

TMR and Digital Engineering

BuildingSMART Xchange
2024



Acknowledgement of Traditional Owners and Elders

I'd like to begin by acknowledging the Traditional Owners of the land where we meet today. I would also like to pay my respects to the Elders both past and present.

I also extend that respect to the Aboriginal and Torres Strait Islander people here today.



'Travelling' by Gilimbaa



Agenda

1. Overview of Transport and Main Road's (TMR's) strategic view
 - Digital Engineering and how it fits within TMR's bigger picture
2. Quick recap since 2023
3. Overview of what is to come
4. Case Study – BIM for Bridges

TMR's Strategic View

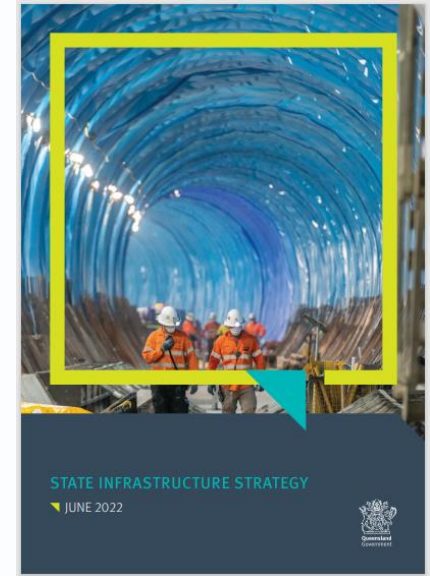
TMR Strategic Plan 2023–2027



Quick recap

Digital by default mandate

- State Infrastructure Plan (2016) mandated use of digital technologies on State Government infrastructure projects
- State Infrastructure Strategy (June 2022) further outlines this digital by default mandate
- TMR implemented digital technologies such as Building Information Modelling (BIM) in 2016
- This is the pathway TMR has committed to between now and 2032
- Implementing these digital engineering processes is a long-term view for TMR

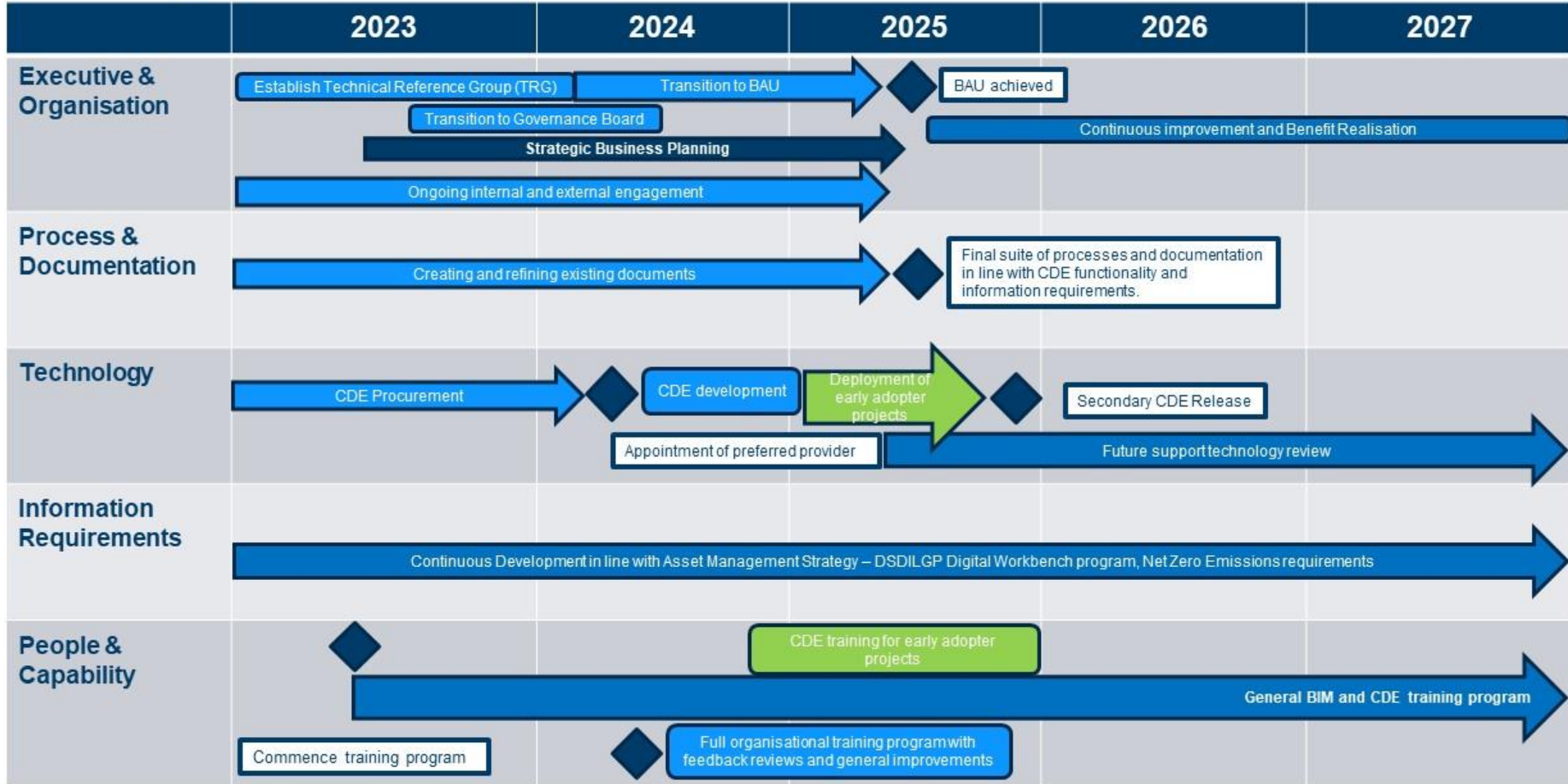


Digital by default

Implementing and integrating 'digital by default' into infrastructure projects will require a cultural shift for government and the infrastructure sector, including the need to build knowledge and capability and demonstrate the benefits of digital approaches.



