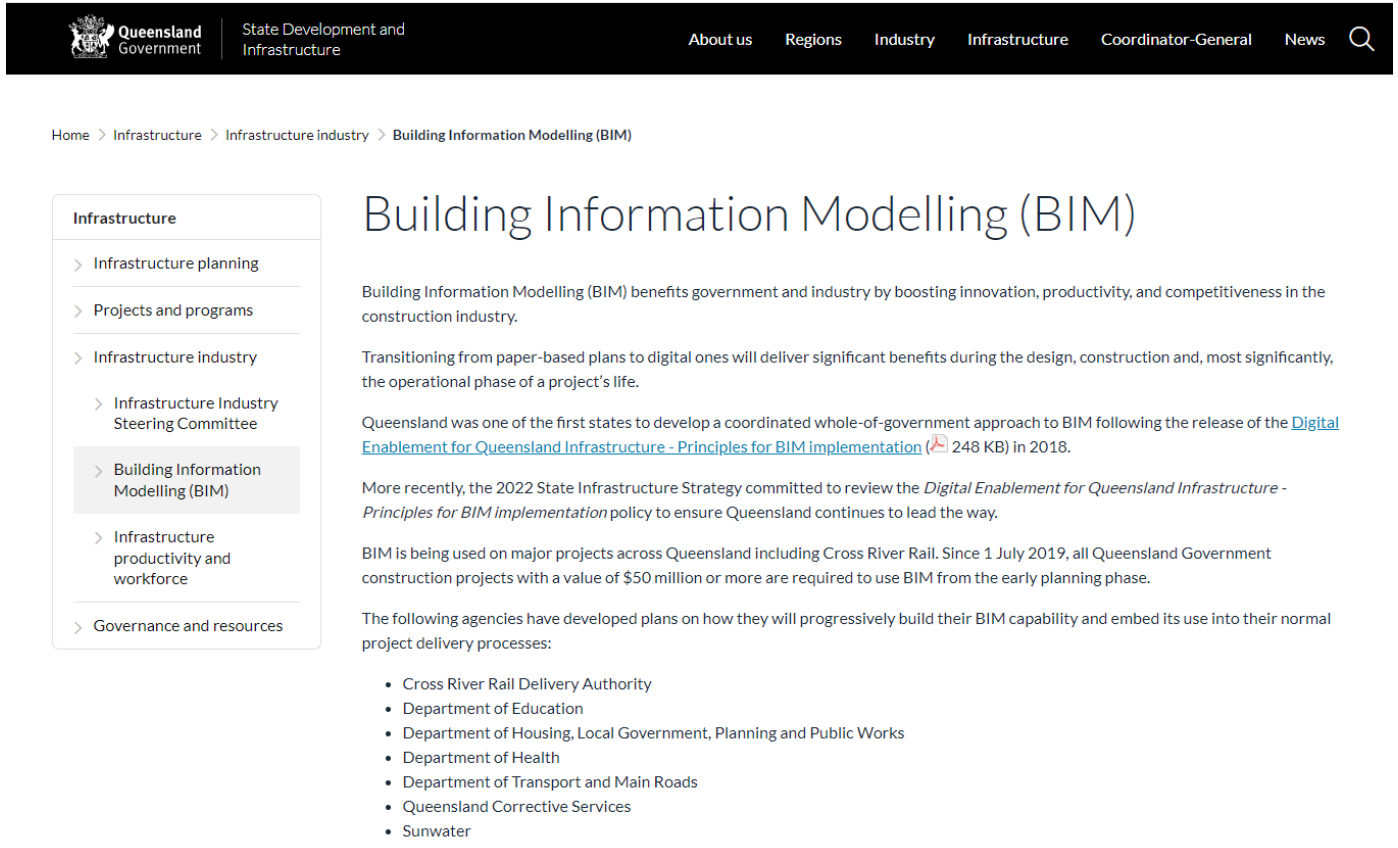
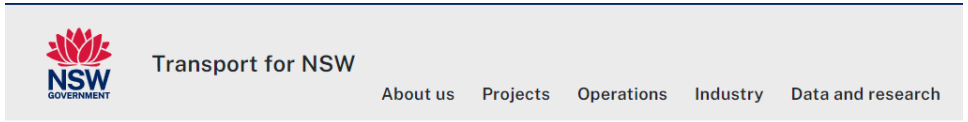
MetaBIM: Unlocking the power of your BIM data

Dr Jun Wang
Senior Lecturer in BIM/DE
Western Sydney University
2024.09

Why do we need to develop the MetaBIM?





Data Structure & Level of Information Needs (LOIN)

Why do we need to develop the MetaBIM?

36 attributes required for a single bridge pier column

TfNSW Property Validation Report

Author	..... – Digital Engineering Manager
File Name	XXXX-TFNSW-XXXX-XX-RPT-000001-Validation.xlsx
Project Details	Project Name and Contract Code / Discipline or Subdiscipline
Date	August 25, 2022

ATTENTION:

This worksheet contains sample data.

Delete existing data prior to use and upload project data from the Project Data Building Blocks.

Contact for your project TfNSW DE Manager for assistance.

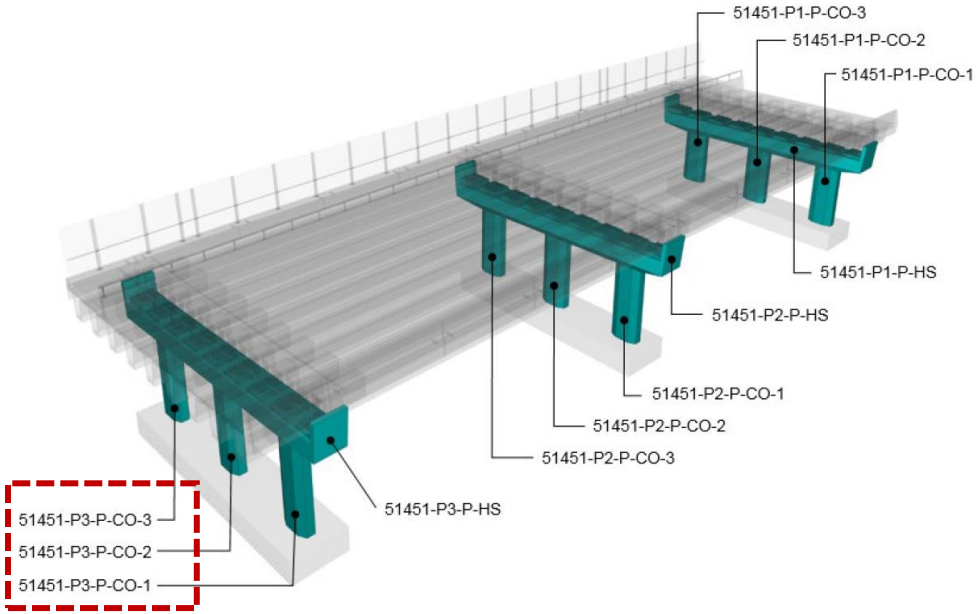
Mandatory - Check 1 - Values Populated

Property Check Group	TfNSW Property				
TfNSW_Project	Project And Contract Name	1	1	0	100.00%
TfNSW_Project	Project Contract Code	1	1	0	100.00%
TfNSW_Project	Contracted Organisation Code	1	1	0	100.00%
TfNSW_Project	Contracted Organisation Name	1	1	0	100.00%
TfNSW_Project	Design Company Code	1	1	0	100.00%
TfNSW_Project	Design Company Name	1	1	0	100.00%
TfNSW_Project	Co-ordinate System	1	1	0	100.00%
TfNSW_Project	Project Milestone Description	1	1	0	100.00%
TfNSW_Project	State Description	1	1	0	100.00%
TfNSW_Project	Suitability Description	1	1	0	100.00%
TfNSW_Project	Document Number	1	1	0	100.00%
TfNSW_Project	Document Title	1	0	1	0.00%
TfNSW_Project	Discipline Code	1	1	0	100.00%
TfNSW_Project	Sub-discipline Code	1	1	0	100.00%
TfNSW_Location	TfNSW Asset Location ID	1	1	0	100.00%
TfNSW_Location	TfNSW Parent Asset Location ID	1	1	0	100.00%
TfNSW_Location	Project Asset Location ID	1	1	0	100.00%
TfNSW_Location	Parent Project Asset Location ID	1	1	0	100.00%
TfNSW_Location	Asset Location Code	1	1	0	100.00%
TfNSW_Location	Parent Asset Location Code	1	1	0	100.00%
TfNSW_Location	Asset Location Description	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Code	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Title	1	1	0	100.00%
TfNSW_Location	Work Zone Code	1	1	0	100.00%
TfNSW_Location	Work Zone Name	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Code (Complex)	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Title (Complex)	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Code (Entity)	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Title (Entity)	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Code (Space)	1	1	0	100.00%
TfNSW_Location	Uniclass Asset Location Title (Space)	1	1	0	100.00%
TfNSW_Location	Network Complex Code	1	0	1	0.00%
TfNSW_Location	SEL Location Requirements ID	1	0	1	0.00%
TfNSW_Asset	TfNSW Asset ID	1	0	1	0.00%
TfNSW_Asset	TfNSW Parent Asset ID	1	0	1	0.00%
TfNSW_Asset	MCL Asset ID	1	0	1	0.00%
TfNSW_Asset	MCL Asset Description	1	0	1	0.00%
TfNSW_Asset	Project Asset ID	1	1	0	100.00%
TfNSW_Asset	Parent Project Asset ID	1	1	0	100.00%
TfNSW_Asset	Asset Data Standard	1	1	0	100.00%
TfNSW_Asset	Asset Type Code	1	1	0	100.00%
TfNSW_Asset	Asset Instance	1	1	0	100.00%
TfNSW_Asset	Asset Grouping Instance	1	0	1	0.00%
TfNSW_Asset	Asset Code	1	1	0	100.00%
TfNSW_Asset	Parent Asset Code	1	1	0	100.00%
TfNSW_Asset	Asset Description	1	1	0	100.00%
TfNSW_Asset	Asset Label	1	1	0	100.00%
TfNSW_Asset	Uniclass Asset Code	1	1	0	100.00%
TfNSW_Asset	Uniclass Asset Title	1	1	0	100.00%
TfNSW_Asset	Asset Type Configuration Code	1	0	1	0.00%
TfNSW_Asset	Asset Type Configuration Description	1	0	1	0.00%
TfNSW_Asset	Asset Discipline Code	1	1	0	100.00%
TfNSW_Asset	Asset Sub-discipline Code	1	1	0	100.00%
TfNSW_Asset	Work Package Code (Design)	1	1	0	100.00%
TfNSW_Asset	Work Package Code (Supply)	1	1	0	100.00%
TfNSW_Asset	Work Package Code (Construction)	1	1	0	100.00%
TfNSW_Asset	Work Package Code (Commissioning)	1	1	0	100.00%
TfNSW_Asset	Asset Status Code	1	0	1	0.00%
TfNSW_Asset	Asset Owner Organisation Name	1	1	0	100.00%
TfNSW_Asset	Asset Operator Organisation Name	1	1	0	100.00%
TfNSW_Asset	Asset Maintainer Organisation Name	1	1	0	100.00%
TfNSW_Asset	Start km	1	1	0	100.00%
TfNSW_Asset	End km	1	1	0	100.00%
TfNSW_Asset	GPS Start Latitude	1	1	0	100.00%
TfNSW_Asset	GPS Start Longitude	1	1	0	100.00%
TfNSW_Asset	GPS End Latitude	1	1	0	100.00%
TfNSW_Asset	GPS End Longitude	1	1	0	100.00%
TfNSW_Asset	Uniclass Asset Code (Element Function)	1	1	0	100.00%
TfNSW_Asset	Uniclass Asset Title (Element Function)	1	1	0	100.00%
TfNSW_Asset	Uniclass Asset Code (System)	1	1	0	100.00%

