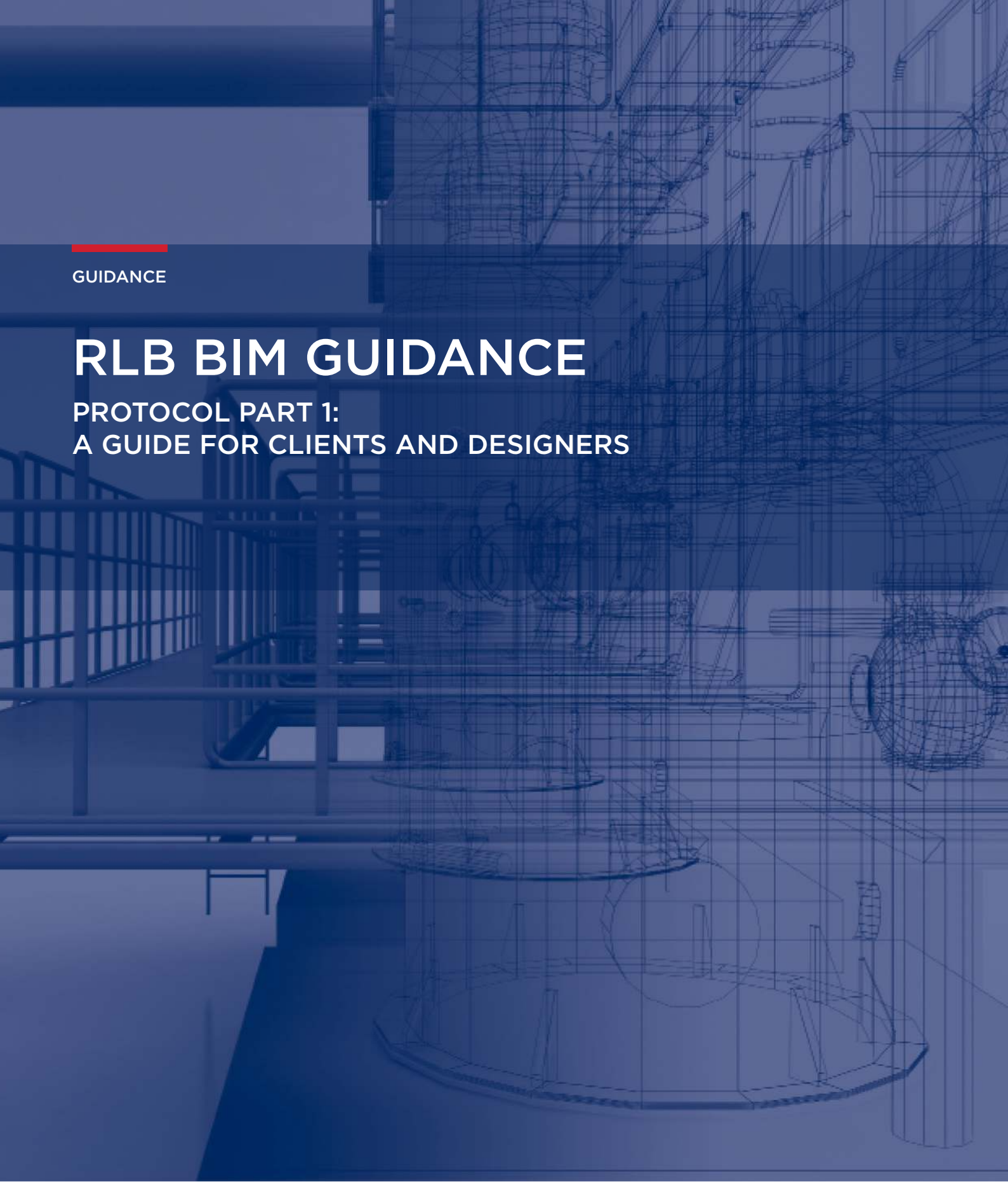
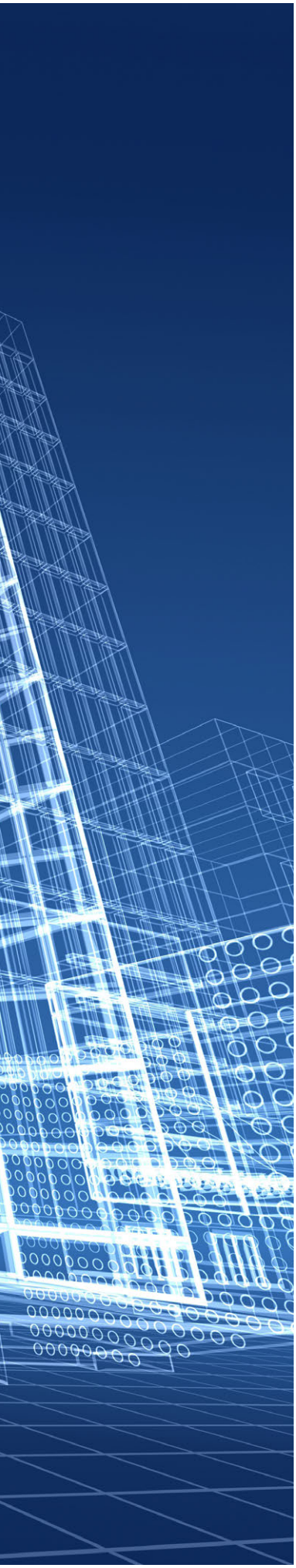


