Issue of Building Information Modelling Implementation into the Czech Republic’s Legislation using the Level of Development

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Abstract. The object of this paper is the issue of links between the Level of Development of particular project in Building Information Modeling environment and the projects of certain stages of project documentation within the existing Czech Republic’s Legislation. This research article uses the experiences from the initiative of active working group „WG#03: BIM & Realization“, which is the part of the Czech BIM Council, especially the document called “Draft of unified data structure for Building Information Modeling in the Czech Republic”. The findings of this paper are in the defining specific Level of Development of relative parameters, mentioned in this document, connected to the specific level of information and details requested by the Czech Republic’s Legislation. These findings could be used as an underlay to create document called “Level of Development draft assignment to the individual stages of project documentation in the Czech Republic”. The Level of Development is the most useful way of the information visualization, which leads to the most effortless way of exact stated implementation of Building Information Modeling into the practice of designing structures and buildings in the Czech Republic. The Implementation of using Building Information Modeling technology in designing structures and buildings will lead to the enhanced quality of the project documentation and generally to more effective cost savings during whole life cycle of buildings. Moreover, the all over using of the BIM technology in the Czech Republic will be very useful in the Facility Management area, especially in the facility management and maintenance of state buildings.

1. Introduction

Building Information Modeling (hereinafter BIM) Technology is no longer a novelty. BIM history can be dated from the 70’s of the last century. Concept BIM represents a new way not only for structure design, but also for the management of building processes. Virtual modeling of buildings is getting to consciousness of various construction experts. The BIM Technology is increasingly getting popular in all sectors of the construction practice. It is becoming a useful tool for its attractive presentation and visualization, and it’s useful in the field of marketing, too [2, 11, 13, 14].

This stream using BIM thoughts seeks to unify and improve the work efficiency of all the participants within the construction process [12]. When working in different professions of building design, there is often a complicated model transferring from different software or discrepancies of document comprehension. That causes a time-consuming requesting of additional information and its provision, but also frequent errors, thus a mismatch of different parts of documentation. That could reduce the
human errors, which can occur in all human activities across the construction process, especially in a traditional building design process using 2D tools [1].

BIM Environment, especially the Management of BIM, seeks to remove these weaknesses in building designing. Management of BIM is the way of the building life cycle managing [5], which aims to assign particular elements as much information that required by construction process participants in various parts of the building life cycle. The aim of BIM is to develop the model, which each participant is able to work on simultaneously with the others, with the most efficient coordination of construction design. All project changes are registered in the single model and all construction process participants have immediate access to the modifications [12].

This paper handles more specific part of BIM, the Level of Development (hereinafter LOD). LOD deals with the amount of information given to elements in different part of the building life cycle. This information is requested in various levels of detail or building structure development. The object of this paper is to perform research of request for information (hereinafter RFI) from the perspective of the designer and BIM implementation into the Czech Republic’s legislation using LOD.

2. Level of Development

Implementation of BIM technology into the Czech Republic’s legislation certainly needs numerous challenges. There is an option for wider number of potential alternative BIM implementation strategies [3]. Level of Development represents the clearest visualization and the most presentable way for BIM structuring aiming the implementation of BIM technology as easy as possible and its wide using in AEC industry within the Czech Republic.

Various project stages differ by levels of documentation processing, thus by amount of information within a model section or an element. Level of Development handles differences within the various requests for information [14].

Figure 1. BIM Maturity Level., Source: [6]
Level of development should be promoted as a summary of Level of Detail and Level of Information. Level of Detail basically provides how much detailed information is included in the model element and it represents the graphical part of information. Level of Information provides the non-graphic part of information about the element. This means, that LOD as a Level of Development provides graphical and non-graphic information within the model elements. LOD represents a reliable output, which is used by all the construction process participants [16].

The level of documentation, modeling and information sharing in the construction process could be represented graphically by Figure 1 known as “BIM Maturity Level” created and published in 2008, by M. Richards and M. Bew [15].

2.2. Document Level of Development Specification
LOD Specification is a reference, which allows practitioners in the AEC industry to specify and formulate a high degree content clarity and credibility of building information models in different stages of design and construction process [10]. LOD Specification is a detailed interpretation developed by American Institute of Architects (AIA) and it defines visualized model element characteristics in various levels of development. Intentions within this document are to explain the LOD framework and to standardize its use in order to become more useful communication tool. The following Figure 2 is an example of graphical part representation of information about the specific element processed in BIM by using LOD Specification [16].

![Figure 2. Example of graphical part representation of information about the specific element processed in BIM by using LOD Specification., Source: [16]](image-url)

2.3. LOD and model definition
Project models at any design stage will always contain elements and assemblies at various levels of development. Building system progress from concept to precise definition evolved at a different pace. That causes there will be different elements in different points of this progress in a single model at that time. That means there will be elements in LOD 200, LOD 300, even in LOD 100 or 400 at the same time [16].

