



NCIB

ADVANCED CONSTRUCTION
INFORMATION DEVELOPMENT LTD.

BUILDING INFORMATION MODELLING

STANDARD

V1.2

MARCH 2018

PREFACE

Building Information Modelling (BIM) offers vast benefits in the life cycle of a construction project, from feasibility studies and planning to schematic design, detail design, statutory submissions, cost estimation, tender and construction. It enables all stakeholders of a project including the project owner, building professionals of various disciplines and the contractor to share information of the project digitally. The team can hence collaborate effectively to produce the best design and achieve efficiency during the entire development of the project.

The many benefits offered by BIM have led to its adoption on a global scale. The Hong Kong construction industry, being one of the most advanced in the world, has developed and used a wide variety of BIM software successfully in the last decade. However, the proliferation of software developed by different bodies resulted in a lack of common platform for data inter-operability to allow seamless and accurate information flow. In consequence, the power, capacity and efficiency of BIM in carrying a construction project from one stage to the next have been hampered considerably.

Undoubtedly, therefore, the Hong Kong construction industry urgently needs to adopt a common and aligned set of BIM standards and guidelines. This would be the key to successful collaboration among the stakeholders of a project. To this end, the Hong Kong Construction Industry Council (CIC) being the coordinator for Hong Kong’s BIM development, published the CIC BIM Standards (Phase One) in 2015. This was a very important first step in establishing the blueprint for the further development of BIM in Hong Kong.

In 2016, the Hong Kong Housing Authority (HKHA) embarked on revamping its BIM Standards and Guidelines (HABIMSG) with a view to dovetailing and supplementing CIC’s Phase 1 BIM Standards to provide the essential operational guidance.

The new HABIMSG is set to achieve the following objectives:

- (a) To revamp HABIMSG in alignment with the framework set by CIC’s Phase 1 BIM Standards, with a view to setting an example for other organizations to follow and creating a synergistic effect of the further development of BIM in Hong Kong.
- (b) To supplement CIC’s Phase 1 BIM Standards through the compilation of a document which gives comprehensive and practical guidance with prescriptive standards covering a wide range of technical details, including modelling and collaboration methodologies, file structures and naming conventions, resource planning and other essential information.
- (c) To contribute to the development of BIM by sharing the HABIMSG with both the BIM community in Hong Kong and the whole world via the HKHA website.

From the very beginning of the mammoth exercise in revamping the BIM Standards and Guidelines, HA has a crystal clear concept of its approach and aims. It holds a strong belief that a good set of standards and guidelines is of fundamental importance for effective model building, electronic file exchange, data and information compatibility and people communication. It is therefore fully committed to producing a new HABIMSG which achieves two main breakthroughs that will set it apart from all other local and international BIM guides:

- (a) The HABIMSG is to be centred on a “Purpose Driven BIM” approach which guides the user to implement BIM in a focused and efficient manner, achieving his specific goals with minimum efforts and resources. In other words, the HABIMSG is set to ensure that the “means” (i.e. modelling input) are driven by the “ends” (i.e. various output such as statutory submissions, quantity take-offs, environmental analyses, etc.) for target oriented results.
- (b) Most BIM Guides are either too general, which fail to give sufficiently detailed operational guidance to practitioners, or too technical, which project managers cannot comprehend. The HABIMSG is to bridge this gap and provide comprehensive guidance for all members of a project team in implementing a BIM project from start to finish. In other words, the HABIMSG aims to facilitate all involved personnel in the project team in providing their respective input and to offer the appropriate interface in bringing the project forward from commencement till completion.

The adoption of BIM in a large organization such as the HKHA presents many challenges. Standards and Guidelines are important for effective model building, electronic file exchange, data and information compatibility, and people communication in the multi-disciplinary organisation. The HABIMSG is thus an instrument that serves as the backbone of BIM collaboration.

With the facilitation of HABIMSG, everyone can capitalise on BIM on a shared platform, continue to innovate and advance their frontiers. In a sense, the HABIMSG will enable BIM use to sustain and thrive in HKHA.

It is hoped that the publication of the revamped HABIMSG which aligns with the overall direction set out in CIC’s Phase 1 BIM Standards will be a substantive contribution to the further development of BIM not only in HKHA but the entire construction industry in Hong Kong.

It is also hoped that users of the revamped HABIMSG will find the following feature to be of considerable practical value:

Clear Hierarchical Structure

The HABIMSG consists of four hierarchical levels, each with a specific target user group and purpose.