GUIDANCE

RLB BIM GUIDANCE

PROTOCOL PART 1:
A GUIDE FOR CLIENTS AND DESIGNERS

RLB Rider Levett Bucknall



CONTENTS

1.0 EXECUTIVE SUMMARY

Rider Levett Bucknall (RLB) has embraced Building Information Modelling (BIM) and is working within a BIM environment across all of our service areas. To support this change in our working environment, RLB has developed its own in-house software (ROSS 5D) which interfaces with BIM files created by the different software used by designers and consultants. ROSS 5D also dynamically links to our extensive cost database.

BIM represents a massive opportunity for our industry to improve the effectiveness and efficiency in various aspects of design, construction, operation and maintenance. RLB believes we are rapidly moving towards Integrated Project Delivery (IPD). This move will see further procurement benefits as all stakeholders collaborate and share risk / return to achieve optimised outcomes.

As an industry leader, RLB has both the knowledge and expertise to contribute to projects throughout all phases, from concept design to facility management. Our vast experience includes working with architects, engineers and facility managers across a variety of platforms and BIM software.

RLB is confident that effective collaboration across the project team can provide greater value to our clients and the project as a whole.

This document is part of a suite of documents which includes:

- BIM General Awareness
- BIM Protocol Part 1: A Guide for Clients and Designers
- BIM Protocol Part 2: A Guide for RLB Cost Managers

2.0 INTRODUCTION TO BIM

Building Information Modelling (BIM) is a collaborative process based around a digital model of a building. BIM is not software, nor is it simply a 3D model of a building – the fundamental aspect being that the BIM file contains 'information'; hence the 'I' in BIM is the key element.

Designing in a BIM environment involves assembling objects and assigning relationships between objects to create the BIM file.

The BIM process is used to create, manage and share information on a project throughout its life cycle. It can be used to integrate the design, construction, operation and maintenance in a common environment, with the same information being used by all parties.

Sharing the common information allows for collaboration, greater efficiency and coordination of the model in a virtual environment.

The key difference between 2D/3D drawings and a BIM object is that rather than a series of connected lines to form a shape (e.g. a door), a BIM object is a self-contained shape that has information embedded/attributed to it. Examples of information data attributed to objects include:

- Visual
- Dimensional and geometric
- Functional
- Performance
- Specification
- Sequencing information and build time
- Life cycle and maintenance information

2.1 BENEFITS OF WORKING IN A BIM ENVIRONMENT

RLB has the skill sets and tools to realise the benefits of working in a collaborative BIM environment. Collaboration and a common understanding at the outset will allow us to work more efficiently, adding greater value to project outcomes.

