BIM Project Execution Plan (PXP)

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Appendices

1 Project Information

1.1 Project Name

1.2 Project Description

Phase 2 (Stage 1) redevelopment consists decanting and demolition works of Staff Quarters Blocks (Block A, C, D, E) and -- (Lecture Theatre) for the construction of a new In-patient Extension Block (IP Block). The new IP Block will accommodate clinical services for a planned capacity of approximately 1,200 in-patient and day beds, A&E Department, a Peri-operative Centre (with at least 16 operating theatres), Cardiac Interventional Centre, Day Surgery, Labour & Delivery Department, ambulatory services, clinical laboratory services, education and training facilities, and administration and supporting services.

1.3 Project Workstage

As this project consists of the following major works:

- -- Decanting Building
- Block B A&A
- Demolition of existing Staff Quarters
- IP Block
- MCB A&A

Each of the works will consist of the following six workstages where there will be a different programme for each (staggered schedule):

Workstage 1:	Inception/ Feasibility, Brief Development
Workstage 2:	Outline Proposals and Sketch Plan
Workstage 3:	Detail Design
Workstage 4:	Documentation / Tendering
Workstage 5:	Construction Supervision
Workstage 6:	Post Handover Services

1.4 Key Programme Milestone for --

Based upon the Master Programme (Rev. 0), the key milestones are:

	SH Decanting Building	Block B A&A	IP Block	MCB A&A
End of Workstage 1	NA	NA	Jan 2018	TBD
End of Workstage 2	Nov 2017	NA	Aug 2018	TBD
End of Workstage 3	Jan 2018	Feb 2018	Apr 2020	TBD
End of Workstage 4	Aug 2018	Aug 2018	Jul 2021	TBD
End of Workstage 5	Dec 2019	May 2020	Dec 2025	TBD
End of Workstage 6	Dec 2020	May 2021	Dec 2026	TBD

1.5 BIM requirements in Consultant's General Conditions of Consultancy Agreement

This PXP is a response to -- (--) Tender Brief Clause 6.1(m) and Annex 4, shall be used in conjunction with the clauses in the Schedule. This covers:

- Scope
- Use
- Deliverables and responsibilities per Workstage
- Approach
- Minimal level of detail
- Clash detection and analysis for design coordination
- 4-D BIM application for construction

2 Introduction

2.1 BIM Overview

Building Information Modelling (BIM) is a process of creating, managing and exchanging a digital information model of a building project to enable quality and efficiency benefits to be realised during design, construction, operation and future redevelopment of the building.

Properly implemented, BIM can deliver major performance improvements in programme efficiency, design quality, health and safety, environmental performance and capital and operational cost management.

2.2 Purpose of the PXP

The implementation of BIM on a project requires changes to both the process followed and the technology utilised over and above a traditional construction project. The ultimate level of BIM that can be utilised for any given project is therefore dependent on the degree to which these changes can be brought about within the constraints of time, budget and the contractual relationships which exist between the different parties involved.

Successful implementation requires detailed planning at the earliest stages of the project to establish the ultimate BIM goals for the project, assess the baseline of BIM capability within the team and produce a set of protocols for the project that map out the specific BIM tasks and the information interfaces between them.

A BIM Project Execution Plan (PXP) is created at an early stage to align project-wide objectives to BIM uses and deliverables and serve as a roadmap for BIM processes. It is essential that the project teams comply with the requirements of the PXP to support the successful delivery of the client's and the project's objectives.

The contents of the PXP will evolve as part of the project and will address the following:

- Define the collaboration team and model managers for the project
- Define project milestones and deliverables by stage
- Identify file formats to be used; naming; structure; software and should be in-line with the HKCIC BIM Standard and other international standards such as the BS1192:2007
- Establish file sharing protocol and information transfer standards
- Identify what models will be created, the purpose each model is intended to serve
- Establish Model Content and Progression Specification
- Establish expected contents and level of development (LOD) by project stages
- Establish the required dimensional accuracy of the BIM model
- Establish origin point (X, Y & Z)
- Define model analysis requirements

2.3 Key Team Members and Contact Details

The project requires integrated BIM direction at both management and technical levels. According to Hong Kong Contraction Industry Council BIM Standards (HK CICBIMS), responsibility for this is split between the project **BIM Auditor**, **BIM Manager**, **Discipline BIM Coordinators** and the **BIM Quantity Surveyor**. Both these individuals need to work closely with the design teams to ensure the BIM process integrate smoothly with the overall design activities.

The primary role of the **BIM Auditor** of the project are:

- Manage and certify the BIM PXP for --'s approval
- Administer, lead and manage the BIM process as per the approved BIM PXP

The principle responsibilities of the **BIM Manager** are summarised as follows:

- Management of the processes and procedures for information exchange
- Implementing the PXP
- Assisting project team members – via their Discipline BIM Coordinators – in the preparation of their information outputs
- Implementing the BIM protocol and updating the associated documentation
- Generating clash reports of the combined model and follow up the clashes between disciplines
- Lead and manage reviewing of clash detection in filtering, grouping and sorting prior to BIM coordination meetings
- Ensure the BIM deliverables are met

BIM model authoring for the project will be managed within each part of the design team by the nominated **Discipline BIM Coordinator** with the following responsibilities:

- Development of the discipline model(s)
- Coordinating between designers and modellers in the discipline
- Managing the discipline model and ensure the discipline modellers produce compliant models, drawings, schedules and documents to the requirements of the PXP
- Checking model quality and integrity prior to sharing models with other disciplines and generation of deliverables
- Attending BIM coordination sessions, and making sure the BIM process is optimised for the all disciplines

The BIM Quantity Surveyor shall be responsible for:

- Extraction of data from the BIMs provided by the design team in order to develop cost estimates for the project
- Review model quality from the design team to ensure sufficient information are extracted from the model to perform quantity take-off / cost estimates at different workstages.
- Attend BIM coordination sessions (if required)

The table below summarises the project's key BIM contacts:

Role	Company	Key BIM Contacts
Client BIM Representative		
Project Management Consultancy		

Role	Company	Key BIM Contacts
Architect		
Structural & Civil Engineering		
Building Services Consultant		
Quantity Surveyor		

3 BIM Objectives and Uses

3.1 Client BIM Objectives

--'s objectives have been included in this PXP to give overall context and direction. Below is quoted from --'s Detail of Services 6.1 Clause (m).

The goal of the application of BIM is to create a digital 3D building information model of the facility, comprising models from each design discipline in a coordinated and federated format. The creation of the BIM and the management processes are to be established and managed by the Consultant continuously and progressively throughout the entire Project duration from the design at the outset to the post-construction stage. The Consultant shall work closely with and manage

consultants of other disciplines in achieving the objectives of the BIM. The BIM is for the following beneficial purposes:

i) To minimize design discrepancies, improve design coordination and deliver a clash-free design through the use of the 3D digital BIMs and clash analysis tools.

ii) To improve speed and accuracy on quantity take off (QTO) and cost estimating through use of the digital 3D BIMs.

iii) To enhance visual communication between the Design Team and stakeholders and improve mutual understanding of the design intent through the digital modelling process, to achieve a more effective design approval process with reduced timescales.

iv) To support the statutory and non-statutory approvals submission process (for example to the Independent Checker in accordance with Buildings Department's PNAP ADV-34 and compliance with BIM recommendations under ArchSD Design Guide AR03).

v) To support the efficient delivery of 2D drawings, including Combined Services Drawings (CSDs) and Combined Builderswork Drawings (CBWDs) and 3D room loaded drawings directly derived from the coordinated BIMs.

vi) During the construction stage, (i) to support the Contractor in developing 4D digital construction sequence models to enhance communication, predict and manage construction progress and logistics, and (ii) to support the Contractor in developing an 'as-built' asset information model (AIM) at handover to provide more effective operation of the facility

The project will be in accordance with the principles of BIM Level 2 as defined in PAS1192-2:2013.

Level 2 BIM constitutes a managed and coordinated 3D environment with individual disciplines using compatible tools to produce models with relevant data embedded and attached.

The needs of all project parties over the whole asset lifecycle are considered and the BIM requirements are driven by the Employer's objectives in order to deliver value.

The model should be developed during detailed design to produce a rich data of Asset Information Model (AIM) to comply with the protocols.

3.2 Project BIM Objectives (BIM Uses)

According to --'s Detail of Services Clause 6.1(m) with reference to HK CICBIMS, the project BIM uses during Workstage 1 to 3 are:

- Design Authoring
- Design Reviews

- 3D Coordination
- Visualisation
- Engineering Analysis
- Room Data Sheets
- Cost Estimation

The project BIM uses during Workstage 4 to 6 are:

- As-Built Modelling
- Digital Fabrication
- Room Data Management – as-built data input and linkage
- Phase Planning (4D)
- Quantity Take-off for BQ Production & Cost Estimation
- Facility Information Management / Asset Information Management

3.3 Model Level of Development (MLD) Matrix

It is essential that the required LOD of models (both graphical and non-graphical data) is mapped against Workstages and commonly understood and documented in advance, including responsibilities by organisation. Over modelling the model geometry beyond the requirements of the Workstage is to be avoided, however early attention should be given to delivering a comprehensive data structure which will serve downstream uses.

The MLD Matrix is contained in Appendix A – note this uses HK CICBIMS model element breakdown, which is also in line with AIA LOD definitions in E202-2013 – Building Information Modelling Protocol Exhibit and UK BIMForum 2017.

4 Collaborative Working

4.1 Method of Communication

Continuous and effective communication is essential to the smooth running of a BIM project. It is also important that the BIM workstream does not develop separately from the design development process.

4.1.1 BIM Coordination Group Meetings / Virtual Design Review (VDR) Meetings

It is recommended to have bi-weekly (or separately agreed) BIM coordination meetings chaired by the BIM Manager and Contractor (post tender) attended by BIM Coordinators from each project discipline. These should take place directly after design team meetings if possible. The active use of models during design reviews is also essential and meeting facilities should include provision for a projector, screen and laptop / PC. In order to facilitate better communication and change tracking in the VDR meeting, Navisworks Manage (or agreed equivalent) shall be used for all annotations, comments and markups.

Furthermore, in order to improve the quality of the BIM model for measurement and estimation, it is essential for each design discipline to collaborate with the BIM Quantity Surveyor to manage and configure the BIM model for quantity take-off (QTO) throughout the Project during VDR.

A schedule of meetings with required attendees and format will be included as an appendix to this PXP when available. A standard Agenda for use in BIM Coordination Group Meetings is included as Appendix E.

