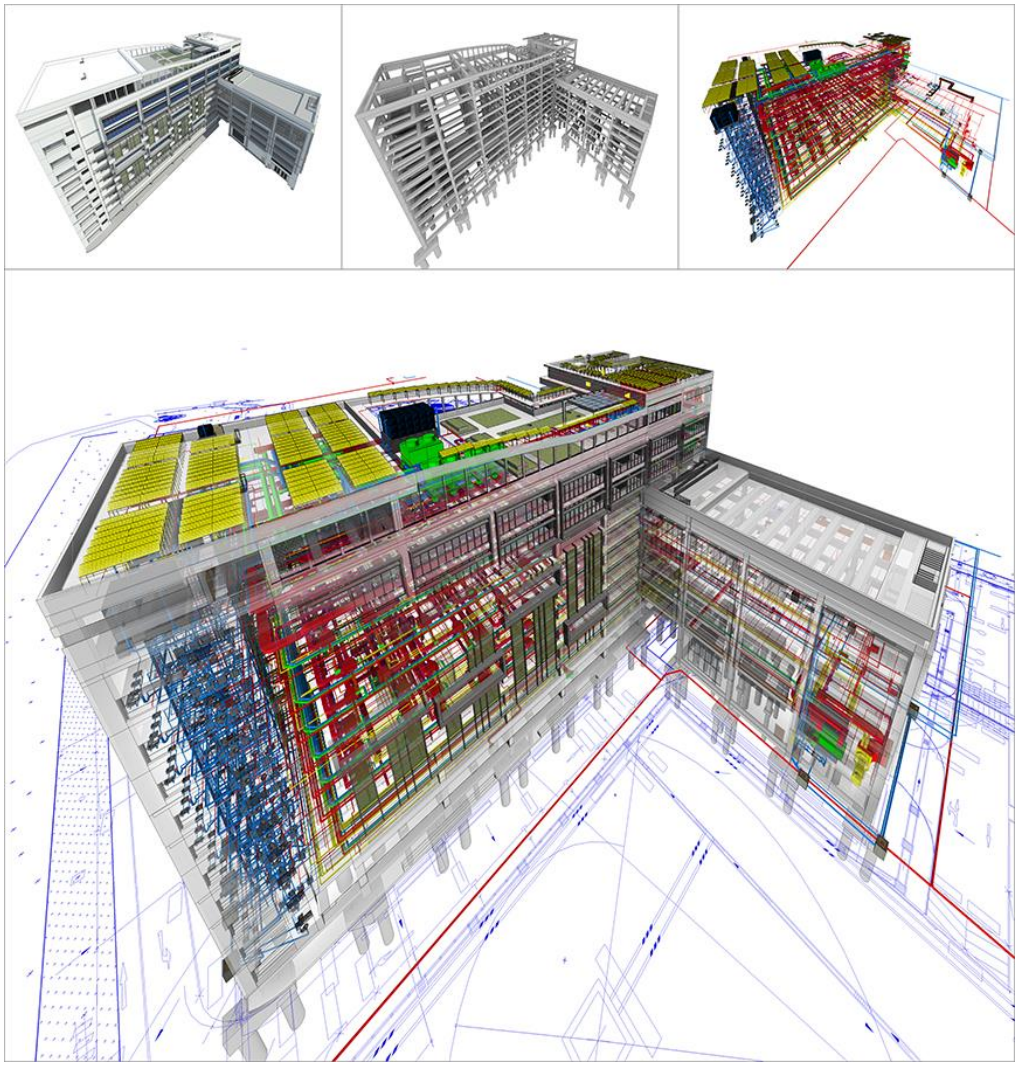
Building and Construction Authority

BIM Handover Technical Guide

Releasing BIM as part of Contract Documents



VERSION 1

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This Guide has been prepared by the Digitalisation department on behalf of BCA and the IDD Steering Committee.

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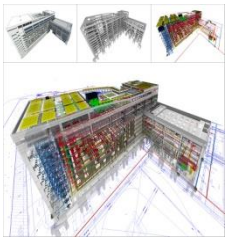

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1. Introduction

As a common practice today, 2D drawings generally form part of Contract Documents even though consultants' BIMs are provided to contractors for reference. In the event of any discrepancy, 2D drawings would take precedence over BIM. As a result, contractors would rely on consultants' 2D drawings to create their BIM for tender preparation and subsequent construction purposes.

The current practice is very inefficient as there are many pain points identified in Figure 1. To overcome the inefficiencies, there is a need to incorporate **BIM as part of Contract Documents in addition to a set of 2D drawings**. This would enable project stakeholders to rely on BIM as the Single Source of Truth and derive the following benefits (Figure 2).

Figure 1: Current 2D Drawings Practice

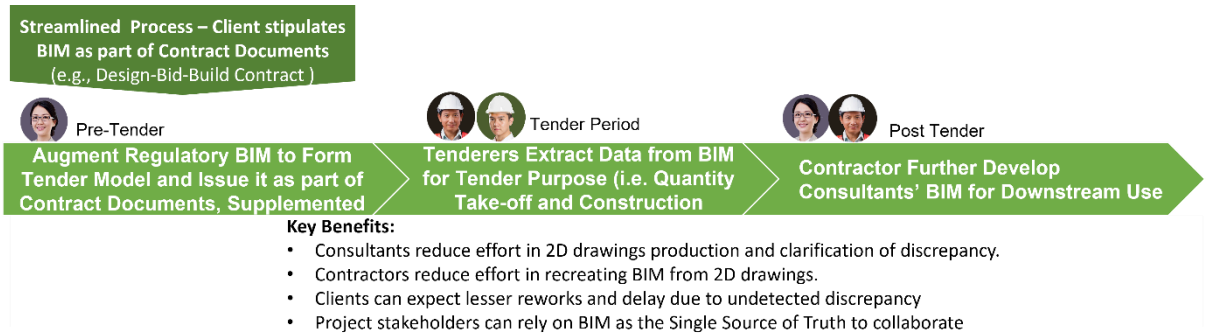


Figure 2: Streamlined Process to Make BIM as part of Contract Documents

2. Objectives

This Guide establishes the essential **Model Content** and **2D Drawings** (Figure 3) that form part of Contract Documents for Construction Tender.

- **Model Content** - a list of essential BIM elements and attributes.
- **2D Drawings** - a list of essential 2D drawings, both generated from BIM and not, to supplement BIM to define the project scope.

