New Zealand BIM Handbook

Appendix A - Modelling and documentation practice

July 2014

A guide to enabling BIM on building projects

BRANZ Funded by BRANZ from the Building Research Levy

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Appendix A - MODELLING AND DOCUMENTATION PRACTICE

CONTENTS

1 PLANNING THE MODELLING PROCESS

The Project BIM Brief will define BIM Uses on a project. This will determine the extent of modelling required to deliver the final 2D / 3D graphical output and non-graphical data. The BIM Execution Plan will specify the common modelling standards and workflows necessary to achieve the desired deliverables.

Parametric modelling should be used on all BIM projects. Parametric modelling is designing with objects that have real-world behaviours and attributes, using parameters (numerical, text or formulae based characteristics) to determine the behaviour of a graphical entity and define relationships between model components.

Before modelling begins, the project team should address the following:

- modelling methodologies
- definition of discipline models
- definition of items to be included in the models
- definition of information exchanges
- assignment of model element author responsibilities
- definition of non-graphical information necessary to achieve chosen BIM Uses
- use of material properties
- coordination of models including the sequence of clash detection and definition of coordination precision
- publication of models and exports of documents and data
- audit and purge methodologies to maintain model performance and data integrity
- methodology for importing files.

2 QUALITY CONTROL

Quality control measures should be applied to all aspects of modelling and documentation to eliminate errors and achieve desired project outcomes. The principle underpinning these measures can be summarised as “model to a standard, check to a standard”.

In addition to agreeing standards as part of the development of the BIM Execution Plan, the project team should agree protocols and procedures for checking compliance regularly throughout the project. Quality control measures that should be applied at different times are described in the Section 5.3.

The ability to own, reuse, and properly manage building data throughout the facility life cycle accrues significant advantages for stakeholders. The accurate creation and management of “building information” is of utmost importance. Data created during design and refined during the construction process can provide a valuable resource for Facilities Management (FM).

3 GENERAL MODELLING GUIDELINES

3.1 Modelling standards

It is recommended that, as a minimum, each discipline in the project team model to industry proven “best practice methodology” along with complying with their in-house standards and protocols. The client may

also have specific modelling and documentation requirements and standards which need to be adhered to. These will be specified in the Project BIM Brief and documented in the Project BIM Execution Plan.

After the project modelling methodology has been agreed by the BIM team, the BIM Manager is responsible for ensuring its consistent application.

The following points should be considered as part of the overall project modelling methodology:

- model setup including how large models are divided
- project templates (control 2D output appearance)
- model naming conventions
- system naming conventions (services, etc.)
- element naming conventions (walls, partitions, doors, windows, columns, fan coil units, etc.)
- object classification standards (Uniclass, Omniclass, CBI, etc.)
- materials and finishes naming conventions
- properties/parameters to be included for model objects
- object property/parameter naming conventions.

3.2 Model management

Discipline BIM Coordinators have a responsibility to manage the Building Information Model(s) to maintain data integrity, manage file size and ensure compliance with the Model Element Author schedule and agreed LODs. It is recommended that the following activities are defined in the BIM Execution Plan and undertaken on a regular basis:

- audit, purge and compress the model(s) at key deliverable milestones
- interrogate the model(s) to ensure compliance with agreed modelling standards, project LODs and the MEA schedule.

3.3 Model sharing

The model sharing methodology should be agreed between the Discipline BIM Coordinators and documented in the BIM Execution Plan at the start of a project. As a minimum, the methodology should cover the following points:

- intended collaboration / data sharing platform
- frequency of model exchanges
- how models will be shared, e.g., DVD, e-mail, FTP, file transfer site, cloud hosting, etc.

When issuing a model, the Discipline BIM Coordinator should include a model description document (MDD) that includes crucial information about the model. The format and content of the MDD should be agreed and documented as a part of developing the BIM Execution Plan.

4 MODEL SET-UP AND AUTHORING

4.1 Good modelling practice

It is expected that a company taking part in a BIM project has a solid set of internal modelling standards and follows industry best practices. Discipline BIM Coordinators are responsible for implementing best practice

methodologies with their teams, and should regularly audit models to ensure consistency in the application of these methodologies. A few key best practice points to consider are:

- common coordinate system, gridlines and reference points in all models
- modelled elements must be used for their purpose
- no overlapping modelled elements (duplicate elements / one element on top of another)
- consistent BIM object naming (CBI is a common standard for New Zealand).

4.2 Creating model objects

It is recommended that, as a minimum, model objects are created to meet in-house company standards, templates and industry best practice methodologies. An exception to this is if the client has specific requirements for object creation or an object naming convention.

