

Particular Specification PS.G11

Building Information Modelling (BIM)

Particular Specification for Building Information Modelling (BIM)

1. SCOPE OF WORK

- 1.1 The *Contractor* is required to apply Building Information Modelling (BIM) technology for this project according to the design concept for the Works, provide the services and submit all the deliverables as detailed in this Particular Specification.
- 1.2 The *Contractor* is required to set up a BIM Team with a Building Information Modelling Team Leader (BIM Team Leader) leading the BIM Team and to provide, a minimum of, 5 disciplinary BIM coordinators and 5 modellers in architectural, structural, building services, landscape and quantity surveying disciplines as detailed in the below table. Qualifications of the BIM Team are specified in **Appendix 1** of this Particular Specification.

	Disciplinary BIM Coordinator (No.)	Modeller (No.)
Architectural	1	1
Structural	1	1
Building Services	1	1
Landscape	1	1
Quantity Surveying	1	1

- 1.2.1 The BIM Team Leader of the *Contractor* shall carry out the following duties and functions
1. lead and manage the BIM Team and be responsible for the overall BIM management and provide control to ensure the deliverables are issued on time;
 2. coordinate with the Project Manager (PM) and his delegates including the PM's consultants;
 3. plan, develop and manage the project BIM standard and implementation strategy;
 4. provide quality control and checking procedures; and
 5. provide advice/guidance to the PM and his delegates in
 - a) reviewing BIM modelling formats/protocol and co-ordination;
 - b) reviewing analysis and findings on application by using different softwares such as the clash detection and resolving the clashes; and
 - c) providing technical support to the PM's delegates regarding modelling enquiries.
- 1.2.2 The BIM Team shall provide the following services:
1. to coordinate all parties including but not limited to different design disciplines, subcontractors, Specialist Subcontractors, Specialist Contractors, suppliers, PM and his delegates, Government Departments and utility undertakings and collect suitable information and data from them;
 2. to build and develop the BIM models and all deliverables based on the information and data collected, to manage the BIM databases, to report any clash/conflict or difficulties in BIM models production and to resolve such difficulties with relevant parties;

1. SCOPE OF WORK (CONT'D)

3. to utilise BIM for avoidance of risks and minimisation of changes, to monitor project costs and programmes in various stages, and to enhance safety design for construction and operation;
 4. to input the updated information and data, including but not limited to all variations, from time to time; to create, manage, develop and update the BIM models to all deliverables for the construction works; to ensure the updated BIM models are coordinated and always kept ahead of the site construction to enhance the project delivery process through BIM adoption;
 5. to coordinate the BIM models and all deliverables to ensure consistency among all deliverables; to use the best practice in setting up the system for coordinating BIM models among all parties;
 6. to provide technical support and guidance to the PM and his delegates in using the BIM models, managing the BIM database and resolving potential construction difficulties; and
- 1.2.3 The *Contractor* shall submit the organization chart and qualification of the members of the BIM Team for the PM's acceptance within 14 calendar days after the commencement of the Contract. For any proposed staff movement or change in the BIM Team, the *Contractor* shall notify the PM as soon as possible and provide a CV of the replacement personnel together with evidence of equivalent BIM competency to the PM within 7 calendar days of the notification for acceptance. The *Contractor* shall provide sufficient and technically competent resources as agreed or directed by the PM or his delegates in order to complete all BIM tasks and deliverables specified in the Contract according to the approved programme.

2. OBJECTIVES

- 2.1 The objective of the application of BIM is to create a digital building information model for the project and to use BIM as a platform to facilitate project planning, site administration, safety planning, design co-ordination, clash detection prior to construction, financial planning, minimization of abortive works, waste reduction, efficient asset management and smart city planning in order to achieve the following beneficial purpose:
1. to minimize design discrepancies and improve design co-ordination through the use of 3D modelling technique;
 2. to enhance visual communication between the *Contractor* and all stakeholders, improve mutual understanding of the design intent and facilitate design review and vetting process;
 3. to support efficient delivery of drawings, including Combined Services Drawings (CSDs) and Combined Builder's Work Drawings (CBWDs);
 4. to support the development of 4D modelling construction sequence during the construction stage to enhance communication, predict and manage construction process;
 5. to support the development of digital fabrication to facilitate efficient design and fabrication processes, and offsite fabrication;
 6. to support the development of asset management by using BIM with an as-built BIM model for effective operation and maintenance of the buildings; and
 7. to facilitate the integration between BIM and Geographical Information System (GIS) as well as the development of Common Spatial Data Infrastructure (CSDI).

