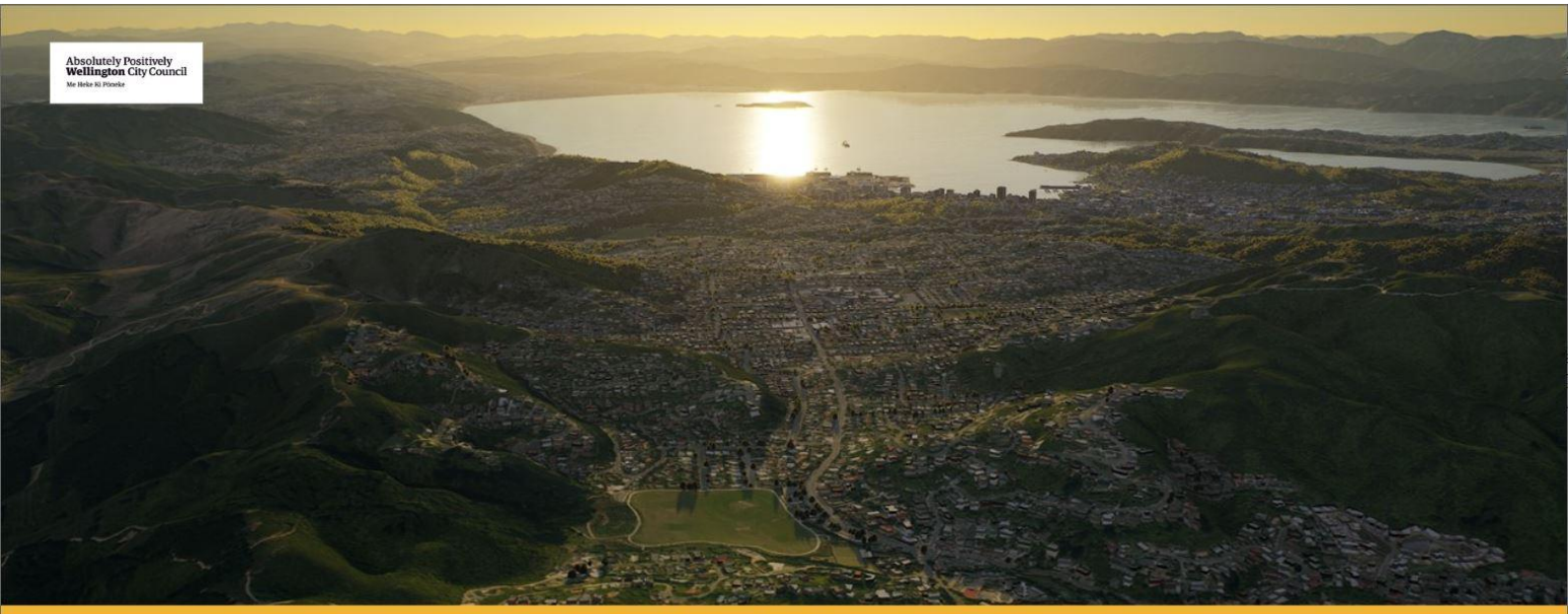
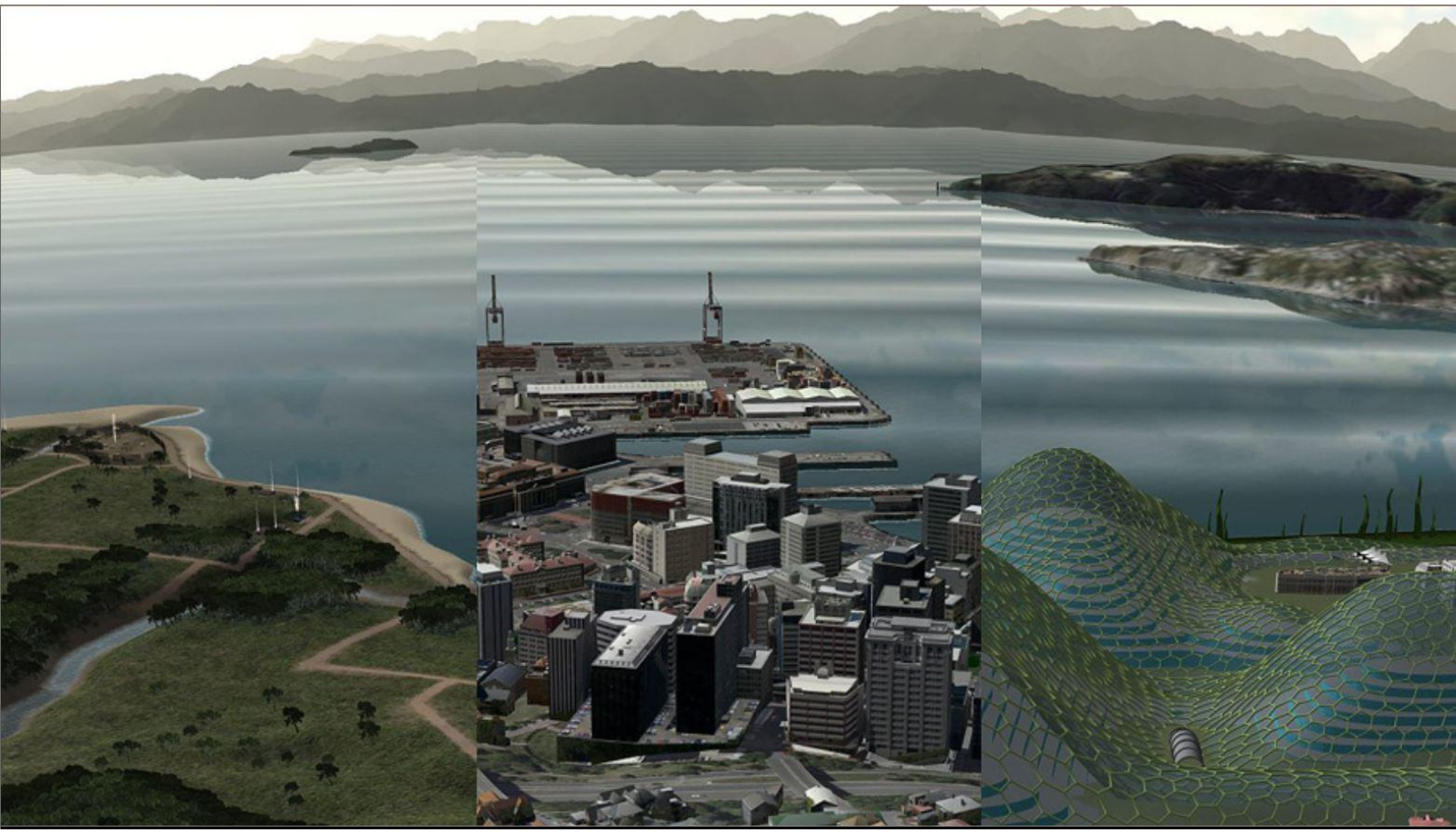
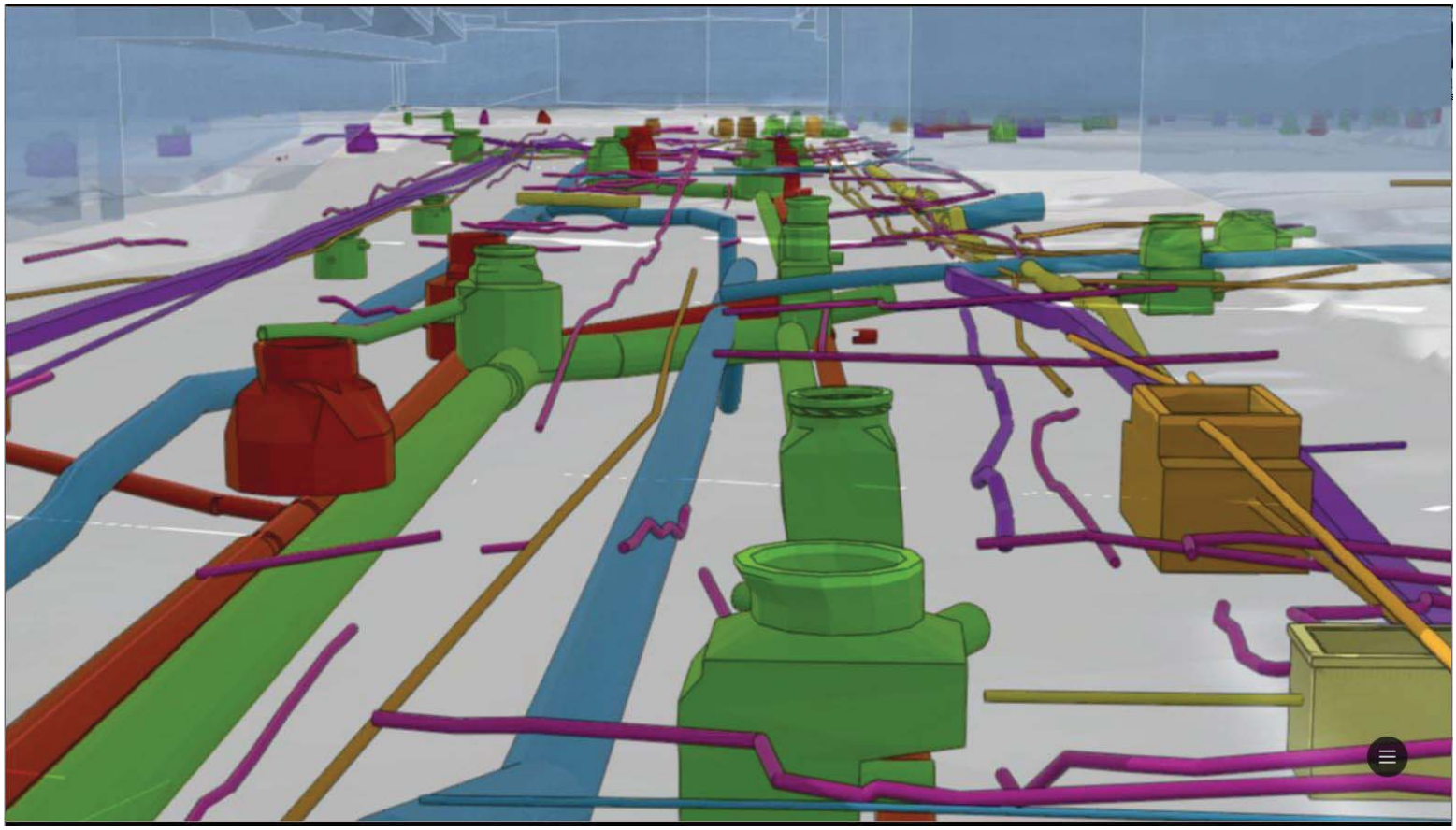


Digital Twins

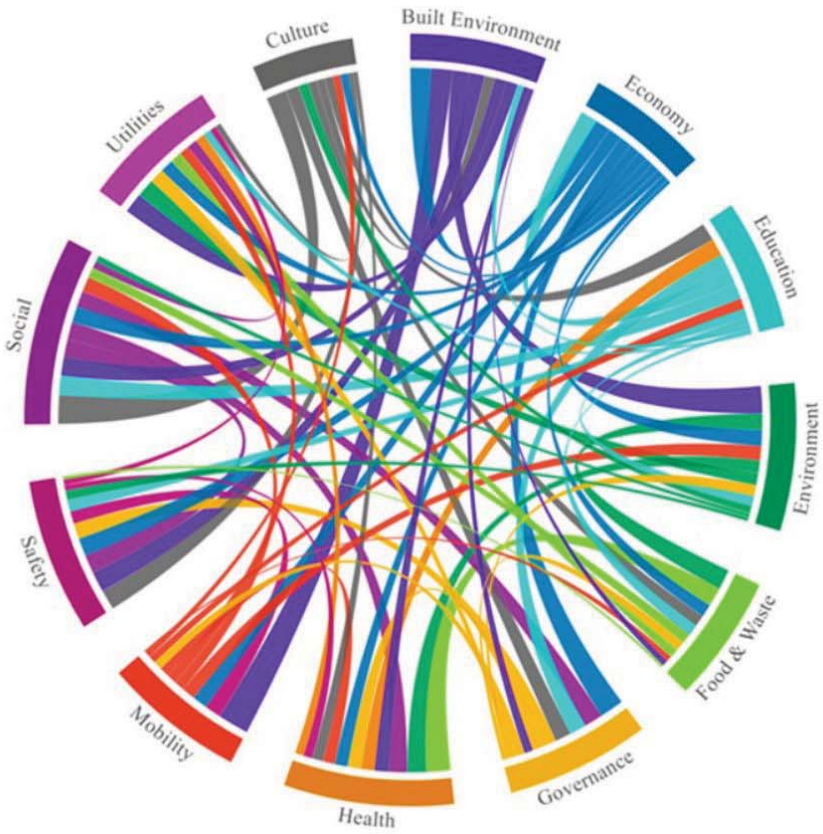
Sean Audain
Wellington City Council.



> **A Digital twin is a fusion between a physical reality & a digital representation**




WIS
IKA RERE



Digital Twin Types

Product Twin

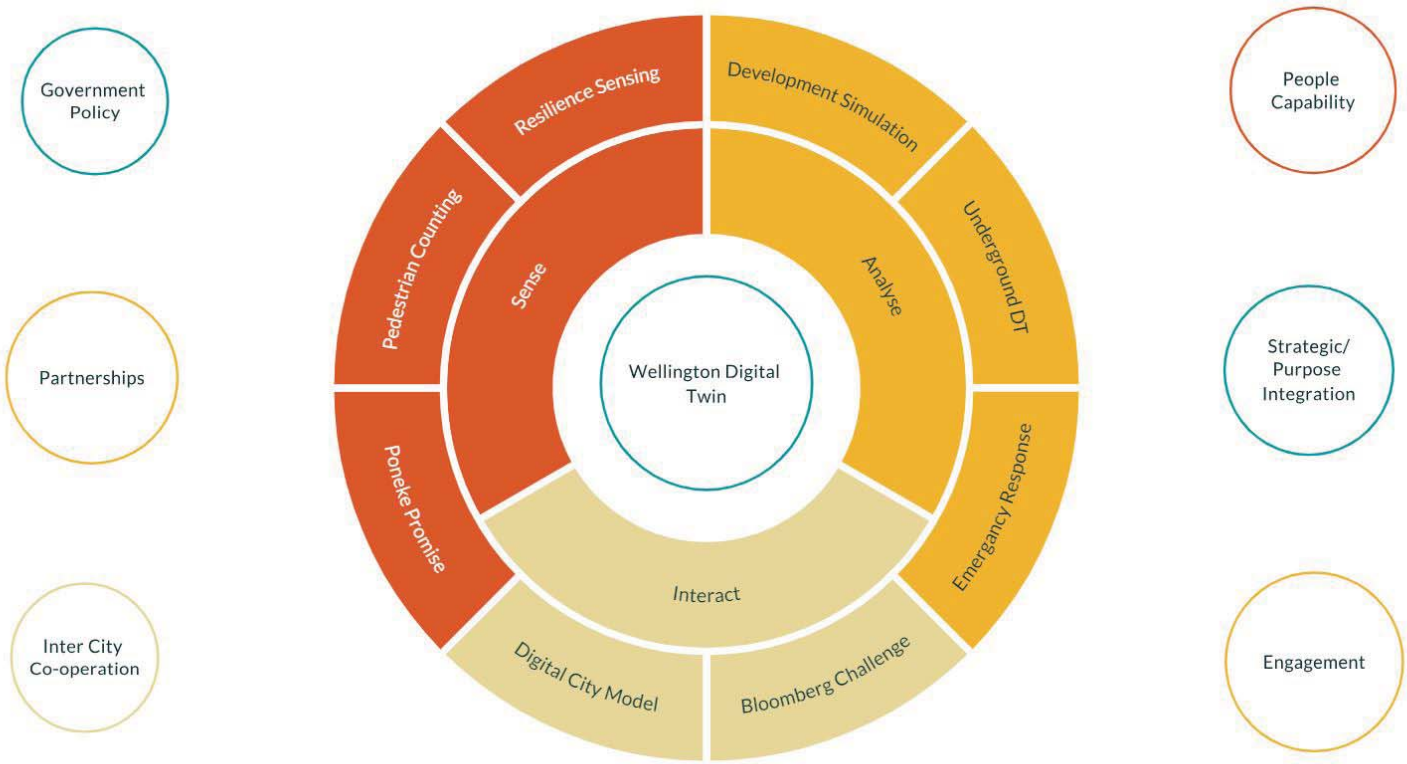
Process Twin

System Twin

Market twin

Model

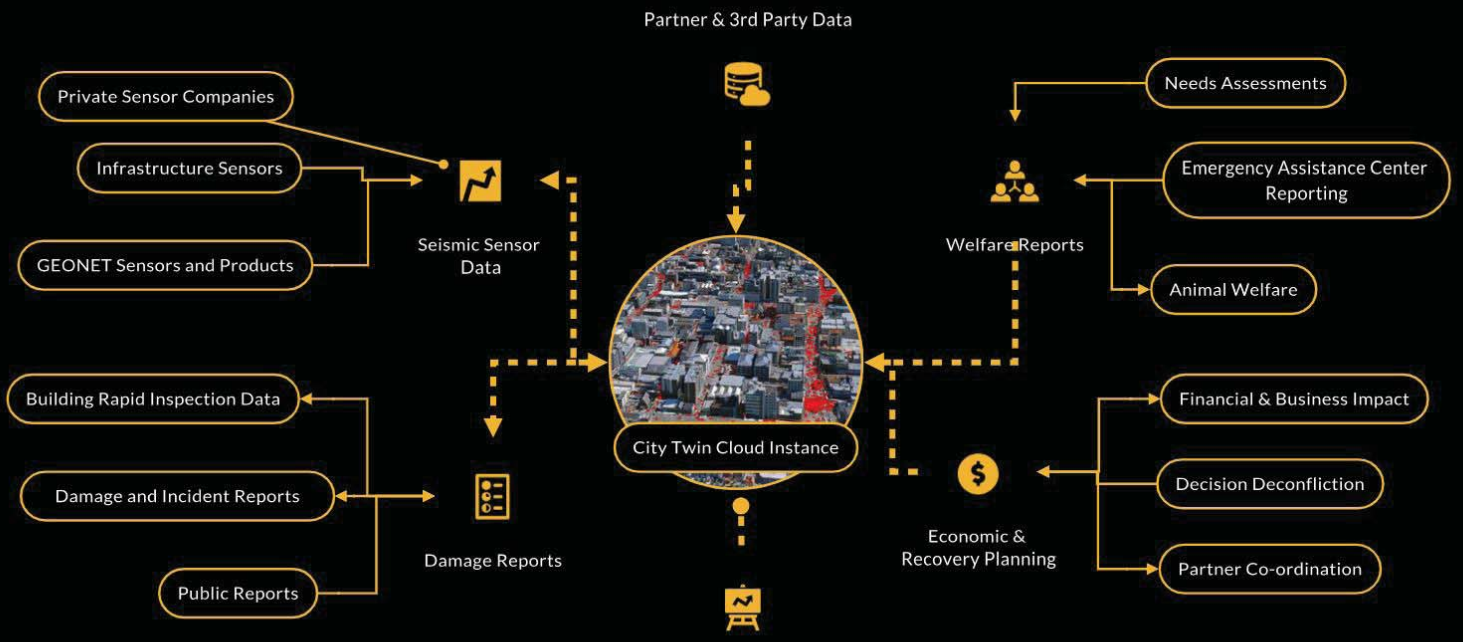
Market



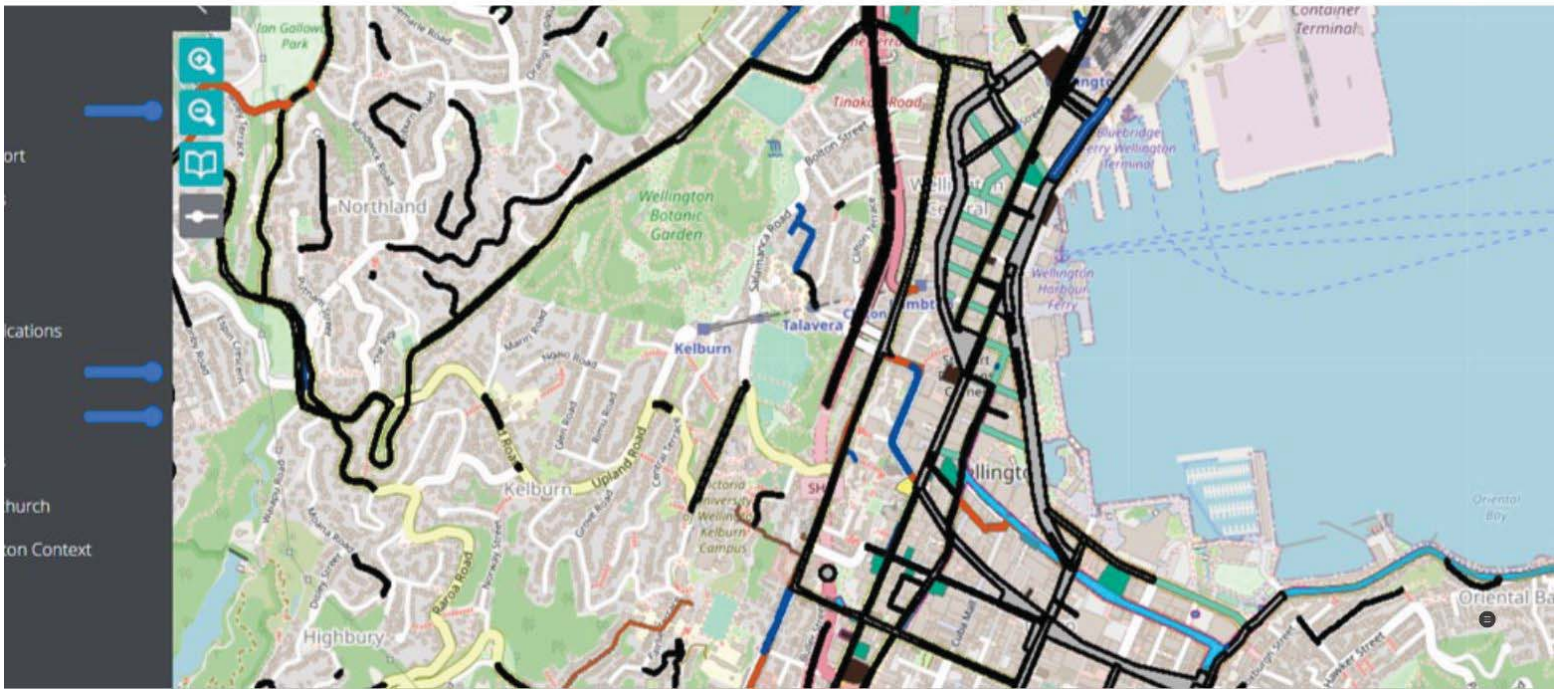
Growing Strength

Smart is a how - not a what

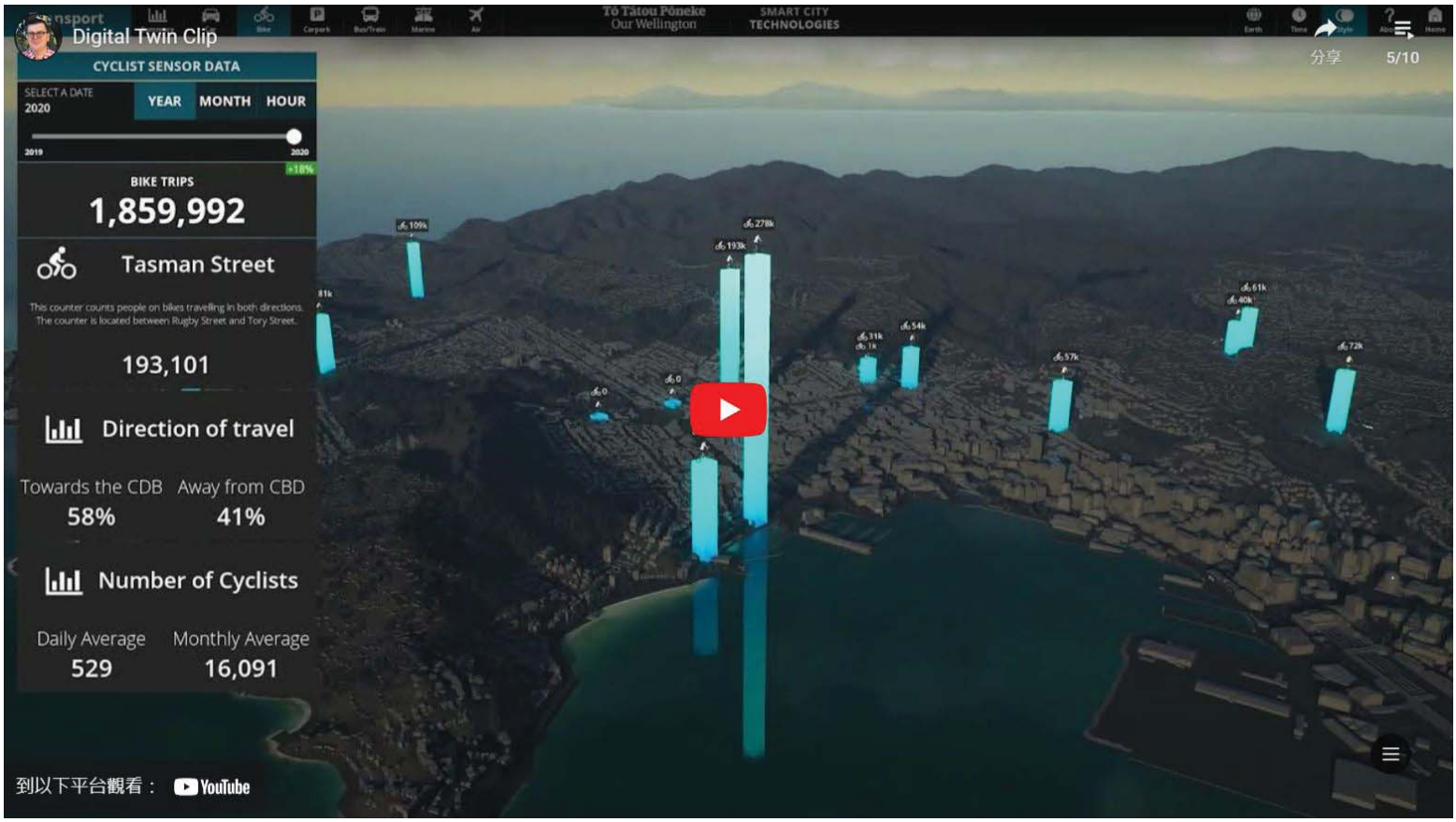
Disaster Response



Analyse - Forward Works Viewer

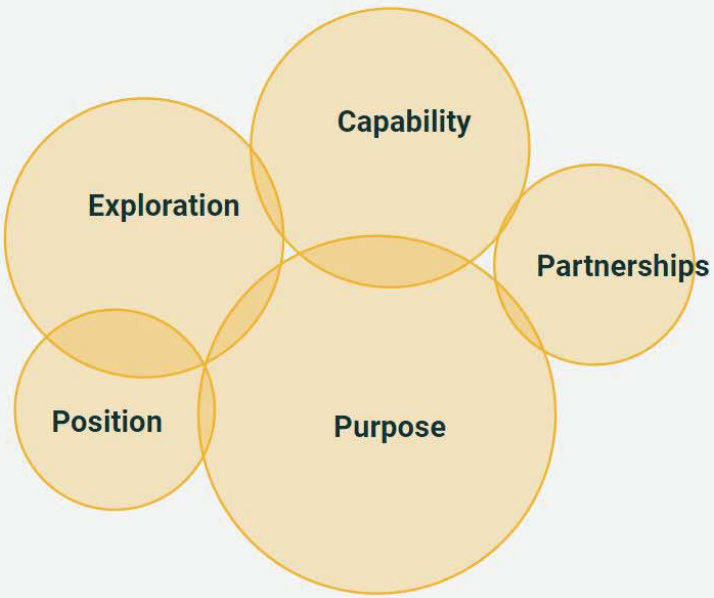


Analyse - Underground



Interact: Global Mayors Challenge

Developing Twins



Earthquake - Message (HTML)

File Message Help Acrobat Tell me what you want to do

Share to Teams | Mark Unread | Find | Zoom | Send to OneNote

Earthquake

Barbara McKerrow

To **DL: All Staff**; **DL: Councillors**; Liz Kelly

Reply | Reply All | Forward

Wed 15/02/2023 8:17 pm

FYI

Kia ora koutou

Well that was a big shake! If you've checked the GeoNet app, it was a 6.1 north of Paraparaumu. A timely reminder that we should always be vigilant in our preparedness for an unexpected event.

In the meantime, I can reassure you that we have seismic sensors in place across the city that provide us with rapid intel. According to the report, our buildings are safe to return to tomorrow.

Here's to a calm night.