4.1.2 Common Data Environment (CDE)

Information in the form of documents, drawings, models and RFIs are to be uploaded / logged via a CDE / Asite (see Section 5). This process will ensure consistent and accessible information is provided to the project team and also accountability can be determined.

An exploration of the use of electronic markups to ensure better communication and tracking of required changes to the design will be carried out and adopted using the DWFx file format as well as PDF. The Asite CDE should be used to exchange these files and to request due by dates.

Lines of communication will be defined following production of the project quality plan. However, it is hoped that the BIM coordination team will show best practice leadership by utilising the Asite electronic mail system wherever possible to record general communications and requests / supply of information. An Asite BIM distribution group will be established and the Asite workflows will be explored for possible use in BIM activities.

4.2 Project BIM Standards

The project processes and procedures shall use the following standards. In the event of an inconsistency or conflict between or among the standards, the inconsistency shall be resolved by giving precedence in the following order:

i) HK CIC BIM Standards

ii) PAS1192-2:2013

iii) PAS1192-3:2014

iv) BS1192:2007

v) AIA E203-2013

vi) UK BIMForum 2017 Level of Development Specification Guide

Although the Standard Method of Measurement (SMM) is not a BIM Standard in itself, it will be referred to in conjunction with other BIM Standards listed to ensure the BIMs produced are in the correct standard of measurement.

4.2.1 General

Any clarifications and detailed addendums to these standards are to be included in this PXP and agreed with --. Aspects to be addressed include:

- Modelling methodologies – e.g. 3D, 2.5D, placeholders
- File and document naming and numbering
- Room and space planning
- LOD
- Incorporation of metadata
- Data classification system
- Submission file formats

4.2.2 Model Structure Setup (incl. Worksets)

The Lead Consultant is responsible for managing model setup initiatives with guidance from the BIM Manager. All members of the design team are required to input. General protocols to be followed are summarised below:

- Each discipline will create its own BIM model(s) which will be federated by the BIM Manager to create an overall project model. The underlying principle for model structure will be decided by the Lead Consultant with advice given by the BIM Manager after coordination between the main design team members.
- Models generally will be split by “discipline”.
  If models need to be subdivided further by sub-discipline – e.g. BSE into BME, BPD, they should be recorded in this PXP.
  Post tender if specialist subcontractor design is involved, any further splitting of the model in any discipline should be coordinated by the BIM Manager and recorded in the PXP. All subcontractor models should follow the standards and protocols contained in the PXP.
- Model files for each building shall be aligned with real world coordinates, agreed at a specific model location and produced to true height above project datum. Worksets (Revit specific) and splitting of models is to be used to manage the size and complexity of each discipline model. Additional worksets are to be created for massing objects, links and 3D gridlines for use with Navisworks.
- The Lead Consultant together with the BIM Manager will assess the scale and complexity of the models. If a developing model causes performance issues it can then be split into linked models only after approval by the BIM Manager after liaison with the other project design consultants.

A standard agenda item has been included in Appendix E to ensure the review of the above protocols is performed regularly to continuously optimise the BIM process.

Examples of typical worksets are specified below. Actual project worksets setting and model subdivision will be recorded in this PXP once defined and will evolve during the project lifecycle as needed.

Discipline	Worksets
Architecture	Building name (location), external envelope, internal partitions, floors, roofs, ceilings, massing, stairs, rooms, FFE, cores, links
Civil and Structural	Building name (location), floors, substructure, demolition
MEP	Building name (location), floors, plumbing, HVAC, electrical, ELV, fire protection, drainage, plumbing, medical gas and other special systems

4.2.3 Linked Models

For coordinated collaborative working, particularly where team members from different organisations are working closely on the same areas it is proposed to use Revit's linking functions. A document explaining this methodology and possible limitations is included as Appendix G "Modelling Guidance". Avoid the development of disparate centrally uncoordinated models by team members with the coordination risks and extra effort this brings.

4.2.4 Model Naming Structure

According to HKCIC BIM Standard, model naming structure should be followed or as an alternative the file naming convention as below:

[Project] – [Author] – [Discipline] – [Type] – [Document Number] – [Building Zone] – [Building Level] – [Workstage]

Definition	Code Format	Details
Project	1 to 8 alphanumeric	Project reference coding
Author	3 alphanumeric	The list of agent responsible codes can be downloaded from the Development Bureau website at: www.devb-wb.gov.hk/cswp
Discipline	3 alphanumeric	Indicates the discipline code
Type	3 alphanumeric	Document Type
Document Number	4 alphanumeric	Identifier of the document / file number
Building Zone	3 alphanumeric	Identifier of the building, area, phase or zone of the project the file is relates to if the project is sub-dived by zones
Building Level	3 alphanumeric	Identifier of the level
Workstage	3 alphanumeric	Identifier of the project workstage

[**Discipline**]:

ACO	–	Acoustic Engineering
ARC	–	Architecture
BIM	–	Building Information Modelling
BEL*	–	Electrical Engineering
BFS*	–	Fire Services Engineering
BLT*	–	Lighting Design
BME*	–	Mechanical Services Engineering
BDR*	–	Drainage Engineering
BPL*	–	Plumbing Engineering
BTG*	–	Town Gas
CIV	–	Civil Engineering

ELV*	–	Extra Low Voltage System Engineering
FAC	–	Façade Engineering
ICT*	–	Information System Relevant Discipline
INT	–	Interior Design
FFW	–	Furniture, Fittings and Equipment
LAN	–	Landscaping
LTE*	–	Lift / Escalator / People Movers
MDE*	–	Medical Equipment
PIW	–	Public Infrastructure Works
STR	–	Structural Engineering
TRA	–	Traffic Engineering

* Refer to Appendix F for detailed list of Building Services Systems.

[**Type**]:

CSD Combined Services Drawing

MDL Model (BIM)

RDS Room Data Sheet

SCH Schedule Drawing (Door/Window/Equipment/etc.)

REP Report

PRT For Presentation Drawings

GBP For Submission Drawings

TND For Tender Drawings

[**Workstage**]:

WS1 Workstage 1: Inception/ Feasibility, Brief Development

WS2 Workstage 2: Outline Proposals and Sketch Plan

WS3 Workstage 3: Detail Design

WS4 Workstage 4: Documentation / Tendering

WS5 Workstage 5: Construction Supervision

WS6 Workstage 6: Post Handover Services

4.2.5 Component Library (Revit Families) Naming Standard

BIM component objects (e.g. families in Revit) should be named in a consistent manner for each discipline.

The following Revit family naming convention are counter proposed and agreed to be adopted in this project.

Format

<Functional Type> - <Sub-type> - <Originator> - <Descriptor 1> - <Descriptor 2>

Family Name	DOR – SGL – AEC – Wood – w_Louver .rfa	Descriptions
Functional Type*	**DOR** – SGL – AEC – Wood – w_Louver .rfa	A Door, DOR is the short form of the functional type **"door"**
Sub-Type*	DOR – **SGL** – AEC – Wood – w_Louver .rfa	A Single Door, SGL is the short form of the sub-type **"single"**
Originator	DOR – SGL – **AEC** – Wood – w_Louver .rfa	AEC is the short form of the default **Architecture -Engineering -Construction Industry**. It can be replaced by the name of the creator in short form of three characters. (e.g. MTR, CLP, HKU)
Descriptor 1	DOR – SGL – AEC – **Wood** – w_Louver .rfa	A door is made of **Wood**. An optional descriptive text.
Descriptor 2	DOR – SGL – AEC – Wood – **w_Louver** .rfa	A door is built **with Louver** This text further describes the Family
File Extension	DOR – SGL – AEC – Wood – w_Louver **.rfa**	**R**evit **Fa**mily File Extension

4.2.6 Room and Space Naming

As soon as it is practicable before the first formal statutory submission a standardised room / space naming and numbering system should be agreed by the -- and project team and strictly adhered to.

4.2.7 Level Naming and Numbering

Together with the room and space naming a level numbering and naming system should be implemented commonly by all project disciplines.

Level numbering and naming shall follow the Hong Kong convention:

R/F	(Roof level)
21/F	(Twenty-first floor)
20/F	(Twentieth floor)
…	…
4/F	(Fourth floor)
3/F	(Third floor)
2/F	(Second floor)
1/F	(First floor)
M/F	(Mezzaninne floor)
G/F	(Ground floor)
B1/F	(Basement level 1)
B2/F	(Basement level 2)

Intermediate floors shall be notated LG/F, LB/F or UG/F, UB/F or U3/F, L3/F meaning lower or upper.

4.2.8 Measurement and Coordinate Systems

The project team will use the **metric** measurement system, to specify length, area, volume, mass, temperature, electricity and time.

Survey coordinate systems will be extracted by the Lead Consultant, with support from the BIM Manager, from the survey. Drawing and gridlines will be aligned accordingly. All disciplines are requested to use coordinates, gridlines and levels agreed and included in the architectural model.

The architectural finish levels, structural levels and building services elevations for each major building model shall be shown in metres (m) to **three decimal places** in reference to **Hong Kong Principal Datum (mPD)**.

4.2.9 Revision Tracking

Revisions of the models are tracked automatically through the CDE.

All deliverables shall have the revision number (00, 01, 02 and etc.) at the end of the document number. For example:

01234A-AAA-ABC-REP-0001-XXX-XXX-WS2-**00**

4.2.10 Other Modelling Guidance

The following Revit specific sections are included in Appendix D "Modelling Guidance" for further reference:

- Copy Monitoring for Coordination Review
- Design Options
- Setup File

4.2.11 Data Exchange Protocols

As the regular exchange of BIM data is an essential part of a successful BIM project, the project data exchange protocol will be developed to include:

- Method of data exchange (CDE)
- Use of Work in Progress (WIP) data
- Agreed format of exchanged model data
- Model naming convention
- Distribution protocols and users lists (see Asite Project Protocols PIMS)
- User privileges for CDE / Asite folder structure (see Asite Project Protocols PIMS)
- Stakeholders responsible for information upload

The following table documents proposed information exchanges and file transfers that will / may occur on the project. A schedule showing frequency of distribution will be developed by the BIM manager in consultation with the project team.

BIM Use	User	Model Software	Native File Type	Exchange File Type
Design Authoring	ARC/ STR/ CIV/ BSE/ FAC	Revit	.rvt	.ifc/.rvt
Spatial Planning	ARC	Revit	.rvt	.xls/.ifc
3D Design Review (formal and informal)	All	Navisworks Freedom Acrobat Reader Revit Viewer*	-	dwfx, dwf, pdf, ifc, dwg, nwd, nwc, nwf
Visualisation	ARC	-	-	.png / .pdf / .jpg
3D Coordination	BIM	Revit Navisworks Manage	.rvt .nwd	.nwd .nwc .ifc .dwfx
Construction Simulation (4D)	BIM/ CON	Navisworks	.nwd	.nwd .avi/.mp4/.wmv
2D Schedules and Submissions	All	-	-	pdf, dwf, dwfx, ifc, dwg, nwc, nwd, nwf

4.3 2D Graphical Outputs

As 2D graphical outputs (e.g. drawings, schedules) will also be required as an output of the BIMs, traditional drawing conventions will still apply. For details, refer to **CSWP CAD Standards Manual**.

