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Particular Specification for Building Information Modelling (BIM)

Revision History

[Group 16 Ref. No. 42/2018] First Issue on 4.9.2018
[Reference: SA/BIM's email dated 20.8.2018]

[Group 16 Ref. No. 01/2019] Revised on 21.1.2019
- Guidance note no. 4 deleted.
- Clause 3.1 updated the BIM Guides and the BS Standard.
- Clauses 3.1.9, 4.13.2, 4.13.3, 4.13.5 and Appendix 4 updated the BIM Guide for Facilities Upkeep from "version 1.0" to "version 1.1".
- Clauses 4.5.1, 4.5.2, 4.6, 4.8, 4.9, 4.13.2, 4.13.4, Appendix 2 and Appendix 3 revised.
- Clause 4.10 added for digital fabrication and the subsequent clauses renumbered.
- Clause 4.13 and Appendix 4:
  i. regulate the phrases "as-built BIM model",
  ii. add guidance note for projects maintained by PSB and
  iii. add alternative clauses for projects not be maintained by PSB.
- Clause 8.2, Appendix 1 and Annex 1 to Appendix 2: Update based on DEVB TC(W) No. 18/2018 dated 27.12.2018.

[Reference: BIMWG members' emails to SQS/16 dated 14.1.2019, 9.1.2019, 8.1.2019, 4.1.2019 and 31.12.2018 and DEVB TC(W) No. 18/2018 dated 27.12.2018]

[Group 16 Ref. No. 16/2019] Revised on 21.3.2019
- Clause 4.5.1: updated the drawing generation requirements
- Clauses 4.9, 8.1 and Appendix 3: revised the wordings to be consistent with DEVB TC(W) No. 18/2018

[Reference: DEVB TC(W) No. 18/2018 dated 27.12.2018]
- Clause 4.5.2: housekeeping changes as per SE/124's advice

[Reference: BIMWG members' email to QS/QSB/16(4) dated 28.2.2019]
- Clause 3.1: updated the revision no. of BIM Guides for Asset Management
- Clause 4.14: add guidance note and clauses for Infrastructures of Asset Management for Building Services Installation
- Appendix 4: updated the requirements on BS Model by excluding "Panel Schedule for Distribution Boards"

[Reference: BIMWG members' email to QS/QSB/16(4) dated 13.3.2019]

[Group 16 Ref. No. 25/2019] Revised on 24.4.2019
- Clause 4.11.1: updated the reference to Hong Kong Standard Method of Measurement of Building Works, Standard Method of Measurement for Building Elements and Standard Phraseology for Bills of Quantities for Building Works

Revision History (Cont'd)

[Group 16 Ref. No. 28/2019] Revised on 18.11.2019

I. Updated / Added reference publications by CIC, BSI and ArchSD
- Clause 3.1 and Appendix 3

II. Revise content
- Clause 4.2:
  i. Updated the requirements of BIM model and revised the title
  ii. Clause 4.2.3: Updated the requirements of Building Services BIM model
  iii. Clause 4.2.4: Updated the file size of model
- Clause 4.5: Updated the requirements for cost estimation
- Clause 4.6.1: Added item 9 "facilitate the preparation of Financial Model"
- Clause 4.8: Added the requirements for construction activities with very high to extreme risk level
- Clause 4.9 and 4.12: Revised the title and minor amendments to the clauses
- Clause 4.10: New clause for "Maintenance Scheduling"
- Clause 4.13: Added requirements for submission of BIM Objects
- Clause 4.14: Added requirements to submit progress report on SAM
- Clause 8.2: Revised training requirements according to Technical Circular (Works) No. 18/2018
- Appendix 2: Revised the requirements of the BIM Project Execution Plan
- Appendix 4: Deleted the original Appendix 4 and Replaced by related standard method of measurement for SAM

III. Housekeeping changes
- Clause 1.2.3, 4.3 to 4.7, 4.9, 4.11 to 4.15, 6.2, 7.4, 7.5, 8.1, Appendix 1, 3 and Annex 1 to Appendix 2

[Reference: SA/BIM's email to BIMWG members dated 30.10.2019]

[Group 16 Ref. No. 06/2020] Revised on 17.1.2020
- Clause 4.7, 8.2, Appendix 1 and Annex 1 to Appendix 2: Amendments made in accordance with DEVB TC(W) No. 9/2019.

