EXTERNAL

BIM PROTOCOL 3

PROJECT MANAGEMENT
RIDER LEVETT BUCKNALL

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RLB Rider Levett Bucknall

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For any questions regarding this Protocol, please contact

Tom Chatterton: tom.chatterton@nz.rlb.com
Guy Robinson: guy.robinson@uk.rlb.com

1.0 EXECUTIVE SUMMARY

Rider Levett Bucknall (RLB) has fully embraced Building Information Modelling (BIM) and has the capability to work within a BIM environment across all of our service areas.

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

The use of BIM within a project can be instrumental in the successful delivery of a project and in storing large quantities of project information in one central location. It is therefore integral that Project Managers know the requirements and responsibilities of all members of the team and understand how to implement BIM and manage the process to ensure that the project is delivered successfully.

This document has been compiled to help our Clients understand their responsibilities when using BIM and to help guide the decision as to whether to use BIM, the levels that should be implemented and the requirements of each of the project members.

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 Part2: A Guide for RLB Cost Managers
- BIM Protocol Part3: Project Management (External)
- BIM Protocol Part4: Project Management (Internal)

2.0 INTRODUCTION TO BIM

BIM is commonly defined using the Construction Project Information Committee (CPIC) definition as:

'...digital representation of physical and functional characteristics of a facility creating a shared knowledge resource for information about it forming a reliable basis for decisions during its life cycle, from earliest conception to demolition.'

BIM has evolved as a collaborative process for design based on a digital model of a building, with the facility to embed extensive detail and supplementary information within the model, attached to the component objects. BIM is not a software, nor is it simply a 3D model of a building, although it is commonly misrepresented in this way. The fundamental difference is that the BIM file contains additional 'information' providing significantly more detail and with wider applications.

The BIM process is used to create, manage and share information on a project throughout its life-cycle, providing the opportunity to design, construct and operate buildings in a common environment, with the same information being used by all parties. Designing in a BIM environment involves assembling objects to form the digital model. Each object (e.g. a wall) has information embedded in the model as attributes (e.g. material, thickness, finishes, specifications, etc.).

The information attributed to the objects can be accessed and used by all parties. By allowing other parties to re-use the common information, this allows for collaboration, greater efficiency and co-ordination of the model in a 'virtual environment'. Examples of information attributed to objects include:

- Visual data
- Dimensional and geometric data
- Functional data
- Performance data
- Specification data
- Cost data
- Construction programme data

The information contained within a BIM file is described in a number of ways; typically by the type of data and level of detail. Commonly used terms to describe this information include:

- BIM Dimensions (3D, 4D, 5D, 6D)
- Level of Detail or Development (LOD)
- BIM Maturity Levels

The definition of these three methods can be referred to in RLB BIM Guidance Protocol Part1: A Guide for Clients and Designers.

2.1 BIM DIMENSIONS

BIM dimensions are different to BIM maturity levels. BIM dimensions are classified by the type of data which is inputted to an information model. The addition of supplementary dimensions of data provides an enhanced comprehension of a construction project such as understanding how the project will be delivered, the costs of the project as well as ways of maintaining the development. BIM Dimensions are categorised as 3D, 4D, 5D and 6D.

3D – Shared Information Model/ Design
3D BIM involves the process of creating graphical and non-graphical information with the sharing of information within a Common Data Environment. 3D BIM would include a three-dimensional representation of a building with its basic attributes. 3D BIM facilitates visualization of building geometry as well as being used as a tool in identifying design clashes between different design disciplines in order to reduce potential claims and disputes. As the project advances, the attributes included in the model are expected to be enriched in detail until the project data is handed over to the client at the completion stages.

4D – Construction Programme and Sequencing
4D BIM would include the addition of extra dimension of time-related information to a project information model. As the project evolves, the data added to the components would be more detailed. Accurate programme information could be derived, and this information would also enable to visualize how the construction project will develop sequentially.