Regards

Barbara

Get Outlook for iOS


Thank you

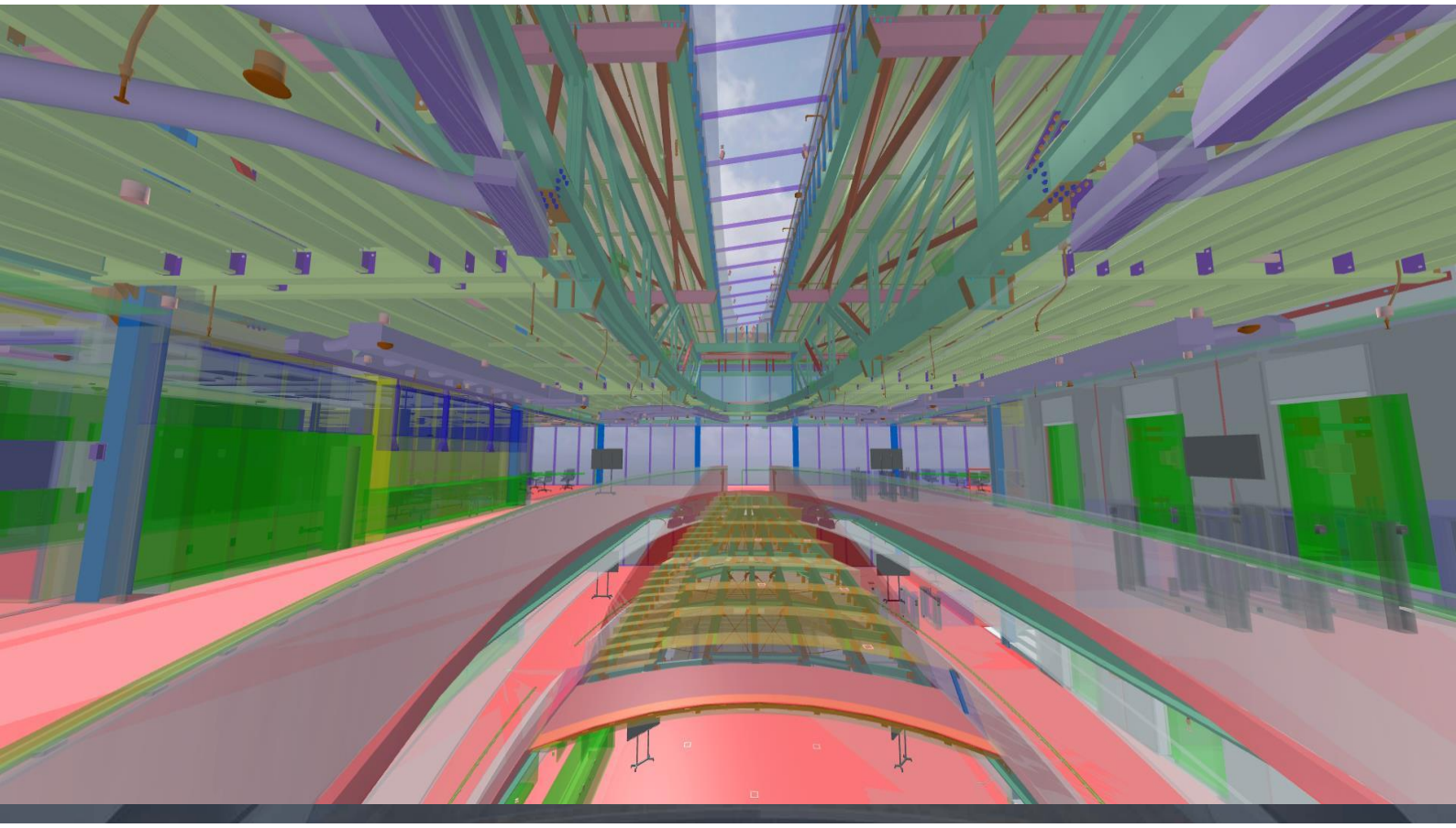
Foodstuffs HQ at Auckland Airport

The Journey from Design to Handover and Beyond

Adam Tindall

Client – Auckland Airport
Tenant – Foodstuffs NI
Project BIM Managers - Assemble

3 hectares of hardscape | **80,000** m² Distribution centre | **8500** m² Head office

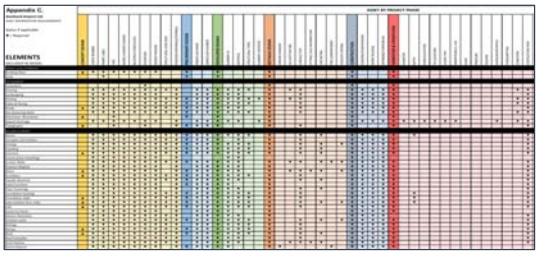


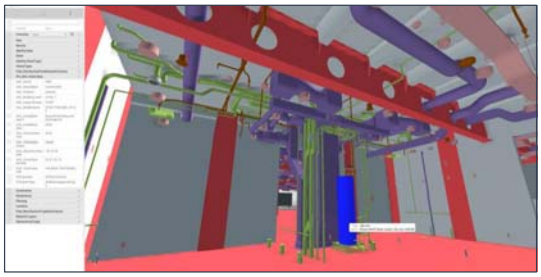
Asset information requirements

22
IFC models delivered at handover

360,000
Elements at Handover

4m
Asset Attribute Data Points





Appendix C.

Auckland Airport Ltd

ASSET INFORMATION REQUIREMENTS

Status if applicable

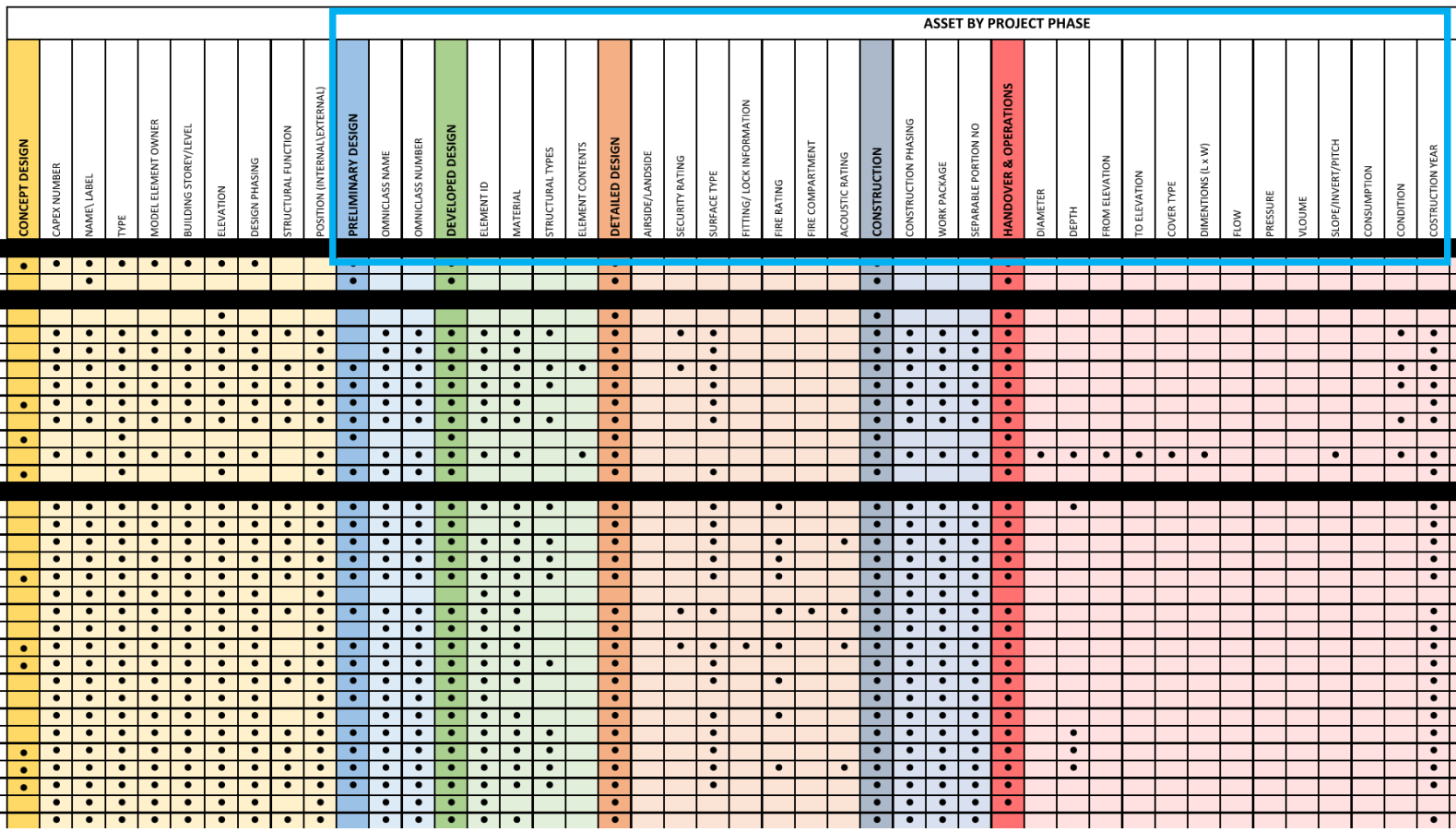
● = Required

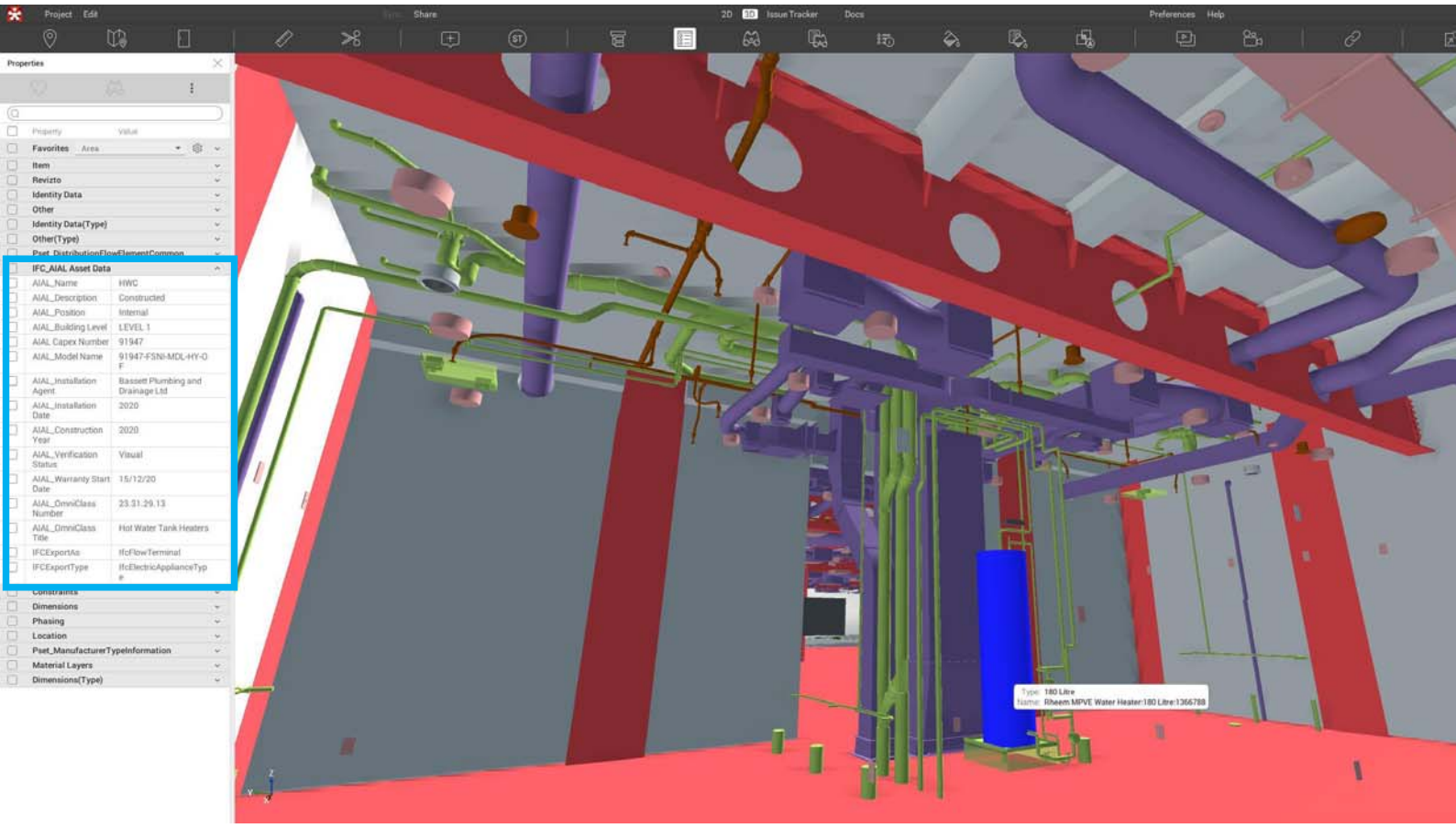
ELEMENTS

INCLUDED IN MODEL

ASSET BY PROJECT PHASE

ELEMENTS INCLUDED IN MODEL	CONCEPT DESIGN	CAPEX NUMBER	NAME\ LABEL	TYPE	MODEL ELEMENT OWNER	BUILDING STOREY/LEVEL	ELEVATION	DESIGN PHASING	STRUCTURAL FUNCTION	POSITION (INTERNAL\EXTERNAL)	PRELIMINARY DESIGN	OMNICLASS NAME	OMNICLASS NUMBER	DEVELOPED DESIGN	ELEMENT ID	MATERIAL	STRUCTURAL TYPES	ELEMENT CONTENTS	DETAILED DESIGN	AIRSIDE/LANDSIDE	SECURITY RATING	SURFACE TYPE	FITTING/ LOCK INFORMATION	FIRE RATING	FIRE COMPARTMENT	ACOUSTIC RATING	CONSTRUCTION	CONSTRUCTION PHASING	WORK PACKAGE	SEPARABLE PORTION NO	HANDOVER & OPERATIONS	DIAMETER	DEPTH	FROM ELEVATION	TO ELEVATION	COVER TYPE	DIMENTIONS (L x W)	FLOW	PRESSURE	VLOUME	SLOPE/INVERT/PITCH	CONSUMPTION	CONDITION	COSTRUCTION YEAR
PROJECT LEVEL ATTRIBUTES																																											
Building Mass	●	●	●	●	●	●	●	●			●			●					●								●				●												
Grids			●								●			●					●								●				●												
SITE ELEMENTS																																											
Excavation							●												●								●				●												
Fencing		●	●	●	●	●	●	●	●	●		●	●	●	●	●			●		●	●					●	●	●	●	●										●	●
Landscaping		●	●	●	●	●	●	●		●		●	●	●	●	●			●			●					●	●	●	●	●											●
Parking		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●					●	●	●	●	●										●	●
Paths & Paving		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●					●	●	●	●	●										●	●
Roads	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●			●					●	●	●	●	●											●
Site Retaining Walls		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●					●	●	●	●	●										●	●
Site/Lease Boundaries	●			●							●			●					●								●				●											
Subsoil Drainage		●	●	●	●	●	●	●			●	●	●	●	●	●		●	●								●	●	●	●	●	●	●	●	●	●	●	●			●	●
[illegible]	●			●			●				●	●	●	●					●			●					●				●											●
BUILDING ELEMENTS																																										
Beams		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●			●		●			●	●	●	●	●		●								●
Canopies and shelters		●	●	●	●	●	●	●	●	●	●	●	●	●					●			●					●	●	●	●	●										●
Ceilings		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●		●		●	●	●	●	●	●										●
Cladding		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●		●			●	●	●	●	●										●
Columns	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●		●			●	●	●	●	●										●
Construction Hoardings		●	●	●	●	●	●	●		●					●	●			●								●	●	●	●	●										
Curtain Walls		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●		●	●		●	●	●	●	●	●	●	●										●
Displays (Digital)		●	●	●	●	●	●	●				●	●	●	●	●			●								●	●	●	●	●											●
Doors	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●			●		●	●	●	●		●	●	●	●	●	●										●
Escalators	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●					●	●	●	●	●										●
Façade elements		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●			●		●			●	●	●	●	●										●
Fixed Furniture		●	●	●	●	●	●	●		●	●	●	●	●	●	●			●								●	●	●	●	●										●
Floor Coverings		●	●	●	●	●	●	●		●		●	●	●	●	●			●			●		●			●	●	●	●	●										●
Foundation footings		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●					●	●	●	●	●		●								●
Foundation slabs	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●					●	●	●	●	●		●								●
Intermediate floor slabs	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●		●		●	●	●	●	●	●		●								●
Lifts	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●					●	●	●	●	●										●
Loose Furniture		●	●	●	●	●	●	●		●		●	●	●	●	●			●								●	●	●	●	●										
Seismic Restraints		●	●	●	●	●	●	●	●	●		●	●	●	●	●			●								●	●	●	●	●										●
Partition walls		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●		●		●	●	●	●	●	●										●
Railings		●	●	●	●	●	●	●		●		●	●	●	●	●	●		●			●					●	●	●	●	●										●
Ramps	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●					●	●	●	●	●										●
Roof	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●		●			●	●	●	●	●										●
Roof Catwallks		●	●	●	●	●	●	●	●	●		●	●	●	●	●			●			●					●	●	●	●	●										●
Roof Hatches		●	●	●	●	●	●	●	●	●		●	●	●	●	●			●			●					●	●	●	●	●										●
[illegible]		●	●	●	●	●	●	●		●	●	●	●	●	●	●			●	●	●	●	●		●		●	●	●	●	●										●



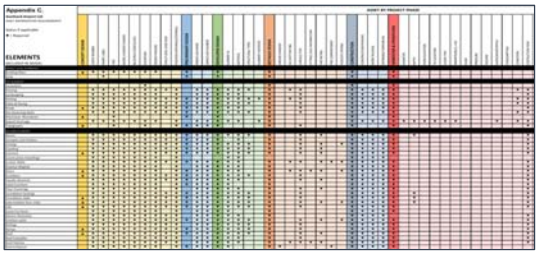


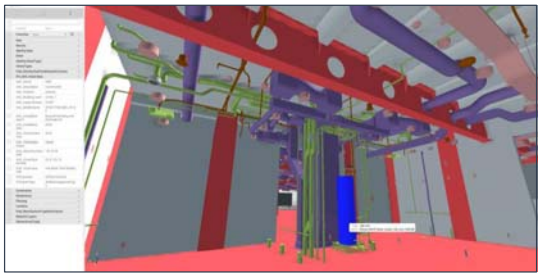
Asset information requirements

22
IFC models delivered at handover

360,00
Elements at Handover

4m
Asset Attribute Data Points



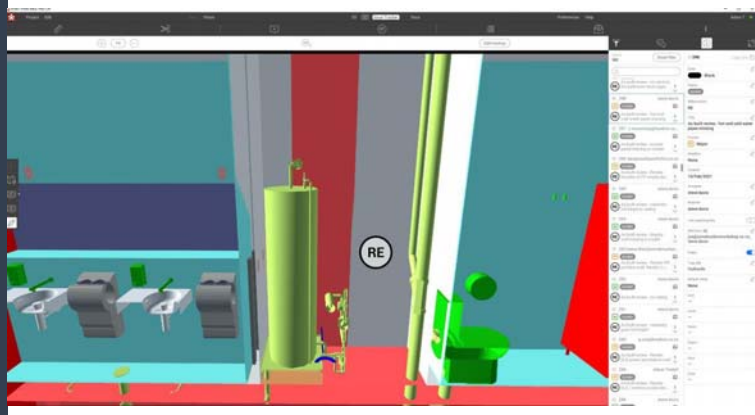


Verification at handover

Verification is an important piece of work

Validation and trustworthiness of handover information is key

Graphical and non-graphical



1. Issue identified

Verification at handover

Verification is an important piece of work

Validation and trustworthiness of handover information is key

Graphical and non-graphical

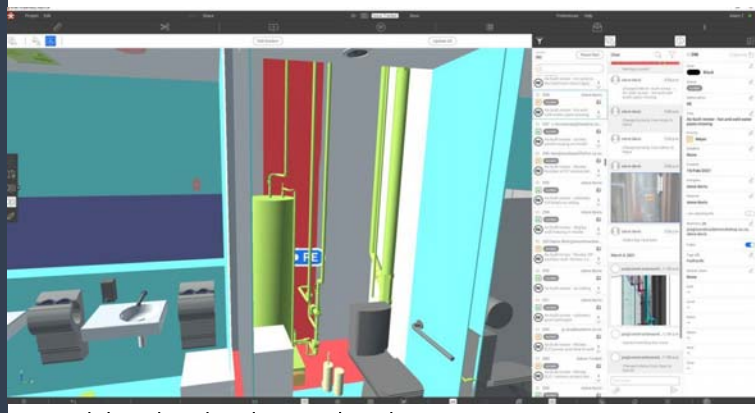
2. Supporting information attached

Verification at handover

Verification is an important piece of work

Validation and trustworthiness of handover information is key

Graphical and non-graphical



3. Model Updated and Issue Closed Out

Record Model Handover to Tenant

FSNI utilising the Base Build Record Models

Space planning
Digital Asset & Facilities Management
Renovations & Construction Work

Base Build Record Models updated with FSNI Assets

8000+ new elements
Graphical and non-graphical

- Define information requirements and include operations team early
- Understand why you want it
- Work with delivery teams to ensure they understand why the information is needed
- Verify the information to ensure trustworthiness

The Journey from Design to Handover and Beyond

Adam Tindall

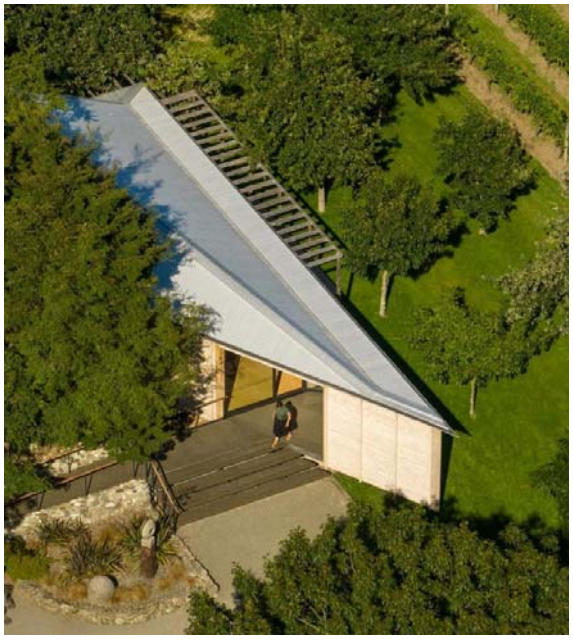
MAKERS

makers of architecture

Architecture | Landscape | Collaboration

makers fabrication

Prefabrication | Construction | Management



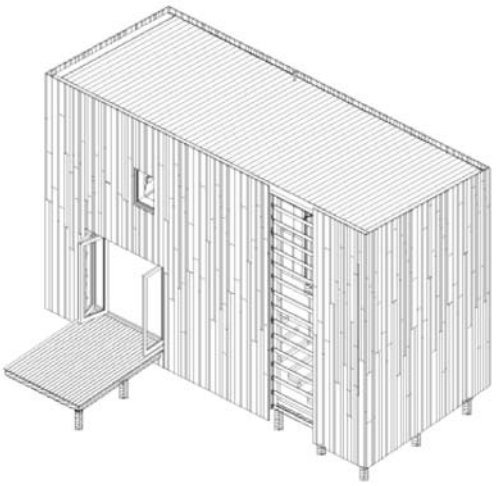
Photography - Simon Devitt

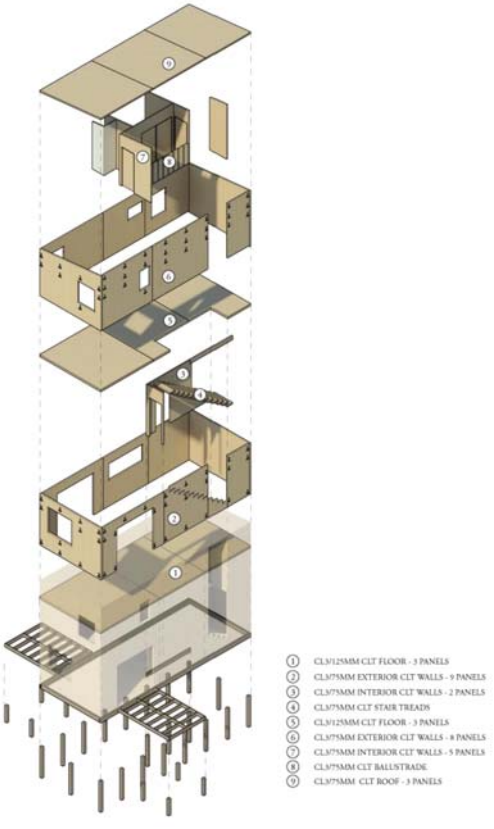
makers of architecture

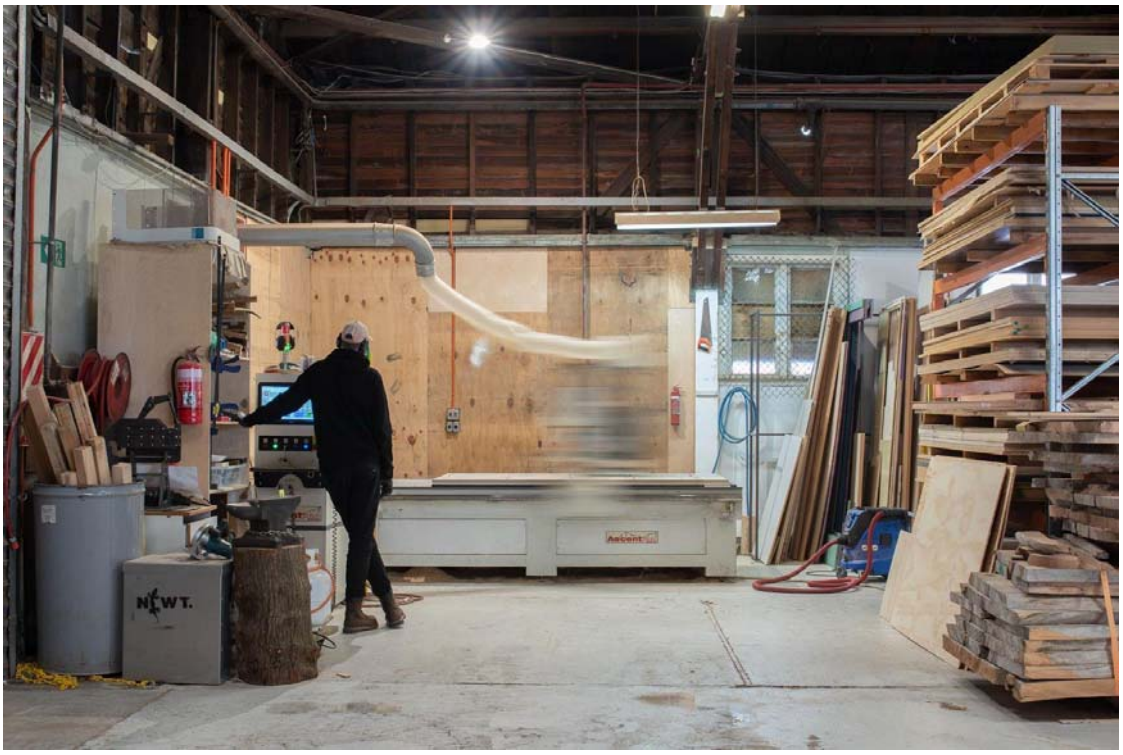
Architecture | Landscape | Collaboration

makers fabrication

Prefabrication | Construction | Management



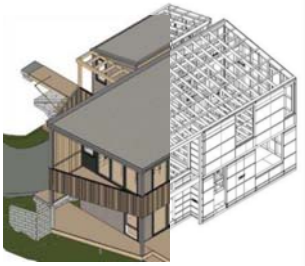
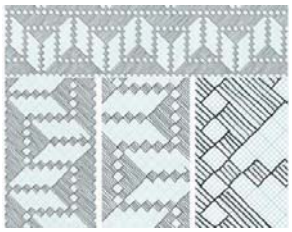

1 CLT/125MM CLT FLOOR - 3 PANELS
2 CLT/75MM EXTERIOR CLT WALLS - 9 PANELS
3 CLT/75MM INTERIOR CLT WALLS - 2 PANELS
4 CLT/75MM CLT STAIR TREADS
5 CLT/125MM CLT FLOOR - 3 PANELS
6 CLT/75MM EXTERIOR CLT WALLS - 8 PANELS
7 CLT/75MM INTERIOR CLT WALLS - 5 PANELS
8 CLT/75MM CLT BALUSTRADE
9 CLT/75MM CLT ROOF - 3 PANELS



Photography - Patrick Reynolds

we are makers

Our goal is to produce custom beautiful architecture with a DfMA focus, supported by shared processes

	Construction	Joinery & Fitout	Artwork & Installations
Design			
Make		 	
Beauty			

engagement

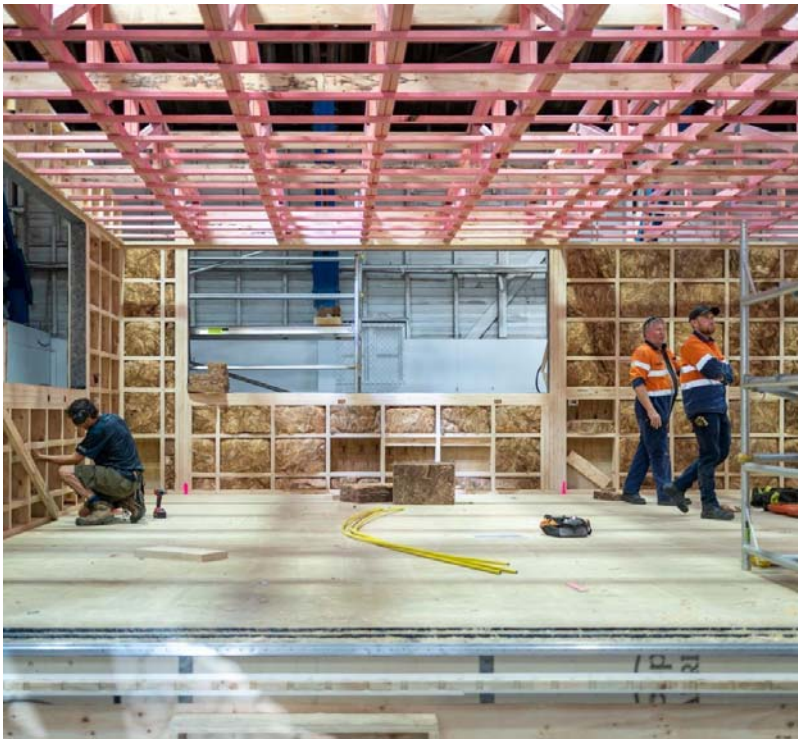
virtual reality supports the communication between the architectural and construction environments.

