

**ACEI Building Information Modelling (BIM) Advice Note
for
Building Services Consulting Engineers**

December 2023

1 Introduction

This advice note is intended to give guidance to ACEI members and to create an industry benchmark in defining a standardised scope of service (appointment) and how we deliver BIM projects in the BIM environment. It aims to highlight the areas where we can achieve increased efficiency and identify the primary areas of risk for Building Services / MEP consultants working in BIM including:

- Level of Information Need
- Costing and Quantity Take-Offs
- Model Coordination and Design Clashes
- Change Management
- Architectural Interface

This advice note also intends to clarify what can reasonably be expected from consulting design engineers. It also links these expectations to the guidance set out in BSRIA BG6/2018: “A Design Framework for Building Services” while conforming to EN ISO 19650 requirements which deal specifically with the process for structuring electronic or digital building information using BIM.

The key early-stage documents setting out the BIM deliverables required are the EIR (Exchange Information Requirements) and the BEP (BIM Execution Plan). These documents are required to plan efficient workflows, and to ensure that all parties understand their responsibilities and that the best project outcomes are achieved. The EIR is written by / on behalf of the client and defines the project BIM scope of works. It should include details on what the models will be used for, and any standards or classifications required. The Pre-Appointment BEP should be written in response to the EIR during the bidding process and it should indicate the proposed delivery team approach. Plain language should be used to describe requirements and proposals in concise BIM documentation in order that information can be easily understood by all stakeholders.

A high-level Responsibility Matrix should also be included in the bid documents indicating the elements which will be modelled and the Level of Information Need (previously a combination of Level of Detail and Level of Information) at each stage of the project. The Responsibility Matrix should also note elements which will not be modelled. The Pre-Appointment BEP should be updated following award of contract to form the Post Appointment BEP and should be agreed by all members of the design team and under current practice is managed by the Project Lead and should include specific details of how the requirements of the EIR will be achieved. The same process should take place prior to appointment of the contractor(s) for construction stage.

The contractor(s) should refer to the design stage Post-Appointment BEP, the EIR and all other relevant BIM documentation when establishing their construction stage Pre-Appointment BEP. It is

important to note that the EIR is an appointment-level document. Each entity that enters into an appointment which specifies BIM should be in receipt of an EIR at tender stage. A clear understanding of the Appointing Party's Information Requirements is required to facilitate the delivery of a quality project using BIM. If BIM is specified by the Appointing Party and an EIR is not provided, one should be requested. In the absence of comprehensive Information Requirements, designers should include details of the basis of their fee and service proposal, and any associated assumptions in their tender response. Following the tender issue at the end of design stage, it is important to ensure that all parties are aligned on the overall project BIM expectations as set out in the EIR, Design Stage BEP and associated documents during a contractor pre-appointment meeting. Any agreements discussed at these meetings should be recorded.

2 Typical Level of Information Need

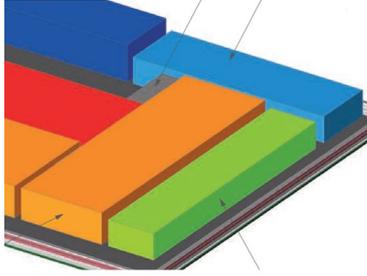
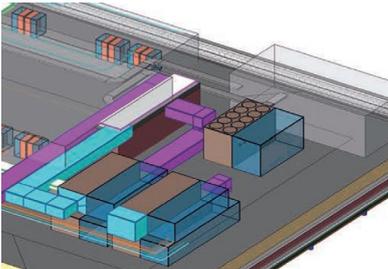
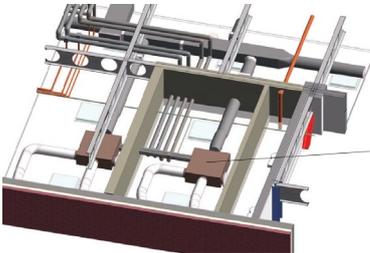
The typical Level of Information Need table overleaf is based on the guidance set out in BSRIA BG6 2018. As the latest industry standard is the ISO19650 international information management standards, we should refrain from referring to the outdated PAS 1192-2 British NBS LOD (Level of Detail) and LOI (Level of Information) definitions and the American AIA BIM Forum versions as these have been open to interpretation (particularly when referring to the NBS LOI definitions which have now been withdrawn). Whilst "LOD" and "LOI" are now superseded by the 'Level of Information Need' approach, it can be useful shorthand to think about these two aspects of data development (graphical and non-graphical information) occurring in tandem. The table assumes building services engineers taking the model to BSRIA BG6 Stage 4a (feasible-generic design model) described as:

A model showing detailed building services designs, with locations and sizes of all items of plant, pipes, ducts and cable containment using generic objects in positions that are feasible for building services contractor and trade contractor pricing and for installation without major rerouting. This is analogous to the level of detail in Technical Design drawings using generic objects.

"Generic objects" are distinct from supplier specific objects. (e.g., company specific / "out of the box" elements). As structured data is a very important factor in efficient BIM processes and workflows, all modelled elements should follow a classification / naming convention agreed in the Post-Appointment BEP.

Level of Information Need can be specified following the guidance set out in EN17412-1:2020 "*Building Information Modelling - Level of Information Need - Part 1: Concepts and principles*". MEP consultants should describe / prescribe the graphical and non-graphical requirements for each modelled element considering: detail, dimensionality, location, appearance and parametric behaviour. (refer to Figure 8 of EN17412-1).

Specific client requirements set out in the EIR / Asset Information Requirements should also be considered when developing the Responsibility Matrix.

Sample Workstage (see following page for alignment)	Typical level of graphical detail	Typical level of non-graphical detail
<p>Concept Design / Outline Proposal</p>	<p>Visual information to provide general principles of the design. Preliminary graphical detail and location to support general spatial planning.</p> 	<p>General description (eg Air Handling Unit / Distribution Board) and element identification (eg AHU 01 / MDB 03).</p>
<p>Spatial Coordination / Scheme Design</p>	<p>Visual information to provide developed principles of the design. Graphical detail showing location, general size and relationship between different elements identifying key requirements of the design such as access and maintenance zones to validate the design strategy for detailed design stage.</p> 	<p>General description (eg Air Handling Unit / Distribution Board) and element identification (eg AHU 01 / MDB 03), size (W x L x H).</p>
<p>Technical Design / Detailed Design & Production Information</p>	<p>Visual information to provide fixed principles of the design supporting procurement. Developed feasible coordination between all professions. Graphical detail showing location, size and relationship between different elements of the design indicating primary performance characteristics and maintaining key requirements such as access and maintenance zones.</p> 	<p>General description (eg Air Handling Unit / Distribution Board) and element identification (eg AHU 01 / MDB 03), size (W x L x H).</p>
<p>Point at which MEP model ownership transfers to the Contractor (Construction stage Level of Information Need should be detailed in the Contractor's Responsibility Matrix. The design stage Responsibility Matrix should leave Stages outside of the design team's scope blank to maintain clarity)</p>		
<p>Construction / Handover / As Built</p>	<p><i>As per EIR</i></p>	<p><i>As per EIR</i></p>

