ACEI Building Information Modelling (BIM) Advice Note
for Building Services Consulting Engineers - May 2020

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 MEP consultants working in BIM including: Levels of Information Need (LoIN - previously Level of Model Definition), costing, coordination and levels of clash resolution in the design model. It also intends to clarify what can reasonably be expected from consulting design engineers. Finally, it links these expectations to the standards set out in BSRIA BG6/2018: "A Design Framework for Building Services" while conforming to the requirements of I.S. EN ISO 19650 and the PAS 1192 suite of documents 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-Contract BEP should be written in response to the EIR and it should indicate the approach agreed by the design team. A Responsibility Matrix / MPDT (Model Production Delivery Table) should be included in the contract documents indicating the elements which will be modelled and the Level of Information Need (combination of Level of Detail and Level of Information) at each stage of the project. The Responsibility Matrix / MPDT should also note elements which will not be modelled. The Pre-Contract BEPs should be collated to form the Post Contract BEP and should be agreed by all members of the design team. It is managed by the project lead and should include specific details of how the requirements of the EIR will be achieved.

2   Typical Level of Information Need (LoIN)

The typical LoIN table overleaf is based on the requirements set out in BSRIA BG6 2018. As we are generally working to UK Standards it is more suitable to use the British NBS LOD (Level of Detail) and LOI (Level of Information) definitions, rather than the American AIA BIM Forum versions. 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 re-routing. This is analogous to the level of detail in Technical Design drawings using generic objects.

| RIBA Stage | RIAI / ME2000 Stage | BSRIA BG6 2018 Stage | Irish Government Contract Stage | LoIN | | Responsibility | Coordination | Clash Resolution | Use of Model for BOQ |
				LOD (NBS)	LOI (NBS)				
2 (Concept Design)	2 (Outline Proposal)	2 (Concept Design Model)	Stage 1 (Preliminary)	LOD 2	LOI 2	Design Team	Not coordinated	No clash resolution	N/A
3 (Developed Design)	3 (Scheme Design)	3 (Developed Design Model)	Stage 2A (Developed Sketch Design) Stage 2B (Detailed Design)	LOD 3	LOI 3	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 2C (Tender)	LOD 3	LOI 3	Design Team	Coordinated for feasible design	Primary clash resolution (see section (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 defined in BSRIA BG6 2018 at RIBA Stage 4 and the Contractors then moves to stage 4b/c as defined in BSRIA BG6 2018 at RIBA Stage 5									
5 (Construction)	*Construction*	*4.b (Technical Design Model - Coordinated Generic Design)*	*Stage 3 (Implementation)*	*LOD 5*	*LOI 5*	*Contractor*	*Primary services fully coordinated*	*Primary services are clash free*	*Can be used as a guide for bulk quantities with caution*
5 (Construction)	*Construction*	*4.c (Technical Design Model - Coordinated Specific Design)*	*Stage 3 (Implementation)*	*LOD 5*	*LOI 5*	*Contractor*	*Primary services fully coordinated*	*Primary services are clash free*	*Can be used as a guide for bulk quantities with caution*
5 (Construction)	*Construction*	5a (Installation Model) *5b (As Built Model)*	*Stage 3 (Implementation)*	*LOD 5*	*LOI 5*	*Contractor*	*Fully coordinated*	*Clash free*	*Should be possible to quantify all services*
6/7 (Handover / In-Use)	*Construction*	*6/7 (As Built Model)*	*Stage 4 (Review)*	*LOD 6*	*LOI 6*	*Contractor*	*Fully coordinated*	*Clash free*	*Should be possible to quantify all services*

"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-Contract BEP.

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 / MPDT, 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 BSRAI BG6 for the purpose of defining and assigning design activities and outputs. As consulting design engineers, we complete 'feasible generic design' as per BSRIA BG6 Stage 4a. We do not complete to BSRIA BG6 Stage 4b/c Stage '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.

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.

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.

5   Summary

- EIR and BEP (including a well detailed Responsibility Matrix / MPDT) are key documents. A clear understanding what the client is expecting is needed in order to facilitate the delivery of a quality BIM project. It is important to read and fully understand the requirements set out in these documents.
- Establish project standards, methods and procedures between the whole design team at an early (project concept stage) 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 / MPDT.
- Unless specified otherwise LoD / LoI 3 is standard for M&E at stage 4a. (LoD /LoI definitions as per NBS toolkit)
- 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 if 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.
- 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.
- NBS toolkit is a valuable resource for defining information development and delivery at each stage of the asset lifecycle: https://toolkit.thenbs.com/

- 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 CDE should be hosted by the Project Lead at design stage and by the Principal Contractor during construction stage.
- 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 agreed in the BEP. Where this is not possible for all disciplines, models should also be shared in *.ifc* format.
- The CIC BIM Protocol includes an exclusion of liability for data corruption caused by conversion of models (to allow accessing in a format different to the authoring software). *Note*: the CIC BIM Protocol is referenced in relation to general clauses; however LoD/LoI definitions should be based on NBS.
- 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)
- Coding / Automation requirements should be discussed with design team in advance of model set up.
- Sufficient time should be allowed for BIM in your program.
- The term "clash resolvable" should be used instead of "clash resolved" when describing the model coordination at stage 4a.
- 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).
- 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.