integrated modelling

designing out the unknown and leaving less to chance

manufacturing

our local makers fabrication workshop creates custom components

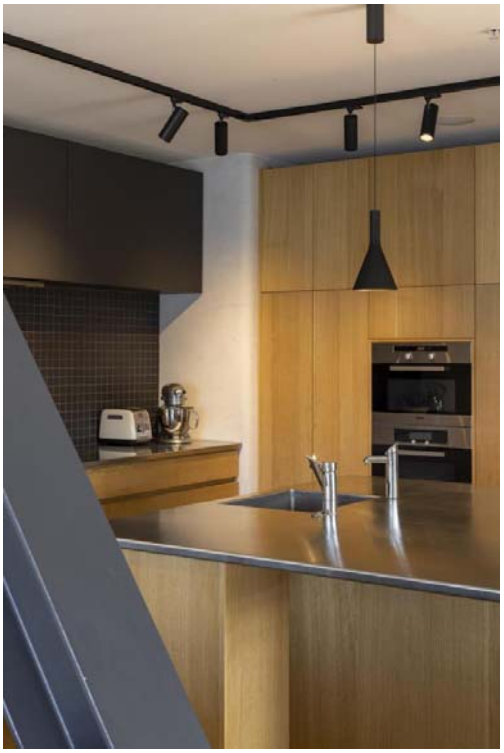


assembly

assessing site constraints

assembly
logistics and planning

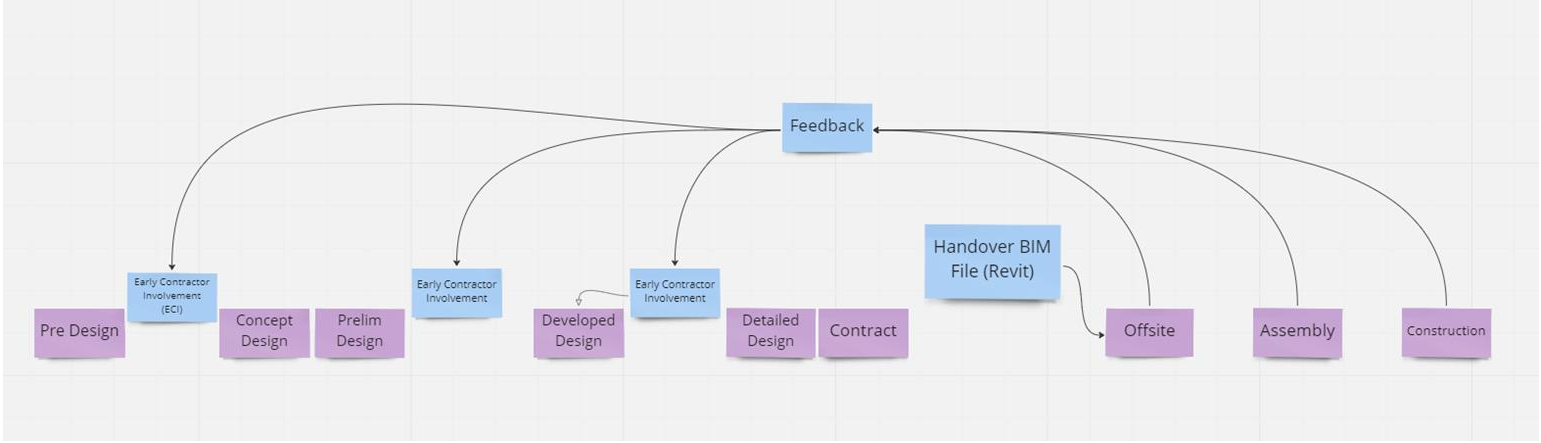
installation
end-to-end project delivery



Photography - Simon Devitt

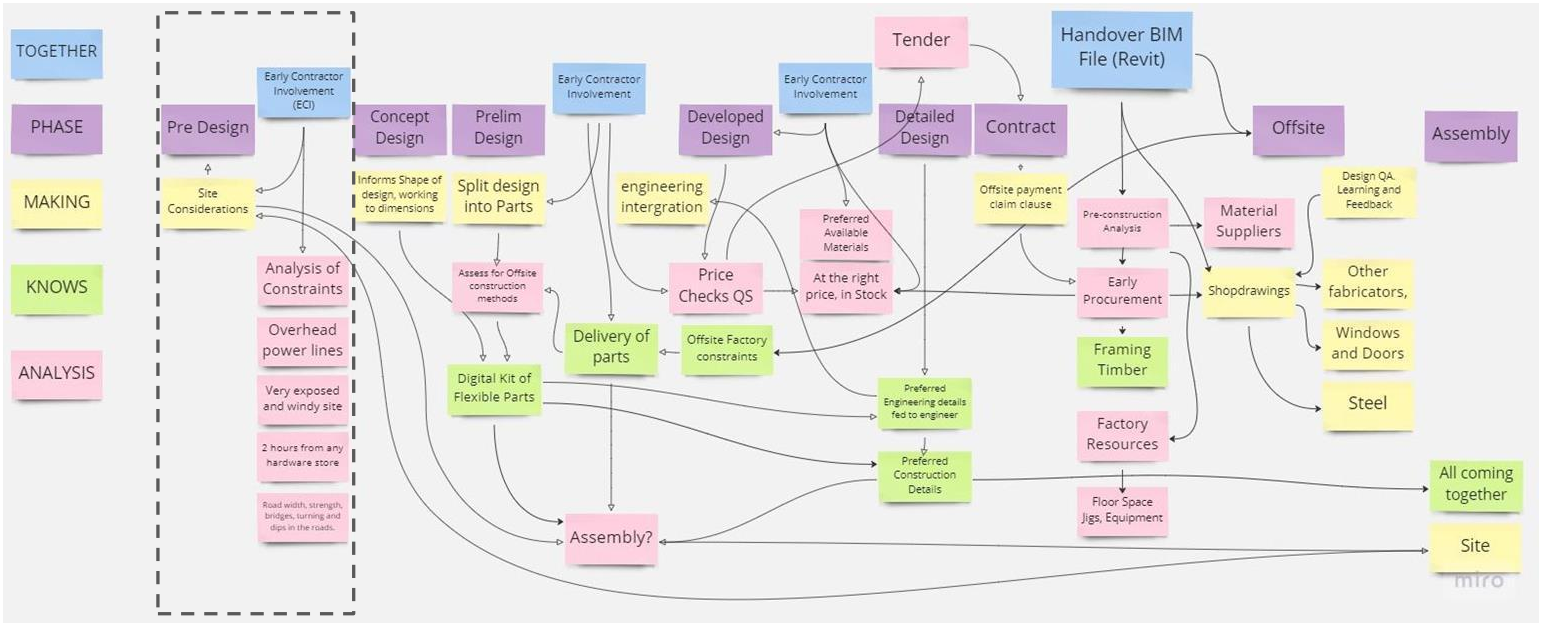
Scale 1 - Construction

Simple Workflow

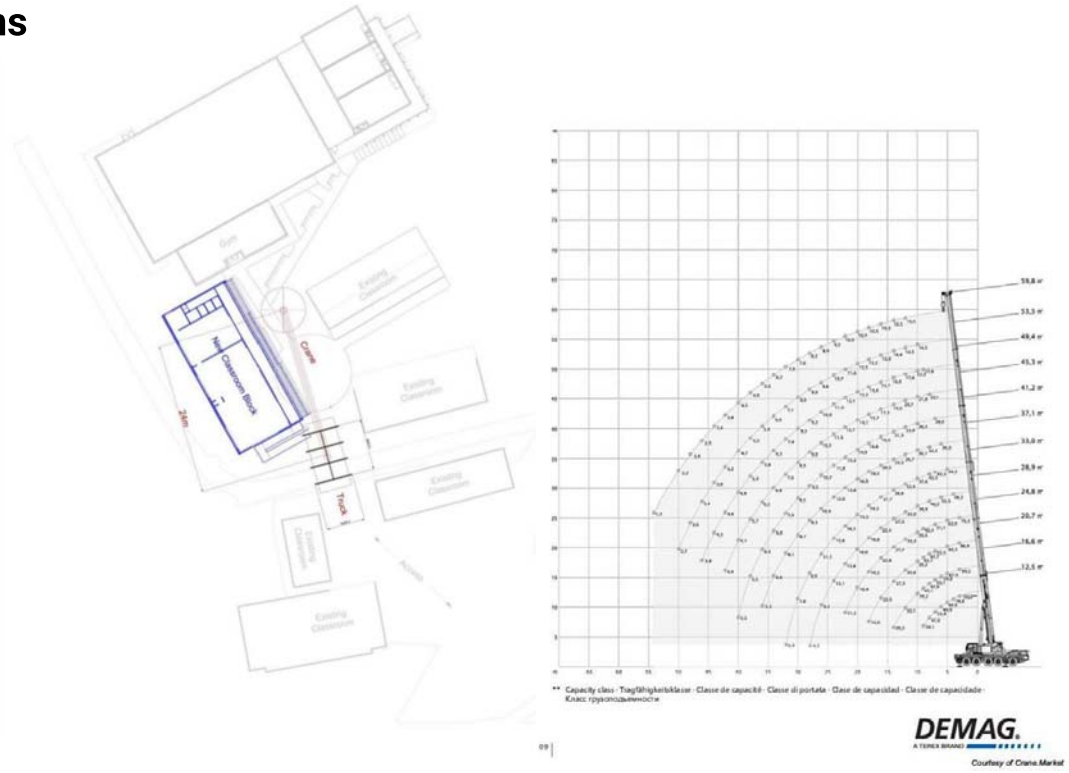


Early Contractor Involvement = **ECI**

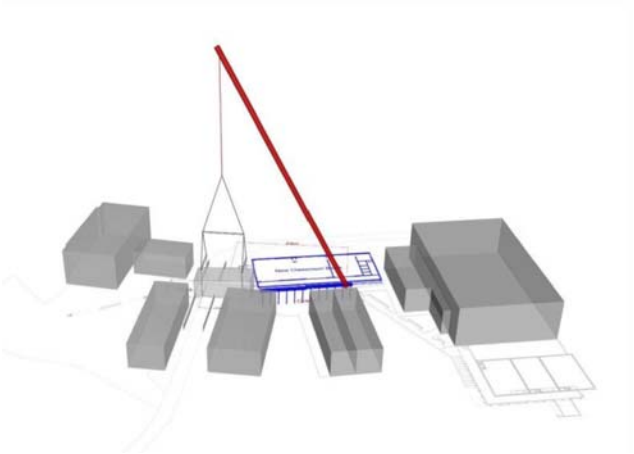
Workflow extended



Site Considerations



Understand Aim



Site Coordination Model

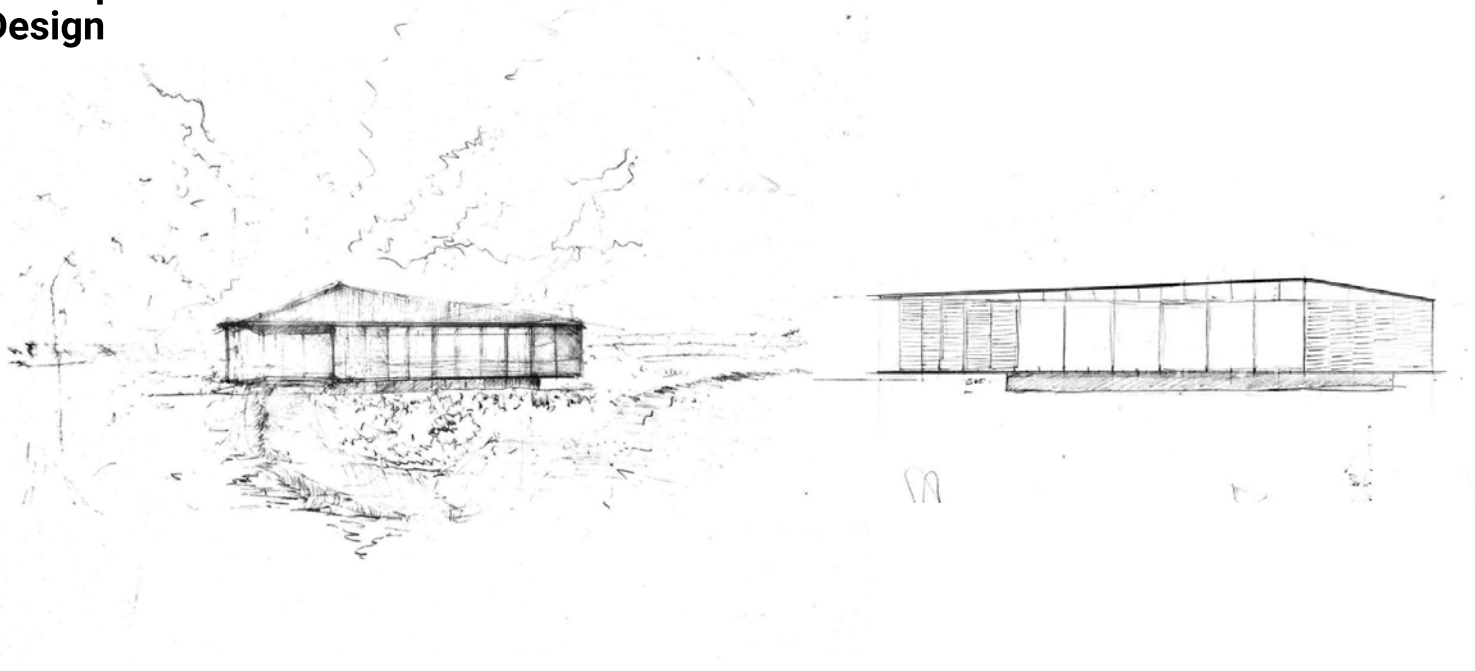
Assembly On-site

Constraints

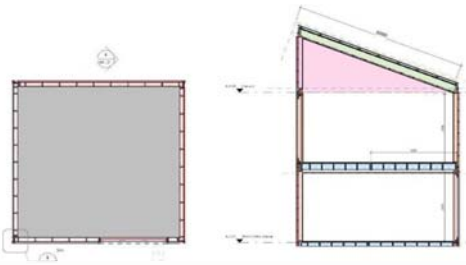
Context

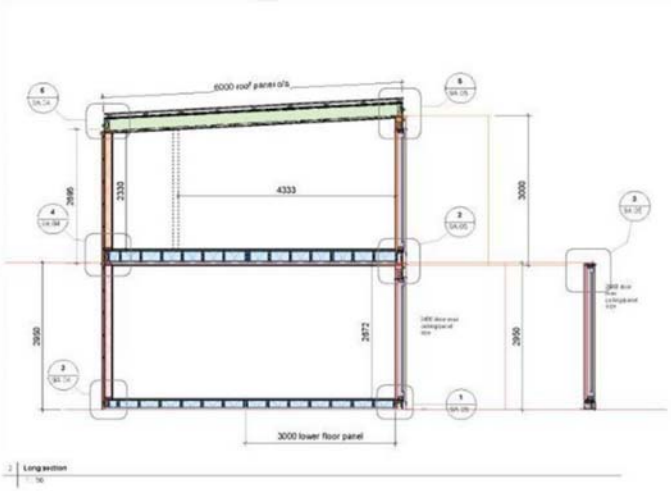
Remote Locations

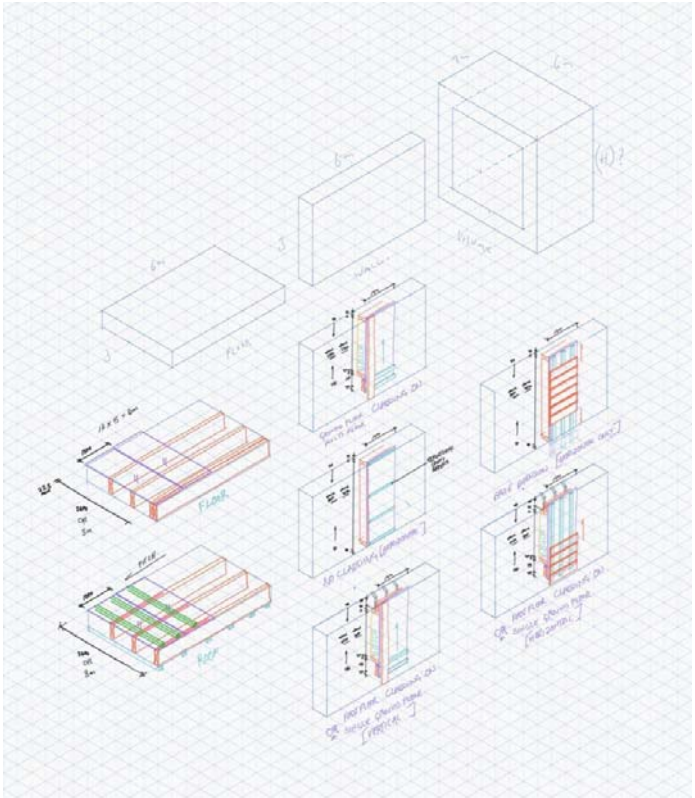
Concept Design



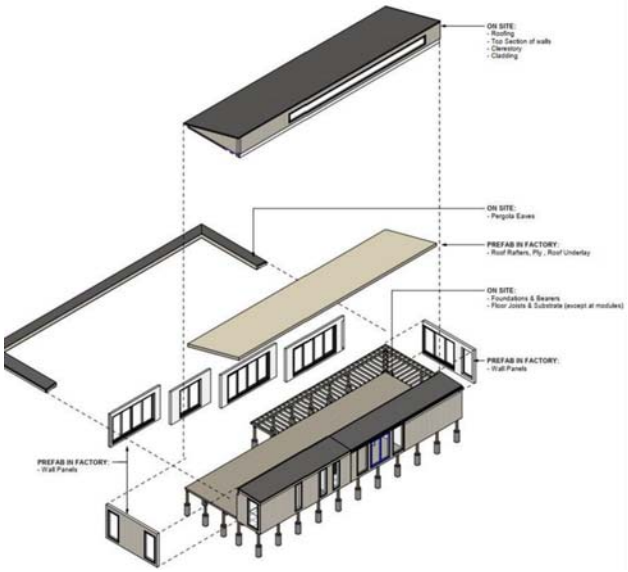
Set of knowns panel constraints



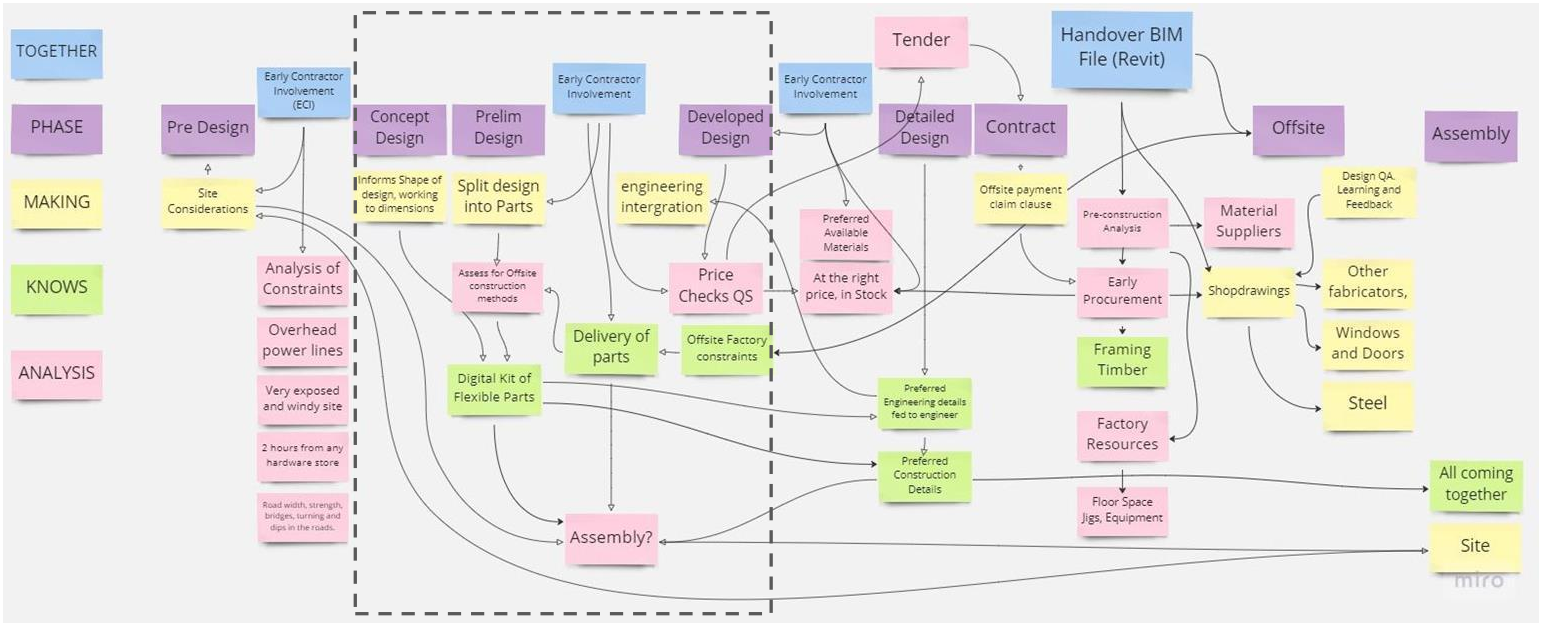




Prelim Design



Workflow extended

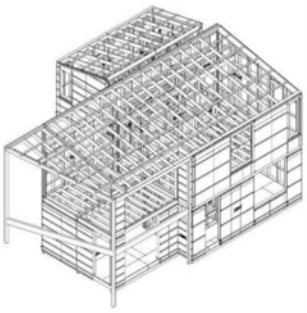


Splitting in to parts

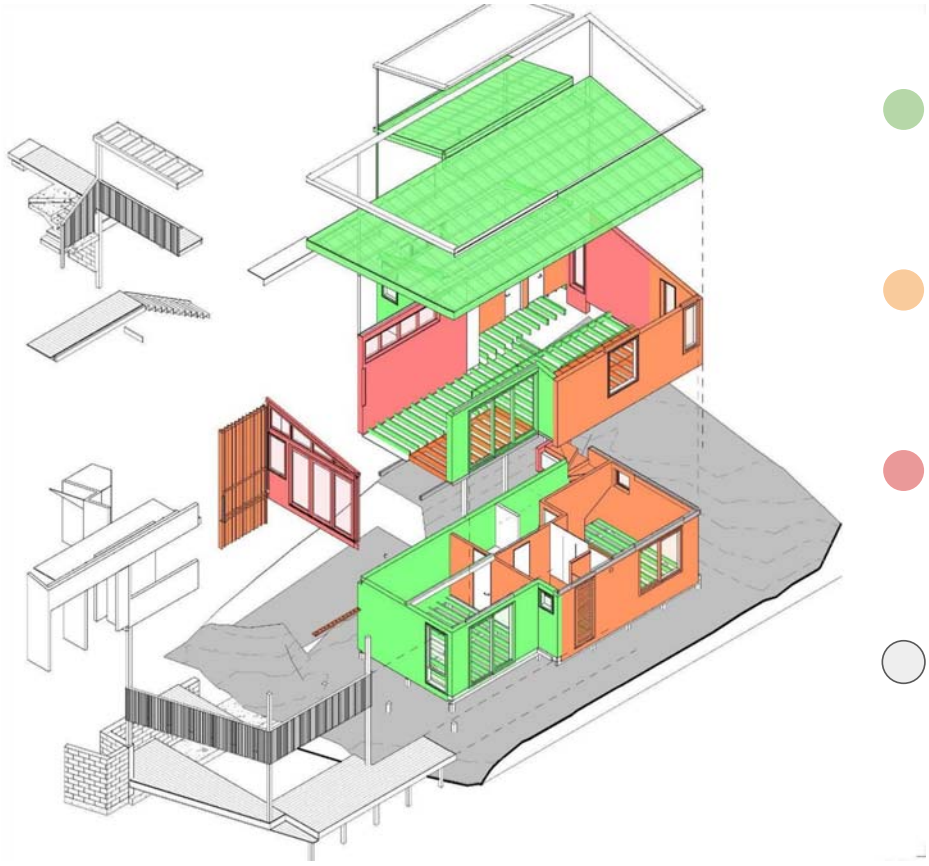
Offsite %

Design team communicating offsite intentions

- 40% Complete panels
- 25% Limited panels
- 8% Special panels
- 27% Onsite



Part Layout Assessment



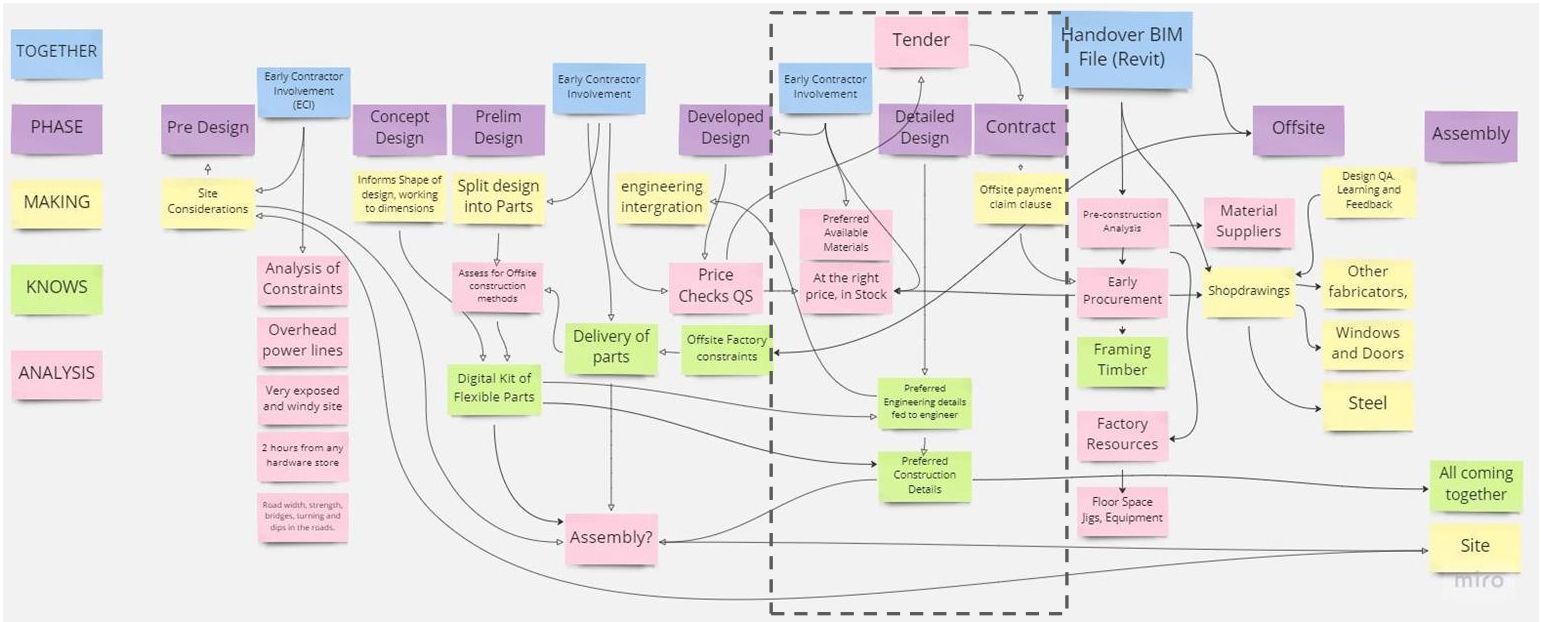
- From our set of “knowns’ - Offsite constructed panels exterior cladding on and windows installed in panels
- Can still be constructed Offsite but requires some onsite work. E.g. Continuous two floors of Metal cladding
- Beyond some limits of our typical ‘Knowns’ and requires specific engineering or detailing.
- Built on site, no benefit to constructing offsite.