The Project Manager is responsible for ensuring that the relevant time-related information is obtained from the relevant stakeholders and included in the information model, so that the construction sequencing and visualization could be carried out efficiently. Project Managers play an important role in a project's programme and outcomes, which is directly impacted by the timeliness and quality of information shared by the project participants. It is important to ensure the correct information is obtained at the appropriate time to avoid decision reversals, potential delays and abortive works, and most importantly to ensure the project is handed over within the stipulated time.

5D – Cost Information
5D BIM includes the addition of cost data to the information model.

Cost-related information might include capital costs or construction costs, the related running costs as well as the replacement costs. 5D BIM is often adopted in value engineering exercises to evaluate the cost impact of different design options and to allow designers in identifying the optimal design solutions effectively and efficiently. It also facilitates change management and provides visibility of changes before any decision is made. With the presence of 4D programme data, the predicted costs and actual spend over the duration of the project could also be tracked. Accurate cash flows can be derived by by linking the programme information (4D) and cost information (5D).

6D – Maintenance/ Project Lifecycle Information
6D BIM focuses on understanding the life cycle costs of assets, and where money is required to make better decisions in terms of capital costs of construction, long term maintenance and replacement costs and sustainability. A 6D BIM file contains information to support the operations and facilities management of a building. This could include information such as component manufacturer, the date of installation, the maintenance required, the energy performance, the operations and configuration instructions, life expectancy and decommission data of components.

2.0 INTRODUCTION TO BIM

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2.2 BIM MATURITY LEVELS

BIM Maturity Levels are a measure of the ability of the construction supply chain to operate and exchange information digitally. The maturity levels range from Level 0 through to Levels 1, 2 and 3. 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. The 2D or 3D CAD format is managed with a collaborative tool and standardised approach to include revision dates to the structure and format. However, 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.

Level 3 – This displays the full implementation of BIM practices; where a model is at its optimum capacity enabling the use of lifecycle asset management. Level 3 involves 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. At level 3, there are time saving opportunities by "live" designing and collaborating with other consultants.

The following figure below illustrates the different BIM maturity levels diagrammatically:

2.3 BIM COLLABORATION LEVELS

4D, 5D and 6D BIM dimensions can all occur within BIM Level 2 workflow. At this level of BIM, 4D construction sequencing and/or 5D cost information could also be included. With the absence of an integrated system under BIM Level 2, stakeholders are removed from fully collaborating on the model and the focus would be more on design coordination issues.

BIM Level 3 in turn fully connects the asset information from start to end, enabling end-to-end efficiencies. Level 3 BIM would utilise 4D construction sequencing, 5D cost data and 6D project lifecycle management information in a fully collaborative environment. This would involve a single model in use with all data comprising of all dimensions, which would be accessed and modified by all parties.

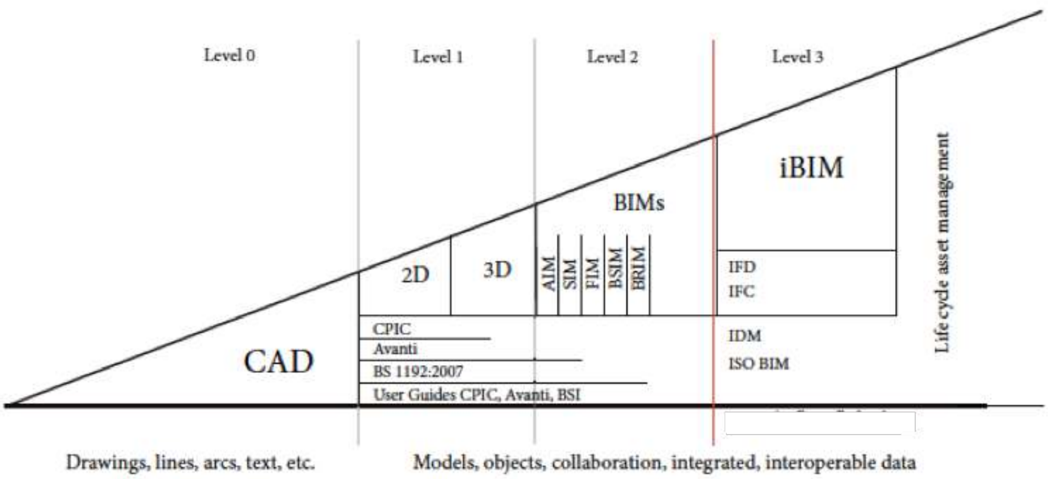

Figure 1: BIM Maturity Level Diagram

3.0 WHEN TO USE BIM

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3.1 LEGAL BIM OBLIGATIONS (UK)

Within the UK, the Government Construction Strategy (GCS) requires that all Public Sector projects utilise BIM to a minimum level 2. This is to ensure that project and asset information, documentation and data is stored electronically to allow collaboration and accurate data sharing between the team.

