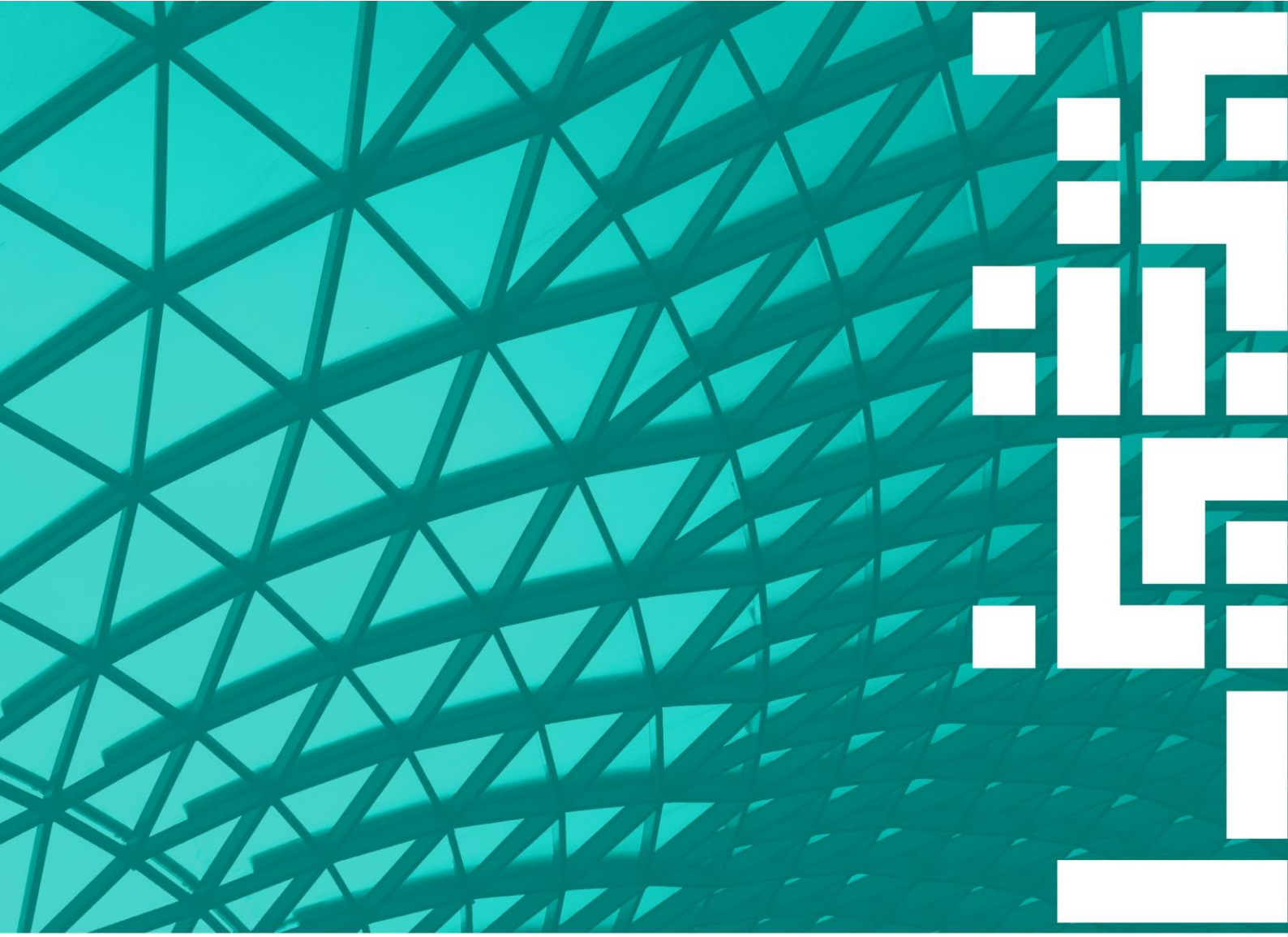

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Ashghal Building Information Modelling Standards (ABIMS)

Modelling and Data Management Guide

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PURPOSE OF THE DOCUMENT

This document is intended for internal and external use by the Public Works Authority (PWA) and external stakeholders. The Modelling and Data Management Guide is the management of graphical data and non-graphical data within the information models which must be shared between all stakeholders through a Common Data Environment (CDE). This shall ensure that project deliverables produced using the guidelines and requirements set out in this document, achieve an agreed level of quality. This Modelling and Data Management Guide is a project-specific document, and it should be used in conjunction with the project's BIM Execution Plan (BEP) and the Exchange Information Requirements (EIR).

1 PROJECT DESCRIPTION

Table 1 documents the project in general terms.

Project Name	[…]
Description of Works	[…]
Project Proposed Address	[…]
Project Number	[…]
Appointment Type	[…]
Project Proposed Design Start Date	[…]
Project Proposed Construction Start Date	[…]
Project Proposed Completion and Handover Date	[…]

Table 1: Project Description

2 INFORMATION PRODUCTION OVERVIEW

In accordance with the clauses in section 5.6 of ISO 19650-2:2018 the collaborative production of information entails;

- Checking availability of reference information and shared resources
- Generating information
- Undertaking quality assurance checks
- Reviewing information and approving it for sharing
- Information model review

This section gives an overview of the activities involved in the collaborative production of information and provides guidance and information references for each activity.

Activity	Overview
Checking availability of reference information and shared resources	All relevant existing asset information as well as shared resources, should be made easily accessible to the delivery team through the project's common data environment (CDE) prior to generating information. The location (folder structure) of this information within the CDE should be evident for the delivery team. For additional information, refer to the CDE folder structure mentioned in the BEP, and sections 3.3 within the Modelling and Data Management Guide. For templates, refer to section 5.
Generating information	Geometric and non-geometric information shall be generated in accordance with each project task team's respective Task Information Delivery Plan (TIDP), and the guidance within the Modelling and Data Management Guide. The generated information should be coordinated and cross-referenced with the shared information in the project's CDE, and it should follow the required level of information need. Furthermore, geometric information should follow spatial coordination and resolution procedures as mentioned in the BEP.
Undertaking quality assurance checks	Quality assurance checks of each information container shall be undertaken prior to the review of the information within it. Refer to quality assurance methods and procedures mentioned in section 12 within the Modelling and Data Management Guide.
Reviewing information and approving it for sharing	As per methods and procedures mentioned in the BEP and the guidance within section 12 of the Modelling and Data Management Guide.
Information model review	As per methods and procedures mentioned in the BEP and the guidance within section 12 of the Modelling and Data Management Guide.

Further considerations are listed below;

- For security considerations related to the distribution of information, refer to the BEP.
- Information deliverable formats are covered in the EIR and the BEP.
- For the information deliverable submission procedure, contact the project's Ashghal Project Manager.

3 MODEL SETUP

3.1 Federation Strategy

The use of separate discipline models can be used to control the Information Model file sizes. For larger projects, each discipline model may be divided into separate zones.

Due to the scale, complexity or anticipated construction stage, the Information Manager may separate the project and discipline models by zones, by sub-dividing the project into separate areas or levels. This should be done as per the construction schedule and included in the BEP. These zones will aid each team to model their discipline more efficiently by reducing the individual information model file sizes.

The zones and the zone file name codes shall be included in the BEP when the overall scale and complexity of the project is understood.[2]

3.2 Project Coordinates

All models shall be set at true world coordinates in relation to QND95 grid and geo-referenced and shall cross reference to the project guidelines. The true world coordinates will be set in the project as the basis for all model sharing systems across the different disciplines.[2]

In accordance with QND95 grid, the origin point and/or project base point shall be defined as ***2YYYYY.YYYN 4XXXXX.XXXE***

For Revit, where there are multiple Revit models for one project, Shared Coordinates must be used for each Revit model to ensure successful model federation. See *Section 8.1.2,* for more information on linking Revit models using Shared Coordinates. The Project Location must be set for each Revit model as the geographic location of the project. When using Shared Coordinates this will also set the Project Base Point. Where there is only one Revit model for a project, the Project Base Point must be set manually for the Revit model using the QND95 grid coordinates as specified. True North shall be set as the real-world north direction based on the site location and coordinates. Project North shall be used to rotate the project view to keep drawings and sketches readable, where necessary.

For Civil 3D, check the coordinates are set to QND95 in the drawing settings and ensure that the UCS is set to World Coordinates.

For buildings, ‘z’ values shall be in mm in relation to QND95 and for infrastructure models the ‘z’ values shall be in m in relation to QND95.

3.3 Templates

Templates which incorporate PWA's standards are available upon request. Proposed changes to these templates should be discussed and agreed with PWA. Table 2 shows the PWA software templates that can be requested.

Code	Title	Type	Format	BIM Uses
S0101	Revit Template Guide	Guide	PDF	Drawing Production, Measurement, Design Review, Design Coordination
S0102	Revit Template	Template	ZIP	
S0201	Civil3D Template Guide	Guide	PDF	Drawing Production, Measurement, Design Review, Design Coordination
S0202	Civil3D Template	Template	ZIP	
S0301	Clash Detection Matrix Template Guide	Guide	PDF	Design Coordination
S0302	Clash Detection Matrix Template	Template	ZIP	
S0303	Clash Detection Template Guide	Guide	PDF	Design Review, Design Coordination
S0304	Clash Detection Template	Template	ZIP	
S0401	Solibri Template Guide	Guide	PDF	Design Review, Design Coordination
S0402	Solibri	Template	SMC	
S0501	Synchro Pro Template Guide	Guide	PDF	Construction Scheduling
S0502	Synchro Pro Template	Template	ZIP	

Table 2: Information Model Software Templates

3.4 File Naming

The file naming convention shall ensure that all files created on the project can be identified quickly, accurately and without ambiguity.

Refer to the File Naming Convention for BIM & CAD.

3.5 Writing Style

All PWA Information models require a homogeneous writing style, element description and characters. The following requirements must be adhered to.

3.5.1 Style Requirements

Font case:

Use the 'Title Case (The first letter of each word is capitalised)' for the descriptions.

Example:

Administrator Room

Fire Pump

Air Bag

3.5.2 Allowable Characters

It is recommended to use the following characters in model descriptions.

- All upper and lower case letters,
- Alpha-characters,
- Alphanumeric,
- All digits (0...9),
- Hyphen (-),
- Underscore (_)
- Parentheses ( ).

It is not permissible to use the following characters in descriptions.

- Forward slash (/)
- Back slash (/)
- Query (?)
- Percentage (%)
- Comma (,)
- Quotation marks (“)
- Currency symbol ($, Etc.)
- Exclamation mark (!)
- Hashtag (#)
- Flower bracket { }
- Bracket [ ]

3.5.3 Date and Duration representation

InstallationDate: [DD]-[MM]-[YYYY]
WarrantyStDate: [DD]-[MM]-[YYYY]
DurationUnit: [hh]:[mm]
StartMeasure: [kk]:[mm]
EndMeasure: [kk]:[mm]

3.5.4 Currency

Qatar Currency Unit:

Name	Unit
Qatari Riyal	QAR

Table 3: Currency Table

3.5.5 Units

The attributes unit has to follow as mentioned in table.

Name	Unit	Symbol
Length	Millimeter	mm
Mass	Kilogram	kg
Time	Second	s
Electric Current	Ampere	A
Thermodynamic Temperature	Kelvin	K
Luminous Intensity	Candela	cd
Energy	Joule	J
Frequency	Hertz	Hz
Force	Newton	N
Illuminance	Lux	lux
Pressure	Pascal	Pa
Pressure Class	Bar	Bar
Potential	Volt	V
Length	Meters	m
Area	Square Meters	m^2
Volume	Cubic Meters	m^3
Density	Kilogram per cubic meter	kg/m^3
Force	newton	N
Velocity	Meters per second	m/s
Acceleration	Meters per second per second	m/s2
Work, energy	Joule	J
Power	Watt	W
Flow	Liters per second	L/s
Fan Speed	Revolutions per minute	RPM
Sound	Decibel	dB

Table 4: Units Format

4 MODEL HIERARCHY & DATA STRUCTURES

For a BIM project, it is not advisable for users to create a single large model and embed all the details in a single file. The project must be divided into logical groups (e.g. by discipline, by trade) and users need to link the models in logical hierarchy for ease of handling.

This section deals with the principles of subdividing a model for the purposes of:-

- Multi-user access
- Operational efficiency on large projects
- Inter-disciplinary collaboration[1]

4.1 Best Practice

The following practices shall be followed;

- The methods adopted for data segregation shall consider, and be agreed by, all internal and external disciplines involved in the modelling.
- No more than one building shall be modelled in a single file
- A model file shall contain data from one discipline only (although exceptions may apply for Building Services where multiple disciplines converge)
- Further segregation of the geometry may be required to ensure that model files remain workable on available hardware
- In order to avoid duplication or co-ordination errors, clear definition of the data ownership throughout the life of the project shall be defined and documented.
- Element ownership may transfer during the project life cycle - this shall be explicitly identified in the BEP.[1]

4.2 Model Division

The division of a model allows multiple users to simultaneously work on a model. Whereby, the properly utilised division of a model can significantly improve efficiency and effectiveness on projects of any size.

Appropriate model divisions shall be established, and elements assigned, either on an individual bases or by category, location, task allocation, etc.

Divisions shall be determined by the lead designer in conjunction with the person responsible for co-ordination. How and when the model is split shall be defined in the BEP.