RIBA Stage	RIAI / ME2000 Stage	BSRIA BG6 2018 Stage	Irish Government Contract Stage	Level of Information Need (LoIN)	Responsibility	Coordination	Clash Resolution	Use of Model for BOQ
2 (Concept Design)	2 (Outline Proposal)	2 (Concept Design Model)	Stage 1 (Preliminary)	Refer to examples on previous page	Design Team	Not coordinated	No clash resolution	N/A
3 (Spatial Coordination)	3 (Scheme Design)	3 (Developed Design Model)	Stage 2A (Developed Sketch Design)	Refer to examples on previous page	Design Team	Partially coordinated	Basic clash resolution (model is not clash free)	N/A
4 (Technical Design)	4&5 (Detailed Design & Production Information)	4.a (Technical Design Model - Feasible Generic Design)	Stage 2B (Detailed Design) Stage 2C (Detailed Design) Stage 3 (Tender Action)	Refer to examples on previous page	Design Team	Coordinated for feasible design	Primary clash resolution (see Section 4 (model is not clash free))	Can be used as a guide for bulk quantities with caution
Point at which MEP model ownership transfers to the Contractor								
Note: The Designer completes stage 4a as described in BSRIA BG6 2018 at RIBA Stage 4 and the Contractors then develop stage 4b/c as described in BSRIA BG6 2018 prior to commencing RIBA Stage 5 (Construction stage Level of Information Need should be detailed in the Contractor's Responsibility Matrix. The design stage Responsibility Matrix should leave Stages outside of the design team's scope blank to maintain clarity)								
5 (Manufacturing and Construction)	Construction	4.b (Technical Design Model - Coordinated Generic Design)	Stage 4 (Construction Works)	As per EIR	Contractor	Primary services fully coordinated	Primary services are clash free	Can be used as a guide for bulk quantities with caution
5 (Manufacturing and Construction)	Construction	4.c (Technical Design Model - Coordinated Specific Design)	Stage 4 (Construction Works)	As per EIR	Contractor	Primary services fully coordinated	Primary services are clash free	Can be used as a guide for bulk quantities with caution
5 (Manufacturing and Construction)	Construction	5a (Installation Model) 5b (As Built Model)	Stage 4 (Construction Works)	As per EIR	Contractor	Fully coordinated	Clash free	Should be possible to quantify all services
6/7 (Handover / Use)	Construction	6/7 (As Built Model)	Stage 5 (Handover & Close Out)	As per EIR	Contractor	Fully coordinated	Clash free	Should be possible to quantify all services

3 Costing and Quantity Take-Offs

2D drawings taken from the model at the end of design stage (BSRIA BG6 Stage 4a) should be suitable for costing by contractors. If design models are to be used for this purpose (not recommended) they should be used with caution and in conjunction with a detailed Responsibility Matrix, paying particular attention to the elements which are not included in the 3D model. It should also be noted that the quantities of scheduled elements in a Revit model will not seamlessly tie in with the Agreed Rules of Measurement 4.

Typical model elements which may not be included in the 3D model are noted below:

- Elements associated with specialist / client design packages (sprinkler, gaseous / foam fire suppression / modular wiring, AV systems, DX refrigeration systems, cold rooms, etc.)
- Typical detail elements e.g. valving arrangements at mechanical equipment / sanitary ware, AAVs / drain points / etc. are not included as 3D elements in the design model but are included on 2D detail sheets / schematics. (Space allowance should however be provided in the model)
- Access hatches
- All services supports, steelwork, plinths, bearers, access gantries and walkways / stepovers, anchors, guides, expansion bellows and loops, anti-vibration mounts, etc.
- Final foul, condensate and soil vent connections to sanitary appliances including traps, WC connectors, adaptors, vent pipe roof cowls, etc.
- Electrical Cabling and conduits under 50mm
- Modular wiring / Lighting termination (Klik) boxes
- BMS field devices sensors, VSDs, trace heating, leak detection tape, control valves, etc.
- Air intake / exhaust louvres
- Below ground water / waste pipework (typically civil engineering scope)
- Lightning protection systems
- Builder's works opening design, modelling and detailing.
- Rainwater pipework
- Room data sheets (elevations with set out by architect).

4 Model Coordination and Design Clashes

The technical design stage (RIBA Stage 4) of a project has been divided into three general phases in BSRIA BG6 for the purpose of defining and assigning design activities and outputs. As consulting design engineers, we complete 'feasible generic design' as described in BSRIA BG6 Stage 4a. We do not complete to BSRIA BG6 Stage 4b/c 'Coordinated generic / specific design' - which includes the production of coordinated working drawings. This is 'coordination' as opposed to 'design' and is completed by the contractor. This point needs to be agreed and clearly communicated in the design stage Pre-Appointment and Post-Appointment BEPs to reduce risk. To maintain an efficient

workflow, it is recommended that all core principles are fully aligned and agreed between all design team disciplines before investing significant time in a detailed modelling process.