Cover page | Preface | Standard governance | Utility Property Check Template | BIM Property Check Template | Utility Data M

Table 5: Pier Column

IFC Property Set	Attribute Name	Example
Design Information	Full BIM Object Code	43614-P2-P-CO-2
	Concrete Class	S50/20
	Concrete Quantity (m3) - Design	7.56
	Element Depth	900
	Element Diameter	1200
	Element Length	7.0
	Element Width	1200
	Exposure Classification	B2
	Location - Easting - Design	681381.63
	Location - Northing - Design	6831239.535
	Minimum Cover	60
	Model is certified issued for construction (RPEQ)	7274
	Typical Ligature Profile	12SZ
	Typical Reinforcement Profile	28/32A
As-Con Information	Average 28 Day Compressive Strength (MPa)	55.5
	Full BIM Object Code	43614-P2-P-CO-2
	Concrete Quantity (m3) - As-Con	7.66
	Contractor Lot Number	CO02
	Date Poured	date'
	Location - Easting - As-Con	681382.64
	Location - Northing - As-Con	6831240.525
	Model is certified as constructed (Name + Surveyors Accreditation)	DK Lillee Reg Surv 3322
	Number of NCR's	2
	Number of RFI's	1
Asset Management Information	Full BIM Object Code	43614-P2-P-CO-2
	BIS Structure ID	43614
	Comments	comment
	Most Recent Level 2 Inspection	date'
	SIM Component Code	C
	SIM Exposure Classification Code	3
	SIM Group Code	P
	SIM Group Number	2
	SIM Modification Status Code	WR1
	SIM Quantity (Count)	1
	SIM Standard Material Code	C
	SIM Standard Number Code	56



TfNSW Asset Property requirement

QTMR Bridge Property requirement

QTMR Bridge Classification and Naming

Why do we need to develop the MetaBIM?

Current solutions

Highly dependent on designers, requires extensive coordination, and lacks flexibility.

Revit

Dynamo

12d

AUTODESK Civil 3D

OpenRoads CONNECT Edition

Tekla

Strive to fulfill these BIM data requirements through the use of ***3D design software***

Costly, challenges with data exchange, and limited flexibility.

SOLIBRI A NEMETSCHEK COMPANY

assemble AN AUTODESK COMPANY

Deswik

simplebim®

Checking

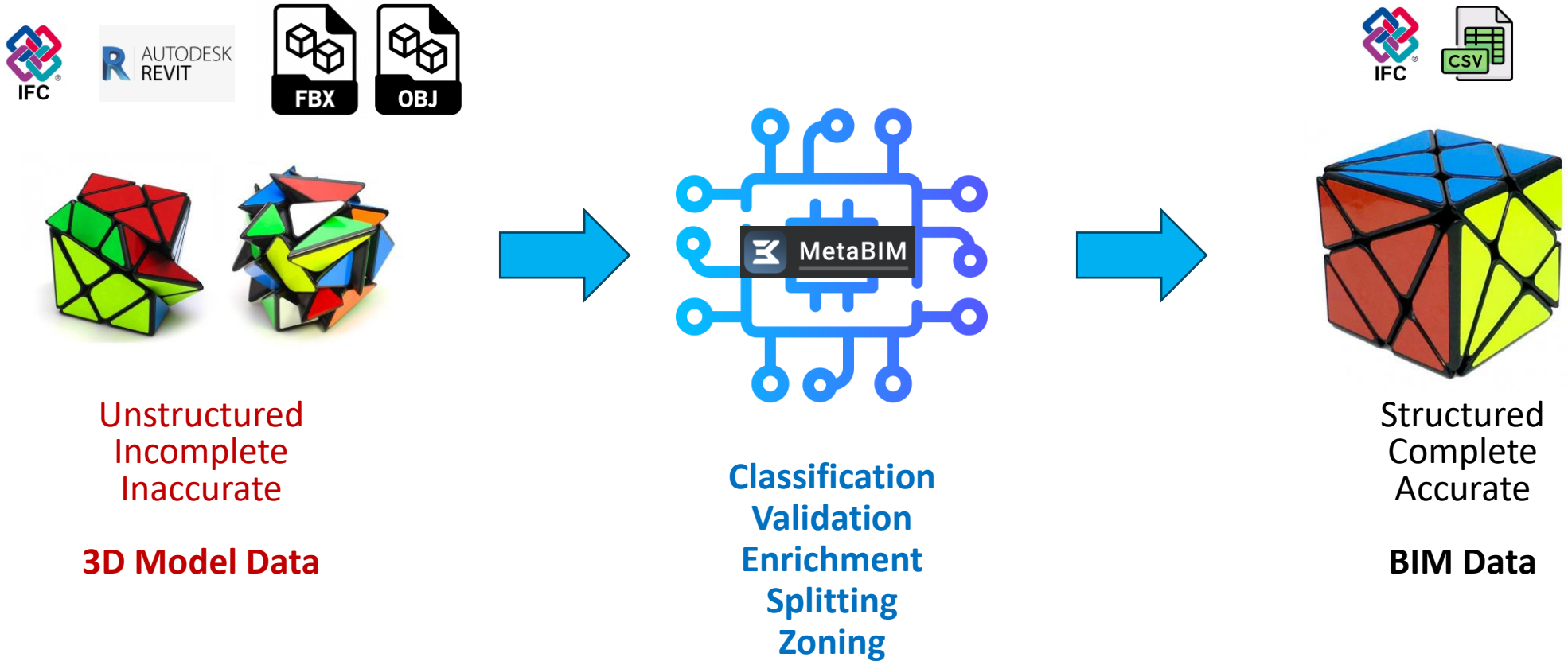
Classification & Property Editing

Splitting & Zoning

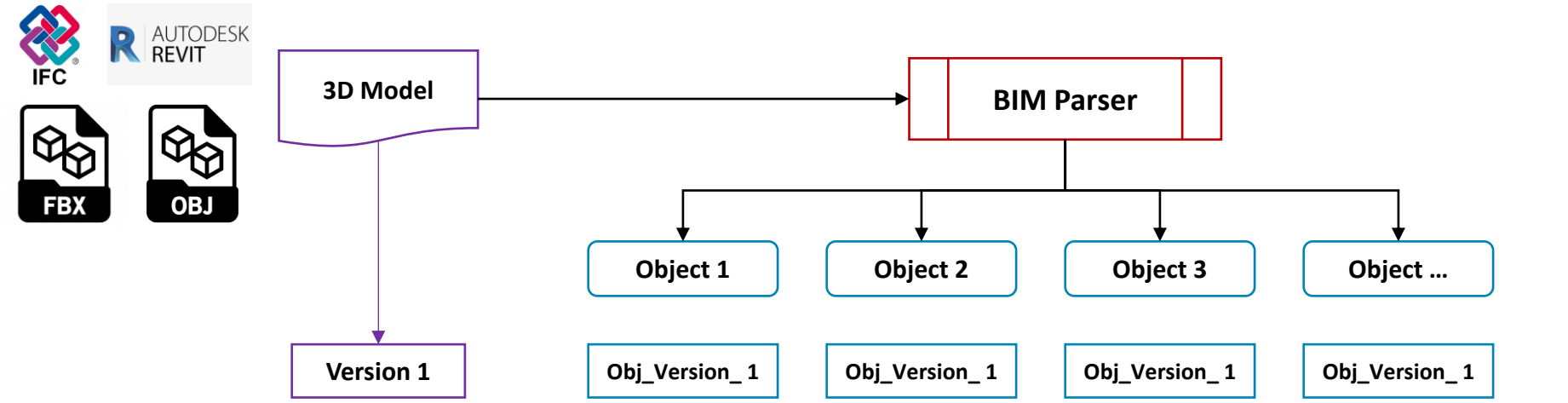
Strive to meet these BIM data requirements by sequentially utilising ***multiple 3D BIM tools***.

MetaBIM

MetaBIM is designed in-house from the ground up to be fully customisable.