3. GUIDELINES AND STANDARDS

- 3.1 The BIM Team Leader should adopt the predominant BIM industry standard on discharging his duties. Reference may be made to the published guidelines, such as:
1. CIC Building Information Modelling Standards - General, August 2019, by the Construction Industry Council in Hong Kong;
 2. CIC Building Information Modelling Standards for Mechanical Electrical and Plumbing, August 2019;
 3. CIC Building Information Modelling Standards for Underground Utilities, August 2019;
 4. CIC Production of Building Information Modelling Object Guide General Requirements, August 2019;
 5. AEC (UK) BIM Technology Protocol – Practical implementation of BIM for the Architectural, Engineering and Construction (AEC) industry, version 2.1.1, June 2015, by the AEC (UK);
 6. BIM Project Execution Planning Guide, version 2.1, May 2011, by The Computer Integrated Construction Research Program of the Pennsylvania State University;
 7. BIM Project Specification, revision 3.0, Jun 2011, by the Hong Kong Institute of Building Information Modelling;
 8. Building Information Modelling for Asset Management (BIM-AM) Standards and Guidelines, version 2.0, 2019 issued by the Electrical and Mechanical Services Department;

3. GUIDELINES AND STANDARDS (CONT'D)

9. Building Information Modelling (BIM) Guide for Architectural Design (Version 2.0) issued by Architectural Branch (AB), Architectural Services Department;
10. Building Information Modelling (BIM) Guide for Structural Engineering (Version 2.0) issued by Structural Engineering Branch (SEB), Architectural Services Department;
11. Building Information Modelling (BIM) Guide for Building Services Installation (Version 2.0) issued by Building Services Branch (BSB), Architectural Services Department;
12. Building Information Modelling (BIM) Guide for Cost Estimation (Version 2.0) issued by Quantity Surveying Branch (QSB), Architectural Services Department;
13. Building Information Modelling (BIM) Guide for Facilities Upkeep (Version 2.0) issued by Property Services Branch (PSB), Architectural Services Department;
14. Drafting Specification for Engineering Survey, Rev. 3.0/Nov 2014 by Civil Engineering and Development Department;
15. BS EN ISO 19650-1:2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling, Part 1: Concepts and principles;
16. BS EN ISO 19650-2:2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling, Part 2: Delivery phase of the assets;
17. BS EN ISO 19650-3:2020 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling, Part 3: Operational phase of the assets;
18. BS EN ISO 19650-5:2020 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling, Part 5: Security-minded approach to information management;
19. BS 1192-4:2014 Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice.

4. DELIVERABLES

The *Contractor* shall submit the following deliverables according to the programme stipulated in Clause 5 of this Particular Specification.

Except otherwise stated in the Conditions of Contract, the copyright of all data and information contained in all deliverables including BIM models and reports created, developed and provided under this Contract, including all draft and final versions, shall be the property of the Employer.

4.1 BIM Project Execution Plan:

The *Contractor* shall **base on the design stage BIM Project Execution Plan** to prepare and submit a BIM Project Execution Plan as per **Appendix 2** for the PM's acceptance.

The *Contractor* shall define the full details of the implementation and collaboration process in the BIM Project Execution Plan.

The *Contractor* shall review the BIM Project Execution Plan regularly.

4.2 Design Authoring and Design Reviews

The *Contractor* shall create, maintain and update the BIM models, including the following:-

1. A Base Model modelled according to Contract Documents for both 3D geometry and information, which serves as a basis for contract administration;
2. Updated model for each *Project Manager's* instruction.

The *Contractor* shall use BIM models to show the following components to the agreement and satisfaction of the PM or his delegates before construction, but not limited to:

4.2.1 Architectural BIM model

The minimum requirements of LOD-Graphics (LOD-G) and LOD-Information (LOD-I) for architectural components/objects shall refer to the BIM Guide for Architectural Design (Version 2.0) issued by the Architectural Services Department.

4. DELIVERABLES (CONT'D)

4.2.2 Structural BIM model

The minimum requirements of LOD-Graphics (LOD-G) and LOD-Information (LOD-I) for structural components/objects shall refer to the BIM Guide for Structural Engineering (Version 2.0) issued by the Architectural Services Department.

4.2.3 Building Services BIM model

The minimum requirements of LOD-Graphic (LOD-G) and LOD-Information (LOD-I) for building services components/objects shall refer to the BIM Guide for BS Installation (Version 2.0) issued by the Architectural Services Department.

- 4.2.4 For efficient handling of models, the BIM model should be sub-divided into separate zones/ services/ systems as appropriate to maintain reasonable file size of the models. The model sub-division strategy (by zones/ services/ systems) should be stated in the BIM Project Execution Plan. File sizes of each sub-divided BIM model shall be kept in minimum by purging of unused views, BIM objects and settings before publish or submission. The maximum file size for each sub-divided BIM model should not exceed 500MB unless otherwise approved.

4.3 Existing Conditions Modelling

The *Contractor* shall make use of 3D digital survey technology to provide existing conditions model and as-built condition verified for the Works. It provides documentation of environment for future modelling and 3D design coordination. It can supplement photographic records of condition survey. The 3D digital survey model shall be georeferenced to the same absolute coordinate system, e.g. Hong Kong 1980 Grid, according to x, y, z coordinates **and comply with the department's standards and guidelines*. The format can be:

1. Point Cloud (.las and .rcs);
2. Build mesh (.tin);
3. Export ortho-image (.jpeg, .png and .tiff); or
4. Video (H.264 & other formats specified in the latest version of OGCIO – The HKSARG Interoperability Framework (S18)).