- Efficiency – More efficient use of time with increased checking and co-ordination, providing greater accuracy, resulting in reduction in build costs
- Collaboration – The whole team works with common data
- Quality – Visualisation helps communication and allows greater coordination between all team members, adding value and reducing risk
- Clarity – 3D visualisation communicates design detail with greater accuracy to all team members and the client
- Accuracy – Better communication and clarity, increased accuracy and reduced reworking

2.2 BIM TERMINOLOGY

Term	Description
BIM Execution Plan (BXP / BEP)	The BXP details the guidance, standards and management of implementing BIM in the project among project teams. This can form part of the project manager's Project Execution Plan.
Clash Detection	Clash detection defines the process of effective identification, inspection and reporting of interference clashes in a coordination model (Federated Model).
Design Model	Design Models are the models created by the architects, engineers, and consultants for the design portion of the project, through construction documentation. They incorporate and derive the documentation of the design elements.
Construction Model	Construction Models are provided by the contractor to their sub-contractors which includes the architectural, structural and MEP elements of the design. This model is either created by the contractor independently or the design team's model re-used and developed further.
Level of Development (LOD)	LOD specification defines the content and reliability of objects in the model. See Section 2.4 for further information.
Federated Model	A Federated Model links all the separate models and other data sources to create a single model.
Multidisciplinary Design Optimisation (MDO)	This is the optimisation of multidisciplinary designs through a series of simulation and analysis on the BIM models and relevant design information aiming to optimise and facilitate design performance and efficiency.
Model Element	A Model Element is a portion of the BIM representing a component, system or assembly within a building or building site.
Model Element Author	The Model Element Author is the party responsible for developing the content of a specific model element to the LOD required for a particular phase of the project.
Model User	Model User refers to any individual or entity authorised to use the model on the project, such as for analysis, estimating or scheduling.

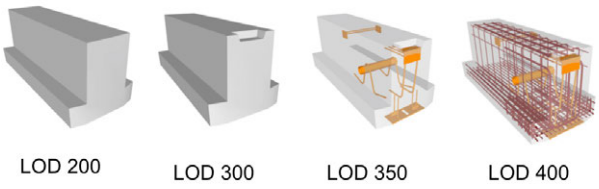
2.3 BIM MATURITY LEVELS

BIM Maturity Levels are a measure of the ability of the construction supply chain to operate and exchange information. These are generally defined as:

- Level 0 – 2D CAD with paper or electronic distribution, no collaboration.
- Level 1 – Typically a mixture of 3D CAD for concept work and 2D for drafting of statutory approval documentation and production information. Common models are not shared between project team members.
- Level 2 – This is distinguished by collaborative working. All parties produce their own BIM files independently. Information is exchanged between different parties through a common file format, which enables any organisation to be able to combine that data with their own in order to make a federated (combined) BIM file. The federated BIM file is then interrogated and any changes required are undertaken independently. This process is repeated at several predefined stages of the project until the model is complete.
- Level 3 – This represents full collaboration between all disciplines by means of using a single, shared project model which is held in a centralised repository. All parties can access and modify the single model, and the benefit is that it removes the final layer of risk for conflicting information.

2.4 LEVEL OF DEVELOPMENT

The Level of Development (LOD) specification released by the BIM Forum (bimforum.org) is a useful reference that enables users to specify and describe both the content and the reliability of objects in the BIM models. An important and useful aspect is the distinction between the content and the reliability of the information, or for what it can be relied on.



Model Level	Model Level Description	Cost Consultant outputs
LOD 100	May be graphically represented in the model with a symbol or other generic representation. No dimensions are included.	Cost Model with assumptions on key quantities.
LOD 200	Graphically represented within the model as a generic system, object or assembly with approximate quantity, size, shape, location and orientation. Non-graphic information may also be attached to the model element.	Preliminary Cost Estimate or Approximate Quantities Cost Estimate with assumptions on items specification and rates.
LOD 300	Graphically represented within the model as a specific system, object or assembly in terms of quantity, size, shape, orientation and interfaces with other building systems. Non-graphic information may also be attached to the model element.	Cost Plan including detail on Quantities, specification and rates, and a high level Life Cycle Cost assessment.
LOD 350	Graphically represented within the model as a specific system, object or assembly in terms of quantity, size, shape, orientation and interfaces with other building systems. Non-graphic information may also be attached to the model element. This level may not be available/used in all countries.	Detailed Cost Plan, Pricing Documents and Bills of Quantities (BoQ).
LOD 400	Graphically represented within the model as a specific system, object or assembly in terms of quantity, size, shape, orientation and interfaces with other building systems. Non-graphic information may also be attached to the model element.	Detailed Cost Plan/ BoQ/ Valuations/ Variations/ Life Cycle cost analysis.
LOD 500	Graphically represented within the model as a specific system, object or assembly in terms of quantity, size, shape, orientation and interfaces with other building systems. The attributes are verified and/or actual object data included. Non graphic information may also be attached to the model elements.	Final Account / Facilities Management.