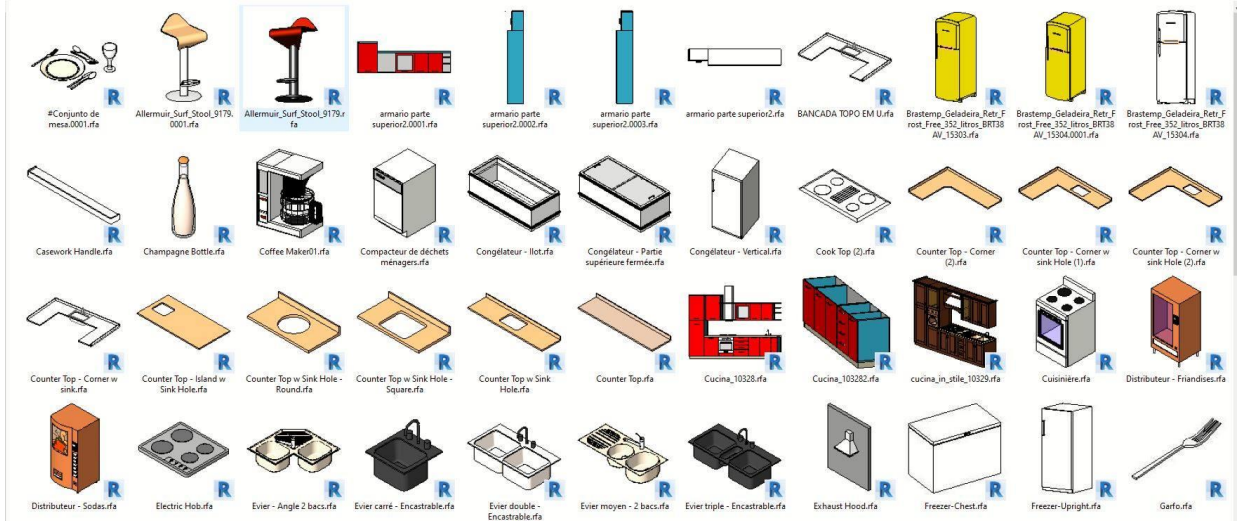


MetaBIM: Data Parser

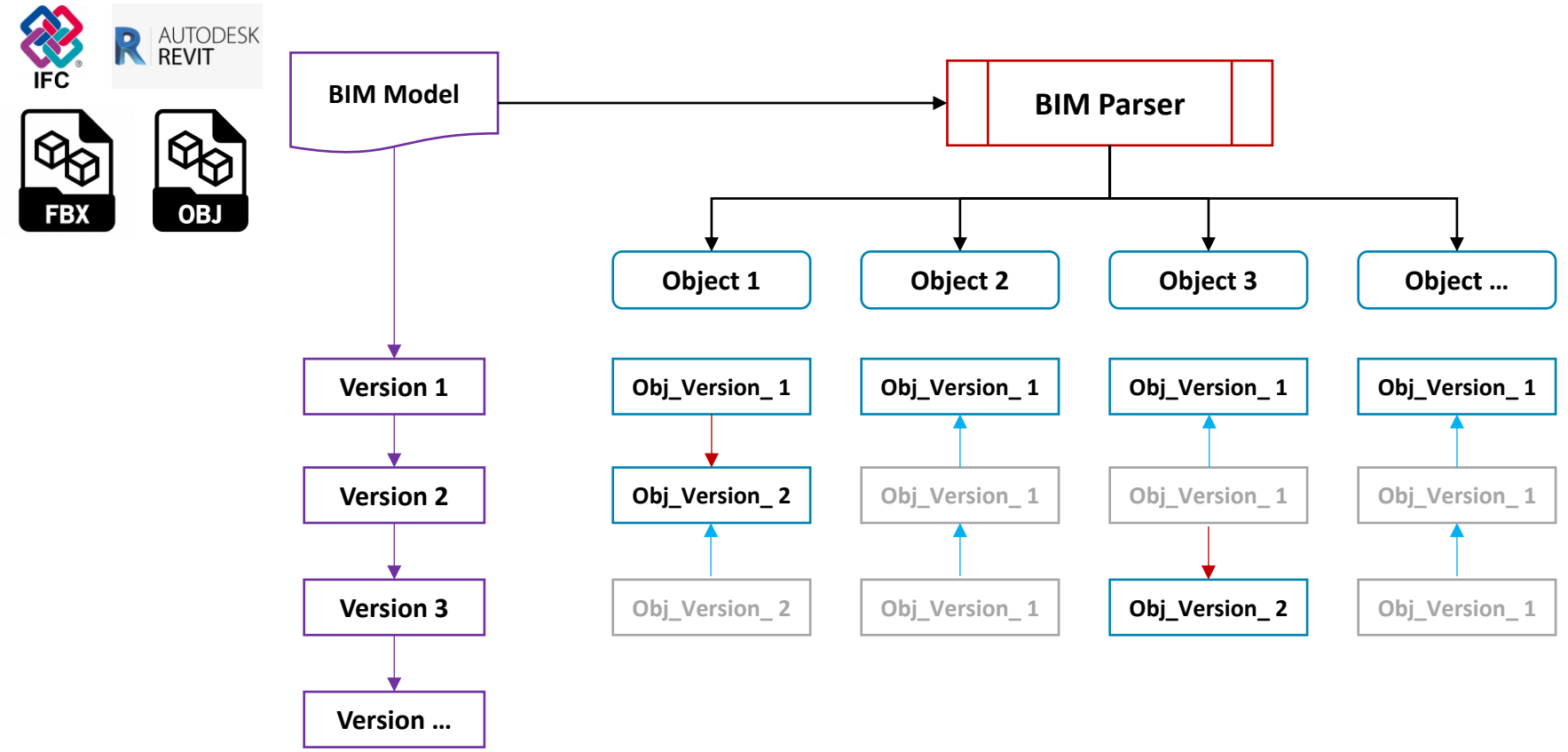


Database

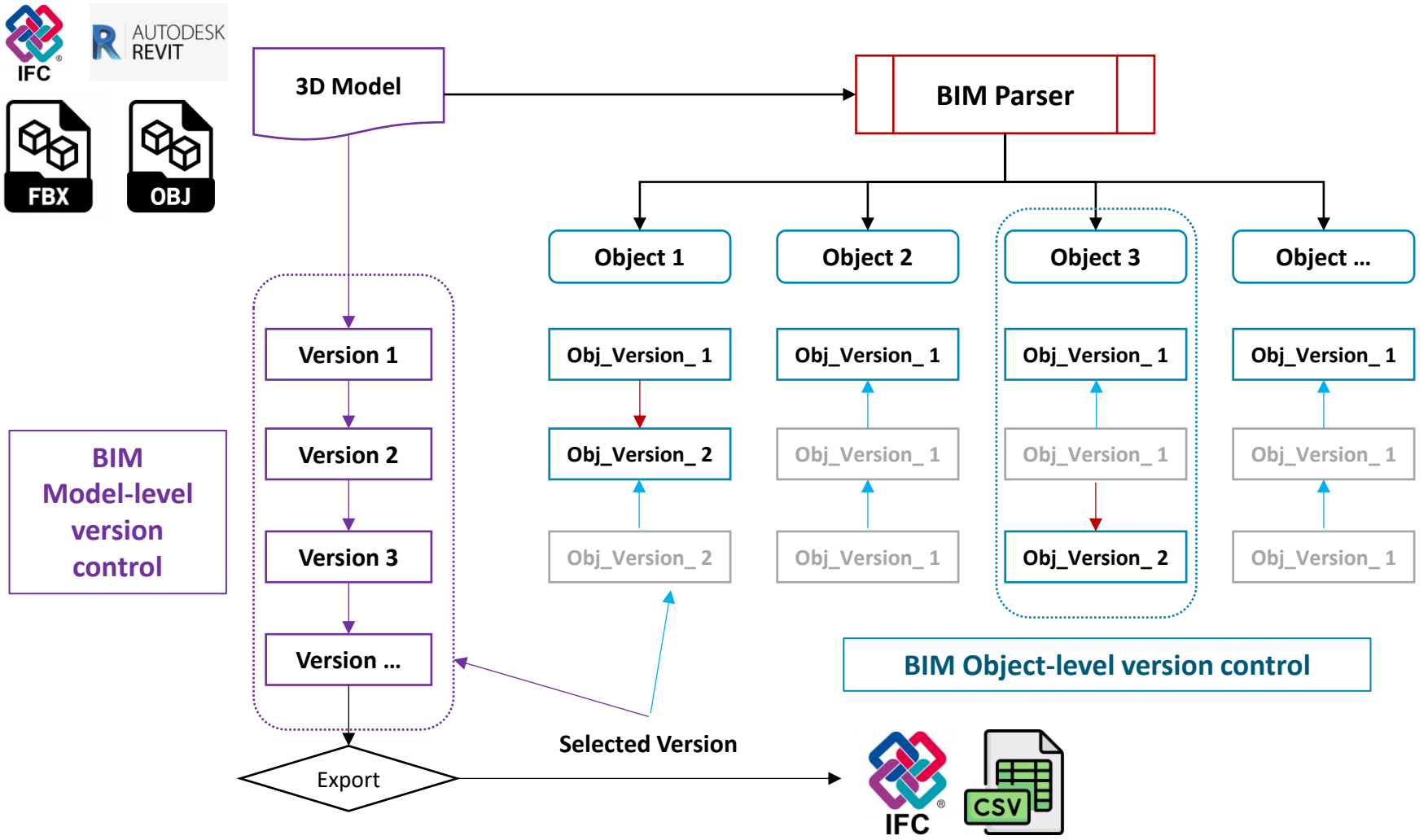
Document



MetaBIM: Data Parser



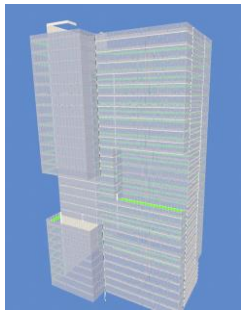
MetaBIM: Data Parser

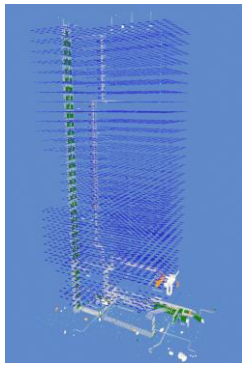


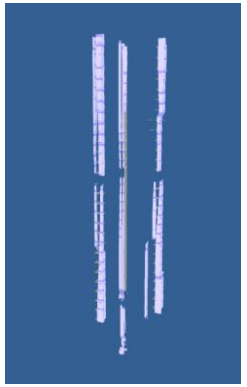
Great efficiency in:

- Storage
- Query
- Comparison
- Auditing

MetaBIM: Data Parser Performance

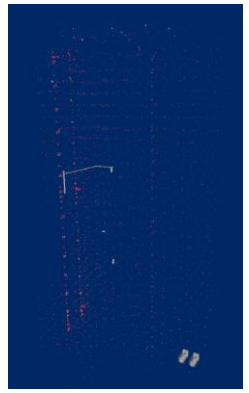


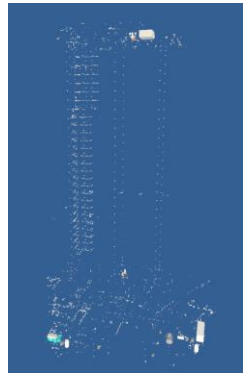


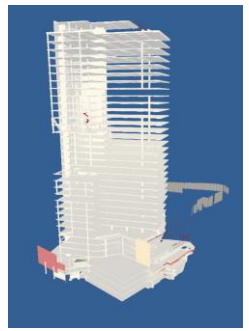


BIM Models	Revit Model Size (MB)	IFC Size Optimised (MB)	Tree Size (MB)	IFC Elements	BIM Objects	Triangles/Vertices (Million)
Architecture	578	40.8	67.1	125,935	25,378	3.1/6.8
Electrical	40.8	37.4	33.1	54,052	12,715	9.6/16.5
Fire Protection	113	66.5	71.4	47,209	15,213	36/46.2
Hydronic	93.9	128	58.5	27,201	9,081	19.2/26.7
Mechanical	110	7.35	8.89	8,954	2,937	0.22/0.3
Structural	99.7	28.1	16.1	11,263	3,821	1.1/1.6