4.4 3D Coordination

- 4.4.1 The *Contractor* shall carry out clash analysis **weekly** during the construction period based on the different BIM models created and updated at different stages in order to resolve all major system clashes prior to construction by identifying and resolving clashes among different disciplines.

4. DELIVERABLES (CONT'D)

4.4.2 Clash analysis shall include the checking of headroom requirements and working spaces for building services operations and maintenance activities. In particular, for major equipment which must provide services without any break, dynamic envelope model showing the estimated dimensions of the physical space sufficient for equipment delivery and maintenance is required as well as installation sequence. The *Contractor* shall liaise with the PM or his delegates to determine the criteria level of acceptable clashes, e.g. sprinkler pipes pass through beams.

4.4.3 Procedure of clash analysis:

1. compare BIM models built up from design of different disciplines and shop drawings from sub-contractors;
2. identify and visualize clashes;
3. report to the PM or his delegates in an agreed format;
4. revise design and shop drawings;
5. revise BIM models; and
6. perform another round of analysis until clashes are resolved.

4.4.4 Clash analysis should be presented in the form of a report to compare the different clashes, record the clash detection process and assumptions on element tolerances, areas and elements, identify any major conflict discovered in the process and generate resolution result summary. The report shall address the following:

1. software used;
2. process overview;
3. responsibilities;
4. outputs;
5. technical query workflow;
6. clash resolution process;
7. action plan with target completion schedule to handle and resolve detected clashes;
8. tolerance levels (mm) for different discipline;
9. operation clearance;
10. maintenance clearance;
11. buildability; and
12. services compatibility.

4. DELIVERABLES (CONT'D)

4.5 Cost Estimation (Financial Model)

4.5.1 The *Contractor* shall reconcile the quantities derived according to the Contract Documents and the Quantity-Take-Off (QTO) extracted from the Base Model as described in Clause 4.2.

4.5.2 The *Contractor* shall base on the 4D Model established in Clause 4.6 for the Works and prepare a financial model for:

1. interim payment simulation;
2. cashflow forecast; and
3. estimate of variations.

4.6 Engineering Analysis

The *Contractor* shall conduct at least one engineering analysis which may be related to structural, lighting, solar and shading, airflow, energy, thermal comfort, acoustic, thermal, mechanical, people movement, hydraulic, etc.

4.7 Sustainability Evaluation

This project aims to obtain the Gold or above rating of “BEAM Plus NB V2.0” certification, the credit(s) for “BIM Integration” shall be achieved. Detail requirements shall be referred to the relevant certification documents.

4. DELIVERABLES (CONT'D)

4.8 Phase Planning (4D Modelling)

4.8.1 The *Contractor* shall provide 4D Model simulations to the construction process of the Works to:

1. establish relationships between the programme and sequence of construction activities including the delivery of material and equipment to be carried out during the construction;
2. demonstrate the *Contractor*'s works sequences;
3. identify potential time and spatial conflicts;
4. optimize the use of critical resources;
5. enhance safety requirements and construction process control;
6. minimize disturbance to the neighbourhood;
7. better co-ordinate with affected parties and resolve interfacing issues at early stages;
8. monitor procurement status of project materials; and
9. facilitate the preparation of Financial Model as required in Clause 4.5.

4.8.2 The 4D simulations shall be demonstrated in *weekly* intervals linking all activities in the master programme and it shall be automatically matched with the activities as shown in the master programme with appropriate file format.

4.8.3 The *Contractor* shall submit a 4D Simulation Report containing the following but not limited to:

1. description of the 4D simulation report, e.g., assumptions, time interval, construction method statement, guide for accessing the files and models...etc.;
2. video(s) of the 4D simulation;
3. BIM native model(s);
4. models(s) for 4D simulation platform; and
5. linked project programme or equivalent deliverable.

[Guidance Note: Delete the following clause 4.8.4 if the designed /required minimum cooling capacity of central air-conditioning chilled water plant not exceeding 10,000kW.]

4.8.4 The *Contractor* shall submit a specific 4D Simulation Report to demonstrate the proper delivery, installation, dismantling and replacement of each air-conditioning chiller. The 4D model shall demonstrate the feasibility and effectiveness of the method statements for installation of the works. All temporary works and site logistic arrangement shall be modelled to demonstrate the feasibility and prove the constructability and buildability of the proposed method statement. (PBSE Please advise)

4. DELIVERABLES (CONT'D)

[Guidance Note: Delete the following clause 4.8.5 if the designed /required steam generation capacity of central steam plant not exceeding 2 ton/hour.]

4.8.5 The *Contractor* shall submit a specific 4D Simulation Report to demonstrate the proper delivery, installation, dismantling and replacement of each steam boiler. The 4D model shall demonstrate the feasibility and effectiveness of the method statements for installation of the works. All temporary works and site logistic arrangement shall be modelled to demonstrate the feasibility and prove the constructability and buildability of the proposed method statement. (PBSE Please advise)

4.9 Digital Fabrication

For mass customized components which are of large quantities and variety in dimensions, shapes, geometries, etc. and modular construction units¹, the *Contractor* shall digitalize the construction details in BIM model to facilitate the fabrication of construction materials. For example, this shall apply to kid's toilet in this project.