Level	Target Users	Content
1	i. Project professionals / managers	Full list of BIM applications to serve as a BIM Execution Plan. For Project Managers to determine and monitor BIM applications for the entire project life cycle from design, construction to facility management.
2	i. Project professionals / managers ii. Technicians	Elaboration of Level 1 BIM applications with guidance on: i. Resource requirements ii. Division of responsibility between professional disciplines iii. Authorship and ownership of BIM models iv. Collaboration requirements v. File structures
3	i. Technicians	Further elaboration of Level 2 with guidance on: i. Specific workflows to implement BIM applications listed in level 2
4	i. Technicians	Further elaboration of Level 3 with guidance on: i. Technical details on how to operate specific software commands to achieve BIM applications listed in level 3

Resource Indicator

Experience shows there must be a realistic estimation of the resources required to implement BIM for the project and carry it through the entire project life cycle. Sustainability in this respect must be established at the commencement of the project.

The BIM Use Card at Quick Guide Level 2 for each BIM application provides an indication of the relative implementation effort in terms of time on a 1 to 10 scale. For a BIM user who is unfamiliar with a particular BIM application being considered, this indicator helps him to estimate the effort required on the basis of his past experience in another BIM application which he is familiar with.

Collaboration with Clear Ownership

The Project Execution Plan sets an information management standard which delineates lines of responsibility, modes of communication, reporting procedures, approval and sign-off procedures, exchange or model sharing protocols, model coordination procedures/meetings, and model and drawing versioning procedures. The concept is to help users to achieve clear ownership, responsibility and liability. In practical terms, each team member or professional discipline would create his/their own models and files, for which he/they would have ownership and data responsibility of the information contained therein. The models and files would provide easy identification of the respective author, and they would not be amended by any other team member or discipline without the owner’s permission

Drawing Production

Although BIM is a superior tool to replace traditional 2D drafting, 2D drop-off from the 3D model is still crucial for the purposes of tendering, construction and statutory submissions. All file setting up and modelling methodologies in the revamped HABIMSG are designed to serve the drawing production purpose. Specifically, Detail Guide Level 4 provides guidance on drawing sheet compilation, drawing detail (e.g. view control, visibility overrides, view templates, annotation etc.) and preparation for publication.

BIM for Statutory Submission

The HABIMSG has dedicated an Annex to highlight the experience of one of HA’s housing projects in using BIM for statutory submission. The HKHA’s technical experience and challenges in submitting General Building Plan and Foundation Plan formats using BIM, as opposed to the conventional method using CAD, is summarized in the Annex.

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1 INTRODUCTION

The Development and Construction Division (DCD) of the Hong Kong Housing Authority (HA) is responsible for

- Implementation and monitoring Public Housing Construction Programme and Public Housing Development Forecast
- Monitoring Housing Information System
- Formulating and reviewing strategies and policies with regard to development, planning, design and construction of public housing
- Formulating, implementing and reviewing corporate procurement, safety and environmental management strategies
- Commenting on territorial / district / local planning studies and planning standards and guidelines

DCD is a multi-disciplinary setup with professionals from Architecture, Structural Engineering, Building Services Engineering, Civil Engineering, Geotechnical Engineering, Quantity Surveying, Landscape Architecture, Land Surveying, Planning etc. With the implementation of Building Information Modelling (BIM) in DCD, electronic models would be developed and carried throughout the project lifecycle from feasibility studies, schematic design, details design, analysis, construction and maintenance. Standards and guidelines are important for effective model building, electronic file exchange, data and information compatibility and people communication, with in-house staff and the consultants and contractors.

1.1 Background

The HA BIM Standards and Guidelines are designed to improve the process of design information production, management and exchange. Initially the initiative to prepare the Standards and Guidelines mainly addressed CAD layering conventions as the primary concern for users of design data. As design needs and technology develop, the initiative has been expanded to cover other aspects of design data production and information exchange.

Throughout the years, the HA has published 10 sets of standards and guidelines which focused on specific BIM applications. As they have been prepared by different working teams, or on ad hoc basis, the contents may not be coherent and, in some cases, may not represent the best BIM practices. Furthermore, in light of the rapid development in BIM technology, there is a need to consolidate the previous publications into a comprehensive BIM Standards and Guidelines for both HA staff and consultants to follow. Thus in 2015, a consultancy was commenced to revamp the existing HA BIM publications and produce a comprehensive HA BIM Standards and Guidelines (HABIMSG).