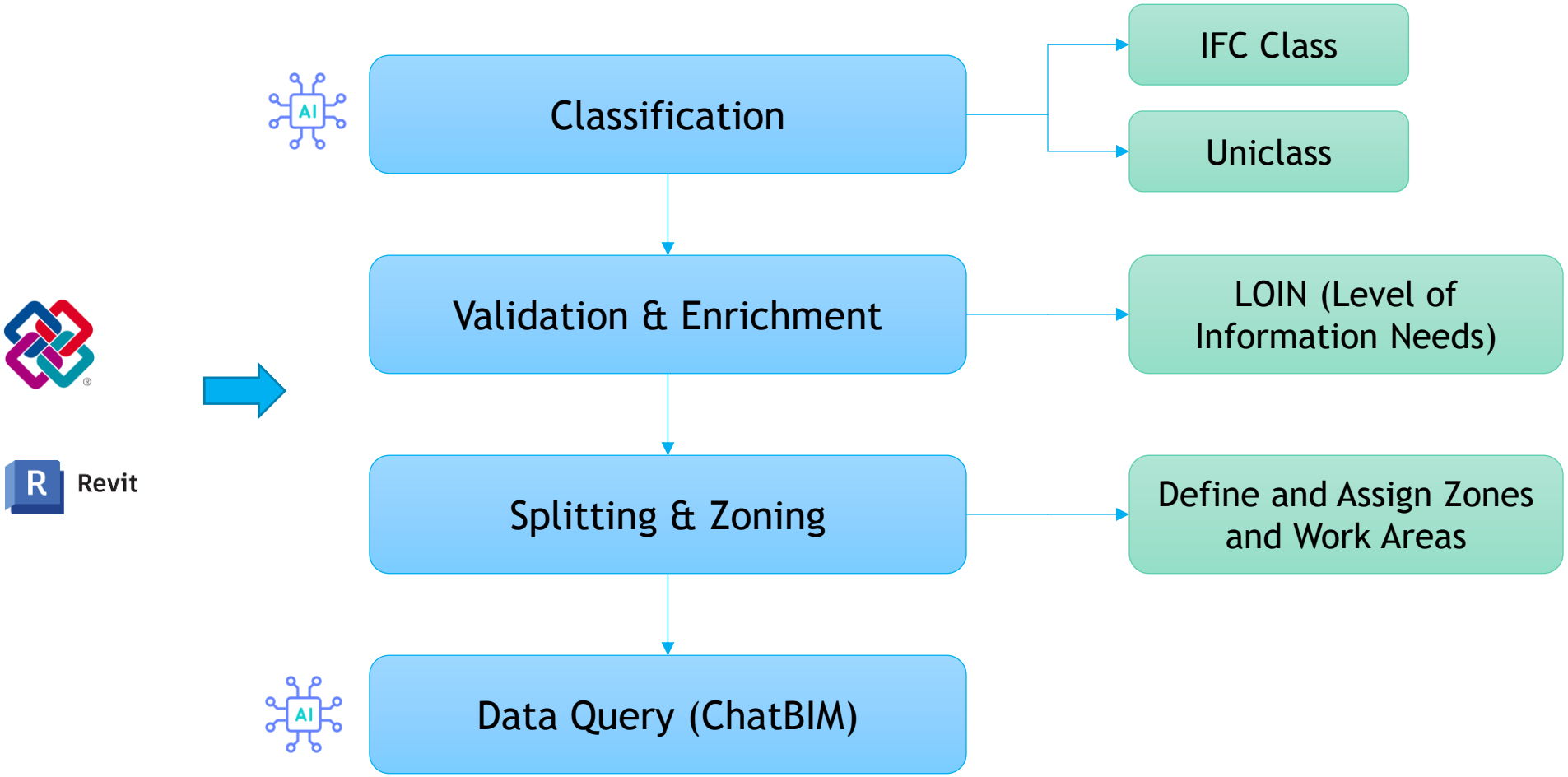
Model Conversion (Second)	Hierarchy Building (Second)	Parser (Second)	Total Server Processing Time (Second)	First Loading Time (Second)	Reloading Time (Second)	Download Time (Second)
15	152	17	**184**	34	6	2-6
41	35	6	**82**	7	2	2-6
51	411	7	**469**	11	2	2-6
271	128	4	**403**	3	1	2-6
122	12	4	**138**	4	1	2-6
44	6	1	**51**	7	1	2-6



