BIM METHODOLOGY IMPLEMENTATION INSTRUCTIONS

PROJECT:

Design of the Dimnikcobau office building

TITLE:

BIM methodology implementation instructions for the design of the Dimnikcobau office building

March 2019, Ljubljana

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1 ABSTRACT

The document is determining crucial employer's information requirements (EIR) for BIM implementation on the Dimnikcobau office building project. Furthermore, BIM methodology fundamental goals and use cases are identified, in order for applicant to get an insight of the client expectations regarding the Level of Development in BIM models and collaboration within the tender winning design team.

1.1 General project information

Dimnikobau enterprise has a vision to erect modern office building along the Leskovškova street in Ljubljana, Slovenia. Aim of the tender is to ensure the most credible solution through tender with invited architectural and urban planning professionals. The winning applicant will be awarded with the project for all of the design phases (named IDZ, IDP, DGD, PZI, supervision provided by the designer, and PID according to Slovenian legislation). One of the tender conditions, highlighted in this particular document, is the demand for BIM methodology implementation and project documentation delivery in BIM format.

The investor:

Dimnikcobau nepremičnine in inženiring d.o.o.
(in the following Dimnikcobau d.o.o.)
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Project name:

Design of the Dimnikcobau office building

Location:

Ljubljana

2 REFERENCE DOCUMENTS AND STANDARDS

Reference documents and standards referred through the BIM implementation guidelines are the following:

- Önorm A 6241 - Digitale Bauwerksdokumentation (Teil 1: CAD-Datenstruktur und Building Information Modeling; Teil 2: Building Information Modeling (BIM) — Level 3-iBIM)
- BSI PAS 1192:2007+A1:2015
- BSI PAS 1192-2:2013
- Computer Integrated Construction Research Program. (2011). "BIM Project Execution Planning Guide – Version 2.1." May, The Pennsylvania State University, University Park, PA, USA.
- Priročnik za pripravo projektne naloge za implementacijo BIM-pristopa za gradnje, IZS, Slovenia.
- Level of Development Specification 2018, BIMForum.

3 BIM USE CASES

The main objective of the BIM methodology implementation on the Design of the Dimnikcobau office building project, is identified as follows:

Delivery of quality and harmonized design project documentation (improved coordination among the design disciplines, quantities check based on the BIM model, delivery of the project drawings and plans based on the BIM models with exception of the reinforcement and formwork plans, which are allowed to be produced in 2D CAD technology).

To successfully implement the BIM methodology on the project, the awarded applicant has a duty to provide a well-structured and defined BIM execution plan (BEP). BEP will be checked and confirmed by the client before the launch of the IDP design phase.

3D BIM model has to be established and delivered at least for:

- Architectural design
- Structural design
- MEP design

BIM use case	**Design phase according to Slovenian legislation**			
	IDZ	**IDP**	**DGD**	**PZI**
Establishment of the common data environment (CDE)		**x**	**x**	**x**
BIM Modelling		**x**	**x**	**x**
3D Coordination		**x**	**x**	**x**
General quantities check based on the BIM model		**x**	**x**	**x**

Table 1: BIM use cases according to the design phase

Common Data Environment (CDE)

The success of a BIM supported project delivery process is highly dependent upon the level at which the entire design team can collaboratively produce and manage information for the duration of the project. For the purpose of the collaboration, establishing of common data environment (CDE) appears as the most reasonable solution. Besides predefined folder structure, rules for data, models and drawings exchange through CDE platform, have to be defined in the BIM execution plan (BEP).

BIM modelling

BIM modelling is the process in which 3D BIM modelling software is used to develop a model. Modelling results in geometrical and alfa-numerical data developed to the certain degree. Demanded level of development (LOD) for the particular project is set to LOD 300, or LOD 200 for the elements, where reduced LOD is sufficient to successfully fulfil the defined BIM use cases objectives. As a reference regarding LODs, client recommends Level of development Specification 2018 provided by BIMForum.