A large part of the HABIMSG is based on the use of Revit as the BIM software, even though the HA adopts a non-discriminatory policy on software procurement. This is due to historical reasons: the HA started with Revit when it first introduced the use of BIM in developing public housing projects and accounted of its capability and flexibility. Over the years, the use of Revit has been extended to the entire project life cycle. In consequence, BIM development in the HA has been tied to the use of Revit. In its daily operations, the HA nevertheless accepts BIM submissions based on software other than Revit and engages BIM service providers (BIMSP) which use other BIM software.

1.2 The Committee

The following setups were consulted during the development of the HABIMSG:

1. BIM Project Steering Committee (BIM PSC);
2. BIM Working Group (BIM WG); and
3. Information Technology Sub-Division (ITsD).

The Editorial Board included representatives from:

1. The BIM Service Team (BIMST)
2. A-C-I-D Limited

1.3 Disclaimer

All the advices outlined in this document is for information only for all readers other than the HA. The authors and contributing parties take no responsibility for the use of the standards and guidelines in other government or private projects. Their suitability should be considered carefully before embarking on any application to current work practices.

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The framework of Chapter 4 D.LOD-3 Responsibility Matrix of this guide is referenced from "CIC Building Information Modelling Standards (Phase One)". September 2015, Construction Industry Council, 15/F, Allied Kajima Building, 138 Gloucester Road, Wanchai, Hong Kong

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1.5 Executive Summary

This Guideline ensures all parties are clearly aware of the opportunities and responsibilities associated with the incorporation of BIM into the project workflow. It defines the appropriate Uses for BIM on a project (e.g., design authoring, design review, and 3D coordination), along with a detailed design and documentation of the process for executing BIM throughout a project's lifecycle. By following the procedures set out, the team can follow and monitor their progress against this plan to gain the maximum benefits from BIM implementation.

This Guideline provides a structured procedure for implementing BIM within the DCD:

1. **Quick Guide Level 1 – BIM Use Overview:** Identify possible BIM applications that are common throughout the DCD's project lifecycle
2. **Quick Guide Level 2 – BIM Application Detail:** Identify BIM model sets, data sets and their owners involved, level of development (LOD) required and source of information of each BIM application. Team leaders should base on this information to assess their desired BIM applications against available resources.
3. **Quick Guide Level 3 – BIM Workflow:** Adopting BIM execution process for each BIM application
4. **Detail Guide Level 4:** Implement the standards and procedure for LOD, collaboration, modelling methodology and presentation, etc.

1.6 Reference

Reference is made to the following documents:

- CIC Building Information Modelling Standard (Phase One) - 2015
- Autodesk Technical Papers
 - Autodesk Revit Model Performance Technical Note – 2016
- Mastering Autodesk Revit MEP 2015
- BIM Project Execution Planning Guide and Template (V2.1-2011)
- UK BIM Standards
 - AEC (UK) BIM Standard for Autodesk Revit
 - Collaborative Production of Architectural, Engineering and Construction Information – Code of Practice (BS_1192:2007+A2:2016)
- US National BIM Standard
- National Guidelines for Digital Modelling
- Singapore BIM Guide (Version 2)
- Singapore VDC Guide (Version 1.0 –October 2017)
- LOD Specification, BIM Forum 2016, 2015 & 2013
- HK Standard Method of Measurement of Building Works (SMM4)
- Building Information Modelling for Asset Management (BIM-AM) Standards and Guidelines (Version 1.0 – Nov 2017)

1.7 Glossary

A

AEC A collective acronym of Architecture, Engineering and Construction for the built environment.

ArchiCAD BIM modelling application from Graphisoft. Joint developers of IFC format as Tekla & Vinco.

AutoCAD Computer 2D/3D drafting software developed by Autodesk.

B

BIM "Building Information Modelling" or "Building Information Management". The process of developing and using three-dimensional, digital representation of building data throughout its life cycle.

BIM Manager The BIM Manager shall be responsible for the supervision, management and administration of the Services including planning, coordination, monitoring, and liaising with the HA for all matters in connection with the Services. The BIM Manager shall work with the BIM Modeller to coordinate with all disciplines and generate the required modelling for the project delivery to the satisfaction of the Employer. BIM Manager shall regularly federate and undertake clash analysis on the BIMs from their own discipline and other disciplines.