In defining the contractor's responsibility for post-tender coordination, the requirement should be clearly described in the Works Requirements (contract documentation). Sample wording below: (The drafters should consider if the clause enables tenderers to price the obligations and if it is transferring an appropriate level of risk to the tenderers)

"In recognising that the works are Designed by the Employer, tenderers accept that it may be necessary to co-ordinate their works into the Employer's design (i.e. interface or connection between any contractor or sub-contractor/specialist designed portion to Employer's base design). It is estimated that such co-ordination would include but is not limited to, the following:

- *settling final locations of plant and equipment*
 - *modelling of bracketry, hangers and supports.*
 - *incorporating contractor / specialist designed plant into the Employer designed Works*
- (Adjust above bullets as required)**

In submitting a price for the Works, Tenderers confirm that they have allowed for elements of final co-ordination with the Employer's design (such as, but not necessarily limited to those bullet points listed above), and that they have allowed for this within their submitted tender price - and further accept that no allowance will be made for additional time or payment for final co-ordination.

It is important to note that the design model will not be completely clash free - but will be clash resolvable and coordinated to a point where it has been demonstrated that the services installations can be accommodated within the allocated plant rooms, service routes and risers and that the contractor will be able to develop the construction / coordination model. A typical example of this is where a cable tray or pipe intersects another service at the same offset, and where there is sufficient clear service zone above, below, or adjacent to the clash. Such clashes can be deemed resolvable and may remain in the model at Stage 4 (BSRIA BG6 4a), to be resolved in the Contractor's coordination / working model. It is important to note that the model issued for contract stage (Stage 4a following Tender action) is design intent only and is not suitable for construction; the contractor has responsibility for final working coordination and any specialist design elements which should be developed in their construction model(s).

Main plant equipment and primary distribution services clashing with structural or building fabric elements should be coordinated to avoid major re-routing and to facilitate the design of primary service openings in the structure (Refer BG6 2018 Fig. 5).

It is recommended that a minimum of 20mm tolerance is used for clash detection purposes during design stage.

5 Change Management

Poorly defined change management procedures inevitably increase risk for all project stakeholders, therefore a formal change management process / mechanism should be agreed in advance of contract signing.

Model sharing purpose should be set out in the EIR and design stage BEP. whilst being careful to consider any contractual requirements.

In the event that the BIM model is handed over to the contractor at contract award (for information, or otherwise), the design team model(s) effectively become superseded by the contractor's construction stage model from this stage onwards. This should be maintained by the contractor for the duration of the construction works and validated at handover stage to "as-built" status.

Post-contract design changes may occur and responsibility for Employer-initiated change remains with the Employer. Where changes are proposed, these could be developed by the design team using drawings taken from the contractor's construction (co-ordinated working) model. Minor changes could be communicated using a pdf markup - but more substantial changes may require the MEP consultant to obtain a copy of the MEP contractor model to re-engineer the change, and then re-present to the MEP contractor as a 2D PDF sheet (contract deliverable format) as an updated design intent for the contractor's incorporation/co-ordination into the live working construction model.

6 Efficient Interdisciplinary Workflow

To support and improve the workflow between disciplines, increase model quality and support an efficient BIM process, the following modelling requirements should be established. These requirements could be documented in the MEP Pre-Appointment BEP and discussed at a BIM kick-off meeting for inclusion in the project Post Appointment BEP.

- *Shared-coordinates, grids, and levels to be fixed as early as possible.*
- *The model status sheet should summarise changes to enable other Task Teams to update their models accordingly.*
- *All volumes representing rooms including external spaces that form part of the project (rooftop plant areas, parking areas, etc) should contain a named and uniquely numbered room. These identifications should remain unchanged for the duration of the project.*
- *Ensure that all floors and walls are "room bounding" with all junctions properly joined. Ensure that ceiling types requiring / not requiring room bounding are agreed.*
- *All walls and doors should include a parameter with fire rated information derived from the latest fire consultant's certification layouts. (parameter name and sample values to be detailed in Post-Appointment BEP)*
- *All architectural MEP fixtures should be accurately set out. Specialist design elements should be agreed and set out at an early stage e.g. kitchen equipment and fit-out, sprinkler design, specialist labs etc.*
- *Ceilings should be modelled to show the intended set out and whole ceiling build-up including the height of the framing, this could be provided as a "thickness" rather than individual components.*
- *Floor build-ups should be modelled, to enable better coordination if using a "raised floor".*

Timeframes for frozen layouts and room data sheet information from each discipline should be agreed at an early stage considering dependencies in the context of overall project critical path and documented in the Post-Appointment BEP.