Rolling 5 Year Plan



Achievements to date

- Creation of key BIM documentation (2017 to present)
 - BIM Guide
 - Exchange Information Requirements (EIR Version 10, 2024)
 - BIM execution plan template
 - Asset ID Manuals (Civil, Structural, Intelligent Transport Systems & Electrical)

Achievements to date

- 2023 awareness, readiness and implementation of BIM
 - Roadshow around the state visiting numerous TMR regional offices
- Established a Statewide Technical Reference Group and subsequent Governance Committee
- Created online BIM training modules for TMR staff and external stakeholders (April 2023)
- Implemented a statewide enterprise license to manage and service the Common Data Environment (CDE) requirements for project delivery
 - InEight was appointed the successful Software as a Service (SaaS) provider from April 2024

What else is to come?

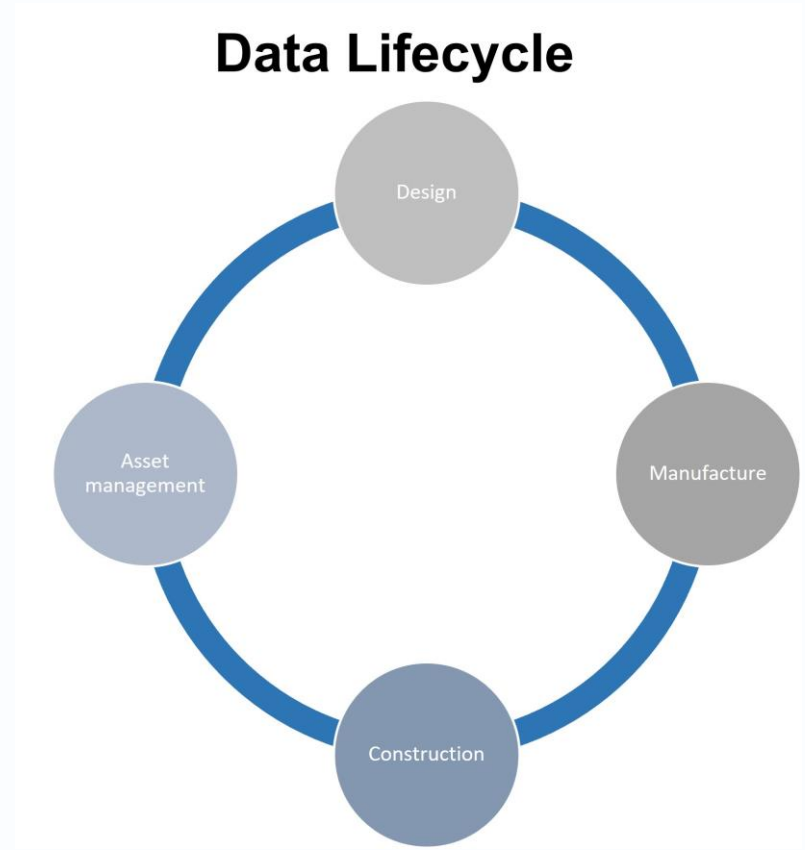
- Further development of beneficial functions to provide trusted data requirements
- Benefits of monitoring and reporting
- 2024 will continue to be a paced build, to ensure TMR staff are able to move along the journey
- This shift is across government and is bigger than just TMR, so it is important we upskill, support, guide, and grow our capability
- Change of business processes to bring BIM and the CDE across TMR as a whole

Case Study: Bridge BIM data lifecycle

Gavin Cairns, Principal Designer
(Digital Systems)

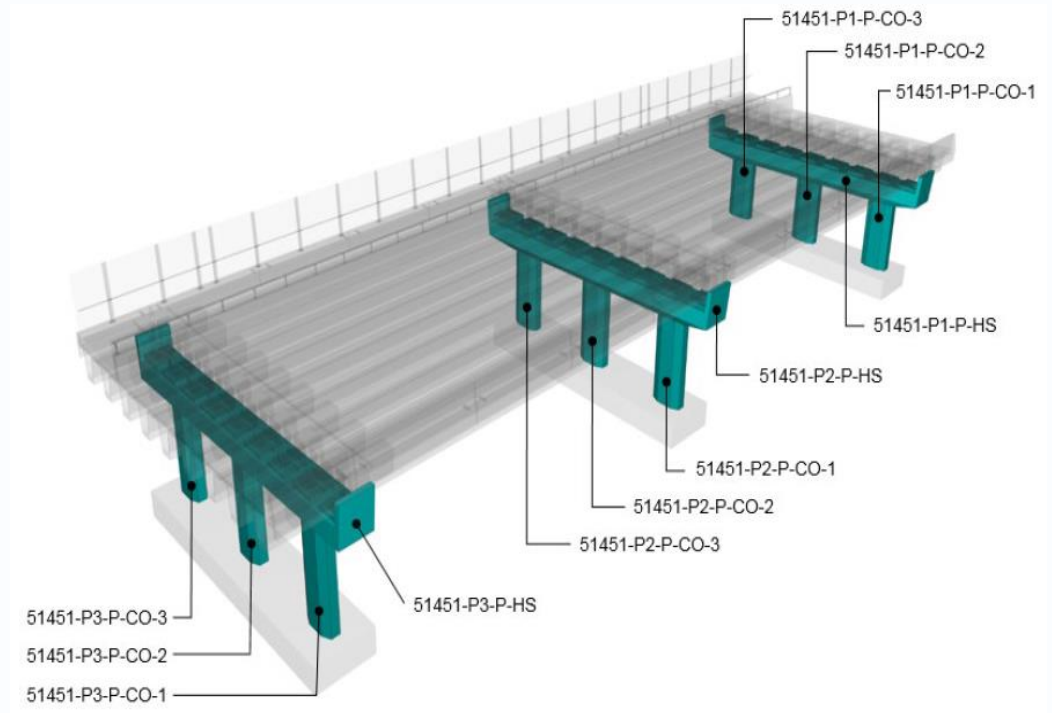
Case study overview

- Systems and documentation have been developed since 2014
- Administered into contracts from 2018