3D coordination

3D coordination is the process in which clash detection software is used to determine field conflicts by comparing 3D models of building systems. The goal of clash detection is to trace, estimate and eliminate the system conflicts during the design phases. Process is predominantly used for Identifying consistency of all models provided, and has to be coordinated by the responsible person. Apart from naming the BIM coordinator, 3D coordination procedure and clash detection software have to be identified and described in the BIM execution plan as well.

General quantity check

Quantities have to be obtained from the BIM model with the appropriate software for the quantity take off. Quantities obtained from the model are used as a reference for control and check-ups of bill of quantities provided by the conventional methodology.

4 BIM PROJECT ORGANIZATION

As a result of BIM methodology implementation on the project, additional organization requirements have to be presented. Roles and responsibilities required on the project are described as follows.

4.1 Roles and responsibilities

The awarded applicant has to present the list of key personnel together with roles and responsibilities as a part of BIM execution plan.

BIM Manager (client)

- BIM execution planning and supervision of BIM implementation
- Providing BIM execution plan control and reports
- Model quality control and ensuring their compliance with EIR
- General supervision of BIM methodology implementation (quality, cost, deadlines)

BIM Manager (design team)

- BIM execution planning and supervision of BIM implementation
- Creating of BEP in compliance with EIR, BEP updates during the design processes
- Creating of reports in order to keep the client informed about the BIM implementation state
- Establishing and maintaining of Common Data Environment (CDE)
- Management and coordination of BIM processes, delivery deadlines coordination

BIM Coordinator (design team)

- Coordination of BIM use cases defined in BEP
- Coordination of BIM models among different disciplines
- Implementation of BEP in all of the BIM use cases
- Model quality control for all of the disciplines
- Creating federated model and performing clash checks

BIM Modellers

- Creating of BIM models, changes applications, providing input for BIM implementation
- Daily BIM model check-ups

5 BIM IMPLEMENTATION PROCESS PLANNING

BIM execution plan (BEP) has to depict general diagram of BIM methodology implementation and the diagram of 3D coordination processes.

6 BIM MODEL DEVELOPMENT

6.1 Level of development (LOD) definition

Level of development (LOD) levels are defined according to »*Level of Development specification*« (*AIA - The American Institute of Architects*; http://bimforum.org/lod/), proposed by the BIM standard NBIMS.

6.2 Level of development

Level of development (LOD) includes level of geometry (LOG) and level of information (LOI)l. BIM execution plan has to define LOG, LOI, and LOD for each of the design phases.

Client proposed LOD for all BIM elements in the execution design phase:

- LOD 300 or LOD 200 for the elements, where decreased LOD is sufficient to successfully fulfil the defined BIM use cases objectives

7 COLLABORATION PROTOCOL

7.1 Collaboration environment

Collaboration has to follow predefined rules for communication and for the use of Common Data Environment (CDE) platform. All CDE users have to follow the rules for files exchange, file naming and folder structure, defined by the awarded applicant. It is recommended that the awarded applicant defines CDE rules in compliance with one of the commonly used standards; e.g. »*UK standard PAS 11922:2013 (Specification for information management for the capital/delivery phase of construction projects using building information modelling«*).

7.2 Software

For each of the BIM use cases, the list of software has to be presented in the BIM execution plan (BEP).

7.3 Communication

For the purpose of efficient communication, the list of phone numbers and contact data for project collaborators has to be provided in the BIM execution plan (BEP).

Formal communication will be carried out through e-mail. For the information and agreements achieved through verbal communication, additional formal e-mail confirmation is recommended. For communication among the different discipline models and IFC models commenting, BCF standardized communication is advised. The awarded applicant has to define BCF compliant communication process in the BIM execution plan (BEP).

7.4 Model and data exchange protocol

BIM execution plan (BEP) has to define model exchange protocols among the design project parties. It is recommended to use »*Open BIM*« principles for the particular project. From that reason, the use of IFC standard for model exchange and BCF standard for model-based communication is practically inevitable.

