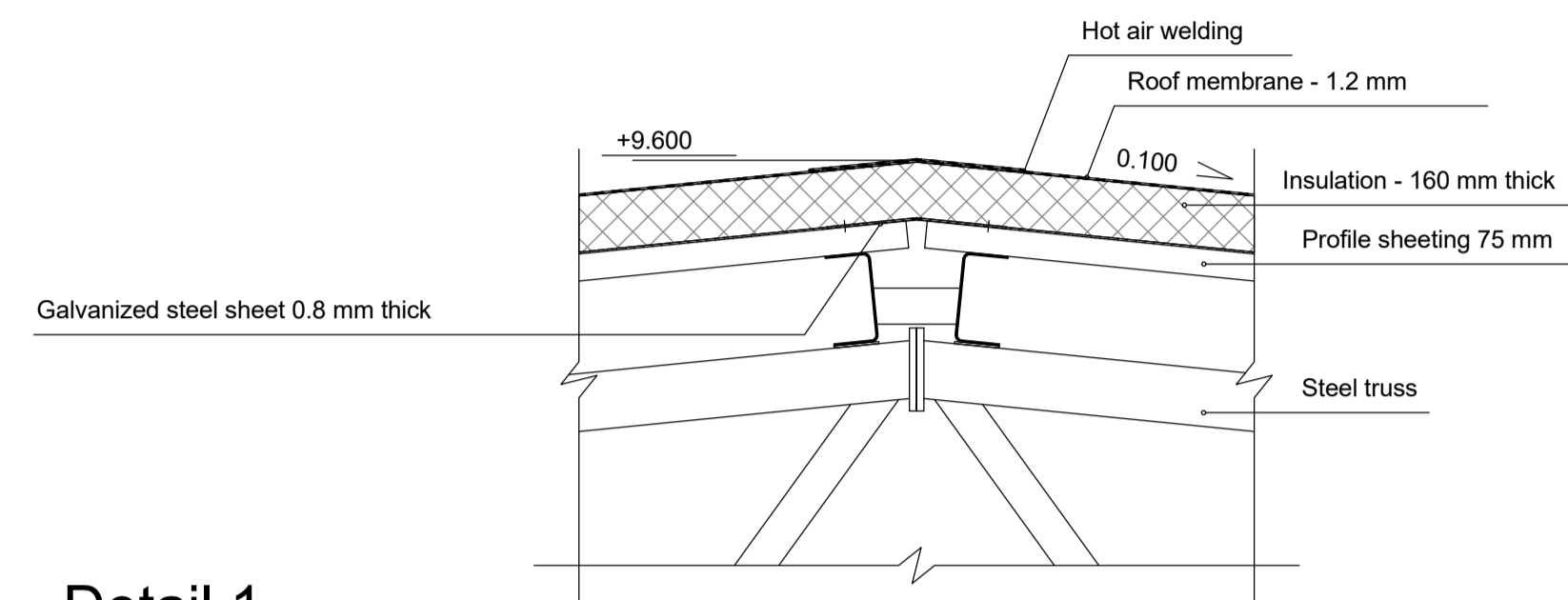


- Fibre-cement facade panels - 8 mm
- Steel structure
- Air gap - 57 mm
- Insulation - 80 mm
- Ordinary solid brick wall - 250 mm
- Internal surface plastering - 20 mm