Unless otherwise agreed with the -- / BIM Auditor, DWG files exported from Revit or other object-based BIM authoring software shall comply with the CSWP CAD Standards Section 5.1. It is a minimum to ensure CAD drawings exported from the BIM model shall **comply to a minimum of grouping the generic elements under the first number in each main class**, e.g. 210_ can be used for all external wall elements and 240_ can be used for all types of stairs. Please refer to section 5.3 Element Coding Table of the CSWP CAD Standards.

4.4 Modelling Units

The common modelling system of measurement will be **Metric**. Models will use consistent units across the project and project units will be **millimetres** of integer to achieve sufficient levels of accuracy.

Other BIM uses may require a higher level of accuracy (e.g. fabrication) in which case consideration should be given to increased accuracy and noted in this document, but not to the extent of compromising efficient design modelling.

Sheet dimensions shall not be overwritten – e.g. 2998mm should not be manually adjusted to read 3000mm. The model should be corrected to reflect the correct dimension.

2D input and output files will conform to the unit and measurement protocols designated for specific drawing types, for example:

1 unit = 1 millimetre	Site layout drawings relating to the project coordinate system. Elements, details, sections, elevations and building structure outlines to an accuracy of 0 decimal places

2D CAD data and 3D geometry from other authoring software will be scaled to the appropriate units prior to linking into the BIM environment.

4.5 Area Calculation Methodology

The method and standards for accommodation schedules and area calculations will be established between the designers, cost consultant and -- prior to model creation. This data will be derived directly from the design models to assist rapid design development appraisal.

The General Conditions, Scope of Services Schedule 1 – "Definitions and Abbreviations" defined the area measurements required as follows:

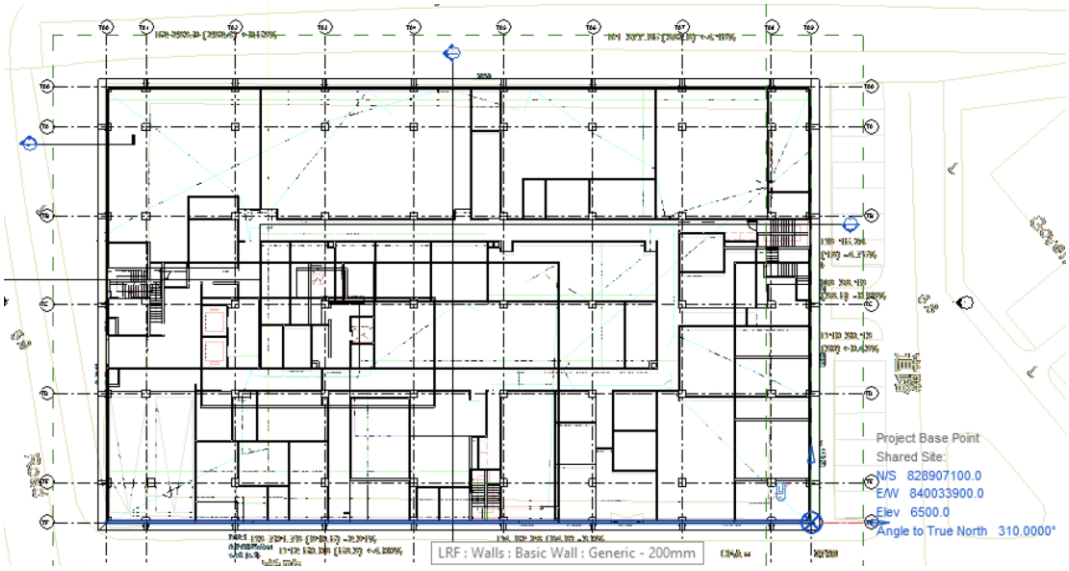
- Net Operable Floor Area (NOFA) – The NOFA of a building is the total area of all functional rooms and spaces within the building.
- Gross Floor Area (GFA) – In broad terms, the GFA of a building is the area contained within the outer surface of external walls of a building. For details, refer to Regulations 23(3)(a) and (b) of the Building (Planning) Regulations, CAP123F of the Laws of Hong Kong SAR.
- Construction Floor Area (CFA) – The CFA measured from drawings can be defined by "as-covered" floor areas that fulfil the functional requirements of the building measured to the outside face of the external walls or external perimeter. It includes floor areas occupied by partitions, columns, stairwells, lift shafts, plant rooms, water tanks, balconies, utilities platforms, vertical ducts, service floors higher than 2.2m and the like, but excludes bay windows, planters projected from the building, and the areas covered by canopies, roof eaves and awnings.
  Sloping surfaces such as staircases, escalators and carpark ramps are to measure as flat area on plan.

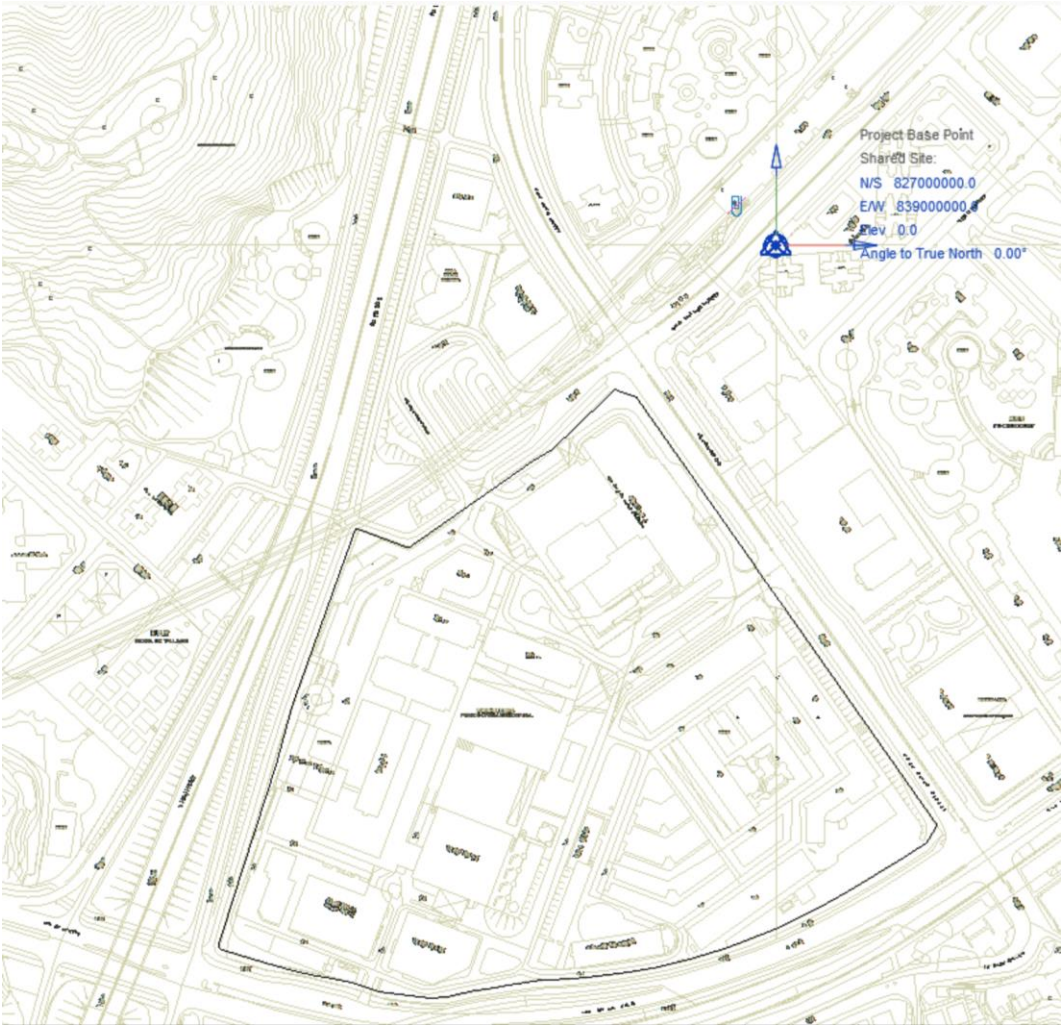
4.6 Shared Datum and Coordinates

The Lead Consultant is required and has established a known location (project / survey point) and defined this correctly in their Revit model. They should then share the coordinates and datum with all design consultants who should publish this into their Revit models.

Following this, the relative location of all models should be checked by the design team continuously throughout the design process to ensure that there are no conflicting project coordinates or inaccurately placed models or building elements.

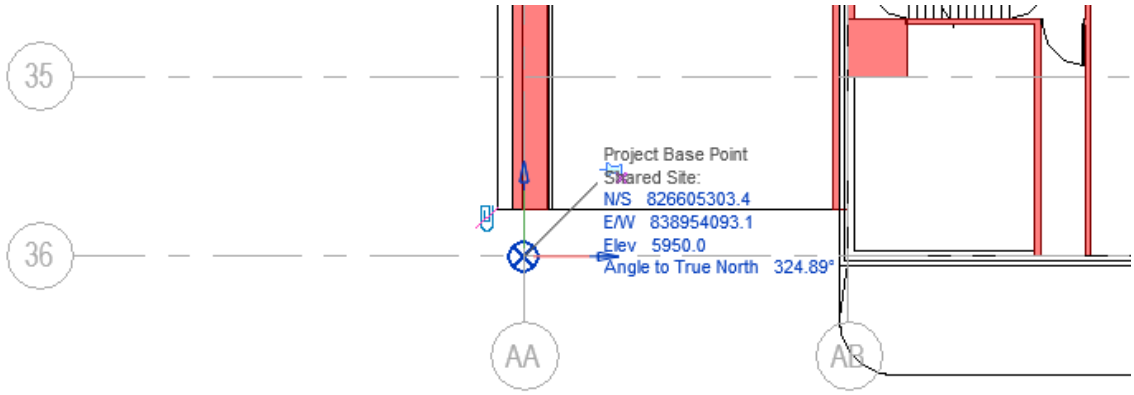
In order to increase overall precision and have better control of the modelling environment, a closer Project Base Point to -- site are adopted as below. The various "linked files" to the model can use the "By Shared Coordinates" option to be accurately placed at the correct location.


