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Ref : DEVB(W) 430/80/01
Group : 2, 5, 6

23 December 2020

Development Bureau
Technical Circular (Works) No. 12/2020

Adoption of Building Information Modelling
for Capital Works Projects in Hong Kong

Scope

This Circular sets out the policy and requirements on the adoption of Building Information Modelling (BIM) technology.

2. This Circular applies to works either by government staff, consultants or contractors.

Effective Date

3. This Circular takes effect on **1 January 2021**.

Effect on Existing Circulars and Circular Memoranda

4. This Circular supersedes DEVB TC(W) No. 9/2019.

Background

5. In its meeting in April 2013, Works Policies Coordination Committee (WPCC) endorsed the proposal to adopt an incremental strategy in using BIM technology in public works projects. Pilot projects with relatively complex building and/or structural works, and of different nature (such as water/sewage treatment plant, various building projects, etc.) were selected for trial with a view to obtaining more information on the performance of the technology in public works projects in various aspects.

6. In 2014, WPCC endorsed the proposal to promote wider use of BIM technology in different stages of public works projects of any nature, scale or complexity and explore the use of BIM technology for asset management so as to enable staff of Works Departments (WDs) from senior management to frontline staff to appreciate the benefits of the technology and acquire the hands-on experience.

7. Under the endorsed proposal, WDs should continue to provide training to their staff from introductory level to advanced level for the smooth delivery of pilot projects and to establish a pool of colleagues capable of building up and administering BIM models.

8. The Government is firmly committed to the promotion and adoption of BIM technology in capital works projects with a view to enhancing the design, construction, project management, asset management and improving the overall productivity of the construction industry. In this connection, DEVB TC(W) No. 7/2017 was issued to require consultants and contractors to use BIM technology when undertaking design of major government capital works projects from 2018 onwards. Subsequently, DEVB TC(W) No. 18/2018 was also issued to mandate some BIM uses relating to construction planning (4-D) and cost estimation (5-D) so as to promote wider use of BIM technology in public works projects. In 2019, DEVB TC(W) No. 9/2019 was issued to further extend the scope of mandatory BIM uses, among other aspects, to certain applications in investigation, feasibility and planning stage, design for digital fabrication as well as sustainability evaluation (6-D).

9. Superseding DEVB TC(W) No. 9/2019, this Circular enhances the implementation requirements for BIM adoption in response to WDs' feedback

and extends the scope of mandatory BIM uses relating to asset management (7-D), surveying of underground utilities, engineering analysis, 3-D control and planning, etc. so as to further foster adoption of BIM technology in public works projects.

Policy

10. Capital works projects with project estimates more than **\$30 Million**¹ shall use BIM technology. The policy is applicable to projects in the investigation, feasibility, planning, design or construction stages in the Capital Works Programme irrespective of the modes of delivery as detailed in the ensuing paragraphs. For entrustment works, sub-vented capital works projects and works that are undertaken by private parties but will be handed back to the Government for maintenance, the BIM adoption policy is covered in paragraph 20.

Road Map on BIM Adoption for Government Projects

11. To reap more benefits from BIM application, DEVB has developed a BIM road map for enhancement of BIM uses from fundamental BIM uses in project management at design and construction stages to more sophisticated BIM uses on digital fabrication, asset management, smart city planning and adopting BIM for e-tendering so as to apply BIM to the whole project life cycle and smart city development. The intended BIM uses at various stages are described in the ensuing paragraphs.

e-Tendering with BIM

12. It is our ultimate goal to include BIM models as part of tender information for electronic tendering (e-tendering). The BIM models should be further enriched and developed by the design team for detailed design and then by the construction team for construction details, and finally provided to the maintenance agencies for asset management and to the BIM data repository for smart city planning. Therefore, WDs should be working towards using BIM models to prepare documents for tendering as far as practicable.

¹ Project estimate data recorded in the FSTB Capital Works Expenditure database.

Investigation, Feasibility and Planning Stage

13. Sometimes a detailed information model may not be required at the early stage of a project or has little reference value at subsequent stages. Thus, the use of BIM technology is optional for projects during the stage of preparing Technical Feasibility Statement (TFS). However, WDs should adopt mandatory BIM uses in certain applications in the investigation, feasibility and planning stage after TFS has been approved in accordance with the Financial Circular No. 7/2017.