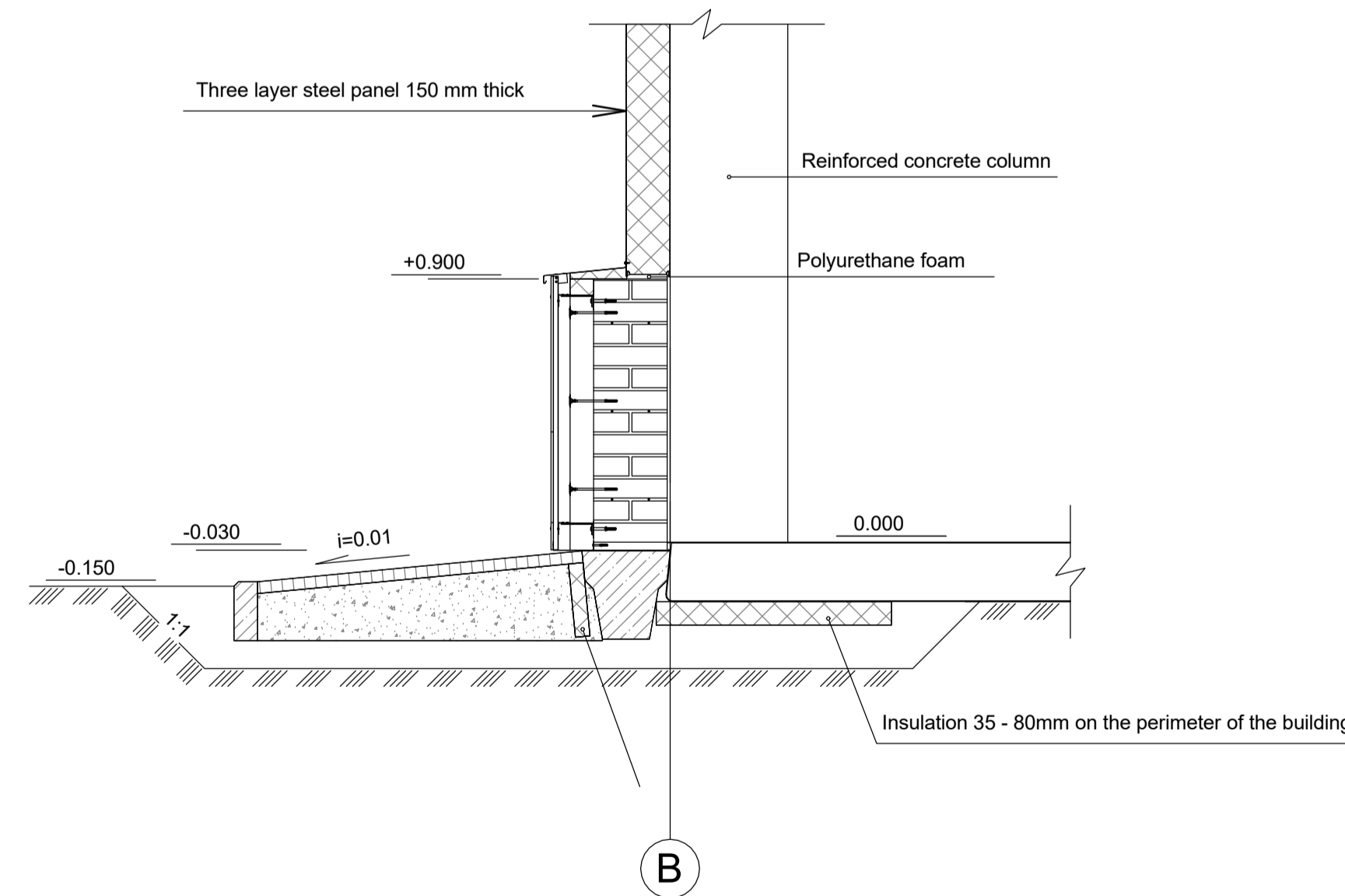
- Roof membrane - 1.2 mm
- Insulation - 160 mm
- Wapour barrier - 2 mm
- Profile sheeting - 75 mm
- Girder
- Steel truss

**1 Building Section**  
1 : 100

**2 Detail 1**  
1 : 20



**3 Detail 2**  
1 : 20



**4 Detail 3**  
1 : 20

No.	Description	Date

**SUAS**

Carriage wheelsets  
maintenance workshop

Building section and  
Detailing

Project number 001  
Date 04.08.2016  
Drawn by Shafranov  
Checked by Lehtoviita

**A106**

Scale Как указано

**ARCHITECTURAL MODEL DESCRIPTION DOCUMENT**

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## **1. PURPOSE**

The purpose of creating and publishing a carriage wheelsets' maintenance workshop architectural model is to demonstrate the basics and principals of architectural design according to publication series Common BIM Requirements 2012. The use of the model is at educational purposes only.