2.5 BIM DIMENSIONS

There is some discussion as to the exact content of each level, but the definitions below are generally accepted with each additional dimension adding more information to the BIM model.

3D Design

Three Dimensional representation of the building, with basic attributes

4D Program & Scheduling

3D BIM with the addition of Time and Program / scheduling information

5D Cost Estimating

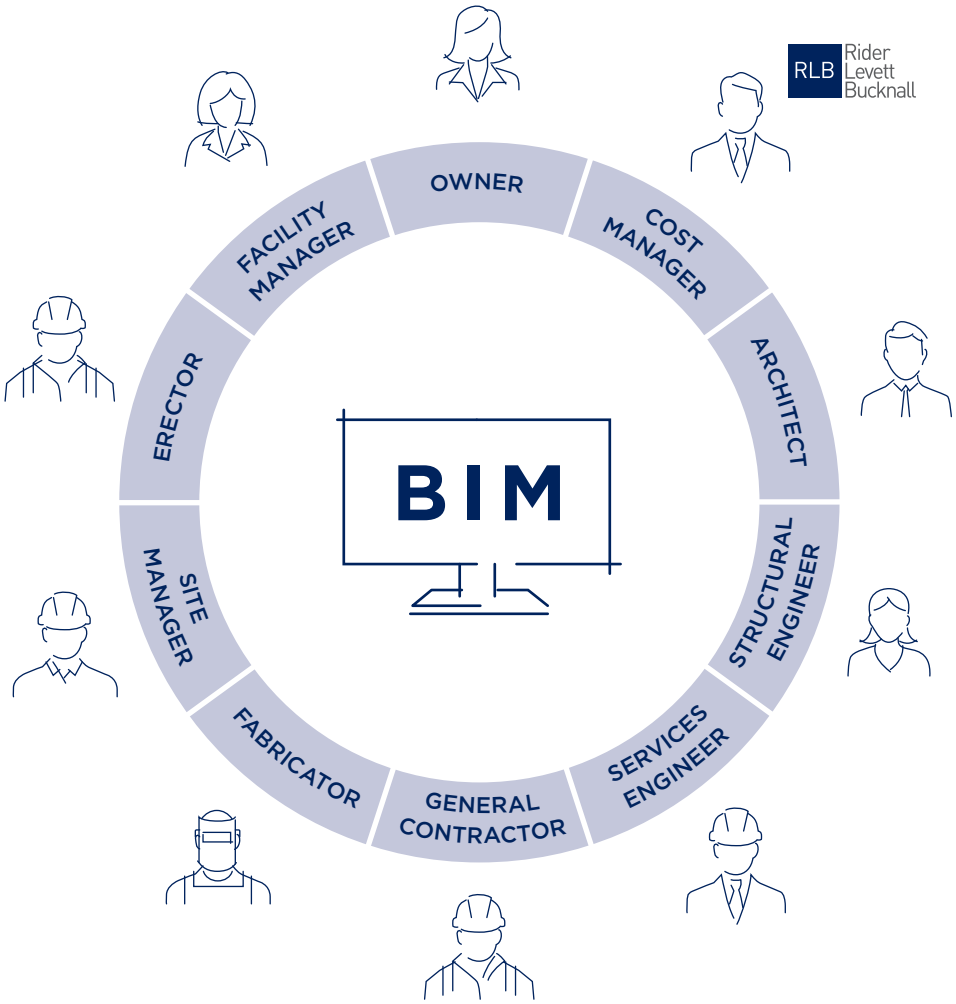
4D BIM with the addition of Cost information

6D Operation / Maintenance

5D BIM with the addition of Sustainability, Operational and Energy information

3.0 OUR COLLABORATIVE APPROACH

- RLB looks to be involved at the outset of any BIM project as a necessary way of meeting the project's deliverables adequately and efficiently
- We work collaboratively with design teams and avoid the traditional approach where the cost consultant receives the design late in the process and produces their required output reactively as a 'bolt-on' service
- We understand the process undertaken to produce the design and utilise the data in the model from an early stage
- We work as part of the design team enabling them to produce commercially viable projects without stifling their creativity
- We highlight potential issues and solve them before they become a problem
- Joint decision making allows all viewpoints to be considered with speedier resolution
- We will spend time with your BIM teams to agree the information required for the agreed outputs, reducing unnecessary design work