BIM Level 2 requires all project and asset information, documentation and data to be electronic, which supports efficient delivery at the design and construction phases of the project. At the design stage, designers, clients and end users can work together to develop the most suited design and test it electronically before it is built. During construction, BIM enables the supply chain to efficiently share precise information about components which reduces the risk of errors and waste.

There is currently no legal requirement in the UK to use BIM within the private sector.

3.2 OBLIGATIONS OF THE CLIENT ONCE BIM IS ADOPTED

- Determine Level, Dimension and Maturity of BIM for the project
- Decide whether a BIM Manger is required
- Assisted by the Project Manager produce the Employer's Requirements
- Appoint project members
- Ensure the BEP meets the Employer's Requirements
- Agree handover strategy

3.3 OBLIGATIONS OF PROJECT MEMBERS

Many clients are adopting BIM to some level without realising it. This could be as simple as utilising AutoCAD, Dropbox or requesting the use of RLB ROSS 5D software. However, choosing to begin a project employing BIM to Level 2 or 3, requires decisions to be made at the very front end of a project concerning the Data and Stakeholders.

The following are key tasks that project members must consider from the project's inception if choosing to adopt BIM:

PROJECT MANAGER

- Development of client's brief
- Identify if the client is financing privately or publicly
- Development of Employer's Information Requirements including the desired BIM Level
- Identify Client's Asset/Facilities BIM requirements
- Appoint, work closely with and monitor a BIM manager
- Hold the Master Information Delivery Plan
- Ensure all project members are aware of their role and additional BIM responsibilities as specified within their Scopes of Service
- Production of the pre-contract and post-contract execution plans
- Ensure Data Storage System Architecture matches the clients' requirements
- Engage with stakeholders, such as the Facilities Manager
- Agree with the client a handover strategy
- Identify Programme requirements and milestones particularly relating to BIM development & design

3.0 WHEN TO USE BIM

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ARCHITECT

- Coordinate technical discipline BIM development, standards, data requirements, etc. as established within the BEP
- Lead the technical discipline BIM team in its documentation and analysis efforts
- Coordinate clash detection and resolution activities
- Coordinate trade items into the Design BIM (depending on procurement plan)

ENGINEER/ DESIGNER

- Assist with the technical discipline BIM team in its documentation and analysis efforts
- Coordinate clash detection and resolution activities

BIM MANAGER

- Develop the Employer's Information Requirements
- Create and agree the BIM Execution Plan between all Project Stakeholders
- Establish the required data standards, level of information and processes for each project element
- Chair and minute weekly BIM Coordination meetings highlighting issues within the BIM environment and correct issues accordingly
- Receive information into the Information Model in compliance with agreed processes and procedures
- Develop processes and procedures within the BIM environment, and ensure that these are adhered to
- Review and creation of Process, Workflows & methodologies within the BIM environment
- Maintain the Information model to meet integrity and security standards in compliance with the Employer's Information Requirements
- Set up and manage the Common Data Environment process and procedures for quality, validating compliance with them and advising on non-compliance

COST MANAGER

- Provide input to the BIM Execution Plan (BEP) from the commencement of the project
- Analyse the model and work with the design team to suggest any additional elements
- Work collaboratively with the designers and comply with the agreed specifications/labelling standards
- Produce cost plans, estimates and Bills of Quantities to fill in any areas within the model not captured through BIM take-off

4.0 BIM EXECUTION PLANS

Project Execution Plans (PEP) are tools utilised by Project Managers that describe the proposed strategy for managing the project. It is the opportunity to put in writing the proposed policies, strategies and procedures that will be adopted throughout the project. It is written in response to the Employer's Information Requirements (EIR) and sets out critical information in order to meet these specified requirements.