4.10 Site Utilization Planning

The *Contractor* shall use the 4D model by assigning the transportation path of the construction plant and equipment in the model to demonstrate the feasibility and effectiveness of the site logistic arrangements. For construction activities with very high to extreme risk level identified from the Systematic Risk Management (SRM) according to ETWB TC(W) No. 6/2005 or other identified activities of significant added values at construction stage, all temporary works and the *Contractor's* proposed method statements of the Works shall be modelled to demonstrate the feasibility and to prove the constructability and buildability of the proposed method statement.

4.11 3D Control and Planning

For a large-scale project requiring Digital Works Supervision System, the *Contractor* shall utilize the BIM model for digital setting-out, construction checking, etc. as appropriate by means of 3D laser scanners, robotic total stations, etc. as far as practicable.

4.12 As-built Modelling

4.12.1 The *Contractor* shall prepare and submit the as-built BIM models of all components (including Architectural, Structural and Building Services Installation) as described in Clause 4.2 of this Particular Specification.

¹ Modular construction units refer to construction units which are modularized in the design, integrated with all construction components/elements as far as practical, constructed in either off-site or on-site prefabrication yards and then delivered to site for installation/fixing.

4. DELIVERABLES (CONT'D)

4.12.2 The as-built BIM models shall be based on the final approved construction information that had actually been built, and shall be used to produce as-built drawings. Information on location such as room number and building name, staircase number, washroom number, lift lobby number is required to be incorporated into the as-built BIM models. The *Contractor* shall also import and display the operation data, product catalogues, manuals, warranties and maintenance history of equipment etc. into the as-built BIM models.

4.12.3 The as-built BIM models shall be prepared in accordance with the BIM Guide for Facilities Upkeep (Version 2.0) issued by the Architectural Services Department.

The *Contractor* shall include as-built construction and equipment components of the Works with information as listed below for acceptance:

- [1. Room Data Sheets;
2. Door Schedules;
3. Ironmongery Schedules;
4. Window Schedules;
5. Access Panel Schedules;
6. Shutter Schedules;
7. Cat ladder Schedules;
8. Louvre Schedules;
9. Sanitary Fitment Schedules;
10. Signage Schedules;
11. Roofing System;
12. Comprehensive materials data sheet list and completed materials/equipment warranty list;
13. Other textual information subject to agreement of facility management at later stage;
14. 360-degree spherical panoramic photographic record showing the on-site as-built condition and 3D Digital Point Cloud Scanning in accordance with the BIM Guide for Facilities Upkeep (Version 2.0) issued by the Architectural Services Department;
15. As-built BIM models and 2D drawing files;
16. Export data files;
17. Folder storing all the object files;
18. Testing and Commissioning reports;
19. Operation and Maintenance manuals;
20. Relevant statutory certificates, approval documents and forms; and
21. Other relevant project information as required.]

4. DELIVERABLES (CONT'D)

4.12.4 The as-built BIM models shall be provided with animation(s) showing the assembly, disassembly, repair and replacement procedures for viewing in the ArchSD's Asset Information System (AIS):

1. Roofing and waterproofing: corrugated or profiled sheeting roofing;
2. Plastering and Finishes: stone or marble slabs/ tiles;
3. Curtain Wall; &
4. Modular Integrated Construction

4.12.5 In general, the animation shall not be lower than LOD-G 400. The objective of the animation is to illustrate how to maintain the special part of the building. The extent of the animation required will depend on the design of the building. The *Contractor* shall propose the animation which shall fulfill, inter alia, the requirement in the BIM Guide for Facilities Upkeep (Version 2.0) for acceptance.

4.12.6 The required as-built data and relevant documentations shall be stored in a standardized file folder structure.

4.12.7 The *Contractor* shall follow the requirements stipulated in EMSD's BIM-AM Standards and Guidelines (Version 2.0) in delivering the as-built BIM model for building services installation.

[Guidance Note: Delete the following clause 4.12.8 if the designed /required minimum cooling capacity of central air-conditioning chilled water plant not exceeding 10,000kW.]

4.12.8 The *Contractor* shall submit a 3D textured digital model for the central air-conditioning chilled water plant. The digital model shall be created by using photogrammetry and laser scanning technology for accurate geometric and photogrammetric detail. Browsing software for the digital model shall be provided during the maintenance period. (PBSE Please advise)

[Guidance Note: Delete the following clause 4.12.9 if the designed /required steam generation capacity of central steam plant not exceeding 2 ton/hour.]