Project Base Point
Shared Site:
N/S 828907100.0
E/W 840033900.0
Elev 6500.0
Angle to True North 310.0000°
LRF : Walls : Basic Wall : Generic - 200mm

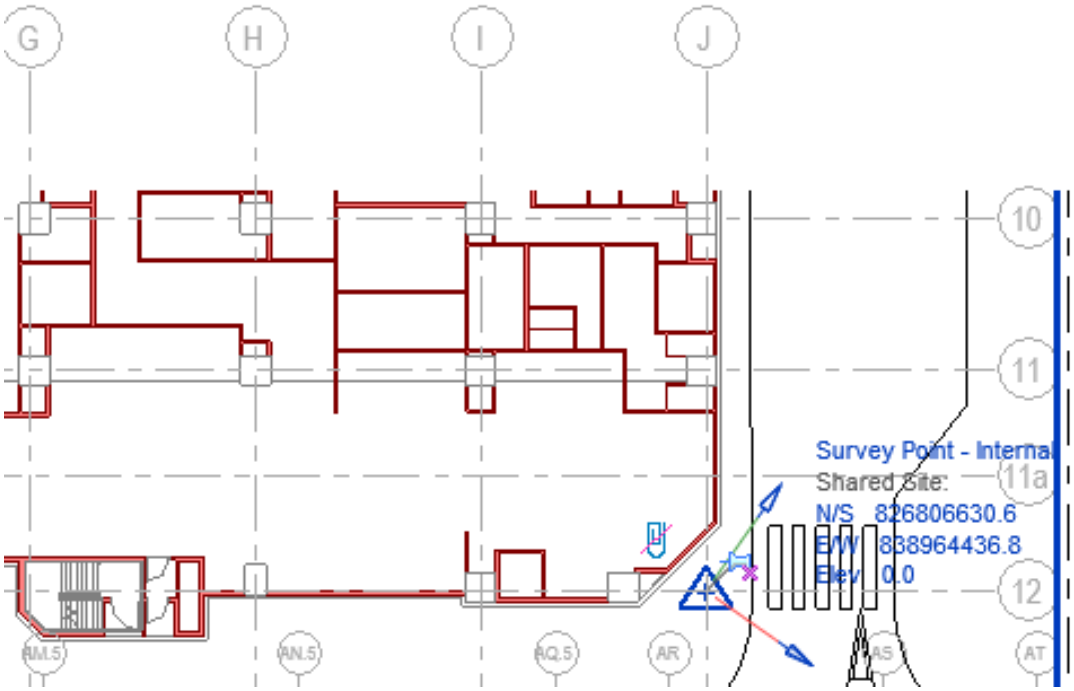

Project Base Point
Shared Site:
N/S 827000000.0
E/W 839000000.0
Elev 0.0
Angle to True North 0.00°

In Patient Block (IPB)

Project Base Point: N/S:826605303.4, E/W:838954093.1, Elev:5950.0, A2TN: 324.89°

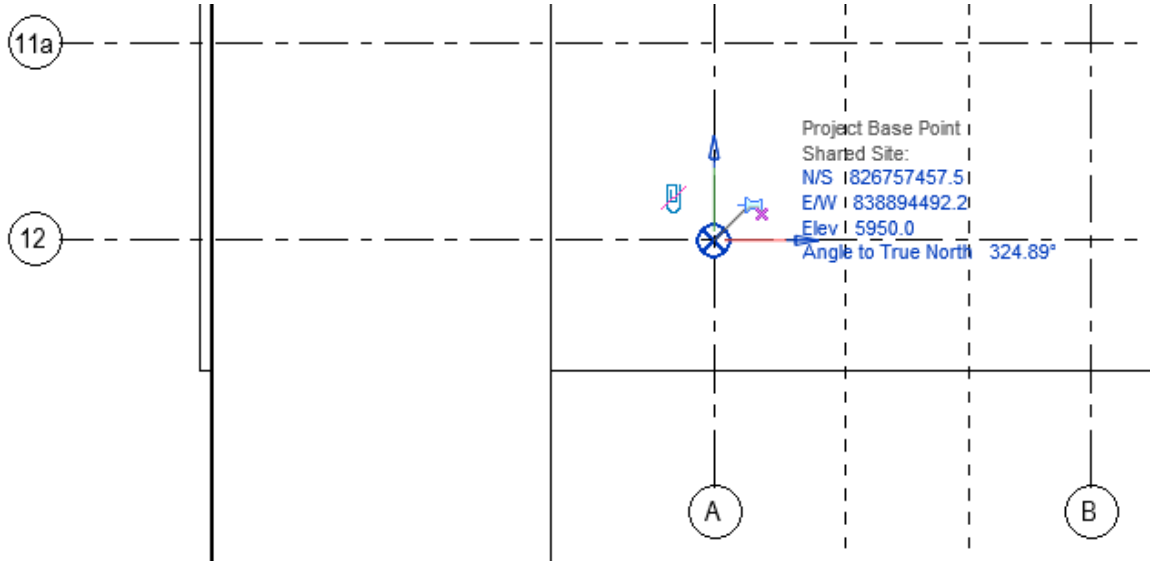


Survey Point: N/S:826806630.6, E/W:838964436.8, Elev:0.000

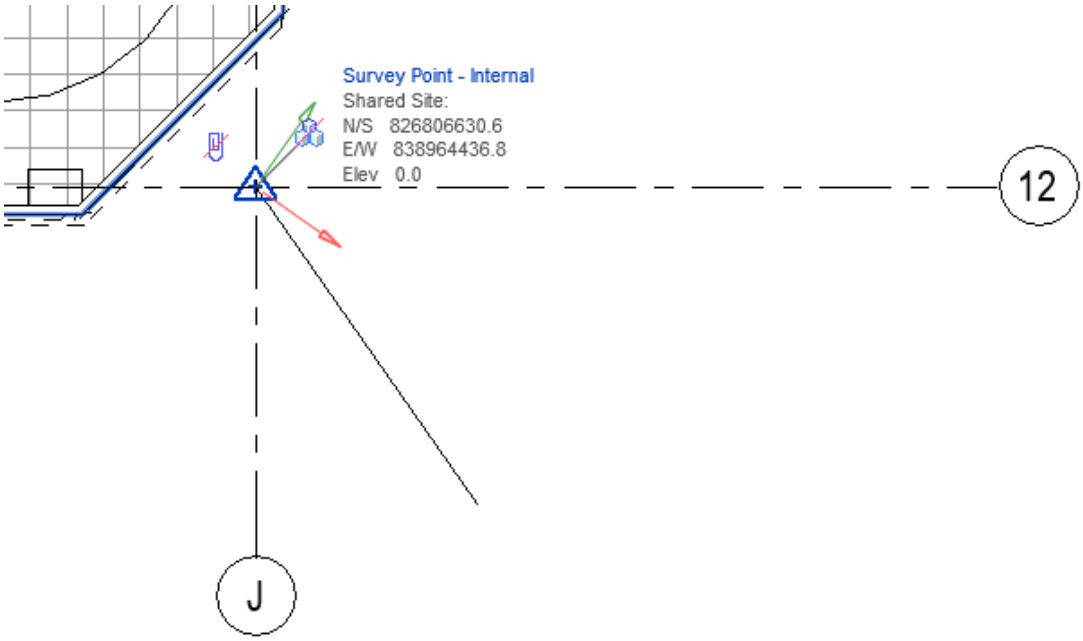


Main Clinical Block (MCB)

Project Base Point: N/S:826757457.5, E/W:838894492.2, Elev:5950.0, A2TN: 324.89°



Survey Point: N/S:826806630.6, E/W:838964436.8, Elev:0.000



4.7 Model / Data Validation Protocols

All members of the team should have in-place suitable internal quality procedures for validating model data during prior to issue and upon receipt. Rigorous quality

control should be applied throughout the process and both visual and automated checks should be carried out possibly using tools, such as Navisworks where appropriate.

In addition, each organisation should record that these procedures are being followed throughout the life of the project. Use of a CDE / Asite can streamline this process for both formal submission and work in progress exchange. At all times the Asite CDE should contain the latest project information with an attribute set for its purpose and authorised/allowable use.

4.7.1 General Good Practices

Below summarise other good practices when authoring and managing models:

- Design consultants may be required to include 2D information as part of a model using masking regions and intelligent 2D detailed components. The model (and associated coordinated models) should always be checked against the hard copy / DWFx / PDF/ DWG issue of drawings and associated specifications, which is for all purposes the reference copy and / or the controlled electronic copy. For internal coordination during design stages (i.e. WS2 and WS3), if an inconsistency is identified between the issued 2D drawings and the 3D model information, it should be noted that the 3D information will take precedence over the 2D information. 2D information are to be updated to rectify such discrepancies. However, during the tender documentation stage (i.e. WS4), 2D drawings should take precedence over the 3D model information, 3D model shall be updated to rectify all discrepancies found, if any.
- Outstanding software warnings will be reviewed regularly and important issues resolved as they arise.
- Design development to 3D models and data should not be undertaken as 2D patches or unlinked manual data entry, in order to maintain the integrity of models. Any offline design development should always be reflected back in the production 3D models.
- Any significant offline 2D uncoordinated production drawing (as opposed to design development tools) should be recorded in a BIM risk register by each design discipline and formally reviewed.
- Modelled objects and data will be segregated into manageable sized elements. This can take many forms and will be dictated by the specific needs of the project. Subject to further discussion with the design team, this subdivision will take account of:
    - The number of models required for each discipline
    - The subdivision of key worksets within each model
    - Details of any linked models within each sub model
    - Details of any model link types, e.g. overlay
- Prior to uploading models to the CDE system, files must be purged and audited by respective team members. In addition, any external links or objects not

directly associated with design information are to be removed. If linked files are needed, then they should be named correctly and uploaded alongside the models.

- Email notification to all parties for any update in the CDE system or FTP website.
- Users should deploy the zoom extents or zoom all command in the 3D viewpoint of the model, prior to closure and delete obsolete elements located at a significant distance (1km or more) from the project extents.
- All users are required to close models in a 2D drafting view. This will enable the model to be reopened more efficiently. Models created must always be aligned with setup coordinates specified by the architectural team. Discipline BIM coordinators are encouraged to include a sheet or view that provides a useful summary to the model structure and close the model in that view.
- For large projects carefully consider model breakup. It is advisable to consider the following:
    - Level of Detail and BIM Uses: highly detailed models will need to be split in to multiple models.
    - Model Size: file size above 250Mb is considered a heavy model, the maximum usable size is 400Mb. If the Central File will grow larger than this, consider splitting the model.
    - Common ways to break up models are: individual buildings in the development, along expansion joints within a single large building, vertical transitions (eg. podium to tower), or by delivery packages (core and shell, interiors, FFE).