Design Stage

14. The use of BIM technology is mandatory for all projects to be designed under Design and Construction consultancy agreements (DC) or Investigation, Design and Construction consultancy agreements (IDC), or by in-house resources. The design BIM models shall be prepared to target for tendering purpose.

Construction Stage

15. All tenders for construction contracts are required to use BIM technology. For the avoidance of doubt, this requirement applies also to Design-Build and Design-Build-Operate projects.

Digital Fabrication

16. Digital fabrication is the process for digitalising the construction details as parametric objects in the BIM model for mass customised components so as to make the design and fabrication processes more efficient and can be done offsite. In this connection, some pilot projects from WDs have been selected for trial use of BIM technology for rebar prefabrication and modular Mechanical Electrical Plumbing/Building Services installations although these applications have not been regarded as mandatory BIM uses at the moment.

Asset Management

17. In addition to enhancing productivity and reducing risks and costs of capital works projects, BIM technology can also optimise operation and

maintenance. WDs should critically review their departmental asset information requirement and management strategy in order to leverage the information contained in the BIM models to facilitate asset management over the whole asset lifecycle. Therefore, WDs should proactively collaborate with their maintenance agencies of the built assets to agree on a standard practice for handover of as-built BIM models and documentation which contain the essential asset information requirements (AIR) to facilitate effective asset management.

Smart City Planning

18. BIM models contain rich information of built assets which can facilitate the integration between BIM and Geographic Information System (GIS) as well as the development of Common Spatial Data Infrastructure (CSDI).

19. Therefore, WDs shall provide their design and as-built BIM models to LandsD to facilitate the development of the BIM data repository and should ensure that the models are prepared for information sharing according to the harmonised BIM standards, as far as practicable, which is being developed by CEDD and LandsD in a pilot study for a New Development Area (NDA) due for completion in 2021 tentatively.

BIM Adoption for Entrustment Projects, Sub-vented Projects and Private Projects to be Handed Over to the Government

20. This BIM adoption policy is also applicable to entrusted projects within the Government departments. For projects entrusted to organisations outside the Government (Airport Authority, MTR Corporation Limited, private developers, etc.), sub-vented projects and private projects to be handed over to the Government, the scope of BIM implementation should be aligned with the BIM adoption/implementation policy of the organisations. However, WDs shall encourage these organisations to use BIM technology as far as practicable.

Mandatory BIM Uses

21. A number of mature BIM uses have been identified and a list of

mandatory and optional BIM uses set out in **Annex 1** should be implemented in capital works projects. To keep up with the fast BIM technology development, the BIM uses in works projects will be reviewed and updated from time to time.

Exemption

22. On exceptional grounds such as serious contractual implications, substantial impact on project delivery or projects of little technical content², the Heads of WDs may exempt the adoption of BIM technology or part of the mandatory BIM uses as required under this Circular. WDs shall appropriately keep records on such decision and inform DEVB of the approvals for exemptions with detailed justifications.

BIM Workflow

23. BIM is more than an authoring tool to create 3D digital representation of the designs. To reap the full benefits of BIM, project teams should re-engineer the workflow for the whole project delivery cycle to make good use of the BIM data/model for collaboration among project team members with an aim to improve productivity, reduce abortive works, enhance construction safety and/or optimise operation efficiency. In addition, WDs should start charting the BIM adoption effectiveness in public works projects by monitoring the BIM Key Performance Indicators (KPI) which have been developed by DEVB as described in **Annex 3**.

BIM Software

24. Specific brand names and models of BIM software shall not be stated in tender specifications of consultancy studies and works tenders. Notwithstanding considerations on compatibility, product makes and models

² The exemption applies to a project, the main scope of which has little technical content such as in-pipe condition survey & rehabilitation, operation of public fill banks & test laboratories, paving and painting works, slope maintenance works, greening works, maintenance/improvement works under term contracts, procurement of vehicles, etc.

should not be specified. WDs shall ensure that tender specifications must be performance and function based to align with the software-neutral policy. An open BIM strategy should be adopted as far as practicable.