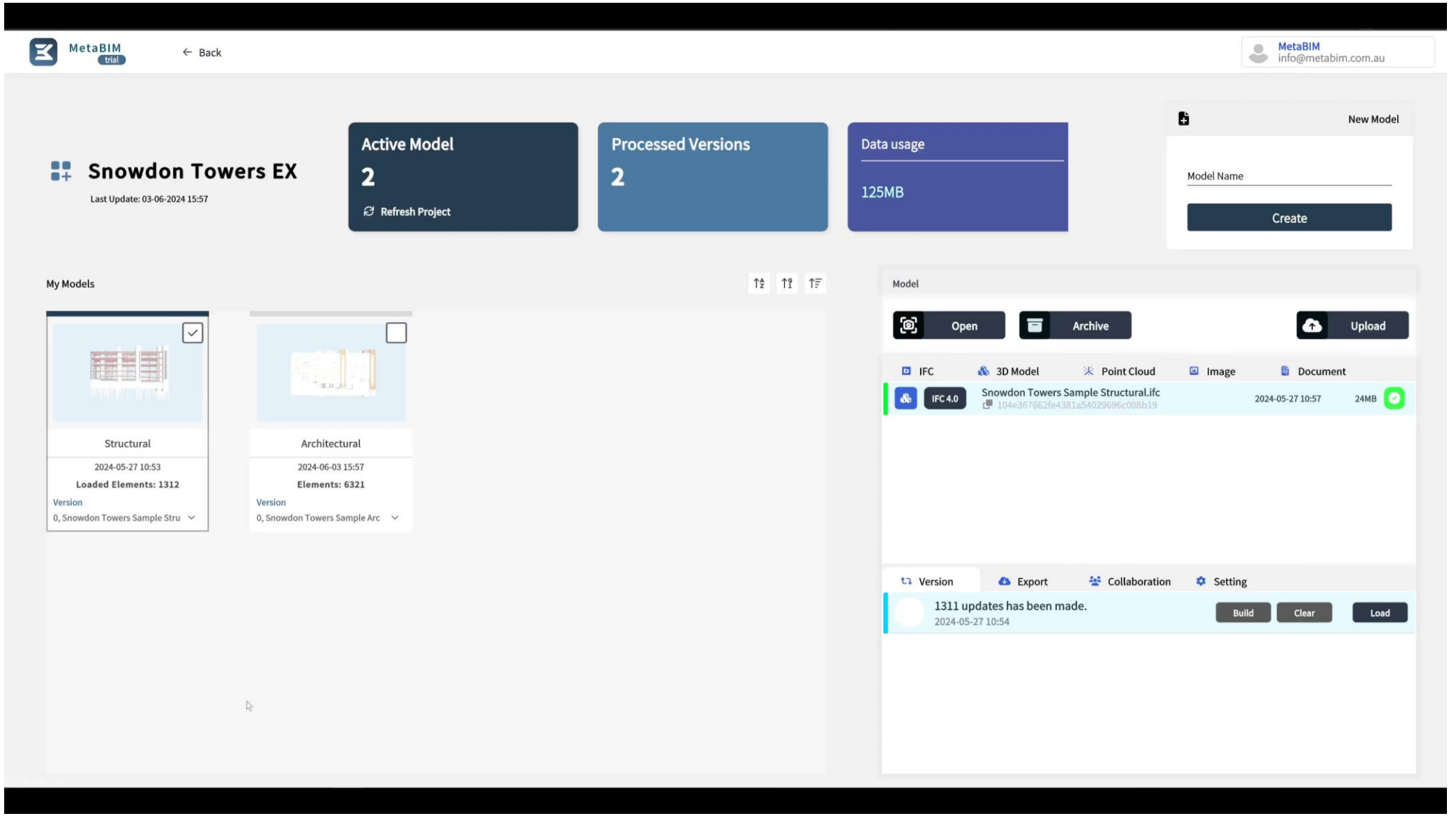




MetaBIM: Processor



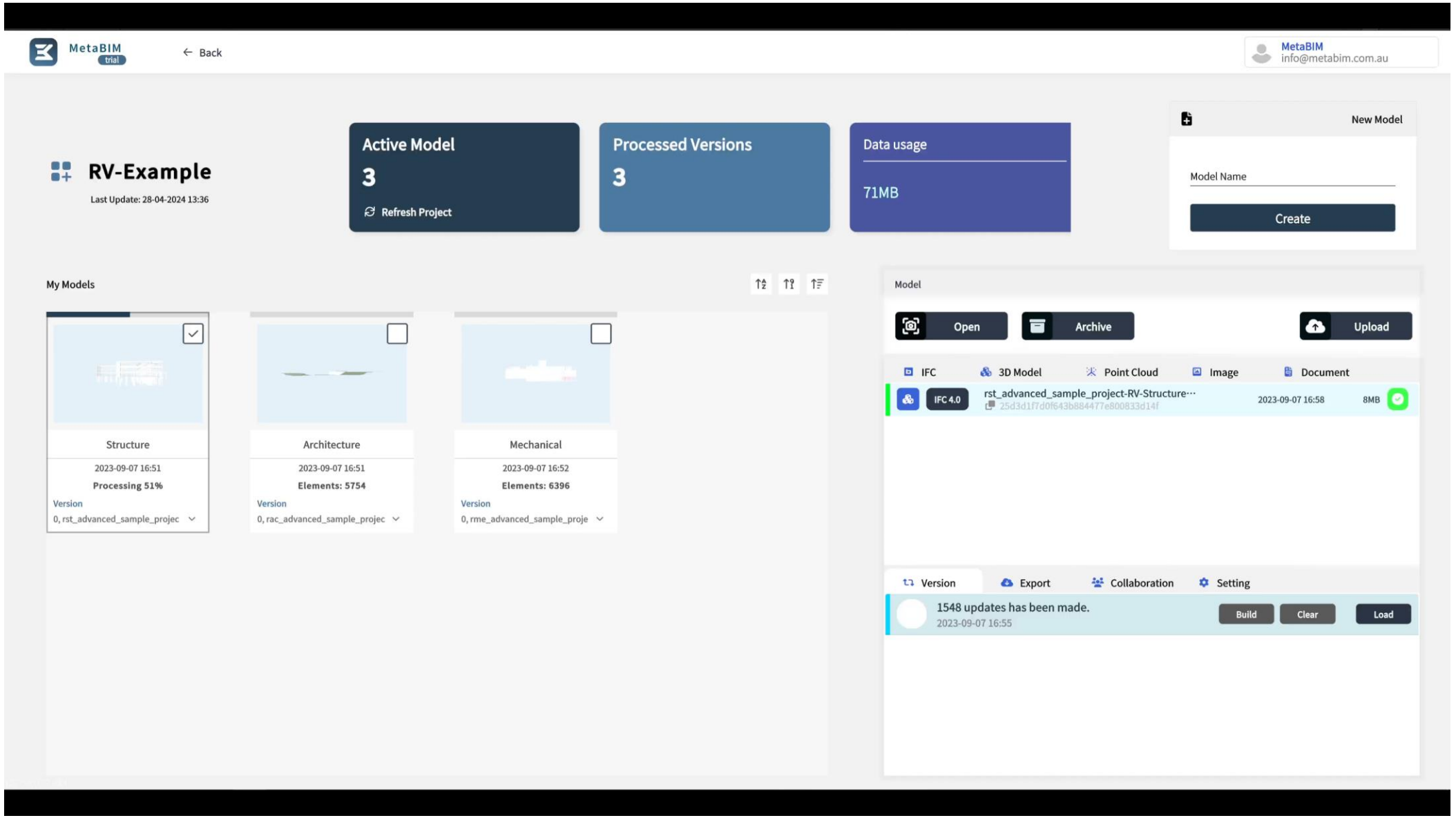
MetaBIM: Classification



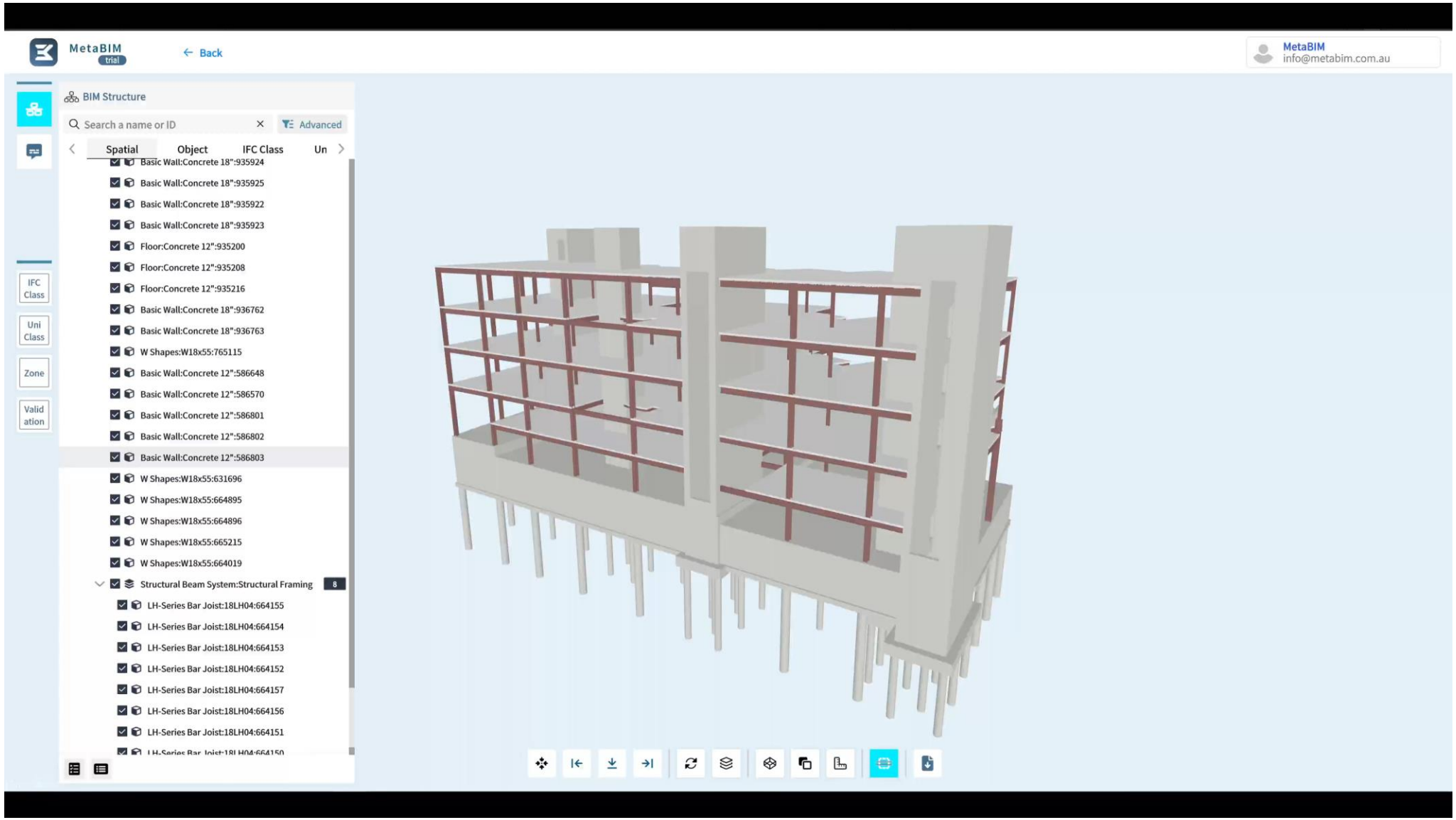
MetaBIM: Validation & Enrichment

IfcWall	
Properties	***Values***
GlobalId	~
Uniclass	Level 3 classification
Status	New, Existing, Demolish, Temporary
FireRating	~
AcousticRating	[30, 50]
Combustible	TRUE, FALSE
IsExternal	TRUE, FALSE
LoadBearing	TRUE, FALSE
ExtendToStructure	TRUE, FALSE
ThermalTransmittance	[0, 100] W/(m2·K)
FireExit	TRUE, FALSE
SelfClosing	TRUE, FALSE
SmokeStop	TRUE, FALSE
Compartmentation	TRUE, FALSE
IfcColumn	
Properties	***Values***
GlobalId	~
Uniclass	Level 3 classification
Status	New, Existing, Demolish, Temporary
Slope	[0, 90] degree
FireRating	~
IsExternal	TRUE, FALSE
LoadBearing	TRUE, FALSE
ThermalTransmittance	[0, 100] W/(m2·K)