## **2. DEGREE OF PRECISION**

According to BIM requirements for various phases of the project and BIM content levels classification, the model corresponds to detail design phase and provides BIM content level 2.

## **3. VERSIONS**

The original model is the only version created. The current version of the model is created and published for the first time and is considered as a complete model.

## **4. SOFTWARE**

The software used for modeling is Autodesk Revit Architecture version 2015.

## **5. ORIGIN OF THE MODEL**

The position of the origin of the model is at the intersection of the grids 1 and A. The x-axis direction is from the grid 1 to 8.

## **6. CONTENTS OF THE MODEL**

### **6.1. Model views**

The model includes views created:

- Floor plan at level 0.000
- Floor plan at level +3.600
- Two 3D views and visualization take-offs accordingly
- Four facades to every cardinal point accordingly
- Building lateral section
- Three detail views

- Wall types legend
- Room specification

## **6.2. Spaces**

The model includes spaces created:

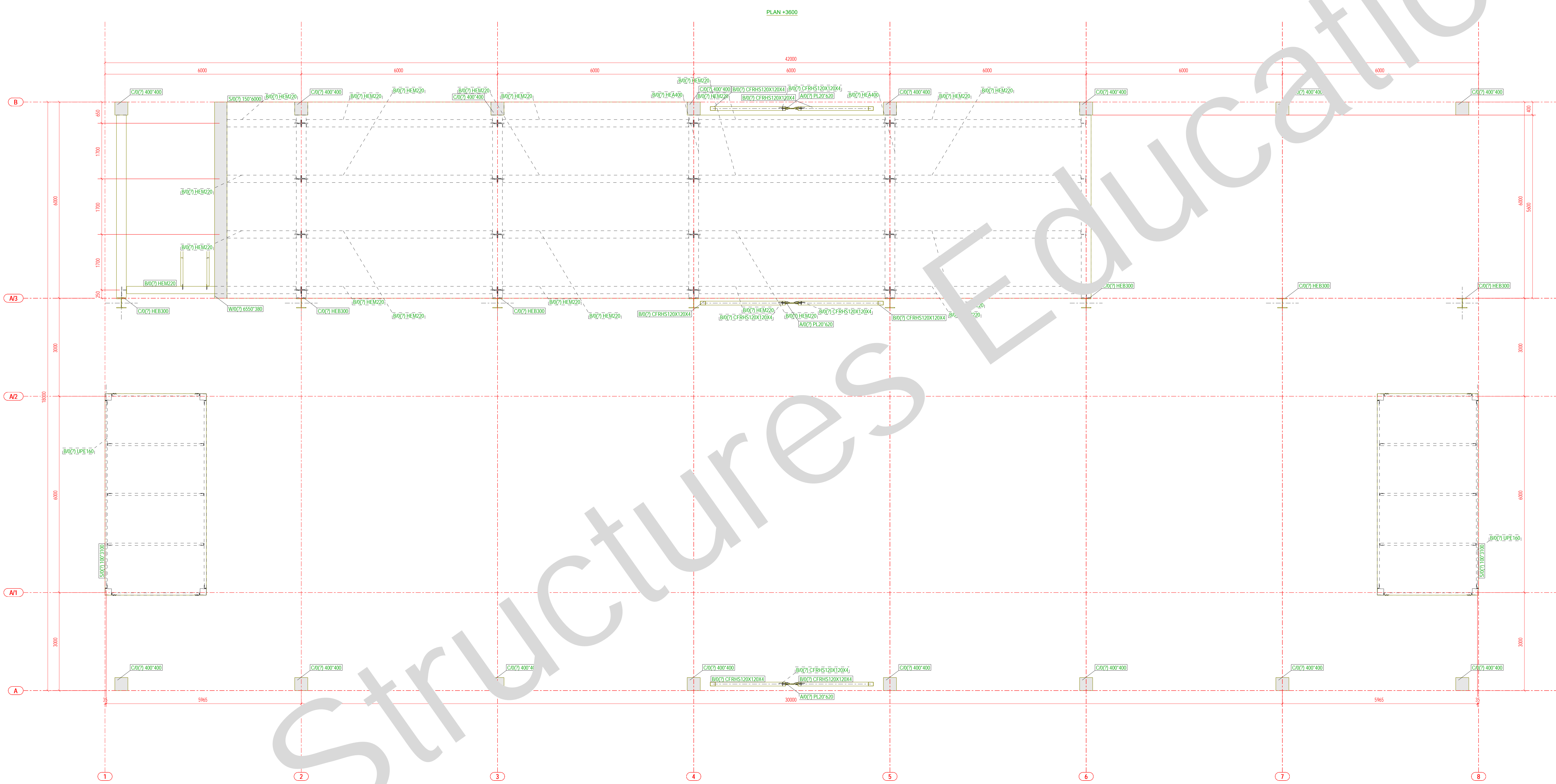
- Tambours
- Halls
- Stairwell
- Wheelsets maintenance site
- Pantries
- Baths
- Toilets
- Wardrobes
- Heating plant room
- Gauging post
- Master room
- Mechanic site
- Ventilation chamber room
- Dining room
- Showers
- Rest room
- Waiting rooms

