

BIM based digital building permit process

Process development and validation using lean management methods

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ABSTRACT: This master's thesis presents the development of a reference model based on building information modeling for the largely digital representation and partially automated compliance check of the Tyrolean development plan (BBP).

As part of the processing, the traditional building permit procedure was first recorded as an overall process and possible potential for improvement was evaluated using digital technologies and lean management methods. Furthermore, the current initiative of the state building guild regarding a digital building application in Tyrol was scientifically accompanied in cooperation with software developers and a Tyrolean municipality.

The results obtained form the basis for the conception of a BIM-based building submission, which is no longer based on 2D planning documents, but on digital building information models. By integrating largely semi-automated check routines based on collision analysis and rule-based checking, the building permit process can be significantly optimized in terms of transparency and efficiency.

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KEYWORDS: BIM, reference model, code compliance check, building submission, building permit, lean management

1 INTRODUCTION

“Coming together is a beginning. Keeping together is progress. Working together is success.” – HENRY FORD

As the founder of one of the largest automobile manufacturers in the world, HENRY FORD was already aware at the beginning of the 20th century that successful cooperation between all participants is the key to a successful project. Building on this principle, FORD succeeded in revolutionizing assembly line production based on the efficient cooperation of its employees using modern technologies. The collaboration methods developed by HENRY FORD were adopted by numerous manufacturers and continue to shape the automotive industry to this day. [1]

Following Henry Ford's principle, this master's thesis contributes to improving cooperation within the building permit process using BIM. In this context, successful cooperation not only includes the companies involved, but also the responsible authorities in a holistic view. To make this possible, there is a need to make official building permit processes largely digital and BIM-compatible in order to ensure efficient cooperation between applicants and authorities.

2 BASICS

2.1 Building Information Modeling

“Building Information Modeling describes a cooperative working method, with which, on the basis of digital models of a building, the information and data relevant to its life cycle are consistently recorded, managed and exchanged in transparent communication between the participants or handed over for further processing.” [2]

According to the definition above, BIM is a collaborative process with several dimensions. The core of this process is the information modeling of the corresponding building. Building information modeling can therefore be literally translated into German as *“Bauwerksinformationsmodellierung”* - the associated models as *“Bauwerksinformationsmodelle”*. [3]

The responsible building authorities can be integrated into the BIM process as *“participants”*.

2.2 Legal Bases

The legal basis for the building permit process is the public building law. It falls within the competence of the federal states and is therefore different throughout Austria. In Tyrol, public building law includes the following laws, regulations, and guidelines: [4]

- Tyrolean Building Code (TBO) 2018
- Technical building regulations (TBV) 2016
- Guidelines 1 - 6 of the Austrian Institute for Building Technology (OIB)
- Tyrolean Regional Planning Act (TROG) 2016

In the context of this master's thesis, in addition to the basic TBO specifications, the focus is primarily on the content of the development plan (BBP) defined within the TROG.

3 BIM BUILDING SUBMISSION

3.1 Process abstract

The BBP content is transferred to a digital development plan reference model (REM) using BIM. This serves both as a planning basis and as a reference for the official check with the submitted building application model (BAM). [5]

The transparency of the permit check can be significantly improved, since the building applicant is provided with official check rules which allow a preliminary check of the planning.

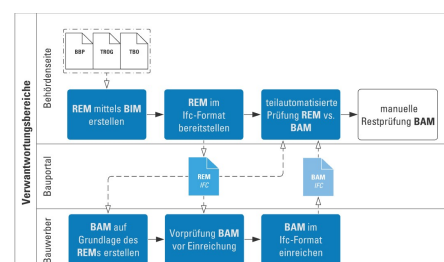


Fig. 3-1: development and function of the REM

3.2 Development plan reference model

3.2.1 Content

The REM maps the content of the Tyrolean BBP defined according to § 56 TROG 2016 BIM-based. Appendix 3 to the Plan Basis and Plan Signs Regulation 2019 serves as a guide to content, which contains all usable BBP content and plan signs in a structured form.

3.2.2 Parameterization

The REM is created in the BIM Software Autodesk Revit 2022. The semantic modeling is based on previously defined, so-called shared parameters, which can also be used to create further REMs. The parameters map the above-mentioned contents of the BBP using suitable data types.

3.2.3 Modeling

The building plot is modeled as a spatial object according to its boundaries. In order to adequately represent the possibility of building within the property, the space above and below ground that can be built on is exposed by modeling a deduction body. The geometry of the deduction body results from the correspondingly defined building alignment and building boundary lines, the permissible roof pitch and ridge direction, the building heights and the TBO minimum distances. These are defined by using pre-defined shared parameters.

The side surfaces of the deduction body are classified using adaptive families - which, for example, approximately map building lines in the form of a minimally slender extrusion body as a plane.

The other, shared parameters allow a description of the semantic content (e.g.: building densities, construction methods, etc.) and a derivation of further geometric information.

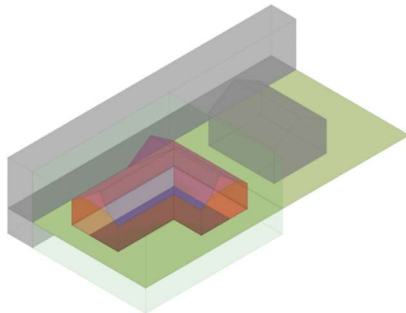


Fig. 3-2: REM project file

3.2.4 Overlay of REM and BAM

The actual verification of the BBP requirements is based on a comparison of the REM with the submitted BAM in suitable verification software (e.g.: Solibri Model Checker). In the course of this, a suitable BAM was modeled in the form of a single-family house. In terms of its information content, the BAM corresponds to the requirements for approval planning defined within the AIA and BAP and thus has a LOIN of 300.

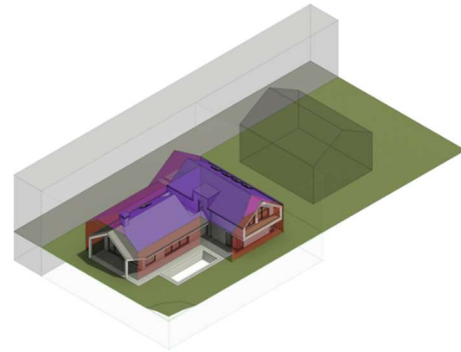


Fig. 3-3: overlay of REM and BAM

Overlaps between REM and BAM on the gable end can be seen in Fig. 3-3 - the specified buildability of the property was deliberately not fully complied with.

With software support, the geometrically mapped requirements can be checked within a collision analysis between both models, the properties stored in Psets are checked based on rulesets.

4 CONCLUSION

In the course of this master's thesis, a solid foundation was laid for the further development of a BIM-based building permit process. The contents of the Tyrolean BBP defined in Appendix 3 to the Plan Basics and Plan Sign Regulations 2019 can be fully mapped using an REM. The partially automated check of the selected BBP content was successfully implemented.

5 OUTLOOK

With regard to the increasing digitization, the BIM submission for Tyrol is of great relevance, since the digital submission currently being developed will only represent a bridging technology (see Fig. 5-1).

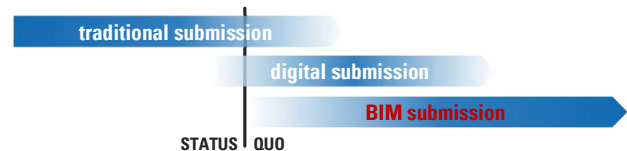


Fig. 5-1: status quo building permit procedure in DACH-region

In the long term, the BIM submission will establish itself as the central building permit procedure in the entire DACH region.

6 REFERENCES

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