3.0 OUR COLLABORATIVE APPROACH

CONTINUED

3.1 HOW RLB USES THE MODEL

In the past RLB has found that models do not meet all the requirements for efficient measurement/quantities extraction and it is common that these models lack key information required for the preparation of Cost Plans/Estimates and/or Bills of Quantities. With early upfront discussions with the client and design team, alongside an adopted collaborative approach, RLB and the design team can work together to produce mutually beneficial results and improved deliverables for the project. Consequently, RLB has developed techniques and our own in-house global software which allows us to work with the BIM model and designers to gain the maximum benefit at each stage of design development.

RLB has tools that allow us to see all the data in the model, not just that relating to the quantities of the specific object required, as is often the case with standard QS software. Rather than requiring additional information to be added to the model by the designers for elements not yet drawn, we can identify, extract and re-use existing data enabling us to derive quantities, without creating additional work for the designers and saving time on the project. More cost information can be included earlier than by using standard QS software and techniques. This enables RLB to produce more accurate results, check the accuracy of data in the model and save time, allowing us to concentrate on adding value and detail for the client and the overall project.

One of the key challenges when extracting quantities from the BIM model is to align the extracted information with the measurement requirements for estimating, or in accordance with a standard method of measurement.

Examples of information excluded from the model are:

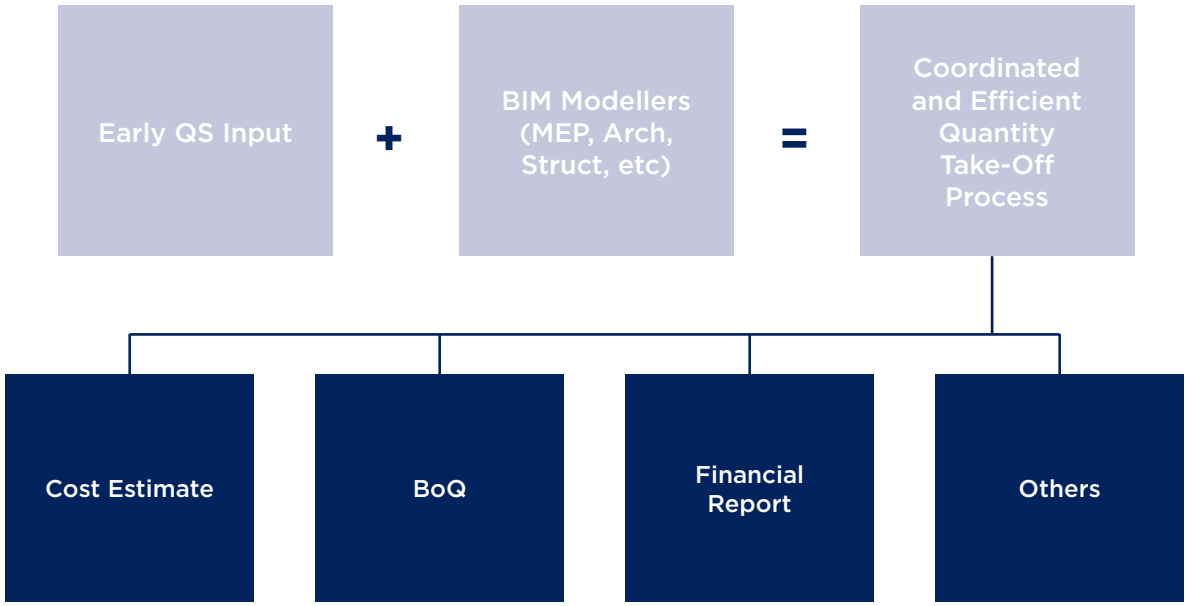
- Concrete grades
- Reinforcement ratios
- Formwork classes
- Temporary works
- Finishing materials
- Ironmongery i.e. door, window, and sundry hardware & miscellaneous metals

3.0 OUR COLLABORATIVE APPROACH

CONTINUED

In order to ensure models are appropriate for quantification purposes, RLB will:

- Provide input into the project BIM Execution Plan at the beginning of a project
- Analyse the model and work with the design team to suggest any additional objects or information required to streamline the process of quantification
- Work collaboratively with the designers and BIM modellers in order to understand the information contained in the model and what additional data may be required to speed up the production of the project deliverables
- Discuss with the design team on assumptions made regarding composite items, or items with similar quantities, in order to streamline work flows
- Always aim to minimise any reworking or additional design by using information already contained in the model for multiple purposes. This information is often not visible using standard QS software tools designed exclusively for quantity take off purposes, however we use numerous BIM software tools, including design tools to be able to identify and utilise all information contained within the model
- Use their extensive global experience and shared knowledge as quantity surveyors to produce cost plans, estimates and Bills of Quantities to fill in any areas within the model not captured through BIM take-off



3.2 GENERAL INFORMATION REQUIREMENTS

GENERAL PRINCIPLES

- Models to be created consistent with client drivers and consideration for cost planning deliverables and/or budget allocations or contract works packages as determined for the project
- Design milestones and cost planning milestones to be aligned and agreed between the parties and LOD requirements for each milestone clearly identified and adhered to. Geographically based industry recognised LOD definitions should be adopted for clarity, as per the BIM Execution Plan
- Cost planning deliverables should be determined early in the project with definitions of LOD requirements to be determined and understood by all project team members
- All models provided by the design team are to be verified and validated prior to issue confirming they meet the LOD requirements as identified for the relevant design milestones as set out in a BIM Execution Plan
- Identification of items not modelled at each design milestone for all disciplines to allow for a complete and accurate cost plan, estimate and/or Bill of Quantities

BIM MODELS – DESIGN PHASES AND LEVEL OF DEVELOPMENT

Feasibility BIM models should be modelled as 3D detailed objects, based on a defined level to enable the calculation of the floor area, external surface area, volume and perimeter and the information can be exported through schedules.

Conceptual BIM models can be developed from pre-design BIM models by converting the 3D space objects to the major building elements. The detail of the building element might not be included in the model at early stages, however should be consistent with the required LOD definitions at each design stage.

The material information in the building elements might not be included in the model at early stages, however should be accurately identified at later stages consistent with the required LOD definitions at each design stage.

RLB anticipates quality assurance will be undertaken by the relevant design disciplines prior to issue of information. If a BIM Manager is involved in the project then RLB anticipates all models will be validated by the BIM Manager prior to issue of information. Some common considerations for quality assurance include:

- Who is coordinating the model for updates, changes and for passing this information on to all users?
- LOD certification by the designer and is it in accordance with the BIM Execution Plan?
- Date and revision number of the model
- Does the model identify ‘objects’?
- Which consultant/contractor input into the model?
- What is the context of the services and deliverables we are providing to the client?

DATA EXCHANGE FILE FORMAT

RLB has the ability to measure from a variety of drawing/model formats. Our preferred format is verified IFC files for compatibility with our measurement software. In addition to the verified IFC files, we also require the model in its native authoring software (e.g. Revit, ArchiCAD) and PDF formats. This allows us to ensure that objects are not missed from the exporting and importing of the IFC files. However, we can also use DWF or DWFx files if IFC files are not available.

IFC Files – Factors to consider

IFC is a neutral file format that facilitates cross-discipline data sharing by providing a broad based, vendor neutral repository and is used purely for data exchange. There are a number of issues to be considered when providing IFC files, including:

- Proprietary data models need to be mapped to their correct IFC categories which may involve the use of override settings and creation of additional IFC specific parameters
- Proprietary element classifications do not always have corresponding place holders in the IFC scheme so certain objects in the host model have to be user-modified prior to export
- The current version of IFC specification does not support certain proprietary data types required to define the specification of an object, so the IFC model is not always an exact representation of the host model
- Export of dimensions is not part of the IFC definition. Consequently, a standard IFC export from most IFC compliant applications in the construction industry will not include quantity data unless the base quantity add-on is used. Base Quantity definitions have currently been written for selected building elements and spaces, thus limiting measurement

DWF or DWFx files – Factors to consider

The DWF or DWFx is a proprietary format developed by Autodesk for distributing information between the members of project team. When using DWFx files, the following should be considered:

- Request one single DWF or DWFx file that contains the 3D view and the 2D views and sheets of required plan, elevations and sections etc. The 3D views will be mainly used for quantity taking-off purposes and the 2D views and sheets will be used to check and review the quantities
- The exchange information and data format need to be agreed between design discipline and the QS consultant prior to issuing the model for measurement or estimating purposes
- Review the visibility settings in Revit and ensure that all the required objects are not hidden in the model before exporting to the DWF or DWFx format
- The project units in Revit need to be set at least two to three decimal places to provide an accurate cumulative total before exporting to the DWF or DWFx format
- The DWF or DWFx format can be opened with various design review and measurement software or just opening it in Autodesk's collaborative online platform e.g. BIM 360, etc
- Exporting a model from Revit and opening it in Autodesk's viewer and other measurement software allows users to view comfortably across its geometry and database
- DWF or DWFx files are generally not editable and smaller in terms of file size and thus it is faster to transmit the files than the native format

3.3 DETAILED INFORMATION REQUIREMENTS

DEMARCATION OF OBJECTS AND ELEMENTS BY DESIGNERS

To enable the BIM model to be utilised effectively for cost planning, the model needs to align with principles of cost planning and the categorisation of relevant building elements, as set out in the Australian Institute of Quantity Surveyor's 'Australian Cost Management Manual'. It is important that the requirements are agreed by the project team and documented in a consistent manner from outset of the project.

Below is a general guide for common building elements, and description of a QSID parameter that when completed will enable the sorting and categorisation of information in the model to inform the cost plan.

WALLS

All walls should be modelled using a wall element in BIM tool. It should be modelled from slab to slab, except for the enclosure walls and walls of staircases, which must be modelled according to their storey heights. Internal or external walls should be specified in the wall property.

Walls with a height spanning multiple storeys must be modelled separately for each storey with the height of the respective storey.

DOORS AND WINDOWS

Doors and windows should be modelled using a door element and windows element in the BIM tool. The type and fitting information must be included in the model as part of their properties. The dimension of window and door frames must be indicated in a consistent manner using either frame or opening dimensions.

CURTAIN WALLS, LARGE WINDOWS

Curtain walls and large windows are usually modelled as windows in some of the BIM tools. If this is the case, the host wall must be modelled first, before the glass walls are inserted. In Autodesk Revit, the curtain element should be used to model curtain walls. Curtain walls with a height spanning multiple storeys must be modelled separately for each storey with the height of the respective storey.

FLOOR (GROUND FLOOR, UPPER FLOORS)

The ground floor and upper floor slabs of the building must be modelled using a floor element. The joining of floor and walls are usually modelled such that the floor ends at the surface of the load-bearing wall structure without extending inside it. This is to ensure the quantity extracted is consistent with the GFA measurement rule. Floors must be modelled so that they extend to the internal surface of the external wall. Special checks are required to ensure the model complies with this requirement as the practice of the design team might be different from the QS team.

BEAMS AND COLUMNS

Beams should be modelled using a beam element in the BIM tool. Columns should be modelled using a column element in the BIM tool. A column with a height spanning multiple storeys should be modelled separately for each storey with the height of the respective storey. Special checks are required for the column beam joint and beam wall joint as the practice of the design team might be different from the QS team.

STAIRS

Stairs must be modelled using a stair tool or stair object, separately for each storey. If required, the resting, storey and stair platforms may be modelled as slabs.

OTHER BUILDING ELEMENTS

All building elements with different types should be modelled as separate elements and provided with information, so they can be extracted separately. If the standard building element tool in the BIM tool is not sufficient to support the element required, the generic element should be developed, and the naming and the presentation style of the generic element should be agreed by the project team. Source: Royal Institution of Chartered Surveyors, 2014

ENGINEERING SERVICES

All engineering services should be modelled using appropriate elements or objects in the BIM tool. Objects are to be coded to the functional area they service or support.

QSID PARAMETER

All modelled objects should be assigned a value to a QSID parameter (or similar) based on the definition of elements as set out in the Australian Institute of Quantity Surveyors Australian 'Cost Management Manual'. The QSID parameter can be used to sort information in the model into relevant elements for the purpose of cost planning. Clarification of assignment of elements to relevant categories may require clarification with the cost planner.