Where required, access permissions and model ownership shall be managed to avoid accidental or intentional misuse of data.[1]

4.3 Referencing

Referencing enables additional geometry and data to be used within a project. This may be used for parts of a project which are too large to manage in a single file, or data from another discipline or an external company.

Task allocation shall be considered when dividing the model to minimise the need for users to switch between models.

When referencing, the models shall be positioned relative to the agreed project origin. The real-world co-ordinates of an origin point on the project shall be defined and coordinated in all models.[1]

5 FOLDER STRUCTURE

The following general guidance applies and will be subject to the project-specific requirements of the EIR and BEP. This section defines how BIM data shall be stored within the project filing system. All project model files, drawings, references and data, regardless of project size or type, shall be organised and filed into a standard folder structure on a central server. During daily working of a model, a copy of the model must be placed on a local workstation.

All models need to be stored on a central server to ensure backup and disaster recovery facilities are provided to safeguard the models and databases. Subfolders structure under the central server should be standardised and setup by the System Administrator. In general, other users are restricted from modifying the folder structures.[2]

5.1 Project CDE

All project data shall be held within the standard project folder structure located on central network servers or an appropriate Document Management System. This includes all work in progress files, components, and assemblies.

The defined structure must follow the principles of ISO 19650:2 'Work in Progress (WIP)', 'Shared', 'Published' and 'Archived' segregation of data within a designated set of folders.

Where a project comprises a number of separate elements, such as multiple buildings, zones or areas, the BIM structure shall be maintained within a set of designated subfolders representing the various project elements.[2]

Documentation should continuously be updated by issuing revisions. The documentation should be categorised by a suitability code as defined in ISO 19650. For example, during the design stage, information available to team members only, should be categorised as "**S0",** for the period during which all documentation is meant for internal use only. When the levels of development reach the planned step, after a compliance control and verification stage, the documentation is moved to the 'Shared' area and the relating suitability code updated to status "**S1**", meaning suitable for coordination.

5.2 Resource Folder Structure

PWA standard templates, drawing borders, objects and other non-project specific data shall be held within the central server resource library, with restricted write access. For information on how to add objects to the resource library, please refer to the Object Library Guide.

The Object Library shall be organised by software and version. Resources for each product and version shall be maintained within each folder.[2]

5.3 Local Folder Structure

Where it is a requirement of the model authoring software to store files on each local workstation, a strict folder convention shall be defined and employed throughout.[2]

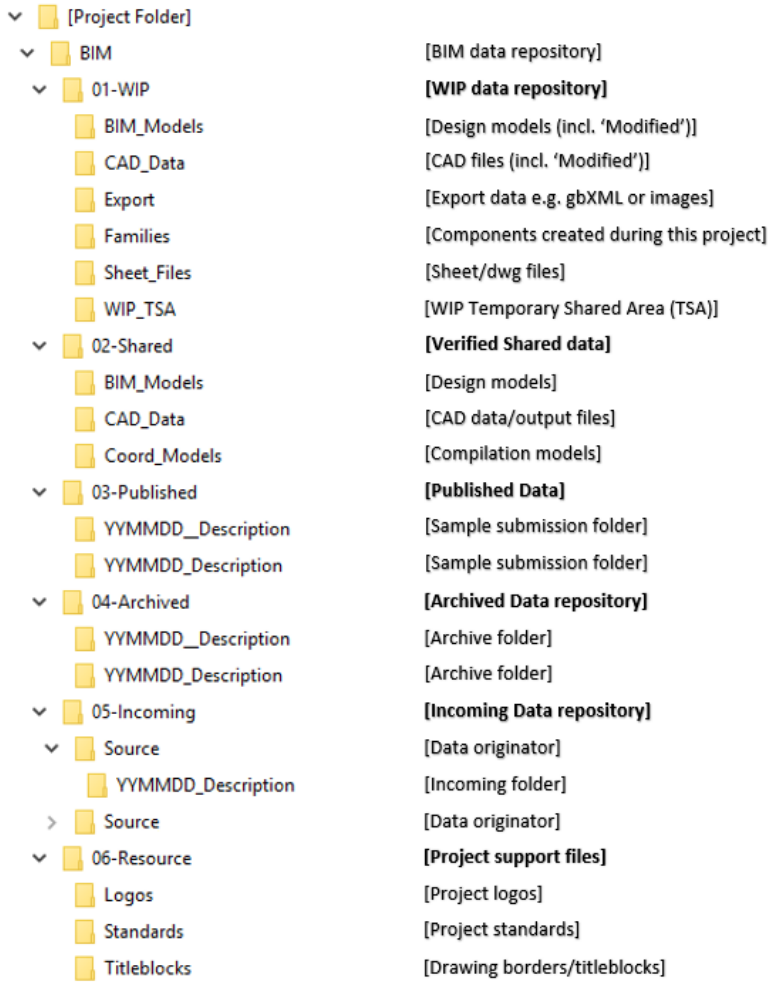

Figure 1: Project Folder Structure

Figure 1 illustrates an example only, it should be reviewed and aligned to any internal company standard folder structures as appropriate. Users must always consider company specific processes and procedures.

No spaces are to be used in the folder naming as this can be potentially interfere with certain file management and collaboration tools, instead an underscore should be used along with words written in title case.

Well organised project data both within project folders and internally within the information model authoring software will help to identify, locate and efficiently use the information required. Maintaining separate folders for WIP, Shared and Published data is part of a best practice approach even if they are not named exactly in this manner.[2]

6 GENERAL MODELLING GUIDELINES

6.1 Existing Conditions Modelling

1. The Contractor/Consultant should survey the site so as to identify levels, kerbs, building outlines, walls as well as identifying location of existing services (manholes, gullies etc.) and any other features deemed necessary to create an accurate model of the existing situation and supplied in .DWG format.
2. The model author should create an accurate surface grading model based on the information supplied in the topographical survey as mentioned in paragraph 1.
3. The levels of development for each project stage is outlined in the PWA Level of Information Need Guide. Site topography and associated elements should be created using the appropriate tools within Civil 3D. For instance, surfaces for roads, hardscape and landscape should use the surfaces creation tool. Elements for walls, fences etc. should be created using feature lines or 3D polylines to the correct levels.
4. Laser scanning should be utilised where practical to ensure accuracy of all existing condition models.

6.2 Architectural Modelling

1. The model author shall carry out the modelling at each project stage whereby the level of development of elements produced at each project stage will be aligned with the PWA Level of Information Need Guide.
2. The building or feature elements shall be created using the appropriate software, tools and components for walls, slabs, doors, windows etc. If the features of the information model authoring tool are not sufficient for modelling an element, then it shall be created using other appropriate objects and defined with an appropriate ‘’type’’ name.
3. Building or feature elements shall be modelled separately for each floor level of a project.
4. 2D lines and symbols should be used to complement the model when it is not appropriate for smaller elements to be modelled in 3D. For example, some elements smaller than 10mm may not need to be modelled but this need should be assessed on a project by project basis. 2D details may be used on drawings produced using the information model authoring tools to complement drawing packages.
5. If an architect, models structural elements, particularly in preliminary design stage, the size and location shall be as per the information provided from the structural engineers. It is recommended that the architect uses the structural model as a reference within the architectural model to avoid duplication of building elements.
6. The architect should use the actual dimension, thickness or detail to model an element accurately.[2]

6.3 Structural Modelling

1. The structural engineer shall carry out the modelling at each project stage whereby the level of development of elements produced at each project stage will be aligned with the PWA Level of Information Need Guide. The structural engineer may produce both an analysis model and a graphical model with actual member sizes and position. The model shall be used for documentation including calculations for regulatory approvals.
2. The building or feature elements shall be created using the appropriate tools (wall tool, slab tool etc.). If the features of the information model authoring tool are not sufficient for element modelling, the required building elements shall be created using other appropriate objects. In that case, users must define the ''Type'' of the element clearly.
3. A structural Information Model may include all load-bearing concrete, roof and steel structures, as well as non-load bearing concrete structures. Building elements shall be modelled separately for each storey or floor levels. If the structural design includes precast or prefabricated components, the element can be modelled and incorporated into the model.
4. Reinforcement and steel joint details may be executed in the detailed design or construction stage within a separate tool, based on the capability of the information model authoring tool, and the requirements should be stated in the BIM Execution Plan.
5. 2D drawings or standard details may be used to complement the Information Model when the elements are smaller than the agreed size, e.g. elements smaller than 10mm may not need to be modelled but should be accessed on a project by project basis. 2D drawings with standard hatching and annotations may also be used for loading spans.
6. Unless otherwise required in the PWA Level of Information Need Guide, structural models may not be required at the concept or feasibility stage. In such circumstances, for new building projects, the structural engineer may provide alternative framing options as sketches for the Architect to assess alternative design layouts for differing massing models.
7. For existing buildings, the structural engineer may develop an initial model from record drawings. The as-built model should be verified on site in advance using laser scanning technology and amended where necessary.[2]

6.4 Infrastructure/Landscape Modelling

1. The infrastructure engineer shall carry out the modelling at each project stage and the level of development for elements produced at each project stage will be aligned with the PWA Level of Information Need Guide.
2. The infrastructure or feature elements shall be created using the appropriate tools (Roads, road markings etc.). If the features of the information model authoring tool are not sufficient for modelling the element, the required elements shall be created using other appropriate objects. In that case, define the ''Type'' of the element clearly. For example, road markings can be created using surfaces if no other software is available so should be clearly defined in the property data.
3. An Infrastructure/Landscape Information Model may include all roads, junctions, trees, tree pits and street furniture, as well as road marking and signage. Infrastructure elements shall be modelled separately for each zone (as per the construction schedule).

4. 2D drawings or standard details may be used to complement the Information Model when the elements are smaller than the agreed sized, e.g. elements smaller than 50mm may not need to be modelled but should be assessed on a project by project basis.

5. The model elements shall contain the information and data available at each project stage in line with PWA Level of Information Need Guide.

6.5 Mechanical/Electrical/Plumping Modelling

1. The MEP engineer shall carry out the modelling at each project stage of the project and the level of development for elements produced at each project stage will be aligned with the PWA Level of Information Need Guide.

2. The MEP or equipment elements shall be created using the appropriate software, tools and components for pipes, ducts, valves sprinklers etc., if the features of the information model authoring tool are not sufficient for modelling the element, the required building elements shall be created using other appropriate objects. In that case, users must define the ‘’Type’’ of the element clearly.

3. 2D lines and symbols be used to complement the model when it is not appropriate for smaller elements to be modelled in 3D. For example, some elements smaller than 10mm may not need to be modelled but should be assessed on a project-by-project basis. 2D standard details may be used on drawings produced using the information model authoring tools to complement overall drawing packages.

4. The model elements shall contain the information and data available at each project stage in line with PWA Level of Information Need Guide.[2]

7 CIVIL 3D MODELLING GUIDELINES

7.1 Technical Requirements

7.1.1 PWA CAD Standards

PWA CAD standards consist of the following;

- PWA layers names and styles, line types and drafting standards made available as AutoCAD templates.
- Civil 3D Sub-assemblies
- Civil 3D Template
- Title block (included in template)
- PWA Roads_Drainage CAD Standards Manual
- PWA Roads_Drainage GIS Standards Manual

All projects must comply with PWA CAD standards and details. The standards and details are available upon request.

7.1.2 PWA AutoCAD Templates

For the latest PWA AutoCAD templates please refer to the PWA CAD Standards Manual.

All CAD files must be based on these templates. Additional support files are also included within the CAD standards package. If Consultants/Contractors require additional layers not catered for in the CAD standards, they must request these from PWA.

7.1.3 PWA Custom Subassemblies/Parts

PWA has created a set of subassemblies and parts that are fully compliant with PWA standard details and are available upon request.

7.1.4 PWA Layer Naming Convention

The PWA layer naming convention for Civil 3D is based on Uniclass – 2015. Any new layers required that may be project specific must abide by the same naming convention.

7.2 Data Shortcuts Folder Structure

Civil 3D files must be organised in a folder structure of the default Civil 3D project template.

The default project folder structure can be created on Tool space Prospector tab, scroll down to the Data Shortcuts section, right click and select 'New Data Shortcuts Project Folder'.

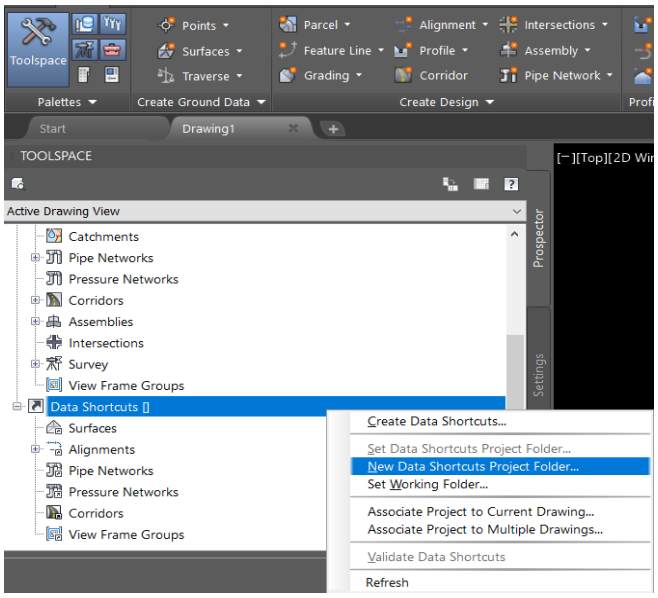

Figure 2: Tool Space - Data Shortcuts

Next step is to specify the project a name and select the use project template dialog box. The default project template folder is always located on the C:\ Drive and this should select automatically.