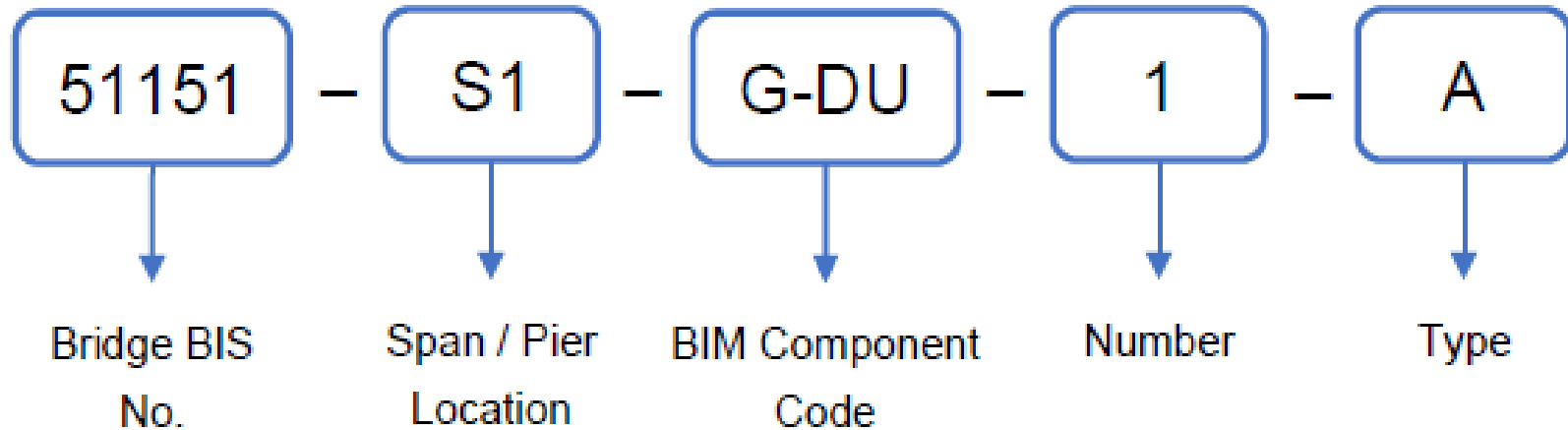
BIM for bridges documentation suite

- TMR BIM for Bridges manual
- TMR Object Attributes for Bridges
- TMR Revit to .ifc export pack



TMR BIM for Bridges manual

Figure 5.1.2(b) – Full BIM object code example for a deck unit



TMR Object attributes for bridges

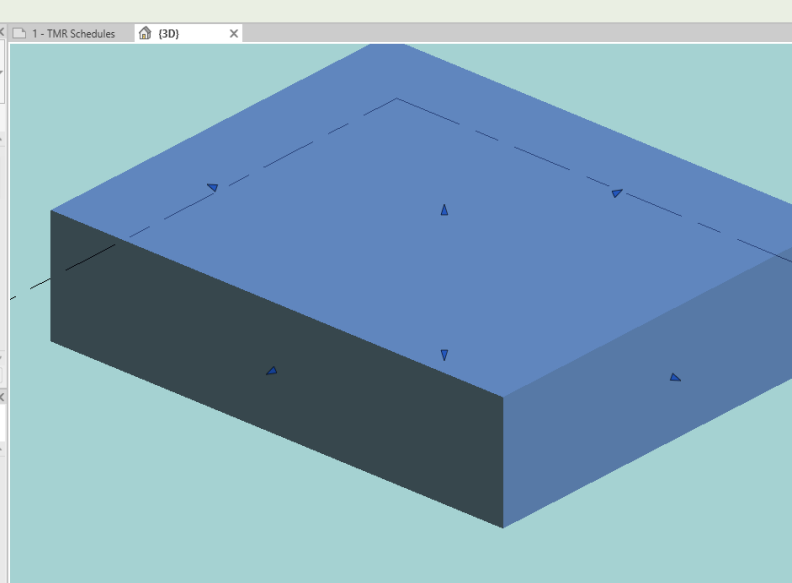
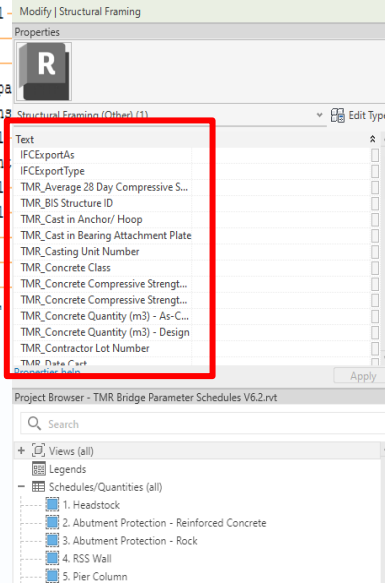
Table 1: Headstocks