The utilisation of a BIM Execution Plan (BEP) can be useful in order to assist with BIM projects. This is critical for all public projects within the UK, as UK law requires BIM to be adopted to Level 2.

When including the requirements of BIM there are two key BEPs; a pre-contract execution plan and a post-contract execution plan. They contain slightly different information; however, they are both intended to assist with the collection and monitoring of data.

A pre-contract plan will importantly contain a Project Implementation Plan (PIP). This statement illustrates the suppliers' IT and human resources capability to deliver the project to the standard of the EIRs. Also typically included will be the programme, project milestones and information modelling targets.

A post-contract plan will typically describe the layout of the information required to meet the EIRs. Within BIM there is such a range of terminology, programmes and delivery strategies that these must be specified clearly to the project team. A post contract BEP should cover four main areas;

1. Management
2. Planning and documentation
3. Standard method and procedure
4. IT solutions

5.0 HANDOVER REQUIREMENTS

The handover of the BIM model is one of the most important stages to enable an efficient soft landing for the client. A soft landing typically describes the transition from design and construction to the operational phase of a building.

Where teams implement Common Data Environments, such as Aconex or Zutec, workflows can be automated on a shared, neutral platform, whilst providing a comprehensive information resource accessible by interested parties and shared during or after the project. In this way, the risk of losing asset information created earlier on in the project is lessened. Accurate information should be recorded, verified, and submitted in a timely fashion throughout the process, not just collected at the end.

BIM gives owners a multidimensional model of the as-built asset, but more importantly, the opportunity to develop a structured digital information source of the asset so that the design can be modified and approved while testing its constructability. In the future, the facilities manager has the opportunity to influence the quality of the information they receive, including a complete digital representation, and a geospatial view, with all relevant project and handover information detail included.

A popular characteristic of 6D BIM that is being explored more extensively is the sustainability aspect. There are many advantages to being able to model the whole building that are changing the way that we design buildings. One such process is the ability to carry out a conceptual energy analysis. This is the process of using the model to test the required energy in various scenarios. If this is carried out soon enough, any designs reliant on the energy findings, can utilise the information from the study and designs can be adapted. If aiming to achieve a sustainability accreditation with a building, such as LEED, SKA, BREEAM or WELL, 6D can also be exploited to track information required for the award, by monitoring everything from the sourced materials to estimating the pollution made by constructing a certain way.

6.0 THE RLB APPROACH TO BIM

RLB has invested extensively in the development of BIM within the company, as the benefits associated with the efficiency and the accuracy are highly recognised within the industry. At all levels RLB has different software programmes to assist Project Managers with their projects.

RLB utilizes Autodesk 'Revit' software in managing the 3D BIM representation of building plans. This allows project members to share, update and track changes to the building plans from anywhere.

Through the use of 4D planning software that RLB has access to such as ASTA or Synchro, it is possible to link the individual components of the model to their counterpart activities within the project schedule, thereby creating a more accurate programme, based on a single reliable source of federated design information. Ultimately this then allows the 3D model to be animated, demonstrating the construction sequencing of the building. Distinct from a 3D model visualisation, 4D allows key stakeholders to visualise how the building will look at any given date during its construction.

As progress is updated on the project schedule, this integrates with the BIM model to create an 'As Built' model. This can then be compared with the planned model to demonstrate whether progress is ahead or behind programme and ensures that any mistakes are spotted early on. This may assist where interfaces with other projects need to be aligned and managed or when the project includes complex staging and the safety of the public needs to be assessed.

Similarly, by using the planned versus actual 4D BIM model progress comparison, 4D BIM can also be used to demonstrate or defend delay claims as a result of improved visualisation of the delay event and its impact.

Having the ability to simulate the construction process provides the programmer with the ability to refine and improve the construction schedule, test and develop staging methodologies, consider alternative methodologies and de-risk problem areas.

RLB has developed our own in-house global 5D software, ROSS 5D, which allows us to work with the BIM model and designers to gain the maximum benefit at each stage of design development. 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.