Model objects can also be derived from the following sources:

- numerous BIM object resources online
- a National BIM Object Library: a consistently formatted library of generic and proprietary model elements. This currently does not exist in New Zealand, but there is a national object library hosted by NBS in the United Kingdom
- manufacturer specific content: as BIM matures in New Zealand, it will be important for product manufacturers and suppliers to develop their own library of data rich BIM objects, (similar to how manufacturers currently supply 2D CAD details of their objects). This will also assist in the transition from design Building Information Models to As-Built Facilities Management-ready Building Information Models.

It is considered best practice for stakeholders to create and use company and/or project-specific content that complies with in-house templates and standards, rather than defaulting to non-controlled, downloaded content from the internet.

4.3 Model location and orientation

All BIM projects should use a real world coordinate system. New Zealand has a number of geodetic and vertical datum. The final system used could vary depending on the project location and client. The datum that is chosen should be specified in the BIM Execution Plan.

Real world coordinates might not be available at the start of a project, in which case, the project should be located at 0,0,0. Once the coordinates become available the Discipline BIM Coordinator will be responsible for establishing the real world coordinate system inside the model(s). When the coordinate system is established it should only be changed by the mutual consent of all stakeholders.

As well as ensuring that the model(s) are set to the correct northing and easting, the Discipline BIM Coordinator will also be responsible for making sure the model(s) are set to the true height above sea level.

4.4 Requirements for modelling space

To leverage the possibilities of reusing data within the BIM model for multiple purposes, it is important that spaces within the model are consistently defined and named. The importance of space modelling will vary, depending on the BIM Uses being pursued.

Defined spaces and the elements within them, can be used for analysis for sustainable design, heat loads, lighting levels, etc. This information can be exported to gbXML for use in third party software. Concept massing can also be exported to gbXML and used for analysis.

The client area brief can be provided in multiple formats (usually Word tables or Excel spread sheets). By correctly modelling the spaces, BIM can be used to generate space/area schedules dynamically updated from the model geometry.

The method of measurement of areas needs to be confirmed. For New Zealand commercial buildings the BOMA/PMI Guide to the Measurement of Rentable Areas 2013 is a commonly accepted standard.

All areas above an agreed size (e.g., $1m^2$) should be tracked and identified by name. A physical space may contain several areas that have different functional space classifications. They should be modelled as separate spaces.

4.5 Model development and Level of Development (LOD)

The use and importance of LODs is one of the most misunderstood aspects of the BIM process. There are numerous documents on the subject, the most complete being the 2013 LOD Specification produced by the BIM Forum (https://bimforum.org/lod/).

LOD is a scale that can be used to show the reliability of content that is expected to be included for specific model elements at different times during model development. The main purpose of LOD, when incorporated in LOD tables and BIM Execution Plans, is to give clarity to each member of a design/construction team as to what they are required to author in their models at each stage and to what extent others can rely on them.

Appendix C contains a summary definition of LODs.

5 MODEL COORDINATION

5.1 General

Successful model coordination relies on the different BIM disciplines understanding their roles and only modelling what they are responsible for (typically following an MEA schedule). Coordination is much more than just clash detection; the key to successful coordination is regular communication between all parties.

General coordination should take place during early design phases (preliminary and developed), via visual inspection of the model.

Clash detection and model coordination (if defined as a BIM Use for the project) is the responsibility of all Discipline BIM Coordinators. Identified issues are distributed to all stakeholders via the BIM Manager. The accumulation of clashes detected will inform priority zones and element types for resolution.

5.2 Clash severity criteria

Nearer design completion and for preconstruction planning, clash severity criteria will be defined and clash severity levels created that will support element-level coordination. Clash type definition will be key to avoiding “false positives” and ensuring that efforts are spent on real issues.

Clash severity criteria should consider:

- model discipline
- component type/category
- intersection orientation (parallel or crossing)
- component size
- construction state (proposed/existing)
- construction sequencing and critical path.

Examples of critical issues:

- duplicate components

- components inside one another
- all intersections with doors, windows, columns and beams
- parallel intersections with intersection depth of more than (say) 20mm
- intersection depth generally – hard (intersecting) and soft (within Xmm zone) clashes for construction tolerances.

Examples of low severity issues:

- crossing between small pipes
- partition walls against architectural slabs
- pipes penetrating partition walls where no penetrations have been modelled.

Typically, larger, fixed objects are harder to move or adjust than smaller components. A simple rule is that the larger (e.g., cooling tower) or more permanent (e.g., foundation) the object, the greater the "right of way" in a clash scenario.

