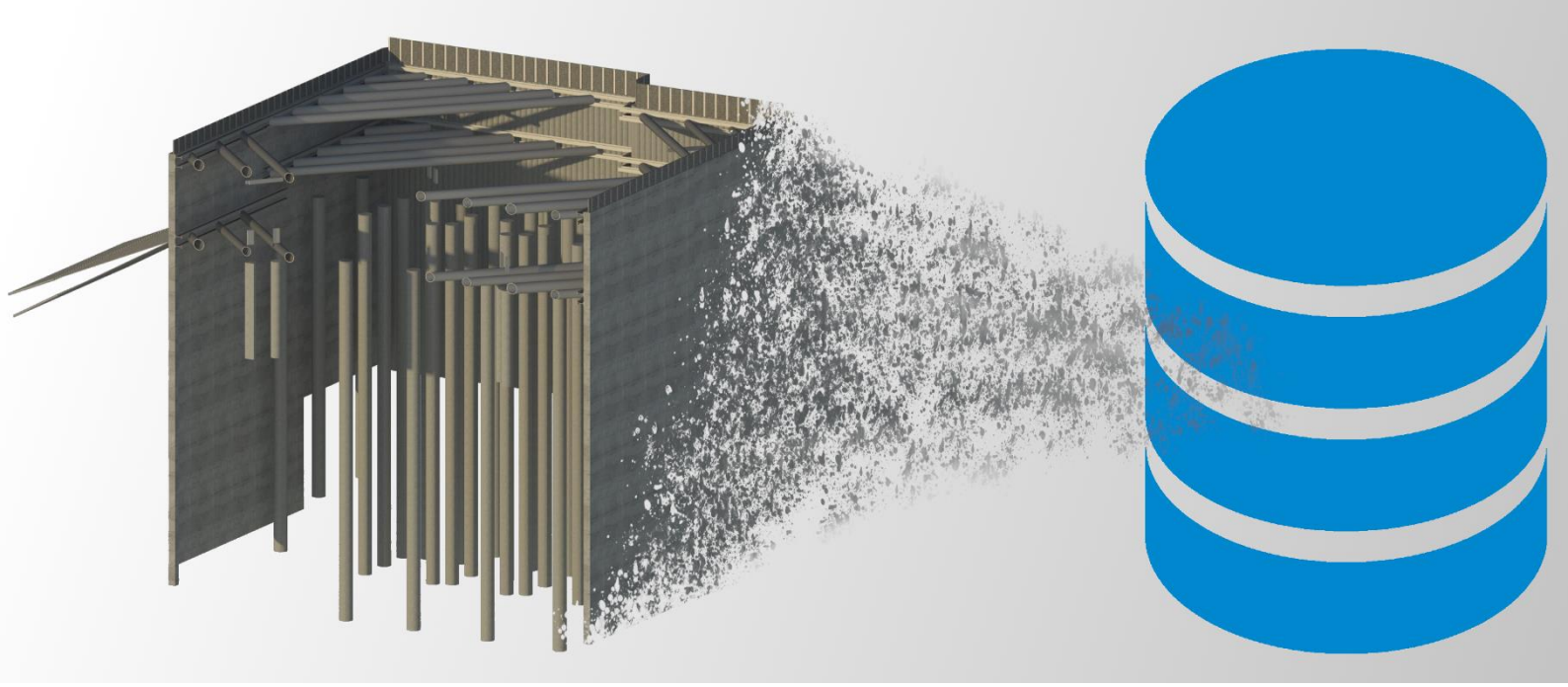

Automatic generation of 3D models from data sources

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Background

The definition and following implementation of a clear and agile digital business strategy is one of the most important aspects that is currently under consideration and development in many industrial sectors. A correct strategy shall be based on an innovative integrated thinking concept, which shall be flexible enough to adjust and mutate in the long term according to the challenges and speed characterizing today's digital market.