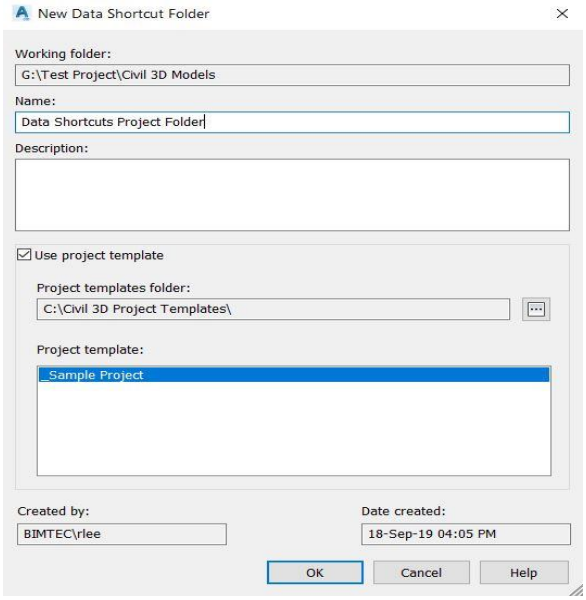

Figure 3: Creating New Data Shortcut Folder

The default folder structure has now been created. The folder must be cut and pasted into the project directory. Once those steps have been completed, users must go back to the Data Shortcuts section within the Toolspace Prospector tab, right click and select 'Set Working Folder'.

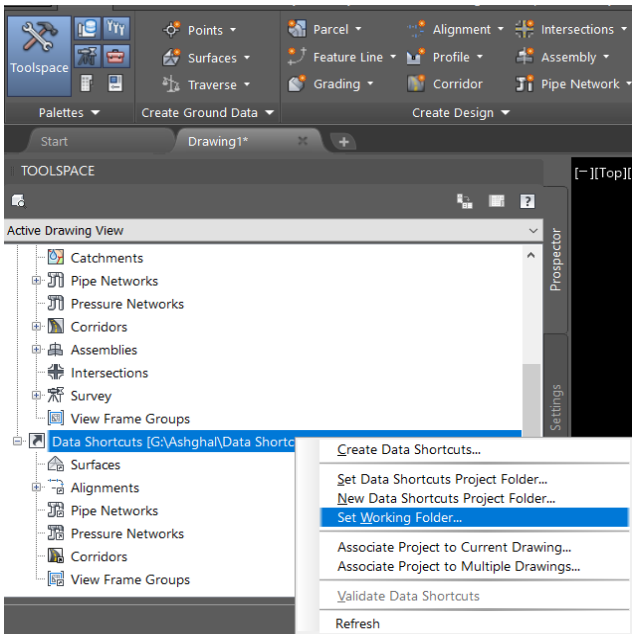

Figure 4: Set Working Folder

The folder structure should be set out as illustrated below by default. Under no circumstances must this structure be renamed, or the folders shuffled around. Additional folders can be added if necessary.

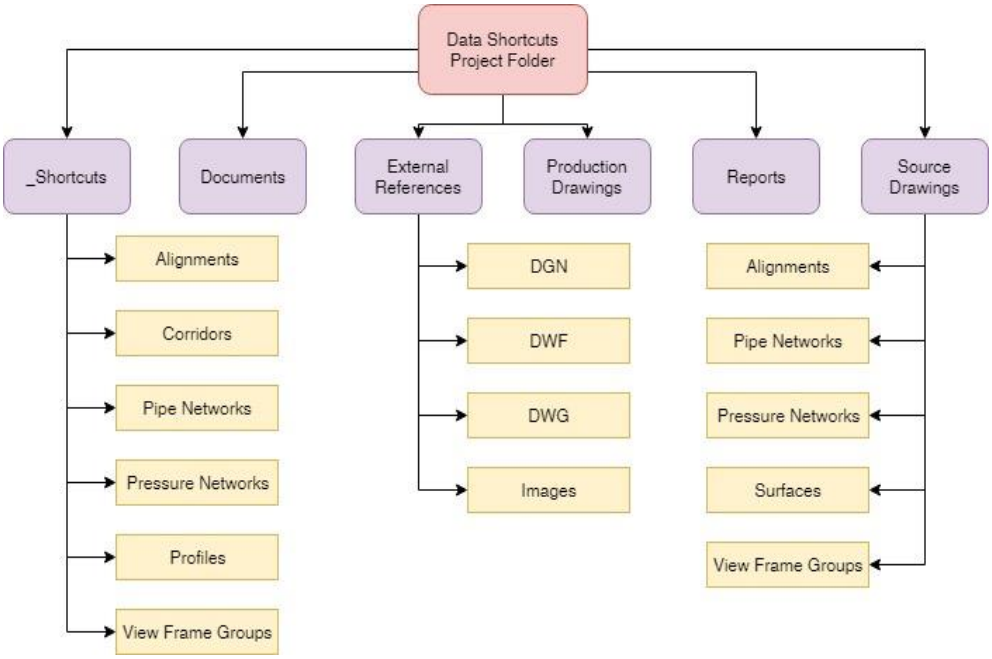

Figure 5: Data Shortcut - Folder Structure

7.3 Modelling Regulations

7.3.1 Existing Ground Surface Model

The importance of an accurate and complete digital model of the project site terrain cannot be overstated since it is the foundation of the 3D model. Survey data must cover the full extent of the project boundary including any tie-ins to existing infrastructure outside of the boundary and meet the requirements for the state of Qatar survey standards.

Consultants must create a digital terrain model (DTM) in Civil 3D from the survey data and save the file in accordance with the PWA File Naming Convention for CAD & BIM. An export of the existing ground surface should be done by right clicking on the surface in the Toolspace Prospector tab and selecting export to LandXML. The existing ground surface must be kept in a separate file so that it can be easily referenced. The original survey files (as received from the surveyor) and the AutoCAD .dwg must be supplied with the submission of the Civil 3D model.

7.3.2 Alignments/Profiles

The number of alignments in a project will depend upon the design team's requirements. Project design teams may choose to subdivide alignments with a project into several zones in order to make the design process more manageable. If this is the case, all alignments and their vertical profiles must be created and designed in a separate file. If two alignments are connected but in separate files, they must join seamlessly. The naming convention for zones must comply with the PWA File Naming Convention for CAD & BIM.

All alignment styles must follow the PWA standards available in the Civil3D Template. This can be done by selecting 'PWA Style' when creating an alignment.

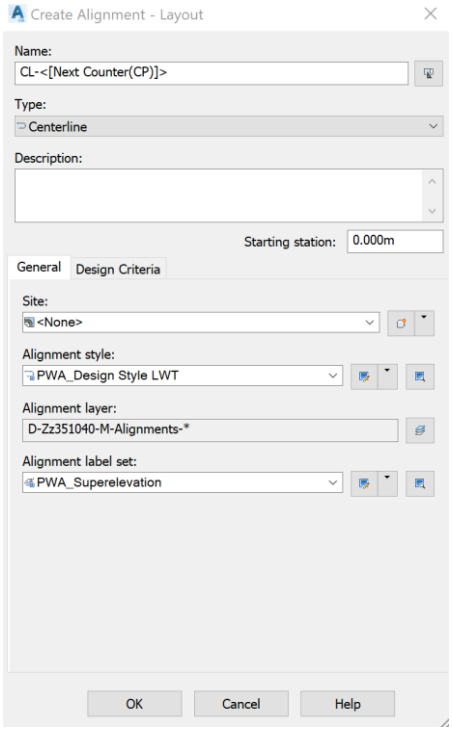

Figure 6: Creating Alignment

The design must adhere to design standards provided by the Qatar Highway Design Manual. It is incumbent upon designers to ensure that their Civil 3D models meet this standard. Civil 3D provides several tools to check and validate the design. Centreline alignments can be designed with the use of the Civil 3D Criteria-Based Design feature. A custom design criteria file should be created based on the default criteria of the particular project (if applicable). The Design Checks Set tool can then be used to set up and check the alignment and profile parameters that are not included in the design criteria file.

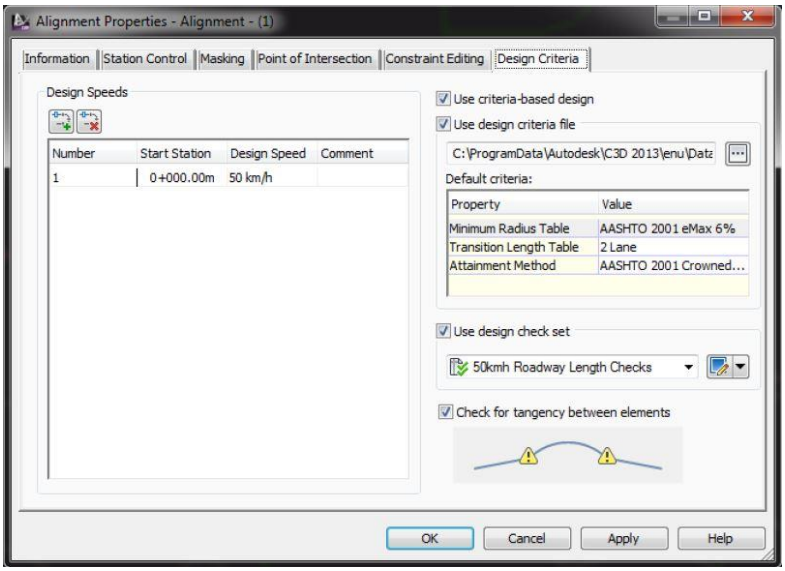

Figure 7: Alignment Properties

Creating this design criteria is not mandatory but is viewed as best practice for modelling as it ensures adherence to design standards.

Profiles must be produced for every alignment and follow the PWA standards available in the Civil 3D template. These band sets can be expanded depending on the amount of data required in the profile e.g. Road Channels, Surface Water, and TSE etc.

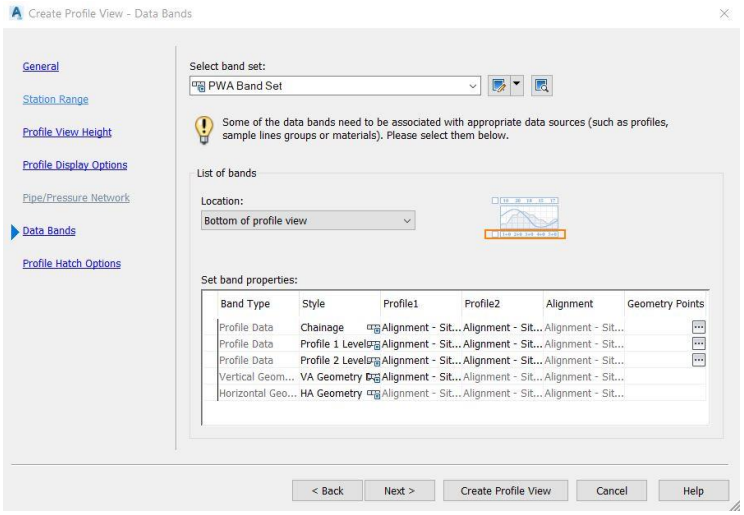

Figure 8: Profile View Properties

For large expressway projects, the use of multiple alignments in the same zonal areas is required to accurately targets widths and elevations as well as to create well-presented sheet layouts at a reasonable scale.

7.3.3 Corridors & Corridor Surfaces

In order to keep corridors and corridor files at a manageable size, users must subdivide the project to best facilitate construction/design activities if required. Hardware limitation aside, the approach must focus on keeping a rational subdivision of the design and limiting model size to no greater than 200mb. Corridors should be modelled as per the construction schedule (if available) or to facilitate construction modelling where specified.

Surfaces must be created by material type, e.g. footpath, road, hardscape, landscape. Surfaces must be extracted from the corridors using the Top link code as separate surfaces and named as per the construction zone followed by the surface description e.g. Zone 1-Footpath Surface Course.

Once the top surface is created for all material types, they must be exported from the model. Once exported, a new drawing needs to be created, and the top surfaces imported. The new model is now clean and free from all constraints such as target lines. All construction layers should have a corresponding surface (see *Figure 9*). This can be done by copying the surface and by using the 'Raise/lower surface' command the surface level can be altered as per the construction details.

Figure 9: Surface Naming

It is important to note that each of these models serve their own purpose, therefore both models need to be provided to PWA for validation.

Additionally, all the 2D polylines in the model used as width targets must be placed on a layer called 'Targets'. Prior to submission, all data shortcuts must be validated as to ensure that there are no dead data shortcuts or broken object references. Civil 3D models not compliant will be rejected by PWA.

7.3.4 Utilities

7.3.4.1 Gravity Networks

Wet utilities that will be built as gravity systems, should be modelled with regular Civil 3D pipe networks. This includes storm sewer and foul sewer networks. A foul sewer rising main is a pressure network, therefore, it should be represented with a Civil 3D pressure network.

All the elements that are in physical contact with each other should form part of a single pipe network. Pipes and structures must be sized and positioned correctly and must match the design exactly. During the laying out of a pipe network, the finished ground surface must be used as a reference surface for all the parts of the network.

Prior to creation of a network, the appropriate pipe network catalogues should be selected, and a parts list created based on the design material. Parts lists should only contain elements used in the network design. The **Part Builder** tool should be used to add new sizes to a parts family or customize existing parts. Prior to editing any catalogue, we recommend that a backup copy of the catalogue be made as a precaution.

