ACEI Building Information Modelling (BIM)

Advice Note

for

Structural Engineers

January 2023

1   Introduction

This Advice Note in relation to BIM, according to the ISO 19650 series (hereafter referred to as BIM), has been prepared following various queries raised by ACEI members and aims to inform ACEI member firms involved in the Structural design of projects. In particular, it addresses what can reasonably be expected from consultants engaged on projects utilising BIM when the consultant is providing "*Normal Services*" as defined in the Conditions of Engagement Agreement SE9101. Other queries raised include:

- Is BIM considered to be a "Normal Service"?
- What Level of Information Need is expected from consultants engaged on projects utilising BIM when the consultant is providing "Normal Services"?
- Training and up-skilling required for BIM?
- Are additional fees required for the project when BIM is used?

2   Definitions

Building Information Modelling (BIM) is defined in ISO 19650-1 as the '*use of a shared digital representation of a built asset to facilitate design, construction and operation processes to form a reliable basis for decisions*'. It is a very broad term that describes the process of creating and managing project information, which includes reports, specifications, schedules, drawings, etc. and most prominently for a lot of people when they think of the term BIM, a data-rich digital 3D model of an asset.

Where previous BIM standards and documentation referred to BIM 'Levels' of maturity, e.g., BIM Level 2, the ISO 19650 standards, which supersede these standards, have moved away from this towards 'stages' of BIM maturity. The defined Stages 1 to 3 provide perspective on the maturity of information management from analogue to digital process. Stage 2 maturity involves the use of both manual and automated information management processes to develop a federated information model containing all information delivered by project team members. Stage 2 maturity can also be referred to as 'BIM according to the ISO 19650 series.

3   Standards

Some of the relevant standards for BIM include:

- IS EN ISO 19650-1: Organisation and digitisation of information about buildings and civil engineering works, including building information modelling - Information management using building information modelling Part 1: Concepts and principles.

- IS EN ISO 19650-2: Organisation and digitisation of information about buildings and civil engineering works, including building information modelling - Information management using building information modelling Part 2: Delivery phase of the assets.

- BS 8541-1: Library objects for architecture, engineering and construction Part 1: Identification and classification – Code of practice.

A list of other relevant BIM standards can be found here: CEN - CENELEC - Search standards (cencenelec.eu). There are many publications and reference documents relating to the delivery and use of BIM on projects. Some UK examples include:

1. Outline Scope of Services for the Role of Information Management - Construction Industry Council (CIC);

2. Uniclass 2015 - https://www.thenbs.com/our-tools/uniclass-2015

3. NBS Toolkit https://toolkit.thenbs.com/

Section 12 (Building Information Modelling (BIM)) of the '*Code of Practice for Tendering*' published by the Liaison Committee for the Construction Industry includes guidance on BIM and ISO 19650 tendering practices for the industry. We also refer members to the RIAI BIM Pack prepared by the RIAI BIM Sub-committee. Previously published in 2019, this BIM Pack has been updated to align with ISO 19650 standards and can be ordered from the RIAI.

4   Tendering and Appointment

According to the ISO 19650 series, the starting point and a key requirement of any project where BIM is proposed to be adopted, is for the employer/client (hereafter referred to as the 'Appointing Party' in accordance with ISO 19650 terminology) to set out its requirements for the digital information produced. This should be provided in the Appointing Party's Exchange Information Requirements (EIR), prepared in accordance with IS EN ISO 19650-2, and should consider what the information produced will be used for and what is its level of information need. This document supersedes the previous Employer's Information Requirement (EIR) document referred to in UK Standard PAS 1192-2.

An Information Protocol should also be provided by the Appointing Party at tender stage and incorporated into any appointment. The Information Protocol provides the vehicle for BIM to be included as a contractual requirement. This is reinforced under clause 9.0 (g) of Conditions of Engagement SE9101 (2020 edition) which states '*Where the Works specify BIM and / or digital deliverables, information shall be provided by the Client in line with the requirements of ISO 19650, including Exchange Information Requirements (EIR) and an Information Protocol.*'

Also of note in this clause: '*If BIM is introduced after the Consultant's Appointment, it is to be paid for as an Additional Service under Clause 10.2*'.