The resources planned to fulfill this strategy shall be continuously verified, compared and updated according to the actual requirements. Especially in the building industry, such requirements can vary significantly depending on many factors and conditions. One of them is the increasing presence of BIM models during the initial tender phase of construction projects. For example, tender engineers more and more frequently need to derive the quantity take-off tables necessary for the price estimation directly from 3D geometrical models. BIM models can be delivered or created on-demand in a second stage as well, i.e. during work preparation or directly implemented in execution.

Additionally, the individual nature, size and sensitivity of a project persuade, in many situations, the stakeholders to embrace a different process and data management system, involving geometrical, physical, productive, geospatial details to be collected, analyzed and handled by means of digital approaches.

On the other hand, a well-structured and accessible documentation is becoming a significant part of clients' specifications, which force contractors to adopt suitable solutions to deal with project-related information in a more efficient and comprehensive way.

Taking into account all factors mentioned above, the tendency in Züblin Ground Engineering (ZGE) is to understand the influence of market's, project's, client's and internal needs and, from this knowledge, to promote the concept and implementation of 3D model-based projects.

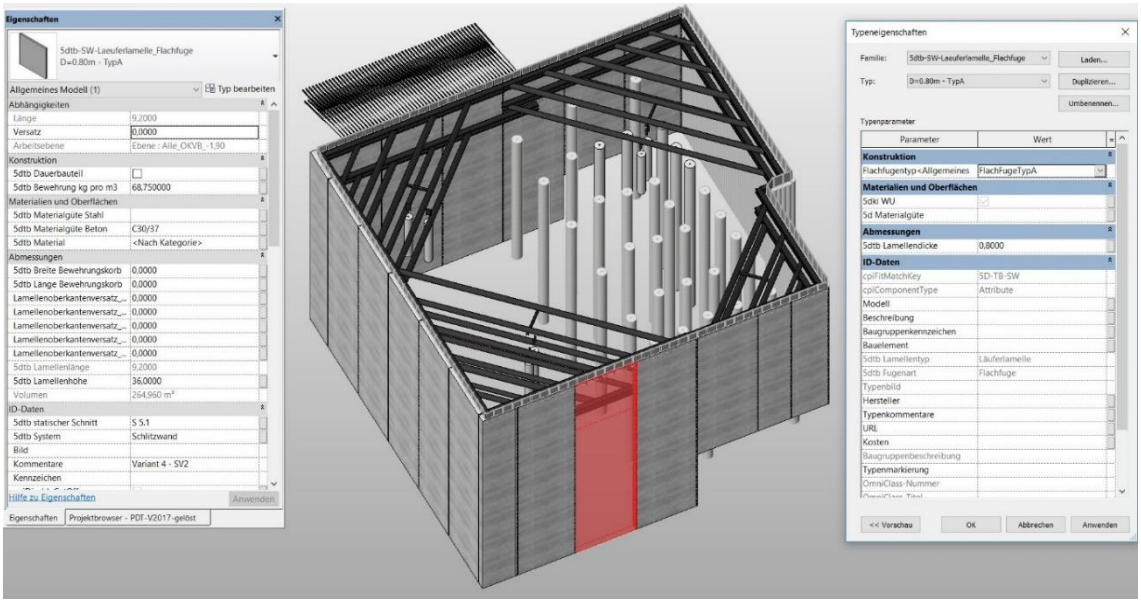

Figure 1: 3D visualization of a construction projects in Autodesk Revit together with its elements and related parameters.

3D models are regarded as one of the fundamental components of projects, whereby assumptions can be defined with a higher reliability, different scenarios can be represented three-dimensionally and access to the related information is eased. To reach these ambitious targets, methods allowing an effortless generation of 3D models are planned to be developed based on a collection of meaningful parameters for each 3D element to be visualized. Such input values can be prepared and delivered under the form of a spreadsheet or directly queried from a database.

Concept description

The preparation of a geometrical model is sometimes a challenging activity, which requires time and has to be carried out by specialized BIM personnel. Nevertheless, an automatic generation of 3D models from a list of parameters is also possible and currently under development in ZGE in cooperation with the BIM 5D department of Züblin Zentrale Technik.

The basic approach is based on the use of Autodesk Dynamo scripts, which read the parameters associated to distinct Autodesk Revit families arranged in a predefined order in a spreadsheet. After the input acquisition, the script selects the proper Revit family and draw the corresponding exemplars in the Revit environment at the given location and with the preset attributes.