APPENDIX A: BIM GLOSSARY

TERM	DESCRIPTION
4D	Leveraging a 3D model linked to time or scheduling data. Model objects and elements with this data attached can be used for construction scheduling analysis and management.
5D	Leveraging a 3D Model linked to cost data.
6D	Not yet established as an industry-accepted singular definition. The 6th definition is typically the use of BIM to support either sustainability or operations-centric activity. Rather than considering either of these as a 'dimension', better to make reference to specific Model Uses, such as Operations Planning
Asset information modelling	A sub-type of Information Models supporting the maintenance, management and operation of an asset throughout its lifecycle. An Asset Information Model (AIM) is used (a) as a repository for all information about the asset; (b) as a means to access/link to enterprise systems (e.g. CMMS and BMS); and (c) as a means to receive and centralize information from other parties throughout project stages
Asset information requirements	The data or information requirements related to an Asset. Asset Information Requirements (AIR) are typically fed into the Asset Information Model and form part of the Employer's Information Requirements
BIM Execution Plan (BEP)	A formal document that defines how a project will be executed, monitored and controlled with regard to BIM. A BEP is developed at project initiation to provide a master information/ data management plan and to agree roles and responsibilities for model creation and data integration throughout the project. The BIM Execution Plan is developed by suppliers - typically pre-contract to address the Employer's Information Requirements (EIR)
BIM Management Plan (BMP)	Same as BEP.
BIM Manager	Leads and coordinates the BIM processes for the project.
Classification Systems	Classification systems used for organising library materials, product literature and project information. Common systems include OmniClass, UniClass, MasterFormat, and UniFormat
Common Data Environment (CDE)	A single source of information which collects, manages and disseminates relevant, approved project documents for multidisciplinary teams in a managed process. A Common Data Environment (CDE) is typically served by a Document Management System that facilitates the sharing of data/information among Project Participants. Information within a CDE need to carry one of four labels (or reside within one of four areas): Work In Progress
Construction BIM Execution Plan	A BIM Execution Plan for the construction phase of a project.
Construction Operations Building Information Exchange (COBie)	COBie (Construction Operations Building Information Exchange) is a specification for the capture and delivery of design/ construction information to Facility Managers. COBie Specifications can be collated using a spreadsheet template or a COBie-enabled software solution
Design BIM Execution Plan	A BIM Execution Plan for the design phase of a project.
Federated Model	A BIM Model which links (does not merge) several Mono-Discipline Models together. As opposed to Integrated Models, Federated Models do not merge the properties of individual models into a single database.

Geographic Information System (GIS)	A system that integrates hardware, software and data for capturing, managing, analysing and displaying all forms of geographically referenced information.
Globally Unique Identifier (GUID)	A unique code identifying each object/space.
Industry Foundation Class (IFC)	IFC refers to a neutral/open specification (schema) and a non-proprietary 'BIM file format' developed by buildingSMART. Major BIM Software Tools support the import and export of IFC files (also refer to ISO 16739
Interoperability	The ability to exchange Information without Data loss and without a special effort. Interoperability may refer to systems, processes, file formats, etc. Interoperability is not synonymous with openness. For example, interoperable file formats can be proprietary-closed (e.g. RVT), proprietary-open (e.g. DWF) and non-proprietary (e.g. IFC)
Level of Development (LOD)	The Level(s) of Development (LOD) is a scale used to describe the level of completeness to which a model element can be relied upon at different times during model development. The levels defined (with associated content requirements) are: ■ LOD 100 Conceptual: Overall building massing indicative of area, height, volume, location and orientation may be modelled in three dimensions or represented by other data. ■ LOD 200 Approximate geometry: Model Elements are modelled as generalised systems or assemblies with approximate quantities, size, shape, location and orientation. Non-geometric information may also be attached to model Elements. ■ LOD 300 Precise geometry: Model Elements are modelled as specific assemblies accurate in terms of quantity, size, shape, location and orientation. Non-geometric information may also be attached to model Elements. ■ LOD 400 Fabrication: Model Elements are modelled as specific assemblies accurate in terms of quantity, size, shape, location and orientation with complete fabrication, assembly and detailing information. Non-geometric information may also be attached to model Elements. ■ LOD 500 As-built: Model Elements are modelled as constructed assemblies actual and accurate in terms of quantity, size, shape, location and orientation. Non-geometric information may also be attached to model Elements
Metadata	Commonly defined as “data about data”, this differs from the data itself.
Model Element Authoring Schedule (MEA)	Assigns responsibilities to Model Elements via an Author and defines the Level of Development (LOD) of model elements aligned to project phases.
Discipline Model Manager	Same as Discipline BIM Coordinator
OmniClass	Refer to classification system
Project BIM Brief	A document developed by a client to outline their BIM requirements when engaging designers or design and build teams. Can also be referred to as Employers Information Requirements (EIR)
Uniformat	Refer to classification system

