Design of Methodological Procedure of Hall Modeling in the Revit Software

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Abstract: In this article, we will show you how to use the Revit software application developed by Autodesk. This software application is focused on parametric 3D modeling and drawing of elements used in the construction industry. It is one of the BIM tools (Building Information Modeling), which is the only one that provides the project from the concept phase to construction and throughout the use and management of the building. We'll also show you the benefits of Autodesk ReCap software, which is used as a tool to clean up the point cloud after scanning, show you the results of working after editing the point cloud and transferring it to Revit software.

Keywords: Revit; Autodesk; modeling; digitization

1. Introduction

3D modeling is actually a part of graphics that deals with creating 3D models. 3D modeling requires, like everything else, a certain amount of experience and gradual training. 3D constraint modeler lies only in his skills and imagination.

There are several types of modeling techniques are known, whether realistic modeling or accurate modeling according to the technical drawing documentation. 3D modeling has its rules whose adherence leads to quality end models. There are a number of criteria that modelers take into account when modeling. These are, for example, the materials or composition used. Top modelers rely on model accuracy in many ways. This fact is considered as a necessity.

Today, digitization has become an indispensable sector in various industries. Whether in the engineering or construction industries. Digitization is also an important part of medicine, art but also the gaming and film industries. Over time, the development of computer technology reached a level that allowed the introduction of 3D scanning in areas of industry, which subsequently provided improvement and acceleration of work for engineers. This topic is automatically followed by the issue of digital enterprises, where the Digital Enterprise is a whole consisting of modern technologies that enable the acquisition of digital form of various elements of the enterprise. It is basically a digital image of a business. The biggest advantage of a digital business is that it can detect the impact of changes before they are implemented.

The functions of the digital enterprise are mostly used in optimization, workplace design, design and, last but not least, design of production systems. One of the basic pillars of Industry 4.0 is the tools of the Digital Enterprise. The answer to this question

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today is addressed by enterprise standards, which are considered to be the application of various system requirements, which ultimately solve many problems of modern enterprises.

2. Revit software operating conditions

3D building models are efficiently created in the Revit software environment. This software allows you to easily create any view or section or later detail. Also allows you to use the "walk" tool to create an animated visualization of a project that has for the task of simplifying communication with the customer or just for the sake of a better idea of the virtual buildings.

The Revit software environment also includes an automatic overview of building blocks. These are, for example, quantities, materials but also individual prices. These reports are always current and are generated from the given model. Another advantage is the number of libraries that allow you to create your own components. One of the applications of Revit software is automatic saving. This means that the project is saved continuously even during important changes or at a preset time interval.

2.1. Autodesk ReCap

Autodesk's ReCap software lets you directly open point clouds and filter unnecessary data and work with more manageable files with several customizable import settings. In addition, because points are generated using Autodesk, points can be extracted or imported into all other Autodesk products. You can use a ReCap point file to clean up a point cloud after the process of scanning an existing building, and then import it into Revit to begin accurate 3D model design (Fig. 1).
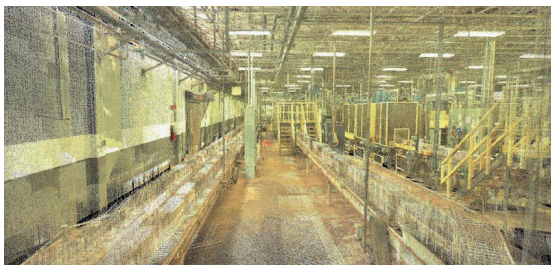

Figure 1: Point cloud of the interior points of production hall.

The need to create a new methodological procedure arose on the basis of inconsistent outputs of 3D models of halls created in the

according to the standard) needed for modeling, thus avoiding inconsistencies in modeling and unifying the procedures of all employees within department. The term "family" refers to a group of elements (such as doors, windows ...) in a template that is used for faster selection in modeling.

The advantages of such a "template" are clear only in terms of time savings compared to work without such a template, when all elements need to be redefined and created. Without the use of such a template, the time of creating a 3D model of the hall can be extended by several days.

Another advantage is the use of suitable elements (families) of the software so that the output of such a model is beneficial for further use of the model within the company. Due to the diversity of production halls, especially in terms of design and equipment, this template focuses on the basic elements that will be used in each hall model. Also, the template remains created to be able to add other elements needed to model the hall.

The template contains information on all the properties that the production hall should contain, whether it is the colors, structures or materials of the walls, columns, pipes and other essential elements of the production hall (Fig. 2). The template is created

Figure 2: Standard pattern for exterior surface colors (own resource).

digital enterprise department. This procedure was incorporated into the so-called "template" software Revit. Such a "template" allows reloading into the software in seconds with already preset settings of individual elements (families, and colors and settings

in English, so that there are no complications in understanding at the international level. In general, standards are subject to update, which is subject to various changes. These changes also occur thanks to engineers who gain practical experience and thus improve possible mistakes.

3. Modeling in Revit software

The first step in modeling is to create a new project and load the template into the project. Modeling patterns are preset in this template. An essential component of this template is that "families" are loaded into it. These families contain all the elements needed for modeling. Whether families of walls, doors, columns or various fittings for modeling pipes, air conditioning or cable trays, etc.

After loading the template, it is approached by inserting a point cloud that has been modified and filtered to the required properties and size. For larger objects, a point cloud is output after scanning, which is usually more computationally intensive because it contains a larger amount of data. It is not uncommon for such a cloud to have 400Gb.

For the needs of this article, illustrative examples of modeling various components from revit software were selected, which will represent the methodological procedure. The images that will be displayed below will be from the revit software environment only in Czech, as the English version was currently unavailable.