BIM Model An object-based digital representation of the physical and functional characteristics of a facility. The Building Information Model serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onwards.

BIM PEG Building Information Modelling Project Execution Guide. A document, as a management tool, to provide project team guidance and document template for good practices which facilitates and streamlines the BIM process throughout a project.

BIMPxP Building Information Modelling Project Execution Plan. A document, as a management tool, to show the roadmap of the use of BIM in the subject project by defining various BIM tasks and process.

BIMSP Building Information Modelling Service Provider.

BIMST Building Information Modelling Service Team established in 2009 under Business Information and Technology Unit (BTU) to provide BIM central support and advise project teams of the implementation of BIM technology.

BIM Software Computer applications that create, modify, integrate, and/or manipulate digital BIM models in whole or parts.

Building Information Management Synonym to "Building Information Modelling" with emphasis on the requirement to manage/structure the information.

Building Information Modelling A collection of defined model uses, workflows, and modelling methods used to achieve specific, repeatable, and reliable information results from the model. Modelling methods affect the quality of the information generated from the model. When and why a model is used and shared impacts the effective and efficient use of BIM for desired project outcomes and decision product.

C

CDE Common Data Environment. Single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multi-disciplinary teams in a managed process.

CFD Computational Fluid Dynamics. A branch of fluid mechanics that uses computer programs to simulate the behaviour of fluids and gases when interacting with surfaces. In an architectural context CFD is used to analyse airflows around buildings, ventilation patterns, stack effects in multi-storey buildings, fire/smoke behaviour, etc.

CIC Construction Industry Council.

Civil 3D A civil modelling tool with geotechnical design analysis ability. It is part of Autodesk Civil Design Suite 2016.

Clash detection Process of identifying conflicts and issues using 3D collaboration and coordination software tools.

Cloud Cloud Internet connected computer resource (with extensive storage/processing) remote from a user's computer.

COBie Construction Operations Building Information Exchange (COBie). A data format for the publication of a subset of building model information focused on delivering building information not geometric modelling. It is closely associated with building information modelling (BIM) approaches to design, construction and management of built assets, and was devised by Bill East of the United States Army Corps of Engineers. In December 2011, it was approved by the US-based National Institute of Building Sciences as part of its National Building Information Model (NBIMS-US) standard. COBie may take several approved formats including spreadsheet, STEP-Part 21 (also called IFC file format), and ifcXML. In early 2013 BuildingSMART was working on a lightweight XML format for COBie, namely COBieLite, which became available for review in April 2013.

E

ETABS ETABS is a structural engineering analysis software based on Finite Element Method. The software is developed by Computers and Structures, Inc. (CSI) and has been adopted by local construction industry for more than 30 years.

F

Family Category Families usually belong to a category to assist filtering in a project an example could be "Trees" which would be the category for several families in a project.

Federated Model Compilation of Models from one or more programs that can define a complete or partial data set for a design.

G

GIS Geographic Information System.

I

IFC Format The Industry Foundation Classes (IFC) data model is intended to describe building and construction industry data. It is a platform neutral, open file format specification that is not controlled by a single vendor or group of vendors. It is an object-based file format with a data model developed by buildingSMART (formerly the International Alliance for Interoperability, IAI) to facilitate interoperability in the architecture, engineering and construction (AEC) industry, and is a commonly used collaboration format in Building information modelling (BIM) based projects.

Infraworks A software by Autodesk to integrate different models from various sources, such as BIM and GIS, and to present the design in a totality.

Integration Ability to manage and communicate product and project data between software tools and collaborators enabling integration of business, planning and delivery processes.

Interoperability Term used to describe the ability to translate program data from one platform to another. Allows access to BIM data across and within different software tools. Standards such as IFC facilitate interoperability and proprietary exchange methods can link specific software components.

L

LOD Level of Development (LOD) is the term generated and used in the HA's BIM Standards based on the existing HD CAD standards. New elements were added in developing this guideline to include additional features provided in BIM which did not exist in two-dimensional (2D) environment. The LD (for Architecture) states the drawing and model requirement (Level of Detail) for each Submission Stages. The LDs' mainly focus on Modelling requirements and do not integrate the Cost, Schedule or Performance Criteria inputs for Analysis.

M

Massing Model Study model showing the disposition of building volumes in a site. Usually described by LD0 BIM model in HD.