IFC Property Set	Attribute Name	Example
Design Information	Full BIM Object Code	43614-AA-A-HS
	Concrete Class	S40/20
	Concrete Quantity (m3) - Design	15
	Element Depth	1m
	Element Length	10m
	Element Width	1.5m
	Exposure Classification	B2
	Minimum Cover	60
	Model is certified issued for construction (RPEQ)	7274
	Typical Bottom Longitudinal Reinforcement	24NJ lapped with 24G
Typical Ligature Profile	16S and 12EX	
Typical Top Longitudinal Reinforcement	24NH lapped with 24F	
As-Con Information	Average 28 Day Compressive Strength (MPa)	55.9
	Full BIM Object Code	43614-AA-A-HS
	Concrete Quantity (m3) - As-Con	15.5
	Contractor Lot Number	HS 02
	Date Poured	date'
	Headstock Soffit Level	161.209
	Model is certified as-constructed (Name + Surveyors Accreditation)	DK Lillee Reg Surv 3322
Number of NCR's	2	
Number of RFI's	3	
Asset Management Information	Full BIM Object Code	43614-AA-A-HS
	BIS Structure ID	43614
	Comments	comment'
	Most Recent Level 2 Inspection	date'
	SIM Component Code	A
	SIM Exposure Classification Code	4
	SIM Group Code	A
	SIM Group Number	1
	SIM Modification Status Code	L2
	SIM Quantity (each)	1
	SIM Standard Material Code	C
SIM Standard Number Code	50	

.ifc property set definitions for standard TMR bridge elements

TMR Revit to .ifc export pack

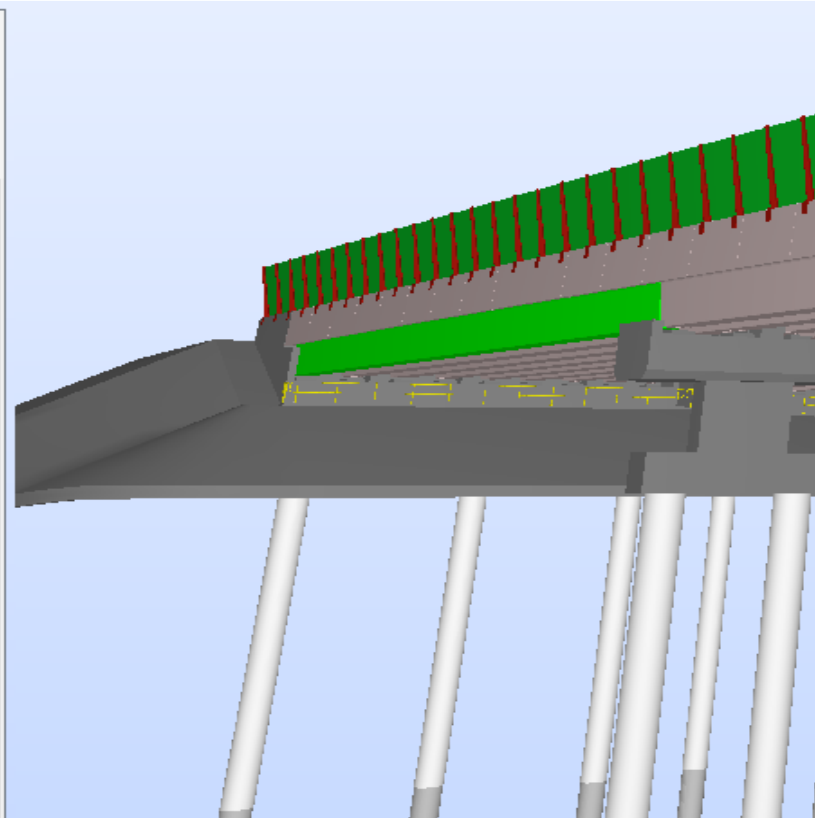
```
# This is a Revit shared parameter file. CR LF
# Do not edit manually. CR LF
*META -> VERSION MINVERSION CR LF
META -> 2 -> 1 CR LF
*GROUP -> ID -> NAME CR LF
GROUP -> 1 -> TMR_Bridge_Element_Attributes CR LF
*PARAM -> GUID -> NAME -> DATATYPE -> DATACATEGORY -> GROUP -> VISIBLE / DESCRIPTION / USERMODIFIABLE -> HIDEWHENNOVALUE CR LF
PARAM -> 0f061e04-3d55-4480-87e1-162aae2d56b6 -> TMR_Rock_Socket_Material_-_Design -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> 6666b1508-f106-4bd8-a54e-657e985eb36b -> TMR_Number_of_5m_Voids -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> 7c596508-64ee-43f8-a061-fb1fb098000e -> TMR_Element_Width -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> eef82e09-3f65-416c-8239-13ecf6cd655b -> TMR_Location_-_Easting_-_As-Con -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> 5938a00f-ed82-4bc8-88bc-9fe8849c39e7 -> TMR_Design_File_Ultimate_Geotechnical_Capa -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> c89e4c15-321c-4cde-9617-d6fb385df75a -> TMR_Concrete_Compressive_Strength_at_Trans -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> bfbdc2c17-9252-4176-8b70-bf25f554f36f -> TMR_Mass_(T) -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> 9cfb9518-cdbc-4ae3-b0e5-8cc2a2ba8ca0 -> TMR_Typical_Top_Longitudinal_Reinforcemen -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> dafd2c19-be1d-40d4-98db-67ac8b9f1e4b -> TMR_Liner_Length_-_Design -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> e4895119-9641-4c96-bea7-5befcd241d91 -> TMR_Number_of_Small_Voids -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> 3483221a-591c-4be2-93e4-59f8c272fb46 -> TMR_Rock_Socket_Material_-_As-Con -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> 45aab51d-95b5-4f9c-8b5b-fafc215a4fcb -> TMR_Driven_Depth -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
PARAM -> 8009071f-8f78-4629-968a-271dfe54fbc8 -> TMR_SIM_Standard_Number_Code -> TEXT -> 1 -> 1 -> 1 -> 0 CR LF
```