## **6.3. Building elements**

All elements of the building are modeled with proper tools:

- External walls are modeled with a curtain tool and divided into the panels of the proper size and material layers
- Internal walls are modeled with a wall tool
- Floors are modeled using floor tool
- Internal and external doors, garage doors are modeled with a door tool
- Windows are modeled with a window tool
- Roof system is modeled with a roof tool

- Internal stair is modeled with a stair tool, external stair is modeled as a solid standard component
- Entrance peaks structures are modeled with beam and roof tools using proper list of materials
- Structural engineering parts are modeled roughly and simply for visualization
- Concrete and steel columns are modeled using structural column tool. Steel beams and trusses are modeled using beam tool



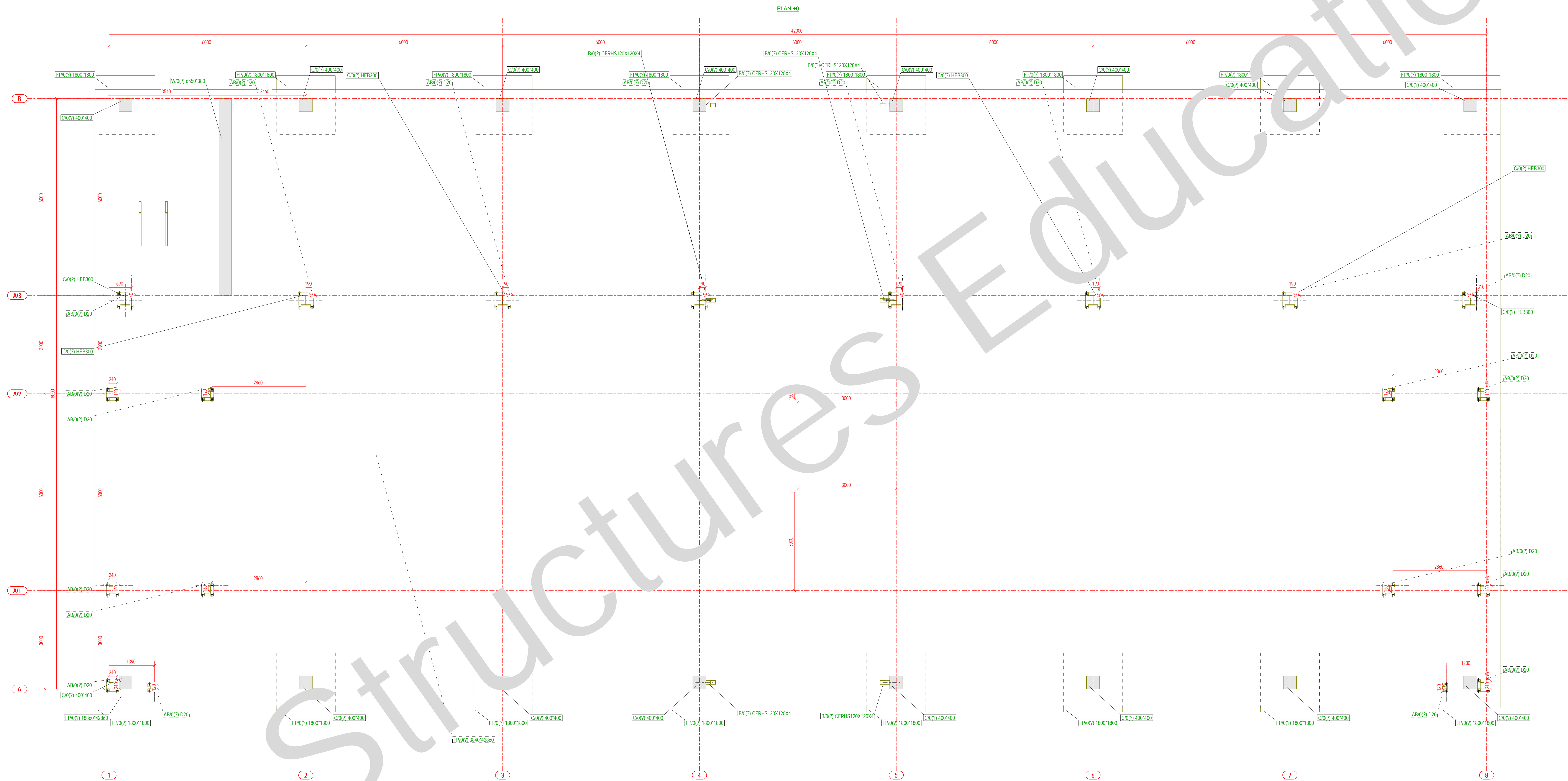
Tekla Structures Educational

No	REV MARK	REVISION DESCRIPTION	CREATED	APPROVED	REV. DATE

DRAWING TITLE		GA-drawing
PROJECT NAME		Trimble Solutions Corporation
DESIGNER		ISSUE DATE
PROJECT No.	1	SCALE 1:50
DRAWING No.	[1]	REVISION No. 0