7.3.4.2 Pressure Networks

Potable water, Treated Sewage Effluent (TSE), and foul sewer rising main networks should be created with Civil 3D pressure networks. All the pipes, fittings, accessories and chambers must be included in the network as per the design. The general rule is that the pressure networks should be modelled with Civil 3D pressure networks and gravity networks with the Civil 3D gravity networks. 3D model must reflect the same information as found in the 2D design layouts.

Provided the only material that is available in the Pressure Network Catalogue for the pressure networks is ductile iron, Content Catalogue Editor (a small app which is part of the Civil 3D installation) should be used to create new materials, part families and parts based on the material used in the design. If some pipe network parts are not available by default (e.g. caps and hydrants), content files should be created with the AutoCAD solids and imported into the Content Catalogue Editor to create pressure parts. All the elements of the network must be shown in the model, including the thrust blocks. Thrust blocks do not have to be pressure parts but can be represented independently as solids.

Structures are not available in the pressure network catalogue, therefore chambers for the pressure networks can be modelled using the gravity network tools.

7.3.4.3 Dry Utilities

Dry utilities should also be modelled using Civil 3D networks. The screenshot shown in *Figure 10* illustrates a part of a MV network built with the Civil 3D pipe networks. Structures must be custom-made from AutoCAD solids with the Parts Builder.

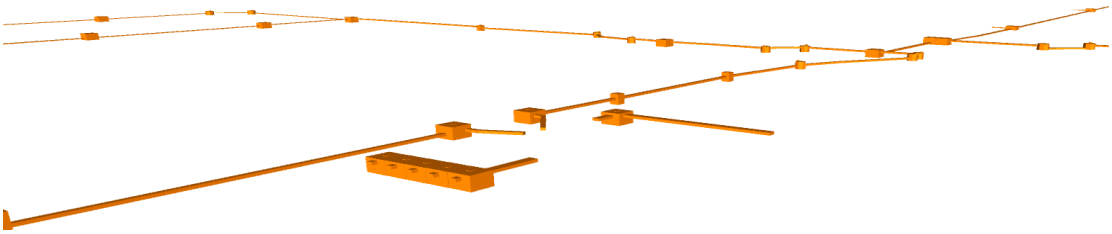

Figure 10: Dry Utilities: MV Network

7.3.5 Infrastructure Colour Coding

A consistent colour coding is needed for clearly representing a discipline 3D model. For guidance, refer to the colour coding mentioned in the PWA CAD Standards Manual, and the templates in section 3.3. This should be further defined on a project-by-project basis and included in the BEP.

7.3.6 Assemblies/Subassemblies

Before consultants create a new subassembly, they must analyse requirements and check if the required subassembly already exists within the PWA provided templates.

Consultants must not under any circumstances rename PWA issued subassemblies or respective **.pkt** files. Making any changes to PWA issued subassemblies will cause serious compatibility problems between the consultant's models and the client's system. Renaming PWA issued subassemblies is not an acceptable practice and submissions of models with renamed subassemblies will be rejected.

All new subassemblies created by consultants must follow the naming conventions below.

	Originator	Source	Type	Subtype/ Product Code	Differentiator (optional)
Description	Object/ library provider	Object manufacturer (omitted in generic objects)	Identify object type or material type	Identify predefined (sub) type or manufacturer range	Identify additional specialisation information
Example	PWA	_Marshalls	_K3	_DroppedKerb	_150x250

Table 5: Object Naming Convention

Example: ***PWA_Marshalls_K3_DroppedKerb_150x250***

The names of the subassembly preview images are subject to the same naming convention rules and must be identical to the subassembly name or the image will not appear in the Tool Palettes.

PKT files should also match the name of the subassembly. Naming a **.pkt** file differently will result in unnecessary complications when trying to identify installation files for certain subassemblies.

Point, link and shape codes need to be consistent across all subassemblies and can be equivalent to the point, line and shape codes in PWA issued subassemblies.

Shapes are used for quantity take-off calculations. They are created when links completely enclose an area. Shape codes should bear names descriptive of the items they are representing.

All subassemblies and associated files created by the consultant should be submitted to PWA with every submission. These subassemblies will be audited in the same way as the model and if deemed to be inadequate the full package will be rejected.

7.3.7 Pipe/Pressure Network Parts

The PWA template contains a series of pipe network parts and pressure network parts. These parts, as with the subassemblies should not be modified or renamed under any circumstances. If additional parts are required, the consultant should model these in the Autodesk Parts Editor and submit to PWA with every submission as detailed in the project BEP.

7.4 Drawing Production

PWA has created several different production templates as discussed in *Section 7.1.2*. The standard PWA drawing frames are contained in all the available templates. These templates should be copied to the project folder and the project attributes applied.

Drawing production should be done by extracting drawings directly from the model from the tools available in Civil 3D. First 'View Frames' must be created using the 'Create View Frames' option within the 'Output' tab.

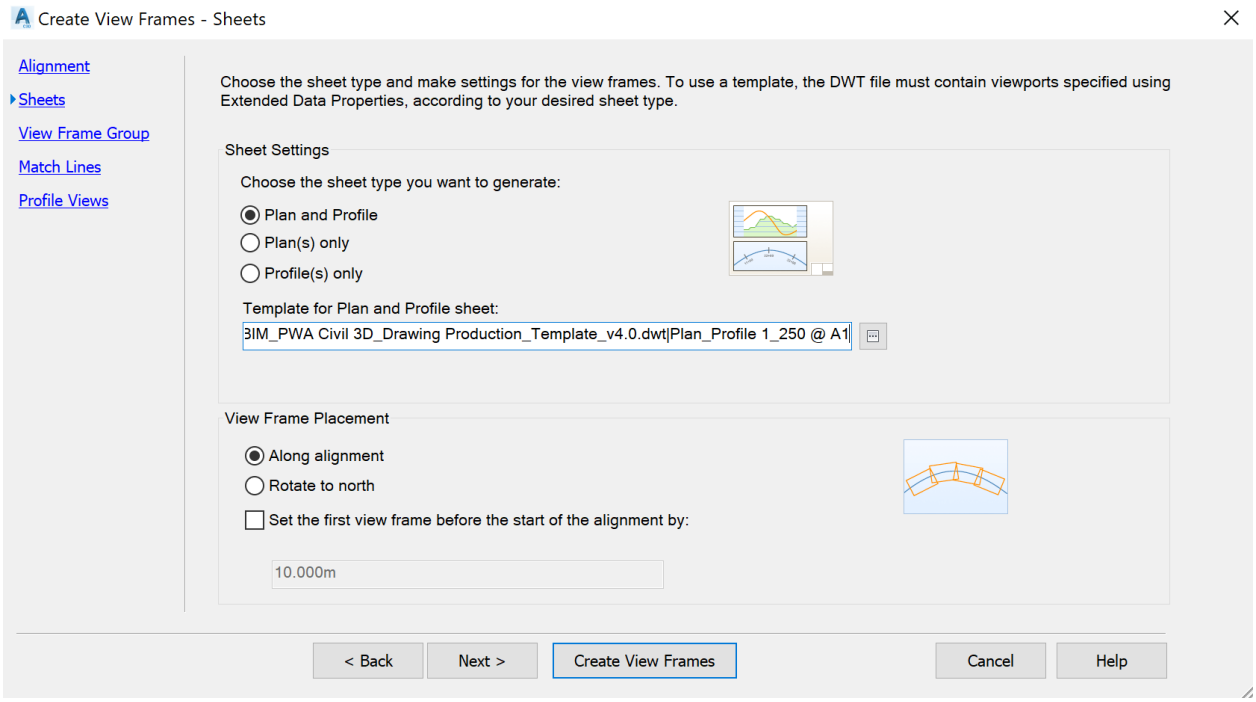

Figure 11: Create View Frames

View Frames should be created using the 'Along alignment' option. Profiles views should always use PWA standard band set incorporated within the Civil 3D template.

The next step is to create the sheets using the 'Create Sheets Option'.

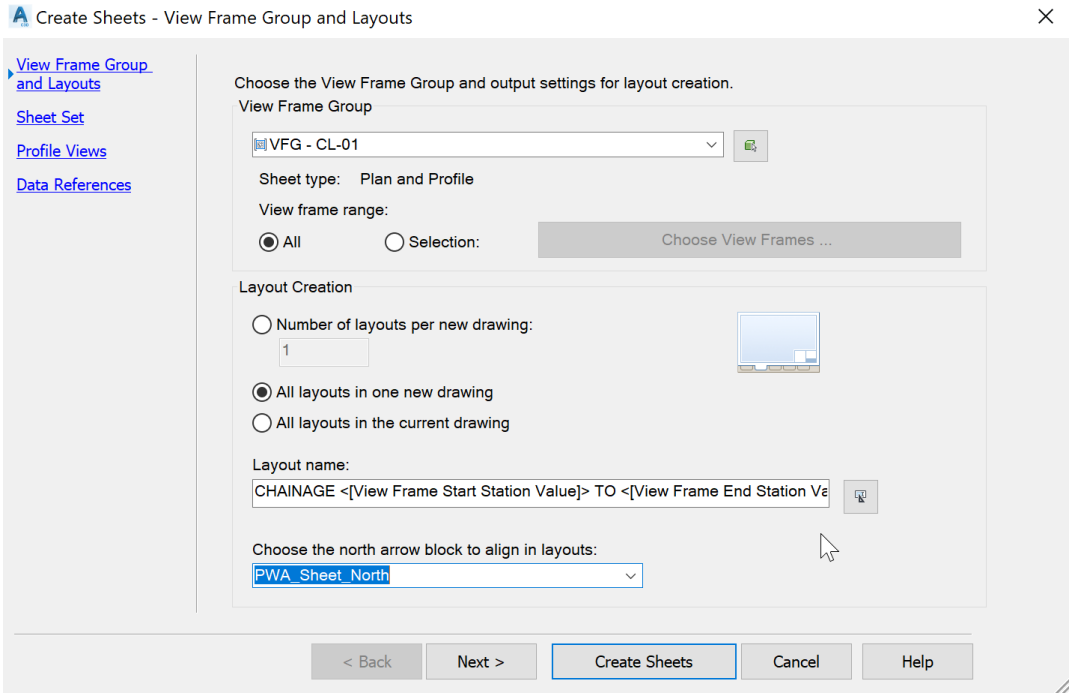

Figure 12: Create Sheets Sets

7.5 Data Shortcuts

The use of data shortcuts is a requirement for all Civil 3D model submissions. Data shortcuts must be used in order to subdivide the model into a number of corridor files of manageable size, and to maintain a dynamic link between objects in different files. Data shortcuts help distribute data load over several files ensuring that the 3D model does not become too large. It also makes it possible to share the work within a team through subdivision of the project into segments each consisting of a number of Civil 3D corridors. Alignments and profiles must be created in a separate file from the rest of the model and referenced into the corridor files with data shortcuts. In this way if an alignment or profile needs modification, only the original file will require editing.

Data Shortcuts Editor is an application within Civil 3D and must be used to fix broken data shortcuts when moving a 3D model from one place to another. After setting the 'Data Shortcut Project Folder' discussed in *Section 7.2*, fixing data shortcuts with the Data Shortcut Editor and saving the changes, it is still necessary to validate data shortcuts with the 'Validate Data Shortcuts' command. Fixing data shortcuts using the Data Shortcut Editor is not a guarantee that the data shortcuts will work. Data Shortcut Editor fixes only the path to the source file where the object is located but it does not check whether the source object still exists.

Submissions that do not have properly set up and validated data shortcuts will be rejected.

To access the Data Shortcuts Editor, do the following;

1. From the windows desktop, click the start menu and navigate to the list of programs.

2. Open the Autodesk Civil 3D folder and click Data Shortcuts Editor. The editor will open in a separate window.

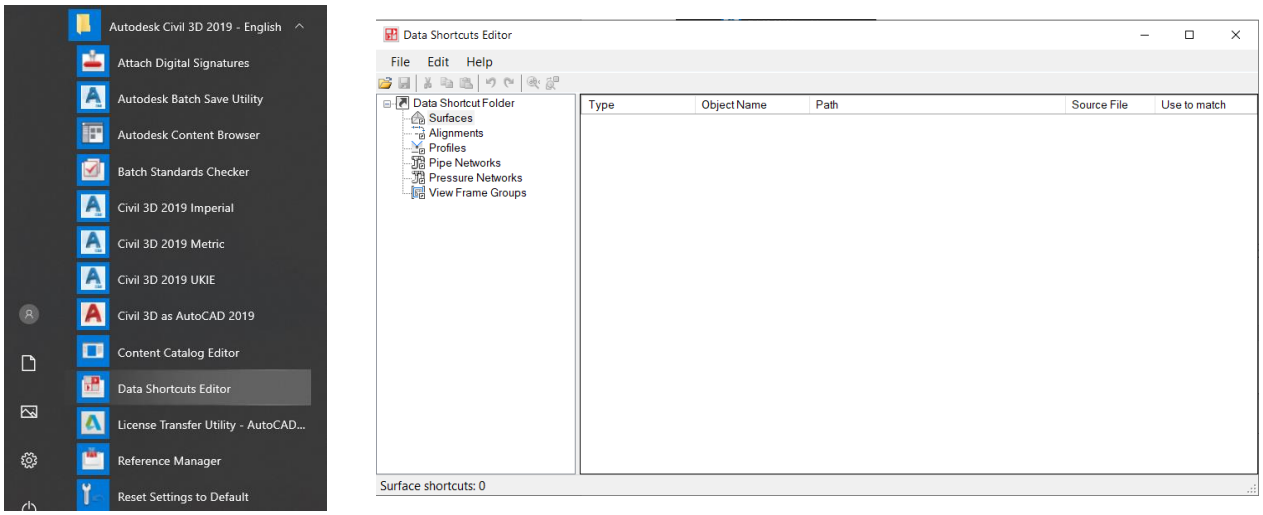

Figure 13: Data Shortcut Editor

3. In the Data Shortcuts Editor window, click 'File' menu > Open Data Shortcuts Folder, and navigate to the project folder that contains the data shortcuts you want to edit.