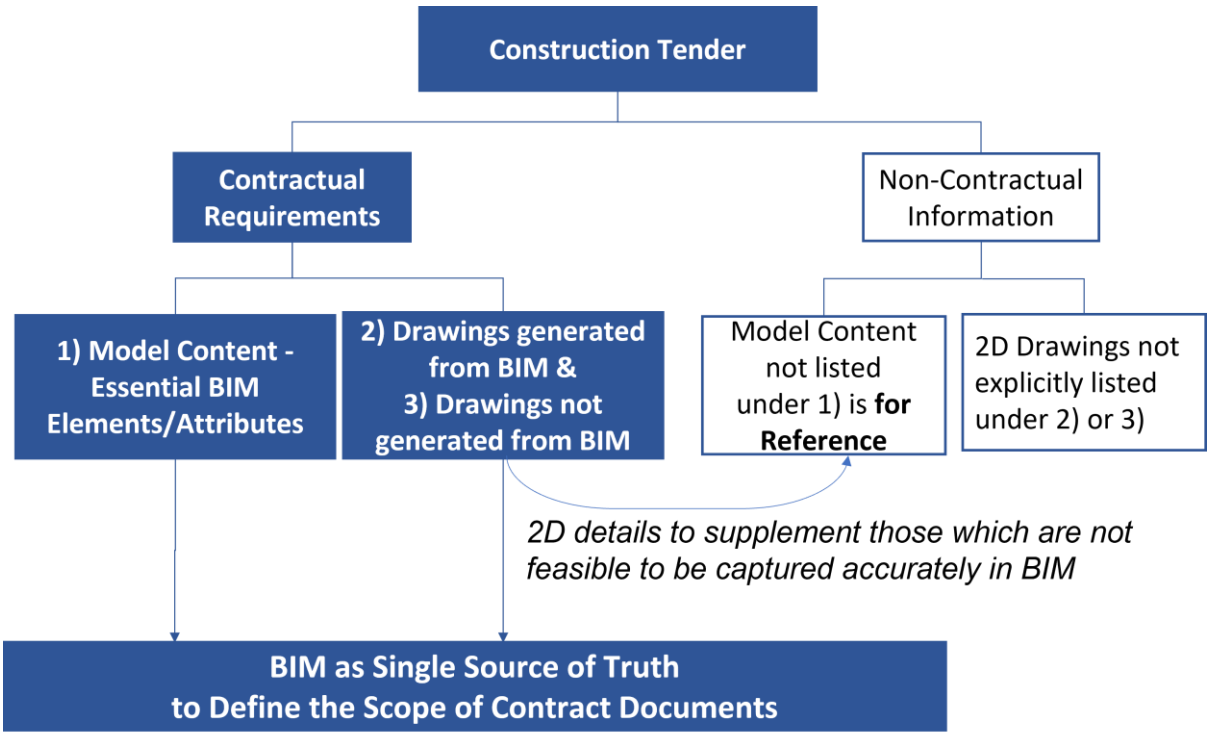


Figure 3: Essential Model Content and 2D Drawings as Part of Contract Documents

Client's Requirements should include explicitly the following:

1) Model Content - the list of essential BIM elements and attributes,
2) 2D Drawings generated from BIM, and
3) 2D Drawings not generated from BIM within the Contract to define the scope of Contract Documents clearly.

This Guide also recommends a set of guidelines for preparing and issuing BIM as follows:

- **Modelling and Coordination Methodology** - a set of modelling and coordination methodology for preparing the Model Content
- **Model Structure and File Format** - specific model structure and file format that models are organized and issued
- **Model Handover Process** - briefings to explain the model content and modeling methodology to contractors. Consultants' BIM Execution Plan (BEP) for the project should also be shared during the briefing

3. Model Content

Model Content that forms part of Contract Documents shall consist of a list of essential BIM elements and corresponding attributes. They shall be clearly defined in the Contract. The Model Content not defined in the Contract are to be used for reference only.

Model Content are applicable to both Design & Build and Design-Bid-Build contract types. The key difference is on the geometrical level of details of the BIM elements to be modelled as stated below and in the Singapore BIM Guide Version 2.

- Up to schematic/preliminary level of details for Design & Build contract
- Up to detailed design level of details for Design-Bid-Build contract

A recommended list of essential BIM elements and corresponding attributes for Design-Bid-Build Contract is provided in **Appendix A.** They are categorized by discipline and form a subset of Model Content Requirements (MCR)[1] for model handover at tender stage.

For Design & Build contract, Client could refine the list of essential BIM elements based on project requirements. The Contractor should further develop their BIM after contract award.

Consultant's Quantity Surveyor (QS) should also be given access to the Model Content at early design stage to perform quantity take-off (QTO) and cost estimate.

[1] Model Content Requirements (MCR) refer to the information required at different stages by building typology for project delivery.

4. 2D Drawings

To achieve a Single Source of Truth, 2D drawings should be generated from BIM to reduce discrepancies and inconsistencies. Detailed annotations and tags may not be necessary if essential attributes are correctly captured in the model properties fully. Not every building detail needs to be modelled in BIM. As such, there would be 2D drawings not generated from BIM but required to form part of Contract Documents. Both lists of 2D drawings should be clearly specified under the Contract. Example of such lists are shown in Table 1 below. See **Appendix B** for more detailed description.

Table 1 – Example of 2D Drawing Types

Drawings Generated from BIM
General Notes
Site Plans
Floor Plans
Roof Plans
Reflected Ceiling Plans
Elevations
Sections
Door/Window/Room Schedule
Household Shelters/ Storey Shelters / Staircase Storey Shelter Plans
Foundation Plan
Structural Elements Schedule
Equipment Schedule
Drawings not Generated from BIM
Standard Details
Structural Connection Details
Reinforcement Details
Services Schematic Drawings and Single Line Diagrams

5. Modelling and Coordination Methodology

Model Quality is an important part of model handover. It can be achieved by practising good modelling and coordination methodology (based on the Singapore BIM Guide Version 2 and Singapore VDC Guide). The essential scope of the methodology is summarized in the table below.

Table 2 – Essential Scope of the Methodology

S/N	Category	Modelling Methodology
1	**Standard**	✓ BIM elements and attributes naming convention ✓ MEP System colors
2	**Authoring Software and File Format**	✓ BIM authoring software and version ✓ File formats for model sharing ✓ File naming convention
3	**File Workability**	✓ Optimized file size ✓ Removed elements, 2D objects, sheets, views, legends, links and schedules not intended to hand over
4	**Control Elements**	✓ Origin points geo-referenced to the Singapore SVY 21 coordinate system (x, y) and to the Singapore Height Datum for Height (z) ✓ Site model presented in True North or real-world orientation ✓ Grids must be aligned across all models and disciplines ✓ Set up building levels
5	**Model Content**	✓ All essential BIM elements and attributes ✓ 2D details, schedules, views and sheets ✓ Use correct BIM category/ elements ✓ BIM elements are created by level when applicable
6	**Intra-discipline Coordination (Appendix C)**	✓ No duplication of BIM elements ✓ No overlapping of BIM elements
7	**Inter-discipline Coordination (Appendix C)**	✓ No significant clash and clearance issue ✓ Alignment and consistency between trades ✓ Watch out for elements modelled by > 1 discipline* ✓ ICE session to address inter-discipline issues

*Additional coordination effort is needed to remove potential discrepancy when the same BIM element is modelled in different discipline Models. For instance, columns are modelled in both Architectural Model and Structural Model. To avoid additional coordination effort, structural elements (e.g., structural columns, structural slabs, structural walls, stairs etc.) should ideally be modelled in the Structural Model and linked by the Architectural Model as a reference to show the finishes. If such practice is not feasible, consultants must coordinate their models across disciplines before issuing it for tender. Consultants are recommended to specify which discipline model would take precedent in the event of a discrepancy.