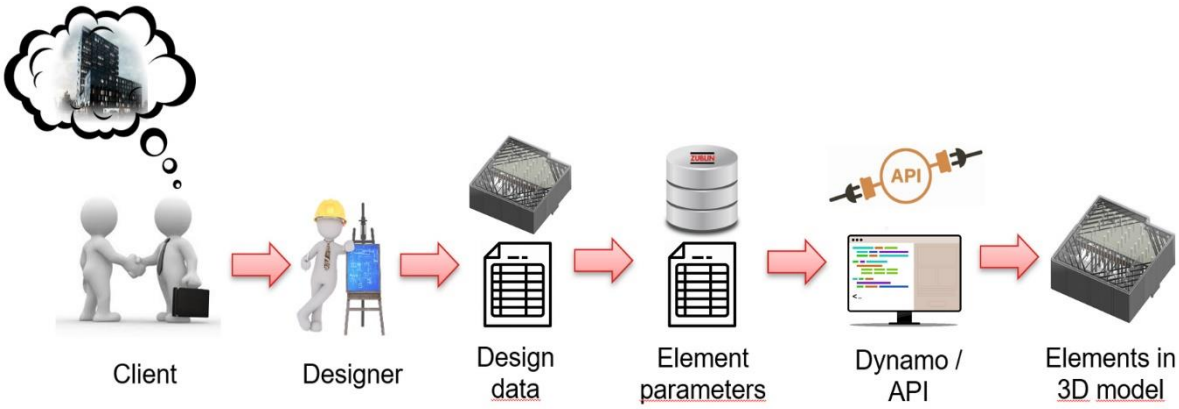

Figure 2: sequence of phases from concept to creation of Revit model by means of Dynamo scripts or Revit API.

To achieve a more general solution independent from Revit yearly releases, Dynamo scripting will be replaced by an actual software interacting with Revit through application-programming-interface (API). This procedure is expected to eliminate the limitations of Dynamo and to provide a more flexible interpretation and elaboration of the information related to the most common families encountered in special foundation projects.

Moreover, such a dedicated software will further enable the storage of design parameters directly into a well-structured repository available for different kind of users, e.g. a cloud-based database. The advantage, in this case, is that the model can be reproduced at any time simply by retrieving the geometrical features stored in the repository and using the program to process them into the final 3D structure in Revit.

Besides design information, production data referred to the building works carried out at the site (e.g. start and end drilling time, performance, rig operator, wear & tear etc.) are meant to be collected in the ZGE database as well and to be reused later on as a sort of digital reference archive from which future projects will benefit. Once properly filtered and processed, these values can be fetched and integrated in Revit by filling in programmatically the matching parameter fields for each instance within the 3D model.

An evident outcome of this method is linked with the possibility for the personnel employed at the site and for potential stakeholders to clearly visualize production details in a 3D representation of the construction elements already installed in situ. This measure is supposed to help site engineers with the review of the productivity obtained, for example, in a certain section of the project or during a certain phase. In addition, they will also provide a great support whenever disputes or claims with other parties occur.

Figure 3: integration of production data from construction site to 3D model through database

Conclusion

This paper aims at describing the basic steps which Züblin Ground Engineering intends to pursue in order to reach an integrated working strategy involving BIM models and production data. Methods to generate automatically 3D models from a list of design parameters properly arranged in spreadsheets or in a cloud database have been briefly illustrated together with the main respective advantages. Furthermore, construction data obtained directly during the execution stage are planned to be placed in a unique repository system along with the design geometry. It is worth mentioning that an efficient collection, storage and processing of data is also deemed to play a fundamental role in this context and is currently under development.

A general scheme combining geometrical and production information is expected to considerably improve the management and control of construction activities at the site simply due to the easier access to specific features of interest. At the same time, it provides a solution that can be offered to a wide audience of clients to fulfill their particular needs. In conclusion, this comprehensive approach is considered as a key factor in successfully facing the challenges and the high level of competition characterizing the present and future of the special foundation industry.