.ifc in model file viewer for review

Info Beam.0.59

As-Con Information		Asset Management Information				
Identification	Location	Quantities	Material	Relations	Classification	Hyperlinks
Design Information			Manufacture Information			
Property	Value					
BIM Component Code	78696-S2-G-CG-01-A					
Cast in Anchor/Hoop	Philipp Lifting Hoop Part No. 442650					
Cast in Bearing Attachment Plate	20 thick Galvanised Steel Plate					
Characteristic Compressive Strength (MP...)	50					
Characteristic Minimum Cover	40					
Concrete Class	S50/20					
Concrete Compressive Strength at Transf...	40					
Element Depth	1825					
Element Length	35.40m					
Exposure Classification	B2					
Hog 100 Days - Design	155					
Hog 30 Days - Design	120					
Hog Transfer - Design	70					
Mass (T)	86					
Nominal Length of End Blocks	2325					
Nominal Top Flange Width	1770					
Number of 5m Voids	6					
Number of Small Voids	0					
TMR Specification	MRTS73					
Typical Strand Profile	62/15.2					



Data validation

- Simplebim's excel functionality

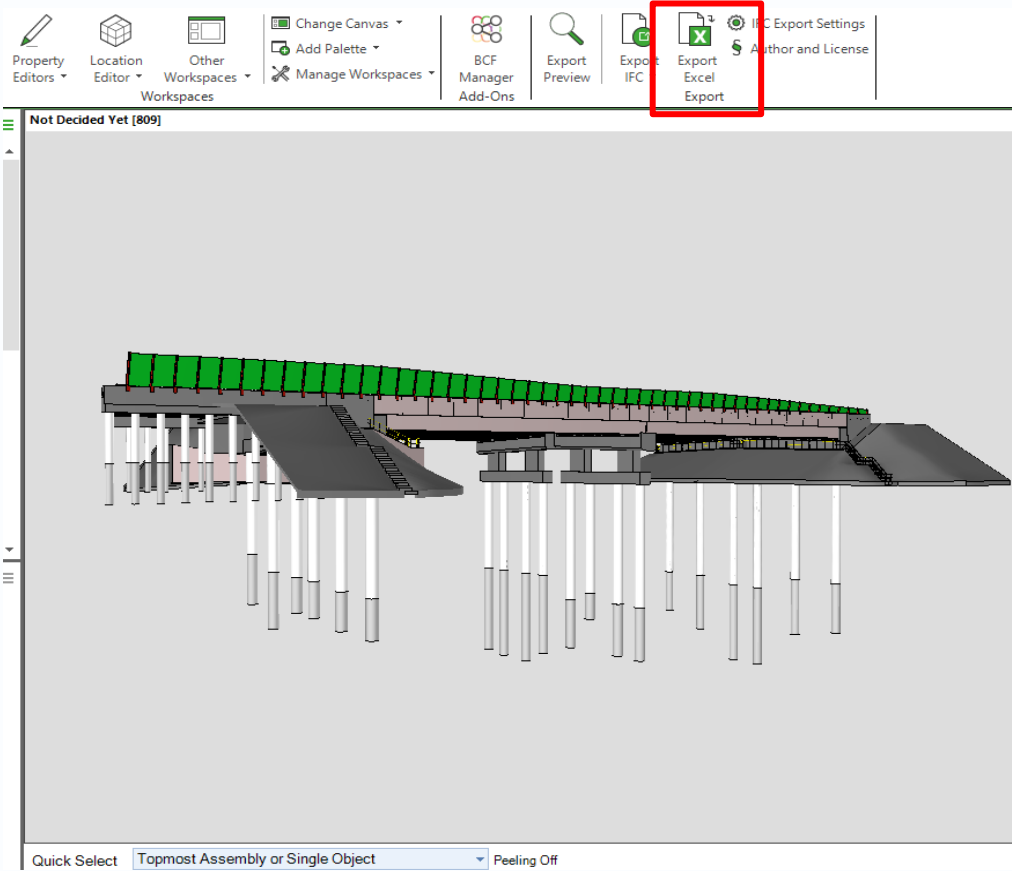
The screenshot displays the Simplebim software interface. The ribbon at the top contains various toolsets including File, Home, 3D, History, Models, Automate, Trimmer, Property Editors, Location Editor, Workspaces, Add Bimsheet, Add Table, Manage Workspaces, Add-Ons, and Export. The 3D view shows a building structure with a red beam highlighted. The 'Objects' panel on the left shows a list of elements with their counts and validation status:

Member	Count	Status
Model Information	1	Valid
Plate	204	Valid
Project	1	Valid
Railing	5	Invalid
Site	1	Valid
Slab	126	Invalid
Wall	11	Invalid

The 'Properties: Beam (1 of 315)' panel shows the following properties for the selected beam:

Property	Value	Status
BIM Component Code	BR04-S3-G-CG-13-A	Valid
BIS Structure ID	78690	Valid
Comments	Northbound	Warning
Most Recent Level 2 Inspection	-	Warning
SIM Component Code	G	Valid
SIM Exposure Classification Code	13	Valid
SIM Group Code	S	Valid
SIM Group Number	03	Valid
SIM Modification Status Code	-	Invalid
SIM Quantity	27964	Valid
SIM Standard Material Code	P	Valid
SIM Standard Number Code	22	Valid