6. Model Structure

As part of model handover requirements, the model breakdown structure should be tabulated in the BIM Execution Plan and handed over to contractors for better understanding of how different parts of the models are linked together. The following table and tree diagram are two examples of model breakdown structure that can be adjusted according to the project requirements.

Table 3 – Example of Model Breakdown Structure Listing for illustration

S/N	Model File Name[2]	Discipline	Description
1	Main Model	ARC	Overall BIM model container combines all other model files
2	Site Model	ARC	Site model including roads, sidewalk, pavement, etc.
3	Façade Model	ARC	Façade model
4	Landscape Model	ARC	Landscape model
5	Basement Model	ARC	Basement model
6	Block A Model	ARC	Tower A model
7	Site Model	STR	Site model including drain, piling and pile cap
8	Block A Model	STR	Tower A model
9	MEP Model	MEP	Federated MEP model
…			…

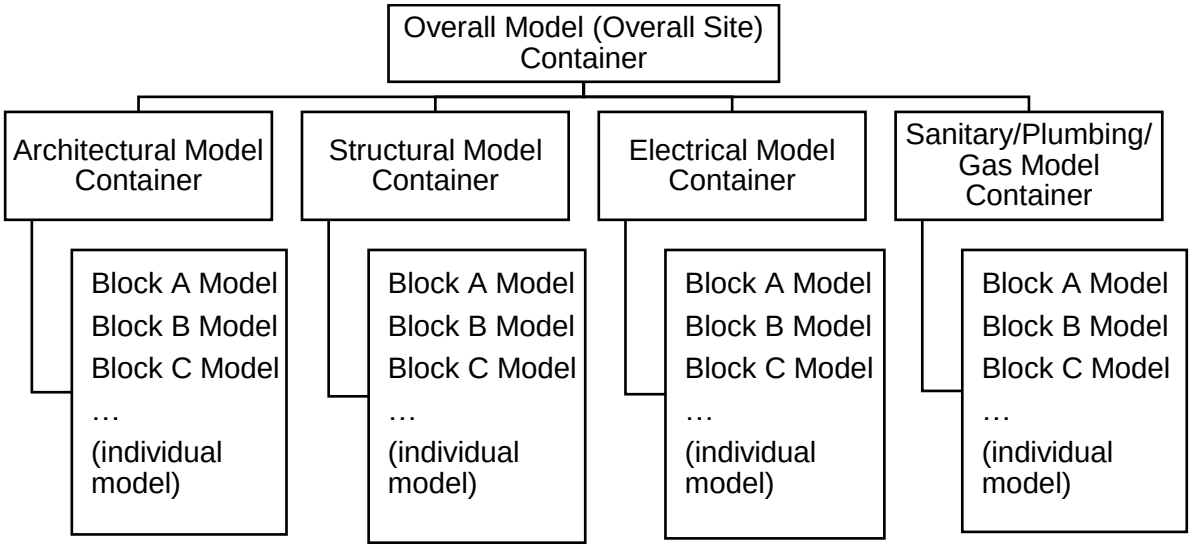


Figure 4: Example of Tree Diagram for illustration

[2] Model file naming convention refers to Code of Practice for Building Information Modelling (BIM) e-submission General Requirements

Abbreviations: ARC – Architectural, STR – Structural, MEP – Mechanical, Electrical, & Plumbing

7. Model File Format

Native and/or read-only format (such as iModel (i.dgn), Design Review (.dwf), Navisworks (.nwc), etc.) should be issued to tenderers at tender stage while native format to the successful tenderer upon contract award.

Native and read-only model should include essential BIM elements with embedded attributes and 2D drawings (drawing sheets) generated from BIM. With that, tenderers should be able to use BIM to extract and export information for quantities take-off and construction planning purposes.

OpenBIM format[3] may also be released when different brands of authoring tools are used by the contractor.

[3] OpenBIM format includes Industry Foundation Class (IFC), BIM Collaboration Format (BCF), COBie, CityGML, gbXML, etc.

8. Model Handover Process

8.1 Model Validation

Prior to the Tender Issuance, all BIMs must be validated according to the model quality requirements outlined in **Chapter 5** of this Guide and the BEP. Respective consultants are to ensure that their BIMs are fit for purpose. Lead consultant is to organize interdisciplinary coordination to ensure that all BIMs are coordinated and stored in the combined model container.

The essential scope for coordination should include Architectural and Structural essential elements, and MEP main equipment and main service routing.

8.2 Model Briefing During Tender

Consultants should organize a Model Briefing for tenderers to understand the following:

- The Client's Requirements for Construction and As-built stages and how BIM are structured, its contents and naming convention used;
- The **"what"** have been defined in the BIM Execution Plan but not produced in the respective BIM models due to last minute design change or other consideration, i.e., the set of BIM elements not modelled, essential data attributes not included, a list of drawing not generated from BIM, file folder structure; and
- For what purposes the model can be used for (e.g., visualization, quantity take-off, construction planning).

This would enable all tenderers to have the same understanding of what is to expect from BIM. Tenderers in return should take responsibility to point out any issue or discrepancy between BIM and 2D drawings for clarification during tender period.

Tenderers must also have the capability to make use of relevant digital tools to identify the changes in BIM or drawings (e.g., version comparison features).

8.3 Tender Addendum and Corrigendum

Design changes during tender period to essential BIM elements and its corresponding attributes shall be reflected in BIM. As a minimum requirement, such changes should be captured in BIM and issued to tenderers during or before the last tender addendum / corrigendum.

8.4 Post-Tender Workshop

There should be post-tender workshops organized for consultants to brief the successful tenderer on the following:

- Updated Contract Models
- Timeline for handover
- Mode of handover (e.g., using an agreed project Common Data Environment (CDE) platform)

The contractor should also present the BIM Execution Plan for Construction Stage during the workshops, particularly the timeline for BIM deliverables and use of BIM for different milestones of the project.