4.12.9 The *Contractor* shall submit a 3D textured digital model for the central steam plant. The digital model shall be created by using photogrammetry and laser scanning technology for accurate geometric and photogrammetric detail. Browsing software for the digital model shall be provided during the maintenance period. (PBSE Please advise)

4.13 Maintenance Scheduling

The *Contractor* shall provide and input the following information or documents related to building fabric and structure, subject to periodic maintenance inspection or testing into the as-built BIM models:

1. Recommended frequency of maintenance inspection or testing;

2. Recommended scope of maintenance inspection or testing activities;
3. Recommended maintenance cycle of the building fabric or structure;
4. Shop drawings;
5. Operation and Maintenance Manuals;
6. Warranties and guarantees (together with the names and addresses of specialist contractors and/ or suppliers);
7. Technical information (such as specifications of materials and design standards); and
8. Relevant material certificates and test reports, etc.

4.14 Asset Management

- 4.14.1 The *Contractor* shall submit asset information as exported from the approved as-built models in the format of excel spreadsheet. The requirements of data set and data formats for building elements shall refer to Appendix 1 of the BIM Guide for Facilities Upkeep (Version 2.0). The proposed format of the spreadsheet shall be submitted to the PM for acceptance.
- 4.14.2 The *Contractor* shall also submit Project Underground Utilities (UU) BIM model based on UU surveys by means of photogrammetry, 3D laser scanning, etc. for all opened-up areas.

4. DELIVERABLES (CONT'D)

4.15 Drawing Generation (Drawing Production)

- 4.15.1 The *Contractor* shall generate drawings in the required file format from the BIM models including but not limited to architectural drawings, building services drawings, structural drawings, Combined Services Drawings, Combined Builder's Works Drawings etc to facilitate the co-ordination and operation for the construction of the Works during the contract period. As far as practicable, the 2D drawings should be generated from the BIM authoring software directly. Production of 2D drawings by other platforms shall be ceased if those drawings can be generated from the BIM model. 2D drawings which are generated from the BIM model need not follow the CAD Standard for Works Projects (CSWP).
- 4.15.2 It is acceptable that certain 2D drawings such as architectural details, building services schematic /control logic diagrams /drawings and reinforcement details cannot be generated from the BIM model directly. Alternative software, i.e. non-BIM authoring software, could be used and these 2D drawings shall be prepared in accordance with the CAD Standard for Works Projects (CSWP).

4.16 Virtual Prototyping

The *Contractor* shall conduct virtual mockup or prototyping for the following areas with an aim to review the effectiveness of spatial design:

1. Congested plant & equipment room for installation & future maintenance
2. 6/F pool and filtration system
3. 5/F - 6/F Cone and Science Area

The *Contractor* shall liaise with the PM or his delegates to determine the extent of such design reviews.

4.17 BIM Object

All BIM objects created by the *Contractor* for the Works shall comply with the latest version of the related guidelines and standards. The *Contractor* shall create and submit *not less than 20* project specific BIM objects. Upon 6 months from the target date of completion of the Contract, the *Contractor* shall submit a proposed list of BIM objects to the PM for agreement. The *Contractor* shall submit alternative BIM objects if their proposal was rejected. The *Contractor* shall demonstrate which BIM objects are being used to facilitate the construction stage BIM.

4. DELIVERABLES (CONT'D)

4.18 Standard Approach of Modelling (SAM) (PQS Please advise)

4.18.1 The *Contractor* is required to develop a set of Standard Approach of Modelling for [concrete works] based on the scope of BIM application as described in Clause 1.1 of this Particular Specification, with reference to the following documents:

1. [In-situ / Precast Concrete] of the standard method of measurement as attached in **Appendix 4**.
2. Standard Method of Measurement for Building Elements published by the Architectural Services Department which can be viewed on the ArchSD internet website via the following pathways:
https://www.archsd.gov.hk/media/publications-publicity/schedule-of-rates/asdsmbe_2020.pdf
3. Standard Phraseology for Bills of Quantities for Building Works - 2017 Edition (2nd Revision) published by the Architectural Services Department which can be viewed on the ArchSD internet website via the following pathways:
https://www.archsd.gov.hk/media/publications-publicity/bill-of-quantities,-method-of-measurement-and-schedule-of-rates/standard_phraseology_2017_2ndrev.pdf

4.18.2 The SAM shall be devised to enable easy QTO by extracting quantities from the BIM model in which the quantities extracted can comply with the requirements in the method of measurement as attached as far as possible. The *Contractor* shall provide a report on the processes for developing the SAM including providing comments on the method of measurement.

4.18.3 The *Contractor* shall carry out QTO by the BIM model to demonstrate the workability of the SAM and shall review the SAM according to comments from the PM and his delegates to the satisfaction of the PM and his delegates.

5. PROGRAMME

The BIM models are built and developed for the purposes of design co-ordination, phase planning and communication.

The *Contractor* shall produce and submit at regular intervals updated BIM models on part or whole of the Works in the required file format, such that the project team can easily view and capture the images and perform simple marking-up of annotations on the selected images and transmit through the internet or intranet.

The target programme for production of the BIM models and the deliverables, which will be subject to change according to actual circumstances as per the direction of the PM or his delegates, is at **Appendix 3**.

