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Sharing for Introduction and Key Concept on Building Information Modelling (BIM)

Abstract

Building Information Modelling (BIM) is becoming a hot topic among all consultants and contractors in the building industry in recent years. Also, the HKSAR has encouraged BIM on all new capital projects to help consultants and contractors to use BIM. Thru participation of several BIM projects, I would like to take this opportunity for introduction and sharing for key concept on BIM.

Introduction

BIM is not just a 3D computer-aided design (CAD). From my experience, BIM is just a platform that to share data, design data and modify data for all parties in whole building life cycle stage including inception, design, construction and operation and maintenance in a real time basis.

Since BIM become more mature, Development bureau had issued circular letter 18/2018 regarding to 'mandatory BIM' and 'optional BIM' in respective stages extracted in the table in right hand side.

Annex 1

BIM Use

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	O	M	M
2	Design Reviews	O	M	M
3	Existing Conditions Modelling	O	M	M
4	Site Analysis	O	M	
5	3D Coordination		M	M
6	Cost Estimation	O	M*	M*
7	Engineering Analysis		O	O
8	Facility Energy Analysis		O	O
9	Sustainability Evaluation	O	O	O
10	Space Programming	O	M*	
11	Phase Planning (4D Modelling)		M*	M
12	Digital Fabrication		O	M*
13	Site Utilization Planning			M
14	3D Control and Planning			O
15	As-Built Modelling			M
16	Project System Analysis			O
17	Maintenance Scheduling			M*
18	Space Management and Tracking			O
19	Asset Management			O
20	Drawing Generation (Drawing Production)		M	M

Legend:
M – Mandatory BIM Use for the mentioned stage, including that carried forward from previous stage
O – Optional BIM Use

DEVB TC(W) No. 18/2018 Page 7 of 11

Roles in BIM Management

Discipline Modellers

Source: HKCIC BIM Standard

At the start of a project it is important to identify the roles and responsibilities of the consultant and contractor team members. There are several key roles in BIM.

BIM Manager – To set up, lead, monitor and support BIM process with relevant construction knowledge and design coordination experience.

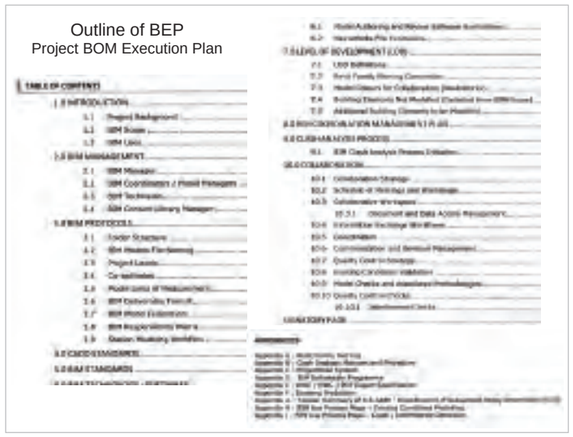
Discipline Coordinator – Manage a specific discipline model and ensure the discipline modellers produce compliant models, drawings, schedules and documents; Coordinate among project team; BIM Analysis for specified discipline.

Discipline Modeller - Create, maintain or amend models, drawings, schedules and documents to the LOD prescribed in the BIM PXP. List and track changes.

CAD Manager – Enforce drawing standard; 2D drawing sheet production. A table shall be used to record the names and contact details of the individuals fulfilling the necessary project roles.

Project Execution Planning (PXP) / / BIM Execution Plan (BEP):

The client may assign the role of BIM Manager to one or more individuals to develop these requirements. If the client does not have experience of specifying or managing the use of BIM, they may develop the BIM Project Execution Plan with the lead consultant* during the concept stage of a project.