- **IFC 2x3 Coordination view**: IFC 2x3 CV shall be used for the referencing among the discipline models and for the production of the coordination and federated model. IFC4 standard is currently not supported by many of the software packages available on the market yet, therefore use of IFC 2x3 CV is advised.
- **BCF** (Open BIM Collaboration Format): BCF shall be used as standardized open file format that allows the addition of textual comments and screenshots on top of the IFC model layer for better communication between coordinating parties in the 3D coordination process.
- **DWG**: Drawings and reference files sharing.
- **PDF**: Drawings and reference files sharing.

7.5 File and element naming

Consistent file and element naming is crucial for efficient collaboration between the parties and development of quality BIM federated model. Therefore, BIM execution plan (BEP) has to define the following:

- File naming key

- Naming of site and buildings

Site name	**Building name**
DIMNIKCOBAU-LJUBLJANA	DIMNIKCOBAU DCB III

Table 2: Suggested naming of site and buildings

- Naming key for sections and floors

Floor	
Code	Description
_01K-BASEMENT	Basement 01
00P-GROUND	Ground floor
01N-FLOOR	Floor 01
02N-FLOOR	Floor 02
03N-FLOOR	Floor 03
00P-GROUND-PAVE	Proposed floor division in the MEP models
00P-GROUND-REF-01	
00P-GROUND-CEILING	

Table 3: Example of floor naming key

7.6 Element classification

BIM execution plan (BEP) has to define element classification used for the particular project. It is reasonable to implement one of the international classifications, such as IFC 4 or Uniformat. Furthermore, BEP has to define how the classification will be assigned to the elements and present the example of the classification methodology.

8 QUALITY CONTROL

8.1 Quality control strategy

Quality control strategy has to be determined in the BIM execution plan (BEP). Two factor quality assurance strategy is advised by the client.

Factor 1: **BIM Coordinator**
Interdisciplinary quality control of discipline models and model coordination executed monthly (visual control, clash checks, standards compliance, classification checks)

Factor 2: **BIM Modellers**:
Internal quality control for the models of each discipline performed daily or during the modelling (visual control, standards compliance)

8.2 Types of model quality control

All of the produced BIM models have to be included in the quality control process. Combinations of the interdisciplinary clash checks and quality controls are depicted in the table below.

MODEL	ARCHITECTURAL MODEL	STRUCTURAL MODEL	MEP MODEL
ARCHITECTURAL MODEL	**X**		
STRUCTURAL MODEL	**X**	**X**	
MEP MODEL	**X**	**X**	**X**

Table 4: Quality control among the disciplines

Additional attention has to be given while performing the following controls:

Model (part of object)	**Control description**	**Type of control**
All models	Doubled elements check	Clash check
All models	Check if elements are overlapping	Clash check
All models	Libraries and classification checks (consistent naming)	Classification check
All models	Check if elements are connected to each other (e.g. pipes)	Visual control
Arch, Stru	Large openings compliance between architectural and structural models	Clash check
Arch	Zones and spaces check (limited by walls and ceilings)	Classification check
Arch, Stru	Connection of structural elements (e.g. beams and columns)	Clash check
Arch, Stru, MEP	Clash checks between architectural, structural and MEP elements (allowed exceptions)	Clash check
Arch, Stru, MEP	Sufficient space guaranteed for normal use of furniture, opening of doors and windows	Clash check
Arch, Stru, MEP	Sufficient space guaranteed in front of stairs and ramps	Standards compliance
Arch	Width of stairs and ramps	Standards compliance
MEP	Clash checks among the MEP models	Clash check

Table 5: Essential model controls

8.3 Level of coordination (LOC)

One of the main goals of quality control is to ensure geometrical compatibility of the elements for each discipline model, consistent use of classification and compliance between BIM models and entire project documentation, including the consistency of the federated model. The highest level of compatibility between the BIM models and project documentation, is expected at the end of the execution design phase, often referred as PZI in Slovenian legislation.