6. BIM AUDIT

- 6.1 The *Contractor* shall be responsible for ensuring the integrity of their BIM and drawings as well as compliance with the BIM standards. The *Contractor* shall formulate BIM audit strategy and establish a BIM audit plan to ensure appropriate checks on accuracy and quality of the information models. The BIM audit plan shall include the strategy and methodology of checking. The BIM audit plan shall be included in the BIM Project Execution Plan for PM's acceptance. The *Contractor* shall submit BIM Audit report to PM at *bi-monthly* intervals.

The final BIM version shall be fully coordinated and without any conflict with as-built asset attributes.

The quality assurance and control shall include but not limited to the following contents:

1. model compliance according to the modelling methodology which is stated in the BIM Project Execution Plan;
2. model quality (LOD-G);
3. model data integrity check and validation (LOD-I);
4. interference check & clash analysis checking;
5. document deliverable check; and
6. as-built point cloud scanning/ field survey for verification

6. BIM AUDIT (Cont'd)

6.2 Model Compliance Check

Model compliance checks shall include but not limited to the following:

1. format, such as software version and extension;
2. naming, such as naming of the files and their corresponding folders;
3. general settings, such as grid, survey point, project base point, shared coordinate and coordinate system, shared parameters, attributes;
4. LOD-G of geometry;
5. modelling errors;
6. unintended model components;
7. consistency of 2D information generated from model;
8. attributes for asset entries tracking;
9. model cleanliness including flag links, unpurged elements and unused views in final model submission; and
10. compliance with the design.

6.3 Documentation Compliance Check

Documentation compliance checks shall be carried out to the BIM Project Execution Plans, federation maps, lists of self-check items, clash reports and model register list.

7. HARDWARE AND SOFTWARE REQUIREMENTS

- 7.1 The *Contractor* shall submit a proposal with details on specification and quantities of compatible software and hardware to build up a Common Data Environment (CDE). After the PM or his representative's acceptance of the proposal, the *Contractor* shall provide, set up and maintain the proposed hardware and software for the CDE.
- 7.2 The *Contractor* shall provide a dedicated CDE for storage, viewing and sharing of BIM models, drawings, animation, rendering and other related files of the Works with the following properties:
1. it shall have a clear folder structure, being part of the CDE to store various BIM related information;
 2. it shall contain encryption function for data security and be of sufficient capacity to store all files during the whole project life cycle; and
 3. it shall be installed with anti-virus software and maintained with updated security patches for all software.
- 7.3 The *Contractor* shall be required to:
1. submit the folder structure of the BIM storage CDE for the PM or his delegates' agreement before uploading files into the BIM storage CDE;
 2. prepare access control plan of the BIM storage CDE for the PM or his delegates' agreement and ensure no unauthorized access to the BIM storage CDE;
 3. provide daily backup and off-site backup for the BIM storage CDE in which the backup media shall be stored properly away from the working office;
 4. maintain the BIM storage CDE to ensure it operates properly during the whole project life cycle; and
 5. handover the CDE's files in an approved folder structure format to the PM before the issuance of the maintenance certificate.
- 7.4 Preferred File Formats
- The *Contractor* shall submit native and editable BIM and an open format file of the BIM such as Industry Foundation Classes (IFC) format to the PM. The *Contractor* shall ensure that data in the file is in order, without data loss and consistent with those in the native file. The *Contractor* shall ensure all the BIM deliverables comply with the approved software versions during the contract period and at the time of delivery. The *Contractor* shall also convert the final version of the BIM to other additional software versions specified by the PM.
- 7.5 All tools and software applications used must be IFC compliant in order to allow BIM model interoperability.

8. TRAINING

8.1 The *Contractor* shall conduct BIM training with different levels of training courses for project participants. Project participants shall include Employer's staff and the Contractor's project team members. The *Contractor* can use the project data as training materials. Training courses shall cover but not be limited to the following:

1. the BIM software adopted in this Contract to enable them to understand and familiarize with the operation, retrieval, modification, etc. of the BIM models;
2. the operation, retrieval of information and drawings and modification of the as-built BIM models for *Property Services Branch* and parties involving in facilities upkeep of the project;
3. BIM project implementation;
4. BIM fundamentals and Common Data Environment (CDE) management;
5. BIM data management - training including data quality verification processes and data exchanges;
6. financial modelling and
7. BIM application on digital fabrication.

The *Contractor* shall prepare BIM training plan and provide the training venue for the approval by the PM. The *Contractor* shall provide each attendee with a workstation with necessary BIM software and hands-on exercise based on the Works.

The *Contractor* shall collect training assessments to revise the training materials for the preparation of the next training classes.

8.2 The *Contractor* is required to nominate suitable staff or sub-contractors' staff for the PM's approval to attend, within 6 months from the commencement of the Contract, suitable BIM skill training courses under the pre-approved list of the Construction Innovation and Technology Fund (CITF) managed by the Construction Industry Council (CIC) as follows:

4 staff members for the *Contractor* and

4 staff members for the engaged sub-contractor(s).