Early Cost checks

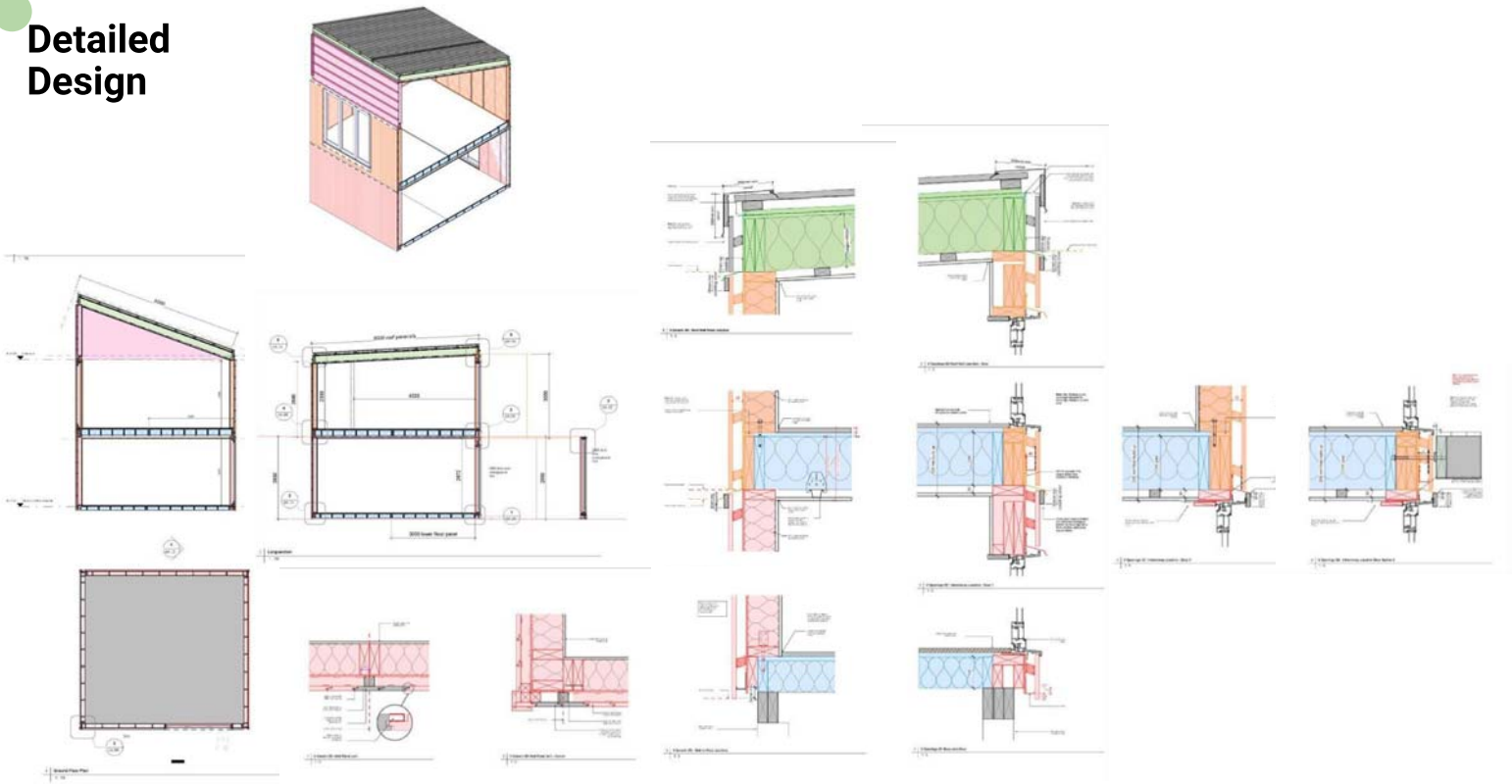
costing analysis compare design changes

Code	Description	Quantity	UOM	Rate	SubTotal	Total	%	Notes	Former Price	Difference	% Diff
1000	Preliminaries & General	177	m2	478.64	84,720	84,720	7.09%	Project Management, Rates, Scaffolding, Insurance	56,721.00	27,999	49.36%
2220	Site preparation	3	no	966.67	2,900	2,900	0.24%		3,000.00	-100	-3.33%
2240	Excavation, Piling & Foundations	201	m2	465.76	93,617	93,617	7.84%		112,971.00	-19,354	-17.13%
3400	Steel Structure	28	m	865.62	24,237	24,237	2.03%	Steel prices & rates, Steel Stairs	7,978.00	16,259	203.80%
3800	Timber Structure	615	m2	293.66	180,601	180,601	15.12%	Labour rates, Material rates, further detail, allocations	86,085.00	94,516	109.79%
4100	Pre-Cladding	314	m2	115.11	36,143	36,143	3.03%	Material Costs Increases, Labour rates	22,629.00	13,514	59.72%
4200	Wall cladding	258	m2	297.01	76,628	76,628	6.42%	Material Costs Increases, Labour rates	65,858	10,770	16.35%
4300	Roofing	77	m2	149.10	11,481	11,481	0.96%	Material Costs Increases, Labour rates	8,511.00	2,970	34.90%
4500	Windows and doors	70	m2	1,054.29	73,800	73,800	6.18%	Material Costs Increases, Labour rates	74,400.00	-600	-0.81%
4700	Insulation	615	m2	29.49	18,139	18,139	1.52%	Rates for subcontractor installation	7,191.00	10,948	152.24%
5100	Wall and ceiling linings	566	m2	92.50	52,356	52,356	4.38%	Rates for subcontractor installation & material costs	46,998.00	5,358	11.40%
5200	Partitions and doors	8	no	945.75	7,566	7,566	0.63%		8,570.00	-1,004	-11.72%
5500	Joinery fixtures and hardware	1	LS	73,242.00	73,242	73,242	6.13%	Stairs put into timber structure	78,493	-5,251	-6.69%
6200	Tiling	12	m2	1,465.22	17,583	17,583	1.47%	Assumption of material amendment	10,000	7,583	75.83%
6300	Overlay flooring	138	m2	121.77	16,805	16,805	1.41%	Subcontractor general rates for flooring	24,475.00	-7,670	-31.34%
6500	Carpeting	43	m2	135.00	5,805	5,805	0.49%	Area change	2,334	3,471	148.71%
6700	Painting, decoration and coating	835	m2	40.49	33,812	33,812	2.83%	Rates for painter	33,750.00	62	0.18%
7100	Plumbing	177	m2	155.37	27,500	27,500	2.30%	Estimate & Assumptions. Excl. Drainlaying	29,670.00	-2,170	-7.31%
7150	Client Fixture Selections	1	LS	11,666.24	11,666	11,666	0.98%	Material Costs Increases	10,000	1,666	16.66%
7400	Gutters & Downpipes	30	m	140.92	4,228	4,228	0.35%	Subcontractor Cost Increases	2,025.00	2,203	108.77%
7500	Heating and Cooling	177	m2	36.36	6,435	6,435	0.54%	Lower HWC Spec Change	11,690.00	-5,255	-44.95%
7700	Electrical	177	m2	146.89	26,000	26,000	2.18%		25,974.00	26	0.10%
8100	Retaining Walls	116	m2	406.42	47,144	47,144	3.95%	Area calculations, apportioning of materials	53,417	-6,273	-11.74%
8400	Landscape Structures & Decking	102	m2	780.63	79,624	79,624	6.67%	Decking prices, Labour Rates, Detailed Information	46,770.00	32,854	70.25%
	Offsite Overheads 8%	117	m2	691.99	80,962	80,962	6.78%				
	Margin 10%	177	m2	571.77	101,203	101,203	8.47%				
	GFA	177	m2	6,746.87	1,194,196	1,194,196	ex GST				
	Additional from ROC Rev 0										
7700	Solar/Mains	177	m2	51.10	9,045	9,045					
7500	LUNOS & Heating	177	m2	149.83	26,520	26,520					
8400	Carpad	30	m2	960.66	28,820	28,820					
	Overheads 8%	117	m2	44.02	5,151	5,151					
	Margin 10%	177	m2	36.38	6,438	6,438					
	GFA	177	m2	429.23	75,974	75,974	ex GST				
	TOTAL FOR BUILDING					**$ 1,279,170.**					
						$ 1,460,695.					

Workflow extended



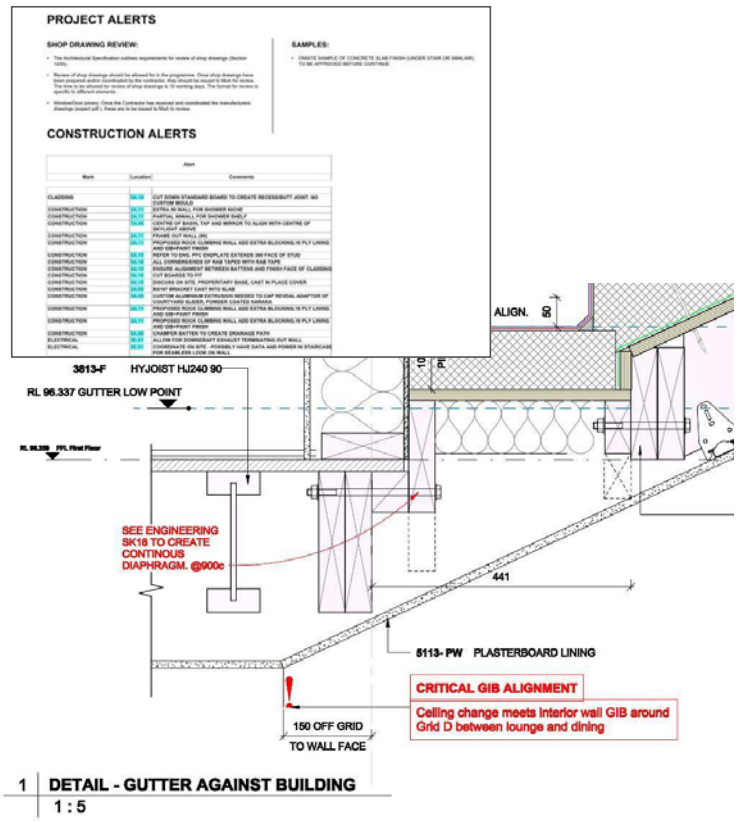
Detailed Design



construction drawings

Construction alert lists

“Supporting each other”



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Contract

Tender Summary

1000	Preliminaries & General	$81,178.00
2220	Site preparation	$5,720.00
2240	Excavation & Foundations	$0.00
3400	Steel Structure	$27,709.42
3800	Timber Structure	$158,937.97
4100	Pre-Cladding	$26,939.38
4200	Wall cladding	$69,759.36
4300	Roofing	$29,515.30
4500	Windows and doors	$71,423.00
4700	Insulation	$11,556.23
5100	Wall and ceiling linings	$38,381.27
5200	Partitions and doors	$6,545.00
5500	Joinery fixtures and hardware	$58,663.00
6300	Overlay flooring	$36,724.19
6700	Painting, decoration and coating	$18,749.50
7100	Plumbing	$53,880.57
7400	Gutters & Downpipes	$7,021.49
7500	Heating and cooling	$31,479.57
7700	Electrical	$28,600.00
	Margin 10%	$76,278.33
	GFA	$839,061.58
8400	External Works & Decking, incl. Stairs	$120,072.62
	Margin 10%	$12,007.26
	GFA	$132,079.88
	TOTAL FOR BUILDING	**$971,141.46**

Itemised Areas

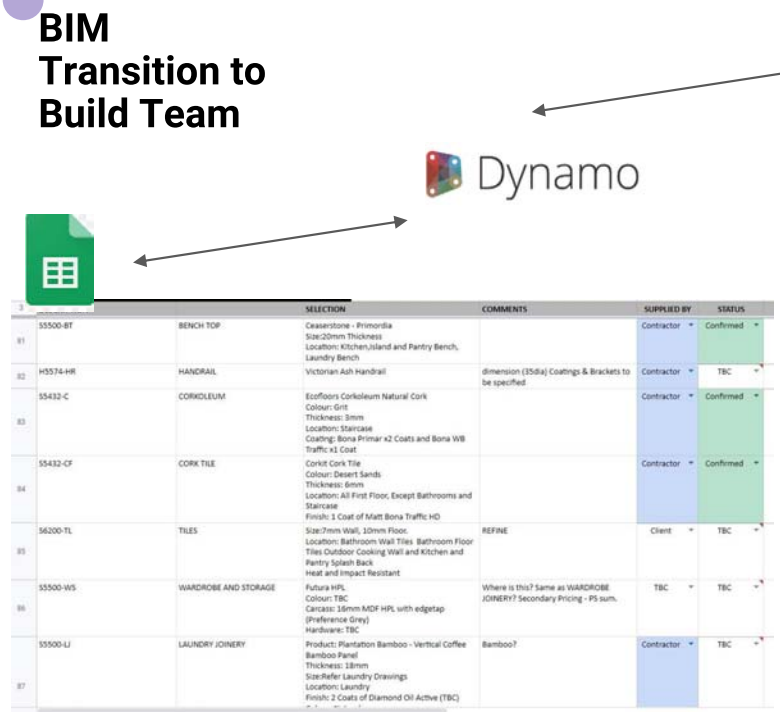
All itemised areas include margins and overheads. GST is excluded.

House
Accoya Cladding 115 Cover | **$52,364.93**
Lunawood Cladding 135 Cover | **$29,920.88***
Verdus Thermally Modified Spruce Cladding 113 Cover | **$31,772.18***
Sarking Ceiling /m2 Cost (incl. Material & labour install/no painting) | **$193.60/m2**
Gib Ceiling /m2 Cost (incl. material/labour/stopping/no painting) | **$54.45/m2**
Primary interior joinery (Kitchen/ Bathroom/ Laundry) | **$53,845.00**
Secondary interior joinery (Lounge Shelving and Entertainment/ Wardrobes)* | **$12,100.00**

External
Car Pad | **$27,331.90**
Engineered stairs and balustrade | **$18,220.07**
Simple low level straight flight stairs as above | **$9,483.69**
Decking area | **$25,698.48**
Paving area | **$4,138.20**
On site built canopy including entry screen | **$14,053.55**

*Excluded from pricing/not in summary total

BIM Transition to Build Team

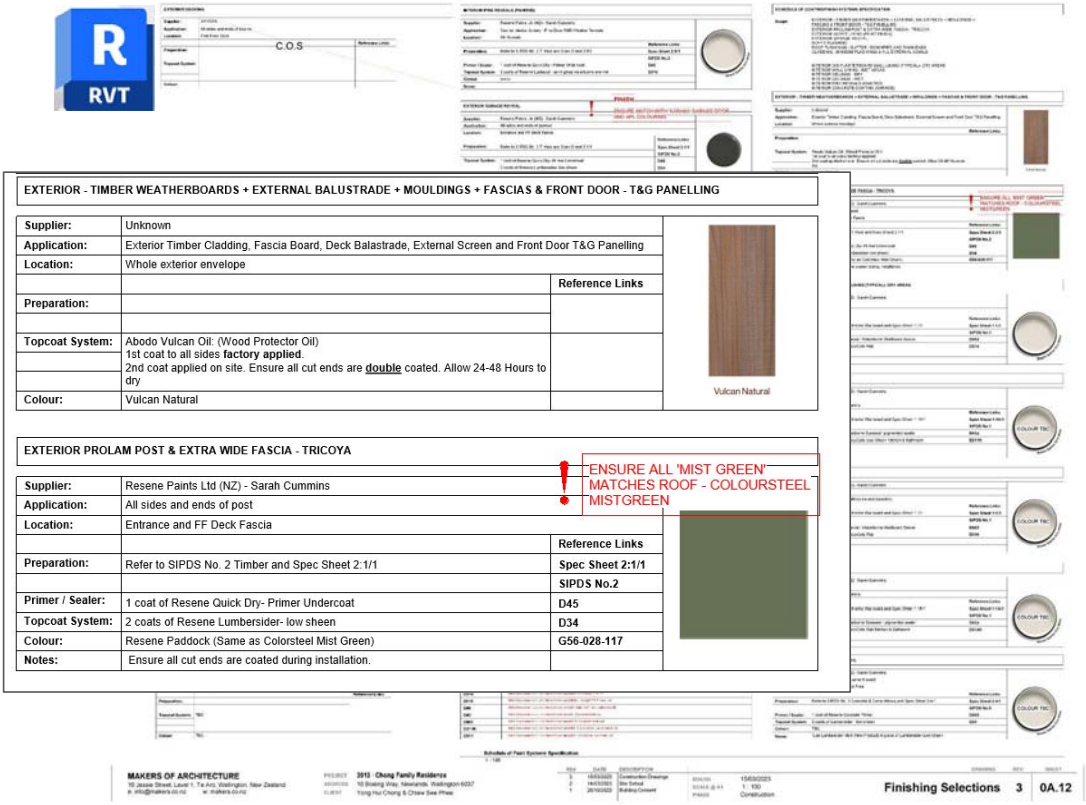


		SELECTION	COMMENTS	SUPPLIED BY	STATUS
81	S5500-BT	BENCH TOP	Ceaserstone - Primordia Size:20mm Thickness Location: Kitchen,Island and Pantry Bench, Laundry Bench	Contractor	Confirmed
82	H5574-HR	HANDRAIL	Victorian Ash Handrail	dimension (35dia) Coatings & Brackets to be specified	Contractor	TBC
83	S5432-C	CORKOLEUM	Ecofloors Corkoleum Natural Cork Colour: Grit Thickness: 3mm Location: Staircase Coating: Bona Primar x2 Coats and Bona WB Traffic x1 Coat		Contractor	Confirmed
84	S5432-CF	CORK TILE	Corkit Cork Tile Colour: Desert Sands Thickness: 6mm Location: All First Floor, Except Bathrooms and Staircase Finish: 1 Coat of Matt Bona Traffic HD		Contractor	Confirmed
85	S6200-TL	TILES	Size:7mm Wall, 10mm Floor. Location: Bathroom Wall Tiles Bathroom Floor Tiles Outdoor Cooking Wall and Kitchen and Pantry Splash Back Heat and Impact Resistant	REFINE	Client	TBC
86	S5500-WS	WARDROBE AND STORAGE	Futura HPL Colour: TBC Carcass: 16mm MDF HPL with edgetap (Preference Grey) Hardware: TBC	Where is this? Same as WARDROBE JOINERY? Secondary Pricing - PS sum.	TBC	TBC
87	S5500-LJ	LAUNDRY JOINERY	Product: Plantation Bamboo - Vertical Coffee Bamboo Panel Thickness: 18mm Size:Refer Laundry Drawings Location: Laundry Finish: 2 Coats of Diamond Oil Active (TBC)	Bamboo?	Contractor	TBC

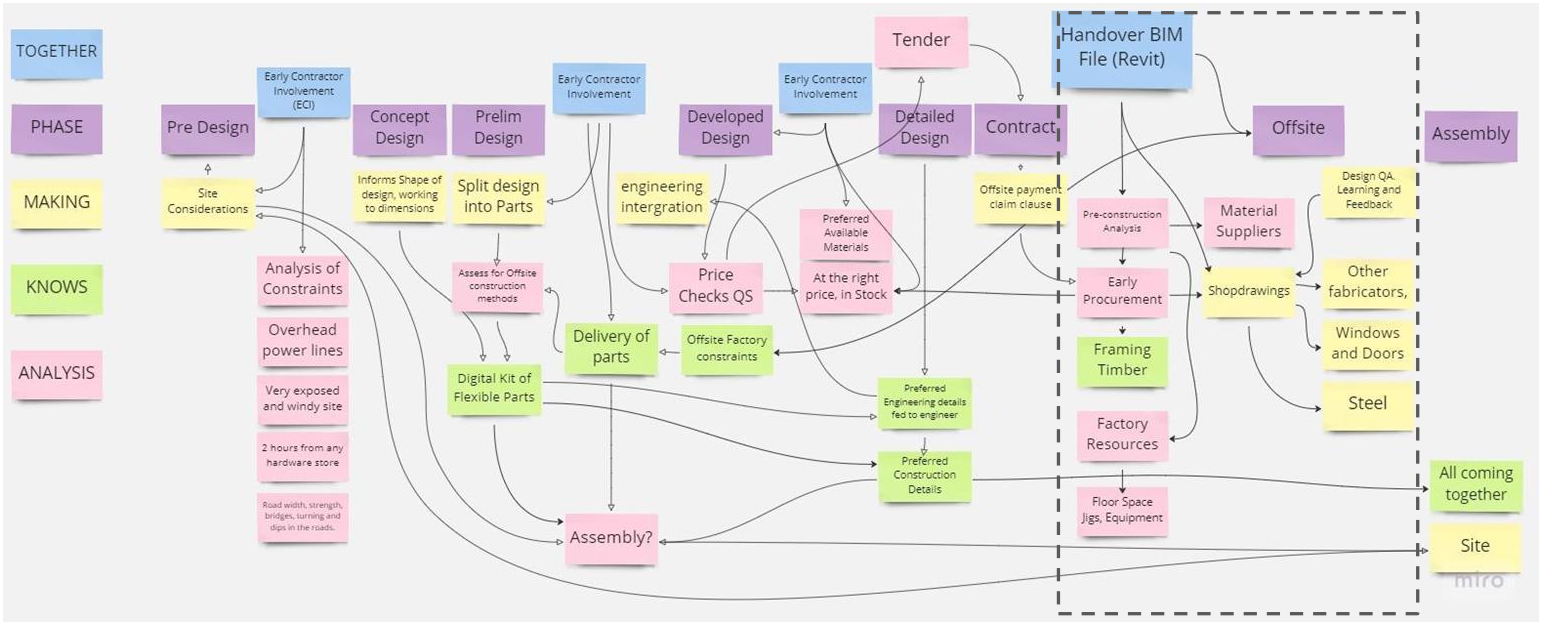
X SURFACES

ID	Title	Description	Supplied	Status
S5432-C	CORKOLEUM	Ecofloors Corkoleum Natural Cork Colour: Grit Thickness: 3mm Location: Staircase Coating: Bona Primar x2 Coats and Bona WB Traffic x1 Coat	Contractor	Confirmed
S5432-CF	CORK TILE	Corkit Cork Tile Colour: Desert Sands Thickness: 6mm Location: All First Floor Except Bathrooms and Staircase Finish: 1 Coat of Matt Bona Traffic HD	Contractor	Confirmed
S5500-BT	BENCH TOP	Ceaserstone - Primordia Size:20mm Thickness Location: Kitchen,Island and Pantry Bench Laundry Bench	Contractor	Confirmed
S5500-LJ	LAUNDRY JOINERY	Product: Plantation Bamboo - Vertical Coffee Bamboo Panel Thickness: 18mm Size:Refer Laundry Drawings Location: Laundry Finish: 2 Coats of Diamond Oil Active (TBC) Colour: Natural Hardware: TBC	Contractor	TBC
S5500-V	VANITY JOINERY	Product: Plantation Bamboo - Vertical Coffee Bamboo Panel Thickness: 18mm Finish: 2 Coats of Diamond Oil Active (TBC) Colour: Natural Hardware: TBC	TBC	TBC
S5500-WS	WARDROBE AND STORAGE	Futura HPL Colour: TBC Carcass: 16mm MDF HPL with edgetap (Preference Grey) Hardware: TBC	TBC	TBC
S5510-W	KITCHEN JOINERY	Product: Plantation Bamboo - Vertical Coffee Bamboo Panel Thickness: 18mm Size:Refer Kitchen Drawings Location: Kitchen Finish: 2 Coats of Diamond Oil Active (TBC) Colour: Natural Hardware: TBC	TBC	TBC
S5510-W	WARDROBE JOINERY	Futura HPL Colour: TBC Carcass: 16mm MDF HPL with edgetap (Preference Grey) Hardware: TBC	TBC	TBC
S6200-TL	TILES	Size:7mm Wall 10mm Floor. Location: Bathroom Wall Tiles Bathroom Floor Tiles Outdoor Cooking Wall and Kitchen and Pantry Splash Back Heat and Impact Resistant	Client	TBC

BIM Transition to Build Team



Workflow extended

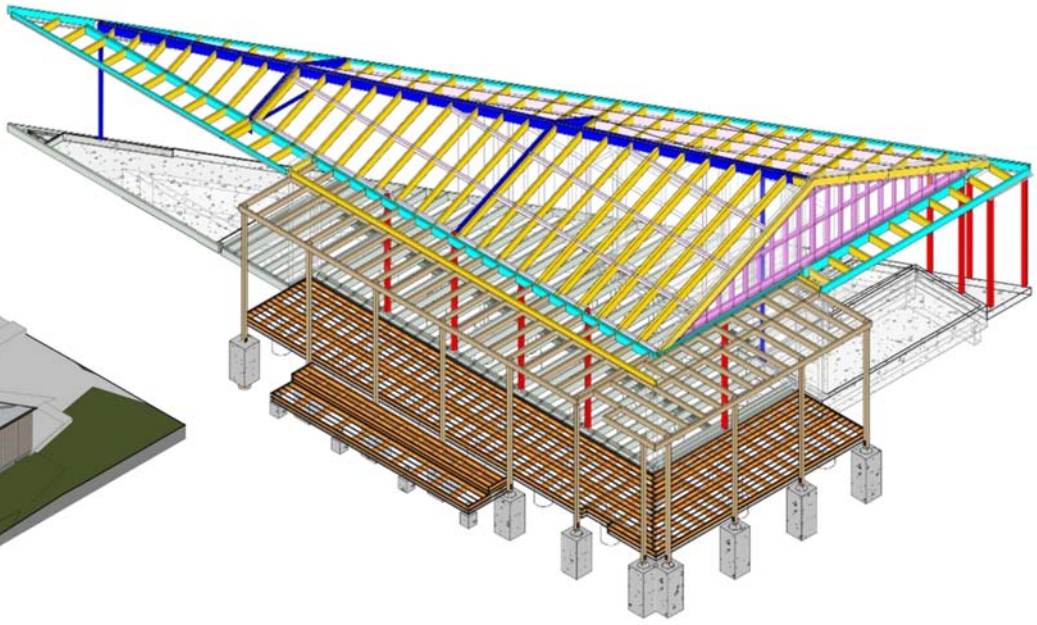


Procurement & Administration

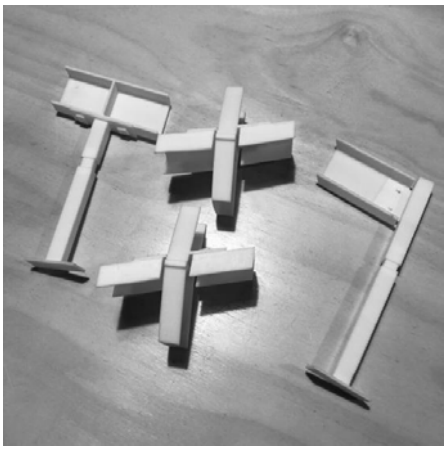
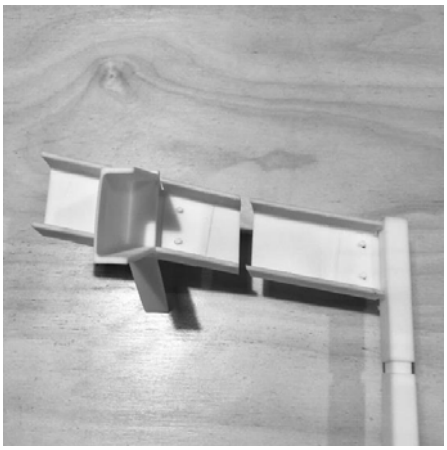
BIM Transition to Build Team