The contractor must also further update the post-tender BIM Execution Plan with consensus of all the project stakeholders and in accordance with Client's Requirements before the commencement of works.

8.5 Contract Models

Contract Models mean models furnished during tender, which are included as part of the Contract Documents as modified by tender addendum and corrigendum. Such models shall be issued to the successful tenderer upon contract award.

It is recommended to hand over the Contract Models using the agreed project CDE platform in line with the international standard ISO 19650 file exchange workflow. All the Model Authors, including consultants, contractor, sub-contractors, sub-sub-contractors, are required to use CDE to ensure Single Source of Truth. Key Model Users should also be included so that they are alerted when changes are made.

Subsequently, consultants should continue to capture design changes (e.g., due to Regulatory Submission) in their Design Models, collaborate with the project stakeholders to resolve the design issues and update BIM in the CDE.

9. Summary

In summary, the following are essential **Model Content** and **2D Drawings** that form part of Contract Documents for Construction Tender.

Architectural Model for Design-Bid-Build Contract Type

Discipline	Contractual Requirements			Non-Contractual Information
	1) Model Content – Essential BIM Elements	**2) Drawings Generated from BIM**	**3) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
Architectural	• Site / Contract Boundary • Internal/External Wall/ Structural /Non-Structural Wall • Column • Door • Window • Roof • Ceiling • Floor • Staircase • Ramp • Room/Space • Parking Lot • Shaft/Pit	• Drawing List • General Notes • Site Plans • Floor Plans • Roof Plans • Reflected Ceiling Plans • Elevations • Sections • Staircase Details • Door Schedule • Window Schedule • Drainage Plans and/or Rainwater Downpipe Plans	• Ironmongery Details/Cutsheets • Standard Details • Interfacing Details with Neighboring Contract • Signage Key Plans	• Curtain Wall • Façade • Railing • Plumbing Fixtures • Fitting, Furnishings and Equipment • Signages

Structural Model for Design-Bid-Build Contract Type

Discipline	Contractual Requirements			Non-Contractual Information
	1) Model Content – Essential BIM Elements	**2) Drawings Generated from BIM**	**3) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
Structural	• Structural Foundation • Structural Wall • Structural Framing • Structural Column • Structural Slab • Staircase • Ramp • Shaft/Pit • Precast, PBU & PPVC	• Drawing List • General Notes • Site Plans • Floor Plans • Roof Plans • Household Shelters/Storey Shelters/Staircase Storey Shelter Plans • Foundation Plan • Structural Elements Schedules	• External Works • Sewer Works • Standard Details • Connection Details • Reinforcement Details* - Foundation - Slab - Beam - Column - Wall - Ramp - Staircase	• Underground Utilities • Drains, Canals and Underground Harvesting Tanks

*Recommendation: A set of 2D reinforcement details could be eliminated if these structural elements with its essential attributes are derived from BIM in a table form (e.g., Beam Schedule); structural engineers key in the reinforcement data outside of BIM; and then sync the data back to BIM through computational approach (e.g., dynamo, grasshopper) or third-party plug-in to BIM. The same data in the table form can be used to automatically produce 3D rebars.

MEP Model for Design-Bid-Build Contract Type

Discipline	Contractual Requirements			Non-Contractual Information
	1) Model Content – Essential BIM Elements	**2) Drawings Generated from BIM**	**3) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
ACMV System	**Main Equipment** • AHU • Air Curtain • Chiller • Compressor • Cooling Tower • Control Panel • FCU • Fan • Heat Exchanger • Heat Pump • Motor • Air Conditioner • Pump (e.g., Chilled Water Pump) • Computer Room Air Conditioning (CRAC) Unit **Main Service Routing** • Duct (Size ≥ 600mm) and Duct Insulation • Chiller Pipe (Diameter ≥ 150mm) and Pipe Insulation	• Drawing List • General Notes • Site Plans • Floor Plans • Ceiling Plans • Elevations • Sections • Equipment Schedules (with essential design details info derived from BIM)	• Schematic Diagram • Standard Details	**Accessories & Branch Routing & Terminal** • Duct (size < 600mm) & Duct Fittings • Duct insulation • Damper (e.g., Fire dampers, motorized dampers, volume control dampers) • Chiller Pipe (diameter <150mm) & Pipe Fittings • Pipe insulation • Thermostat/ Portable Remote Control • Variable Air Volume (VAV) • Sensors (e.g., humidity, etc) • Air Terminal • Exhaust Terminal

Discipline	Contractual Requirements			Non-Contractual Information
	1) Model Content – Essential BIM Elements	**2) Drawings Generated from BIM**	**3) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
Plumbing and Sanitary System	**Main Equipment** • Control Panel • Motor • Pump • Tank (e.g. Water Holding Tank) • Water Heaters/Storage Heaters **Main Service Routing** • Pipe (diameter ≥ 100mm)	• Drawing List • General Note • Site Plans • Floor Plans • Ceiling Plans • Elevations • Sections • Equipment Schedules (with essential design details info derived from BIM)	• Schematic Diagram • Standard Details	**Accessories & Branch Routing & Terminal** • Bulk Water Meter • Pipe (diameter <100mm) & Fittings • Pipe insulation • Plumbing fixtures • Valves • Floor Trap Covers • Inspection Chamber (IC) • Manhole
GAS System	**Main Service Routing** • Pipe (Gas Piping and Supply, diameter ≥ 100mm)			**Accessories & Branch Routing** • Pipe (Gas Piping and Supply, diameter <100mm) & Fittings • Valves Meters

Discipline	Contractual Requirements			Non-Contractual Information
	1) Model Content – Essential BIM Elements	**2) Drawings Generated from BIM**	**3) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
Fire Protection System	**Main Equipment** • Fire Fight Equipment • Pump (e.g. Fire Sprinkler Pump) • Tank (e.g. Sprinkler Tank) • Control Panel/ Monitoring Panel • Manual Call Point **Main Service Routing** • Pipe (diameter ≥ 100mm)	• Drawing List • General Notes • Site Plans • Floor Plans • Ceiling Plans • Elevations • Sections • Equipment Schedules (with essential design details info derived from BIM)	• Schematic Diagram • Standard Details	**Accessories & Branch Routing** • Pipe (diameter <100mm) & Fittings **Fixtures and Devices** • Fire Alarm Device • Fire Extinguisher • Fire Hydrant • Sensor & Detector (e.g. Heat or Smoke Detector) • Sprinkler • Breeching Inlet (with or without cabinet) • Hose Reel (with or without cabinet) • Warning Light • Monitors/TVs • Breakglass