Tekla Structures Educational



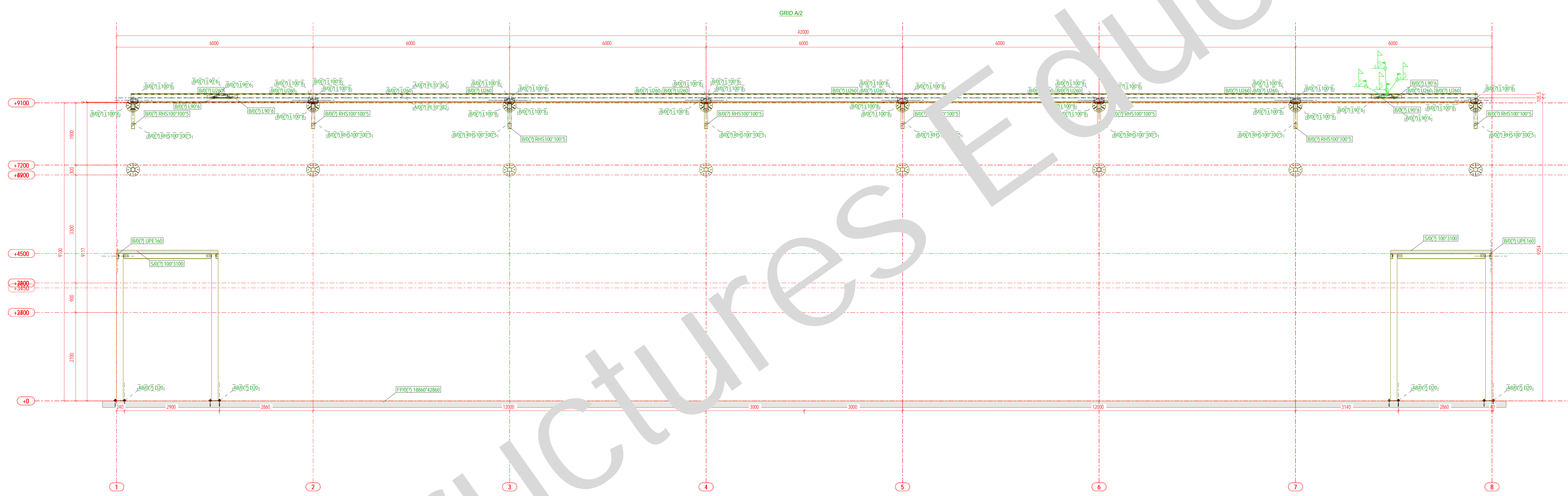
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PROJECT NAME		Trimble Solutions Corporation
DESIGNER		ISSUE DATE
PROJECT No.	1	SCALE 1:50
DRAWING No.	[2]	REVISION No. 0