Simplebim export to .xls



.ifc class and type definitions

Table 5.3 – Bridge BIM model object IFC assignment

Group	Group code	IFC Class	IFC Type
Abutment	A	IfcSlab	IfcSlabType
Pier	P	IfcMember	IfcMemberType
Foundation	F	IfcPile	N/A
Bridge Traffic barriers	T	IfcRailing	IfcRailingType
Bearings	B	IfcPlate	IfcPlateType
Deck	D	IfcCovering	IfcCoveringType
Girders	G	IfcBeam	IfcBeamType
Miscellaneous	M	IfcBuildingElementProxy	IfcBuildingElementProxyType

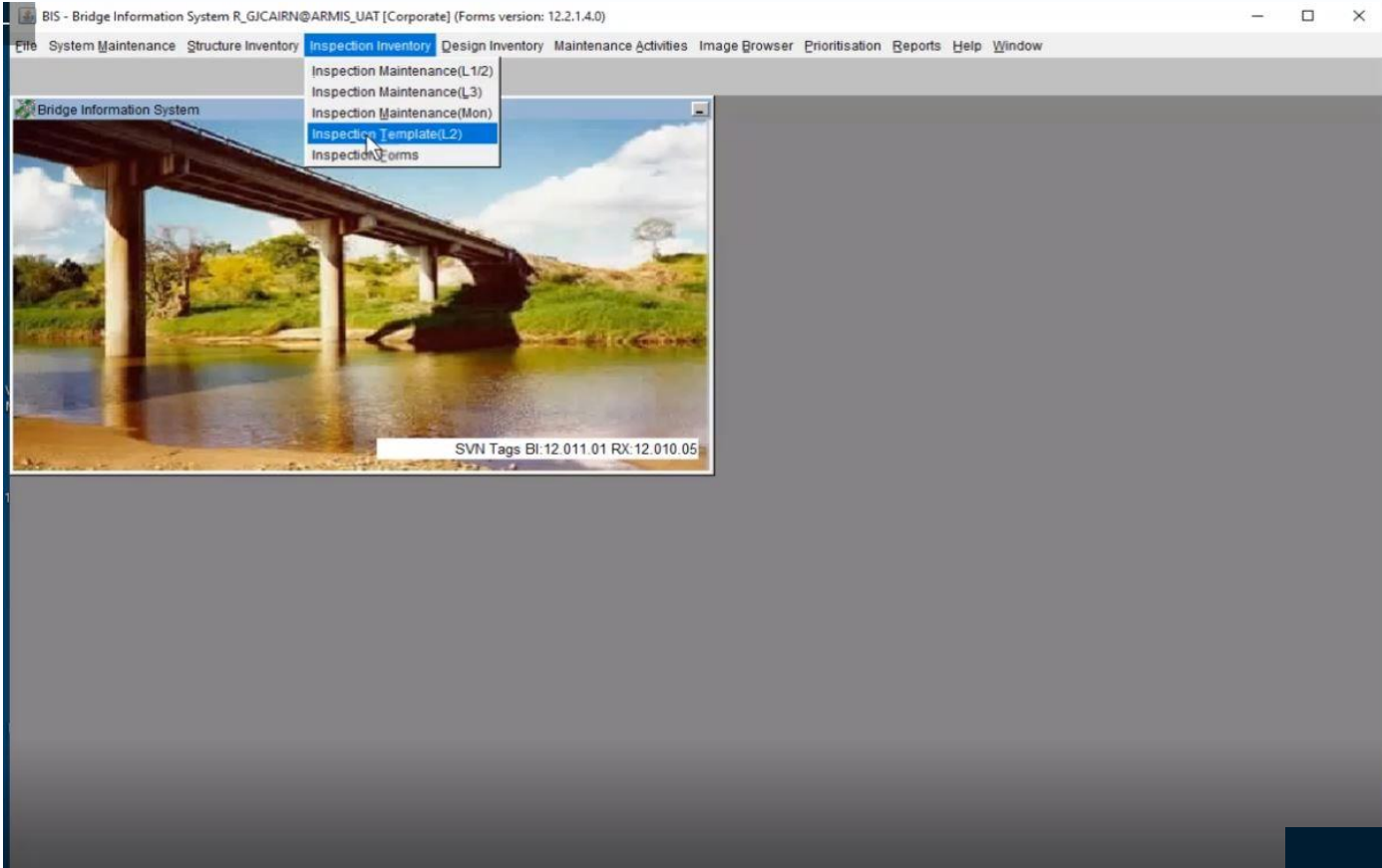
	G	H	I	J	K	L
1						
2						
3	Full BIM Object Code	Characteristic Compressive Strength (MPa) - Design	Characteristic Minimum Cover	Concrete Class	Design Pile Ultimate Geotechnical Capacity (kN)	
4	78696-AA-F-CP-01-B	50	80	S50/10	7153	6
5	78696-AA-F-CP-02-B	50	80	S50/10	8931	7
6	78696-AA-F-CP-03-B	50	80	S50/10	7592	6
7	78696-P1-F-CP-04-B	50	80	S50/10	9162	6
8	78696-P1-F-CP-03-B	50	80	S50/10	8474	6
9	78696-P1-F-CP-02-B	50	80	S50/10	8474	6
10	78696-P1-F-CP-01-B	50	80	S50/10	8329	6
11	78696-AB-F-CP-01-B	50	80	S50/10	6909	6
12	78696-AB-F-CP-02-B	50	80	S50/10	10541	7
13	78696-AB-F-CP-03-B	50	80	S50/10	11936	7
14	78697-AB-F-CP-04-B	50	80	S50/10	11893	6
15	78697-AB-F-CP-05-B	50	80	S50/10	8085	7

Navigation: Slab | Member | **Pile** | Railing | Plate | Covering | Beam | Building Element Proxy | Building | Building Storey | ... (+) | <