N

Navisworks An Autodesk BIM model analysis product mainly for clash detection. It is part of Autodesk Building Design Suite 2013 -- Currently 2 versions: Navisworks Freedom (model viewing) and Navisworks Management (additional features: file editing ability and larger file handling capacity).

O

Object Normally an abbreviation of parametric object.

Open BIM OPEN BIM is a universal approach to the collaborative design, realization and operation of buildings based on open standards and workflows. OPEN BIM is an initiative of buildingSMART International (bSI) and several leading software vendors using the open buildingSMART Data Model.

ORION A structural engineering analysis and design software basic on Finite Element Method. The software is developed by CSC and has been adopted by local construction industry for many years.

OmniClass The OmniClass Construction Classification System is a classification system for the construction industry, developed by the Construction Standards Institute (CSI) and is used as a classification structure for electronic databases. As the basis of its tables, OmniClass incorporates other existing systems currently in use, including MasterFormat for work results, Unifomat for elements and EPCI (Electronic Product Information Cooperation) for structuring products.

P

Parameter The descriptive data used to define BIM components or objects.

Parametric modelling A model or feature defined by relationships between component entities that are governed by rules and constraints. Changing a rule or constraint or modifying a part of the model often has implications on the parametric objects and/or the entire model.

Parametric objects A digital description of a physical object with certain characteristics represented by variables.

Point Cloud A set of data points in some coordinate system.

R

REVIT BIM modelling application from Autodesk. Up to version 2012, it includes three separate applications: Revit Architecture, Revit Structure (Revit SE) & Revit MEP. From version 2013, the Revit Design Suite (Revit DS) has grouped the three modules into a single product package.

REVIT family A group of elements with a common set of properties, called parameters, and a related graphical representation. Different elements belonging to a family may have different values for some or all of their parameters, but the set of parameters (their names and meanings) is the same.

RFID Radio-frequency identification. The wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by electromagnetic induction from magnetic fields produced near the reader. Some types collect energy from the interrogating radio waves and act as a passive transponder. Other types have a local power source such as a battery and may operate at hundreds of meters from the reader. Unlike a barcode, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object.

RFA Parametric object "families" used by Autodesk software products.

RVT a file used by Autodesk software products for storing BIM models.

RTE a template file used by Autodesk software products for storing settings for Architecture, Structure, MEP and construction discipline

S

Solibri A rule-based BIM model checking program. IFC compliance. Capable of handling cross platform models from different BIM authoring tools.

INTRODUCTION

Spatial Analysis The process of examining the locations, attributes, and relationships of features in spatial data through overlay and other analytical techniques in order to address a question or gain useful knowledge

Spatial Data Information about the locations and shapes of geographic features and the relationships between them, usually stored as coordinates and topology.

T

Terrain Vertical dimension of land surface.

Others

3ds Max An Autodesk BIM modelling tool for movie generation, animation and game production use. Adopted as bridging application between Revit, arcGIS; and with video and even 3D printing.

"3D" BIM Modelling & documentation. Utilizing BIM as a tool to develop and deliver design for all disciplines in a 3D format with intelligence built into the delivery to be harvested and/or utilized at a later time.

"4D" BIM Integration for construction. Building upon the "3D" service by adding timeline and schedule attributes to ensure on-time, smooth constructability and delivery of projects.






"5D" BIM Cost estimation. Not just about simulating cost on a BIM model, but re-defines the communication with the owners. Owners are offered live up-to-date information that helps see the current cost and compare it to the estimated total target cost of their project, as well as interim costs against design during design phases.

"6D" BIM Building Lifecycle Integration. Offer integrated, perhaps proprietary, facility management solutions to clients by utilizing BIM information from 3D, 4D, and 5D to integrate in the operation, maintenance and future renovations of buildings.

3D/4D/5D/6D Descriptions of BIM implementation with increasing 'richness' of associated information & functionalities.

1.8 Symbols and Conventions

A series of symbols has been devised for this guide which requires users' attention. The symbols being applied throughout this guide either (1) signifying the importance of the relevant sections, or (2) content being marked carries specific implication. Details as followed:

Signifying importance of relevant sections:		
Must Do		Item that users of this guide must read and follow
Advisory		Strongly recommended best-practice based on preceding BIM experiences
Content carries specific implication:		
Attention		Non-formality practices that BIM uses may deviate from existing standards or common practices in Hong Kong
Refer		Refer to other sections or documents
HA Specific		Item that applies to the HA practice only