Overview of BIM Execution Plan

- Responsibility Matrix
- Discipline Standard and Quality Control
- Level of Development (LOD)
- Visualization, Review and Coordination
- Construability, Product and Equipment Information
- Quantity & Cost Estimation
- Asset Management

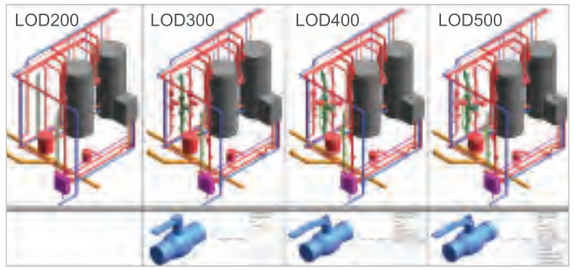
Level of Development (LOD):

The Level of Development (LOD) tables enable clients, architects, engineers, contractors, quantity surveyors and facility managers to clearly specify the content of models at each stage of a project. The LOD will affect the time and effort prepared in BIM. It will be painful if mismatch for time and manpower occur.

The LOD tables follow the LOD definitions developed by the American Institute of Architects (AIA) and are grouped by the key disciplines used in Hong Kong construction projects. Details can refer to CIC BIM standard.

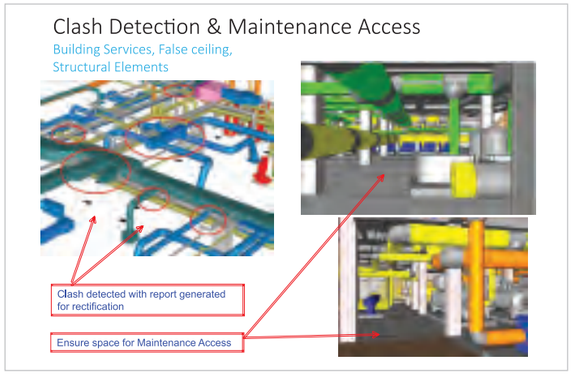
Level of Development (LOD)	Definitions
LOD 100	The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.
LOD 200	The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.
LOD 300	The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.
LOD 350	As per LOD300 but is suitably acceptable by the supervising consultant for construction documentation.
LOD 400	The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.
LOD 500	As per LOD 350 but with sufficient verification as to demonstrate the accuracy of the model and data contained within.

Source: Sample from the other project (Copy right is reserved)



Clash Detection

"The process of using Clash Detection software tools to identify conflicts by analyzing 3D models of the different building systems. The goal of the coordination process is to eliminate clashes before construction of the project. The 3D coordination process shall include checks for headroom requirements, working spaces for building operations and maintenance activities." *Extracted from CIC BIM standard.*



This BIM-facilitated clash detection has proven invaluable to ensure a full and accurate assessment is made of all electrical, mechanical and building services installations so that pipes, ducts and other necessary installations do not conflict with each other.

There are two types of clash:

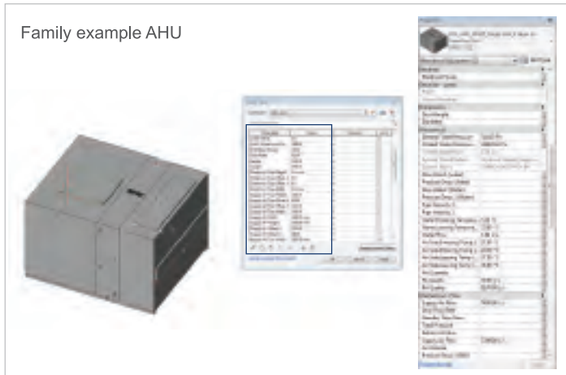
1. Hard clash: Occurs when two objects touch or collide. Some modelling components will be connected and a hard clash with a tolerance of 10mm will be acceptable.
2. Clearance clash: A clear space is required between two elements. The tolerance of a clearance check is usually set at 50mm unless a specific system requires more space.