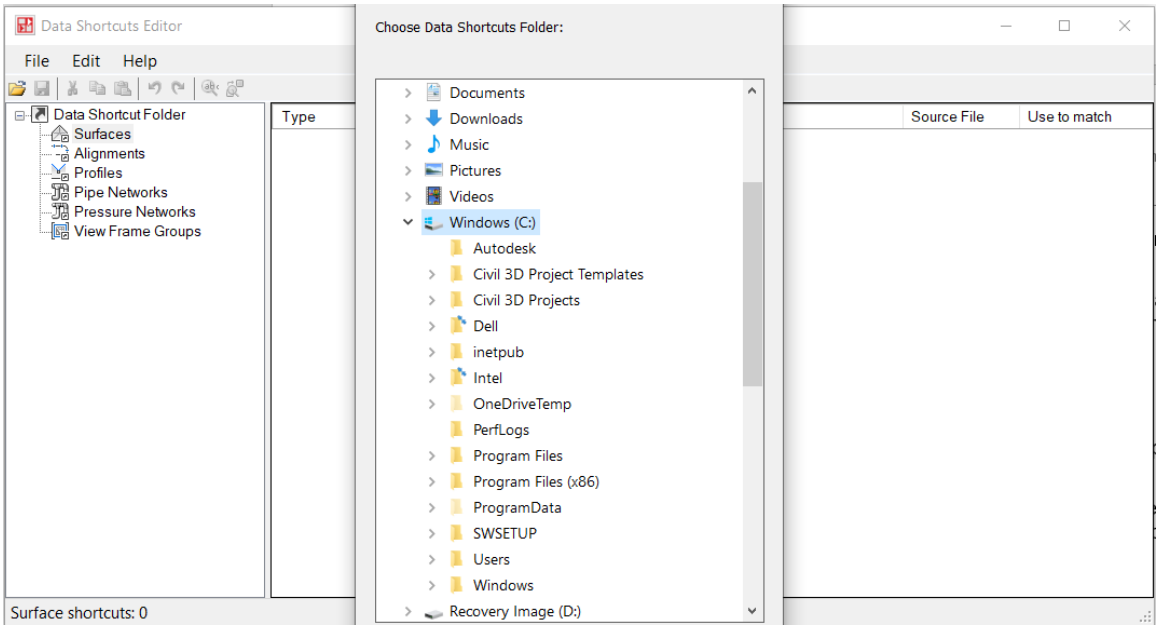

Figure 14: Data Shortcuts Folder

Changes made in the Data Shortcut Editor window do not take effect until shortcuts are reloaded. To reload the shortcuts, set the data shortcuts folder, or close Autodesk Civil 3D and restart it.

7.6 External References

All the XREF files that are used and attached to the model must be delivered as part of the 3D model submission. Include other source files in a separate folder. Detach and remove unused files to avoid confusion. PWA File Naming Convention for CAD & BIM must be followed for all external references.

7.7 Model Attributes

7.7.1 Property Sets

Property sets must be assigned to the model, to incorporate object properties that are not assigned automatically within the Civil 3D model. These properties need to include all the parameters required for asset management. A predefined list of property sets is available within the PWA Civil3D Template_Model Authoring.dwt as shown in *Figure 15*.

Parameters must be defined using the 'Define Property Sets' option within the 'Manage' tab.

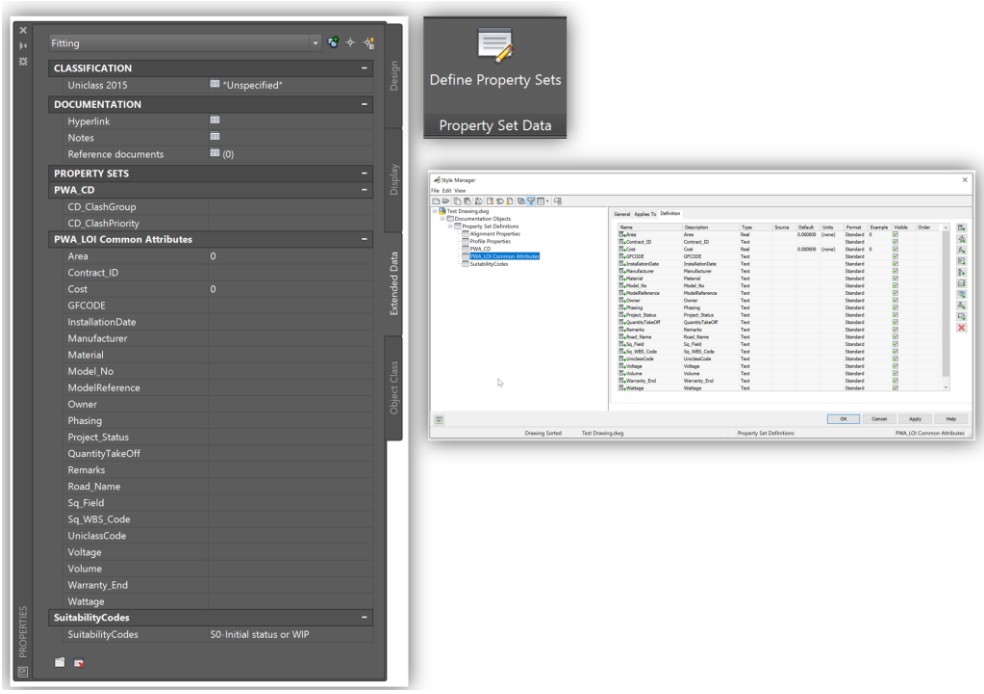

Figure 15: Define Property Set

Parameters applicable to each object must be defined and subsequently be visible when reviewed within the Navisworks software.

7.8 Dynamo for Civil 3D

The use of Dynamo for Civil 3D is encouraged for more efficient design. If Dynamo for Civil 3D is utilized, then the script files must be issued as part of the deliverable files.

7.9 Industry Foundation Classes (IFC) for Infrastructure

To be confirmed in a later revision of this document.

7.9.1 Object Data

Object data is attribute data that is attached to individual objects and stored within tables in the drawing file.

Object data must also be assigned to the models for the same reason as property sets. Object data is required for display in PWA's GIS software. The same parameters should be applied as defined in the Level of Information Need Specification.

To assign object data, the workspace needs to be changed to 'Planning & Analysis':

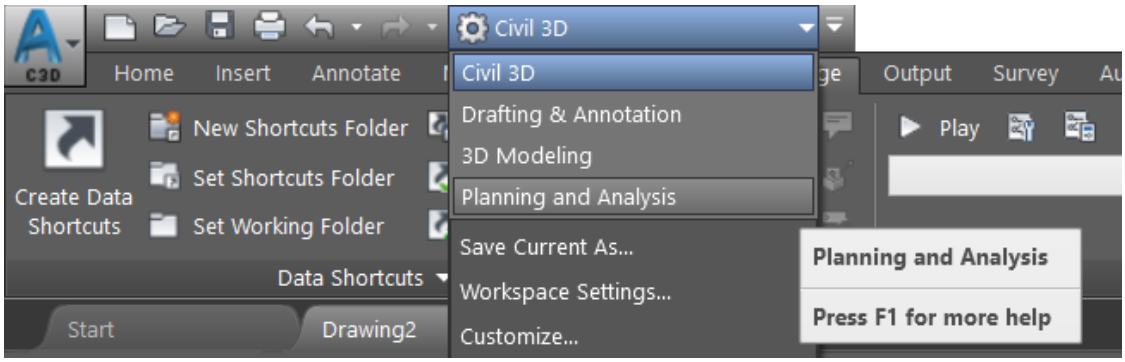

Figure 16: Workspace

Once in the correct workspace, navigate to 'Map Setup' in the ribbon and select 'Define Object Data'. When the dialog box opens the user must select 'New Table' and specify a name for the table as per the Level of Information Attributes and input the data fields as necessary.

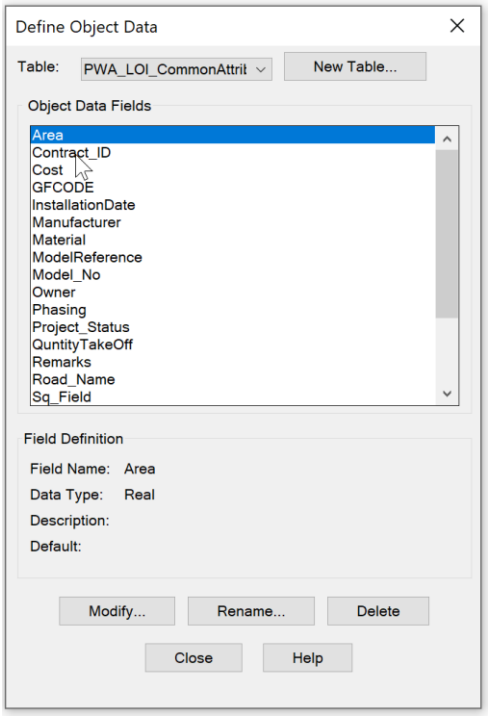

Figure 17: Define Object Data

Following the creation of all the tables, they should be assigned to each object using the 'Attach/Detach Object Data' in the 'Create' tab and the data fields completed.

7.10 File Purge

It is recommended that the DGN Purge utility is used first to purge all files, followed by a second purge using the standard AutoCAD 'Purge' command. Submissions must be free of miscellaneous and unused files as well as dead links/references. There should not be any 2D objects in the 3D model.

7.11 Model Export/Deliverables

Models shall be exported as per the project BEP with the required deliverables which have been specified within the approved document. The deliverables should contain a checklist as discussed in *Section* 12.

All models/drawings should be packaged using the eTransmit function of the software. To access the eTransmit function, navigate to the application icon, select Publish and then eTransmit

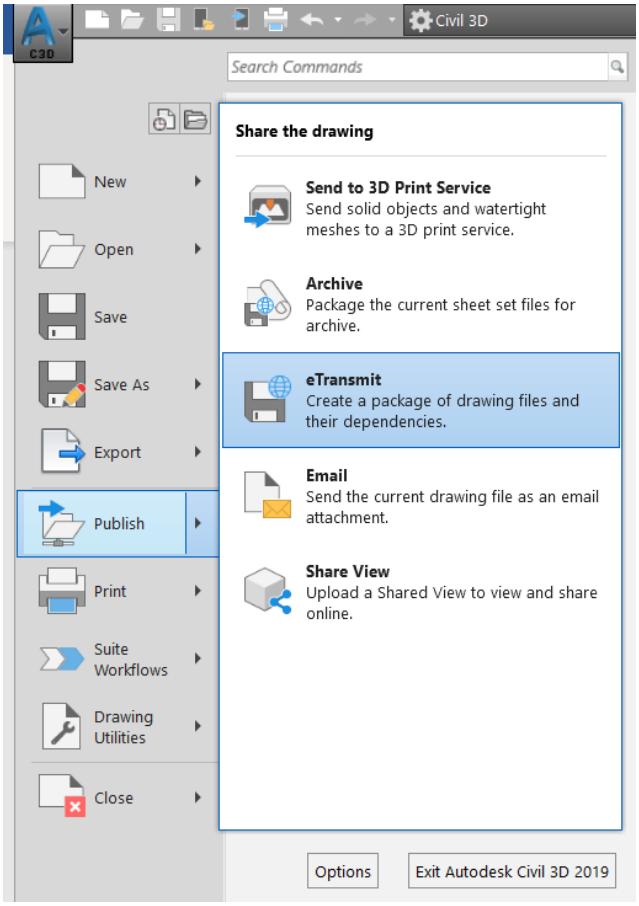

Figure 18: Model Export/Deliverables

8 REVIT MODELLING GUIDELINES

8.1 Collaboration

Unless otherwise specified in the EIR or the BEP, the collaboration tools of Autodesk Revit shall be utilised as appropriate to support the needs of the project. Each discipline will create a separate copy of their central model, if used, and uploaded to the project CDE on a weekly basis, making them accessible to all participants of the team.

Users needing to open a Revit model should do so by opening from the central model, ensuring that 'Create new local copy' is ticked. This option ensures that a local copy/file is created on their local drive, allowing for synchronisation back to the central model. Synchronisation to the central model will ensure that teams can work collaboratively on a model and that changes are kept centrally, avoiding the risk of parallel working and abortive work. The user should make sure that they have connectivity/connection to the central model before attempting to synchronize the model; this will help to avoid potential issues with file corruption. It is best practice to synchronise regularly and not wait until the end of a working day.

The central file should be maintained and audited throughout the project, with backups regularly created to provide redundancy, should the team need to revert due to unforeseen circumstances or file corruption. Issues and errors with central models should be monitored and any found, should be brought to the attention of the Information Manager and communicated immediately.

8.1.1 Worksets

Worksets shall be used to group elements of various Revit categories into logical portions. The use of worksets ensures that project teams can work on models collaboratively, allowing individuals to temporarily take ownership of various elements or portions of the model. By taking ownership, the elements on the associated workset are 'locked/checked', removing the ability for others to edit the elements within the central model, reducing the opportunity for conflicts in modelling.