Production of Two-Dimensional Drawings

25. The industry used to adopt two-dimensional (2D) Computer Aided Drafting (CAD) drawings and WDs have been following the “CAD Standard for Works Projects (CSWP)” for 2D CAD drawings. For BIM projects, 2D drawings shall be generated from the 3D BIM model. WDs and their engaged consultants/contractors shall cease producing 2D drawings by other platforms if those drawings can be generated from the 3D BIM model. 2D drawings which are generated from the 3D BIM model need not follow CSWP if technically impracticable.

BIM Capacity Building

26. It is our aim that the project team should have the necessary BIM knowledge/skills to manage the BIM adoption and collaboration in the projects and not to fully rely on BIM consultant/sub-consultant or contractor/sub-contractor. In this connection, we have arranged trainees of DEVB’s Graduate Training Scheme to take BIM manager courses accredited by the Construction Industry Council (CIC). In-service professional and technical staff of the project teams should take suitable BIM training courses for capacity building.

BIM Requirements for Consultants and Contractors

27. To cater for cases where small consultant or contractor firms may not be very well equipped with BIM expertise, provisions will be stipulated in the agreement or contract allowing the consultant or contractor to engage a BIM sub-consultant or sub-contractor to assist them. The agreement or contract shall also contain terms requiring the consultant or contractor to train up a number of staff of the employer/their staff and their sub-consultant/sub-contractor staff. Sample provisions for the training requirements are enclosed in **Annex 2** for reference.

Construction Innovation and Technology Fund (CITF)

28. The Government launched the CITF in October 2018, which provides financial assistance to the local construction industry on, among others, BIM training and procurement of BIM software and hardware for experiential use and project adoption of BIM technology. WDs should encourage their engaged consultants/contractors and sub-consultants/sub-contractors to apply for the CITF.

Enquiries

29. Enquiries on this Circular should be addressed to Chief Assistant Secretary (Works) 4.

(LAM Sai-hung)
Permanent Secretary for Development (Works)

BIM Uses

1. Works Departments shall adopt the stipulated mandatory BIM uses in respective stages of a project. Works Departments may adopt the optional BIM uses when necessary.

	BIM Use	Investigation, Feasibility and Planning	Design	Construction
1	Design Authoring	M ^h	M	M
2	Design Reviews	M ^h	M	M
3	Existing Conditions Modelling	M ⁱ	M	M
4	Site Analysis	M ⁱ	M	
5	3D Coordination		M	M
6	Cost Estimation	O	M ^a	M ^b
7	Engineering Analysis		<u>M^l</u>	<u>M^l</u>
8	Facility Energy Analysis		O	O
9	Sustainability Evaluation	O	M ^j	M ^j
10	Space Programming	O	M ^c	
11	Phase Planning (4D Modelling)		M ^d	M
12	Digital Fabrication		M ^k	M ^e
13	Site Utilization Planning			M ^f
14	3D Control and Planning			<u>M^m</u>
15	As-Built Modelling			M
16	Project Systems Analysis			O
17	Maintenance Scheduling			M ^g
18	Space Management and Tracking			O
19	Asset Management			<u>Mⁿ</u>
20	Drawing Generation (Drawing Production)		M	M

Legend:

M – Mandatory BIM Use for the mentioned stage, including that carried forward from previous stage. The underlined items are new mandatory BIM uses.

O – Optional BIM Use

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 activities as considered appropriate 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 units³.
- f. Mandatory for the construction activities with very high to extreme risk level identified from the SRM according to ETWB TC(W) No. 6/2005 or other activities as considered appropriate 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 developing/reviewing digital 3D design scheme for a new construction project after TFS has been approved by the WB of DEVB.
- i. Mandatory for collecting sufficient and necessary existing site conditions as far as practicable to develop the design scheme and conduct the site analysis for new construction projects.
- j. 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”.
- k. Mandatory for modular construction units³ including those for MiC, DfMA, prefabrication of BS/MEP installations as appropriate.
- l. 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.

³ 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 the site for installation/fixing.

- m. 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.
 - n. 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.
2. Explanations of each of the above BIM uses shall be referred to the explanation notes below.
 3. The additional mandatory BIM uses as underlined in the above table shall be adopted for all technical & fee proposals of consultancy agreements or construction works tenders to be invited on or after 1 January 2021.