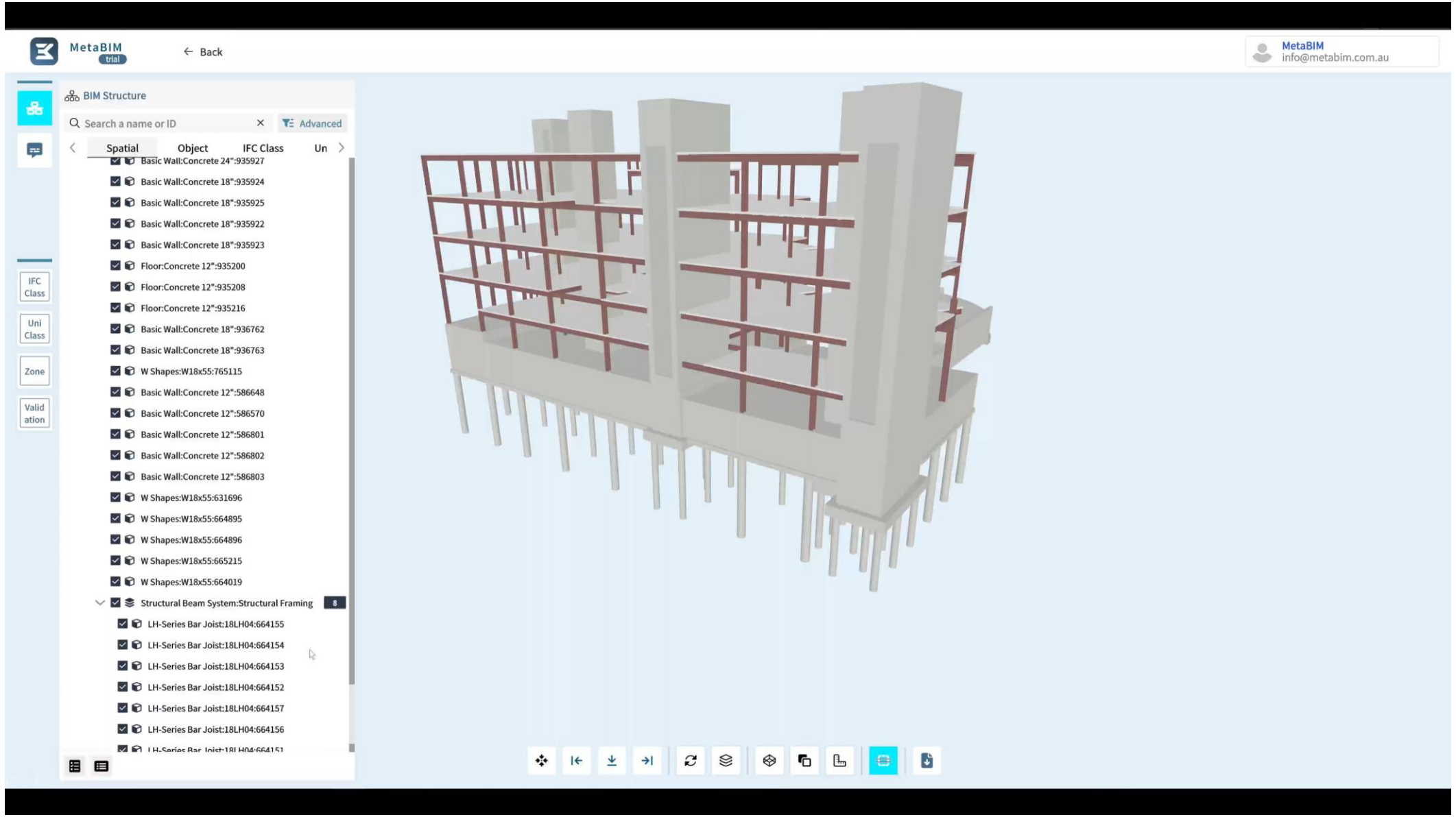
MetaBIM: Validation & Enrichment



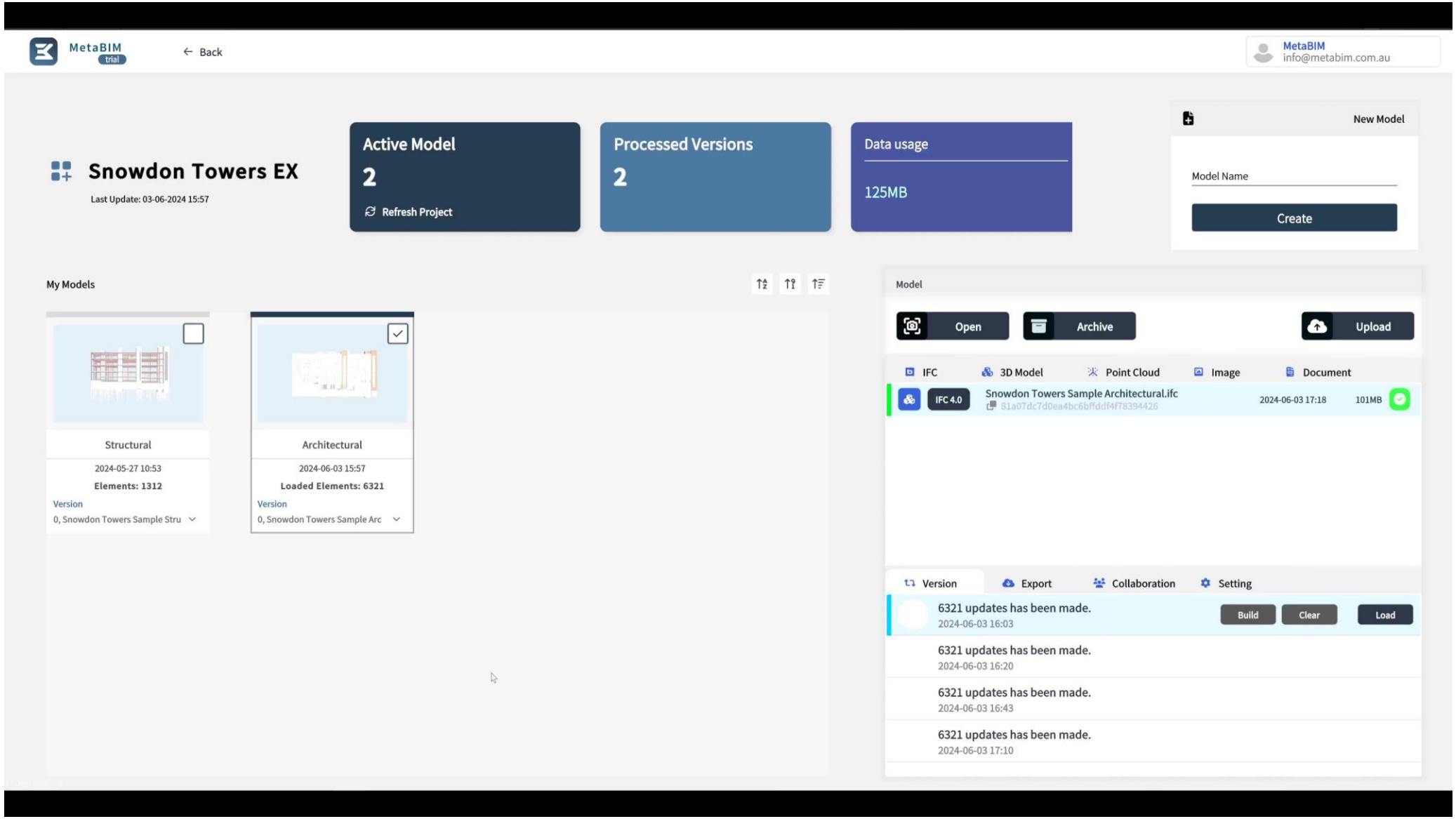
MetaBIM: Splitting



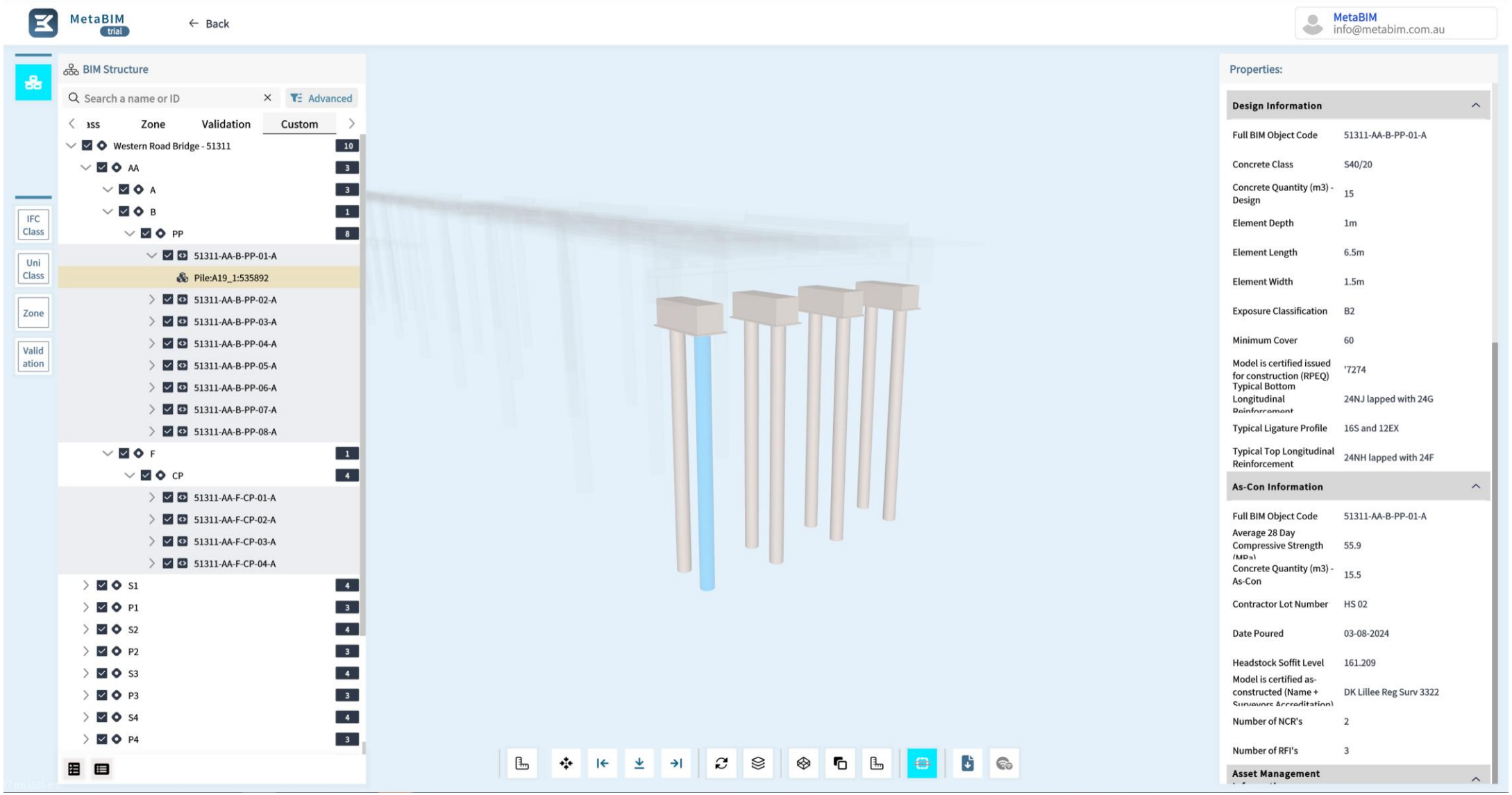
MetaBIM: Zoning



MetaBIM: Data Query (ChatBIM)



MetaBIM: Infrastructure Example (based on QTMR Bridge BIM Requirement)



Why EasyCarbon?

Current Solutions for Building & Infrastructure Construction A1-A5 Carbon Calculation

Material-Oriented Carbon Calculation

Difficult Integration with Costing and Scheduling
Since project management often uses element-based frameworks for cost estimation and scheduling, material-oriented carbon calculations can be challenging to integrate with these processes. This disconnect can lead to inefficiencies in aligning carbon assessments with project budgets and timelines.

Inefficiencies in Optimisation
Optimising carbon reductions across a project is more challenging when calculations are material-based. It becomes difficult to identify which building elements are the best targets for carbon reduction strategies, leading to less effective sustainability efforts.

Why EasyCarbon?

Inspired by Life Cycle Costing (LCC), we aim to develop an ***Elemental-based*** carbon calculation method fully integrated with **BIM** (i.e. MetaBIM).

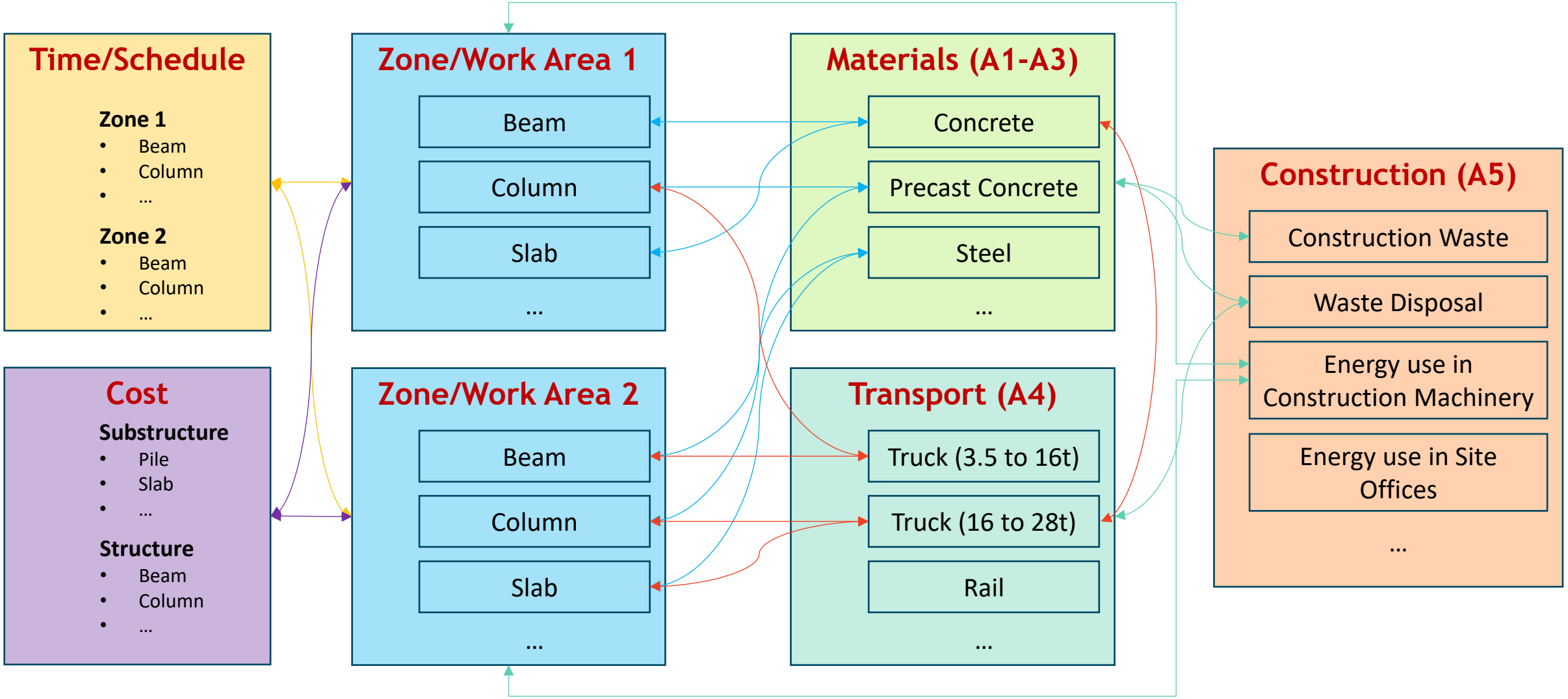
Better Integration with Cost Estimation
Element-based carbon calculations align well with existing cost estimation practices that use elemental cost unit rates. This alignment allows for a more integrated approach to managing both carbon impact and project costs, facilitating more effective decision-making throughout the project lifecycle.

Targeted Carbon Reduction
By breaking down carbon calculations by element, it becomes easier to identify which components of a building or infrastructure project offer the most significant opportunities for carbon reduction. This targeted approach enables more strategic sustainability initiatives and more efficient use of resources.