Motivational Images

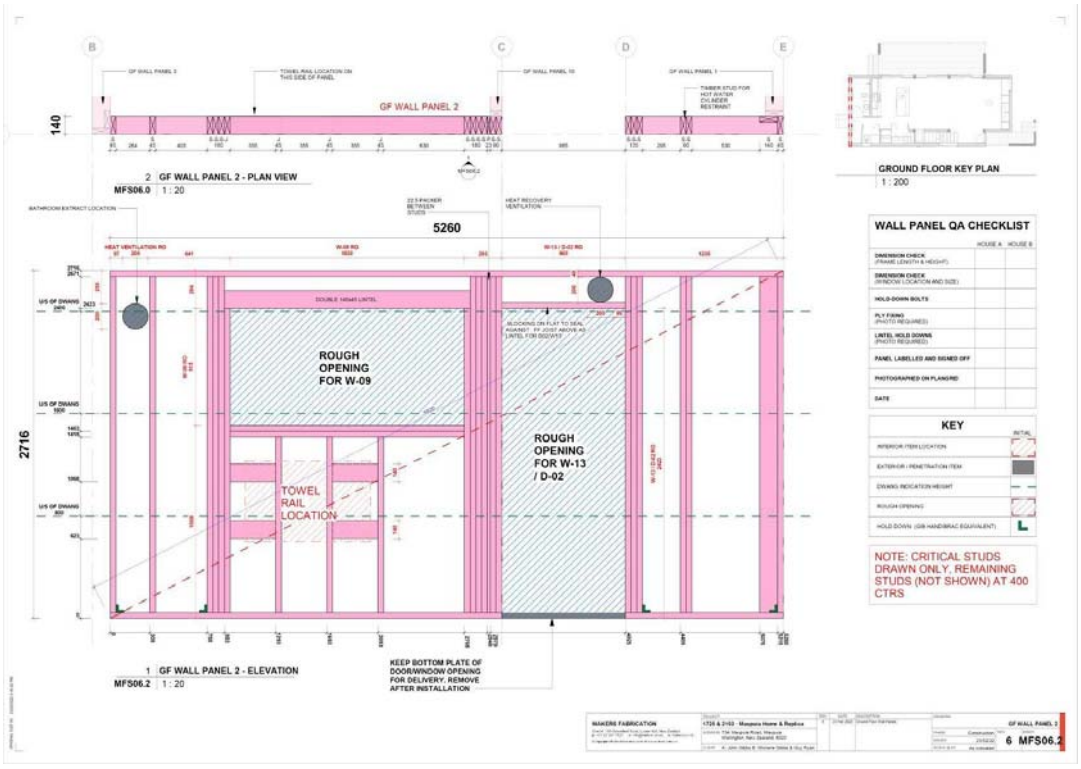
BIM Development



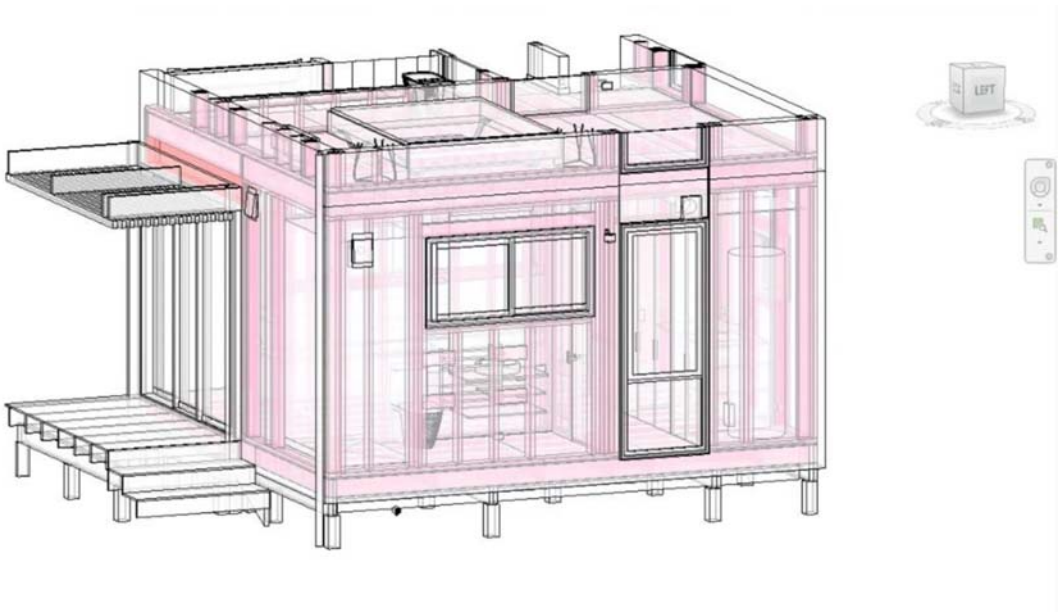
Digital Fabrication

Shop drawings

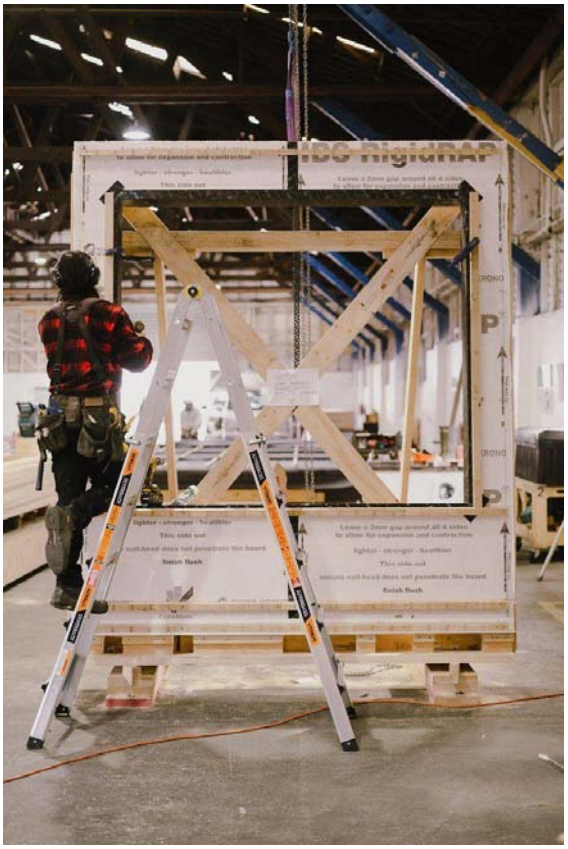


Digital Making



Offsite Control

Fabrication QA Check



Ready to roll

Procurement & Offsite Payments

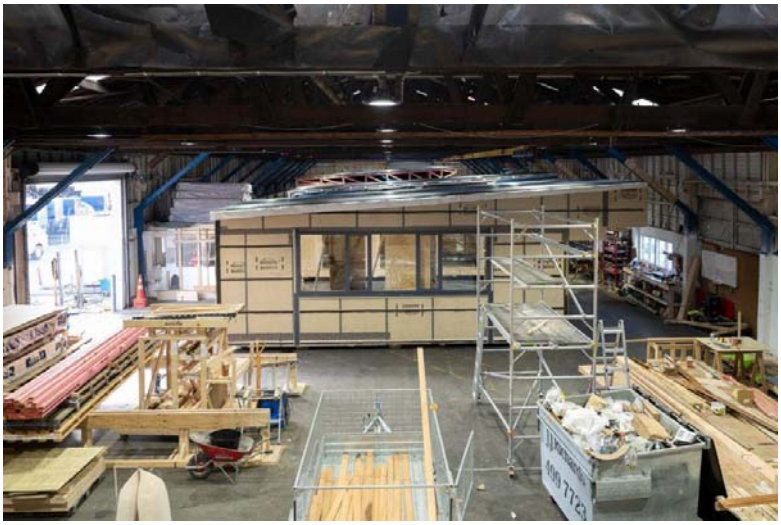
Schedule **B1**

Specific conditions

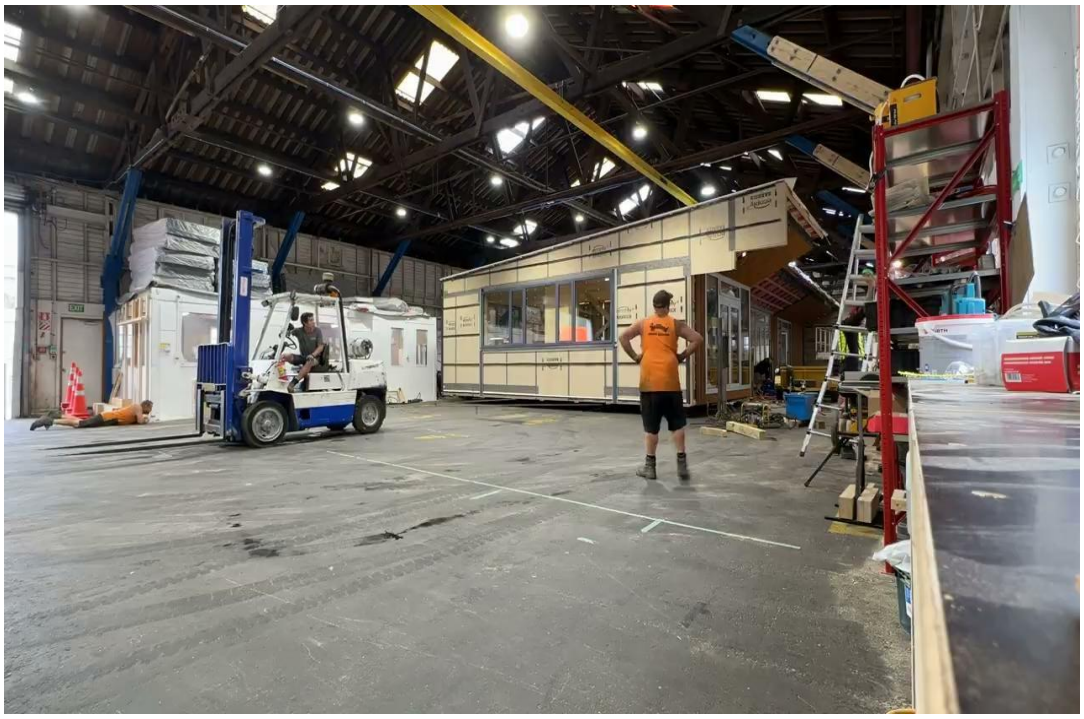
Clause 14.1.2	**Off Site Payments**

Offsite payments are allowed but only for the following:

- Contractors to identify specific elements prior to payment claims. These items are to be identified and tracked in the register by the main contractor outlining ownership of goods by principal until secured on site. e.g. Photos of goods with principal identification, each pack of materials should have packing slip in.



Transport



Assembly

HoloLens Aid

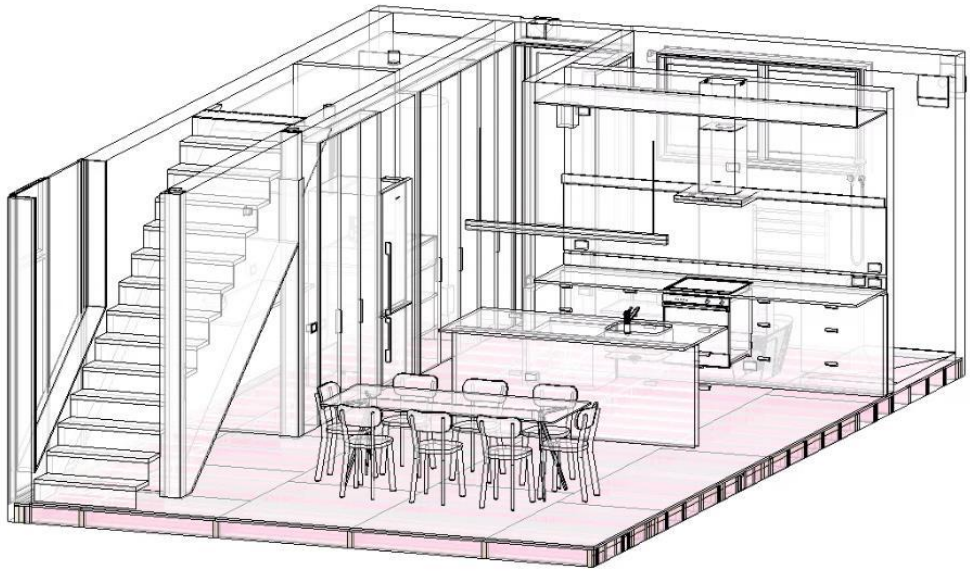
HoloLens Aid

Site Days

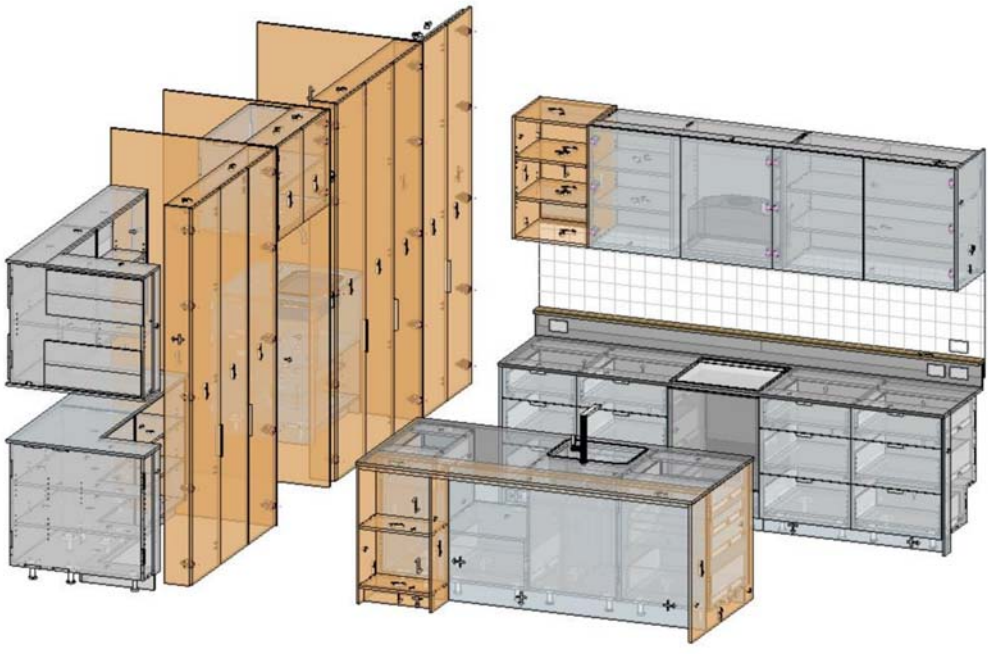
Happy Home

Scale 2 - Joinery & Fitout

Same process and part of the solution

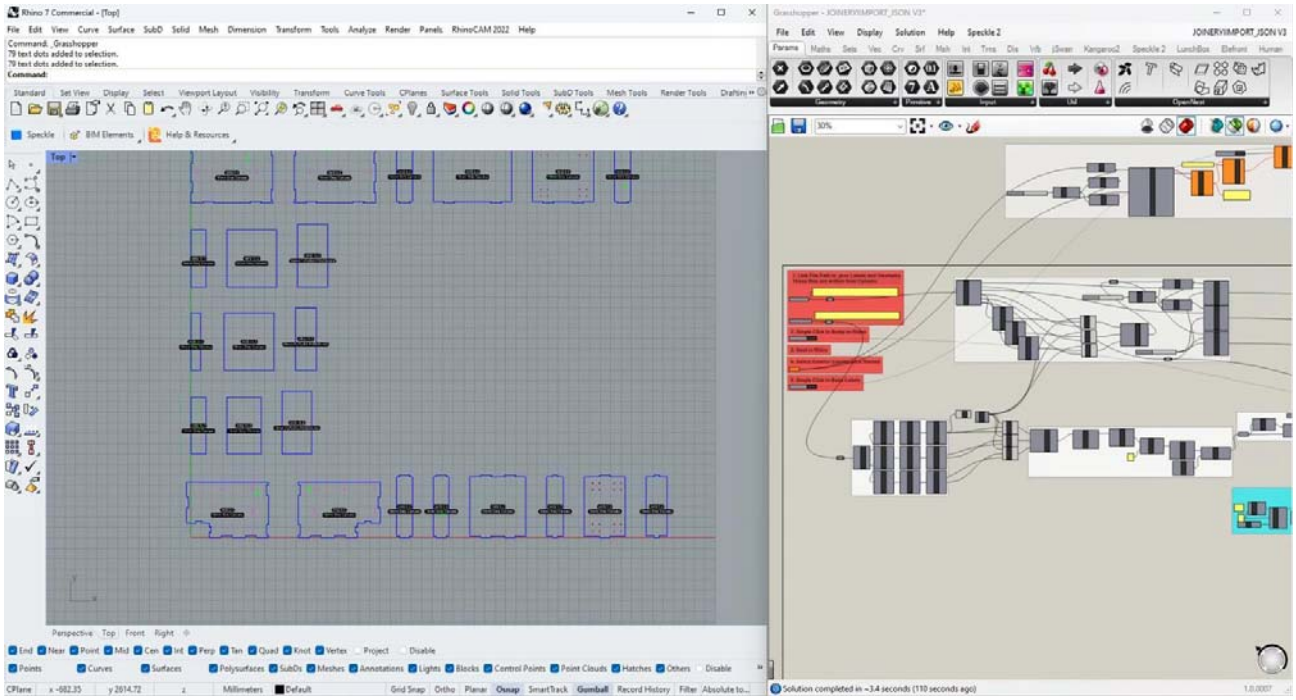


Shop Cabinetry

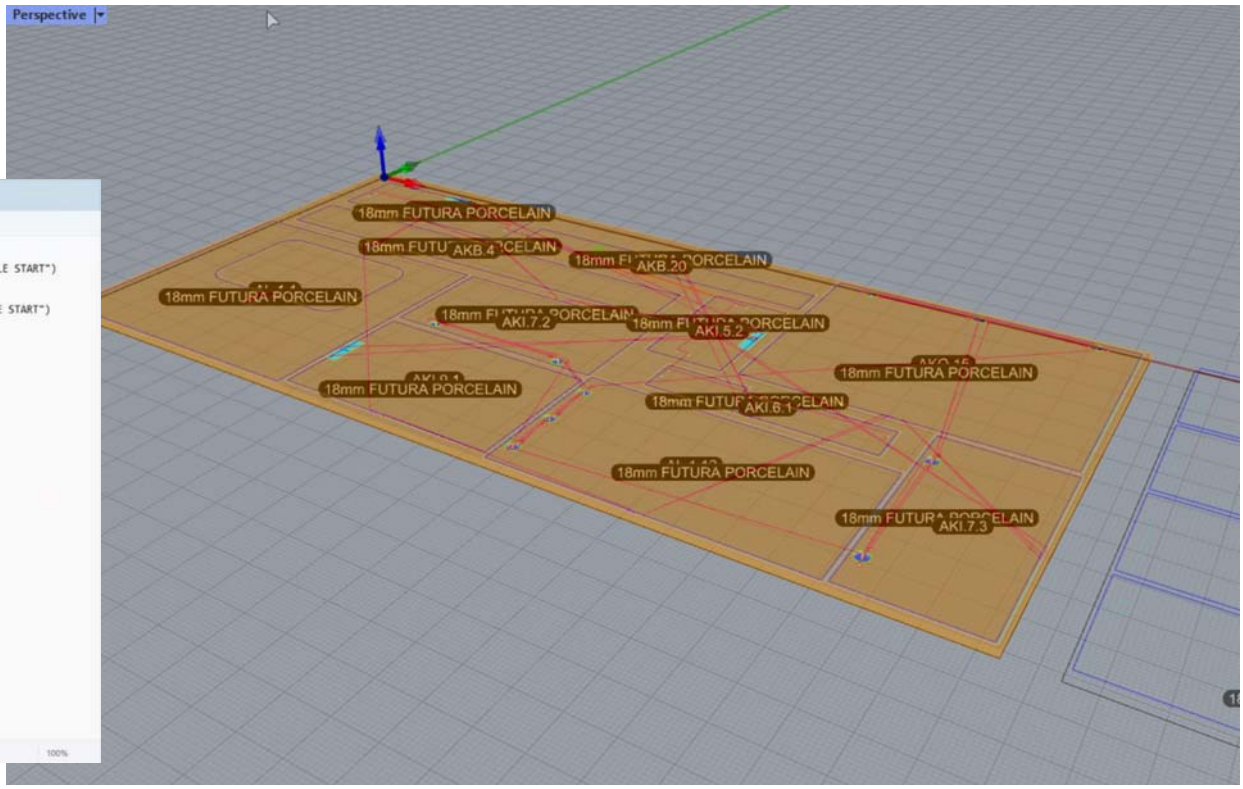


Tools of the Trade

Tools of the Trade



CAM Path Ready to Cut




```
Setup 1_2 1_2 Axis Profiling
File  Edit  View
M142
(DIS,"LOAD PANEL,ACTIVATE VACUUM,PRESS CYCLE START")
M00
M143
(DIS,"CHECK THAT PINS ARE DOWN, PRESS CYCLE START")
M00
(DIS,"")
G90
G17
G40
G80
G79 Z0
T0
M52
(UAO,1)
G27
;2 1/2 Axis Profiling
G79 Z0
M06 T2
M03 S18000
M54
M49
G27
G0Z24.
X972.124Y-577.
G1X990.Y-577.Z9.F7000
G1X1965.Y-577.Z9.
G17
G3X1968.Y-574.Z9.R3.
G1X1968.Y-15.Z9.
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G3X12.Y-15.Z9.R3.
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G1X990.Y-577.Z9.
Ln 1, Col 1  100%
```
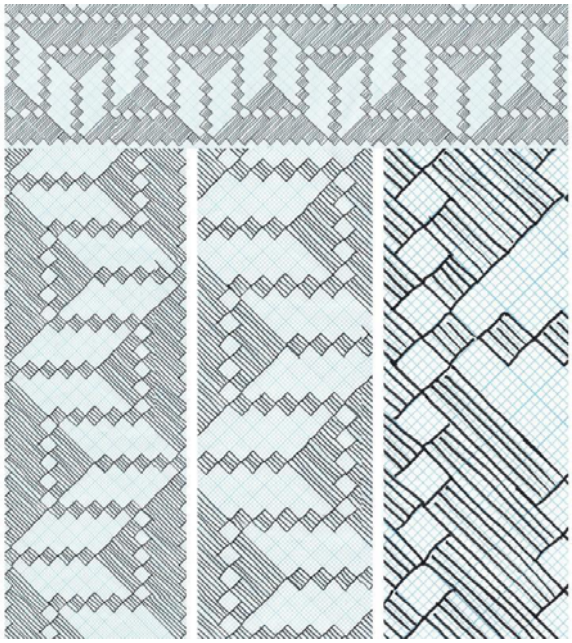


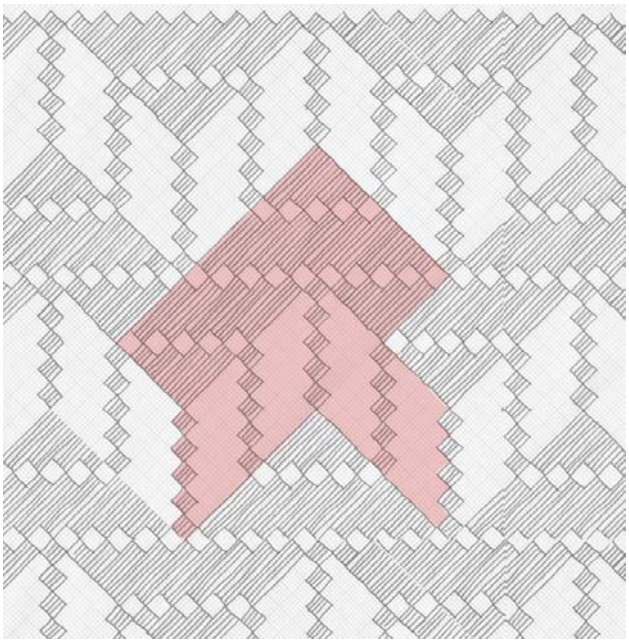
Cutting & Assembly

Site
Install

Scale 3 - Artworks & Installations

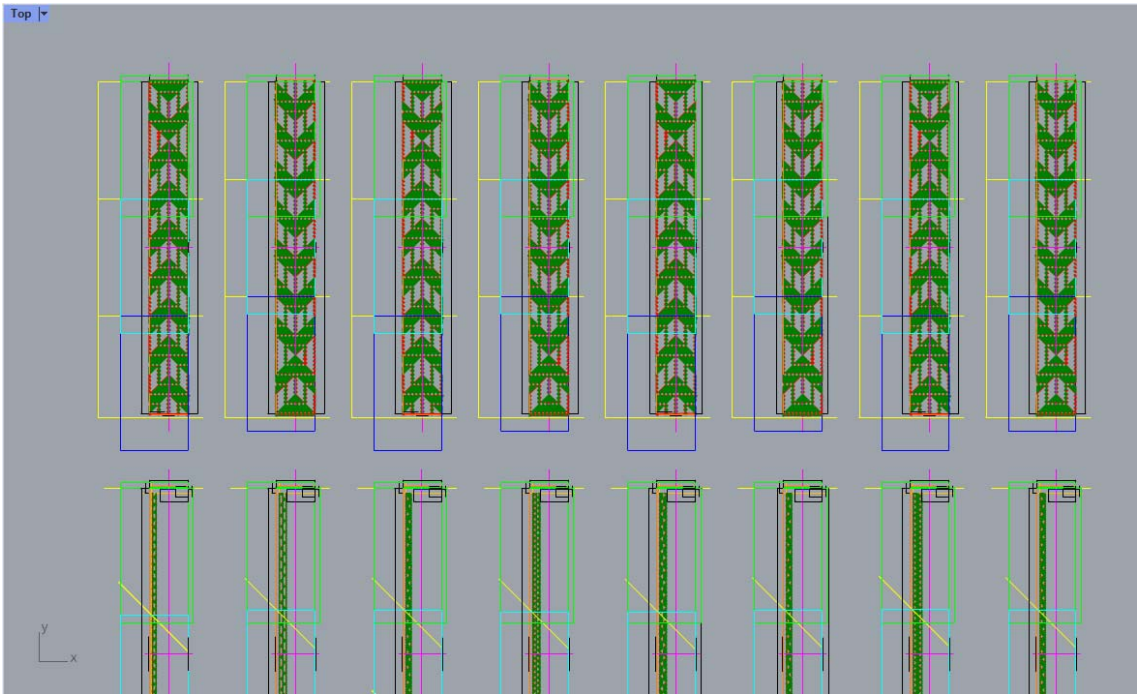
Concept Design



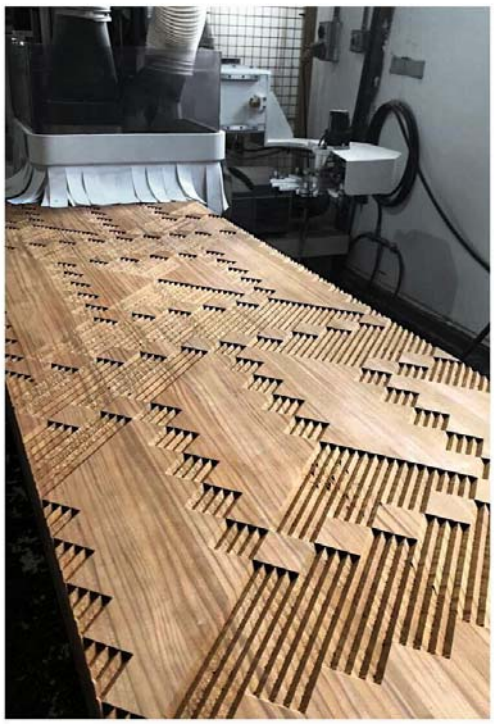


Artwork - Matthew McIntyre Wilson

Digital Design + CAM



Cutting



Artwork - Matthew McIntyre Wilson

Site Result

Artwork - Matthew McIntyre Wilson
Photography - Jason Mann Photography
Architect - Athfield Architects Limited

Key Takeaways:

- Seek out repetitive tasks in your workflow and automate them out
- Have early and continuous contractor engagement to create a feedback loop and develop a ‘system of knowns’
- Create one source of truth (BIM Model) and leverage technology to develop it further

Makers of Architecture

Jae Warrander
jae@makers.co.nz
021 850 758

Makers Fabrication

Glen Stricot-Tarboton
glen@makers.co.nz
027 717 1727

BUILDING OUR DIGITAL COMMUNITIES CONFERENCE
2023

Delivering Net Zero
BIM Enabled Carbon Assessment

WARREN AND MAHONEY®

- Embodied Carbon
- BIM enabled Carbon Assessment
- Case Studies
- Automation and AI
- Towards 2030

How can we reduce carbon emissions in early design?

OPPORTUNITIES

01 Efficient modelling strategies

02 Material Data Management

03 Making informed data driven design decisions

WARREN AND MAHONEY®

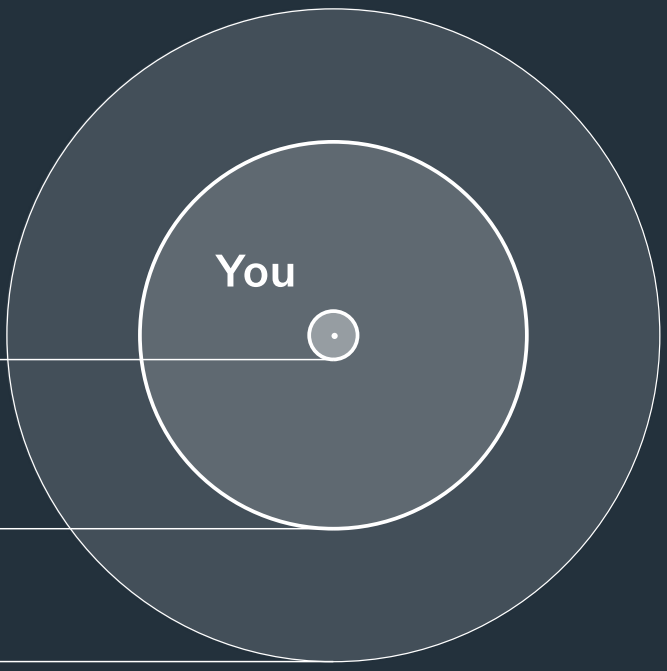
Climate **Emergency**

WARREN AND MAHONEY®

Your Business

Your Work

Your Influence



WARREN AND MAHONEY®

avoided* 1445 tCO_2e-

*estimate based on the embodied carbon it would take to replace the retained structure

TOTAL AVOIDED

1445 tCO_2e-

Upfront excluding Biogenic and Module D of retained structure

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Our Goal

By 2030, our goal —with our clients— is that all new projects designed by us will be net-zero carbon in operation, be 50% more energy efficient and have **40% less embodied carbon**.

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TOITŪ CARBON ZERO ISO:14064-1 ORGANISATION

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Join us on the path to zero

CARBON 101

Embodied Carbon in Design

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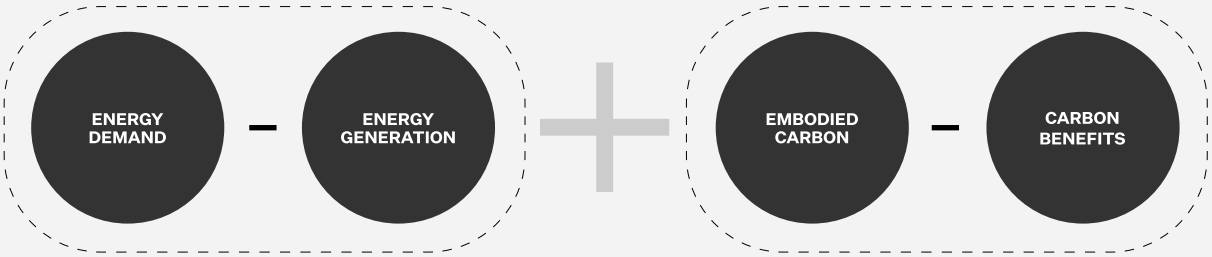
Zero Carbon



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DESIGN STRATEGIES FOR NET ZERO CARBON *

* broadly aligned with ILFI Zero Carbon Certification

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‘Carbon’

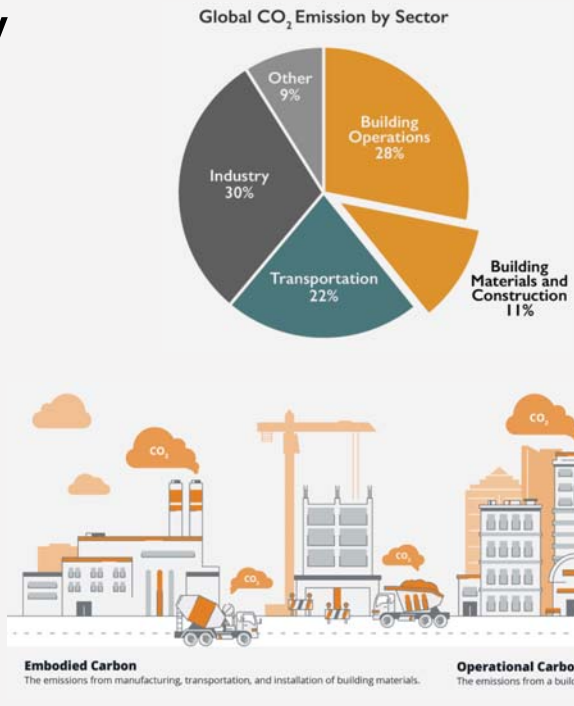
Greenhouse Gas (GHG) are any gas that absorbs heat in the atmosphere such as **Carbon Dioxide (CO_2)** and **Methane (CH_4)**.

The impact of GHGs is **Global Warming Potential (GWP)** which is measured in **Carbon Dioxide equivalent** gas (CO_2e-) measured through a Life Cycle Assessment (LCA).