4.7.2 Quality Control Checks

The following checks should be performed by each discipline before issue:

Checks	Definition	Responsible	Software	Frequency
Visual check	Ensure there are no unintended model components and the design intent has been followed.	Discipline BIM Coordinator	Revit	Weekly or before WIP exchange and end of each workstage
Interference check, Clash detection	Detect problems in the model where two building components are clashing including soft and hard.	Discipline BIM Coordinator	Revit / Navisworks	Weekly or before WIP exchange and end of each workstage
Standards check	Ensure that the project BIM standards have been followed (e.g. fonts, dimensions, line styles, levels, file and object naming, classification, room numbering.	Discipline BIM Coordinator	Revit	Weekly or before WIP exchange and end of each workstage
Model data check	Process used to ensure that the project data set	Discipline BIM Coordinator	Revit	Weekly or before WIP exchange and

Checks	Definition	Responsible	Software	Frequency
	has no undefined, incorrectly defined or duplicated elements and the reporting process on non-compliant elements and corrective action plans.			end of each workstage
Model Audit	See Appendix G "Model Audit Guidelines"	BIM Auditor & BIM Manager	Revit / Navisworks	Bi-weekly

4.8 Engineering Analysis

In order to ensure the consistency throughout the project, engineering analysis such as Environment, structural, sustainability and other engineering analysis conducted will be derived / extracted using information from the design models where appropriate. Due to current technical limitations and interoperability issues, specific computational and graphical modelling may take place in relevant software applications to facilitate production of engineering analysis.

4.9 Title Block and Key Plans

Logos on title blocks should be vectorial and native in the software product, not linked bitmap files to ensure that the logos stay embedded in the sheets on export to other vectorial file formats such as DWG, DWF or DWFx.

Key plans and location plans should be kept as simple as possible to keep file sizes down and aid legibility.

5 Formal Clash Analysis

Formal clash analysis reports are a key deliverable by the BIM Manager at the end of each Workstage.

It is required for -- to be conducted using an integrated BIM approach rather than third-party modelling / retrospective BIM approach to limit the number of clashes identified in these reports due to regular exchanges of work in progress models facilitating designing out clashes earlier in the design process.

Federated WIP models should be used regularly by the design team to coordinate their work with other disciplines to avoid clashes occurring.

5.1 Clash Analysis and Reporting

The BIM Manager shall conduct clash detection prior to bi-weekly (or separately agreed) VDR meetings where clashes detected shall be addressed with the design team.

Protocols for reporting and resolving clashes found during WIP exchange are distribution in the format of HTML file and exchanged between design team

members. Design consultants are required to review these comments, assess the significance of the issues reported and update or amend their BIMs accordingly.

WIP clash detection reports will not be formally produced. Format and protocols for reporting and resolving formal clash detection routines are integrated into the normal coordination activities of the design consultants.

Within two weeks after a milestone submission, the BIM Manager shall conduct a formal clash detection of the submitted BIMs and issue a Clash Detection Report (PDF) together with the NWD and NWF files for the BIM Auditor's review.

5.2 Clash Checking Matrix

Clash Detection will be run with using Autodesk Navisworks Manage (or agreed equivalent) software throughout with a concentration on resolving clashes prior to submission of the models. Clash Detection tests (demarcated as Test #1 (T01) and etc.) will be generated for all critical elements of the Architectural, Structural, MEP and Civil design as well as key inter-discipline clashes.

Tests	ARC	STR	HVAC	EL	PL	DR	FS
ARC	-	T01	T02	T03	T04	T05	T06
STR	-	-	T07	T08	T09	T10	T11
HVAC	-	-	-	T12	T13	T14	T15
EL	-	-	-	-	T16	T17	T18
PL	-	-	-	-	-	T19	T20
DR	-	-	-	-	-	-	T21
FS	-	-	-	-	-	-	-

Specific colours should be used to identify disciplines, where appropriate, when federating models for clash analysis. The recommended colours of each discipline are defined as below. Where further subdivision is required, colours shall be recorded here.

Elements	Color	RGB
Architectural elements	White	255-255-255
Structural elements	Grey	128-128-128
Road elements	Dark salmon	233-150-122
Mechanical / HVAC elements	Green	0-255-0
Electrical elements	Light brown	210-160-0
Fire protection elements	Red	255-0-0
Drainage elements	Blue	0-0-255
Plumbing elements	Cyan	0-255-255
Gas elements	Magenta	255-0-255
ELV / Security Systems	Orange	255-128-64
Telecommunication	Light Purple	230-205-255
ICT elements	Purple	128-0-255
Existing elements	Light grey	192-192-192
(Underground Utilities)		
Power supply	Dark yellow	204-204-0
Street Lighting	Rosy brown	188-143-143
Automatic Traffic Control	Saddle brown	139-69-19
Gas Main	Magenta	255-0-255
ELV / Security Systems	Orange	255-128-64
Telecommunication	Light Purple	230-205-255
ICT elements	Purple	128-0-255
Fire Services / Street Hydrant	Red	255-0-0
Water Cooling Main / DCS	Deep skyblue	0-191-255
Fresh Water Main	Cyan	0-255-255
Salt Water Main	Aquamarine	127-255-212
Sewerage drainage	Blue	0-0-255
Storm drainage	Dark blue	0-0-139
Existing elements	Light grey	192-192-192

5.3 Clash Tolerance

The following settings have been agreed when conducting clash analysis.

During Workstage 2 (Outline Proposals and Sketch Plan):

- Clash detection between MEP services and other disciplines will be run on a Hard (Conservative) setting with 50mm tolerance against Structural elements and 75mm against Architectural.
- The exception to this is MEP inter-discipline and ARC-to-STR clash detection will be run on a Hard (Conservative) setting with a tolerance of 100mm and 50mm respectively.

During Workstage 3 (Detail Design) and 4: (Documentation/ Tendering):

- Clash will be run on a Hard (Conservative) setting with 50mm tolerance against all disciplines and inter-discipline.
- The exception to this is ARC-to-STR clash detection which will be run on a Hard (Conservative) setting with a tolerance of 35mm.

It is a common misconception that a 3D model will be issued clash-free during design stage; in fact, due to technical limitations of the software packages, -- / BIM Auditor understands that the federated model may not be fully clash-free. There are three levels of clash severity defined for this project during pre-construction stage:

1. Major – Have major impact to the construction of structural elements or building services installation that leading to time and cost consequences;
2. Minor – Can be easily addressed in the next stage of the project / construction site; and

3. Erroneous issues – Refer to issues arising from light fittings in ceilings, switches or sockets in walls, insulation around pipes, as clashes.

Since not all clashes are problems, the design team will justify major clashes for which a solution should be provided. Major clash is defined as follows:

- Architectural and structural arrangements
- Lift volume (Lift core & Staircase)
- Structural elements versus MEP equipment and pipe ducts (>150mm in size)
- Clashes among MEP pipes and ducts >100mm in size
- Banks of MEP pipes <50mm in size clashing with structural elements / false ceiling
- Internal drainage pipes
- Internal risers
- Ventilation ducts openings through structure
- Openings greater than 300mm

The BIM Manager is responsible for reporting the identified clashes only. He/ She will initiate coordination meetings and make sure that the design team is well informed about the clashes. The clash report generated by the clash detection function will be shared with the design teams, and for them to sort out major clashes. When the solution is found and models are updated, the process will be reiterated until all major clashes are solved.

At the end of Workstage 2 and 3, the Consultant Team will submit a "Clash Detection Report". This report to be issued within two weeks after Workstage deliverables as per Section 5.1. Whereas in Workstage 4, the Consultant Team shall submit a clash-resolved BIM model, 2D drawings and Clash Detection Report, based on the frozen design at least one month before the scheduled deadline of tender drawings submission to ArchSD's vetting. Any clashes in the model should be properly identified and resolved prior to the issuance for QTO by the PQS.

5.4 Asynchronous Design Iteration

A balance should be struck between using WIP models of the "same design iteration point" for clash analysis and models from the same point in time. As Structural and Building Services design tend to lag behind the Architectural design, if models from a single point in time are used and the Architectural design has continued then this results in more clashes.

During the progression of design, models may be from different design iterations, but at the end of Workstage 4 all models must align in the same design iteration.

6 BIM Project Exceptions

As the project is divided into various major works packages, the BIM process and requirements of each major works may differ and shall be clearly broken down and agreed.

6.1 -- Building (SDB)

To achieve BIM objectives in this PXP within limited timeframe, parts of the scope of BIM use are exempted and made agreeable among the project team. The actual scope of BIM use for each discipline in SDB are broken down as follow: -

1. Architectural BIM Use
    a. Architectural BIM model of the whole building is created, including site model with surrounding existing building massing model.
    b. Full set of GBP Submission drawings are produced from BIM model.
    c. Tender drawings are produced from BIM model, except for detail drawings with scale larger than 1:20, CAD drawing in DWG format is allowed as links in the BIM Project file.
2. Structural BIM Use
    a. Structural Model of the whole building, including the foundation.
    b. Submission Drawings produced from the BIM model is exempted. Structural consultant has successfully tested to produce drawings from the BIM model.
    c. Tendering Drawings produced from the BIM model are exempted.
3. MEP BIM Use
    a. MEP BIM models of public corridor areas, lift lobby areas and underground utilities are created for clash analysis.
    b. Submission drawings produced from BIM model are exempted.
    c. Tendering drawings produced from BIM model are exempted.

6.2 Block B A&A

To achieve BIM objectives state in this PXP within limited timeframe, part of the scope of BIM use is exempted and made agreeable by the project team. The actual scope of BIM use for each discipline in areas / rooms with A&A works are broken down as follow: -

4. Architectural BIM Use
    a. To have the full picture of Block B, Architectural BIM model of the whole building other than areas / rooms with A&A works are created based on recording drawings.
    b. There is no structural design input for the areas / rooms with A&A works, structural elements are created in the Architectural BIM model based on recording drawing for clash analysis.
    c. Submission Drawings produced from the BIM model are exempted.
    d. Tender Drawings are produced from the BIM model, except for interior plans with scale larger than 1:50 and Detail drawings with scale larger than 1:20, CAD drawings in DWG format are acceptable as links in the BIM Project file.

5. MEP BIM use
    a. MEP BIM model of ground floor, first floor and underground utilities are created. For Interfacing areas, MEP BIM model will be created to an extension to the satisfaction of the Architect.
    b. Submission drawings produced from the BIM model are exempted.
    c. Tender drawings produced from the BIM model are exempted.