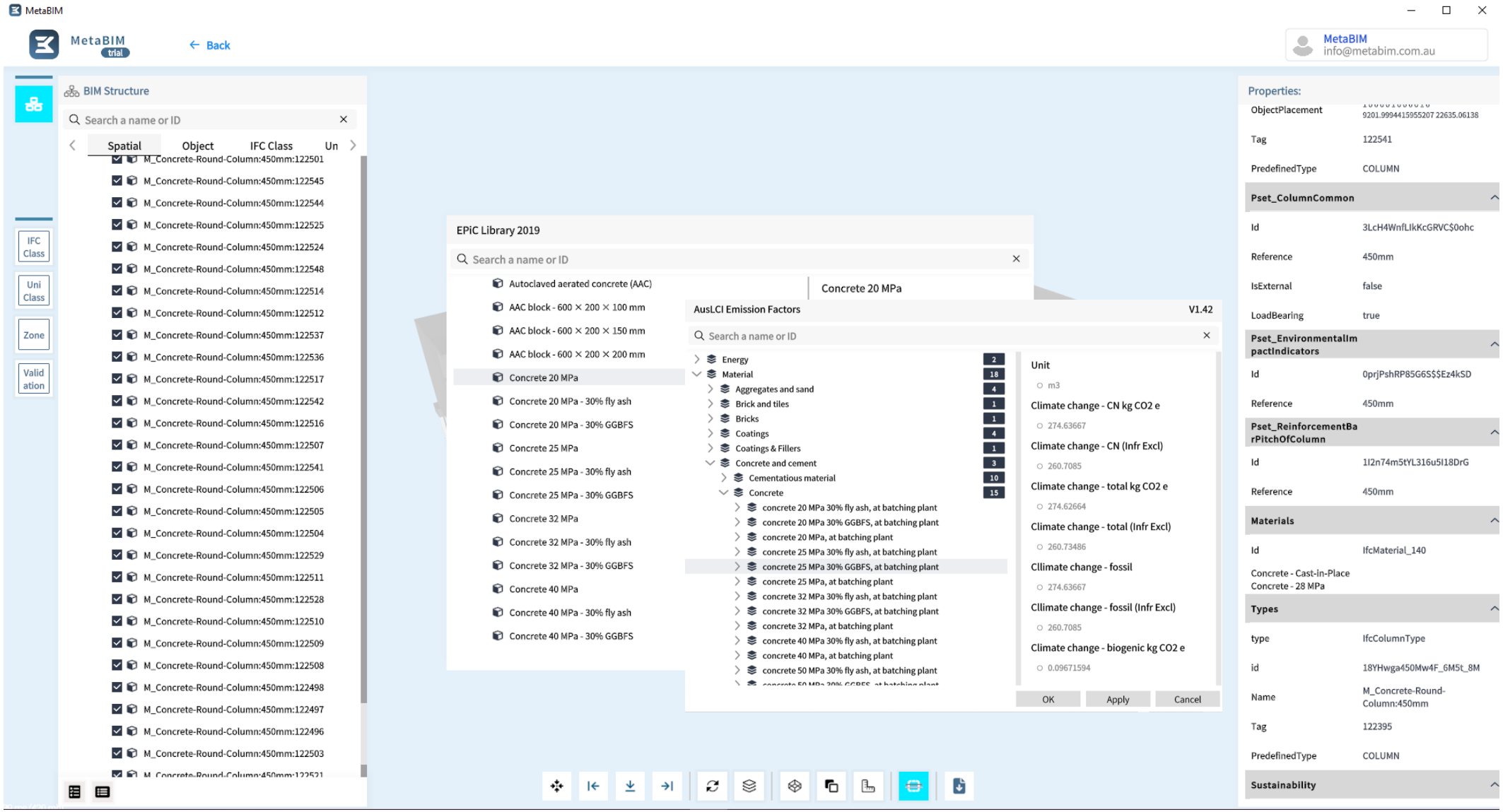
Alignment with Project Management Practices:
Element-based calculations can be more easily integrated into project management tools and practices, such as Building Information Modelling (BIM) and lifecycle cost analysis. This alignment helps streamline the process of monitoring and controlling carbon emissions alongside other key project metrics like cost and time.

Facilitates Comparative Analysis
Element-based approaches allow for better comparative analysis between different design options or construction methods, as they provide a clear understanding of the carbon impact associated with specific building elements. This can be especially valuable in the early stages of project planning when making decisions about design and material selection.

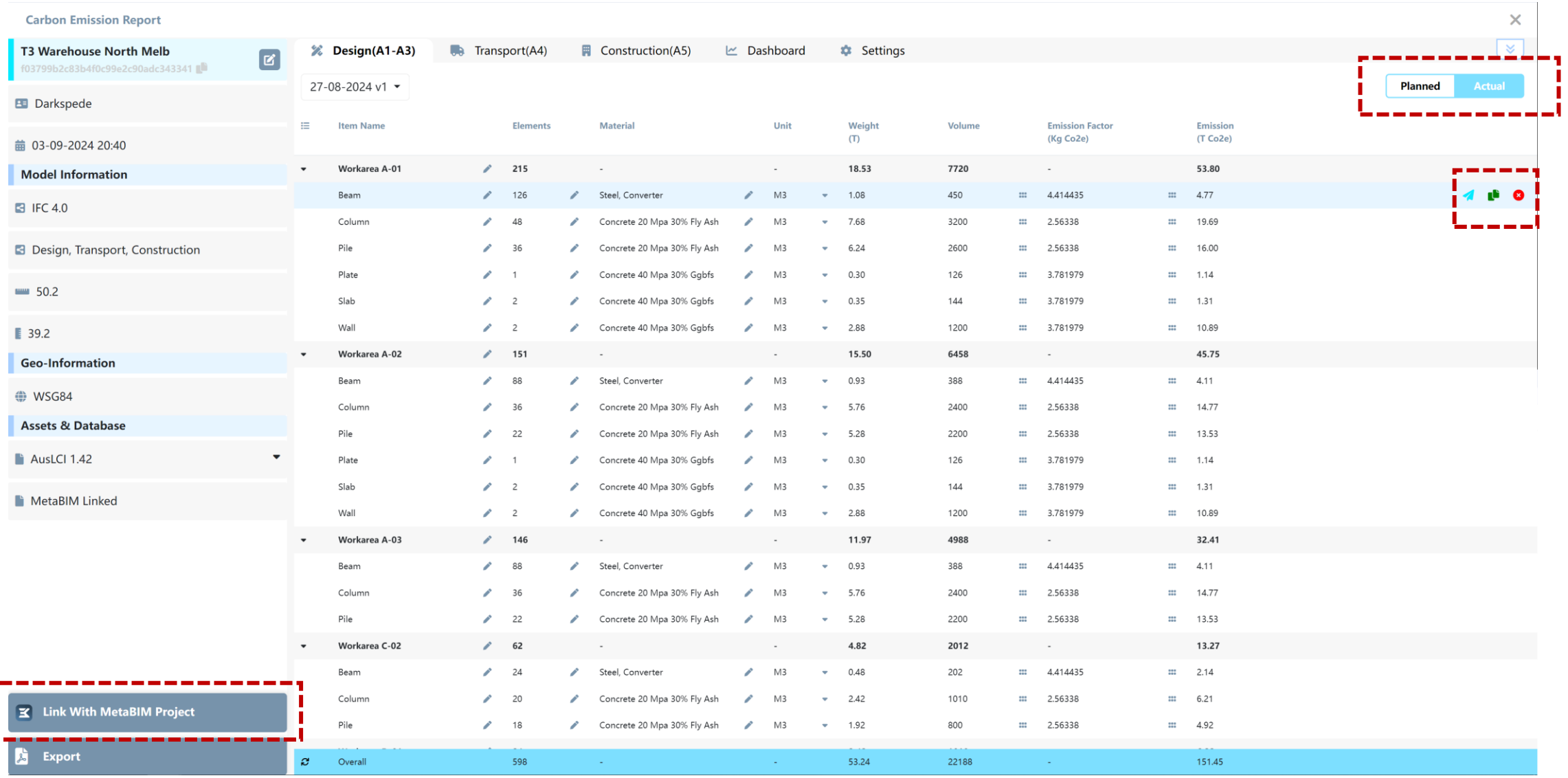
EasyCarbon: Integration of Space, Time, Cost, and Carbon (A1-A3, A4, and A5)



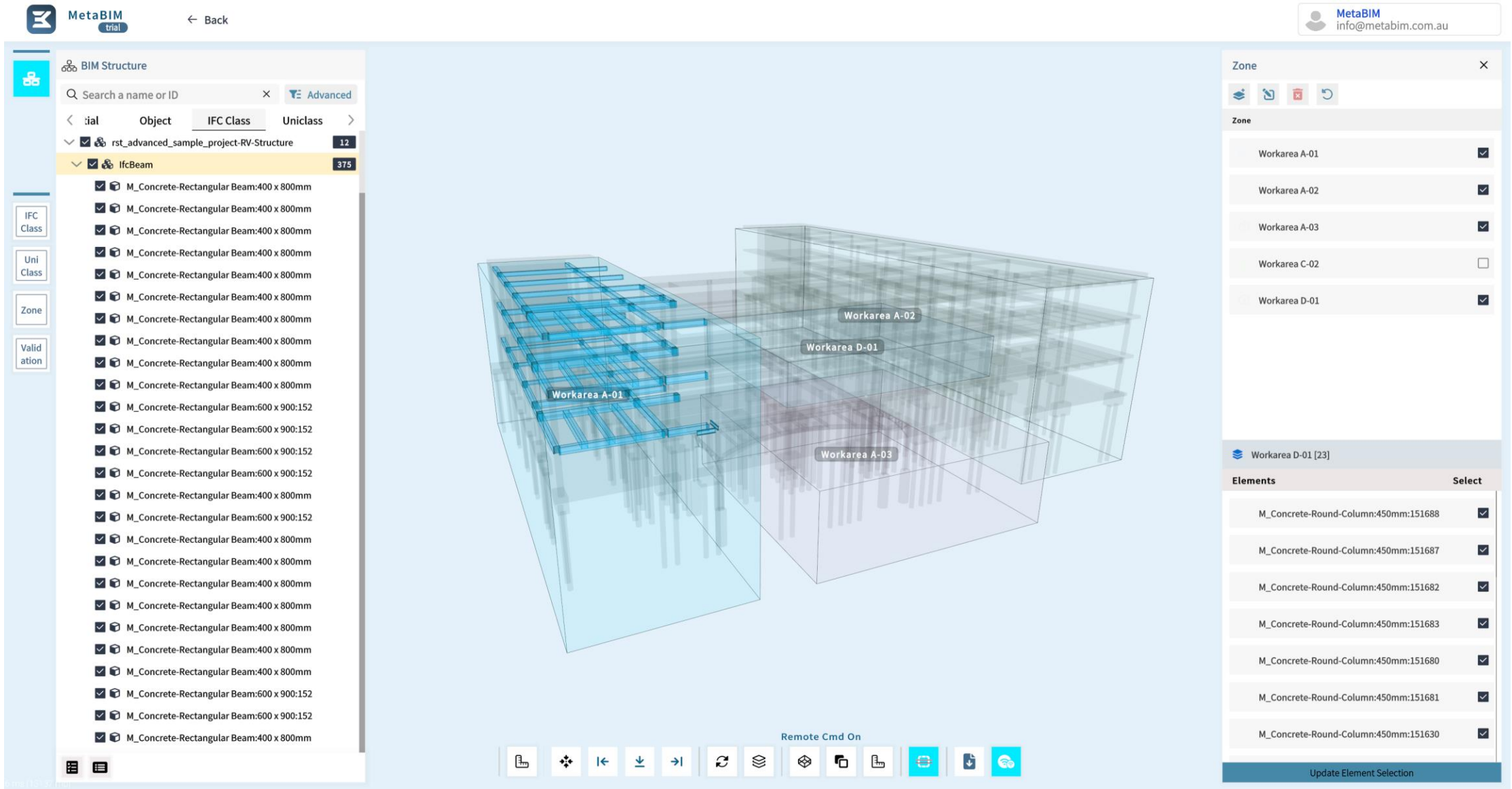
EasyCarbon: Material Mapping (EPiC or AusLCI Database)