Worksets are largely project specific and will vary on a project by project basis, however typical worksets within a model may include:

- Shared levels and grids
- Imported CAD layouts
- Linked disciplinary/consultant models
- Model objects associated with a particular part of the building (for example, external envelope, level 00, internal partitions, building cores etc.)

Notes on using worksets:

- Upon opening a model which utilises worksets, users have the ability to 'specify' which worksets should be opened upon load up. This may help the user to reduce the model opening time by only loading the model elements which they require.
- As noted above within the list of typical worksets, a workset for each linked model should be created. This gives flexibility of turning linked models and their visibility on or off prior to loading the model which reduces the time taken to open the model. The same is true for CAD links.

- When creating worksets, users can specify whether or not the workset is visible in all views. This option can be changed retrospectively, users need to be careful to ensure required elements aren't incorrectly hidden, however setting this visibility correctly on creation of the workset can save time in subsequent visibility manipulation.
- When modelling/placing objects within a model, the elements will automatically be placed on the 'current' workset. Users should monitor and regularly check that elements are placed on the correct workset.

Work offsite and offline:

Whilst working offline on a local copy of the model is possible, users should only do so where unavoidable. Working offline can lead to incompatibility issues with the central model and the loss of work.

8.1.2 File Linking

Within Revit, it is possible to link other models and data into a project model. There are different use cases for linking, however typically a project will be broken down into different disciplinary models and/or separate volumes for larger models (such as individual wings for a hospital). Revit is susceptible to significant performance issues as model file size increases, depending on the specifications of the IT hardware being used, therefore splitting models into volumes is often necessary to prevent an individual modelling becoming too large and unmanageable.

Models and external data can also be brought into a model using the import method; this should be avoided where possible.

8.1.2.1 Single Discipline Linked Files

To ensure compliance with maximum file size requirements (stated with the EIR and/or BEP) and to maintain model performance, the splitting of a single disciplinary model into multiple files may be required. These separate model files may remain split for the duration of the project.

Where discipline models are split, a single model shall be provided which contains the split models linked; this model containing links can either be a separate "empty" model (a model containing nothing other than the links) or a primary model (one of the split models clearly indicated as such). The splitting up of models requires consideration as early as possible – note that although it is possible to do retrospectively, this can lead to lost work and errors. Before sub-dividing and splitting models, project teams should consider the following:

- Task allocation – to minimise the need for constant switching between files, consideration should be given to which elements/zones of a project best live together and will be worked on in conjunction with one another.
- Model division should be determined by the lead architect or engineer, with the BIM coordinator's input.
- Model lines should be used to create a reference point/crosshair to help those relinking models be confident they are aligned and in the correct location.
- Ensure shared coordinates have been set up and established

When linking in Revit models (whether that be of the same discipline or not), users are presented with various positioning options. Positioning 'Auto - By Shared Coordinates' should always be used.

If the incoming model does not have shared coordinates established/in use, this positioning option will default to 'Auto – Center to Center' which should not be used.

8.1.2.2 Inter-Disciplinary Model Linking

As a minimum, it is expected that each discipline will have its own model. Disciplines are responsible for their model and its contents. Where reference needs making to another discipline, models should be linked in. To aid with collaborative working, the following points should be noted and considered:

- It is essential that real world shared coordinates and project north is agreed and documented at the outset of a project. These should be noted within the BEP and should not be deviated away from, unless instructed to do so by the BIM Coordinator.
- An agreed list of common levels should be identified. Some models may have discipline specific levels such as 'top of concrete' or 'finished floor level'.
- Further to the point above and noted elsewhere within this document, the copy and monitor tool should be used to duplicate common levels and grids. This tool should not be used for other elements within Revit without understanding the implications of its use.
- Model element production and ownership should be documented and tracked throughout each project stage. Different elements may have different owners throughout the project stages of a project, a typical example being floor slabs, whereby they will reside within the architectural model before ownership being taken by the structural engineer.
- If there is a need for a discipline to create a placeholder/'starter' model (in lieu of a 3D model existing for another discipline), this should be done as a separate model and linked in. For example, if the architectural discipline need to create placeholder structural elements in lieu of a structural model existing, these should be modelled in a separate model which is then linked in to the architectural one.
- If model division is required within one discipline, the BIM Coordinator should be consulted to aid with best practice, highlight potential implications, and agree the overall strategy.

8.1.3 Project Landing Page

The project landing page should be used as the default opening view for all models. This page uses a title block containing basic information about the project. Information on this page should include:

- Project number
- Project name
- Project status
- Address
- Company
- Legal information and notes on use and sharing of 2D and 3D information

It is essential to ensure that the model revisioning is kept up to date and that the current revision is noted on this landing page; a brief description should be included giving an overview of the main updates/changes.

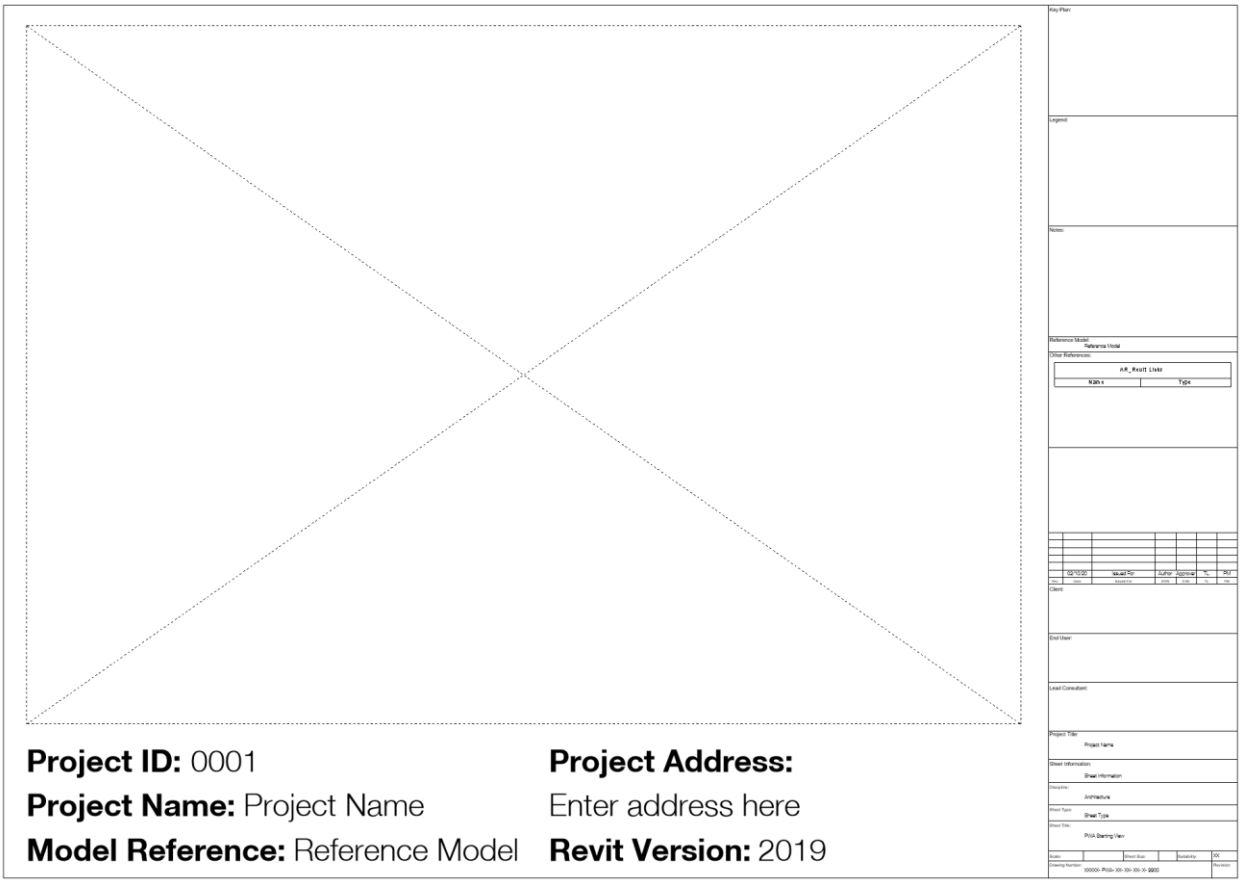

Figure 19: Project Landing Page

8.1.4 Project Browser Set Up

Project browser organization for views and sheets is pre-defined in the Revit Template Guide.

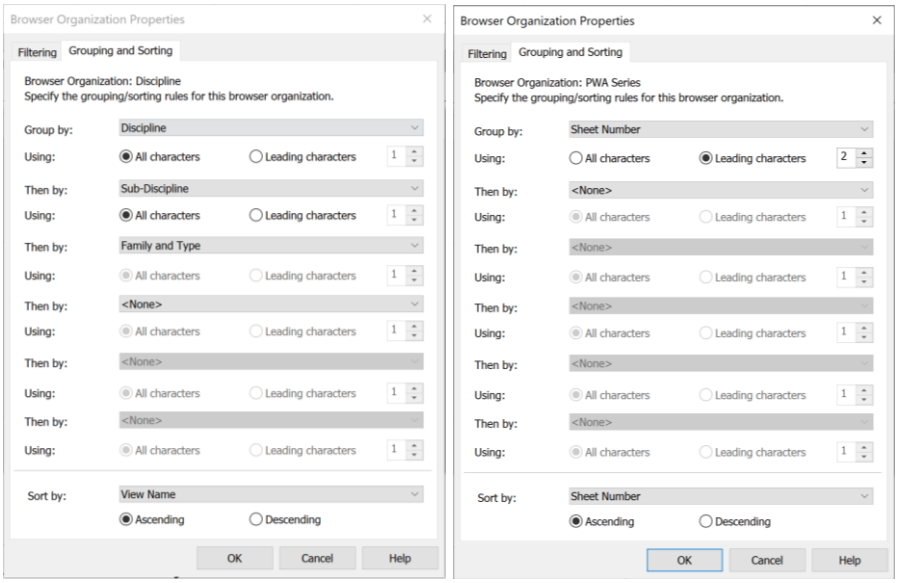

Figure 20: Browser Organization

8.2 Naming Convention

A consistent and logical approach to naming of elements within models is essential. Following standardised naming conventions ensures that there is a uniform approach and minimises the risk of misinterpretation of modelled objects. Naming should always be kept as short as possible but be descriptive enough for users to quickly identify and understand what an object or element is. The following sections outline how different Revit elements should be named. It is the responsibility of both individuals and the project task team manager to ensure that there is a consistent approach to naming across projects and models.

8.2.1 Level Naming

Levels should not be duplicated across different disciplinary models. Use of the 'copy/monitor' tool should be made, this ensuring that the elevation (height of levels) and names of levels are consistent and correct across all models. It is vital that there is consistency across models and design information with regards to level naming – this includes existing and as-built information.

For level naming within buildings, the following naming convention should be used:

- [Discipline] _Level [Value/Description]

  Example: **A_Level 01**

Level values will be two characters aligned to the following list, or, if not applicable, a description of the intended level purpose:

- **ZZ** - Multiple levels
- **XX** - No level applicable
- **00** - Base level of a building

- **01** - Level 1
- **02** - Levels 2, etc
- **R0** - Roof above Level 00
- **R1** - Roof above Level 01, etc
- **M1** - Mezzanine level above Level 1
- **M2** - Mezzanine level above Level 2, etc
- **B1** - First level below the building base level
- **B2** - Second level below the building base level, etc

8.2.2 Grid Naming

As noted in *Section 8.1.1*, a levels and grids worksets should be created within Revit with the respective grids placed on them.

Grids will be named with an alphabetical character horizontally from left to right (west to east in project north) beginning with 'A' through to 'Z', and a numeric character vertically from bottom to top (south to north in project north) beginning with '1'.

Where possible (and depending upon existing information) users should avoid using 'I' and '0' for grid naming as these can cause confusion with similar letters/numbers.

8.2.3 View Naming

Naming conventions for views should be followed. Following the convention ensures that teams can coordinate which views are necessary and their respective purpose. The below convention only relates to Revit views (floorplans, reflected ceiling plans, callout views, sections, elevations etc.). Sheets should be named in accordance with the document numbering system.

Arrangement/layout plans:

- Discipline_LevelName_Description.

  Example: ***A_Level 00_CeilingPlan***

Sections/elevations:

- Discipline_Number/Letter_Direction/Description

  Example (section): ***P_01_FireExtinguisher***

  Example (elevation): ***P_NorthEast***

Views for Navisworks export:

- 3D_Navisworks_Export_Discipline

  Example: ***3D_Navisworks_Export_P***

8.2.4 Material Naming

Materials within the model are required to have a unique, logical name. If known, physical, thermal and appearance properties should be set up/completed.

For material naming, the following naming convention should be used:

- Material_Type_Method_Specification_Description_Dimension (optional)

  Example: ***CeramicTile_UnglazedPressed_X25_White_300x300***

8.2.5 Family and Family Type Naming

The Revit term 'family' refers to almost all graphical entities within Revit. The term 'family' is used due to a Revit family's relationship with other objects and data.

Family names should be composed of the source/originator (typically company, organisation or manufacturer), type (high level description), sub-type (typically predefined subtype, manufacturer's product name etc.) and differentiator (material, size, colour etc.). To help with standardisation and commonality across projects and model files, families should be named in a logical way and follow the naming convention as outlined in the table below.