[Reference: DEVB TC(W) No. 9/2019 dated 20.12.2019 and BIMWG member's comments in Jan 2020]

Particular Specification for Building Information Modelling (BIM)

[Guidance Notes:
1. **Amend the part in *[italics]* to suit the different BIM requirements of each project.**
2. **In formulating the project BIM deliverables, reference should be made to O.I. No. 05/1996, Document Requirements From Contractors Upon Completion of Works.**
3. *** Delete/Amend as appropriate.]**

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, *[disciplinary BIM coordinators and modellers in architectural, structural and building services 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		
Structural		
Building Services		

[Guidance Note: Add other specialist disciplines as necessary]

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 shall be responsible for the overall BIM management and provide control to ensure the deliverables are issued on time,
2. coordinate with the Supervising Officer (SO) and his representatives including the SO's consultants,
3. plan, develop and manage the project BIM standard and implementation strategy,
4. provide quality control and checking procedures,
5. ensure all the deliverables are issued on time,
6. provide advice/guidance to the SO and his representatives 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,
   c) providing technical support to the SO's representatives regarding modelling enquiries.

1. SCOPE OF WORK (CONT'D)

1.2.2 The BIM Team shall provide the following services:

1. to coordinate all parties including but not limited to different design disciplines, sub-contractors, Specialist Sub-contractors, Specialist Contractors, suppliers, SO and his representatives, Government Departments and utility undertakings and collecting 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,

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 SO and his representatives in using the BIM models, managing the BIM database and resolving potential construction difficulties,

[Guidance Notes:
1. Insert scope of works if necessary.
2. Include the following clause if there is/are nominated sub-contract(s) in this Contract.]

7. to consolidate design information from the Nominated Sub-contractor(s) and develop the BIM model and all deliverables as required in this Contract.

1.2.3 The Contractor shall submit the organization chart and qualification of the members of the BIM Team for the SO's approval 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 SO as soon as possible and provide a CV of the replacement personnel together with evidence of equivalent BIM competency to the SO within [*7*] calendar days of the notification for approval. The Contractor shall provide sufficient and technically competent resources as agreed or directed by the SO or his representatives 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 and efficient asset management in order to achieve the following beneficial purpose:

1. to minimize design discrepancies, improve design co-ordination and deliver a clash-free design 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 asset management by using BIM with an as-built BIM model for effective operation and maintenance of the buildings.

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;
9. Building Information Modelling (BIM) Guide for Architectural Design (Version 1.1) issued by Architectural Branch (AB), Architectural Services Department;
10. Building Information Modelling (BIM) Guide for Structural Engineering (Version 1.1) issued by Structural Engineering Branch (SEB), Architectural Services Department;

3. GUIDELINES AND STANDARDS (CONT'D)

11. Building Information Modelling (BIM) Guide for Building Services Installation (Version 1.1) issued by Building Services Branch (BSB), Architectural Services Department;
12. Building Information Modelling (BIM) Guide for Cost Estimation (Version 1.0) issued by Quantity Surveying Branch (QSB), Architectural Services Department;
13. Building Information Modelling (BIM) Guide for Facilities Upkeep (Version 1.2) issued by Property Services Branch (PSB), Architectural Services Department; **[Guidance Note: Delete if the Property is not maintained by PSB]**

[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. PAS 1192-3:2014 Specification for information management for the operational phase of construction projects using building information modelling;

18. PAS 1192-5:2015 Specification for security-minded building information modelling, digital built environments and smart asset 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.

[Guidance Notes: To amend the required deliverables below to suit the different BIM requirements of each project.]

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 SO's approval.

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. DELIVERABLES (CONT'D)

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 **Supervising Officer's / Project Manager's* instruction.

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

4.2.1 Architectural BIM model

Architectural components	Level of Development
[1. Existing site topography, services and buildings; including access to site;	200
2. Site context of surrounding;	100
3. Generic models for design options;	100 - 300
4. Rooms, spaces, corridors, plant & equipment rooms;	200 - 300
5. Floor slabs, ramps & roofs;	200 - 400
6. Internal and external walls and columns;	200 – 400
7. Doors, shutters and their hoods, access panels;	200 - 400
8. Ironmongery;	200 – 400
9. Curtain wall & precast facades;	200 - 400
10. Windows and louvers;	200 - 400
11. Lift doors;	200 - 400
12. Balustrades, parapets and railings;	200 - 400
13. Staircases;	200 - 300
14. Ramps, raised access floor, false ceilings with access openings;	200 - 400
15. Built-in fixed furniture such as toilet partitions, cabinets;	200 - 400
16. Smoke barriers;	200 - 400
17. Drainage/ Services channel covers;	200 - 400
18. Cat ladders, catwalks, maintenance platforms;	200 - 350
19. Exterior elements such as canopies, sun-shading devices, wall features;	200 - 400
20. Sanitary Fitments;	200 - 400
21. Signage;	200
22. External Works such as soft landscape, hard landscape, playground equipment]	200 - 400