The EIR allows each prospective project designer to respond to these requirements by submitting a pre-appointment BIM Execution Plan (BEP) where required. The BEP outlines and demonstrates the designers' proposed approach, capability, capacity and competence in order to meet the EIR, in the context of the required services.

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 in order 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.

Where a designer intends to engage a sub-consultant (task team) to produce any of the specified information requirements, they are required to assess their capacity to produce the information in accordance with the EIR and take any action which may be required where there is a risk of non-compliance with the EIR. It is also pertinent to include an Information Protocol to incorporate BIM requirements into their sub-consultant appointment.

It is also worth noting as part of the ISO 19650-2 requirements, an Appointing Party may request at tender stage a BIM competency assessment, proposed Mobilisation Plan and proposed Risk Register as part of their tender responses. Members should query at tender stage if there is any ambiguity in the tender requirements.

Following appointment, the designer is required to confirm their post-appointment BEP, including any updates agreed during the tender process. While, in accordance with ISO 19650-2, the EIR and BEP are appointment level documents, current practice is for the same EIR to be issued to all Design Team members, even where members are separately appointed, with the post-appointment BEP updates agreed between the Design Team members and prepared by the lead consultant (normally the Architect). It may, therefore, be the case that the designer will have to agree to changes to their pre-contract BEP contents.

5   Design Information

SE9101 does not specify what or how Civil & Structural (C&S) information on a project (digital or otherwise) is to be produced. Unless it is specifically requested within an EIR or BEP, it is a matter for the individual consultant to determine and decide on the manner in which any design information is prepared, shared and communicated, as agreed with their client (or the Client Representative / Design Team Leader) and in the context of the specifics of their role on the project. Clearly, any specific client requirements for the adoption of BIM on a project need to be defined in the EIR and taken into consideration by the C&S Consultant. It should be clarified with the client at tender stage whether the BIM model is intended to be included in the Contract Documents for Construction Stage.

The key duty of the consultant in relation to the production of design information normally includes:

1. Carrying out the design/specification of the Works to comply with the requirements of Part A of the Second Schedule to the Building Regulations;

2. Developing the detail design of the approved scheme design of the Works in collaboration with the Lead Consultant and other members of the design team;

3. Preparing sufficient drawings, estimates of reinforcement, and final specifications of the Works to enable the preparation by others of a Bill of Quantities and/or other tender documents.

6   Additional Works

Depending on the maturity of BIM requirements specified, BIM implementation on a project may require undertaking additional work and services, and/or a change in how a project is resourced through the project delivery stages including the following non-exhaustive list:

1. Production of more regular and detailed information at particular project stages;

2. Attendance at specific BIM coordination meetings;

3. Developing, reviewing and agreeing post-appointment BEP;

4. Preparation and management of project-specific BIM documentation including task information delivery plans (and master information delivery plan where relevant), detailed responsibility matrix, risk register and mobilisation plan specific to information production, which can be quite time consuming;

5. The provision at any project stage of drawing or model information to a level of detail and information beyond what would be expected of a consultant providing "Normal Services";

6. Other project-specific requirements as detailed in the EIR, including applying classification standards to the project information, such as Uniclass 2015;

7. Cost of licences to use some Common Data Environment platforms, if not provided by the Client, as required by ISO 19650-2;

8. Submission of Structural and/or Civil Analytical Model, if defined as an information requirement;

9. Use of specific BIM software, (such as Autodesk REVIT, Tekla Structures, Civil 3D, Navisworks, BIM Collab, Revitzo, etc);

10. Supporting the Appointing Party in the preparation of their Exchange Information Requirements for the construction contract.

In the context of the above, it is a matter for the consultant to determine what resources, tools and costs are required to carry out its duties and obligations where BIM is specified as a project requirement. There is now an increasing requirement across the construction sector for projects to implement some level of BIM requirements. It is the responsibility of individual consultants to be upskilled, resourced and to undertake suitable training to meet these requirements.