	Originator	Source	Type	Subtype / Product Code	Differentiator (optional)
Description	Object/ library provider	Object manufacturer (omitted in generic objects)	Identify object type or material type	Identify predefined (sub) type or manufacturer range	Identify additional specialisation information
Example	PWA	_Sigma	_Door	_DoubleWithTopPanel	_2100x900

Table 6: Family Naming

Where measurements are included within a family name, millimetres should be used as the units of measure. Where possible, width should be the starting dimension with others following.

Different families exist within Revit. The following sections go into these in more detail.

8.2.5.1 Loadable Families

Families that are loaded into a project should follow the naming convention as outlined in *Section 8.2.5*. Each field required should be separated by an underscore. Underscores should not be used elsewhere within the name, for example, a 'space'. Where one would usually use a 'space' to separate words, camel case should be used instead. This is highlighted below.

Example for Family naming: ***PWA_Sigma_Door_DoubleWithTopPanel***

A Family Type is part of a family and specified by parameters which differ to other types of the same family. The family type naming is according to material and measurements. In case material is not applicable relevant significant identification feature like 'duty' could be defined and assigned. Each field shall be separated by an underscore character '_'. Underscores shall not be used anywhere else in the family type naming.

Family 'Types' within Revit are predefined types of a family which may have differing parameters, materials, dimensions etc. A family named '**PWA_Sigma_Door_DoubleWithTopPanel**' may have several variations related to structural opening size. Types should be named using the 'Differentiator' field as highlighted within the table in *Section 8.2.5.*

Example for Type naming: ***400x600***

8.2.5.2 System Families

The term 'system family' refers to a predefined Revit family that exists within Revit by default. Examples of system families include ducts, pipes, cable trays, conduit, floors, walls etc.). System families should follow the same naming convention as outlined in *Section8.2.5*. An example can be found below:

PWA_Pipe_WaterSupply

Types should be named using the 'Differentiator' field as highlighted within the table in *Section 8.2.5.*

8.2.5.3 Annotation Object Families

Object styles and annotation families such as lines, detail components, texts etc. should be named as per the following naming convention:

Description_ Dimension/Specification

- Family: Linear Dimension Style — Type: **Diagonal_3mm**
- Family: Text — Type: **Opaque_3mm**
- Category: Line — Type: **SiteBoundaryLine_Red**

8.2.6 Room / Space Numbering

Rooms and spaces placed within the model should all have a unique name and number. These numbers should follow the below naming convention:

- Level Value_Sequential Number (01, 02, 03 etc)

  Example: ***01_03***

8.3 Modelling Regulations

Where possible, the below practices should be avoided due to implications they may have on model performance throughout a project:

- Overly complex geometry. It is important to remember that the primary purpose of Revit is to capture design/construction information, not to provide a photo realistic model, and doing so would have negative impacts on the usability of the model.
- Overly constrained and locked dimensions/geometry. Geometric constraints are beneficial to impart the design logic into the model, however existing constraints are not easily identified, and conflicts are difficult to resolve without deleting all constraints.
- Overuse of model and detail groups. Groups within Revit have a particularly large impact on model performance and are often used where families would be more appropriate.
- Importing files rather than linking. Importing files includes the file and all its data within the Revit model, furthermore in some cases these can be difficult to track and purge later in the project.

The following sections identify and give guidance on best practice with regards to modelling within Revit.

8.3.1 General Principles

3D elements shall be generated in accordance with the appropriate Level of Development specified in the EIR and BEP, with reference to the Level of Information Need Guide and generated either, as design generic or manufacturer's specific representation of real-world objects using the designated toolset.

Where 'out of the box' tools within Revit cannot achieve the desired outcome and model need, users should look to utilise other appropriate software and plugins such as Dynamo.

If 3D objects have been imported and are not of a Revit file type, these should be loaded into a family and then loaded into the project environment to ensure that they are visible and display when the model is linked into others.

8.3.2 3D Solid Elements

Users should avoid representing 3D objects through the use of model lines and creating 'wireframes'. Wireframe objects do not allow for analysis or scheduling. Modelled objects should always be formed of solids.

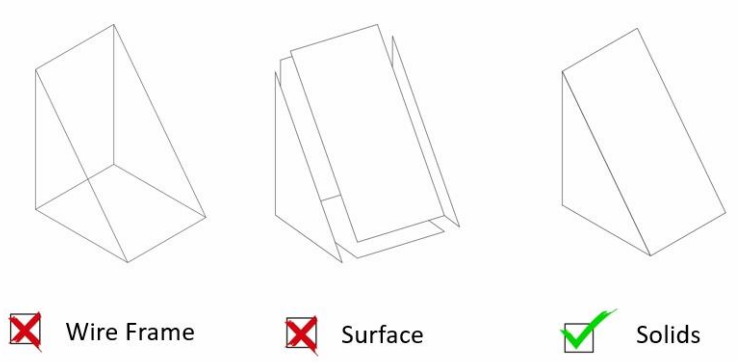

Figure 21: Definition of 3D Solid Elements

8.3.3 Element Identification

As with most other 3D authoring and modelling software, Revit makes use of an Element ID structure, giving a unique ID to every element. These Revit Element ID's allow users to track elements, and also review warnings and errors and the associated modelled object/element.

Global Unique Identifiers (GUID's) are another form of ID that are generated upon export of a model to certain file formats. They enable user to be able to track model elements and changes regardless of the native file format, and are commonly used with the coordination and clash detection process. They play a vital role in the collaborative modelling process.

Upon export from Revit to Navisworks, GUID's are created for all modelled objects. These GUID's produced are based upon Revit Element ID's but may vary due to the method and logic used in generation.

8.3.4 Geometrical Granularity

Models should be assembled as elements will be assembled on site. All modelled objects should correspond with the correct and proposed measurements of building components and be as representative of the intended object as possible. If parts on site are to be assembled using precast elements, these elements should be modelled individually and not as one, as per the diagram below. Regardless of required LOD, the above logic should always be applied.

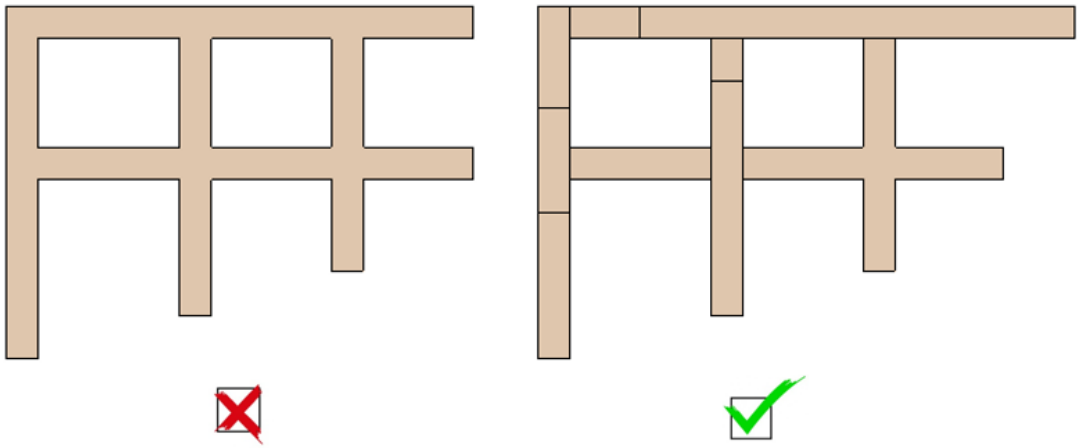

Figure 22: 3D Model as one 3D Element and Divided into on-site Assembly Parts

Users should make use of detail levels within Revit. Where design information may only be schematic, only a series of indicative lines or simple shapes may be required. However, as the progresses, more detailed information will be required. To gain efficiencies and reduce abortive work, detail levels allow a user to switch between 'course, medium and fine'. As an example, in the early project stages, it may only be required to show an opening within a wall to indicate where a door will be situated. This door family may have functionality built within so that when the detail level of a view is changed, additional detail automatically shows (for instance, door frames, swings, architraves etc.) In the case of this example, Revit users should avoid creating 3 separate families for the same door element. Users should instead look to use detail level functionality instead.

Where a user is unsure on the required detail level/geometrical complexity of a modelled object, they should always aim for simplicity (whilst acknowledging the points within the paragraphs above). Scale within Revit does not affect file size, however the complexity of families and geometry does. *Note: the 3D complexity and detail requirements of objects will be stated within the BEP.*

At a minimum, each modelled object should be reflective of the proposed size and account for any protrusions that it may have. An example of the simplification of an element can be seen in the below *Figure 23: 3D Model Simplification Level*.

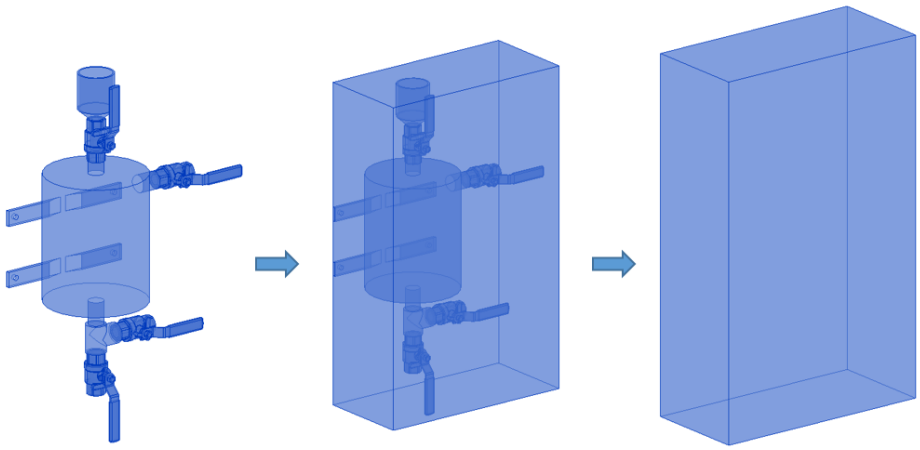

Figure 23: 3D Model Simplification Level

As demonstrated above, the height, width and depth of the object shown remain the same within the two different models, still allowing teams to coordinate spatially.

8.3.5 Modelling Sequence

Where modelled objects are of the same material, users should ensure that the correct cut, join and intersect conditions are used to reflect how the objects are assembled on site. Users should avoid overlapping geometry – primary components should always be cut by the secondary components where an intersection occurs. *Figure 24* below, demonstrates where a slab (primary element) cuts a column, and the column then cuts a beam.

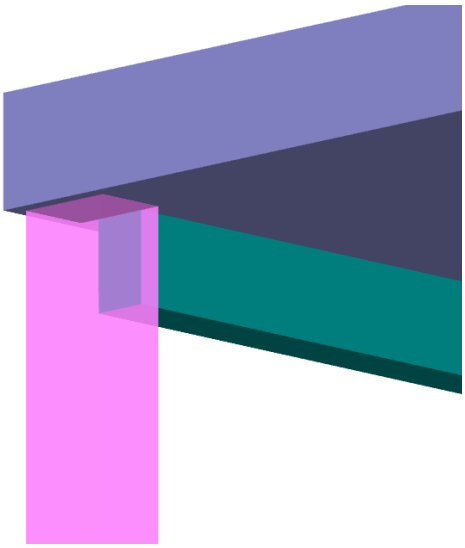

Figure 24: Modelling Sequence Example

8.3.6 Phasing

Users should make use of Revit phasing to help with identification of existing and proposed/new construction elements. Unless otherwise stated within an EIR or BEP, projects should use the two default Revit phases as identified below:

- Existing
- New Construction

The table below identifies element types and the phase they should be placed upon:

Element Type	Phase Constructed	Phase Demolished
Existing and Retained	Existing	No Value (Not Demolished)
Existing and Demolished	Existing	New Construction (Demolished)
Permanent New Construction	New Construction	No Value (Not Demolished)
Temporary New Construction	New Construction	New Construction (Demolished)

Table 7: Phasing

Thought should be given to the way in which elements are modelled. If only part of an element is to be demolished, this element should be modelled as two parts, with each placed onto the appropriate phase.