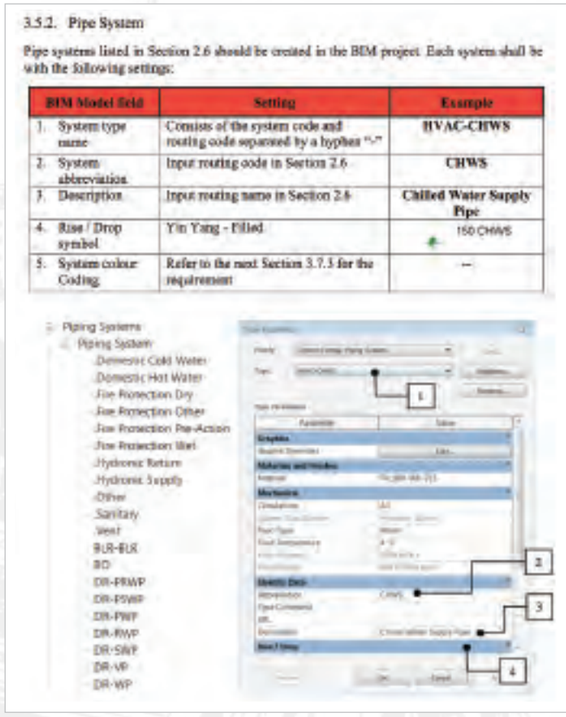
Although clash detection looks powerful, clash cannot be resolved automatically. Resolve clash need to reply on the coordination between discipline by BIM manager and discipline coordinator in Face-to-face meetings in which BIM models are used for design review and clash detection/coordination are the preferred means of facilitating technical discipline coordination. A current clash list shall be produced and circulated to all parties (key stakeholders) before each meeting, then be updated once the revised models have been released into the federated model and a new clash detection process undertaken.

Also, exact level and tolerance to be determined clearly in beginning of project otherwise trouble will occur and difficult to solve. From my experience, a clash free model is difficult to achieve in reality and plenty of time and manpower to be reserved.

BIM Software and Family Set Up

The Building information modeling (BIM) software is widely used by many construction businesses. Each software has its special features / characteristics and BIM manager will specify the year and name of BIM software. *Autodesk BIM 360 (Autodesk Revit)* is one of famous and common software to be used in BIM software. Below captures are extracted from Revit software which I used before.

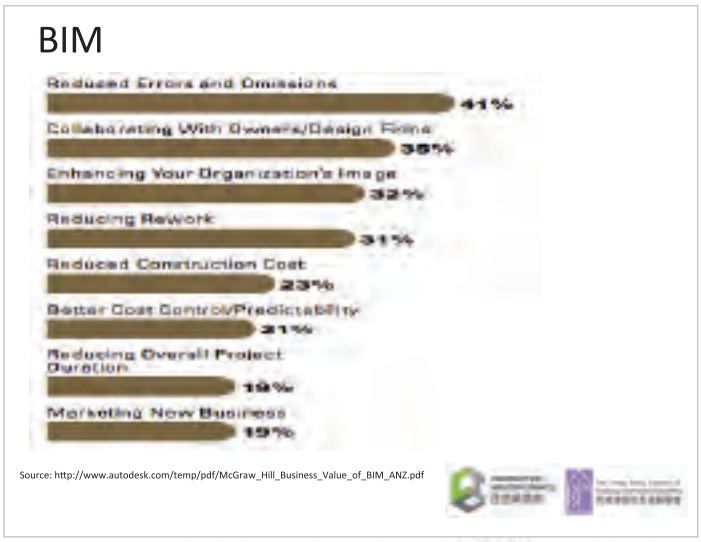




BIM family can be come from many ways, for examples, Previous library set-up, Built-in family in software, supplier / manufacturer or common BIM family share resources. It is crucial to set up family clearly in early stage. Also, the information inside family to be checked carefully to be consistent with actual installation.

Conclusion

As building information modelling in building industry become mature and popular, the roles for BIM will become significant than computer-aided design (CAD) due to the benefits such as saving on materials, time and manpower. Preparation on using BIM is not just hardware (trained manpower) and software, but also commitment and time. Hope this paper on sharing on BIM can raise awareness on preparation of BIM use.



Useful Link:

1. This technical paper to be uploaded on HKIPD website under technical section after AGM - www.hkipd.com.hk/controller/active_page.php?ap_id=technical.
2. Summary for BIM for HK Website - http://ibse.hk/weblinks_BIM.htm

Reference:

1. Construction Industry Council (CIC) BIM standard and Publication - www.bim.cic.hk/en/resources/publications?sorting=last_update&keyword=
2. EMSD BIM standard - www.emsd.gov.hk/en/engineering_services/project_management_consultancy/highlights_of_work/bim_am/index.html
3. Housing Authority BIM Standard: www.housingauthority.gov.hk/en/business-partnerships/resources/building-information-modelling/