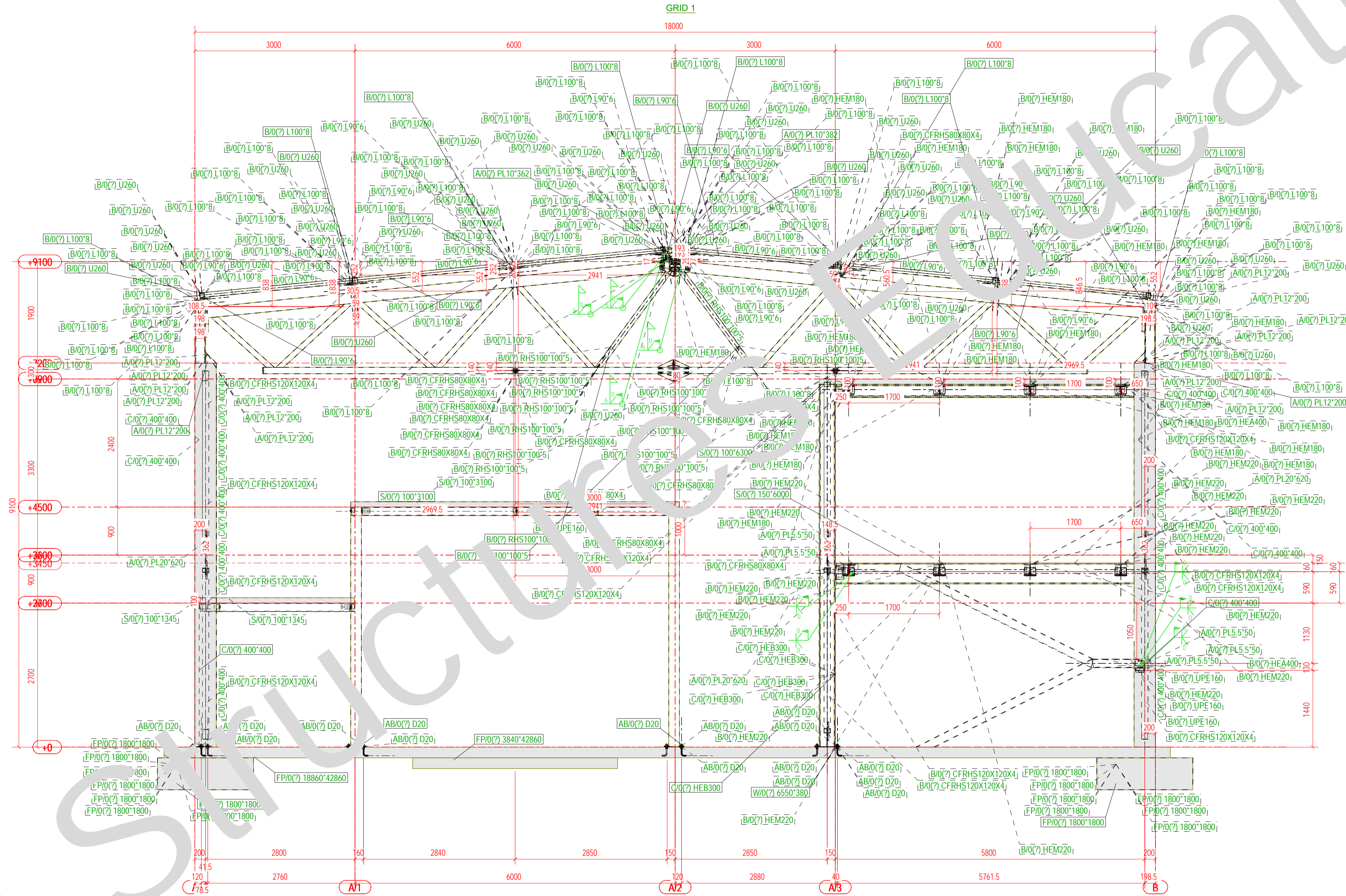


Tekla Structures Educational




No	REV MARK	REVISION DESCRIPTION	CREATED	APPROVED	REV. DATE
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