4. DELIVERABLES (CONT'D)

4.2.2 Structural BIM model

Structural components	Level of Development
[1. All elements requiring structural, foundation and geotechnical design	200-400
2. Any precast/ prefabricated & prestressed elements	200-400
3. Details required in congested areas, cast-ins, changes in level and junctions/ connections between structural elements.	200-400
4. All penetrations /interfaces between structural members and building services/ E&M services /builder's works. (e.g. openings, curbs, voids, pits, recesses, mass concrete, etc).	200-400
5. Reinforcement details at certain congested zones, to be selected by the SO or his representatives, for interfacing coordination between reinforcement and building services elements	200-400
6. Specific rendered views, to be selected by the SO or his representatives, from the BIM model on the structural framework and interfaces to illustrate connections among structural members]	200-400

4.2.3 Building Services BIM model

The minimum requirements of LOD-Graphic and LOD-Information for building services components/objects shall refer to the BIM Guide for BS Installation (version 1.1) 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)
4. Video (H.264 & other formats specified in the latest version of OGCIO – The HKSARG Interoperability Framework (S18))

4. DELIVERABLES (CONT’D)

4.4 3D Coordination

4.4.1 The Contractor shall carry out clash analysis **weekly/ fortnightly/ monthly* 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.

4.4.2 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 SO or his representatives 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 SO or his representatives in an agreed format
4. revise design and shop drawings
5. revise BIM models
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
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:

[Guidance Notes: Include the following clauses for projects undertaken by Group C Contractors.]

1. interim payment simulation in video format with dynamic bar chart showing time and cost relationship for major construction activities;
2. cashflow forecast to compare actual cashflow against planned cashflow;
3. estimate of variations including the schedule for the cost of omission and addition.

[Guidance Notes: Include the following clauses for projects undertaken by Group A and B Contractors.]

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

4.6 Phase Planning (4D Modelling)

4.6.1 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.
9. facilitate the preparation of Financial Model as required in Clause 4.5.

4.6.2 The 4D simulations shall be demonstrated in **weekly/ fortnightly/ monthly/ quarterly* 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. DELIVERABLES (CONT'D)

4.6.3 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.
5. linked project programme or equivalent deliverable.

4.7 Digital Fabrication

For mass customized components which are of large quantities and variety in dimensions, shapes, geometries, etc. and modular construction units[1], the Contractor shall digitalize the construction details in BIM model to facilitate the fabrication of construction materials.

4.8 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.

4.9 **[Guidance Note: Include the following clauses for projects maintained by PSB.]** As-built Modelling

4.9.1 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.

4.9.2 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.

4.9.3 The as-built BIM models shall be prepared in accordance with the BIM Guide for Facilities Upkeep (Version 1.1) issued by Architectural Services Department.

[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)

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

[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 to **[Guidance Note: Project officer should liaise with PSB to determine the special features and structures required scanning.]** *in accordance with the BIM Guide for Facilities Upkeep (version 1.1) by Property Services Branch.*
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.]

4.9.4 The as-built BIM models shall be provided with animation(s) for assemble, disassemble, repair and replacement procedure for viewing in the ArchSD's Asset Information System (AIS):

[Guidance Notes: Project officer should liaise with PSB to determine the workflow/construction process required for production of animation(s), e.g. curtain wall assembly.]

[1…..
2……..]

4.9.5 In general, the animation shall not be lower than LOD350. 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 1.1) for approval.

4. DELIVERABLES (CONT'D)

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

OR

4.9 **[Guidance Note: Include the following clauses for projects not be maintained by PSB, e.g. Hospitals and Aided Schools.]** As-built Modelling

4.9.1 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.

4.9.2 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. The as-built BIM models shall be able to create sheet records.

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

[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. As-built BIM models and 2D drawing files;
14. Export data files;
15. Folder storing all the object files;
16. Testing and Commissioning reports;
17. Operation and Maintenance manuals;
18. Relevant statutory certificates, approval documents and forms; and
19. Other relevant project information as required.]