The Level of Development issue straddles BIM within the meaning of Building Information Modeling and BIM within the meaning of Building Information Management. Building Information Modeling fully enables the development of effective project management not only in the levels of development connected to project design itself but also in subsequent sustainability and facility management [8].

3. Intentions in the Czech Republic
In the Czech Republic, there are intentions to pursue using BIM technology in construction industry practice. It’s called “Construction 4.0” initiative, which is based on the government resolution on the initiative “Industry 4.0” no. 729 dated August 24th, 2016. It leads to establishing of the “Alliance Society
4.0” as a coordinating mechanism involving economic and social partners and academic scientific communities’ representatives to coordinate agendas related to the 4th Industrial Revolution [17].

3.1. Czech Republic’s organizations dealing with BIM
In the Czech Republic, there are two main associations dealing with BIM. These are Czech BIM Council (BIMcz) and Czech civic association BIM-Forum.

BIM-Forum was founded with the aim of sharing professional discussions and contributes to ease of use Autodesk® Revit® software. This association makes efforts to help in easy and efficient using Revit and other tools for BIM. BIM-Forum also seeks to combine the Czech practice of designing with BIM project settings for all building designer’s professions [18]. The similar purpose has Czech BIM Council (BIMcz).

3.2. Czech BIM Council - BIMcz
Czech BIM Council with its members and other interested partners supports the Initiative Society 4.0 with specific initiative “Construction 4.0.” BIMcz wants to systematically long-term address the issue of BIM regarding to the specific of the Czech environment, its legislation and practice. This council also initiates scientific research collaboration between faculties in academic environment and also has interest in cause substantial cooperation with professional chambers: ČKA (Czech Chamber of Architects), ČKAIT (The Czech Chamber of Chartered Engineers and Technicians) and professional associations: SPS (Association of Building Entrepreneurs), ČSSI (Czech Association of Civil Engineers) [17].

3.3. WG#03: BIM & Realization
This research article uses the experiences from the initiative of active working group „WG#03: BIM & Realization“, which is the part of the Czech BIM Council, especially the document called “Draft of unified data structure for Building Information Modeling in the Czech Republic”.

Research of this article contribute to the current efforts of this group, namely to shape the design to create a uniform data structure for BIM in the Czech Republic. This research verifies the connection of LOD in BIM framework with national legislation and the certain stages of project documentation from the designer’s perspective. The findings of this paper are in the defining specific Level of Development of relative parameters, mentioned in this document, connected to the specific level of information and details requested by the Czech Republic’s legislation. These findings could be used as an underlay to create document called “Level of Development draft assignment to the individual stages of project documentation in the Czech Republic”.

4. Research Methodology
The actual problem of research work consists in preparing BIM data table, that determine which element’s parameters are relevant for the specific Level of Development. Parameters include the relevant data required at specific stage of project development.

In the first phase, there is an existing BIM data table within the WG#03: BIM & Realization’s “Draft of unified data structure for Building Information Modeling in the Czech Republic”. The reference of this table is shown in following Table 1.

The second phase involves the identification and selection of relevant attributes from the “Draft of unified data structure for Building Information Modeling in the Czech Republic” table. This table contains 7010 lines and approximately 900 different attributes. There are 575 lines and 277 attributes within the architectural-constructional solution.
Table 1. Reference of “Draft of unified data structure for Building Information Modeling in the Czech Republic”

| GROUP OF ATTR. | No. | ATTRIBUTE | REMARK | UNIT | TYPE |
|----------------|-----|-----------|--------|------|------|
| SUBSTRUCTURE   |     |           |        |      |      |
| Basic Information | 1   | Type designation | PRINCIP |      |      |
|                  | 12  | Building’s code   | SHQ0    |      |      |
|                  | 3   | Number of shots   | NUM RVT |      |      |
|                  | 13  | Code of composition | TEXT    |      |      |
| Dimensions      | 14  | Width            | mm      | NUM RVT |      |
|                  | 15  | Thickness         | mm      | NUM RVT |      |
|                  | 16  | Circuit           | bm      | NUM RVT |      |
|                  | 17  | Capacity          | m3      | NUM RVT |      |
|                  | 18  | Area              | m2      | NUM RVT |      |
| Technical       | 19  | Concrete recipe   | LIST    |      |      |
| specification    | 10  | Concrete classification | LIST |      | |
|                  | 20  | Reinforcement stage | LIST |      |      |
|                  | 11  | Other elements    | f.e.: geotextiles | TEXT |      |
|                  | 21  | Technical solution of substructure’s hydroinsulation | TEXT |      |      |
| Reinforcement    | 22  | Steel             | f.e.: 10505 | LIST |      |
|                  | 23  | Weight            | t       | NUM RVT |      |
|                  | 24  | Covering - inner surface | mm | LIST |      |
|                  | 25  | Covering - outer surface | mm | LIST |      |
|                  | 26  | Covering - other surface | mm | LIST |      |

Source: author according to “Draft of unified data structure for Building Information Modeling in the Czech Republic”

The identification and selection of these attributes follow the requirements of the following Czech Republic’s legislative documents from the designer’s perspective:

- Ministry for Regional Development’s Decree no. 499/2006 Coll., On construction documentation (as no. 62/2013 Coll.)
- Act no. 183/2006 Coll., On Territorial Planning and Building Code (Building Act)
- Ministry for Regional Development’s Decree no. 268/2009 Coll., On technical requirements for buildings (as no. 20/2012 Coll.).