APPENDIX B: EXEMPLAR BIM SCOPE OF SERVICE CLAUSES

DESIGN MODELS

Consultant/Contractor will be expected to comply to the LOD as required for the appropriate design stage. The principles will follow LOD 200 for RIBA stage 3 and LOD 300 for RIBA stage 4.

The Consultant/Contractor and BIM Manager will review the model and the clash reports in coordination meetings throughout the design phases and as required by the BEP, until all spatial and system coordination issues have been resolved.

STRUCTURAL

The Consultant/Contractor will provide a 3D BIM created with structural components that embody proper object information and parametric relationships in accordance with good structural engineering practice. These components include, but not limited to, all substructure and superstructure components.

BIM COMPETENCE AND RESPONSIBILITIES

The architects, engineers, designers and technicians involved with providing services under this Agreement, must be trained and experienced in using BIM technology and processes. Unless BIM software is being provided by the Employer, Consultant/Contractor must have, or must obtain at its own cost, sufficient software licenses and computer hardware to adequately perform the services required.

Consultant/Contractor will provide the employer with past BIM experience of project team members. The experience should include an appropriate BIM projects per team member.

DATA OWNERSHIP AND REUSE

Information regarding the Employer's facilities are important to the Employer's overall facility management programme as well as its continued use, modification and reuse of the project being designed under this Agreement. All building information models and supporting information are the property of the Employer, which have unrestricted right of reuse. Consultant/Contractor are not responsible for any modifications to the building information models made by the Employer subsequent to completion of this Project.

ADDITIONAL USES

The BIM will be used in conjunction with clash detection to check for physical coordination conflicts. In addition, the BIM may be used to develop scheduled programmes, cost estimations and information for operation and maintenance of the Project. Consultant/Contractor will coordinate with the Employer regarding inclusion of operations and maintenance information into the BIM data.

APPENDIX C: CLIENT CHECKLIST

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STAGE 1

- Is the project public or private sector? For publicly funded projects within the UK, the projects must adopt BIM to at least Level 2.
- Choose the level and extent of BIM including 4D (time), 5D (cost) and 6D (FM) following software assessment.
- Decide whether to appoint an independent BIM Manager. The designers may have an in house one so this may not be necessary.
- Do you require an information or interface manager?
- Choose the level and extent of data security
- Together with the Project Manager determine the Employer's Information Requirements

STAGE 2

- BIM pre-start meeting.
- Ensure pre-contract BIM execution plan is produced by Project Manager in response to client brief and Employer's Information Requirements
- BIM data used for environmental performance and area analysis.
- Enable design team access to BIM data, the editing rights of each member may differ.
- Agree extent of performance specified work.

STAGE 3

- BIM execution plan for the designers and suppliers in response to client brief and Employer's Information Requirements. This should cover all project exchange formats, software, protocols and agreed standards.
- Choose and implement a common data environment agreed to allow for data sharing and integration for design co-ordination and detailed analysis including data links between models.
- Review data for the Planning Application.

STAGE 4

- Final review and sign off on the model.
- Agree handover strategy for the project with the facilities manager and Project Manager

STAGE 5

- Agree timing of 'Soft Landings' with facilities manager and Project Manager.
- Receive 'End of Construction' BIM record model data.

STAGE 6

- Facilities Management BIM model data issued as asset changes are made.
- Study of parametric object information contained within BIM model data.

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