The as-built BIM models and 2D as-built record drawings shall comprise customized building attributes and file structure for data submission in format agreed and approved by the SO. The as-built information format, structure, data arrangement and other details shall also be proposed and submitted to the SO for approval.

4. DELIVERABLES (CONT’D)

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

4.9.5 The Contractor shall consolidate the COBie/IFC/asset information requirements and other O&M information requirements from the users and prepare a proposal of COBie/IFC/asset information requirements for acceptance by the SO.

4.9.6 The Contractor shall make reference to EMSD's BIM-AM Standards and Guidelines (Version 2.0) in delivering the as-built BIM model for MEP installation.

[Guidance Note: Delete the following clause for pilot projects selected to provide infrastructures to trial the adoption of asset management for building services installation. Project officers should consult BSB and respective Branch Head before include the clauses.]

4.9.7 The bi-directional linking infrastructure such as RFID tags, QR code and zone tags as stipulated in EMSD's BIM-AM Standards and Guidelines (Version 2.0) are not required. Also, the requirements of "Panel Schedule for Distribution Boards" as stipulated the Section 3.5.5 of EMSD's BIM-AM Standards and Guidelines (Version 2.0) are not required.

4.10 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. DELIVERABLES (CONT'D)

4.11 Drawing Generation (Drawing Production)

4.11.1 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).

4.11.2 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).

*4.12 3D Control and Planning

4.12.1 The Contractor shall utilize the BIM model to layout building elements, such as the position of walls using a total station with survey points preassigned in the model; or to automate control of equipment's movement and location, such as using GPS coordinates to determine if proper excavation depth is reached.

4.12.2 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. Heavy serviced functional room, e.g. operating theatre, data centre control room
3. ……]

The Contractor shall liaise with the SO or his representatives to determine the extent of such design reviews.

*4.13 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 or as assigned by the SO]* 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 SO 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)

*4.14 Standard Approach of Modelling (SAM)

4.14.1 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/377042/asdsmmbe_2019.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/378535/standard_phraseology_2017_2ndrev.pdf

4.14.2 The SAM shall be devised to enable easy Quantity-Take-Off (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.

4.14.3 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 SO and his representatives to the satisfaction of the SO and his representatives.

[Guidance Note: Include the following clauses for pilot projects selected to provide infrastructures to trial the adoption of asset management for building services installation. Project officers should consult BSB and respective Branch Head before include the clauses.]

* 4.15 Infrastructures of Asset Management for Building Services Installation

4.15.1 The Contractor shall follow the Chapter 5 of the Building Information Modelling for Asset Management (BIM-AM) Standards and Guidelines, version 2.0, 2019 issued by the Electrical and Mechanical Services Department to install the necessary radio-frequency identification (RFID) tags and QR code labels to facilitate the interface of asset identification to the BIM-AM system by the maintenance party.

4.15.2 The requirement of "Panel Schedule for Distribution Boards" as stipulated in the EMSD BIM-AM Standards and Guidelines shall be included in the requirements of as-built BIM model for building services installation.

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 SO or his representatives, is at **Appendix 3**.

6. QUALITY ASSURANCE AND QUALITY CONTROL

6.1 Quality Assurance / Control Requirements

The Contractor shall establish quality assurance plan for BIM, to ensure appropriate checks on information and data accuracy. The Contractor will be responsible for ensuring the integrity of their BIM and drawings as well as compliance with the BIM standards. 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 with the LOD and design
3. data validation
4. clash analysis checking
5. **as-built point cloud scanning/ field survey* for verification

6.2 Model Compliance Check

Model compliance checks shall be carried out covering 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. consistency of 2D information generated from model;
5. attributes for asset entries tracking;
6. model cleanliness including flag links, unpurged elements and unused views in final model submission;
7. **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 SO or his representative's approval 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,
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 SO or his representatives' agreement before uploading files into the BIM storage CDE,
2. prepare access control plan of the BIM storage CDE for the SO or his representatives' 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,
5. handover the CDE's files in an approved folder structure format to the SO 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 SO. 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 SO.

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:

[Guidance Note: Project officer to select appropriate training topics to suit project's needs.]

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; and
6. financial modelling.]

The Contractor shall prepare BIM training plan and provide the training venue for the approval by the SO. 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 SO'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 SO 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 SO. 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.