7   Level of Information Need

The Level of Information Need is covered at a high level by clause 11.2 of ISO 19650-1, and in more detail by the EN 17412 series, parts of which remain in development. The method for defining this should be established by the Appointing Party and included in the Exchange Information Requirements (EIR). There are various ways to define and specify the level of information need and any metrics that are appropriate to the project. Currently a common practice in Ireland is to adopt the UK BIM Toolkit approach by defining the Level of Detail (LOD) and Level of Information (LOI) required for particular modelled elements at each

deliverable stage, where LOD describes the level of the geometrical content of modelled elements and LOI describes the non-geometrical content provided within or related to a model object.

Model originators are required to deliver their models in accordance with the level of information need defined for each project stage, noting that different levels of information need can be applied to individual structural and/or civil modelled elements within a project.

Examples of Level of Detail / Level of Information (LOD)/(LOI)

The IStructE BIM Panel has developed a Level of Detail and Level of Information Tool, example in Figure 1 which is available from the IStructE https://www.istructe.org/resources/guidance/lod-and-loi-tool/. This is a free resource to non-members also obtained by registering an IStructE account.

Figure 1: *Example of IStructE LOD/LOI Tool*
Source: IStructE https://www.istructe.org/resources/guidance/lod-and-loi-tool/

It is common for the NBS Toolkit to be specified in EIRs to define LOD and LOI requirements for different modelled elements, which is available at:
https://www.thenbs.com/knowledge/level-of-detail-lod-and-digital-plans-of-work.

Members should note that the current common practices for specifying and verifying Level of Information Need remain over-simplified and subjective, and rely on human interpretation rather than automation. As such, Level of Information Need can present a risk for design consultants.

8   Level of Information Need and Project Stages

Table 1 compares the ACEI SE9101 Project Stages with the RIAI and RIBA Project stages. The table also indicates the recommended and reasonable **LOD** and **LOI** at each Project Stage when providing "*Normal Services*" as defined in SE9101 and when undertaking BIM according to the ISO 19650 series.

This table is intended for guidance only and it is the responsibility of member firms to assess their duties and responsibilities in relation to BIM in accordance with their Appointing Party's Exchange Information Requirements (EIR). The assigned duties and responsibilities will obviously depend on a number of factors, including the EIR, the project stages being utilised and the scale/complexity of the project.

Note 1: On BIM projects, M&E designers typically produce a "feasible-generic design model", which can be used by civil and structural engineers for design coordination purposes. However, construction stage changes may arise when the contractor and/or their M&E sub-contractor(s) select specific products and finalise the M&E coordination. This can result in additional design effort by the C&E engineer. As such, members may wish to raise a tender query such as the following (which assume Standard Conditions of Engagement):

At construction stage, decisions by the Client or Contractor can necessitate changes to the civil and structural engineering design, e.g., relocation or resizing of services openings. Please confirm that the Client will issue a Clause 11.1 change instruction if and when such a case arises.

Note 2: When requested to provide construction stage services, the consultant may be required to develop the C&S model beyond LOD 3 and LOI 3 typically produced at Production of Information stage, for example to LOD and/or LOI 4 or 5. Reference should be made to the project EIR and BIM Execution Plan.

Project implementation of BIM should not be confused with the use of Autodesk REVIT or other 3D drawing/design tools for the normal production of design, drawing or other project information which is required at detailed design or production of information stage when providing "Normal Services" as defined in the SE9101 Conditions of Engagement.

Project Stage Description	ACEI SE9101	RIAI	RIBA	Levels of Information Need	
				Level of Detail (LOD)	Level of Information (LOI)
Outline Proposals	Stage 1	Stage 1 Stage 2	Stage 0 Stage 1	-	-
Scheme Design	Stage 2	Stage 3	Stage 2 Stage 3	2	2
Detailed Design & Tender Documentation	Stage 3	Stage 4	Stage 4	3	3
Production of Information	Stage 4	Stage 5 Stage 6 Stage 7	Stage 4	3	3
	Normally contractor responsibility				
Construction	Stage 5	Stage 8	Stage 5	-	-
Handover & Closeout	-	-	Stage 6	-	-
In Use	-	-	Stage 7	-	-

Table 1: *Comparison of ACEI, RIAI and RIBA Project Stages and the LOD & LOI (based on the UK NBS Toolkit definitions) that can reasonably be expected to be provided as part of "Normal Services" as defined in SE9101 when undertaking BIM according to the ISO 19650 series*