Formatting for asset management system compatibility

A	B	C	D	E	F	G	H	I
STRUCTURE_ID	COMPONENT_CODE	EXPOSURE_CODE	COMPONENT_GROUP_CODE	COMPONENT_GROUP_NO	ORIG_WIDE_CODE	QUANTITY	STANDARD_MAT_CODE	STANDARD_NO_CODE
75091	AP	1	AP	1	O	1	O	70
75091	GR	1	AP	1	O	2	S	72
75091	J	1	A	1	O	19	O	12
75091	BR	1	S	1	O	44	P	2
75091	D	1	S	1	O	262	C	20
75091	BR	1	S	2	O	45	P	2
75091	WS	1	S	1	O	522	O	1
75091	D	1	S	2	O	266	C	20
75091	WS	1	S	2	O	522	O	1
75091	BR	1	S	3	O	45	P	2
75091	D	1	S	3	O	266	C	20
75091	WS	1	S	3	O	522	O	1
75091	BR	1	S	4	O	44	P	2
75091	D	1	S	4	O	262	C	20
75091	WS	1	S	4	O	522	O	1

Upload to asset management system



Upload to asset management system

BIS - Bridge Information System R_GJCAIRN@ARMIS_UAT [Corporate] (Forms version: 12.2.1.4.0)

File Edit Record Block Field Query Help Window

L2 Inspection Template

Structure Condition Timber

Find
 Structure Id Old Bullamon Bridge

Structure
 Structure Id Old Bullamon Bridge
 Structure Type
 Construction Type
 Construction Material
 Last Insp Cond Rating

Owner MR DEPARTMENT OF MAIN ROADS
 SW Region 316 Southern Queensland
 SW District 411 South West
 Status

Permanent Standing Water Vermin Screens
 Security Measures

Last Inspection
 Inspection Date
 Inspection Level

Scheduling
 Programmed
 Exceptional
 Underwater

Next Level 1 Inspect
 Next Inspection Date
 Last Date for Inspection

Next Level 2 Inspect
 Next Inspection Date
 Last Date for Inspection

Inspection Frequencies (months)

	Level 1	Level 2	Underwater
BIM Prescribed	12	60	
SMP Prescribed			

Next Level 2 Underwater Inspection
 Next Inspection Date

Location

Road Section		S		Start		End		Tdist		Length
Id	Description	Cway	S	RPC	Dist	RPC	Dist	Start	End	
3514	Noondoo-Thallon Roa	H	1	H				42.614	42.674	.060

Upload to asset management system

BIS - Bridge Information System R_GICAIRN@ARMIS_UAT [Corporate] (Forms version: 12.2.1.4.0)

File Edit Record Block Field Query Help Window

Bridge Information System

L2 Inspection Template

Structure Condition Timber

Condition Template

Modification	Component Location						Quantity	Unit
	Component Group		Comp	Standard Component No		Exposure Class		
	Category	Number		Category	Material			
RA	S	2	G	21	P	1	20.0	Lin m
L2	A	1	A	50	C	4	1.0	Each
O	A	1	C	56	P	1	1.0	Each
WR1	S	3	BR	2	S	3	1.0	Lin m
S2	A	1	A	50	C	3	66.0	Each

In Progress
 Completed

Challenges

- Cultural shifts across TMR towards using BIM and adopting alternative business processes
- Keeping pace with technological advancements
- Simplification of BIM data capture for Asset Management System compatibility

Future direction and development

- **BuildingSMART Australasia**



- .ifc sub-working groups
- Contributing to .ifc 4 x 3 bridge definitions

B	C	D	E	F	G
Group	Group code	Component code	Component	IfcClass	IfcEnumeration
Abutment	A	HS	Headstock	IfcElementAssembly.ABUTMENT	
		WW	Wing wall	IfcAbutment	
		AP	Abutment protection		
		RS	Relieving slab	IfcSlab.APPROACH_SLAB	
		RW	Retaining wall (includes RSS walls)	IfcWall.RETAININGWALL	
Pier	P	HS	Headstock	IfcBeam.PIERCAP	
		CO	Pier column	IfcColumn	
		BW	Blade wall	IfcWall.SOLIDWALL	
Foundation	F	PP	Precast piles	IfcPile.DRIVEN	
		CP	Cast in place piles	IfcPile.BORED	
		PC	Pile cap	IfcBeam.PIERCAP	IfcFooting
		SP	Driven tubular steel piles	IfcPile.DRIVEN	
		PF	Pad (spread) footing	IfcFooting.PAD_FOOTING	
Bridge Traffic Barriers	T	TR	Steel post and rail type	IfcRailing.GUARDRAIL	
		TC	Concrete parapet type	IfcWall.PARAPET	
		BA	Pedestrian / shared balustrade	IfcRailing.BALUSTRADE	
		SR	Safety rail		