Discipline	Contractual Requirements			Non-Contractual Information
	1) Model Content – Essential BIM Elements	**2) Drawings Generated from BIM**	**3) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
Electrical System	**Main Equipment** • Control Panel • Distribution Board • Switchboard • Switchgear • Generator • Transformer • Uninterruptible Power Supply (UPS) • Fuel Tank • Solar Panel **Main Service Routing** • Cable Tray (size ≥ 600mm) • Trunking & Cable Containment (size ≥ 600mm) • Underground Lead-in Pipe (Size ≥ 100mm)	• Drawing List • General Notes • Site Plans • Floor Plans • Ceiling Plans • Elevations • Sections • Equipment Schedules (with essential design details info derived from BIM)	• Schematic Diagram • Standard Details	**Accessories & Branch Routing** • Cable Tray (size < 600mm) & Fittings • Trunking & Cable Containment (size < 600mm) • Cable Ladder & Fittings **Fixtures and Devices** • Lighting Fixture • Security Device

Discipline	Contractual Requirements			Non-Contractual Information
	1) Model Content – Essential BIM Elements	**2) Drawings Generated from BIM**	**3) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
Vertical Transport System	**Main Service Routing** • Trunking & Cable Containment (size ≥ 600mm)	• Drawing List • General Notes • Site Plans • Floor Plans • Ceiling Plans • Elevations • Sections • Equipment Schedules (with essential design details info derived from BIM)	• Schematic Diagram • Standard Details	**Equipment** • Elevator Car • Motor • Control Panel/Monitoring Panel • Monitors/Computers • Visual Indicators/Call Buttons (for lifts) **Accessories & Branch Routing** • Trunking & Cable Containment (size < 600mm)

Discipline	Contractual Requirements			Non-Contractual Information
	4) Model Content – Essential BIM Elements	**5) Drawings Generated from BIM**	**6) Drawings not Generated from BIM**	**Model Content not listed under 1) are for Reference**
Extra Low Voltage System	**Nil**	**Nil**	• Schematic Diagram • Standard Details	**Equipment** • Audio Visual Equipment • Sensors • Controller • Intercom
Information & Communication Technology System	**Nil**	**Nil**		**Equipment** • Mobile Network Operator Antenna • Telecom Equipment
Security System	**Nil**	**Nil**		**Fixtures and Devices** • CCTV Camera • Card Access Reader

Appendix A - BIM Elements by Discipline

The following **Model Content** comprises a list of **essential BIM elements and attributes*** that form part of **Contract Documents** for Construction Tender.

*Attributes include geometrical (e.g., size, height, area, etc) and non-geometrical information

Architectural BIM Element	Attribute	Remark
Site (External* Works) Site infrastructure (including roads, adjacent roads, pavements, ingress and egress to the site, parking arrangements and surrounding land use) within site/contract boundary *External to be included and extended to x metres from the boundary line depends on different agencies' guidelines, e.g., URA's guidelines is topographical plans with contours extending to a width of one metre beyond the side of development, and subject to the Consultant's own judgement	Spot Level (Existing[4])	
	Spot Level (Proposed)	
Wall Internal/External walls/non-structural walls *Note: Wall finishes information could be captured in Room/Space Attribute*	Length	
	Height	
	Thickness	
	Level	
	Area	
	Type	Wall Type and Finishes
	Fire rating	
	Opening	Geometrical information: include opening in wall if applicable. Duct (size <600mm) and pipe (size

*[4] Existing information other than site works particularly for Additional & Alteration works can be defined as a parameter to be embedded inside the element. Alternatively, it can be represented by "phasing" function or equivalent within the respective authoring tools. It is recommended to read this together with the **Code of Practice for Building Information Model (BIM) e-submission (including the upcoming CORENET X COP**) and the **BIM essential Guides**.*

		<100mm) penetration may not be required).
Column Architectural columns for setting out and the sizes and locations to match the structural columns in the Structural Model *Note: recommend to model only the finishes and non-load bearing columns to avoid double work and potential discrepancy*	Level	
	Height	
	Length	h
	Width	b
	Diameter	For Round Columns only
Door General doors	Level	
	Width	Clear Width
	Height	Clear Height
	Type	Door Type
	Fire Rating	
	Mark	Door Unique ID
	Ironmongery Set	Ironmongery Type ID
	Count	Total number of doors derived from BIM (e.g., Schedule)
Window Fixed panel window, side-hung window, top-hung window, Skylight, sliding window, etc. Louver windows	Level	
	Width	Overall Width
	Height	Overall Height
	Type	e.g., Sliding, Casement Window
	Sill Height	
	Count	Total number of windows derived from BIM (e.g., Schedule)
Roof Roofs with overall thickness	Level	
	Thickness	
	Area	
	Volume	
	Type	Roof Type
	Slope	Include the slope if applicable
Ceiling Ceiling (without support sub-frames)	Level	
	Height	Ceiling Height
	Type	Ceiling Type and Finishes

Note: Ceiling finishes information could be captured in Room/Space Attribute.		
Floor Horizontal floors and raised floors Sloped floors *Note: Floor finishes information could be captured in Room/Space Attribute.*	Level	Finish Level including drops
	Thickness	
	Area	
	Volume	
	Type	Floor Type
	Waterproofing Type	
	Opening	Geometrical information: include opening in floor if applicable
Staircase Steps and stairs including risers, threads and railings and headroom clearance *Note: Recommend to model only the finishes and non-load bearing stairs to avoid double work and potential discrepancy*	Level	
	Type	
	Width	Clear Width
	Riser Height	
	Tread Width	
	No. of Riser	
Ramp Use “Ramp” and/or “Floor” to model in Architectural Model	Level	
	Length	
	Clear Width	
	Gradient	Slope
	Type	Construction Type
	Finish Material	
Room/Space	Name	Room Name
	Level	
	Ceiling Finishes	
	Floor Finishes	
	Wall Finishes	
	Area	
	Mode of Ventilation	

Parking Lot	Level	
	Length	
	Width	
	Type	Parking Lot Type e.g. car parking lot, motorcycle parking lot
	Count	Total number of parking lots derived from BIM (e.g., Schedule)
Shaft/Pit	NA	
Civil & Structural BIM Elements	**Attribute**	**Remark**
Structural Foundation Foundations including pile caps, footings and ground beams For raft foundation, use “Floor” for Structural Model	Level	Structural Floor Level (SFL)
	Depth	
	Breadth	
	Width	
	Volume	
	Mark	Pile Cap/ Footing Unique ID
	Material	Concrete/Steel
	StrengthClass	Concrete Grade
	Count	Total number of pile caps/footings/ raft foundation derived from BIM (e.g., Schedule)
Structural Foundation Foundations including piles For Contiguous Bored Pile (CBP) walls, may use “Wall” for Structural Model, but must indicate as CBP clearly	Length	
	Width	
	Breadth	
	Volume	
	Diameter	For Round Piles only
	Embedment	
	Pile Penetration	From cutoff level to bottom of pile
	Type	Pile Type
	Material	Concrete/Steel
	StrengthClass	Concrete Grade for concrete element
	SteelGrade	Steel Grade for steel element
	Count	Total number of piles and CBP derived from BIM (e.g., Schedule)