Explanation Notes on BIM Uses

1. **Design Authoring:** A process of using BIM software to create and develop a project BIM model and plans, elevations, sections, details, shop drawings and schedules can also be produced by the authoring tools.
2. **Design Review:** A process for stakeholders to view a model or animated walk-throughs of a project, provide feedback and validate various design aspects by means of BIM model viewer, Computer Assisted Virtual Environment (CAVE), immersive lab, etc.
3. **Existing Conditions Modelling:** A process of creating 3D model of the existing site conditions by means of laser scanning, photogrammetry, composition of existing 3D spatial data of the site and other conventional methods.
4. **Site Analysis:** A process in which BIM and/or GIS tools are used to evaluate a site for exploring options or making decisions.
5. **3D Coordination:** A process of identifying conflicts by analysing 3D models of different building/engineering systems. The goal of the coordination process is to eliminate clashes before construction.

6. **Cost Estimation:** Quantities may be extracted from models and used to develop cost estimates for a project.
7. **Engineering Analysis:** A process which uses the BIM model to analyse and assess design options to facilitate the provision of effective engineering solution. Engineering analysis may be related to structural, lighting, solar and shading, airflow, energy, acoustic, thermal, mechanical, people movement, hydraulic, etc. designs.
8. **Facility Energy Analysis:** A process of using a building energy simulation programme with a model to conduct energy assessments of a project design.
9. **Sustainability Evaluation:** A process in which a project model is evaluated based on sustainability criteria from BEAM Plus, LEED or other green building assessment tools.
10. **Space Programming:** A process in which a spatial program is used to efficiently and accurately assess a design layout model in regard to client spatial requirements and statutory requirements. For design stage, some examples for checking client spatial requirements may include compliance with the approved schedule of accommodations, reference plot ratio for building projects and site coverage of greenery for building projects, etc.
11. **Phase Planning (4D Modelling):** A process of linking a programme to the model which is used to plan the phased occupancy or to show construction sequence and space requirements.
12. **Digital Fabrication:** The use of models to facilitate the fabrication of mass customised components or off-site prefabricated assemblies and the models can also be used for prototyping with 3D printers as part of a design intent review process.
13. **Site Utilisation Planning:** The model shall include permanent and/or temporary facilities on site for all the phases of the construction process. This BIM use is normally worked with Phase Planning to review space planning, site logistics, sequencing requirements, temporary works and safety.

14. **3D Control and Planning (Digital Layout):** A process of utilising a model to lay out project elements on the site or automate the plant with Global Positioning System (GPS) and machine control.
15. **As-built Modelling:** A process of preparing an accurate record of the physical conditions and assets of a project, e.g. as-built BIM model and asset templates.
16. **Project Systems Analysis:** A process of measuring how a project performs compared to the design specifications, e.g. operation of mechanical systems, energy use, solar gain, lighting performance and airflow pattern with Computational Fluid Dynamics (CFD).
17. **Maintenance Scheduling:** A process for planning and managing the maintenance of a project structure, building fabric and equipment during the operational life of a facility. The data required for facility management shall be collected during the construction stages and input into an as-built BIM model.
18. **Space Management and Tracking:** The as-built BIM model can be used to assess, manage and track spaces and associated resources within a project. A BIM database may be used to analyse the existing use of space and perform transition planning.
19. **Asset Management:** A process of linking an as-built model database to an organised asset management system, which can be used to maintain and operate the facility and its assets. To achieve this, project teams and maintenance agencies should agree on a standard practice for handover of as-built BIM models, which contain the essential AIR to facilitate effective asset management.
20. **Drawing Generation (Drawing Production):** A process of producing tender drawings and shop drawings as far as practicable by BIM models, which are used as single-source-of-truth.

Organisation, Training and Sub-contracting Requirements

BIM Team Structure

The Consultant/Contractor* shall propose and establish a BIM team that is appropriate for the scale and complexity of the Assignment/Contract*, highlighting key roles and responsibilities of each position, within [14][#] calendar days after commencement of Assignment/Contract*. The team shall be led by a BIM Team Leader who holds a key position in the Consultant/Contractor's* project team structure. The BIM team shall include sufficient and technically competent resources in order to complete all BIM tasks and deliverables specified in the Assignment/Contract*. Notwithstanding, the BIM team shall comprise at least [3][#] personnel well trained in relevant disciplines. These personnel shall have qualifications as follows:

- (a) BIM Team Leader shall be a CIC-Certified BIM Manager (CCBM) with effect from 1 July 2021 for all technical & fee proposals of consultancy agreements or construction works tenders to be invited on or after 1 January 2021

OR

Subject to the approval from a D2 officer, BIM Team Leader who is not a CCBM shall comply with the following requirements:

- (i) shall either have corporate membership of an appropriate professional institution or shall have a minimum of five years relevant post-qualification experience plus university degree or equivalent in an appropriate engineering or construction-related discipline; and
- (ii) shall have a minimum of three years of practical experience in management of BIM projects.