Examples of some QSID Codes are:

- **SB Substructure** – Piles, piers, pile caps, footings, working slabs, sub-soil drainage, damp proofing, floor structures, slabs on ground
- **CL Columns** – Internal and external columns, casings and all protective coatings. Excludes non-load bearing columns (EW/ NW), portal frame columns (RF), columns supporting exposed attached stairs (SC)
- **UF Upper Floors** – Suspended floor structures, metal or timber floors, computer floors, screeds, balconies, steps and ramps
- **SC Staircase** – Stairs, landings, ramps, supporting framework, ladders, treads, risers, handrails and soffit finishes
- **RF Roof** – Portal frames, roof framing members, purlins, insulation, roof lights, walls in roof spaces, parapets, rainwater goods, awnings
- **EW External Walls** – Structural walls and non-load bearing framing forming the exterior vertical enclosure around the building other than windows and external doors, from substructure to roof
- **WW Windows** – Opening in external walls providing lighting and ventilation including windows, louvres, curtains, blinds, sills, and linings. Excludes window walls and glazed screens (EW)
- **NW Internal Walls** – Walls and non-load bearing framing to the interior of the building
- **AR Alterations and Renovations** – Alterations and renovations to existing buildings including works to the substructure, finishes, fittings, internal services and localised demolition. Excludes complete demolition of existing buildings (XP)
- **XP Site Preparation** – Demolition, site clearance, cut/fill, retaining walls, temporary services diversions, underpinning
- **XB Outbuildings and Covered Ways** – Small buildings supplementary to the main building, detached covered areas shelters, bridge links
- **XL Landscaping and Improvements** – Grassing, turfing, garden plots and planting, trees, entrance walls, sculptures, signs

Please refer to the AIQS Australian Cost Management, Appendix A Part 3 Definition of Elements, for more information on the above building elements.

It may be determined that as the project progresses and the model approaches an appropriate LOD the project will require a QSID parameter for allocation of building elements to trades. This requirement can be discussed as project requirements develop.

Further detailed workshops for each discipline may be required to identify specific requirements and to clarify method of modelling.

CONSISTENCY OF ELEMENTS AND QUANTITY INFORMATION – ELEMENT NAMING CONVENTION AND PRESENTATION

It is significant to ensure that all building elements are modelled in the same style as agreed and documented by the project team. It will be problematic when the same element is modelled differently in different parts of the building or project. The standard naming convention for building elements and their type information should be identifiable through the type information from a quantity take-off point of view.

It is important to note there should be consistency within each design discipline and across all design disciplines. An identification system for each element type must be established and documented by the project team. There should be consistency with regards to terminology, format, naming conventions, allocation of data to object properties and allocation of specification information.

For example, we would require the following properties to be completed, as a minimum, in a consistent manner both within each discipline and across all disciplines:

- Level
- Category
- Family
- Type
- Instance
- Assembly Code (Uniformat)

The BIM Manager or Lead Consultant (where applicable) should request the equivalent information to be compiled relevant to the software being utilised by the design disciplines.

QUANTITY INFORMATION OF ELEMENTS

The measurement rules of the cost plan require specific quantity information of each element.

For example, windows can be taken off by count or by area, which both can be provided by the window element.

Quantity take-off typically uses the following quantity information:

- Count
- Length measure
- Length
- Perimeter
- Height
- Area measure
- Net area
- Gross area
- Volume measure
- Net volume
- Gross volume
- Weight

For quantity take-off, it is essential that BIMs are created using elements which provide the quantity information required by quantity take-off. The easiest solution is to model each building element using the modelling tool for that specific building element, for example, modelling walls with the wall tool. If a building element is modelled using a tool that is incompatible with the requirements of quantity take-off, the quantity for that building element cannot be taken off automatically. Source: Royal Institution of Chartered Surveyors, 2014

RLB Rider Levett Bucknall

Unmatched Experience

RLB has worked on over 200 BIM projects globally to date.

RLB has been actively working in BIM since 2010.

RLB has worked with some of the world's leading designers.

RLB has invested in numerous software tools including design tools to enable a greater understanding of the models and interrogation of the data contained within.

Global Reach

RLB has formed a Global BIM Group, with representatives from our offices around the world. This group captures best practice from our offices worldwide and allows us to share information, innovation and knowledge ensuring that RLB is at the forefront of the development of BIM as a tool for Cost Consultants.

Collaborative Approach

In order to efficiently use the information contained within the BIM model, RLB seeks to understand how the model has been created and if the object's attributes have been included.

Interrogation of the model using a variety of tools enables capture of information not available with standard QS software.

Extract quantities for the objects drawn in the model and use the data to quantify items not drawn in the model. Combined with our collaborative approach, this capability allows us to generate information without the designers having to create additional items, saving them time and increasing accuracy.

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