Conversely, some smaller objects might have "right-of-way" over others (e.g., fire sprinkler locations vs. cable trays), as other constraints, such as building regulations, may come into consideration.

The BIM Manager should assign the following clash severity levels to clashes detected, and determine the discipline responsible for resolving them, as appropriate to the project goals.

- Level One Clashes are reported clashes that are considered critical to the design and construction process. The highest priority is assigned to rectifying them as soon as possible after detection.
- Level Two Clashes are reported clashes that are considered important to the design and construction process. They should be rectified during design phases.
- Level Three Clashes are reported clashes that, while considered important to the correctness of the model, will generally be changing on a regular basis throughout the design and construction process. They can be assigned a lower level of priority and should be rectified before end of phase submissions of the models.

5.3 Quality control checks prior to coordination

Coordination methodologies should be documented in the BIM Execution Plan. Outlined below is suggested good practice that should take place prior to model exchange and coordination.

- All files should be exported from the discipline models in the format specified in the BIM Execution Plan for use with the model clash detection and coordination software.
- Prior to exporting models that include light fittings, make sure that light sources are turned off.
- All objects should be modelled as 3D solids, not wire frame or lines.
- All models should be "clean", i.e., they should contain only relevant 3D data and no extraneous 2D data, or any imported files.
- All Discipline BIM Coordinators should, as a minimum, follow the best practice methodologies for model coordination documented in the BIM Execution Plan prior to model exchange for coordination purposes with other disciplines.

6 MODEL HANDOVERS AND SIGN-OFF PROCEDURES

Prior to designated handovers, all models should be checked using agreed procedures and published in the formats defined in the Project BIM Execution Plan.

Each modelling team should include a model description document (MDD) that includes crucial information about the model with each model it publishes and sign-off that it complies with the agreed specification. Name the MDD so that it can be readily associated with the correct model. The document should describe the contents of the model and explain its purpose and limitations.

The specific format of the MDD should be documented in the BIM Execution Plan; it is the responsibility of the sender of a model to communicate change and the model's fit-for-purpose status.

Early in design the use of an MDD could be problematic as models are exchanged frequently between disciplines and the model is constantly evolving. The BIM Manager should consider at which stage of design a MDD is introduced, and document this in the BIM Execution Plan.

7 TRANSITION OF MODEL OWNERSHIP

In this context "ownership" refers to who controls the model and is responsible for it. Refer to New Zealand BIM Handbook, Section 2.3 - Legal implications of BIM for guidance on legal ownership.

As a project progresses through the design stages information (both graphical and non-graphical) contained in fabrication and trade models supersedes information contained in the design models. The ownership of each Building Information Model rests with the model author for the particular stage the project is in.

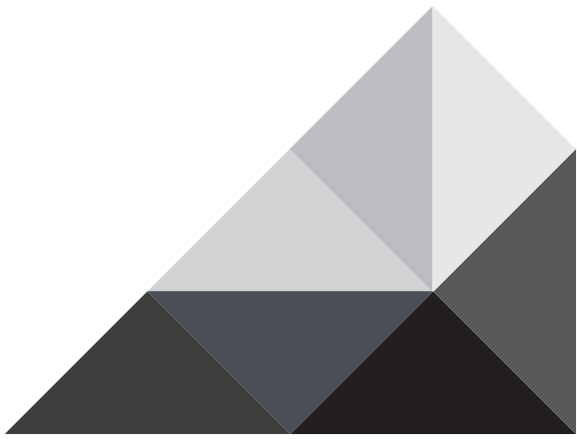
During the construction phase, the contractor will own the federated model which will consist of a mixture of design models (owned by the design team) and fabrication and trade models (owned by the sub-contractors).

8 FINAL BIM DELIVERABLES

One of the primary benefits of the Building Information Model for the client or building operator is being able to use it for Facilities Management upon occupancy. Information that matures during the design and construction process is captured in the appropriate models on an ongoing basis.

The BIM Execution Plan should define the deliverables that the client is going to receive, the required file formats and who is responsible for providing them. These could include:

- 3D geometric deliverables – construction coordination model: As-Built model(s) for all building systems. The model(s) should be fully coordinated. The required instructions on file/folder setup should also be included
- data deliverables: Facilities Management spread sheet or database file, room/space data in an agreed format
- 2D deliverables: As-Built drawings.



Published by the BIM Acceleration Committee with the support of the Productivity Partnership and BRANZ Building Research Levy.

ISBN 978-0-473-29223-2