EasyCarbon: Link with MetaBIM Project



EasyCarbon: Element View in MetaBIM



EasyCarbon: Transportation

Carbon Emission Report

T3 Warehouse North Melb

f03799b2c83b4f0c99e2c90adc343341

Darkspede

03-09-2024 20:40

Model Information

IFC 4.0

Design, Transport, Construction

50.2

39.2

Geo-Information

WSG84

-37.7945821, 144.9373748

17.2

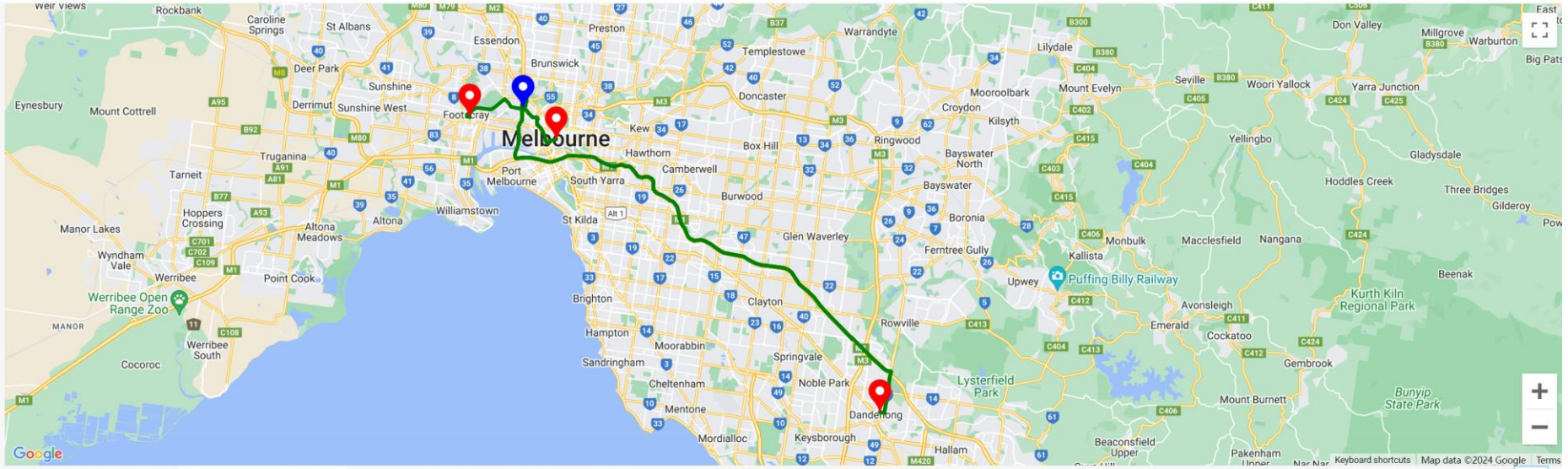
Assets & Database

AusLCI[1.42]

Linked Bim Project:

Link With MetaBIM Project

Export



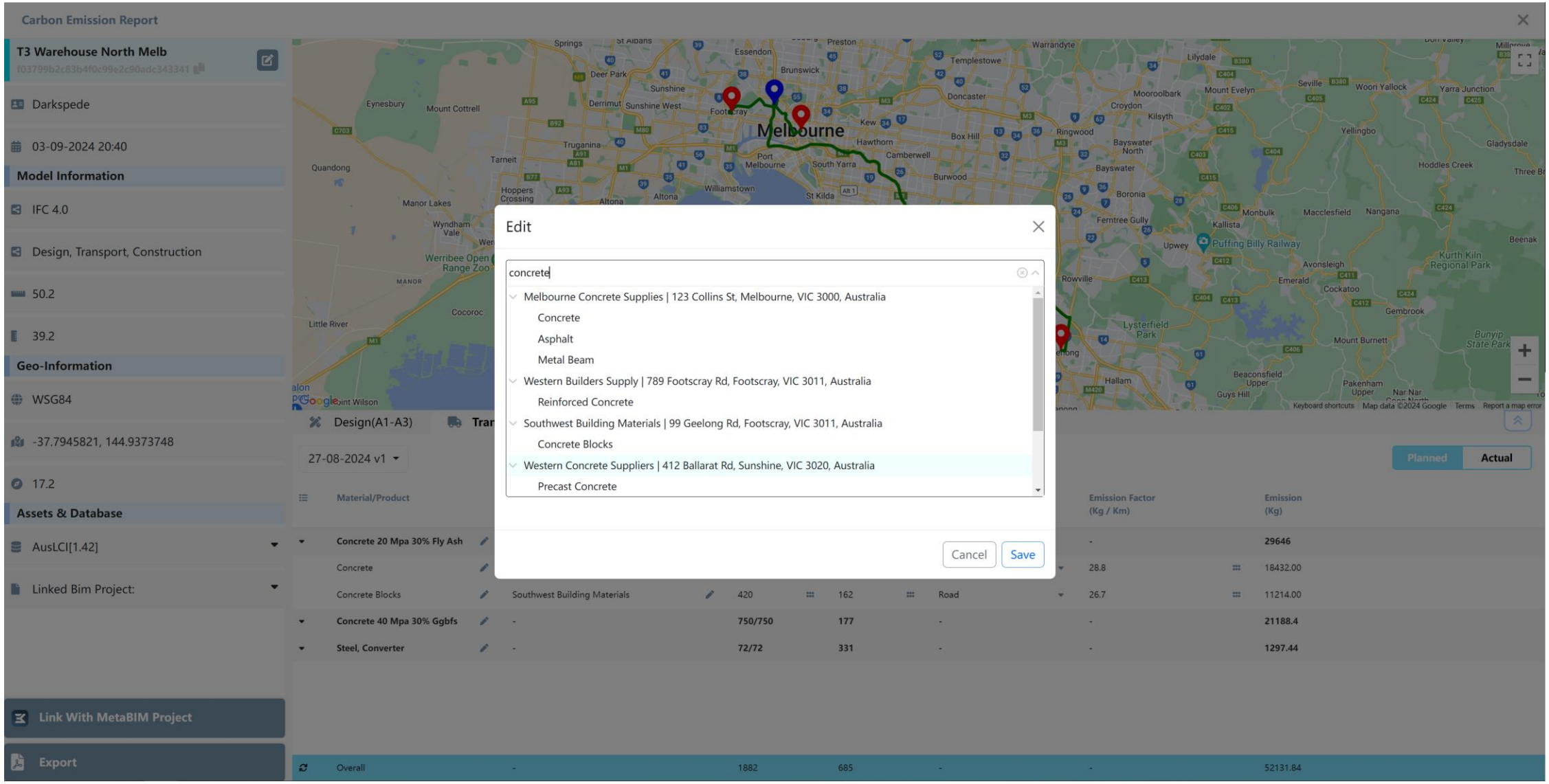
Design(A1-A3) | **Transport(A4)** | Construction(A5) | Dashboard | Settings

27-08-2024 v1

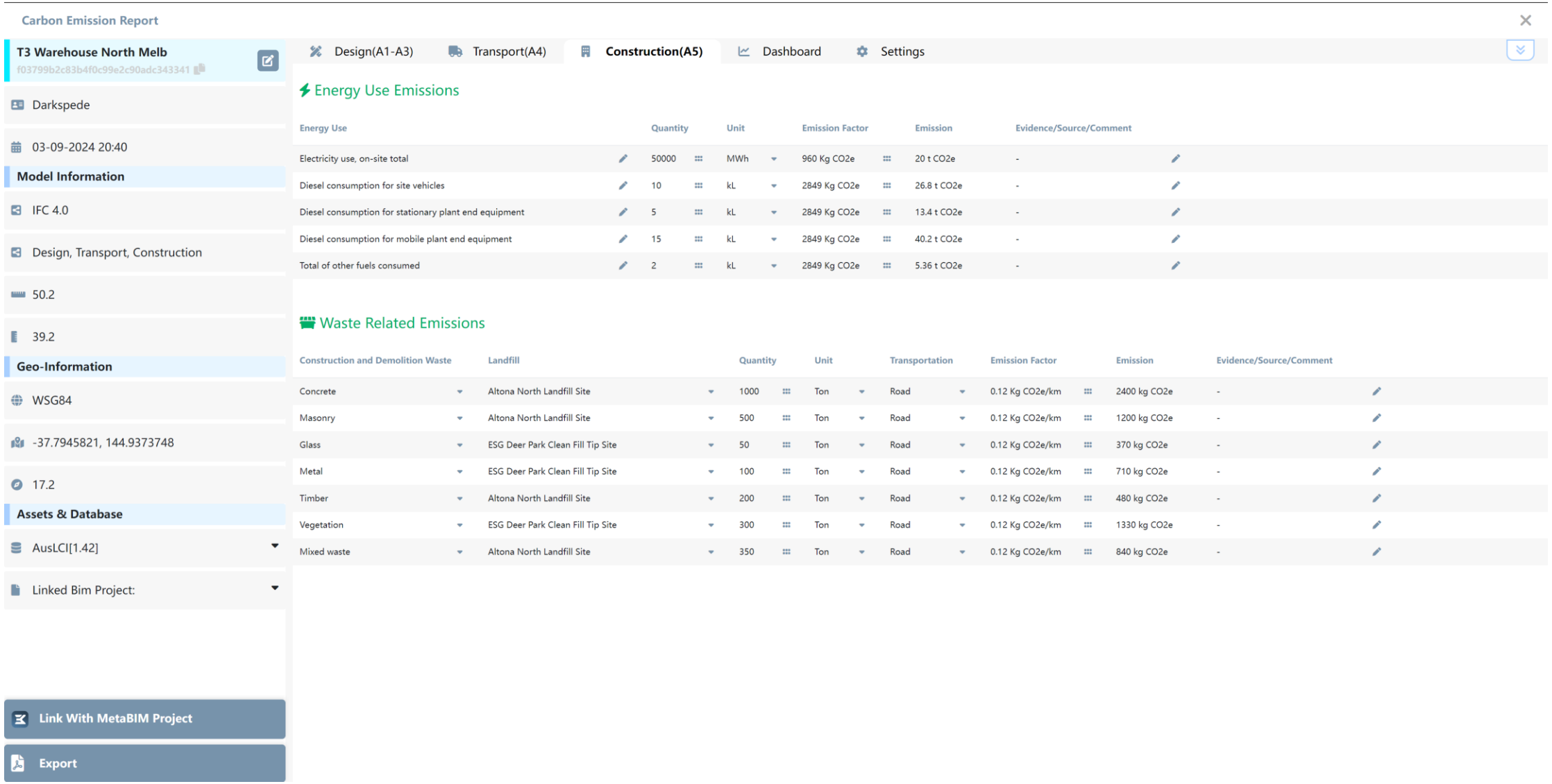
Planned | Actual

Material/Product	Supplier	Quantity (T)	Distance (Km)	Transportation	Emission Factor (Kg / Km)	Emission (Kg)
Concrete 20 Mpa 30% Fly Ash	-	**1060/1060**	**177**	-	-	**29646**
Concrete	Melbourne Concrete Supplies	640	15	Road	28.8	18432.00
Concrete Blocks	Southwest Building Materials	420	162	Road	26.7	11214.00
Concrete 40 Mpa 30% Ggbfs	-	**750/750**	**177**	-	-	**21188.4**
Concrete	Melbourne Concrete Supplies	554	15	Road	28.8	15955.20
Concrete Blocks	Southwest Building Materials	196	162	Road	26.7	5233.20
Steel, Converter	-	**72/72**	**331**	-	-	**1297.44**
Steel Rebars	South East Construction Materials	72	331	Road	18.02	1297.44
Overall	-	1882	685	-	-	52131.84

EasyCarbon: Transportation (Service Provider Database)



EasyCarbon: Construction



Pilot Program with TfNSW (David Kelly)

WSU/TfNSW industry digital accelerator project (three months):

Focus on the Common Data Model (CDM) and data transformation according to the TfNSW Carbon & Cost Management Technical Guidance, to automate carbon estimation as part of cost estimation.

Next SBEnrc Project: AI-based Granular Carbon Accounting in building and infrastructure