Tekla Structural Solutions



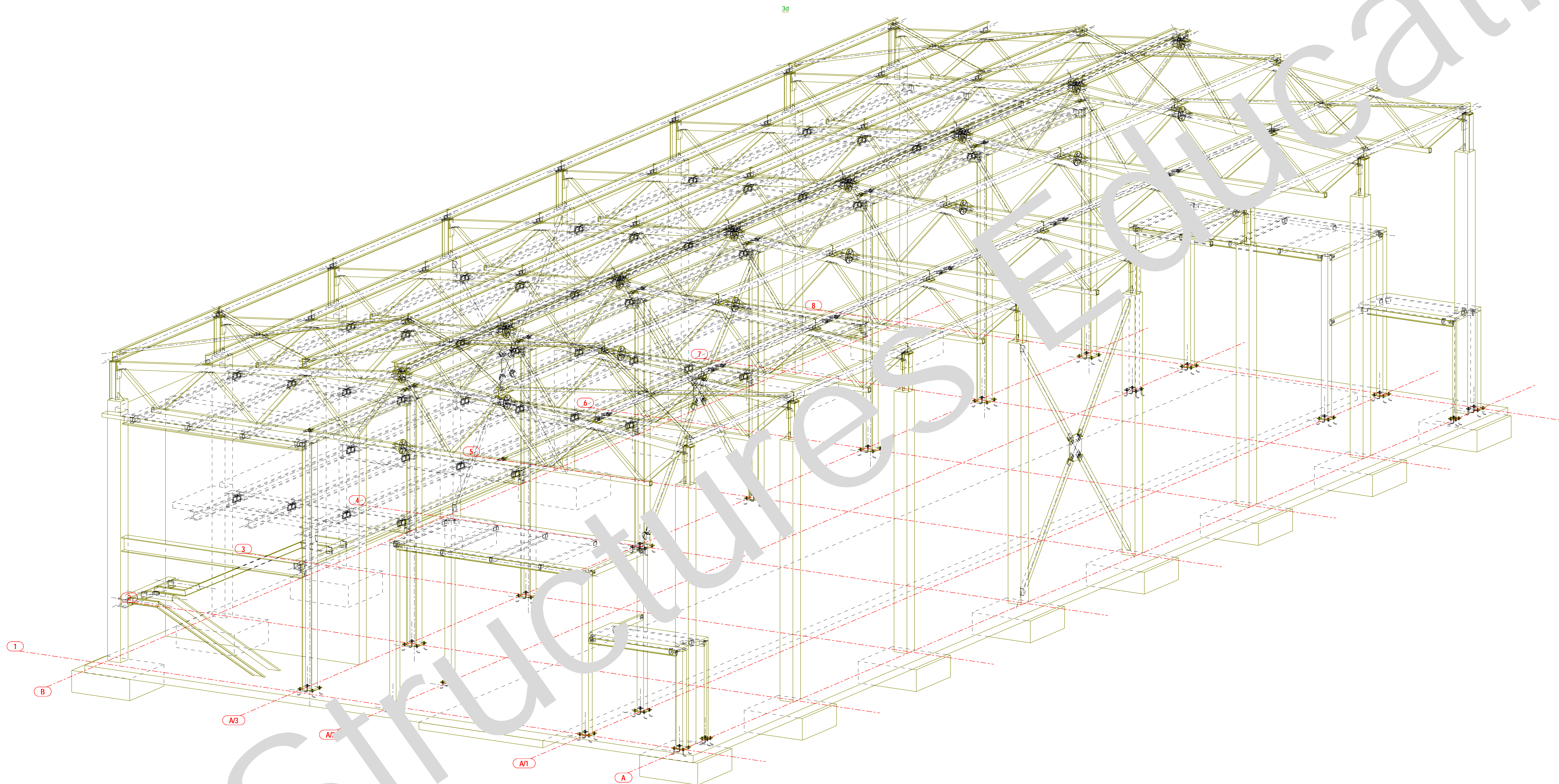
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Powered by  