8.3.7 Model Colour Coding

To help with identification of model objects, a colour coding strategy should be used and applied to 3D views through the use of the filter option within Revit. *Note: filters can be part of view templates will only require set up once, either with the Revit template or in a project environment*. An example colour coding strategy for model components can be found below, this should be further defined on a project by project basis and included in the BEP:

Model Elements Colour Scheme					
#	Description	Colour Name	Colour Code (RGB)	Material	Content
1 Drainage System					
a	All Drain Pipes	Custom	100-250-100	DrainagePipe	All other Drainage Pipes/Fitting/Accessories
b	Vent Pipe	Custom	200-250-100	DrainageVentPipe	All Vent Pipes/Fitting/Accessories
c	Soil Pipe	Custom	150-200-000	DrainageSoilPipe	All Soil Pipes/Fitting/Accessories
d	Waste Pipe	Custom	000-128-000	DrainageWastePipe	All WastePipes/Fitting/Accessories
2 Water Supply					
a	All Water Supply Pipes	Custom	000-150-250	WaterSupplyPipe	All Water Supply Pipes/Fitting/Accessories
b	Hot Water	Custom	000-050-200	WaterSupplyPipe	All Water Supply Hot Water Pipes/Fitting/Accessories

Model Elements Colour Scheme					
#	Description	Colour Name	Colour Code (RGB)	Material	Content
3 Chilled Water System					
a	Chilled Water Supply	Custom	128-000-255	ChilledWaterSupply	All Chilled Water Supply Pipes/Fitting/Accessories
b	Chilled Water Return	Custom	250-150-250	ChilledWaterReturn	All Chilled Water Return Pipes/Fitting/Accessories
4 HVAC Duct System					
a	Supply Air Duct	Blue	000-000-255	HVACSupplyDuct	All HVAC Supply Duct/Fitting/Airoutlets/Accessories
b	Return Air Duct	Magenta	255-000-255	HVACReturnDuct	All HVAC Return Duct/Fitting/Airoutlets/Accessories
c	Exhaust Air Duct	Green	000-255-000	HVACExhaustDuct	All HVAC Exhasut Duct/Fitting/Airoutlets/Accessories
d	Smoke Extract Duct	Custom	200-200-250	HVACSmokeExtractDuct	All HVAC Smoke Extract Duct/Fitting/Airoutlets/Accessories.
e	Smoke Make-up / Pressurization Duct	Custom	200-200-000	HVACMakeupPressurizationDuct	All HVAC Smoke Make-up / PressurizationDuct/Fitting/ Airoutlets/Accessories
5 Fire Protection					
a	Sprinkler Pipe	Red	255-000-000	FireSprinklerPipe	All Fire Sprinklers Pipes/Fitting/Accessories & Sprinklers
b	Hydrant + Breaching Inlet Pipe	Custom	250-100-000	FireHydrantBreachingInletPipe	All Hydrant + Breaching Inlet Pipe/Fitting/Accessories
6 LPG					
a	All LPG Pipes	Custom	250-200-100	LPGPipe	All LPG Pipes/Fitting/Accessories
7 Medical Gas					
a	All Medical Gas Pipes	Custom	255-127-000	MedicaGas Pipe	All Medical Gas Pipes/Fitting/Accessories
8 Electrical System					
a	Electrical Power System Components	Cyan	000-255-255	ElectricalPower	All Electrical Power Cable Trays/Trunk/Fitting/Busbar
b	Electrical Essential Power System Components	Custom	000-128-192	ElectricalEssentialPower	All Essential Power Cable Trays/Trunk/Fitting
c	Electrical Data System Components	Custom	128-000-128	ElectricalData	All Electrical Data Cable Trays/Trunk/Fitting
d	Electrical BACS System Components	Custom	250-100-200	ElectricalBACS	All Electrical BACS Cable Trays/Trunk/Fitting
e	Telecommunication Components	Custom	189-189-126	Telecom	All Telecomm Trays, and Device

Model Elements Colour Scheme					
#	Description	Colour Name	Colour Code (RGB)	Material	Content
f	Fire Alarm Components	Custom	255-255-100	Fire Alarm	All Fire Alarm Trunking, Cables and Device
g	Electrical 3rd Fix	Yellow	255-255-000	Electrical3rd Fix	All Lighting Fixtures/Sensors/Sockets/Devices/Switches/Manual Call Points
9 Equipment's					
a	Mechanical Equipment, Electrical Panels, Plumbing Fixtures, Fire Cabinets, Fire Extinguisher, GSS Cylinders, Hanger & Supports	Custom	128-128-000	MultipleItems	All Mechanical Equipment, Electrical Panels, Plumbing Fixtures, Fire Cabinets, GSS Cylinders, Hanger & Supports
10 Structural					
a	Structural Discipline Components	Custom	098-098-098	Structural	Slab/Floors/Walls/Parapet /MEP Plinths etc.
b	RC Walls – Fire Rated	Custom	150-100-000	RCWallsFireRated	RC Walls Fire Rated
c	Beams, Columns & Structural Steel	Custom	100-000-000	BeamsColumnsStructuralSteel	Structural Framing/Beams, Columns & Structural Steel
d	Structural Steel	Custom	200-050-100	StructuralSteel	Structural Steel
11 Architectural					
a	Architectural Discipline Components	Custom	255-200-165	Architectural	Floor Finishes/Walls/Claddings etc.
b	Block Walls, Partitions – Fire Rated	Custom	200-102-000	BlockWallsPartitionsFireRated	Fire Rated Walls & Partitions
c	Ceiling	Custom	190-215-190	Ceiling	Ceiling

Table 8: Colour Coding

Each new discipline/ system shall be assigned a unique colour, which is not assigned to any other trade or sub trade. For any additional / missing items not listed in the table should be included in BEP for final approval.

8.3.8 View Templates

View templates allow users to predefine the view settings for a particular type of view and apply these templates to multiple views. Their purpose is to ensure consistency across 2D/3D outputs and help with efficiency due to a reduction in the need to manually change view settings and overrides in large numbers of views. All views placed on to sheets should have the appropriate view template applied.

View templates should be consistently and logically named, and follow the below naming convention:

- Originator_Description

  Example: ***PWA_General Arrangement Plan***

8.4 Model Attributes

For Revit models a corporate shared parameter text file shall be created, shared with the model author, and updated when needed by the team leader/discipline head. This is required to avoid parameter duplication and multiple parameter names to describe the same element properties etc. The Shared Parameter file captures the parameters required within the Level of Information Need Specification.

Where COBie is required on a project, it is expected that COBie parameters are added through the use of the COBie Extension for Revit, and these are used as appropriate for the development of project and COBie information on the project, with further guidance provided in the COBie Template Guide. There are a limited number of parameters that are present both in the Shared Parameters file and within COBie, for example 'Installation Date'. Where this overlap exists, the Shared Parameter can be mapped within the COBie Extension for Revit to the relevant COBie parameter, following guidance in the COBie Template Guide, resulting in both uses being fulfilled from the single parameter.

8.5 File Purge

Submissions should be free of miscellaneous and unused files as well links/references. This can be controlled using "*Manage Links*" and "*Purge Unused*". It is recommended to utilise the Purge function multiple times to ensure all unused items are removed as some may be freed up when their parents are purged.

8.6 Model Export/Deliverables

Models should be exported as per the project BEP with the specified deliverables. The deliverables should contain a checklist as discussed in *Section 8.* For central files, models should only be submitted after they have been "Detached" from the central model.

8.6.1 Industry Foundation Classification (IFC)

The IFC format is designed to be a single common format for exchanging of information between software across the whole design, construction and operation lifecycle, as such the potential volume of data that can be contained is significant. Model View Definitions are a subset (or 'View') of the IFC Schema, targeted as specific workflows or uses of the project data. Importantly, they do not contain all the information (geometrically or parameterised) present in the source model, and as a result they need to be carefully chosen to ensure the correct information is available. Further information is available on the Building Smart website.[3]

When exporting models to the IFC format, the purpose of the exchange should be considered and an appropriate Model View Definition (MVD) should be used. The Revit exporter contains a number of view configurations out of the box, and will default to the last used when exporting. The Authority does not require a specific MVD to be used.

9 CONSTRUCTION SEQUENCING

Subject to the requirements of the EIR and BEP, the construction sequence model will be created to support the understanding of construction sequencing, scheduling, phasing, and constructability. Key requirements are:

Every 3D element relevant to the construction sequence shall be clearly identified using level/zone as defined within this document. In addition, the modelling team has to ensure compatibility with the project WBS room/space to enable accurate linking of 3D model elements to related activities of the construction program.

Fragmentation of elements that will not be represented in the drawings, may be achieved using “Create Parts” tool. However, splitting the 3D elements into “parts” should be kept to a minimum, as they contain much less information than in the original 3D element. Parameter values are only inherited by parts if they exist before splitting.

Splitting shall be defined where necessary for buildability, for example, a continuous long wall will not be constructed in one stage e.g. when:

- Construction joints are needed to meet design restrictions
- Construction joints are required by construction management
- Partly demolishment is required; the element has to be split to separate the demolished and retained parts.

For Civil 3D, Roads/Highway networks may be modelled as one continuous corridor, but when the surfaces are extracted, they must be split as per the construction sequencing using the CREATECROPSURFACE command. All the cropped surfaces should be combined in one model file with the 4D parameter (‘**PWA_LOI_Construction Sequencing**’ property set definitions) assigned which shall relate back to the construction schedule.

For the list of attributes to be assigned for Construction Sequencing please refer to the Level of Information Need Specification. All elements should have a prefix ‘XX’ code applied following the guidance within the Level of Information Need Guide.

10 COST MANAGEMENT

In order to enable a 3D model-based quantity take-off, the following modelling requirements shall be met:

- The 3D Model shall be free of model groups. Quantification for a single element cannot be derived from model groups which will provide inaccurate quantities.
- The use of generic model families shall be reduced to a minimum (only objects quantified per item, e.g. furniture) and only 3D elements using the correct family type, shall be used.
- Splitting 3D elements into “parts” should be kept to a minimum, as they contain much less information than in the original 3D element (e.g. perimeter of slab), unless where they will be procured separately.
- Application of materials to the modelled solid geometry is necessary.
- Wall Sweep and Slab Edges require special attention when adding parameters. Unless unselected and re-selected, Revit may not add parameter to 3D elements within this family type.
- For roads/highways, solids should be extracted from the corridors and automated property sets assigned for volumes.
- Sub-assemblies should be amended to show correct depths of road construction build up as per the project design details.

Specified (but not limited to) parameters should be available in the BIM model for their assignment to a BOQ item and cost calculation. For the list of attributes to be assigned for Cost Management please refer to the Level of Information Need Guide.

In terms of 3D model updates, changes are tracked via the 3D element Globally Unique Identifier (GUID). The cost management software does not capture material changes made on existing elements. Thus, 3D elements that need to be modified in terms of material shall be deleted and generated completely from new with assignment to the respective Revit family type or CAD layer. It is not allowed to change the material of an existing 3D element already quantified. Otherwise, where elements are to remain within the model, priority should be given to move them rather than delete and re add. This will maintain their GUID and connection to the cost plan.

The quantification has to consider for all finishes and substrates (e.g. including but not limited to screed, waterproofing, plaster, floor -/ wall -/ ceiling finishes). The aforementioned shall be linked to each room/space they are to be constructed in and to be defined by its unique identifier to allow for re-usage for detailed progress monitoring of finishing works.

PWA must receive in a structured, relational readable format (e.g. MS Excel) providing for each element the UniqueID (IFC and DWF) together with the linked BOQ items, along with their BOQ ID, quantities and location where applicable at a minimum.

11 LASER SCANNING

For the latest guidance on how LiDAR data can be collected for Ashghal assets, including specification, and format of deliverables for LiDAR data, please use the contacts below.

Typically, the captured data should be in industry standard file types such as PTX, PTG or E57. However, these general requirements should be confirmed with the respective Ashghal Operations and Maintenance department.

For Roads Operations and Maintenance Department (ROMD) please contact:

- Name: Harish Pradeep Kalbhairav
- Email: h.kalbhairav@ashghal.gov.qa

- Name: Vara Prasad Lingam
- Email: vlingam@ashghal.gov.qa

For Drainage Networks Operations and Maintenance Department (DNOMD) please contact:

- Name: Hugo Miguel Da Silva Ferreira
- Email: hferreira@ashghal.gov.qa

- Name: Nina MacVinish
- Email: nmacvinish@ashghal.gov.qa

12 QUALITY ASSURANCE

The project Information Manager should establish a Quality Assurance plan for the models, and this communicated in the BEP, to ensure appropriate checks on information and data accuracy. The respective BIM coordinator of each discipline should also establish a quality control procedure to ensure that the discipline model is accurate and correct according to the modelling guidelines.

Each Consultant and Contractor shall be responsible for performing quality control checks of their design, dataset and model properties before submitting their deliverables.

Refer to BIM Quality Assurance Checklist which shows the minimum standard of compliance checking be used to be perform model auditing prior to submission.

Check	Definition	Software	Frequency
Visual Check	Ensure there are no unintended 3D model components. The design intent has been followed.	Autodesk Revit Autodesk Civil 3D Navisworks Manage	Daily / Every Issue
Interference Check	Detect problems in the model where two building components are clashing.	Autodesk Revit Autodesk Civil 3D Navisworks Manage	Weekly / Coordination Reviews as per meeting schedule
Standard Check	Ensure that all information model Standards and requirements explained above have been met.	Autodesk Revit Autodesk Civil 3D	Weekly / Formally Published Data
Element Validation	Ensure that the dataset has no undefined or incorrectly defined elements, all Elements according to specs, All attributes are according to Level of Information Need Specification and geometry not corrupted during conversion.	Autodesk Revit Autodesk Civil 3D	Weekly / Formally Published Data
Model accuracy and Tolerances	Ensure positioning and dimensioning of objects.	Autodesk Revit Autodesk Civil 3D	Weekly / Formally Published Data
Model Integrity Check	Validation process used to ensure that the 3D model data set has no undefined, incorrectly defined or duplicated elements and the reporting process on non-compliant elements and corrective action plans.	Autodesk Revit Autodesk Civil 3D	Weekly / Formally Published Data

Table 9: Quality Check Points

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS AND CREDIT

Credit is given to the Construction Industry Council, who's technical standards have been recognised as international best practice. In recognition of this, and in line with the permissions granted within the relevant standards, sections of this document are directly adapted from, or heavily influenced by, their work; in particular, the Hong Kong CIC Building Information Modelling Standards – General (August 2019).

ENDNOTES

[1] AEC UK BIM Protocol Version 2.1.1 (June 2015)

[2] Hong Kong CIC Building Information Modelling Standards – General (August 2019)

[3] https://technical.buildingsmart.org/standards/ifc/mvd/