Appendix 1

Qualifications of the BIM Team

[Guidance Note: To select the required personnel below to suit the different BIM requirements of each project.]

Position	Qualification
BIM Team Leader	1. 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 2. Minimum 3 years practical experience in management of BIM projects OR 3. CIC – Certified BIM Manager (CCBM)
Disciplinary BIM Coordinators : Architectural / Structural/ Building Services	1. Minimum 3 years related construction project experience 2. Minimum 1 year practical experience in BIM projects
Modeller	1. Diploma holder in construction related discipline 2. Minimum 1 year practical experience in BIM projects

Appendix 2

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. LOD Responsibility Matrix
   - 3.5. [Meeting Schedule]

4. BIM Management
   - 4.1. Roles, responsibilities and authority
     [Guidance Note: project officers should select the appropriate BIM use as listed in Annex 1 to Appendix 2 and append this Annex for the Contractor’s reference in preparing his submission.]
   - 4.2. BIM Team Resources, Competency & Training
   - 4.3. BIM Deliverable Schedule (Programme)

5. BIM Process
   - 5.1. Common Data Environment (CDE)
   - 5.2. Individual Discipline Modelling
   - 5.3. BIM Coordination and Clash Detection
   - 5.4. Drawing Production
   - 5.5. Model Archive
   - 5.6. Quality Control [and Quality Assurance]

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/ Users'* Systems
   8.3. Deliverables and Training
   8.4. Handover of As-built BIM Models

DEVB TC(W) No. 9/2019		**Construction Contract [See Guidance Notes 1 to 4 below]**				**Notes**	
	BIM Use	**Main Contractor**	***NSC**	**DSC**	***Designers (for D&B)**	***Design Stage**	**Const. Stage**
1	Design Authoring	- Lead and consolidate construction design from NSC/DSC and develop combined BIM model - Lead BIM design coordination process	- *Provide construction design information (2D drawing and design data) to MC* - *Participate BIM design coordination process and fine tune design if required*	- Agree between MC and DSC	- *Carry out AIP and DDA design using BIM* - *Architectural designer to take lead to coordinate design BIM model across disciplines*		
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	- *Participate the combined BIM construction model review process* - *Provide changes in construction design information (2D drawing and design data) to MC*	- Agree between MC and DSC	- *Architectural designer to take lead to review combined BIM design model*		
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*	N/A	- *Architectural designer to take lead to incorporate the existing conditions in BIM design model*		
4	Site Analysis	N/A	*N/A*	N/A	- *Architectural designer to take lead to conduct site analysis with BIM*		N/A
5	3D Coordination	- Carry out clash	- *Participate the 3D*	- Agree between	- *Carry out clash*		

DEVB TC(W) No. 9/2019		**Construction Contract [See Guidance Notes 1 to 4 below]**				**Notes**	
	BIM Use	**Main Contractor**	***NSC**	**DSC**	***Designers (for D&B)**	***Design Stage**	**Const. Stage**
		analysis for the combined BIM construction model - Take lead to resolve conflict	*coordination process and contribute the resolve of conflict*	MC and DSC	*analysis and resolve conflict by all disciplines* - *Architectural designer take lead to resolve conflict between disciplines*		
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	- *Prepare a financial model for project cost control, cost evaluation on variation of works, spending analysis for the NSC work for MC's consolidation*	- Agree between MC and DSC	- *Take lead to facilitate the financial model production*	*See Note a below*	See Note b below
*7	*Engineering Analysis*						
*8	*Facility Energy Analysis*						
9.	Sustainability Evaluation	- Consolidate the inputs from NSC/DSC to facilitate the certification process	*-Provide information to MC and participate in the coordination process*	-Agree between MC and DSC	- *Take lead to coordinate the use of BIM to meet certification requirement*	*See Note h below*	See Note h below
10	Space Programming	N/A	*N/A*	N/A	- *Architectural designer to take lead to review the model to meet spatial requirements*	*See Note c below*	N/A
11	Phase	- Consolidate	- *Provide*	- Agree	- *Architectur*	*See Note*	