Due to specifics of the BIM methodology, it is not reasonable to expect perfect compatibility of the BIM models in each and every time through design process. However, to a certain degree coordinated models have to be provided at important milestones (e.g. deliveries at the end of each design project phase). As a consequence of the workflow, two degrees of coordination are predicted.

LOC1 – Working versions coordination:

Before delivering of the working versions to the client, general geometrical coordination with importance for the later project stages has to be assured. Apart from the geometry, coordinated models have to include appropriate file and element naming, taking into account provided naming keys in the BIM execution plan.

LOC2 – Final models coordination:

Before the delivery at important milestones, BIM models of each discipline have to be geometrically compliant and have to follow the naming keys. Normally it is expected that later stages of the project provide better and better coordinated models.

9 MODELLING GUIDELINES

BIM execution plan has to provide modelling guidelines. In the following, general modelling guidelines are presented as an insight:

- Modelling consistency: use of standard tools and same libraries for the elements of the same type (For instance: Beams are always modelled with the beam tool). Consistent naming of properties and property values.
- Use of default software tools, where possible (e.g. beam, wall, column)
- Use of copy command and property transfer command (“Pick up” and “Inject” parameters)
- Model has to be developed and split into elements in the same manner, as the contractor will erect the building (columns have to be modelled for each floor separately and not continuously through the entire building).
- Overdeveloped models with details of less importance have to be avoided (agreed LOD 300 or LOD 200)
- Models have to be developed in a way that changes in the models are straight forward to apply

Federated model

Federated model is compounded of different discipline models.

Discipline models

Before creating of federated model, each discipline model has to be coordinated by the BIM coordinator.

Discipline models file size

Each delivered IFC model size has to be limited to 500 MB in the BIM execution plan in order to ensure efficient BIM coordination of models on an average computer.

Model type	Element type	Guidelines
Architectural model	Entire model	Model has to be divided into floors and zones. Continuous elements present in more than one floor, have to be assigned to the bottom floor.
	Horizontal elements	Ceilings have to include raster, libraries are developed for each type, or modelled with the slab tool. Thermal insulation modelled as separated element. Concrete base modelled as separated element with slab tool.
	Vertical elements	Walls have to be modelled from the upper edge of the bottom slab to the edge of the upper slab. Wall finishing: Where the finishing is applied over the entire wall surface, use of composite elements could be applied. In cases where only part of the surface is covered with finishing (e.g. ceramic tiles) layers have to be modelled as separated elements.
Structural model	Entire model	Model has to be divided into floors and zones. Continuous elements present in more than one floor have to be assigned to the bottom floor.
	Horizontal elements	Footing foundations have to be modelled with slab tool, or footing foundation tool from the bottom of the slab to the upper surface of the concrete base. Strip foundations have to be modelled with beam tool, or the strip foundation tool from the bottom of the slab to the upper surface of the concrete base. Slabs: Reference line on the upper edge of the slab.

Model type	Element type	Guidelines
	Vertical elements	Pile foundations are modelled with the column tool. Concrete columns: Reference point in the centre; have to be modelled from the upper edge of bottom slab to bottom edge of the upper slab or beam. Steel columns: Reference point in the centre; have to be modelled from the upper edge of bottom slab to bottom edge of the upper slab or beam (slab-beam and beam-beam intersection). Walls: Reference point on the outer side of the structural layer; have to be modelled from the upper edge of bottom slab to bottom edge of the upper slab or beam. Stairs have to be modelled with the stair tool.
MEP models		Each of the MEP systems will be modelled and exported in a separated IFC file. More detailed guidelines regarding MEP models have to be provided in the BIM execution plan.

Table 6: Modelling guidelines

10 MODEL DELIVERY

Beside project documentation, all of the BIM models have to be delivered at the end of each design phase (IDP, DGD, PZI). The format of the BIM model deliverables is IFC 2x3. The list of deliverables has to be depicted n BIM execution plan, together with the submission dates. All of the information regarding the delivery, shall be included in Model Production and Delivery Table (MPDT).