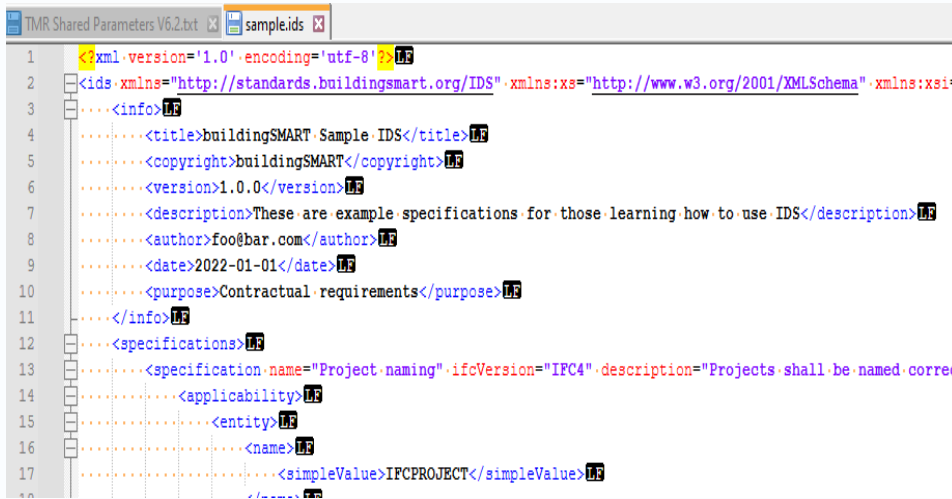
Future direction and development

- **Civil disciplines**
 - .ifc 4 x 3 definitions

Concrete	IfcPavement
Pedestrian Paving	IfcPavement
Road Surface	IfcPavement
Pedestrian Paving	IfcPavement.RIGID
Road Surface	IfcPavement.RIGID
Foundation	IfcPile.BORED
Headwall	IfcPipeFitting.HEADWALL
Culvert	IfcPipeSegment.CULVERT
Foundation Slab	IfcPipeSegment.CULVERT
Precast Headwall	IfcPipeSegment.CULVERT
Wing Wall	IfcPipeSegment.CULVERT
Pipes	IfcPipeSegment.RIGIDSEGMENT
Water Line	IfcPipeSegment.RIGIDSEGMENT
Fence	IfcRailing.FENCE
Guardrail	IfcRailing.GUARDRAIL
Railing	IfcRailing.HANDRAIL
Signage	IfcSign.PICTORAL
Approach Slab	IfcSlab.APPROACHSLAB

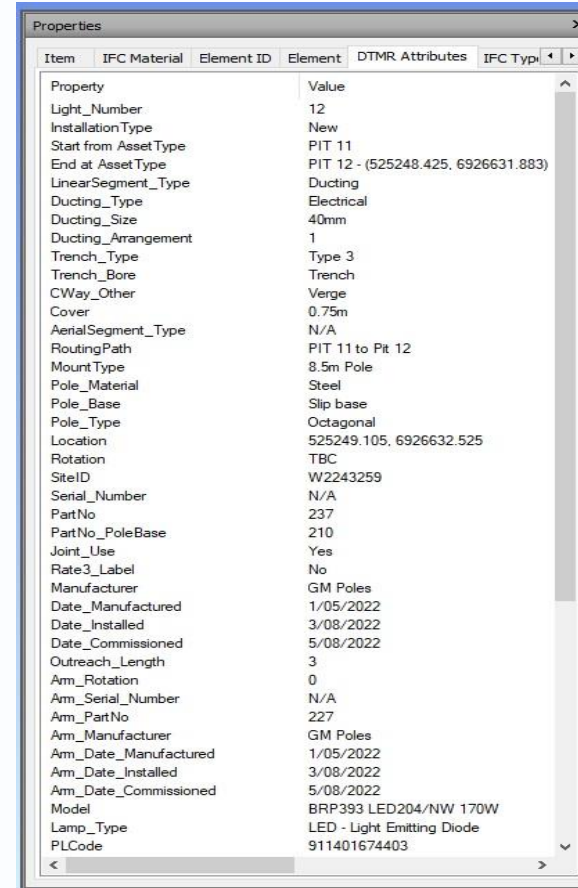
Future direction and development

- ITSE for ROAR upload
- Exploring validation with IDS



```
<?xml version='1.0' encoding='utf-8'?>
<ids xmlns="http://standards.buildingsmart.org/IDS" xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:xsi="
...
<info>
  <title>buildingSMART Sample IDS</title>
  <copyright>buildingSMART</copyright>
  <version>1.0.0</version>
  <description>These are example specifications for those learning how to use IDS</description>
  <author>foo@bar.com</author>
  <date>2022-01-01</date>
  <purpose>Contractual requirements</purpose>
</info>
<specifications>
  <specification name="Project naming" ifcVersion="IFC4" description="Projects shall be named correc
  <applicability>
  <entity>
    <name>
      <simpleValue>IFCPROJECT</simpleValue>

```



Item	IFC Material	Element ID	Element	DTMR Attributes	IFC Type
Property					
Light_Number				12	
InstallationType				New	
Start from Asset Type				PIT 11	
End at Asset Type				PIT 12 - (525248.425, 6926631.883)	
LinearSegment_Type				Ducting	
Ducting_Type				Electrical	
Ducting_Size				40mm	
Ducting_Arrangement				1	
Trench_Type				Type 3	
Trench_Bore				Trench	
CWay_Other				Verge	
Cover				0.75m	
AerialSegment_Type				N/A	
RoutingPath				PIT 11 to Pit 12	
MountType				8.5m Pole	
Pole_Material				Steel	
Pole_Base				Slip base	
Pole_Type				Octagonal	
Location				525249.105, 6926632.525	
Rotation				TBC	
SiteID				W2243259	
Serial_Number				N/A	
PartNo				237	
PartNo_PoleBase				210	
Joint_Use				Yes	
Rate3_Label				No	
Manufacturer				GM Poles	
Date_Manufactured				1/05/2022	
Date_Installed				3/08/2022	
Date_Commissioned				5/08/2022	
Outreach_Length				3	
Arm_Rotation				0	
Arm_Serial_Number				N/A	
Arm_PartNo				227	
Arm_Manufacturer				GM Poles	
Arm_Date_Manufactured				1/05/2022	
Arm_Date_Installed				3/08/2022	
Arm_Date_Commissioned				5/08/2022	
Model				BRP393 LED204/NW 170W	
Lamp_Type				LED - Light Emitting Diode	
PLCode				911401674403	



**Thank you and
stay connected**

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