DRAWING TITLE	GA-drawing		
PROJECT NAME	Trimble Solutions Corporation		
DESIGNER		ISSUE DATE	
PROJECT No.	1	SCALE	1:50
DRAWING No.	[4]	REVISION No.	0



Tekla Structures Educational



No	REV MARK	REVISION DESCRIPTION	CREATED	APPROVED	REV. DATE
DRAWING TITLE		GA-drawing	Powered by		
PROJECT NAME		Trimble Solutions Corporation			
DESIGNER			ISSUE DATE		
PROJECT No.		1	SCALE 1:50		
DRAWING No.		[5]	REVISION No. 0		



**STRUCTURAL MODEL DESCRIPTION DOCUMENT**

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## **1. PURPOSE**

The purpose of creating and publishing carriage wheelsets' maintenance workshop structural model is to demonstrate the basics and principals of structural design according to publication series Common BIM Requirements 2012. The use of the model is at educational purposes only.

## **2. DEGREE OF PRECISION**

According to BIM requirements for various phases of the project, degree of readiness of the model corresponds to general design phase.

## **3. VERSIONS**

The original model is the only version created. The current version of the model is created and published for the first time and is considered as complete model.

## **4. SOFTWARE**

The software used for modeling is Tekla structures 2016 Trimble.

## **5. ORIGIN OF THE MODEL**

The position of the origin of the model is at the intersection of the grids 1 and A. The x-axis direction is from the grid 1 to 8.

## **6. CONTENTS OF THE MODEL**

### **6.1. Model views**

The model includes views created:

- Plan at level 0.000
- Plan at level +2.700
- Plan at level +3.450
- Plan at level +3.600
- Plan at level +4.500
- Plan at level +6.900
- Plan at level +7.200
- Plan at level +9.100

- 3D view
- 3D merged model view

## **6.2. Building elements**

All elements of the building are modeled with proper tools:

- Footings are modeled using pad footing tool
- Concrete and steel columns are modeled using column tool according to its material
- Steel beams are modeled with a steel beam tool
- Stairwell structure is modeled with a steel beam tool
- Floors are modeled using concrete floor tool
- Steel bracings are modeled with a steel beam tool
- Trusses are modeled with a beam tool
- Steel plates are modeled with a steel plate tool
- All the connections between elements are made using standard Tekla components catalogue