The identification and selection of these attributes pursues the different information needs requested on various stages of project documentation within the Czech Republic’s legislation, thus requested information mentioned in Ministry for Regional Development’s Decree no. 499/2006 Coll., On construction documentation (as no. 62/2013 Coll.). This Decree establishes the scope and content of project documentation in various legislative stages.

Identified and selected attributes could be registered in the other table columns as it’s shown in the following Table 2: Reference of identified and selected attributes on various stages of project documentation according to the LOD scheme.
Table 2. Reference of identified and selected attributes on various stages of project documentation according to the LOD scheme.

| GROUP OF ATTRIBUTES | ATTRIBUTE                  | BASIC INFORMATION | PROJECT STAGE | LOD 100 | LOD 200 | LOD 300 | LOD 350 | LOD 400 | LOD 400 |
|---------------------|---------------------------|-------------------|---------------|---------|---------|---------|---------|---------|---------|
|                     |                           | ARCH              | DPL           | DBP     | DBC     | DABC    | FM      |
|                     |                           | Stage 1           | Stage 2       | Stage 3 | Stage 4 | Stage 5 | Stage 6 |
| SUBSTRUCTURE        |                           |                   |               |         |         |         |         |
| FOUNDATION SLAB     |                           |                   |               |         |         |         |         |
| Basin information   | Type designation          | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Building’s code           | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Number of shots           | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Code of composition       | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
| Dimensions          | Width                     | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Thickness                 | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Circuit                   | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Volume                    | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Area                      | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
| Technical           | Concrete recipe           | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
| specification       | Concrete classification   | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Reinforcement stage       | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Other elements            | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Technical solution of     | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | sub. hydroinsulation      |                   |               |         |         |         |         |
| Reinforcement       | Steel                     | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Weight                    | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Covering - inner surf.    | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Covering - outer surf.    | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |
|                     | Covering - other surf.    | ✓                 | ✓             | ✓       | ✓       | ✓       | ✓       |

Source: author according to WG#03: BIM & Realization’s working paper

5. Results and discussions

LOD scheme clearly defines the level of element’s development, i.e. at what stage of the life cycle element is. Thus determines the reliability of the entered information. It is therefore a communication tool and an instrument of cooperation in BIM environment when each participant enters the developing building process design in such an environment.

In a joint model environment, there are both designer and other participants within the construction process, who are dependent on the information provided in the model to move forward their work [4]. There is the working plan gaining importance, which lets BIM model users know when and what level of development will be those information available. This is what the LOD framework does [9]. The LOD framework solves problems with coordination by providing industry-developed standard, which describes the level of development of various systems and components within the BIM. This standard allows for consistency in communication and implementation facilitating detailed milestone definition and BIM deliverables.

Identified and selected attributes on various stages of project documentation according to the LOD scheme accompanying the “Draft of unified data structure for Building Information Modeling in the
Czech Republic” will form the new document “Level of Development draft assignment to the individual stages of project documentation in the Czech Republic”.

The purpose of document “Level of Development draft assignment to the individual stages of project documentation in the Czech Republic” is to define the requested attributes on the different levels of development according to the Czech Republic’s legislation. That’s initiative, which is therefore to need to define the attributes set out in “Draft of unified data structure for Building Information Modeling in the Czech Republic” for each stage of the project.

The relevance of requested attributes was assessed according to the national legislative provisions:

- Ministry for Regional Development’s Decree no. 499/2006 Coll., On construction documentation (as no. 62/2013 Coll.)
- Act no. 183/2006 Coll., On Territorial Planning and Building Code (Building Act)
- Ministry for Regional Development’s Decree no. 268/2009 Coll., On technical requirements for buildings (as no. 20/2012 Coll.).

6. Conclusions

The purpose of WG#03: BIM & Realization’s efforts is to create a “Level of Development draft assignment to the individual stages of project documentation in the Czech Republic”. In the structure of “Draft of unified data structure for Building Information Modeling in the Czech Republic” it is necessary to implement LOD to the individual elements or group of elements as to correspond to a stage of project documentation required by the Czech Republic’s legislation. Linking project documentation stages and LOD is carried out of the based of attributes assignment, which determine the information quantity for a particular element in the particular project documentation stage, i.e. the particular level of development.

“Level of Development draft assignment to the individual stages of project documentation in the Czech Republic” could be a tool for standardization of project design procedure in the BIM environment in the Czech Republic [7]. It could allow the progressive implementation vanguard of standardized BIM technology into the Czech Republic’s legislation, which will help to eliminate the use of traditional building design processes and thereby eliminate possible negative impacts connected to this still widely used process.

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