ACEI Building Information Modelling (BIM)
Advice Note to Structural Engineers
February 2020

1 This Advice Note in relation to 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 detail is expected from consultants engaged on projects utilising BIM when the consultant is providing "*Normal Services*"?
- Training and up-skilling for BIM
- Are additional fees required for the project when BIM is used?

2 Building Information Modelling (BIM) is a very broad term that describes the process of creating and managing a digital model of a building or project. At a basic level, there are different stages of maturity and development for BIM collaboration on projects as follows:

- **Level 0** describes unmanaged CAD (Computer Aided Design).
- **Level 1** describes managed CAD in 2D or 3D.
- **Level 2** involves developing building information in a collaborative 3D environment with data attached but created in separate discipline models (i.e. Architect, C&S, M&E, Specialist designers, etc.)
- **Level 3** has not yet been fully defined but may involve a single, collaborative, online, project model including construction sequencing, cost, and lifecycle management information. BIM Level 3 is more concerned with the production of 'Digital Twin' interactive models of assets which can be used for real-time analysis of the asset's performance.

In developing this advice note, and based on the current experience of member firms, it has been assumed that BIM Level 2 is appropriate to the project, based on the latest standard it equates to.

3 There are many publications and reference documents relating to the delivery and use of BIM on projects. We refer members to the RIAI BIM Pack prepared by the RIAI BIM Sub-committee published in 2019 available for download from the RIAI website:

https://www.riai.ie/uploads/files/RIAI_BIM_Pack_2019.pdf

Other relevant references and standards include:

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

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

- **PAS 1192 Framework** A series of PAS documents set out the requirements for achieving BIM Level 2 by establishing a framework for collaborative working and information requirements. While this document is still regularly referred to, it has been superseded by EN ISO 19650. The PAS 1192-2 framework provides guidance on the level of model detail (the graphical content), model information (non-graphical content, such as specification data), model definition (its meaning) and model information exchanges.

4 According to IS EN 19650 series, the starting point and key requirement of any project where BIM is proposed to be adapted, is for the employer to set out its requirements for the digital information produced - what will the data be used for and what level of detail and information is required? This information is normally provided in the client's **Exchange Information Requirements (EIR)** document, prepared in accordance with IS EN 19650 (Previously called **Employers Information Requirement (EIR)** document in UK Standard PAS 1192").

The EIR document allows each project designer (and other specialists /suppliers) to respond to these requirements by submitting a pre-contract BIM Execution Plan (BEP). The BEP outlines and demonstrates the designers' proposed approach, capability, capacity, and competence in order to meet the EIR, in the context of the services they are appointed to provide. On appointment, the post-contract BEP for the project is normally agreed between the Design Team members and prepared by the Information Manager appointed to the project or the lead consultant (normally the Architect) who is appointed by the client with overall responsibility for BIM implementation.

5 SE9101 does not specify what or how Civil & Structural (C&S) information on a project (digital or otherwise) is to be produced. 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 protocols on the 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 an early 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:

- Carrying out the design/specification of the Works to comply with the requirements of Part A of the Second Schedule to the Building Regulations;
- 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;
- 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 In the context of the above, it is a matter for the consultant to determine what resources and tools are required to carry out its duties and obligations on a project. This may include a client or project requirement to use BIM authorized software, (such as Autodesk REVIT, Tekla Structures, Civil 3D etc). The use of REVIT / Civil 3D to produce drawings or design information does not necessarily or automatically assume that BIM is being implemented on a project. However, there is now an increasing requirement across the construction sector for projects to be undertaken to BIM Level 2 standards. It is the responsibility of individual consultants to be upskilled, resourced and to undertake suitable training to meet these requirements.

7 The implementation of BIM protocols and systems on a project may require additional work and services to be undertaken, and/or a change in how a project is resourced through the project delivery stages including the following non-exhaustive list:

- Production of more regular and detailed information at particular project stages;
- Attendance at specific BIM coordination meetings;
- Preparation of project-specific BIM documentation including task information delivery plans and responsibility matrix which can be quite time consuming to prepare;

- The provision at any project stage of drawing or model information to a level of detail and information beyond what would normally be expected of a consultant providing "Normal Services";
- Other project-specific requirements as detailed in the BIM Exchange Information Requirement (EIR) document, including applying classification standards to the project such as Uniclass 2015;
- Cost of licences to use some Common Data Environment Platforms (the specific one to be used will usually be contained in the BEP);
- Submission of Structural Analytical Model if defined as a requirement.

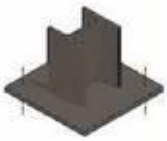
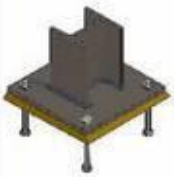
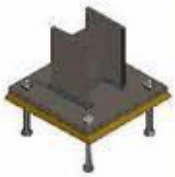
8 The Level of Information Need is included in clause 11.2 of ISO 19650-1. The method for defining this is established by the client's Exchange Information Requirements, and is then applied when defining the Exchange Information Requirements for each design team members' appointment. There are various ways to define and specify the level of information need and any metrics that are appropriate to the project, including the level of model information (LOI) and level of model detail (LOD) can be used:

- The "level of model detail" is the description of the graphical content of models at each of the stages;
- The "level of model information" is the description of the non-graphical content of models at each of the stages.

Model originators are required to complete 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 elements within a project.

9 Example of Level of Model Detail

Below is a diagrammatic representation of the level of detail for a structural steel column.

LOD 1	LOD 2	LOD 3	LOD 4	LOD 5	LOD 6
Symbolic	Conceptual	Generic	Specific	Construction	As built
					

Example of Level of Information

- **LOI 1** Structural Colum, start elevation, end elevation
- **LOI 2** Structural Steel Column, start elevation, end elevation
- **LOI 3** 254x254x89UCS355J0, start elevation, end elevation
- **•LOI 4** 254x254x89UCS355J0, 475x475x20mm Thk. S355J0 baseplate, 4 M20 Gr. 8.8 Holding Down Bolts, start elevation, end elevation
- **LOI 5** 254x254x89UCS355J0, 6mm CFW to 475x475x20mm Thk. S355J0 baseplate, 4 M20 Gr. 8.8 Holding Down Bolts 400mm Long 300mm embedment 100mm projection 100x100x10mm thick. Washer plate, 2 No. 30mm dia grout holes, 25mm weber 5 star high strength non-shrink grout, 70x70x6UKEAS275JR holding down bolt assembly 100mm dia. polystyrene cones, start elevation, end elevation

A useful tool to help define **LOD** and **LOI** for different structural elements is available: https://toolkit.thenbs.com/definitions

10 Table 1 overleaf 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 client (or design team leaders) requirements and the project brief, which may include Exchange Information Requirements documents. The assigned duties and responsibilities will obviously depend on a number of factors, including the client requirements, the project stages being utilised and the scale/complexity of the project.

Note: when requested to provide construction stage services, the consultant may be required to develop the C&S model beyond the LOD and LOI typically produced at Production of Information stage. Reference should be made to the project BIM Execution Plan.

11 The implementation of BIM protocols and systems on a project is likely to result in additional works for Consulting Engineers for which additional fees should be sought. These should be assessed on a project by project basis, particularly in the context of the client's Exchange Information Requirements which should be established at the earliest opportunity in the project timeline.

Project implementation of BIM should not be confused with the use of Autodesk REVIT or other 3-D 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 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 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