The nominated staff of the *Contractor* or his sub-contractors should attend the assigned BIM skill training course, including signing the attendance record, completing all course assignments and undertaking any necessary assessment.

After completion of the training courses, the *Contractor* shall submit a training log to the PM for record. The training log should list out the course information, including but not be limited to, description of the training course, date, duration, venue and attendee details. The content of the training log shall be commented and agreed by the PM. The training log should be reviewed and updated regularly.

In case the nominated staff of the *Contractor* or his sub-contractors fail to complete the course, the Contractor/sub-contractors shall arrange additional BIM training courses to the nominated staff to fulfil the contract requirements at his/their own cost.

Qualifications of the BIM Team

Position	Qualification
BIM Team Leader	<u>EITHER</u> 1. CIC – Certified BIM Manager (CCBM) OR 2. <u>Subject to the approval by PM</u> , comply with the following: (i) Corporate membership of an appropriate professional institution, or University degree or equivalent in engineering or construction-related discipline plus minimum 5 years relevant post-graduation experience; and (ii) Minimum 3 years practical experience in management of BIM projects
Disciplinary BIM Coordinators : Architectural / Structural/ Building Services/ Landscape/ Quantity Surveying	<u>EITHER</u> 1. Minimum 3 years related construction project experience; and 2. Minimum 1 year practical experience in BIM projects OR 3. CIC-Certified BIM Coordinator (CCBC)
Modeller	1. Diploma holder in construction related discipline; and 2. Minimum 1 year practical experience in BIM projects

BIM Project Execution Plan

The Project Execution Plan shall include but not limited to the following sections:

1. BIM Project Execution Plan Overview
2. Project Information
3. BIM Requirements
 - 3.1. BIM Goals
 - 3.2. BIM Uses
 - 3.3. BIM Data
 - 3.4. LOIN Responsibility Matrix
 - 3.5. [Meeting Schedule]
4. BIM Management
 - 4.1. Roles, responsibilities and authority
 - 4.2. BIM Team Resources, Competency & Training
 - 4.3. BIM Deliverable Schedule (Programme)
5. BIM Process
 - 5.1. Information Management Workflow Diagram
 - 5.2. Common Data Environment (CDE)
 - 5.3. Individual Discipline Modelling
 - 5.4. BIM Coordination and Clash Detection
 - 5.5. Drawing Production
 - 5.6. Model Archive
 - 5.7. BIM Audit Plan
6. BIM Procedures
 - 6.1. BIM Origin Point & Orientation
 - 6.2. Modelling Methodology
 - 6.3. Model Division
 - 6.4. Model Units
 - 6.5. Naming Convention
 - 6.6. Drawing Sheet Templates
 - 6.7. Annotation, dimensions, abbreviation and symbols
 - 6.8. [Colour Scheme]
7. IT Hardware & Software Solutions
 - 7.1. Software Versions
 - 7.2. Exchange Formats
 - 7.3. Data Security & Back-up
 - 7.4. Hardware Specifications
 - 7.5. IT Upgrades

8. Asset Management

8.1. Requirements and Data Structure of As-built BIM Models

8.2. Data Conversion for Integration with *ArchSD PSB's and Users' Systems*

8.3. Deliverables and Training

8.4. Handover of As-built BIM Models

DEVB TC(W) No. 12/2020		Construction Contract		Notes
	BIM Use	Main Contractor	DSC	Const. Stage
1	Design Authoring	- Lead and consolidate construction design from NSC/DSC and develop combined BIM model - Lead BIM design coordination process	- Agree between MC and DSC	
2	Design Reviews	- Take lead to review combined BIM construction model and coordinate design changes - Facilitate virtual mock-up for review and approval by designers or employer	- Agree between MC and DSC	
3	Existing Conditions Modelling	- Carry out 3D digital survey and produce BIM model for existing site condition (including E&M if any) to facilitate construction planning	N/A	
4	Site Analysis	N/A	N/A	N/A
5	3D Coordination	- Carry out clash analysis for the combined BIM construction model - Take lead to resolve conflict	- Agree between MC and DSC	
6	Cost Estimation	- Consolidate the inputs from NSC/DSC and prepare a financial model for project cost control, cost evaluation on variation of works, spending analysis	- Agree between MC and DSC	See Note b below
7	Engineering Analysis	- Consolidate the inputs from NSC/DSC to carry out the analysis	- Agree between MC and DSC	See Note j below
8	Facility Energy Analysis	N/A	N/A	N/A
9.	Sustainability Evaluation	- Consolidate the inputs from NSC/DSC to facilitate the certification process	- Agree between MC and DSC	See Note h below
10	Space Programming	N/A	N/A	N/A
11	Phase Planning (4D Modelling)	- Consolidate and coordinate construction programme with inputs from NSC/DSC - Carry out 4D planning using BIM	- Agree between MC and DSC	
12	Digital Fabrication	- Facilitate the fabrication of construction materials or assemblies with inputs from NSC/DSC	- Agree between MC and DSC	See Note e below
13	Site Utilization	- Consolidate and coordinate site	- Agree between MC	See Note f