Structural Wall	Level	Structural Floor Level (SFL)
	Thickness	
	Height	
	Volume	
	ConstructionMethod	Wall Type (e.g. Precast/CIS)
	Type Mark	Wall Type Mark
	Material	Concrete/Timber
	StrengthClass	Concrete Grade
	Opening	Geometrical information: include opening in wall if applicable. Duct (size <600mm) and pipe (size <100mm) penetration may not be required)
Structural Framing Beams including transfer beams and capping beams Steel frame structure including truss and bracing systems	Level	
	Length	
	Width	
	Depth	
	Volume	
	Slope	For slope beam only
	ConstructionMethod	Beam Type (e.g., Precast/CIS/Steel)
	Type Mark	Beam Type Mark
	Material	Concrete/Steel
	StrengthClass	Concrete Grade for concrete element
	SteelGrade	Steel Grade for steel element
	Count	Total number of structural framings derived from BIM (e.g., Schedule)
Structural Column Structural concrete/steel columns (including drop panel and corbel)	Level	Structural Floor Level (SFL)
	Height	
	Breadth	
	Width	
	Diameter	For Round Columns only
	Size	For Steel Columns only

	Volume	
	ConstructionMethod	Column Type (e.g., Precast/Steel/CIS)
	Type Mark	
	Material	Concrete/Steel
	StrengthClass	Concrete Grade for concrete element
	SteelGrade	Steel Grade for steel element
	Count	Total number of structural columns derived from BIM (e.g., Schedule)
Structural Slab Slabs including slab on grade, floating slab and drop panel	Level	Structural Floor Level (SFL)
	Thickness	
	Volume	
	ConstructionMethod	CIS/Precast
	Material	Concrete/Timber
	StrengthClass	Concrete Grade
	Slope	For Slope Slab only
	Opening	Geometrical information: include opening in slab if applicable
Other types of transfer structure not mentioned above	Level	
	Length	
	Width	
	Depth	
	ConstructionMethod	CIS/Precast
	Material	Concrete/Steel
	StrengthClass	Concrete Grade for concrete element
	SteelGrade	Steel Grade for steel element
	Count	Total number of transfer structure derived from BIM (e.g., Schedule)

Staircase Stairs including steps, risers, threads and landings	Base Level	Structural Floor Level (SFL)
	Width	Clear Width
	Riser Height	
	Tread Width	
	No. of Riser	
	ConstructionMethod	Stairs Type (e.g. Precast/CIS)
	Material	Concrete
	StrengthClass	Concrete Grade
Ramp Use “Floor” or “Ramp” for Structural Model	Level	
	Length	
	Clear Width	
	Gradient	
	Volume	
	ConstructionMethod	Ramp Type (e.g. Precast/CIS)
Shaft and Pit (and opening)	NA	
Substructure & Superstructure Specialist Including Precast, PBU and PPVC	Level	
	Dimensions	
	ConstructionMethod	e.g. Precast, PBU, PPVC
	Type Mark	Reference Marking
ACMV System BIM Element	**Attribute**	**Remark**
Equipment • Air Handing Unit (AHU) • Air Curtain • Chiller • Compressor • Cooling Tower • Control Panel • Fan Coil Unit (FCU) • Fan • Heat Exchanger • Heat Pump • Motor	Type	Family/Element Type
	System	System Type
	Size	Dimensions
	Count	Total number of equipment derived from BIM (e.g., Schedule)
	Capacity	Equipment capacity/design details would be used by contractors to propose the material, dimensions, precise location, etc. e.g., air flow, flow rate, temperature, power, etc.

• Air Conditioner • Pump (e.g. Chilled Water Pump, Condenser Water Pump) • Computer Room Air Conditioning (CRAC) Unit *Note:* *The following items are recommended: -* ✓ *"Maintenance Zone" should be modelled as a dummy geometry to be part of the equipment.* ✓ *"Power Requirement" should be provided for the purpose of knowing if power points or isolators are needed.* ✓ *"Plinth requirement" should be provided for Architect's and C&S Engineer's design.*		
Main Service Routing • Duct (size ≥ 600mm) and Duct Insulation • Chiller pipe (diameter ≥ 150mm) and Pipe Insulation	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)
Plumbing and Sanitary System BIM Element	**Attribute**	**Remark**
Equipment • Control Panel • Motor • Pump • Tank (e.g. Water Holding Tank) • Water Heaters/Storage Heaters *Note:* *The following items are recommended: -* ✓ *"Maintenance Zone" should be modelled as a dummy geometry to be part of the equipment.* ✓ *"Power Requirement" should be provided for the purpose of knowing if power points or isolators are needed.*	Type	Family/Element Type
	System	System Type
	Size	Dimensions
	Count	Total number of equipment derived from Schedule in the BIM model
	Capacity	Equipment capacity/design details would be used by contractors to propose the material, dimensions, precise location, etc. e.g., flow rate, pressure headpower, etc.

✓ *"Plinth requirement" should be provided for Architect's and C&S Engineer's design.*		
Main Service Routing • Pipe (diameter ≥ 100mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of accessories & routing derived from BIM (e.g., Schedule)
GAS System BIM Element	**Attribute**	**Remark**
Main Service Routing • Pipe (Gas Piping and Supply, diameter ≥ 100mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)
Fire Protection System BIM Element	**Attribute**	**Remark**
Equipment • Fire Fight Equipment • Pump (e.g. Fire Sprinkler Pump) • Tank (e.g. Sprinkler Tank) • Control Panel/ Monitoring Panel • Manual Call Point	Type	Family/Element Type
	System	System Type
	Size	Dimensions
	Count	Total number of equipment derived from BIM (e.g., Schedule)
	Capacity	Equipment capacity/design details would be used by contractors to propose the material, dimensions, precise location, etc. e.g., flow rate, pressure head, power, etc.
Main Service Routing • Pipe (diameter ≥ 100mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)

Electrical System BIM Element	Attribute	Remark
Equipment • Control Panel • Distribution Board • Switchboard • Switchgear • Generator • Transformer • Uninterruptible Power Supply (UPS) • Fuel Tank • Solar Panel	Type	Family/Element Type
	System	System Type
	Size	Dimensions
	Count	Total number of equipment derived from Schedule in BIM
	Capacity	Equipment capacity details would be used by contractors to propose the material, dimensions, precise location, etc. e.g., flow Rate, temperature, power, etc.
Main Service Routing • Cable Tray (size ≥ 600mm) • Trunking & Cable Containment (size ≥ 600mm) • Underground Lead-in Pipe (Size ≥ 100mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)
Vertical Transport System BIM Element	**Attribute**	**Remark**
Main Service Routing • Trunking & Cable Containment (size ≥ 600mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)

The following BIM elements and attributes are to be modelled for **reference only**. Over time, those shaded could be incorporated to form part of Contract Documents.