(b) BIM Coordinator

- (i) shall have a minimum of three years related construction project experience; and
- (ii) shall have a minimum of one year practical experience in BIM projects

OR

shall be a CIC-Certified BIM Coordinator (CCBC)

The BIM Team Leader shall be responsible for the overall BIM management and process controls. The BIM Team Leader shall delegate BIM Coordinator(s) for handling BIM tasks such as BIM modelling, collaborate information exchange amongst related stakeholders and maintain a drawing/information register to record the information to be incorporated in the model(s).

For any proposed staff movement or change in the BIM team, the Consultant/Contractor* shall provide a CV of the replacement personnel together with evidence of equivalent BIM competency to the Director/Engineer/Supervising Officer* within [7][#] calendar days for approval.

BIM Sub-Consultant/Sub-Contractor*

If the Consultant/Contractor* does not have the necessary expertise, the Consultant/Contractor* shall engage a sub-consultant/sub-contractor* with suitable expertise for the performance of BIM related tasks. If the Consultant/Contractor* intends to or is required to subcontract the BIM works to a BIM sub-consultant/sub-contractor*, the Consultant/Contractor* shall obtain approval from the Director/Engineer/Supervising Officer* before formal engagement and shall indicate this clearly in the project team structure. The positions of the staff members from the BIM sub-consultant/sub-contractor* shall also be indicated clearly in the BIM team organisation structure.

BIM Training Requirements

The Consultant/Contractor* is required to nominate his staff or sub-consultant/sub-contractor*'s staff to attend, within [6][#] months from the commencement of the Assignment/Contract*, suitable BIM skill training courses under the pre-approved list of the CITF managed by the CIC and ensure their successful completion of the attended training courses:

- [4][#] staff members for the Consultant/Contractor* and
- [4][#] staff members for the engaged sub-consultant(s)/sub-contractor(s).

* Delete as appropriate

The number is for reference only and should be suitably determined by the WD according to the nature, scale, complexity, mode of project delivery, number of consultant/contractor/sub-consultant/sub-contractor involved, etc. of the project.

BIM Key Performance Indicators (KPIs)

1. After adoption of BIM technology in public works projects, there is a need to measure the effectiveness for continuous improvement. To effect this, DEVB has engaged a consultant to make reference to overseas experience and develop an objective performance measurement framework which includes 2 sets of KPIs, i.e. (i) a basic set of qualitative measures which can be quickly and easily adopted by all projects and (ii) an advanced set of qualitative and quantitative measures that can be used for in-depth analysis of project accomplishment in terms of BIM adoption.

2. The performance measurement metrics are collected in two Workbooks* (one for baseline measurement and the other one for regular review), which are to be completed by Project Officers. They cover a broad spectrum of benefits or impacts of using BIM in following categories:

- a. Value & lifecycle cost – reduce project cost, reduce changes, etc.;
- b. Programme & timing – shorten project schedule, turn-around time, etc.;
- c. Safety & security – improve worker / work site safety, etc.;
- d. Design & design experience – make available more design options, etc.;
- e. Project delivery – ensure contract requirements are met efficiently, reduce variation orders, etc.;
- f. Asset & facility management – facilitate collection of useful asset data for asset, facility or operation management;
- g. Stakeholder communications – improve coordination, enhance clarity; and
- h. BIM & project management – improve BIM expertise, attract and retain talents, improve organisational and project image, etc.

3. The Project Officers shall fill in the Workbook (baseline measurement) within 60 days of the award of the consultancy agreement / works tender and submit it to the departmental BIM Support Team (BST), and shall regularly report in the Workbook (regular review) the achievement in every 6 months to the BST for auditing. BST would scrutinise the received Workbooks for any insights of BIM adoption gained, challenges encountered, and draw up any necessary improvement or follow up action.

* The Workbooks are available from DEVB's Works Group Intranet Portal.