Where room data sheets are required to be produced, the interface between architectural and MEP disciplines can lead to a complex workflow, however it may be agreed that the MEP model and drawings are used for pricing purposes (quantum) only, and that the architectural model takes priority for coordination and final set out.

7 Summary

- EIR and BEP (including a well detailed Responsibility Matrix) are key documents. A clear understanding of what the client is expecting is needed to facilitate the delivery of a quality BIM project. It is important to read and fully understand the requirements set out in these documents.
- Where the Works specify BIM and / or digital deliverables, information should be provided by the Client in line with the requirements of ISO 19650, including Exchange Information Requirements (EIR) and an Information Protocol. If BIM is introduced after the Consultant's Appointment, it should be paid for as an Additional Service. The Consultant's bid should clearly state any assumptions made and any elements excluded from the fee proposal.
- Establish project standards, methods, and procedures between the whole design team at an early (project concept) stage.
- BSRIA BG6 2018 should be used as the reference point for project teams.
- Design models being used for costing at BSRIA stage 4a should be used with caution, and only in conjunction with a detailed Responsibility Matrix
- The design model will not be completely clash free but will be clash resolvable to enable the Contractor to develop the construction / coordination model.
- In the absence of an EIR, consultants should detail the basis of their fee and service proposal, and associated assumptions. Risk may be increased by either remaining silent, including incomplete protocols / appendices, or inconsistencies in comparison to the agreed BIM approach at project level.
- Many opportunities are possible once information is well structured within the BIM environment (critical for data harvesting and automation). This should be discussed and agreed with the client and project team prior to BIM commencement.
- Early-stage planning and clash prevention strategies ensure a more efficient coordination workflow. Plan, Setup, Execute.
- Project clash detection workshops should be run by the project lead at regular intervals and include a report of issues to be resolved for models to comply with requirements of the BEP.
- The online NBS toolkit definitions for LOD and LOI have now been withdrawn and should be replaced with a description / prescription of what information will be provided for each modelled element at each stage. Refer to EN17412-1:2020 "*Building Information Modelling - Level of Information Need - Part 1: Concepts and Principles*" for further information.
- Establishing and maintaining a Common Data Environment ensures that the whole project team collaborates using the "single source of truth" for all project data. It is important that consultants maintain their own separate back-up/record of all data uploaded to the CDE (reference Trant v Mott MacDonald case)

- The hosting of the CDE should be agreed early in the project and noted in the project BEP. Hosting of the CDE is not typically an MEP scope.
- Quality BIM models will only be achieved if all design team members commit to BIM.
- All design team members should use a common software platform and version agreed in the BEP. Where this is not possible for all disciplines, models should also be shared in *.ifc format.
- The UK BIM Framework Information Protocol includes an exclusion of liability for data corruption after the information model has been shared, published or otherwise issued through the CDE Solution and Workflow by the issuing party.
- A specific construction stage BEP should be included in tender. Design team BEP should be kept separate from contracting team requirements.
- IES is the only SEAI validated software at present. Check the EIR for thermal modelling requirements in the model.
- Post model handover change procedure to be agreed in BEP. (The most efficient workflow would avoid keeping a live design team model through construction)
- Day to day design development updates communicated via CAD or pdf markups are acceptable, however if there is a more fundamental material change in project brief then a more suitable structured approach for the delivery of design information should be agreed between the contractor and the design team.
- Coding / Automation requirements should be discussed with design team in advance of model set up.
- Sufficient time should be allowed for BIM in your programme.
- The term “clash resolvable” should be used instead of “clash resolved” when describing the model coordination at stage 4a (feasible generic design).
- The Consultant will initiate COBie within M&E models to a reasonable level; contractor is responsible for populating parameter values in excel sheet based on the final equipment selection. (Exact requirements to be included in EIR and Post Appointment BEP)
- Under public contract forms, the model does not typically form part of the contract and is issued for information-only to contractors. The BOQ is the primary pricing document.