Architectural BIM Element	Attribute	Remark
Wall Curtain wall with mullions and transoms with true profile and window glazing units Precast/Prefab/GRC/Fiberglass facades	Length	
	Height	
	Thickness	
	Level	
	Area	
	Type	Wall Type (e.g. Dry Wall)
	Fire rating	
Railing Railing and balustrade	Level	
	Length	
	Height	Railing Height
	Type	Railing Type
	Mark	Railing Unique ID
Plumbing Fixtures Toilet fixtures, plumbing faucets	Type	
	Count	
Fittings, Furnishings and Equipment Loose furniture including desks and computer workstations, casework (carpentry) including upper and lower cabinets Placeholders for Equipment (take into consideration the MEP design and system spatial requirement) Signages including fire hose reel, exit, etc.	Level	
	Type	
	Count	

Civil & Structural BIM Elements	Attribute	Remark
Underground utilities	NA	
Drains, canals, crossing and underground harvesting tanks	NA	
ACMV BIM Element	**Attribute**	**Remark**
Accessories & Branch Routing & Terminal • Duct (size < 600mm) • Duct insulation • Damper (e.g., Fire dampers, motorized dampers, volume control dampers) • Chiller Pipe (diameter <150mm) • Pipe insulation • Thermostat/ Portable Remote Control • Variable Air Volume (VAV) • Sensors (e.g., humidity, etc)	Type	Family/Element Type
	System	System Type
	Size	
	Count	Total number of accessories & routings derived from BIM (e.g., Schedule)
Terminal • Air Terminal • Exhaust Terminal	Type	Family/Element Type
	System	System Type
	Size	
	Count	Total number of terminals derived from BIM (e.g., Schedule)
	Capacity	Flow rate, pressure, etc
Accessories & Branch Routing • Duct Fittings– excluding hangars • Pipe Fittings – excluding hangars *Note: Supports and hangers need not be modelled in BIM*	Type	Family/Element Type
	System	System Type
	Size	
	Count	Total number of accessories derived from BIM (e.g., Schedule)

Plumbing and Sanitary System BIM Element	Attribute	Remark
Accessories & Branch Routing & Terminal • Bulk Water Meter • Pipe (diameter <100mm) • Pipe insulation • Plumbing fixtures • Valves • Floor Trap Covers • Inspection Chamber (IC) • Manhole *Note: Supports and hangers need not be modelled in BIM*	Type	Family/Element Type
	System	System Type
	Size	
	Count	Total number of accessories & routing derived from Schedule in the BIM model
	Capacity	Equipment capacity details e.g., flow rate, temperature, power, etc.
Accessories & Branch Routing • Pipe Fittings – excluding supports and brackets *Note: Supports and hangers need not be modelled in BIM*	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of accessories derived from BIM (e.g., Schedule)
GAS System BIM Element	**Attribute**	**Remark**
Accessories & Branch Routing • Pipe (Gas Piping and Supply, diameter <100mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)
Accessories & Branch Routing & Terminal • Pipe Fittings • Valves Meters *Note: Supports and hangers need not be modelled in BIM*	Type	Family/Element Type
	System	System Type
	Size	
	Count	Total number of accessories derived from BIM (e.g., Schedule)

Fire Protection System BIM Element	Attribute	Remark
Accessories & Branch Routing • Pipe (diameter <100mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)
Fixtures and Devices • Fire Alarm Device • Fire Extinguisher • Fire Hydrant • Sensor & Detector (e.g. Heat or Smoke Detector) • Sprinkler • Breeching Inlet (with or without cabinet)	Type	Family/Element Type
	System	System Type
	Count	Total number of fixtures/devices derived from BIM (e.g., Schedule)
Accessories & Branch Routing • Pipe Fittings – excluding supports and brackets *Note: Supports and hangers need not be modelled in BIM*	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of accessories derived from BIM (e.g., Schedule)
Fixtures and Devices • Hose Reel (with or without cabinet) • Warning Light • Monitors/TVs • Breakglass	Type	Family/Element Type
	System	System Type
	Count	Total number of fixtures/devices derived from BIM (e.g., Schedule)
Electrical System BIM Element	**Attribute**	**Remark**
Accessories & Branch Routing • Cable Tray (size < 600mm) • Trunking & Cable Containment (size < 600mm) *Note: The conduit size ⩽50mm needs not be modelled in BIM*	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)

Fixtures and Devices • Lighting Fixture • Security Device	Type	Family/Element Type
	System	System Type
	Size	
	Count	Total number of fixtures/devices derived from BIM (e.g., Schedule)
Accessories & Branch Routing • Cable Tray Fittings • Cable Ladder & Fittings *Note: Supports and hangers need not be modelled in BIM*	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)
Extra Low Voltage System BIM Element	**Attribute**	**Remark**
Equipment • Audio Visual Equipment • Sensors • Controllers • Intercom	Type	Family/Element Type
	Count	Total number of equipment derived from BIM (e.g., Schedule)
Vertical Transport System BIM Element	**Attribute**	**Remark**
Equipment • Elevator Car • Motor • Control Panel/Monitoring Panel • Monitors/Computers • Visual Indicators/Call Buttons (for lifts)	Type	Family/Element Type
	Capacity (kg)	
	Count	Total number of equipment derived from BIM (e.g., Schedule)
Accessories & Branch Routing • Trunking & Cable Containment (size < 600mm)	Type	Family/Element Type
	System	System Type
	Nominal Size	
	Count	Total number of routings derived from BIM (e.g., Schedule)

Information & Communication Technology System BIM Element	Attribute	Remark
Equipment • Mobile Network Operator Antenna • Telecom Equipment	Type	Family/Element Type
	Count	Total number of equipment derived from BIM (e.g., Schedule)
Security System BIM Element	**Attribute**	**Remark**
Fixtures and Devices • CCTV Camera • Card Access Reader	Type	Family/Element Type
	Count	Total number of equipment derived from BIM (e.g., Schedule)