7 Project Resources and IT Requirements

7.1 Project Team BIM Software Expertise

The project team's BIM software skills and experience should correspond to the required BIM uses and objectives stated in Section 3. Should there be a disparity between the required BIM deliverables and these skills, agreement must be reached on the appropriate course of action. Options could include:

6. The project team undergo skills training at their own expense to suit the project delivery programme.
7. The project team recruit the required skills at their own expense, to suit the project delivery programme.
8. The project team incorporate additional skills from external resources such as a BIM modelling consultant.

7.2 Common Data Environments (CDE)

The efficient exchange of data between all project participants is an important factor in execution of a successful BIM project.

7.2.1 Asite

It is understood that a CDE, Asite, has been setup for final formal submissions. The suitability of this CDE will be assessed for the design team’s use for work in progress and other BIM requirements. It is also important that relevant access restrictions are available.

Project team members will be responsible for the storage and maintenance of their own discipline specific information to support operational processes. This information on a secondary level must be made available to the wider project team, by uploading information to a CDE.

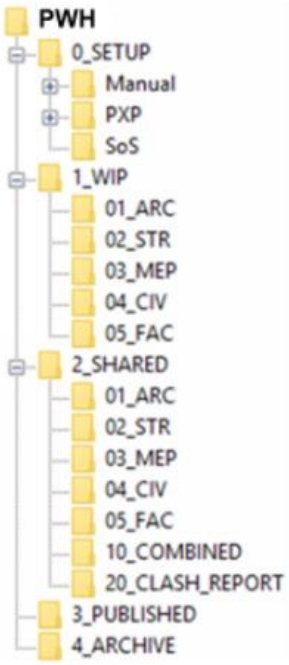
Information will be exchanged within project specific workspaces over CDE. Detail instructions refer to Asite Project Protocols (PIMS) and the overall project quality plan.

When uploading information to CDE, users must select the appropriate purpose of “issue status” in the document settings and follow the PIMS.

Changes to the naming and structure of folders on CDE must be explicitly agreed with all members of the project team. This must be authorised by the -- / BIM Auditor.

CDE user privileges will be allocated to all discipline BIM Coordinators to allow for efficient uploading and distribution of information. Any changes to these privileges must be agreed to and authorised by -- / BIM Auditor.

7.2.2 Work in Progress



WIP information refers to data which is in production and has not been checked or verified for official distribution outside the authoring team. Project team has agreed to include a "_WIP" suffix to the naming of WIP files as a differentiator. WIP Files should be exchanged in their native formats together with a PDF or DWF where appropriate.

The WIP upload frequency shall be weekly unless agreed otherwise by the BIM Auditor. Weekly uploads are from experience considered to be a good balance to achieve positive collaborative working without creating an abortive work caused by design fluidity.

The BIM Manager shall setup a FTP site for WIP files exchange among the design teams. Each team shall upload their model(s) to the corresponding "WIP" folder before the end of every Friday.

Published and issued information will be uploaded to CDE in line with the agreed project programme.

7.2.3 Information Sharing

Verified / approved design data is used to coordinate BIMs between disciplines, facilitating 3D coordination and the production / extraction of unified project data. This information should be checked and approved prior to distribution over CDE.

Each design team shall also save a copy of these files in the corresponding "Shared" folder on the FTP site for other teams to make reference to. Models should be issued as produced, containing all necessary linked and native design information.

Discipline BIM Coordinators are responsible for ensuring information is distributed in the correct location and correct format on CDE and the FTP site (or other cloud means).

7.3 Hardware / Technology Infrastructure Requirements

The project team will ensure the suitability of servers, workstations and network connectivity (both internal and external) to meet the minimum specifications of the adopted BIM tools and allow for software upgrades during the progress of the project.

Appropriate backup solutions must be in place to ensure data loss is kept to a minimum in the event of catastrophic failure or data corruption.

Workstation capability reviews and their effect on model performance has been made part of the standard agenda in the BIM Coordination meetings.

7.4 Software

The following software choices have been established to deliver the prioritised BIM objectives. Any software version changes and updates must be explicitly agreed by design team, contractor (post tender) and the BIM Manager before implementation.

BIM Use	User	Software	Version[2]
Design Authoring	ARC/CIV/BSE/CON/FAC /STR	Revit	2018
Spatial Planning	ARC	Revit	2018
Libraries of assemblies / systems / components	ARC/CIV/BSE/CON/FAC /STR	Revit	2018
Building Environmental analysis	BSE	IES[1] / TAS[1] / Amtech[1] / DIAlux[1] / RElux[1] / HEVACOMP[1]	As required
Engineering Analysis	STR	ETABS[1] / GSA[1] / SAP2000[1]	As required
3D Coordination	ARC/CIV/BSE/CON/FAC /STR	Navisworks Manage	2018
Design Reviews	ARC/CIV/BSE/CON/FAC /STR/Client	Navisworks Freedom / Revit / Design Review	2018
Visualisation	ARC	3DS Max / Photoshop	2015 CC

[1] Optional, other equivalent software

[2] Refer to Section 6.6 for Software Version Upgrades

7.5 Project Specific BIM Content

Project specific BIM content is created and shared by the project team. This should be based on a standard using a pre-agreed dataset to accommodate design, construction and operational parameters. It is important to emphasise that early incorporation of parameters does not necessarily entail early population of values and the need to make additional design decisions upfront.

Any content library objects exchanged by the project team members whether authored by them or others are licensed only for use during the -- project or purposes related to the project.

7.6 Software Upgrades

Software version upgrades will inevitably be available during the project lifecycle and will potentially bring useful new tools to the project team. Each opportunity

(e.g. end of workstage) for upgrade will be evaluated by the BIM Manager and discipline BIM Coordinators. Project files should not be upgraded to new versions until the -- and BIM Auditor has agreed to the upgrade and explicit instruction given. The BIM Manager will coordinate an orderly upgrade process once this decision has been made.

Appendix A – MLD Matrix

BIM is the process of generating and managing an integrated digital model of a building / infrastructure components and systems throughout its lifecycle. A BIM model by nature can contain all aspects of information in it. It is time unnecessary and time-consuming to produce highly detailed models in early stage when the design is still subject to change and the actual site condition and equipment size is based on assumption. Therefore, it is critical to set out clear objectives in the use of BIM in various stages in the whole construction lifecycle so that the production of BIM models is most effective and efficient.

The LOD specification of this project shall follow HK CIC BIM Standards, American Institute of Architects (AIA) Document E203-2013 and UK BIMForum 2017 as the reference of defining a staged LOD guide for the production and classification of Building Information Models. In case of discrepancies between the standards, Section 4.2 shall be referred to the descending order of precedence. The LOD stages are defined as 100 to 500 and are intended for application to the content within the model rather than the overall model itself. The development of individual objects within the model will vary between different disciplines and different systems at any given stage of the project.

The MLD Matrix in the table below identifies the required LOD of BIMs from Workstage 1 - 4 by the responsible parties (ARC, STR, BSE, CIV and FAC). Design elements are tabulated based upon the HK CICBIMS.

LOD of BIMs at Workstage 5 and 6 will be recorded in the PXP once defined.

Graphical data – The graphical level of development of models is not required beyond LOD 350 at the end of Workstage 4.

Non-graphical data –The design team will be responsible for population of data values relating to design performance (e.g. fire resistance, acoustics, specification reference). The Contractor will be responsible for the population of values relating to product properties, operation, maintenance and installation (e.g. barcode, installation date, service life duration).

Key references adopted for LOD definition are listed below (see Appendix C):

- Hong Kong Construction Industry Council – Building Information Modelling Standards (Phase One). Section 3.0 “Level of Development”
- AIA Document E203-2013 – Building Information Modelling and Digital Data Exhibit
- UK BIMForum 2017

Model Element / System	SD	DD
a) Architecture Model (ARC)		
1. Massing model of adjacent areas or surrounding buildings	200	300
2. Room space, corridor, plant & equipment room	200	300
3. Elevator shaft space	200	300
4. Floor, slab, ramp, roof	200	N/A
5. Basic structural columns and walls	200	N/A
6. Basic structural beams and framing	200	N/A
7. Exterior wall	200	300
8. Interior wall / partition / non-structural wall	200	300
9. Curtain wall, including shading devices	200	300
10. Precast façade	200	300
11. Smoke curtain or barrier	200	300
12. Fire shutter and hood / enclosure	200	200
13. Exit sign	200	300
14. Door	200	300
15. Window	200	300
16. Louver	200	300
17. Skylight	200	300
18. Celling	200	300
19. Escalator	200	300
20. Moving walkway	200	300
21. Stairs, Steps	200	300
22. Railing, balustrade, handrail1	200	300
23. Access ladder and catwalk	200	300
24. Toilet fixture	200	300
25. Sink, washbasin	200	300
26. Tap, Faucet	200	300
27. Building maintenance unit	200	300

1All back of house stair railings and disable ramp railings will be indicative only.

Model Element / System	SD	DD
b) Structure Model (STR)		
1. Foundations (piles, pile caps, tie/ground beams, footings)	200	300
2. Diaphragm wall, retaining wall	200	300
3. Excavation & lateral stability system	200	300

Model Element / System	SD	DD
4. Beam	200	300
5. Column, post, hanger	200	300
6. Wall	200	300
7. Slab, floor, ramp, roof	200	300
8. Transfer structure (transfer plate, truss)	200	300
9. Stairs (steps, risers, threads, landings)	N/A	300
10. Bracing	200	300
11. Temporary works, temporary structures, platforms	200	300
12. Tunnel Structure (tunnel box, subway, utilities tunnel)	200	300

1Note of the "Display" column in Building Service Model definition:

"3D" means the information will be modelled in 3D and may be supplement with 2D illustration; "2D" means the information will be drafted in 2D with using Revit Detail Component.