DEVB TC(W) No. 9/2019		Construction Contract [See Guidance Notes 1 to 4 below]				Notes	
	BIM Use	**Main Contractor**	***NSC**	**DSC**	***Designers (for D&B)**	***Design Stage**	**Const. Stage**
	Planning (4D Modelling)	and coordinate construction programme with inputs from NSC/DSC - Carry out 4D planning using BIM	*construction programme information to MC*	between MC and DSC	*al designer to take lead to review combined BIM 4D model across disciplines*	*d below*	
12	Digital Fabrication	- Facilitate the fabrication of construction materials or assemblies with inputs from NSC/DSC	- *Provide fabrication details for the NSC work to MC*	- Agree between MC and DSC	- *Architectural designer to take lead to review the details of modular construction units*	*See Note i below*	See Note e below
13	Site Utilization Planning	- Consolidate and coordinate site utilization with inputs from NSC/DSC - Carry out site utilization planning using BIM	- *Provide site utilization information to MC*	- Agree between MC and DSC	*N/A*	*N/A*	See Note f below
**14*	*3D Control and Planning*				*N/A*	*N/A*	
15	As-built BIM Modelling	- Produce combined as-built BIM model	- *Provide as-built information to MC*	- Provide as-built information to MC - Agree between MC and DSC	- *Verify on site the accuracy of as-built BIM model prepared by contractor*	*N/A*	
**16*	*Project System Analysis*				*N/A*	*N/A*	
17	Maintenance Scheduling	- Consolidate and coordinate the data	- *Provide maintenance information to MC*	- Agree between MC and DSC	*N/A*	*N/A*	See Note g below

DEVB TC(W) No. 9/2019		Construction Contract [See Guidance Notes 1 to 4 below]				Notes	
	BIM Use	**Main Contractor**	***NSC**	**DSC**	***Designers (for D&B)**	***Design Stage**	**Const. Stage**
		required for facility management and input into as-built BIM model					
*18	*Space Management and Tracking*				*N/A*	*N/A*	
*19	*Asset Management*				*N/A*	*N/A*	
20	Drawing Generation (Drawing Production)	- Produce drawing deliverables from BIM model	- *Produce drawing deliverables from BIM model*	- Produce drawing deliverables from BIM model	- *Produce drawing deliverables from BIM model*		

[Guidance Notes:

1. **Follow ArchSD O.I. No. 02/2019 to confirm BIM uses for the project, and obtain necessary approval for deletion of mandatory BIM uses and adoption of optional BIM uses under the current DEVB TC(W).**
2. **Delete rows for BIM uses not applicable for the project.**
3. **Delete the "NSC" column if it is not applicable.**
4. **Delete the columns for "Designers (for D&B)" and "Design Stage" if it is not a D&B project.]**

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 2.0" 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.*]

Appendix 3

Programme

[Guidance Note: ^ Project officer should consider a realistic time frame required for the deliverables and amend as appropriate to suit the different BIM requirements of each project.]

Deliverables	Completion Time
4.1) BIM Project Execution Plan as per Appendix 2.	*Within [1]^ month(s) from the date for commencement of the *Works./ construction of the Works*.**[for D&B contracts]**
4.2) Architectural and structural initial BIM models in Level of Development together with required 2D drawings (i.e. plans, elevations and sections).	*Within [3]^ month(s) from the date for commencement of the *Works./ construction of the Works*.**[for D&B contracts]**
4.2) Building services initial BIM models together with required 2D drawings (i.e. schematic, layout plans, elevations and sections).	*Within [6]^ month(s) from the date for commencement of the *Works./ construction of the Works*.**[for D&B contracts]**
4.2) Submission of CSD and CBWD BIM models together with required 2D drawings (i.e. plans, reflected ceiling plans, elevations and sections).	*BIM models accompanying with the master programme within [9]^ month(s) from the date for commencement of the *Works./ construction of the Works*.**[for D&B contracts]**
4.3) Clash Analysis Report	*Submit to resolve all clashed at least [1]^ month(s) before the construction of those elements*
4.4) Phase Planning (4D Modelling)	*It should be performed at least [1]^ month(s) before the commencement of major construction sequences*
4.5) Drawing Generation (Drawing Production)	*Submit according to the project programme*
4.6) Existing Conditions Modelling	*Submit according to the project programme*
4.7) 3D Control and Planning	*Submit according to the project programme*
4.8) Site Utilization Planning	*Submit according to the project programme*
4.9) Financial Model	*Submit according to the project programme*

4.10) Standard Approach of Modelling	*Submit according to the project programme*
4.11) BIM Object	*Submit according to the project programme*
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*
7.3) Common Data Environment	*Handover the CDE to the SO 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

Appendix 4

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

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