Appendix B – List of 2D Drawings

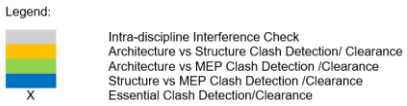
Architectural Drawing Types - 2D Drawings Generated from BIM		**Remark**
Drawing Index	Architectural drawing list	
General Notes	Overall, general, construction notes, legend, etc.	
Site Plans	Location plan, site plan, site hoarding, security fencing & scope of work plan, etc. *Note: The land surveyor's 2D survey plans with survey data could be overlayed in BIM for more site details.*	
Floor Plans	General floor plans and layout views	
Roof Plans	General roof plan, lower roof plan, upper roof plan, etc.	
Reflected Ceiling Plans	General ceiling plans	
Elevations	Overall and block elevations	
Sections	Overall section and enlarged sections	
Staircase Details	Staircase plans, elevations, railings, balustrades, risers, threads, details	
Door Schedule	Door schedule extracted from BIM	
Window Schedule	Window schedule extracted from BIM	
Drainage Plans and/or Rainwater Downpipe Plans	Plans, elevations, sections, details, etc. of the drainage system and/or rainwater downpipes	
Architectural Drawing Types - 2D Drawings Not Generated from BIM		**Remark**
Ironmongery Details/Cutsheets	Ironmongery details, cutsheets, schedule and general notes	Ironmongery need not be physically modelled. A door's **'Ironmongery Set'** may be defined as a parameter to be embedded inside of the Door Element. An Ironmongery Schedule described and referenced to each Ironmongery Set can be prepared separately outside of BIM.

Architectural Standard Details	Architectural standard details include but not limited to wall details, floor details, door details, window details, railing details, ramp details, staircase details, roof details, façade details, ceiling details, etc.	It may be produced in a separate drafting tool, but it must be consistent using call out on drawings. Alternatively, it can be prepared in detailing views with annotations in BIM to complement 3D representations.
Interfacing Details with Neighboring Contract		
Signage Key Plans		
Civil & Structural Drawing Types - 2D Drawings Generated from BIM		**Remark**
Drawing Index	Structural drawing list	
General Notes	Overall, general, temporary works, setting out and level, reinforcement notes, etc.	
Site Plans	Catchment plan, location, site plan, hoarding plan, site utilization plan, borehole & instrumentation layout plan, etc.	
Floor Plans	Piling plan, pile cap layout, general floor plan and structural layout, framing plan, loading plan	
Roof Plans	General roof plan, lower roof plan, upper roof plan, etc.	
Household Shelters/ Storey Shelters / Staircase Storey Shelter Plans	Household Shelters, Storey Shelters, Staircase Storey Shelter Plans if applicable	
Foundation Plan	Foundation and footing elevations, sections and details	
Structural Elements Schedule	Structural wall, column, beam, slab, etc., schedule extracted from BIM	
Civil & Structural Drawing Types - 2D Drawings Not Generated from BIM		
Standard Details	Civil and structural standard details include but not limited to stair details, concrete work details, steel work details, etc.	It may be produced in a separate drafting tool, but it must be consistent using call out on drawings. Alternatively, it can be prepared in detailing views with annotations in
Connection Details	Steel connection details, RC connection details, plates, etc.	
External Works	Longitudinal sections, drainage details, etc.	
Sewer Works	Manhole details, Inspection Chamber details, etc.	

		BIM to complement 3D representations.
Foundation Reinforcement Details	Structural foundation reinforcement schedule and typical reinforcement details	Recommendation: A set of **2D reinforcement details could be eliminated** if these structural elements with its essential attributes are derived from BIM in a table form (e.g., Beam Schedule); structural engineers key in the reinforcement data outside of BIM; and then sync the data back to BIM through computational approach (e.g., dynamo, grasshopper) or third-party plug-in to BIM. The same data in the table form can be used to automatically produce 3D rebars. Otherwise, reinforcement or rebars need not be physical modelled. Reinforcement details can be prepared in detailing views with annotations in BIM. Alternatively, the reinforcement details can be produced in a separate drafting tool and should be clearly specified in the Client's Requirements.
Slab Reinforcement Details	Reinforcement bar details, mesh layouts, lapping length, major/minor axis, etc.	
Beam Reinforcement Details	Reinforcement bar details and schedule, beam sizes, etc.	
Column Reinforcement Details	Reinforcement bar details and schedule, column sizes, etc.	
Wall Reinforcement Details	Reinforcement bar details, general notes, etc.	
Ramp Reinforcement Details	Ramp location on plan, details, etc.	
Staircase Reinforcement Details	Staircase plans, sections and reinforcement details	
MEP Drawing Types - 2D Drawings Generated from BIM		**Remark**
Drawing Index	Drawing list	
General Notes	Overall, general, construction notes, legend, etc.	
Site Plans	Location plan and site Plan	
Floor Plans	Overall plans and partial plans	
Ceiling Plans	General ceiling plans	

Elevations	Overall and block elevations	
Sections	Overall section and enlarged sections	
Equipment Schedule	Equipment capacity information	Mechanical equipment schedule with essential design information (e.g., air flow, flow rate, temperature, power) should be derived from BIM. More detailed design information may be provided outside of BIM in addition to exported Equipment Schedule from BIM.
MEP Drawing Types - 2D Drawings Not Generated from BIM		
Schematic Diagram	Services schematic drawings and single line diagrams	It may be produced in a separate drafting tool, but it must be consistent using call out on drawings. Alternatively, it can be prepared in detailing views with annotations in BIM to complement 3D representations.
Standard Details	Typical details and installation details	

Appendix C - Intra-discipline & Inter-discipline Coordination Matrix



Intra-discipline & Inter-discipline Coordination Matrix		Architecture									Structure					MEP					
		Wall	Floor	Ceiling	Roof	Door	Window	Column	Stair	Ramp	Structural Foundation	Structural Column	Structural Framing	Structural Floor	Structural Wall	ACMV	Plumbing & Sanitary	Gas	Fire Protection	Electrical	Extra Low Voltage/
Architecture	Wall											X			X						
	Floor													X							
	Ceiling												X			X	X	X	X	X	X
	Roof																				
	Door											X	X		X						
	Window											X	X		X						
	Column											X									
	Stair											X	X								
	Ramp											X	X								
Structure	Structural Foundation																				
	Structural Column	X				X	X	X	X	X						X	X	X	X	X	X
	Structural Framing			X		X	X		X	X						X	X	X	X	X	X
	Structural Floor		X																		
	Structural Wall	X				X	X									X					
MEP	ACMV			X								X	X		X						
	Plumbing & Sanitary			X								X	X								
	Gas			X								X	X								
	Fire Protection			X								X	X								
	Electrical			X								X	X								
	Extra Low Voltage/Security			X								X	X								

**The essential scope for coordination should include Architectural and Structural essential elements, and MEP main equipment and main service routing.*