Impact of Buildings Globally

39%

of global greenhouse gas emissions from buildings



Source: Global Alliance for Buildings and Construction - https://globalabc.org/

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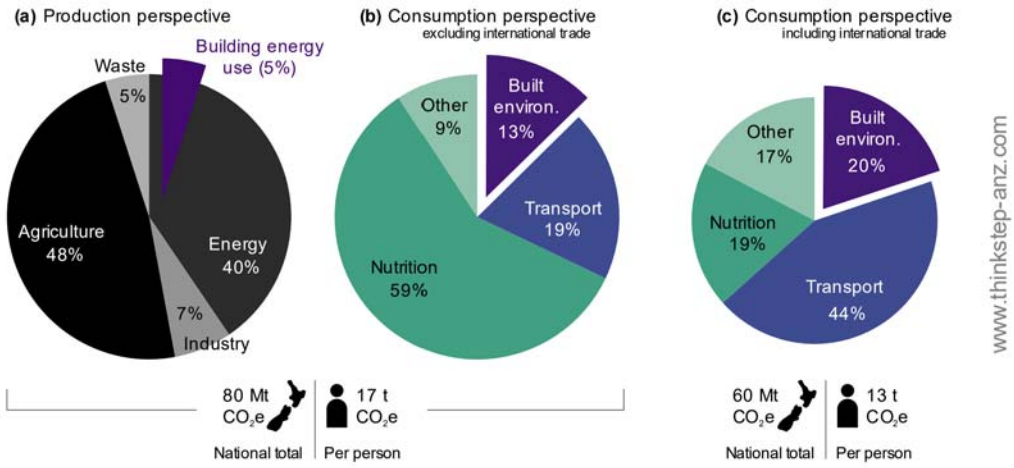
Impact of Buildings in New Zealand



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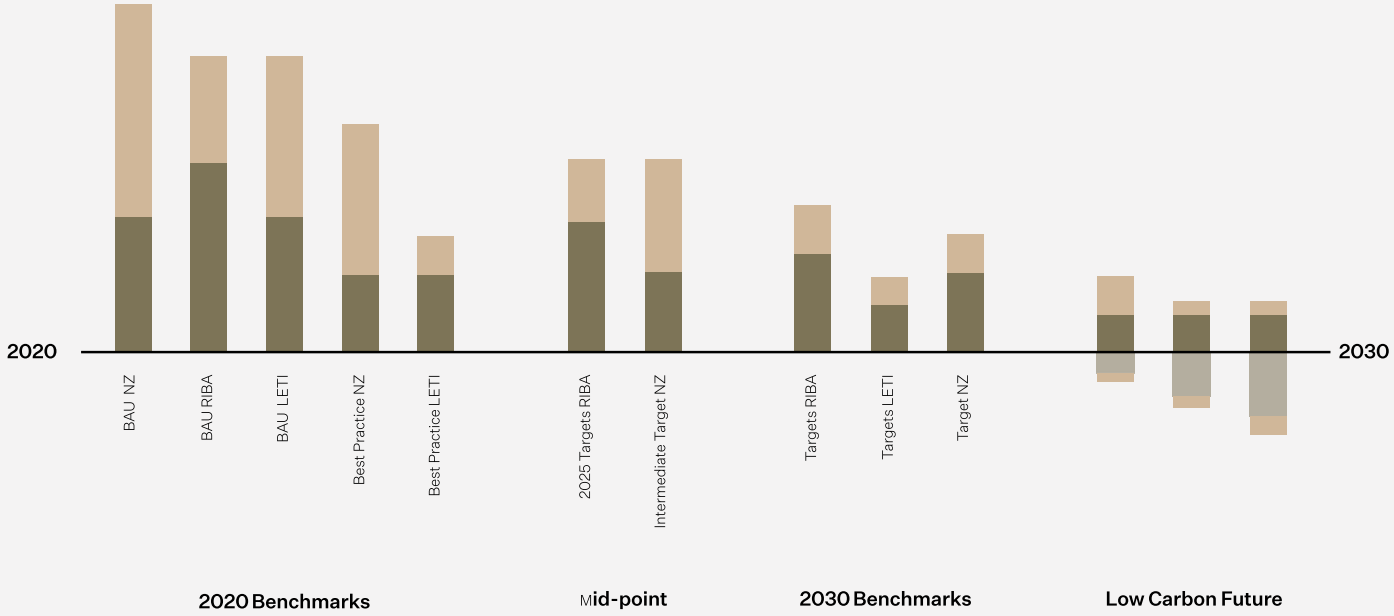
Source: Link to Thinkstep Report- https://www.nzgbc.org.nz/Attachment?Action=Download&Attachment_id=2453

Embodied and Operational Carbon



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CASE STUDY

Flowers Site 6

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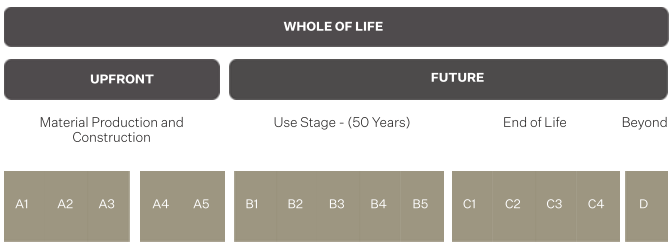
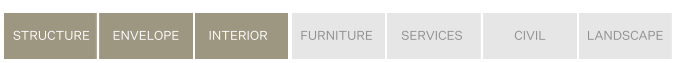
Scope

LIFE CYCLE SCOPE



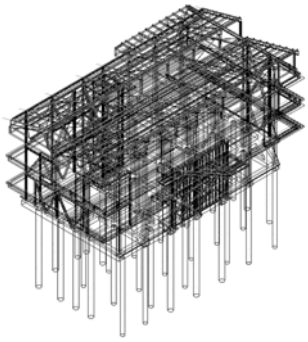
BUILDING ELEMENT SCOPE



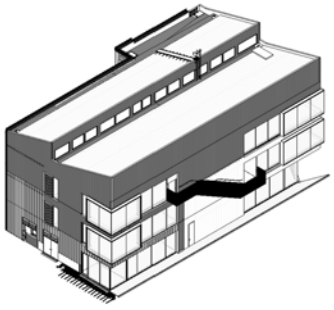
Included In Scope

Excluded in Scope

STRUCTURAL SCOPE



ARCHITECTURAL SCOPE



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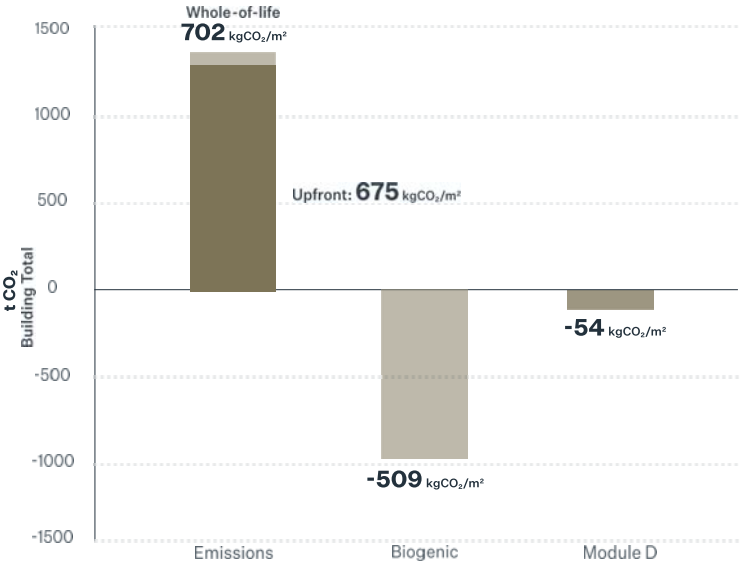
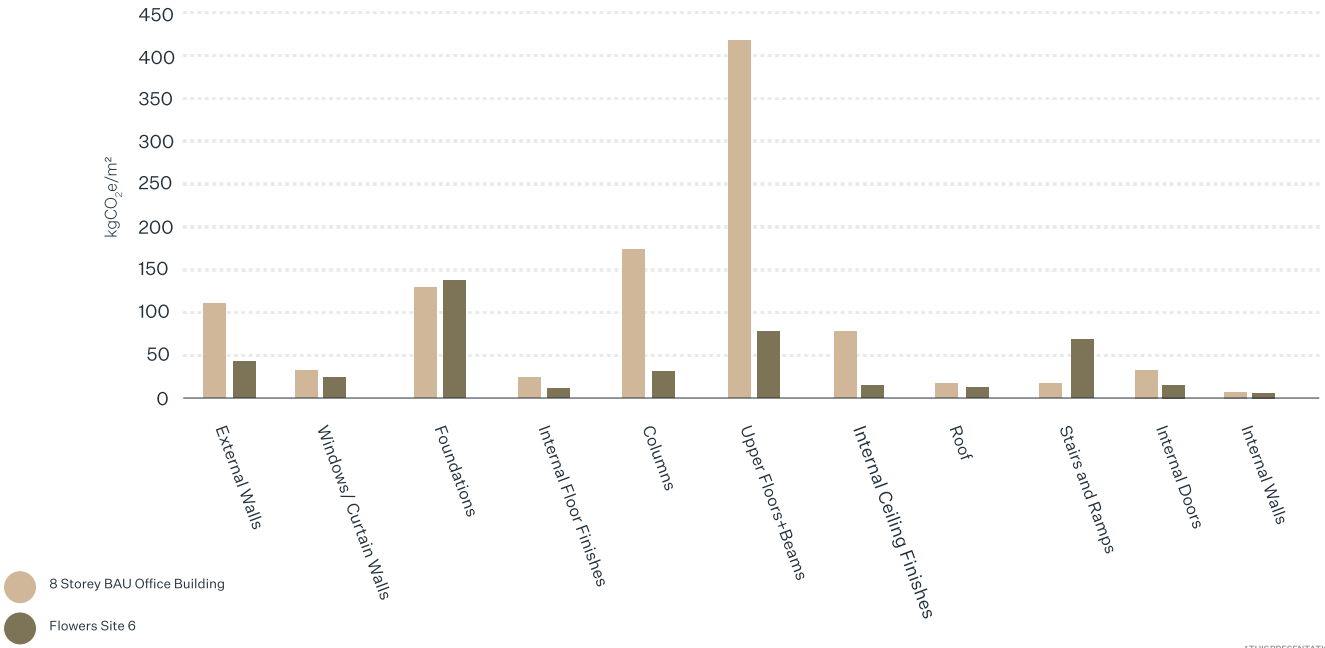
Results



Comparison of Carbon Intensity



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CARBON

BIM enabled carbon assessment

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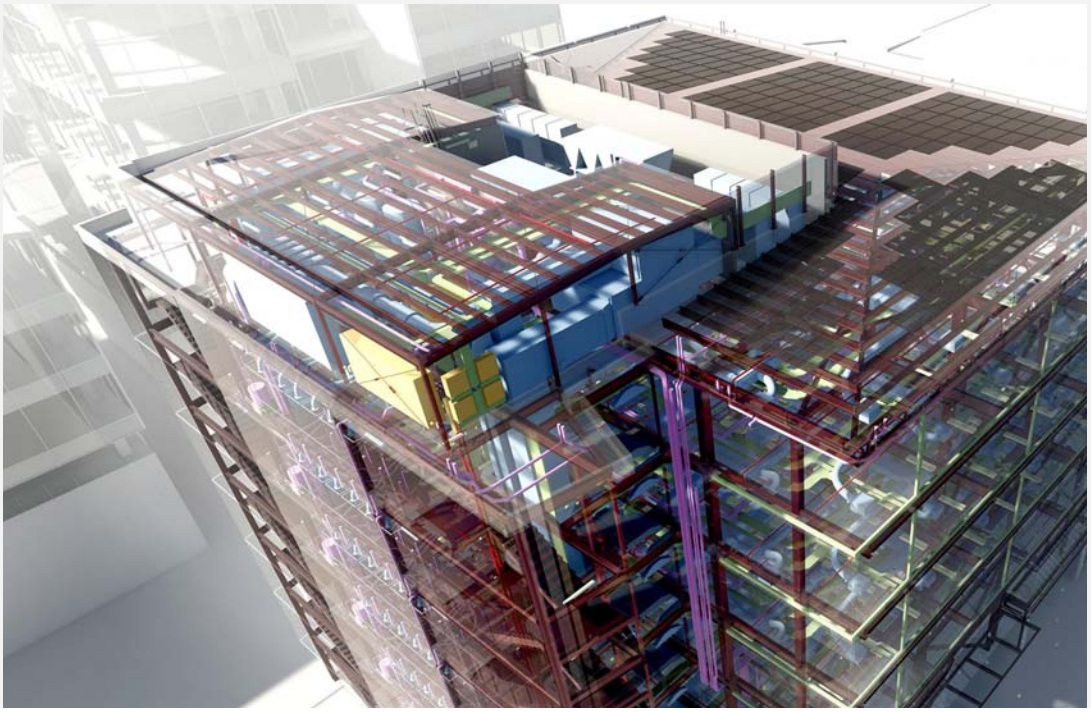
Expectation v Reality



"Expected experience"

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Building Information Model

What you measure impacts how you manage your team.

What is the **building element scope** I am looking to measure?

What is the **building's life cycle scope** I am looking to understand?

PRIMARY MATERIAL ASSEMBLIES	Foundation	• Retaining Walls • Footings
	Structure	• Slabs • Framing • Reinforcement
	Enclosure	• Cladding • Insulation • Fenestration • Roofing
INTERIOR MATERIAL ASSEMBLIES	Finishes	• Ceiling • Wall • Floor • Partitions
	Partitions	• Framing • Insulation • Fenestration
OPTIONAL MATERIAL ASSEMBLIES	*Interior Furnishings*	*• Furniture • Fixtures • Equipment*
	Building Systems	*• Electrical • Mechanical • Plumbing + Fire Protection*
	Site Work	*• Excavation • External Paving*

IFLI Zero Carbon Certification Building Elements

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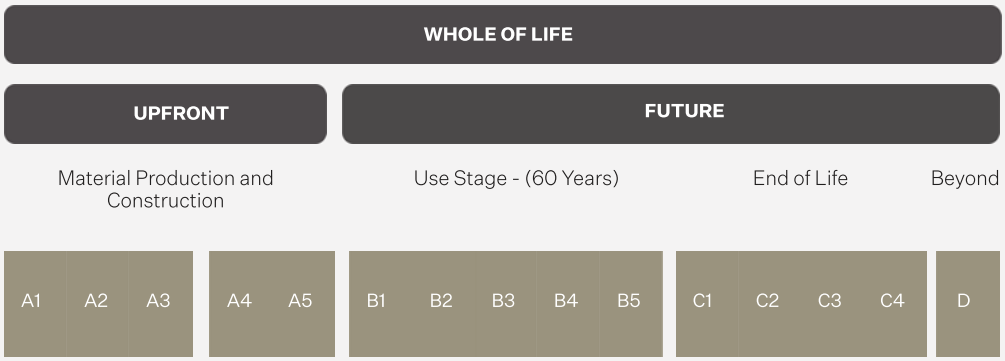
Building Scope - MBIE methodology

Building System	Mandatory: must be included in the assessment	Voluntary: may be reported independently within the assessment
Ground Work	• Substructure/foundations • Earth retaining structures • Basements	• Vegetation • Hard landscaping • Ancillary buildings • External services, including drainage
Structure	• Ground floor structure • Upper floor(s) structure • Load bearing systems: gravity and lateral structural frames and walls • Roof structure	• Temporary works (form work, scaffold etc.) used during construction that are not reused • Stairs • Lifts and escalators
External Envelope	• Cladding/façade primary elements (weather exposed layer, structural support system) • External wall insulation • Roof covering and insulation • External windows and doors	• Cladding/façade secondary elements (seals, brackets etc.)
Non- structural internal elements	• Non-loadbearing walls • Internal doors • Floor and wall finishes	• Ceilings • Fixtures, fittings and furniture
Building Services	• HVAC4 equipment	• Water, drainage, electrical services • Other building systems such as fire and security systems

MBIE Building Elements

Consistent Lifecycle Scope - LCA terms



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Building **Information** Model

Product Specific Database Examples

EPD® AUSTRALASIA

EPD® THE INTERNATIONAL EPD® SYSTEM

GLOBAL GREEN TAG

Generic Database Examples

One Click LCA

ecoinvent Centre

CONSTRUCT

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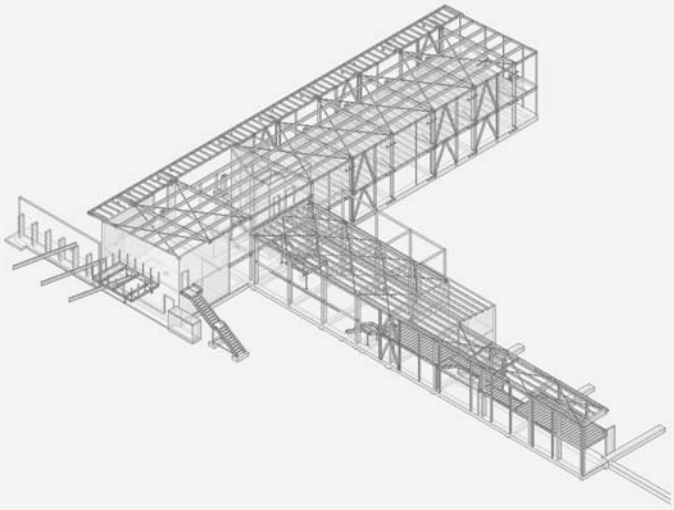
Building Information **Model**



MODELLING STRATEGIES

01 Volume based approach

Model to a level of detail were the volume is a appropriate quantity

02 Area based approach

Using area planes to represent quantities of multiple materials

03 Length based approach

Model lines to represent more detailed elements for example, structure

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Early Design Workflow

1

Simplify

Model efficiently using an area and length based approach

2

Measure

Utilise product specific where possible & input generic data consistently

3

Test

Swap out materials or remodel to identify a reduction pathway

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CASE STUDIES

Head Start on Low Carbon Design

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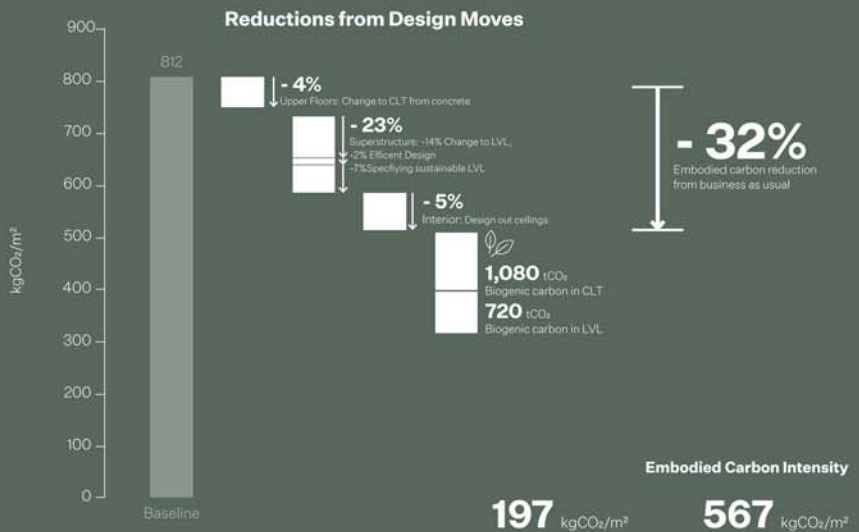
Embodied Carbon in Concept Design

LCA Scope: Whole of life assessment over a 50 year service life
Building Element Scope: Superstructure (beams, columns, ground and upper floors), Envelope (roof,& facade), Interior (carpet, ceilings, stairs). Substructure (foundations) were excluded from the assessment.
Baseline: Was calculated off the same design parameters using business as usual material specifications



Embodied Carbon Intensity

197 $kgCO_2/m^2$
Biogenic carbon sequestered upfront

567 $kgCO_2/m^2$
Embodied carbon emissions

Embodied Carbon in Bulk & Massing

LCA Scope: Whole of life assessment over a 60 year service life
Building Element Scope: Superstructure (beams, columns, ground and upper floors), Envelope (roof,& facade), Substructure (foundations). Interior (carpet, ceilings, stairs) were excluded from the assessment.
Baseline: Latrobe was use as a reference building to make allowances for unknown quantities

1A	2C	3A	4A	2A
707 $kgCO_2/m^2$	**736** $kgCO_2/m^2$	**659** $kgCO_2/m^2$	**729** $kgCO_2/m^2$	**676** $kgCO_2/m^2$
5,658 tCO_2 total whole of life emissions	**5,888** tCO_2 total whole of life emissions	**6,193** tCO_2 total whole of life emissions	**6,199** tCO_2 total whole of life emissions	**6,897** tCO_2 total whole of life emissions
0.185 $kgCO_2$ per visit	**.191** $kgCO_2$ per visit	**0.198** $kgCO_2$ per visit	**0.198** $kgCO_2$ per visit	**0.214** $kgCO_2$ per visit
1.3 km per visit	**1.3 km** per visit	**1.4 km** per visit	**1.4 km** per visit	**1.5 km** per visit
Best Performance				**Selected Design**

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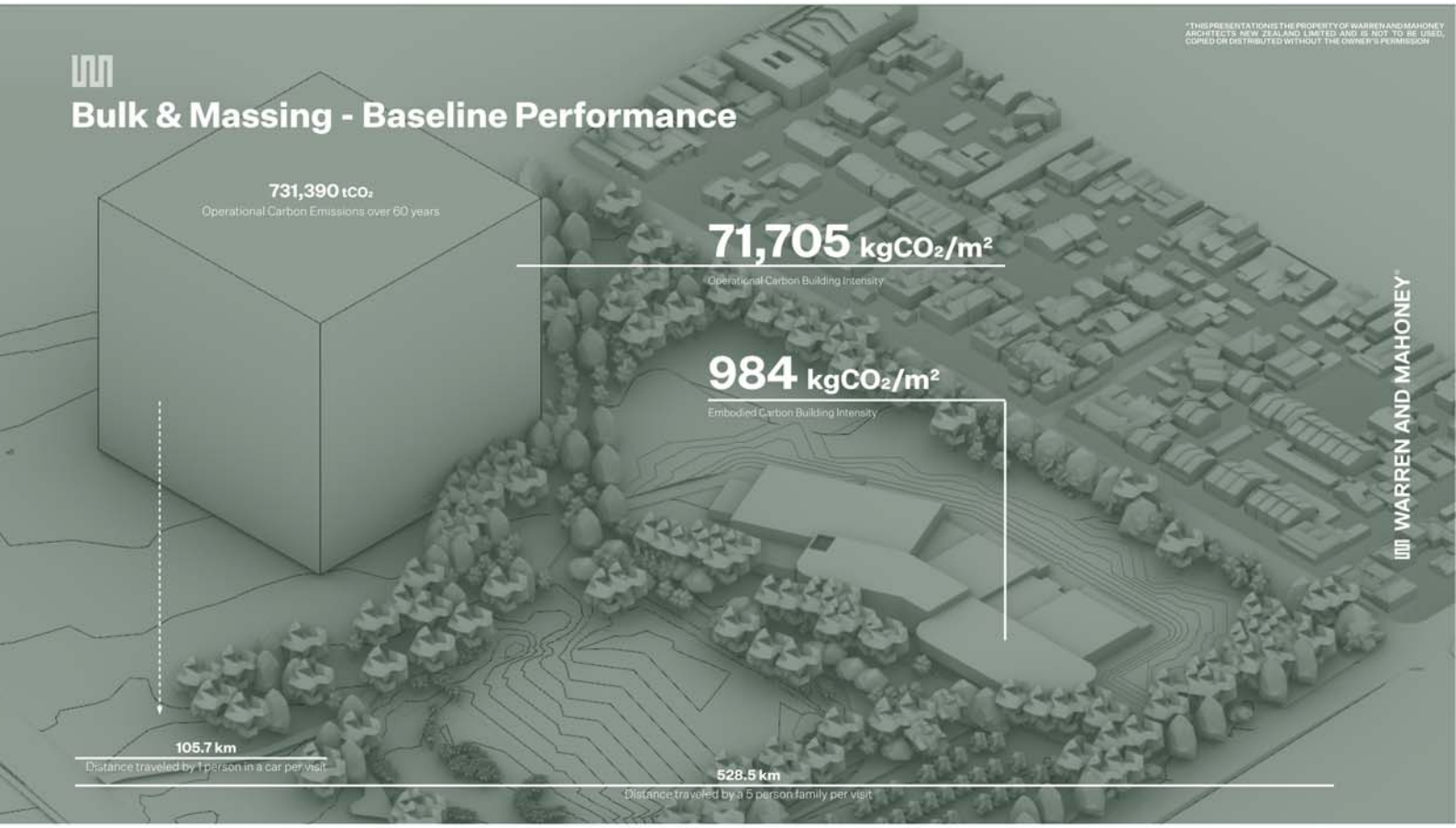

CASE STUDIES

Data Informed Design

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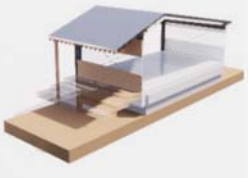
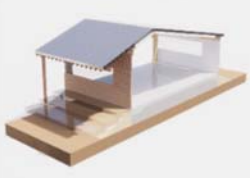
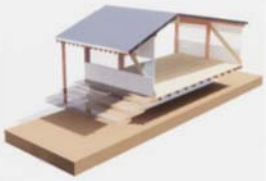
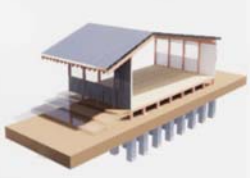
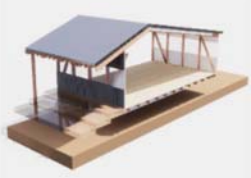
Taita College

Carbon hotspot identification

	822 $KgCO_2m^2$	838 $KgCO_2m^2$	534 $KgCO_2m^2$	610 $KgCO_2m^2$	524 $KgCO_2m^2$
					
	Design System Option 1 (A1, B1, C1, D1, E1)	Design System Option 2 (A2, B2, C2, D2, E2)	Design System Option 3 (A3, B3, C3, D3, E3)	Design System Option 4 (A4, B4, C4, D4, E4)	Design System Option 5 (A5, B5, C5, D5, E5)
Foundations	30%	40%	66%	66%	67%
Ground Floor	45%	44%	11%	19%	12%
Load Bearing Structure	14%	1%	2%	6%	8%
Roof Structure	7%	5%	15%	3%	6%
Cladding/Facade	4%	9%	5%	5%	6%

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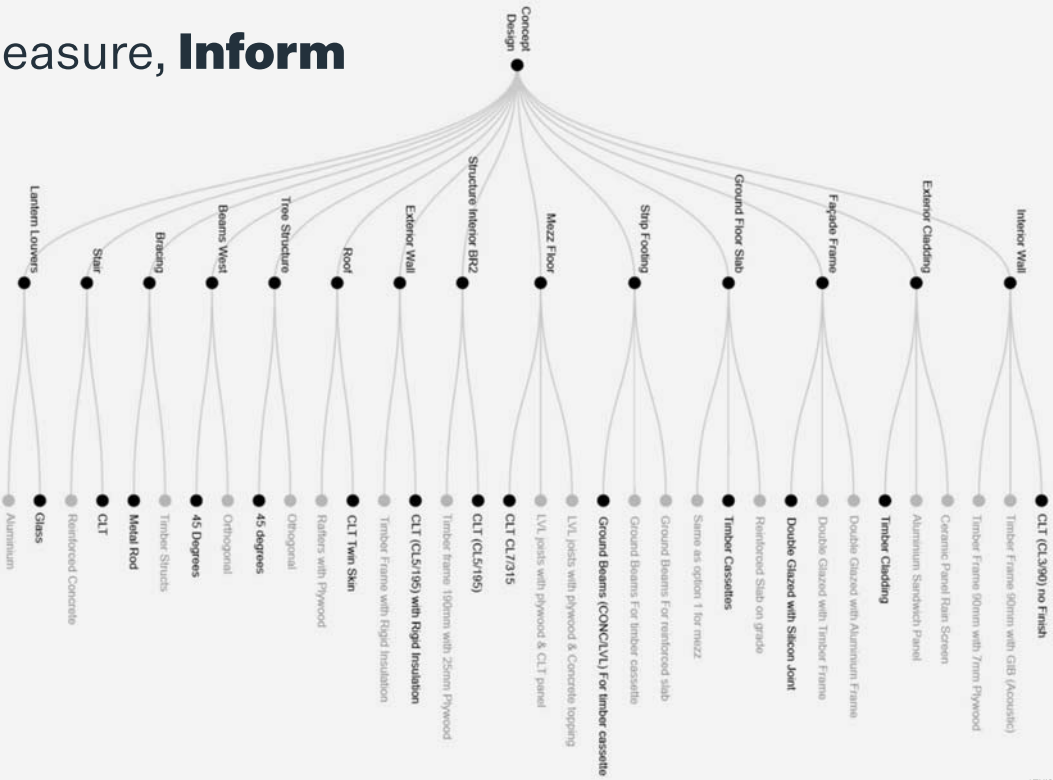
zero carbon certification

Test, Measure, **Inform**



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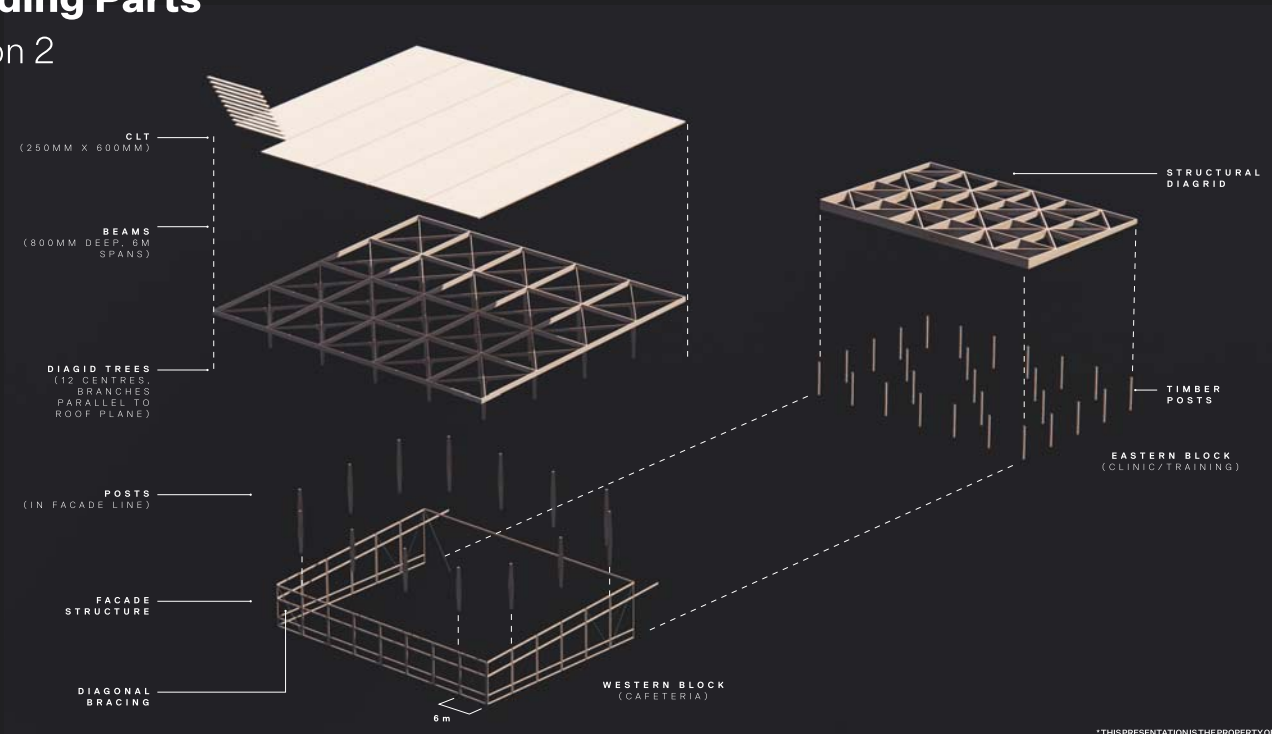
Building Parts

Option 2



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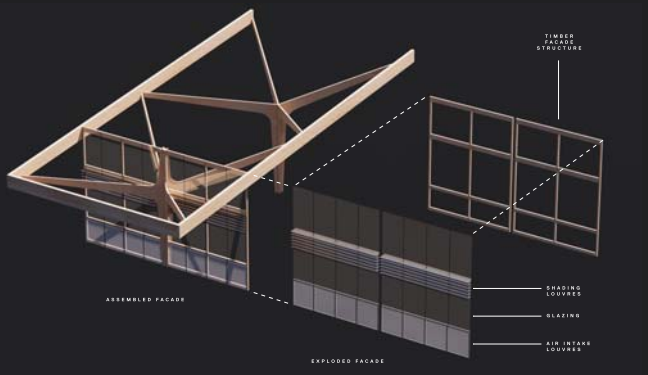
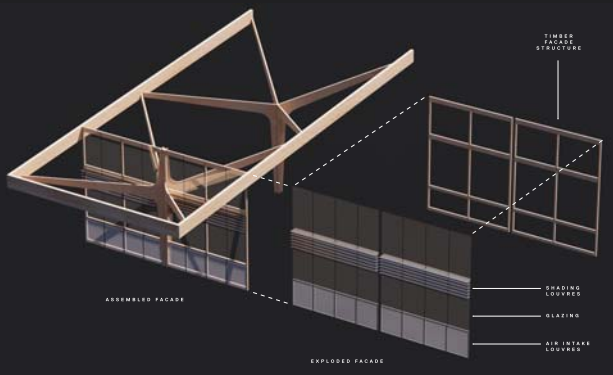
Facades

Flexible and modular construction

The facades and their sub-structure are designed to be modular and flexible with optimised module dimensions. Within it is a framework of apertures that can be filled to respond to the requirements of shading or maximising views and connectivity. The lower portion of the facades accommodate operable louvres to enable natural ventilation at the perimeter whilst the high-level apertures are predominantly glazed to optimise natural day-lighting.