Model Element / System	SD		DD	
	Display	LOD	Display	LOD
c) Building Service Model (BSE)				
Mechanical Ventilation & Air Conditioning Model				
1. Ductwork (1^{st} fix elements for LOD200 and 2^{nd} fix for LOD300)	-		-	
Supply air duct	3D	200	3D	300
Fresh air duct	3D	200	3D	300
Exhausted (extract) air duct	3D	200	3D	300
Return air duct	3D	200	3D	300
Transfer air duct	3D	200	3D	300
2. Fan	3D	200	3D	300
3. Diffuser, air-boot, air grill, air filter, register	N/A		3D	300
4. Damper	N/A		2D	200
5. Fan coil unit	2D	200	3D	300
6. Air Handling unit	3D	200	3D	300
7. Chiller Plant unit	3D	200	3D	300
8. Variable refrigerant volume unit	2D	200	3D	300
9. Cooling Tower	3D	200	3D	300
10. Split-type indoor & outdoor air conditioning unit	2D	200	3D	300
11. Chilled water supply pipe (1^{st} fix elements for LOD200 and 2^{nd} fix for LOD300)	3D	200	3D	300

Model Element / System	SD		DD	
	Display	LOD	Display	LOD
12. Chilled water return pipe (1st fix elements for LOD200 and 2nd fix for LOD300)	3D	200	3D	300
13. Condensate drain pipe (no fall in SD) (1st fix elements for LOD200 and 2nd fix for LOD300)	3D	200	3D	300
Electrical Model				
14. Cable tray, trunking, busduct, busbar, busway	3D	200	3D	300
15. Generator or Emergency generator	3D	200	3D	300
16. Generator exhaust flue incl. acoustic treatment	3D	200	3D	300
17. Diesel tank	3D	200	3D	300
18. Electric Meter	N/A		2D	200
19. Switch board and MCC	3D	200	3D	300
20. Distribution boards	N/A		3D	300
21. Outlet, wall switch, circuiting to device, and "plug mould" (socket point)	N/A		2D	200
22. Light fitting	N/A		3D	300
23. Power point	N/A		2D	200
Plumbing & Water Supply Model				
24. Water pipe (1st fix elements for LOD200 and 2nd fix for LOD300)	3D	200	3D	300
25. Valve (≤50mm)	2D	200	2D	200
26. Valve (>50mm)	2D	200	3D	300
27. Water storage tank	3D	200	3D	300
28. Pressure vessel	3D	200	3D	300
29. Water Meter	2D	200	2D	200
30. Pump	3D	200	3D	300
31. Calorifer	3D	200	3D	300
32. Boiler	3D	200	3D	300
33. Water storage heater	3D	200	3D	300
Drainage & Sewage Model				
34. Rainwater, storm water pipe, storm drain (no fall in SD) (1st fix elements for LOD200 and 2nd fix for LOD300)	2D	200	3D	300
35. Surface channel, slot channel, external drainage	2D	200	3D	300
36. Sewerage pipe, foul sewer drain (no fall in SD) (1st fix elements for LOD200 and 2nd fix for LOD300)	2D	200	3D	300
37. Sump or sewerage pit	2D	200	3D	300
38. Pump	3D	200	3D	300
39. Grease Trap	2D	200	3D	300

Model Element / System	SD		DD	
	Display	LOD	Display	LOD
40. Sand Trap	2D	200	3D	300
41. Kitchen waste pipe work, incl. floor drain, open trapped gully, sealed trapped gully, clean outs and vent (1^{st} fix elements for LOD200 and 2^{nd} fix for LOD300)	3D	200	3D	300
42. Manhole, Terminal manhole	2D	200	3D	300
Fire Services Model				
43. Automatic actuating device	2D	200	2D	200
44. Fire alarm equipment, including gongs & break glass unit	N/A		2D	200
45. Fire detection equipment, including heat or smoke detectors	N/A		2D	200
46. Fire hydrant / hose reel	2D	200	2D	200
47. Portable hand-operated approved appliance, fire extinguisher	2D	200	2D	200
48. Sprinkler pipe work (diameter ≥ 50mm) (1^{st} fix elements for LOD200 and 2^{nd} fix for LOD300)	3D	200	3D	300
49. Sprinkler head	N/A		2D	200
50. Sprinkler valve & flow switch	2D	200	2D	200
51. Sprinkler supply tank	3D	200	3D	300
52. Sprinkler pump	3D	200	3D	300
Specialist Systems Model – Communication & Security				
53. Audio / Visual advisory equipment	N/A		2D	200
54. Closed circuit television (CCTV)	2D	200	2D	200
55. BMS / BRI / radio equipment	N/A		2D	200
56. Cable trays / trunkings / fibre guide for ELV systems including ICT system (1^{st} fix elements for LOD200 and 2^{nd} fix for LOD300)	3D	300	3D	300
57. Telecommunication equipment	N/A		2D	200
58. ELV equipment rack	3D	200	3D	300
59. Access control equipment	2D	200	2D	200
60. Car park control system, equipment	N/A		2D	200
d) Underground Utilities Model (CIV)				
1. Topography (existing site and surrounding land use)	200		200	
2. Topography (Site Formation)	200		200	
3. Connection point, manhole, inspection pit	200		200	
4. Electrical supply cable, trench, power distribution system	200		200	
5. Gas supply main, piping, valve	200		200	
6. Water supply main, control valve	200		200	
7. Underground Telecommunication system	200		200	

Model Element / System	SD		DD	
	Display	LOD	Display	LOD
8. Rainwater, storm water pipe, storm drain	200		200	
9. Sewerage pipe, foul sewer drain	200		200	
10. Sump or sewage pit	200		200	
11. Manhole, Terminal manhole	200		200	
12. External drainage	200		200	
13. Nullah	200		200	
14. Box culvert	200		200	
Pneumatic Tube Transportation System				
Tube	3D	200	3D	300
PTS station	3D	200	3D	300
Medical and Non-medical Gases				
Equipment	3D	200	3D	300
Pipes	3D	200	3D	300
Area emergency shut off valves	3D	200	3D	300
Town Gas				
Pipes	3D	200	3D	300
Valves	3D	200	3D	300

Appendix B – List of Terms and Abbreviations

Term / Abbreviation	Definition
AIA	American Institute of Architects
Assembly	A collection of components and / or modelled elements arranged to define part or all of a building model such as groups or sub models. An assembly typically contains information that can be referenced without repositioning.
PXP	Project BIM Execution Plan (this document)
BIM	Building Information Modelling. The creation and use of coordinated, internally consistent, computable information about a project in design and construction.
BIM Coordinator	Refer to Section 2.3 of this PXP
BIM Manager	Refer to Section 2.3 of this PXP
BuildingSMART	International alliance promoting BIM and the use of IFCs.
CAFM	Computer Aided Facilities Management.
CDE	Common Data Environment. A single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multidisciplinary teams. Note: A CDE may use a project server, an extranet (eg Common Data Environment, 4Projects, Autodesk 360, Asite), a file based retrieval system or other suitable toolset.
COBie	Construction Operations Building Information Exchange. COBie is a data standard that was developed by the US Corps of Engineering to manage the data coming from BIM models into the client organisation, particularly for the handover of operation and maintenance information. UK Government have extended this process on government projects to four data drops during the delivery stage of the project to manage cost and carbon. The data is exchanged using spreadsheets to keep the complexity of systems and training to a minimum. More information http://www.bimtaskgroup.org/cobie-uk-2012/
Component	An individual element which can be reused in a number of situations. Examples include doors, stair cores, furniture, façade panels, columns, walls etc. Components are typically inserted and moved / rotated into required position.
Container model	An optional repository which can be used to compile assemblies and components for specific purposes including export and publication. A container can exist for each individual profession/discipline or for multiple disciplines, for buildings or for a complete project.
IFC	Industry Foundation Class. Standards for project data models developed by BuildingSMART.
IFD	International Framework for Dictionaries. A means of allowing BIM software applications to 'talk to' 'object'/ product databases.
IDM	Information Delivery Manual, the BuildingSMART standard covering processes in BIM, specifying when different types of information are needed.
IPD	Integrated Project Delivery, where design and construction teams work as an integrated virtual organisation and use BIM to deliver the project.
LOD	Level of Development. Describes the level of completeness to which a model element is developed, both graphical and non-graphical data.
Metadata	Data used for the description and management of documents and other containers of information such as BIM objects.
MLD	Model Level of Development. The LOD of a model as a whole related to Workstage, responsibility and intended use.

Navisworks	Autodesk's software that is used to review BIMs for coordination and to plan and simulate project delivery.
NRM	New Rules of Measurement, published by RICS. January 2013 edition.
Objects	Also Object-Oriented (OO) technology. Objects are fundamental to BIM. They are typically digital representations of a building's physical components - e.g. windows, structural beams, and even spaces - that are defined in terms of attributes (geometry, material composition, specification, cost, etc.) so that they can be manipulated digitally within a project model.
Object libraries	Also called product libraries, these are digital collections of groups or families of objects that are available to designers and others working in a BIM environment.
Published	Published information refers to documents and other data generated from shared information. Typically, this will include exported data, contract drawings, reports and specifications. Reference BS1192:2007.
Revit	Autodesk's software that is used to design construction projects using BIM. It has subversions that are optimised for use by each consulting discipline.
Schema	A representation of a plan or theory in the form of an outline or model.
Shared	Information which has been checked and approved and is made available across the project team such as information for data exchange between BIM software, like gbXML, CIS/2 and IFC files. Reference BS1192:2007.
Solibri	Solibri software is used to validate coordinated models.
Uniclass	Unified Classification for the Construction Industry. Published by the Construction Project Information Committee (CPIC) this is a UK standard for classification of construction information.
Views / Output file	A generated rendition of graphical or non-graphical information (a plan, section, elevation, schedule, or other view of a project).
WIP	Work in Progress. Each individual company or discipline's own work in a state of development. This information has not been approved or verified fit to share across the project team. Reference BS1192:2007.
2D/3D	Modelling in two or three geometric dimensions.
3DS Max	Autodesk's software that is used to produce visualisations from BIMs.
4D	Modelling to include construction programme simulation.
5D	Modelling to include cost data and construction programme simulation.
6D	BIM enabled asset management.
nD	Modelling to include a variety of data and simulations, covering, for example, time / programme, cost, carbon impact, energy use, etc. ('n' represents the number of these dimensions).

Appendix C – References

This PXP is based of various published international and local BIM standards and guides. These documents are being widely adopted and adapted throughout the construction industry to encourage wider BIM adoption.

The key reference documents are:

- Hong Kong Construction Industry Council – *Building Information Modelling Standards (Phase One)*

  Download from:
  http://www.cic.hk/cic_data/pdf/about_cic/news_and_update/BIM/Eng/CIC%20BIM%20Standards_FINAL_ENG_v1.pdf

  BS 1192-1:2007 – *Collaborative production of architectural, engineering and construction information – Code of practice*

  Download from:
  https://shop.bsigroup.com/forms/PASs/BS-1192-2007/

- PAS 1192-2:2013 – *Building Information Management – Information requirements for the capital delivery phase of construction projects*

  Download from:
  https://shop.bsigroup.com/en/Navigate-by/PAS/PAS-1192-22013/

- AIA Document E202-2013 – *Building Information Modelling Protocol Exhibit*

  Download from:
  http://www.aia.org/contractdocs/training/bim/aias078742

- BIM Forum – *Level of Development Specification*

  Download from:
  http://bimforum.org/LoD

Appendix D – Modelling Guidance (Revit Specific)

D1 Linking Models

Link models when individual buildings on a campus or different parts of a large building reside in separate project files, or when each discipline works in its own edition of a building model. Users can link models to more easily manage the individual parts or to improve performance when working on a large project.