3.1. Wall and window digitization procedure

Digitization of production hall walls in the Revit program environment is performed using the "wall" function.

For the needs of creating walls in the halls, they were divided into 2 subgroups, namely:

– *Interior*

       - Base walls (mostly sandwich construction)
       - Bricked

– *Exterior*

Such a division was chosen due to the different colors of exterior and interior walls. Following the mentioned interior walls, other subgroups were chosen due to the load-bearing capacity of these walls.

For each wall type, only the basic thicknesses of the structures were selected. Due to the number of different thicknesses of structures, the user can very easily, thanks to the offer of functions "adjust

the type", create a new thickness of structures by duplication. Using the preview function in the "edit type" function, the user can easily check the future appearance of the structure (Fig. 3).
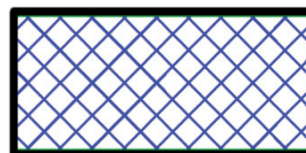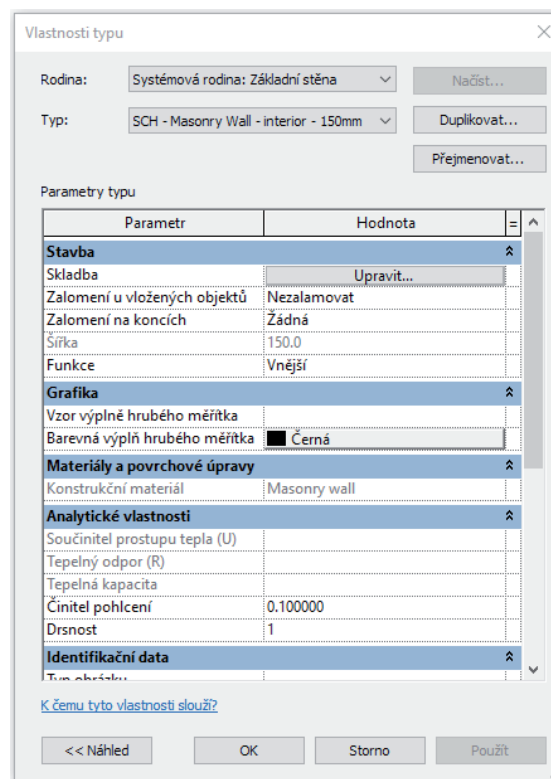

Figure 3: Brick wall hr. 150 mm with standard surface finishes (own resource).

When modeling large windows, which are mostly located in office spaces, the wall function is used, in which the "SCH - storefront window" option is selected. This feature provides easy setting of properties, dimensions, spacing and division of windows. It is also possible to set the type and function of the window, but also the degree of fire protection, which also applies to the setting of the door (Fig. 4).

With the "Duplicate" function, not only for walls and windows but also for all other modeling functions of various elements, the element can be changed or duplicated. In the first step, its name
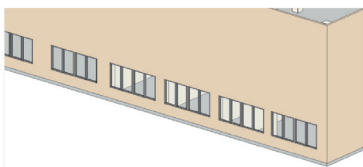
Figure 4: Example of creating window groups using the SCH wall function - storefront window (own resource).

Figure 5: "Duplicate" function (own resource).

is changed with dimensions. In the next step, the dimensions themselves or even the properties change (Fig. 5). This feature elegantly prevents new element families from being downloaded from the Internet, taking up unnecessary space for a single element

3.2. Procedure for digitization of air conditioning and extraction

In production halls, air conditioning is often installed for a reason a large number of machine tools that must be ventilated. By installing air conditioning, the temperature in the halls is reduced on the one hand, and on the other hand, fumes from machines or from hardening furnaces are ventilated, in which heat and fumes are most excreted into the environment.

The duct system is modeled according to another function, namely "duct". The air-conditioning system is provided at the ends with outlets through which heat and vapours are dissipated to the extraction system, which then passes through the filter units. Air conditioning is modeled via the "Piping" function. Different types and sizes can be set in this function. The function offers a choice of round or square pipes.

The template library offers a number of types of shaped pipes to choose from. These fittings are used in modeling of air conditioning, especially in situations where it changes its direction in the horizontal as well as vertical direction. These fittings significantly speed up the modeling of air conditioning, due to the fact that when changing the mentioned directions by rewriting the dimensions, it automatically inserts a fitting from the library that meets the requirements (Fig. 6).
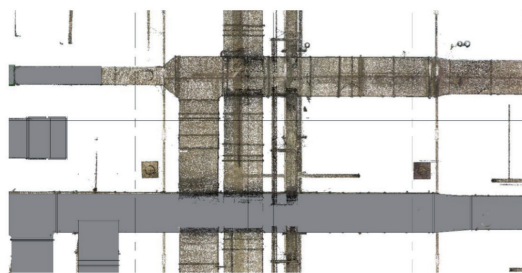

Figure 6: Example of modeling of air conditioning according to a point cloud (own resource).

4. Conclusions

The template that has been created has even more potential because it could be used to create further extensions and extensions in several directions, whether it is an extension solution for families in terms of adding new families for several elements located in production halls such as lighting, fire-fighting equipment, protective elements for workers, but also machine tools. Also to these new families but also to the families of the elements, which the template already contains, features that would greatly enrich these families could be added. For example, in the case of doors, these could be additional properties such as door markings and their numbers, fire durability, soundproofing, safety class and the like.

For families with windows, for example, additional features could include a degree of insulation in addition to soundproofing, such as

doors. Another additional function could be the possibility that the windows contain elements such as blinds or shutters, which are mostly used in office and administrative spaces.

All this additional information mentioned above would be a great helper for building management, which would simply be able to supplement the necessary data in this way, which would help when managing buildings.

Acknowledgments

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