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RESEARCH FILLING GAPS

Facade Study

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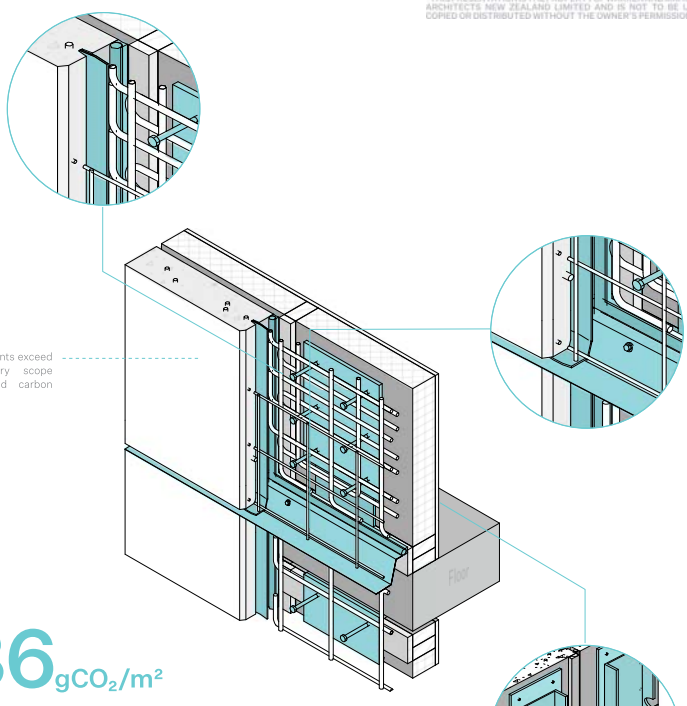
Facade Type Four

Precast Concrete Panels

04



186 gCO_2/m^2

Total upfront (A1-A3) embodied carbon per square metre of facade.

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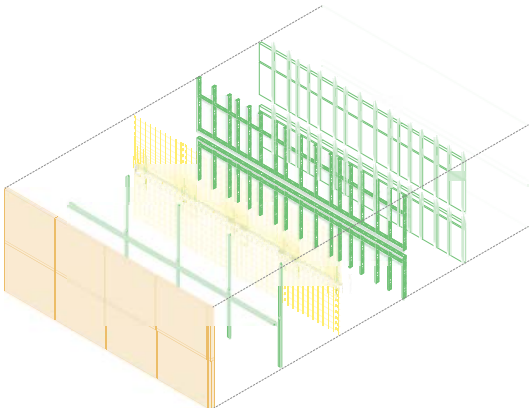
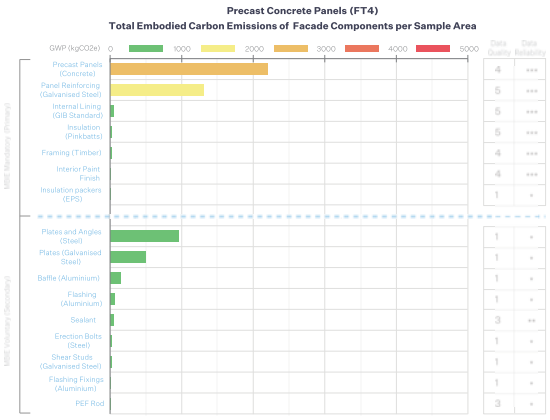
Precast Concrete Panels

Areas of high carbon intensity





4th

Place in carbon intensity within studied facades

186

GWP per square metre ($kgCO_2e/m^2$)

The total sample area of facade ($28.7m^2$) measured at 5343 $kgCO_2e$ of upfront (A1-A3) embodied carbon.

125

MBIE mandatory GWP (kgCO2e)

The 'primary elements' (mandatory MBIE scope) within this facade system accounted for 67% of the total GWP.

61

MBIE voluntary GWP (kgCO2e)

The 'secondary elements' (voluntary MBIE scope) within this facade system accounted for 33% of the total GWP.

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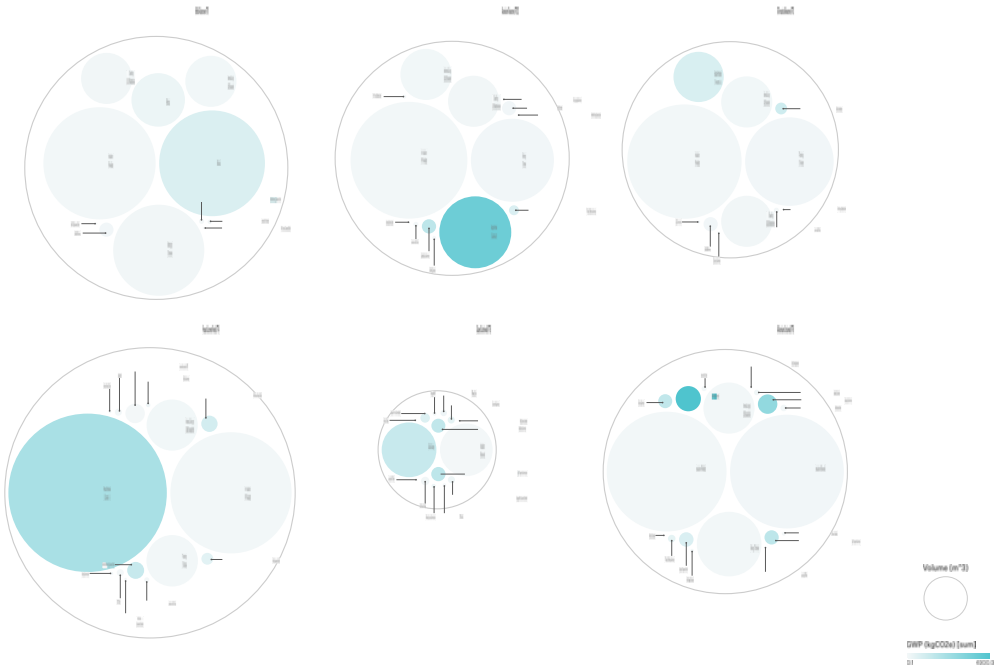
Measure What Matters

Cut-off Criteria



Components with smaller volumes don't always have a smaller carbon impact.

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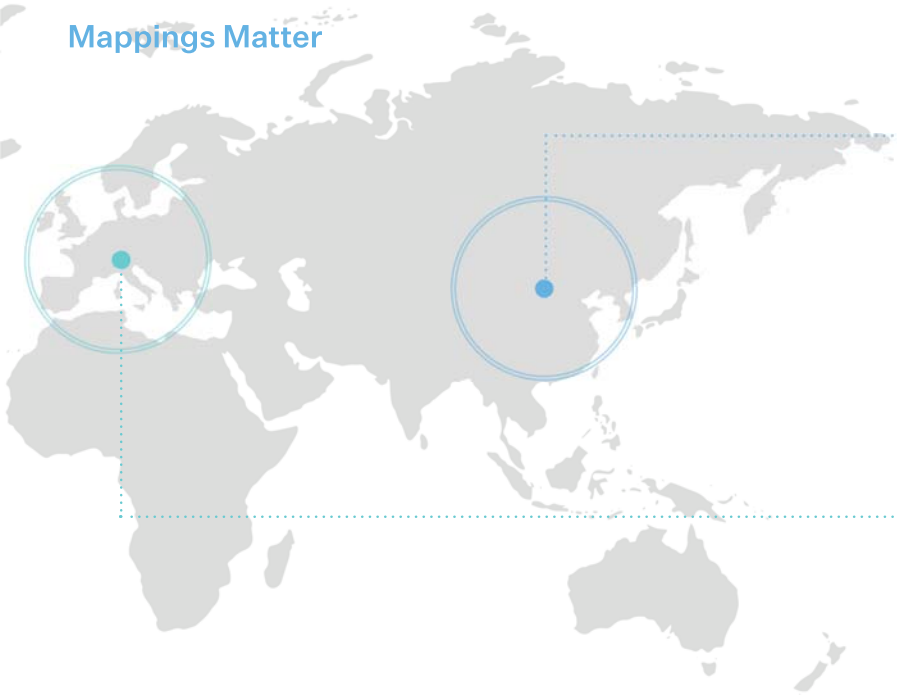
Mappings Matter



Carbon impact of aluminium sourced from two of NZ's common supplier locations

Generic aluminium data from China

29

Upfront Carbon ($kgCO_2e$)

A1-A3 Product Stage	26.00 kg
A4 Transportation	0.02 kg
A5 Construction	2.00 kg

Generic aluminium data from Europe

9

Upfront Carbon ($kgCO_2e$)

A1-A3 Product Stage	8.60 kg
A4 Transportation	0.02 kg
A5 Construction	0.65 kg

ADVANCED TECHNOLOGY

Automation & AI

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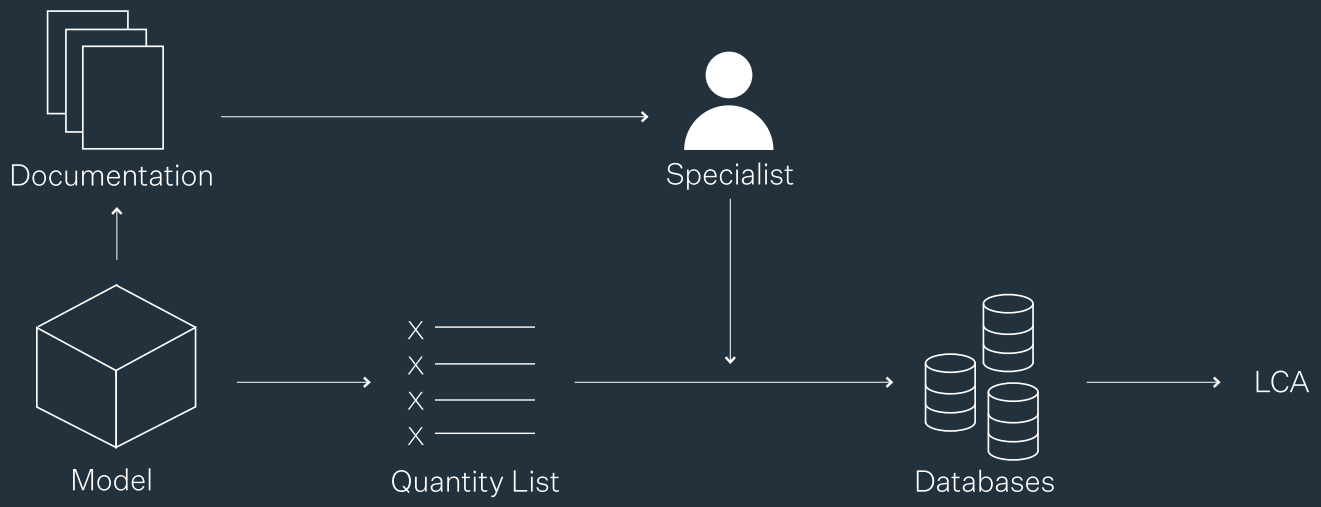
Current LCA Workflow



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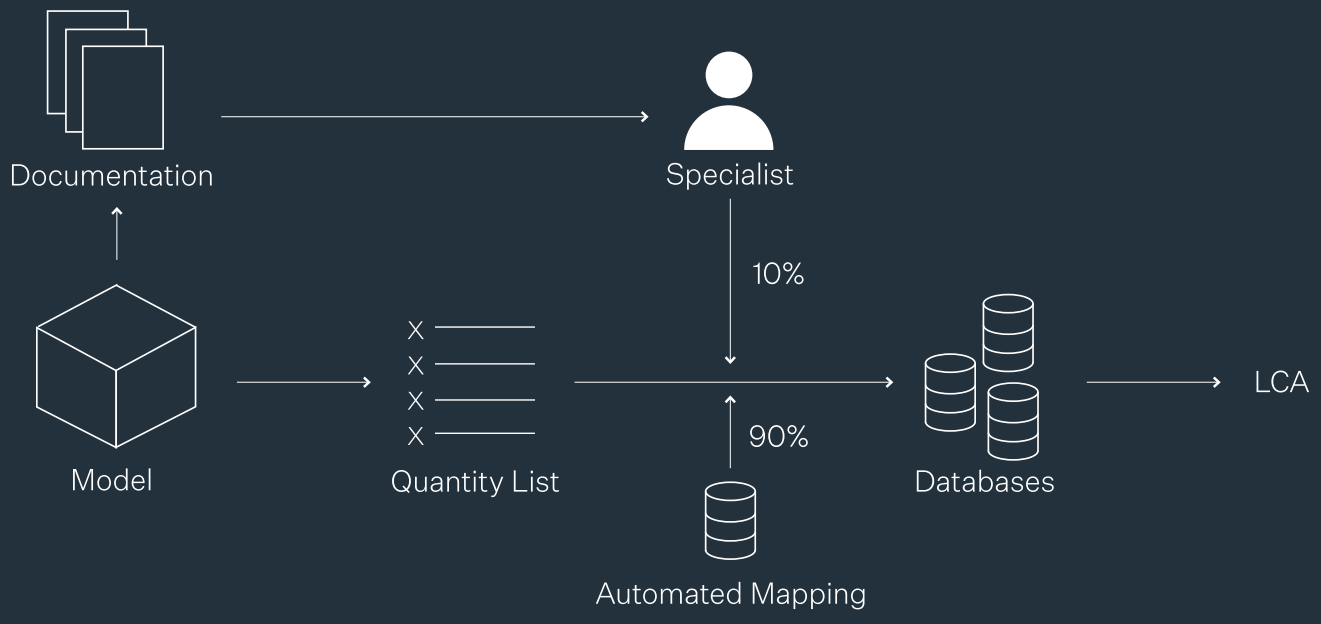
Semi-Automated LCA Workflow



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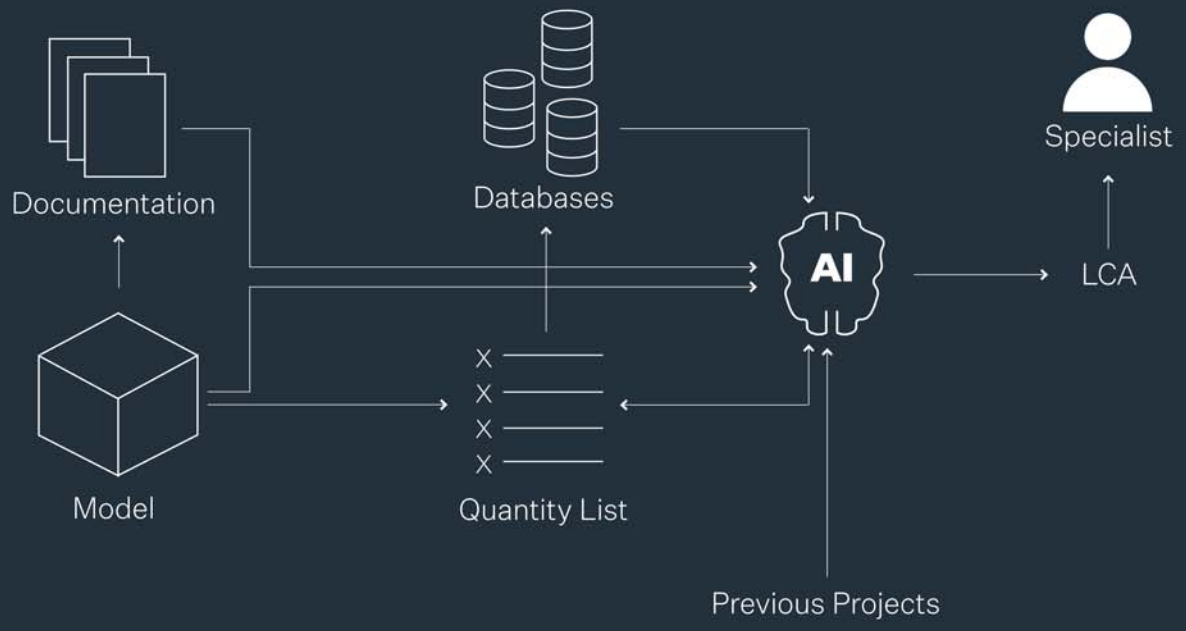
AI Driven LCA Workflow



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Towards 2030

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Embodied Carbon

from	to
good vs bad materials	resourcefulness

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Technology

from	to
auditing a detailed design	informing an active design

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1.5ºC

6 years **117** days

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1,337 tCO_2/s

1,604,400 tCO_2

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he waka eke noa

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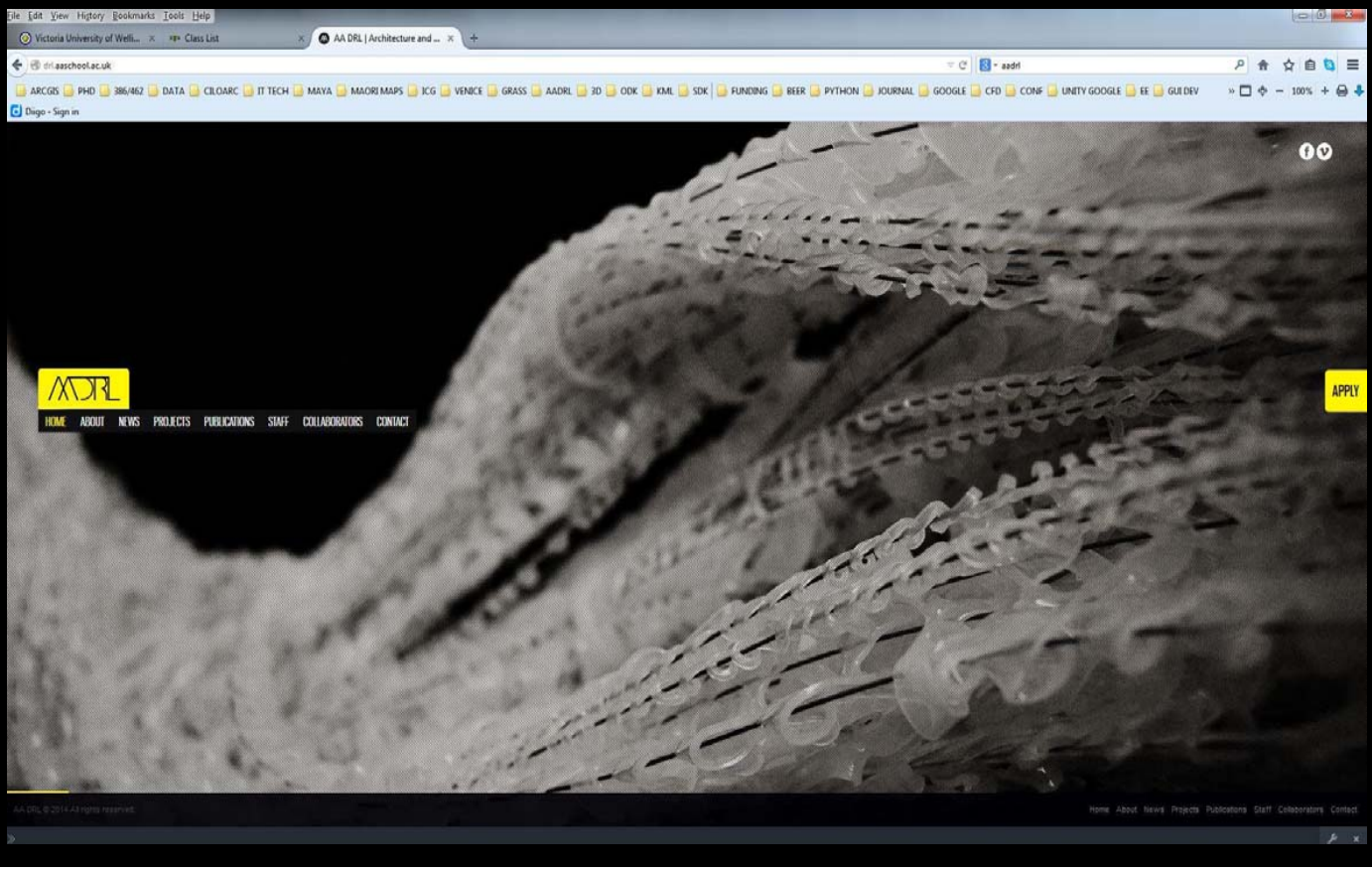

JOHN McASLAN + PARTNERS

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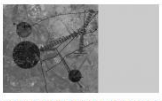
KING'S CROSS STATION

The transformation of King's Cross Station creates a remarkable dialogue between Cubitt's original 19th century station and 21st-century architecture. Opened to the public in March 2012, in advance of the 2012 London Olympics, King's Cross is now an iconic architectural gateway to the capital. The scheme has restored Grade I listed historic fabric, and added the highly innovative new Concourse. At 7,500 sqm, it is three times the size of the original concourse and has become the 'beating heart' of this multi-modal transport hub, linking St Pancras Station, Thameslink services, London Underground, taxis and bus services, and accommodating up to 150,000 passengers daily through a spacious and dynamic multi-modal interchange.

Read more >

RELATED LINKS

KING'S CROSS STATION MASTERPLAN
Widely praised for its design and refurbishment of the Grade I listed Station ...



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NEWS


STED DESIGNS OCAUST MEMORIAL AT THE V&A
a + Partners' design olocaust Memorial one of ...

BELFAST HUB SUBMITTED FOR PLANNING
The Belfast Transport Hub, designed by John McAslan + Partners with Arup for ...

THE ART OF REGENERATION
An exhibition at the Museum of Russian Impressionism celebrates the Museum's ...

NICOLA STURGEON VISITS BURGH HALL
Following almost a decade of restoration work, Nicola Sturgeon, Scotland's First ...

AN + PARTNERS ACCOLADE AT RUST AWARDS
Heart Cathedral of a, won this year's

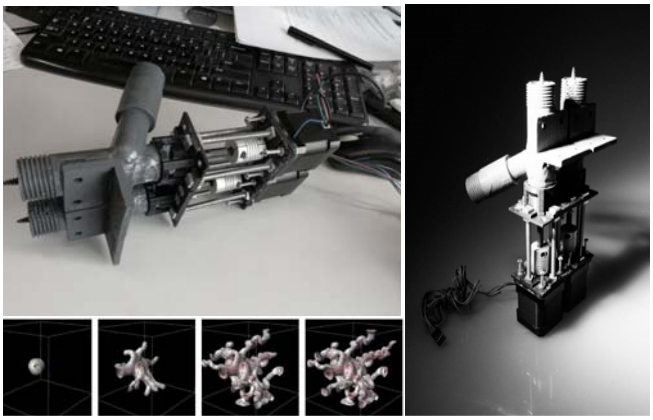
BEST OFFICE AWARDS 2017
The Bolshevik Factory in Moscow has won first prize in the Best Office Awards 2017.

JMP'S SENIOR SCHOOL FOR BRITISH SCHOOL RIO DE JANEIRO OPENS
The practice's new senior school for The British School in Rio de Janeiro, was ...

PAUL EAST APPOINTED TO HEAD UP JMP'S EDINBURGH OFFICE
Paul East has been appointed to head up JMP's Edinburgh office. During his ...

SITUA/ **THE BIOLOGICAL**
Research Sphere 2
Biological Interpolation in Fabrication

Puriri moth behaviour/ korero o nehe.



Dual nozzle construction/ print simulation studies.

Noah Orr/ Derek Kawiti/ Nga Tāmanuhiri: Double Extruder Study/ Clay + Bio matter scaffolding. Pūriri Moth/ Ngāpuhi kaupapa for tool making. Bio-computational partnering/ design orchestration. References to term 'Whakairo' Whaka-Iro. To subtract to carve to eat away/ dissolve.

Material subtraction through biological tooling.
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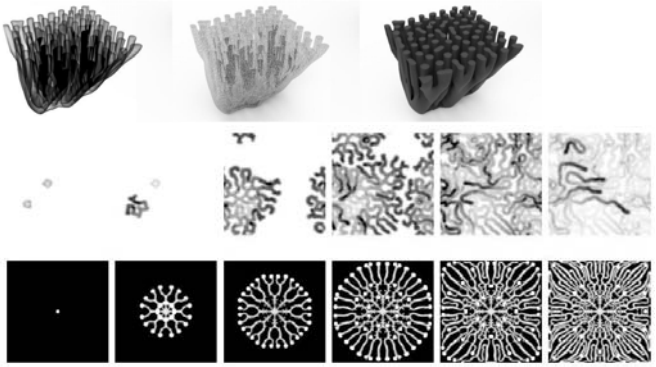
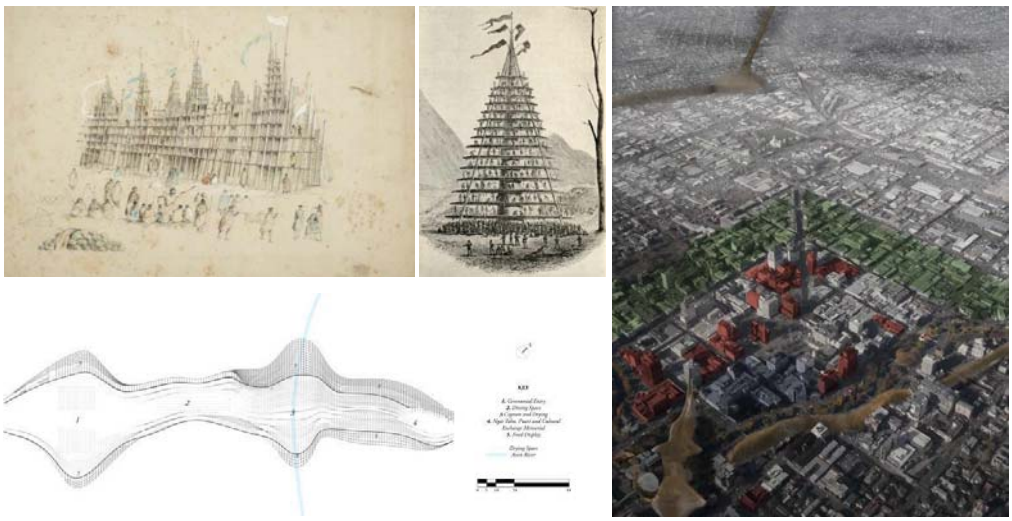


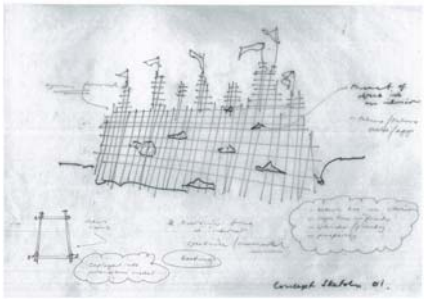
Material subtraction through biological tooling.
Toolpath orchestration/ cellulose depositions.