When linking a model into a project, Revit opens the linked model and keeps it in memory. The more links a project contains, the longer it can take to open.

Linked models are listed in the Revit Links branch of the Project Browser.

D2 Copy Monitoring for Coordination Review

Copy monitoring can be used within the Revit environment to monitor changes made by other disciplines at each model release date. Users should be aware that this process relies on model authors maintaining building elements (i.e. moving a wall rather than deleting and replacing), and accurate modelling.

Categories available to copy monitor include: Levels, Grids, Columns, Walls and Floors.

When using the copy monitor function, it is advised that user minimises the amount of elements that are copy monitored to avoid software lagging.

When information from other disciplines is received, the linked Revit file which has previously been copy monitored should be archived by the recipient and the new version of the file located in its place, named identically as before.

When copying information from other disciplines, users should select the correct import options to avoid misinformation. For example, if an architect is copy monitoring columns from a structural model and those column types are not already present, Revit will automatically replace them with default families that may not be appropriate to the design.

Copy monitor allows users to copy levels from a linked model. Such elements are typically copied from the architectural model. The copy monitoring of grids is often used as an expedient way of monitoring changes to the fundamental layout of a project. Grids in linked models should not be associated with scope boxes before being copied to the host model.

Structural disciplines typically split columns by level before copying an architectural model to avoid issues with analytics.

Users should be mindful that copied floors which have altered geometry will be shown as a flat slab in the host file, and additional work must be carried out to correctly represent slopes.

D3 Design Options

The use of design options can support the investigation and testing of alternative design solutions. Before creating design options in Revit it is best practice to establish which areas of the model will require design option sets (e.g. a set of design options for entrance to the building, or another set of options for a layout in one area of the building).

When progressing the BIM, it is more efficient to prioritise elements which are not affected by the change, through the creation of design option sets. If the model has progressed to a stage where elements in design option areas are already modelled, it is possible to retrospectively move elements to an option set.

It is important that the preferred design option within a set is specified as the primary option to default this information in views and worksheets before sharing information with other members of the design team. Other options can also be shown in views if specified.

Scheduling, analytics and collaboration is still possible when using design options. Design teams must make sure design option sets are consistently named with corresponding options in other discipline models to avoid confusion and potentially inaccurate data.

Once a design option has been agreed by the client and the design team, it is recommended that the design option is incorporated into the main model. This will help reduce file size and increase model performance. Note: this process will erase all other design options within that particular set and they will no longer be available.

D4 Setup File

A setup file is used as a common Revit model file which all members of the design team should use to establish the project location, orientation and levels within the BIM environment.

It is the Lead Consultant's responsibility to establish a setup file which will be shared via the CDE / Asite.

Typically, the architect will create a site setup file by importing survey data provided as a .DWG, sharing World Coordinates System (WCS) data from the .DWG. The architect should check the accuracy of this information before continuing the development of the model. This will be audited by the BIM Manager at regular intervals.

Architectural models are typically saved with local origin, linked into the set up file and then moved to the correct location, orientation and level height. Coordinates can then be acquired and published back into the architectural models.

Appendix E – Standard Agenda for BIM Coordination Group Meetings

1.0 Purpose of Meeting

2.0 General Update Reports from Various Disciplines

- 2.1 Discipline Guidance Requests
- 2.2 Threats and Opportunities
- 2.3 Inter-discipline Component Requests

3.0 BIM Manager Model and Process Auditing Report

- 3.1 Coordinates
- 3.2 Naming Conventions
- 3.3 WIP

4.0 Review

- 4.1 Model / Workstation performance
- 4.2 PXP updates
- 4.3 Model Structure
- 4.4 BIM QTO and BQ Preparation
- 4.5 Upgrades
- 4.6 BIM Risk Register
- 4.7 Asite

5.0 Coordination Review

6.0 Any Other Business

Notes: Projection and powerful workstation should be made available, preloaded with the latest WIP native models from the CDE and the latest federated model in an appropriate format.

Appendix F – List of Building Services System

No.	System Name	System Code	Sub-system Name	Sub-system Code		
				Duct	Pipes	Cable Trays
1	**Lift and Escalator**	LTE	Trunking for Lift and Escalator	LTE		
			Cable Tray for Lift and Escalator			LAE
2	**LV Switchboard**	LVS	Trunking for LV Switchboards	LVS		
			Cable Tray for LV Switchboards			LVS
3	**Emergency Generator**	EMG	Trunking for Emergency Generator	EMG		
			Cable Tray for Emergency Generator			EMG
4	**HVAC**	HVAC	Primary Air Duct	PAD		
			Exhaust Air Duct	EAD		
			Fresh Air Duct	FAD		
			Supply Air Duct	SAD		
			Return Air Duct	RAD		
			Transfer Air Duct	TAD		
			Smoke Extraction Duct	SED		
			Make Up Air Duct	MAD		
			Condensate Drain Pipe		CDP	
			Chilled Water Return Pipe		CHWR	
			Chilled Water Supply Pipe		CHWS	
			Condensing Water Supply Pipe		CDWR	
			Condensing Water Return Pipe		CDWS	
			Chemical Dosing Pipe		CHDP	
			Make-up Water Pipe		MWP	
			Heating Hot Water Supply Pipe		HHSP	
			Heating Hot Water Return Pipe		HHRP	
			CCMS Trunking	CCMS		
5	**Boiler System**	BLR	Boiler Pipes		BLR	
6	**Filtration Plant**	FP	Filtration Plant Pipes		FP	
			Return Pipes		RP	
			Overflow Pipe		OP	
			Supply Pipe		SP	
7	**Fire Services Installation**	BFS	Sprinkler Pipe		SPR	
			Hose Reel / Fire Hydrant Pipe		FSP	
			Automatic Fire Detection and Alarm System Pipe		AFA	

No.	System Name	System Code	Sub-system Name	Sub-system Code		
				Duct	Pipes	Cable Trays
			Gas Suppression System Pipe		GSS	
			FS Trunking	TR-FS		
8	**Uninterrupted Power Supply**	UPS	Trunking for UPS	UPS		
			Cable Tray for UPS			UPS
9	**Burglar Alarm**	BA	Trunking for Access Control System	ACS		
			Cable Tray for Access Control System			ACS
			Trunking for Burglar Alarm System	BAS		
			Cable Tray for Burglar Alarm System			BAS
			Trunking for CCTV and Intercom	CCTVI		
			Cable Tray for CCTV and Intercom			CCTVI
			Trunking for Smart Card System	SCS		
			Cable Tray for Smart Card System			SCS
			Trunking for CAS	CAS		
			Cable Tray for CAS			CAS
			Trunking for Videophone System	VPS		
			Cable Tray for Videophone System			VPS
			Trunking for Keypad Lock System	KLS		
			Cable Tray for Keypad Lock System			KLS
			Trunking for Drop-arm Barrier	DAB		
			Cable Tray for Drop-arm Barrier			DAB
10	**Radar and Navigation System**	RNS	Trunking for Radar and Navigation System	RNS		
			Cable Tray for Radar and Navigation System			RNS
11	**IT System**	ICT	Trunking for ICT	ICT		
12	**Audio Video System**	AV	Trunking for Audio Video System	AV		
			Cable Tray for Audio Video System			AV
13	**Audio System**	AUS	Trunking for Audio System	AUS		
			Cable Tray for Audio System			AUS
14	**Radio System**	RS	Trunking for Radio System	RS		
			Cable Tray for Radio System			RS
15	**Closed Circuit TV System**	CCTV	Trunking for Closed Circuit TV System	CCTV		
			Cable Tray for Closed Circuit TV System			CCTV

No.	System Name	System Code	Sub-system Name	Sub-system Code		
				Duct	Pipes	Cable Trays
16	**Broadcast Reception**	BR	Trunking for UHF TV System	UTV		
			Cable Tray for UHF TV System			UTV
			Trunking for Satellite TV System	STV		
			Cable Tray for Satellite TV System			STV
17	**Lighting**	LTG	Trunking for Lighting	LTG		
			Cable Tray for Lighting			LTG
18	**Electrical**	BEL	Cable Tray for Low Voltage			CT-LV
			Cable Tray for High Voltage			CT-HV
			Cable Ladder for Low Voltage			CL-LV
			Cable Ladder for High Voltage			CL-HV
			Trunking for N Power	TR-N		
			Trunking for E Power	TR-E		
			Bedhead Trunking	BHT		
19	**Drainage**	BDR	Waste Pipe		WP	
			Soil and Waste Pipe		SWP	
			Vent Pipe		VP	
			Rain Water Pipe		RWP	
			Pumped Soil & Waste Pipe		PSWP	
			Pumped Waste Pipe		PWP	
			Pumped Rainwater Pipe		PRWP	
20	**Plumbing**	BPL	Cleansing Water Pipe		CLWP	
			Cold Water Pipe		CWP	
			Flushing Water Pipe		FLWP	
			Fresh Water Pipe		FWP	
			Hot Water Supply Pipe		HWSP	
			Hot Water Return Pipe		HWRP	
			Irrigation Water Pipe		IWP	
			Grey Water Pipe		GWP	
21	**PTS**	PTS	Tube		PTS	
22	**Medical Gas & Non-medical Gas**	MDE	Pipework		MGP	
23	**Town Gas**	BTG	Pipes		TGP	

Appendix G – BIM Model Audit Guidelines

1.0 General Model Status and Project Metadata

- 1.1 Project Summary
- 1.2 Project Discipline Summary
- 1.3 Model Authors comments
- 1.4 Software version and plugins etc. used
- 1.5 Current model size
- 1.6 Notes

2.0 Conformity to Naming Standards

- 2.1 File naming and use of Asite for WIP transfer
- 2.2 Sheet and View naming
- 2.3 Family / Component naming
- 2.4 Room naming

3.0 Model review

- 3.1 Model coordinates
- 3.2 Worksets activated and used
- 3.3 Design options / phasing
- 3.4 Models and files linked
- 3.5 Family / components classifications and data continuity
- 3.6 Appropriateness of use of model components, e.g. ceilings used as floors
- 3.7 Brief review of LOD and appropriateness to project stage
- 3.8 General perception of model integrity, detail and quality – common sense / visual inspection

4.0 Review model Errors and Warnings and record and review KPI

5.0 Report / Feedback / Recommendations

Appendix H - **BIM Workflow (Design Stage)**