DEVB TC(W) No. 12/2020		Construction Contract		Notes
	BIM Use	Main Contractor	DSC	Const. Stage
	Planning	utilization with inputs from NSC/DSC - Carry out site utilization planning using BIM	and DSC	below
14	3D Control and Planning	- Consolidate and coordinate with inputs from NSC/DSC - Carry out digital setting-out/ construction checking using BIM	- Agree between MC and DSC	See Note k below
15	As-built BIM Modelling	- Produce combined as-built BIM model	- Provide as-built information to MC - Agree between MC and DSC	
16	Project System Analysis	- Consolidate the inputs from NSC/DSC to carry out the analysis	Agree between MC and DSC	
17	Maintenance Scheduling	- Consolidate and coordinate the data required for facility management and input into as-built BIM model	- Agree between MC and DSC	See Note g below
18	Space Management and Tracking	N/A	N/A	N/A
19	Asset Management	- Consolidate and coordinate the data sets and data formats required for asset management and input into as-built BIM model - Carry out UU surveys for all open-up areas and deliver a project UU BIM model	- Agree between MC and DSC	See Note l below
20	Drawing Generation (Drawing Production)	- Produce drawing deliverables from BIM model	- Produce drawing deliverables from BIM model	

Notes:

- *a. Mandatory for project cost budgeting, project cost control and cost evaluation on design options, etc. at design stage as far as practicable.
- b. Mandatory for project cost control, cost evaluation on variation of works, cash flow/spending analysis, etc. at construction stage as far as practicable.
- *c. Mandatory for checking client spatial requirements such as compliance with the approved schedule of accommodations, reference plot ratio for building projects and site coverage of greenery for building projects, or other spatial requirements relevant to building/civil projects as considered appropriate.
- *d. Mandatory for the construction activities with very high to extreme risk level identified from the Systematic Risk Management (SRM) according to ETWB TC(W) No. 6/2005 or

- other identified activities of significant added values at design stage.*
- e. Mandatory for digitalizing the construction details in the BIM model for mass customized components such as metal cladding, acoustic panels, building façade panels, ceiling panels, acoustic barriers, metal structural members, etc. which are of large quantities and variety in dimensions, shapes, geometries, etc. and modular construction units.
 - f. Mandatory for the construction activities with very high to extreme risk level identified from the Systematic Risk Management (SRM) according to ETWB TC(W) No. 6/2005 or other identified activities of significant added values at construction stage.
 - g. Mandatory for providing maintenance attributes for facility structures, fabrics and equipment in the as-built models as considered appropriate.
 - h. Mandatory for building projects which aim to obtain the Gold or above rating of “BEAM Plus NB V2.0” certification with credit(s) for “BIM Integration”.
 - *i. *Mandatory for modular construction units including those for MiC, DfMA, prefabrication of BS/MEP installations as appropriate.*
 - j. Mandatory for conducting at least one engineering analysis which may be related to structural, lighting, solar and shading, airflow, energy, acoustic, thermal, mechanical, people movement, hydraulic, etc. as appropriate in building projects.
 - k. Mandatory for a large-scale project requiring Digital Works Supervision System that digital setting-out, construction checking, etc. as appropriate by means of 3D laser scanners, robotic total stations, etc. shall be adopted as far as practicable.
 - l. Mandatory for identifying the required data sets and data formats which can be extracted from as-built BIM models for the maintenance agencies’ use. Besides, underground utilities (UU) surveys by means of photogrammetry, 3D laser scanning, etc. for all opened-up areas are required so that a project UU BIM model can be provided to the maintenance agencies and LandsD for information sharing.]

Programme

Deliverables	Completion Time
4.3) Existing Conditions Modelling	Submit according to the project programme
4.4) Clash Analysis Report	Submit to resolve all clashes at least 2 months before the construction of those elements
4.5) Financial Model	Submit according to the project programme
4.6) Engineering Analysis Report	Submit according to the project programme
4.8) Phase Planning (4D Modelling)	It should be performed at least 1 month before the commencement of major construction sequences
4.12) As-built BIM models	A draft as-built BIM model shall be submitted within 6 months from the issuance of the certificate of completion and the final as-built BIM model shall be submitted within 12 months from the issuance of the certificate of completion
4.14) Asset Management - Project UU BIM model - Asset Information Spreadsheets	The final project UU BIM model shall be submitted within [6] months from the issuance of the certificate of completion
4.15) Drawing Generation (Drawing Production)	Submit according to the project programme
4.17) BIM Objects	Submit according to the project programme
4.18) Standard Approach of Modelling	Submit according to the project programme
7.3) Common Data Environment	Handover the CDE to the PM before the issuance of the maintenance certificate

- Note: The definition of Level of Development shall refer to CIC Building Information Modelling Standards - General, August 2019, issued by the Construction Industry Council in Hong Kong

[In-situ / Precast Concrete] of the standard method of measurement

[Guidance Note: Insert the related trades of the standard method of measurement.]