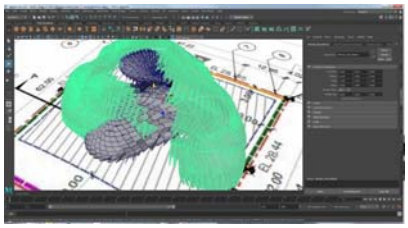
Noah Orr/ Derek Kawiti/ Ngai Tāmanuhiri: Double Extruder Study/ Clay + Bio matter scaffolding. Pūriri Moth/ Ngāpuhi kaupapa for tool making.
Bio-computational partnering/ design orchestration.

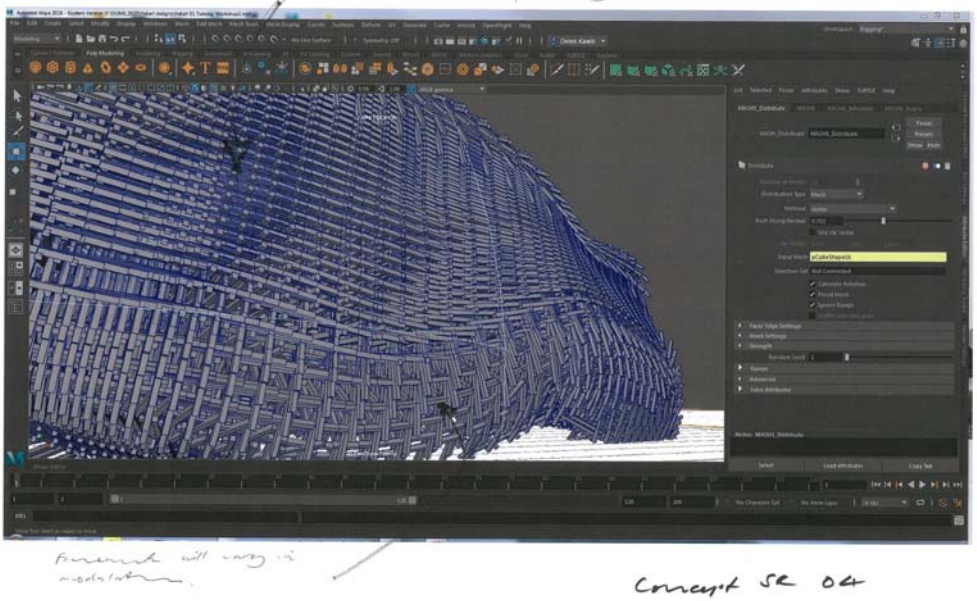
SITUA/ **FORENSIC RE- SETTLEMENT**
Research Sphere 3
Digital heritage, re modulation, re vitalisation



FORENSIC RECOLONISATION MODULATION; HAKARI STAGES. Guy Newton/ Derek Kawiti: Development of historic typologies, structures through performative investigations. Digitisation and prototyping with further formal structural generation.
Collaborative project on a proposal for CHCH CBD.







Digital re generation, procedural modulation of Hakari structural module and deployment..

FORENSIC RECOLONISATION MODULATION; HAKARI STAGES. Guy Newton/ Derek Kawiti: Development of historic typologies, structures through performative investigations. Digitisation and prototyping with further formal structural generation. Collaborative project on a proposal for CHCH CBD.

SITUA/ **TECTONIC RE-ENGINEERING**
Research Sphere 4 **NGA ATUA - RUAUMOKO**
Tectonic re engineering/ High pressure ground grouting

Tyler Harlen/ Derek Kawiti/Huhana Smith/ Ngati Tukorehe: High Pressure Injected Structures run through 3 scenarios:
Sandhill coastal erosion mitigation, Post Disaster scaffold, small scale foundation system. Small scale prototyping in the use of Anenome for GH/RH. Currently under 1:100 scale moving to 1:5 then to 1:1

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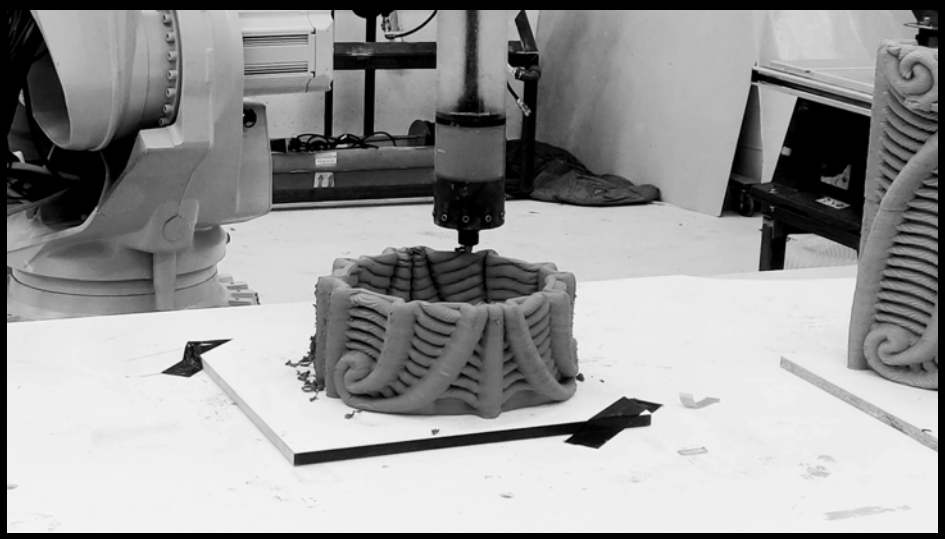
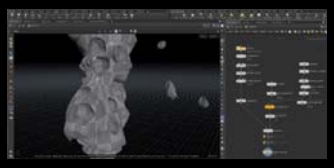
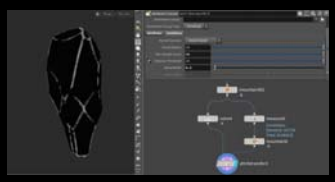
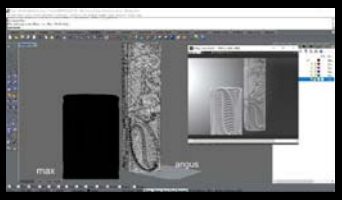


SITUA/ **CILOARC - ALLAN WIHONGI / Derek Kawiti/ ANGUS HORNE/** 3D Robotic Clay Printing
Revitalisation via robotic augmentation, sustainable practices in material exploration. Work undertaken for Te Parahirahi Trust, NGAWHA WAIARIKI. 202O - 2022



SITUA/ **CILOARC - Derek Kawiti/ Max Clifford/** Volumetric resmeshing of complex surface geometry
Procedural re surfacing towards replication. Polyline driven quad meshes from voxel geometry. HOUDINI/ PROCEDURAL ALGORTHM. 2021 - 2022


Stuff ≡ entertainment

arts

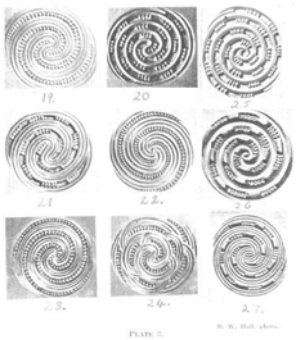
World's largest 3D printed sculpture finally installed in Rotorua

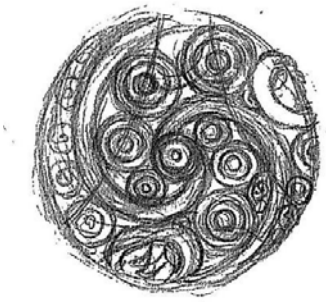
Benn Bathgate • 11:06, Sep 12 2020

More than three years after its original installation date the Hemo Gorge sculpture, Te Ahi Tupau, is finally in place

Trustworthy, accurate and reliable news stories are more important now than ever. Support our newsrooms by making a contribution.

Rotorua's Hemo Gorge sculpture, the largest 3D printed sculpture in the world, has finally been helicoptered into place more than





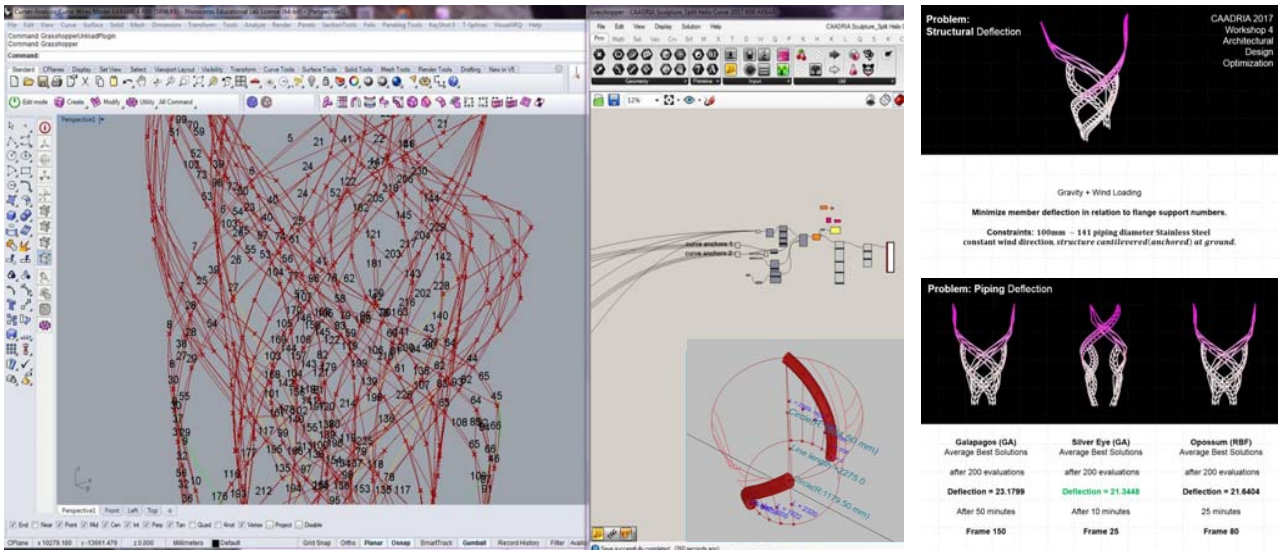
Hemo Rd Sculpture Project Rhinoceros/ Grasshopper Parametric Model. Structurally Optimised PLA Printed & Carbon Fiber Tubing
Project Leads://Stacy Gordine, New Zealand Maori Arts and Crafts Institute, Te Puia Rotorua, Derek Kawiti CILOARC **// GURIT Engineering**// Project Manager Marc Spikerbosch & Nick Dallimore //

TE PUIA

VICTORIA

CILOARC

// KARAMBA MODELLING WORKSHOP 4



Hemo Rd Sculpture Project Rhinoceros/ Grasshopper Parametric Model. Structurally Optimised piping – Maori Geometries Analysis/ **CILOARC**
Project Leads://Derek Kawiti (CILOARC) Stacy Gordine, New Zealand Maori Arts and Crafts Institute, Te Puia Rotorua **// OPUS Engineering**// Project Manager Marc Spikerbosch & Nick Dallimore //

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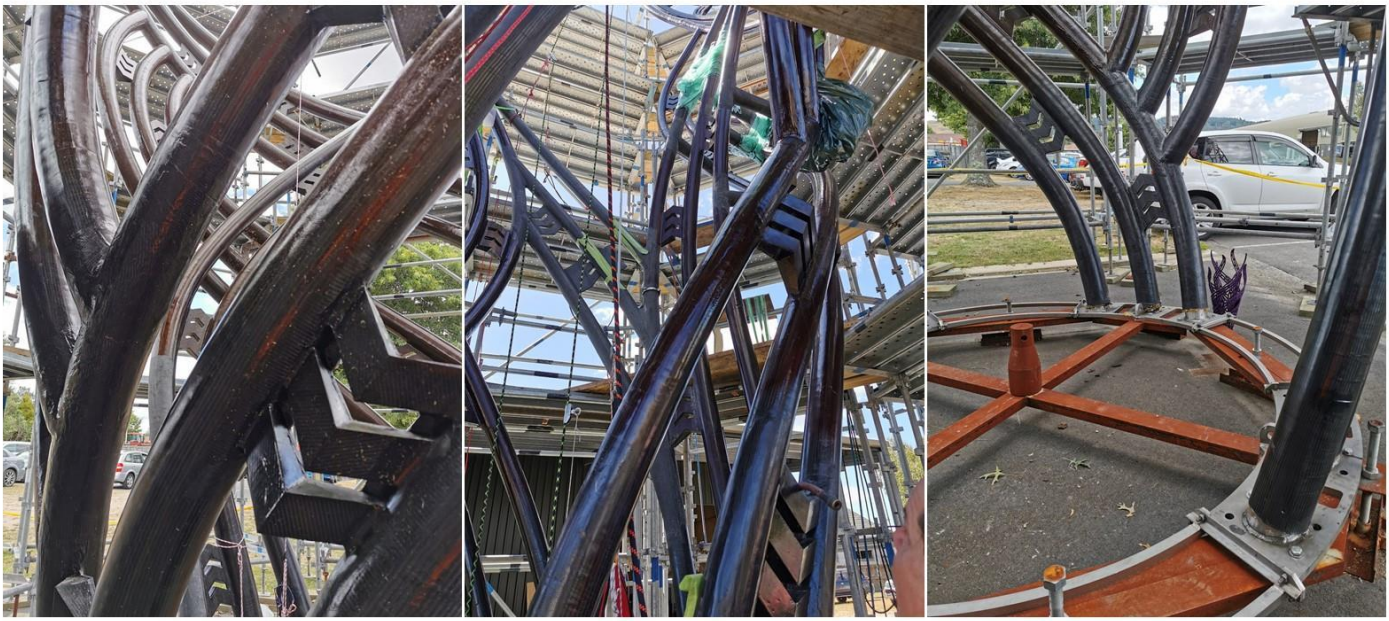

"Technological Mis-alignments: re-aligning fabrication and materials with cultural complexity."
Hemo Rd. Sculpture *'Te Ahi Tupua'* Project Leads://Stacy Gordine/Derek Kawiti/Nick Dallimore New Zealand Maori Arts and Crafts Institute, Te Puia Rotorua **// GURIT/ Opus Engineering**// Kilwell Fiber tube Ltd.

```
// CURRENT MODEL TO FABRICATION
Model sectional cut
164 Curves + Pipe Sections
```

Hemo Rd Sculpture Project Rhinoceros/ Grasshopper Parametric Model. Structurally Optimised piping – Maori Geometries Analysis/ **CILOARC**
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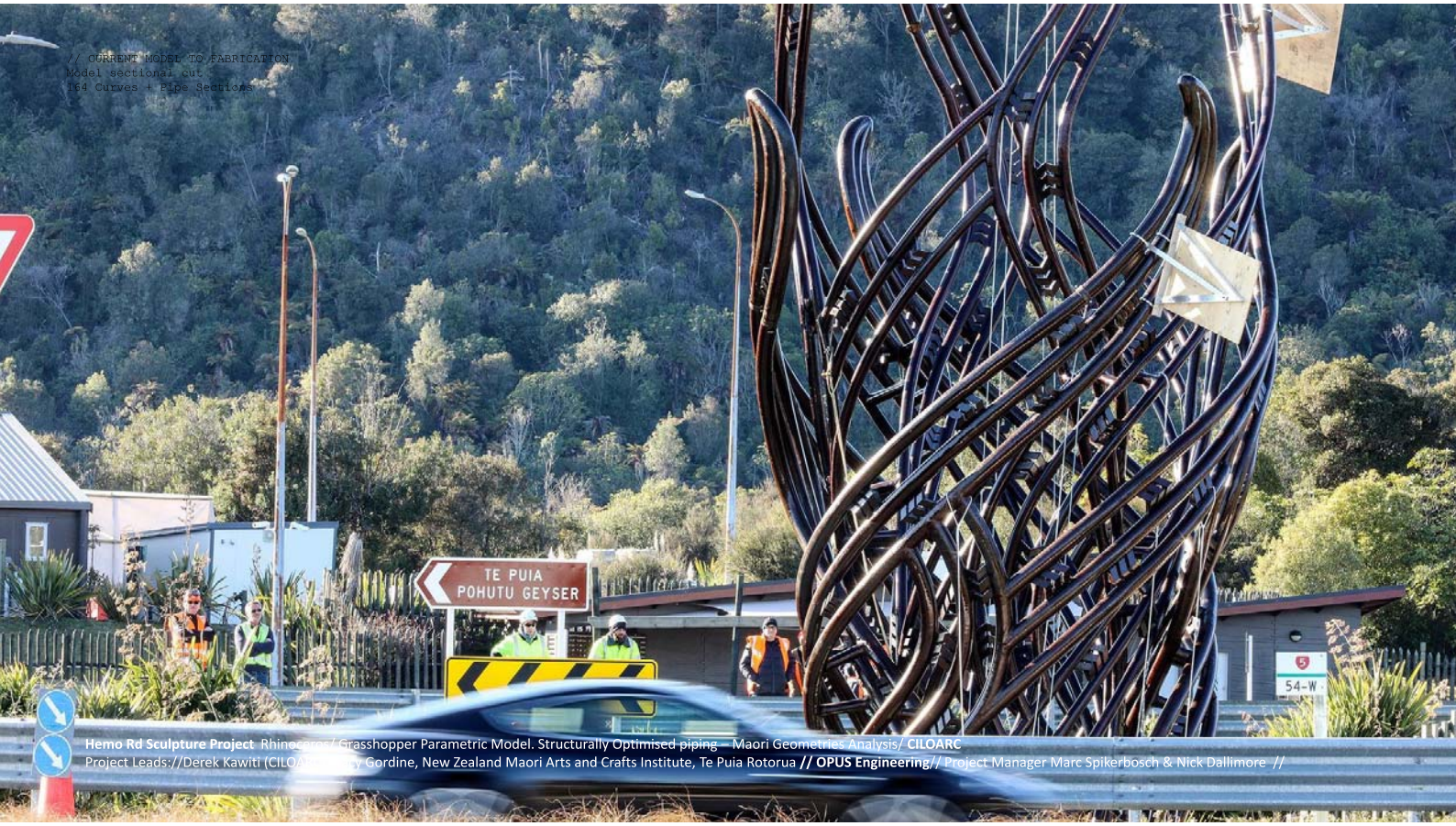

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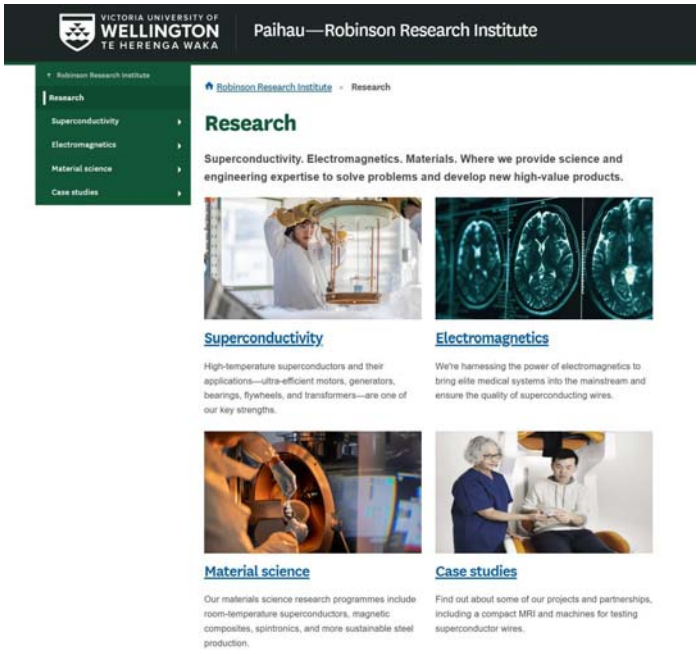
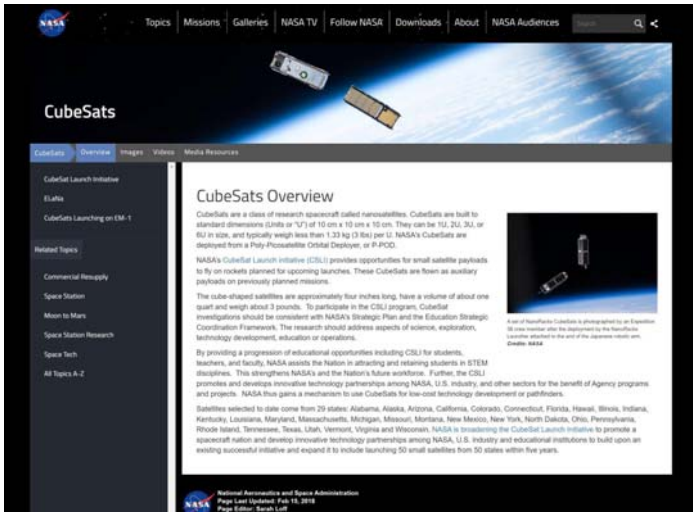
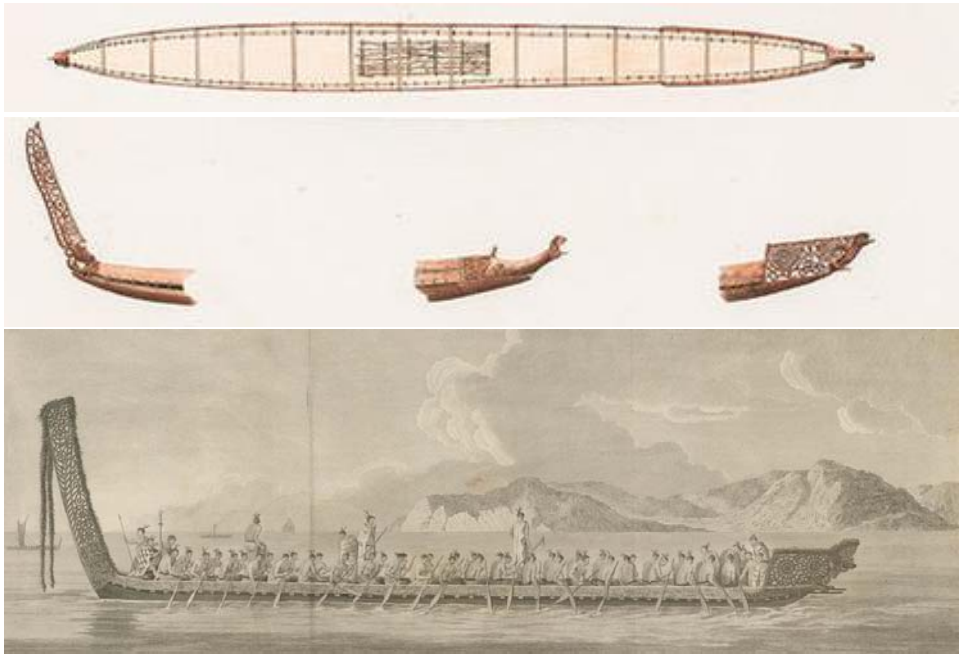
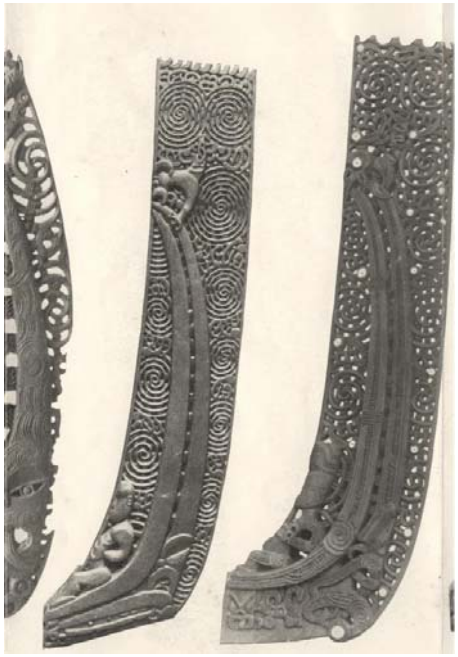




CUBESAT/ Waka Taurapa Research Project 2021 – 2024
Lead Researchers: Jakub Glowacki, Tulasi Parashar, Logan Evans, Max Clifford, Hemi Eruera, Karl Johnstone, Derek Kawiti
SATCUBE GLOBAL CHALLENGE// Development of micro satellite outer casing. Launch 2025. Robinson Space Programme Collaboration





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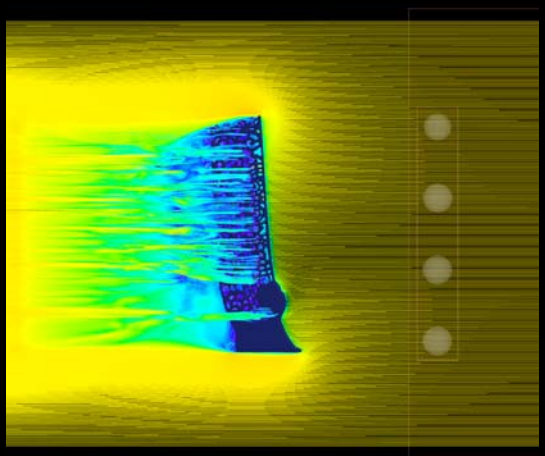

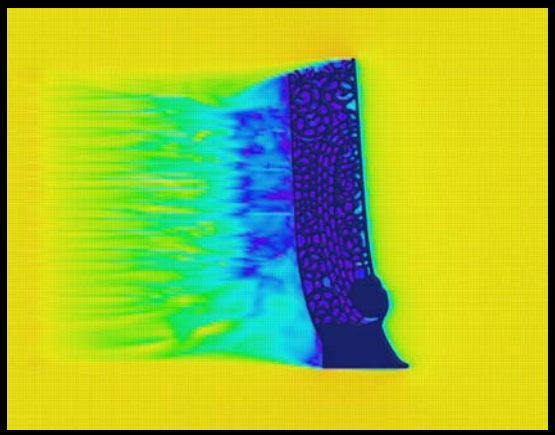

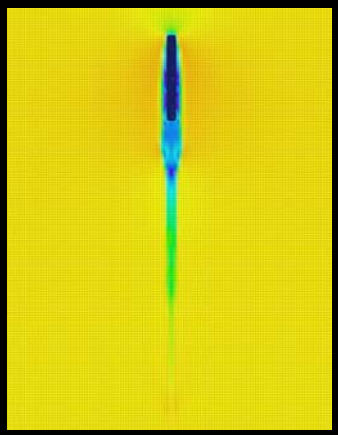

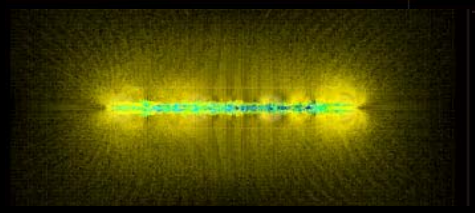

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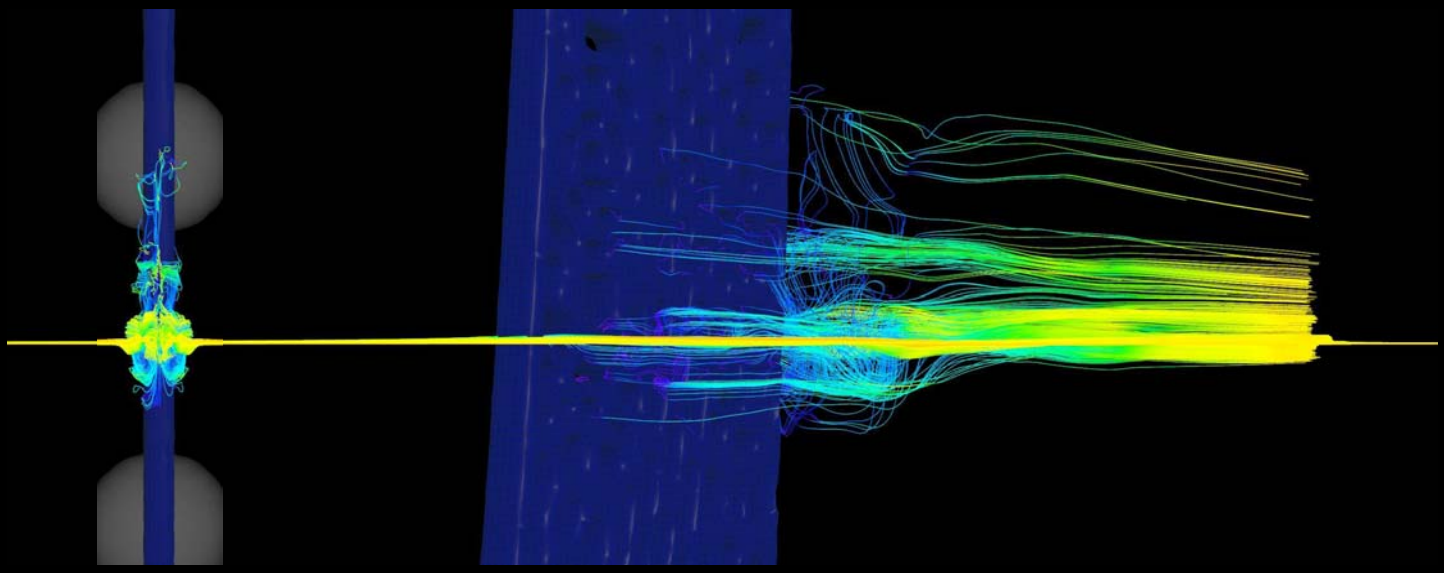

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Te Ruki Kawiti (The Duke) 1770 - 1854

Te Kuhanga Maihi Kawiti 1807 - 1889