APPRENTICE OF THE YEAR 2020

APPLICATION FOR

MARK LOVELOCK

CASE STUDY: ST. OMER, KENEPURU SOUND, MARLBOROUGH SOUNDS

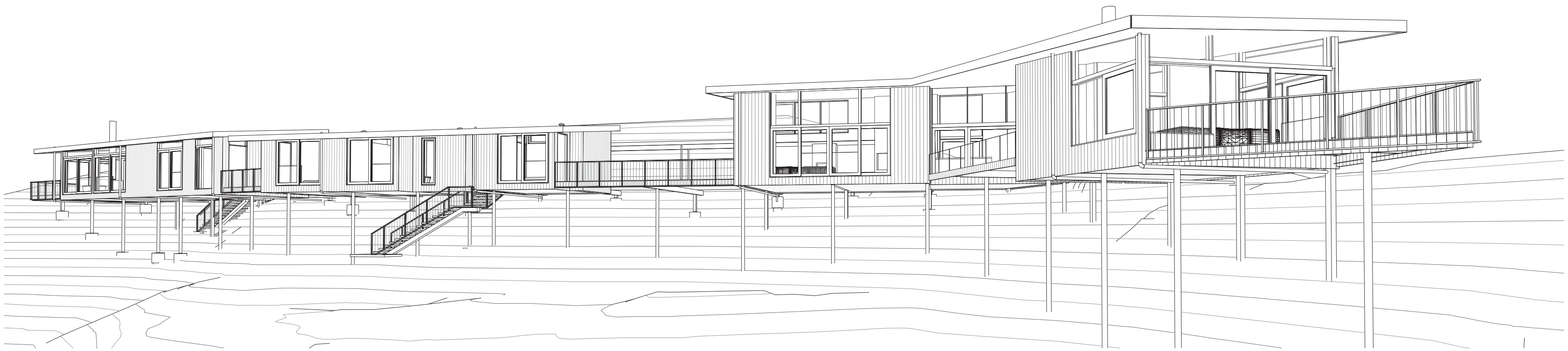


Fig. 1: North elevation of St. Omer bach.
Source: Jarrod Midgley Architect

All images taken by author, unless specified.

INTRODUCTION:

For the last 2 1/2 years I have been undertaking my apprenticeship in the Marlborough Sounds working for David Kepes under the banner of Timbercraft Construction.

David specialises in challenging architectural builds that are often in remote locations. Alternative timbers are incorporated into the design and executed with a level of craftsmanship and detail that is rarely seen today.

I consider myself extremely fortunate to be working with David, we have formed a strong bond working as a two man team. I have had unique opportunities as part of my apprenticeship:

- Early involvement with architects and engineers to establish the most suitable construction method.
- High level of craftsmanship.
- Off-site prefabrication methods.
- Working with engineered timbers.
- Sourcing/use of alternative timber species and recycled timbers.
- Fabrication of exterior joinery.
- Budget estimation, tracking and project time line.

Fig. 2: Working in remote locations requires extra logistical planning for materials, delivery day for the C.L.T floor panels at St. Omer.

SITE INTRODUCTION:

St. Omer is located at the top of the South Island in the Marlborough Sounds.

The building site is located on a remote peninsula accessible only by boat. From the beach, a narrow track leads through the bush up to the site 30 metres above sea level.

The building site itself is steep and surrounded by native bush. All materials are barged out from Havelock and lifted by helicopter up the building site. The house is completely off grid; no road access, power, or water.

The house is single storey, 90m long and 6m wide. The narrow shape of the house includes 270m^2 of interior space and 5 decks totaling 220m^2. The building footprint wraps around the natural contour of the site. The south side of the house is at ground level, while the north side is cantilevers out into the tree canopy, 5 metres above ground level.

Each of these constraints presents its own challenges, and combine together to create a complex and logistically challenging project. David and I are currently 15 months through the two year build.

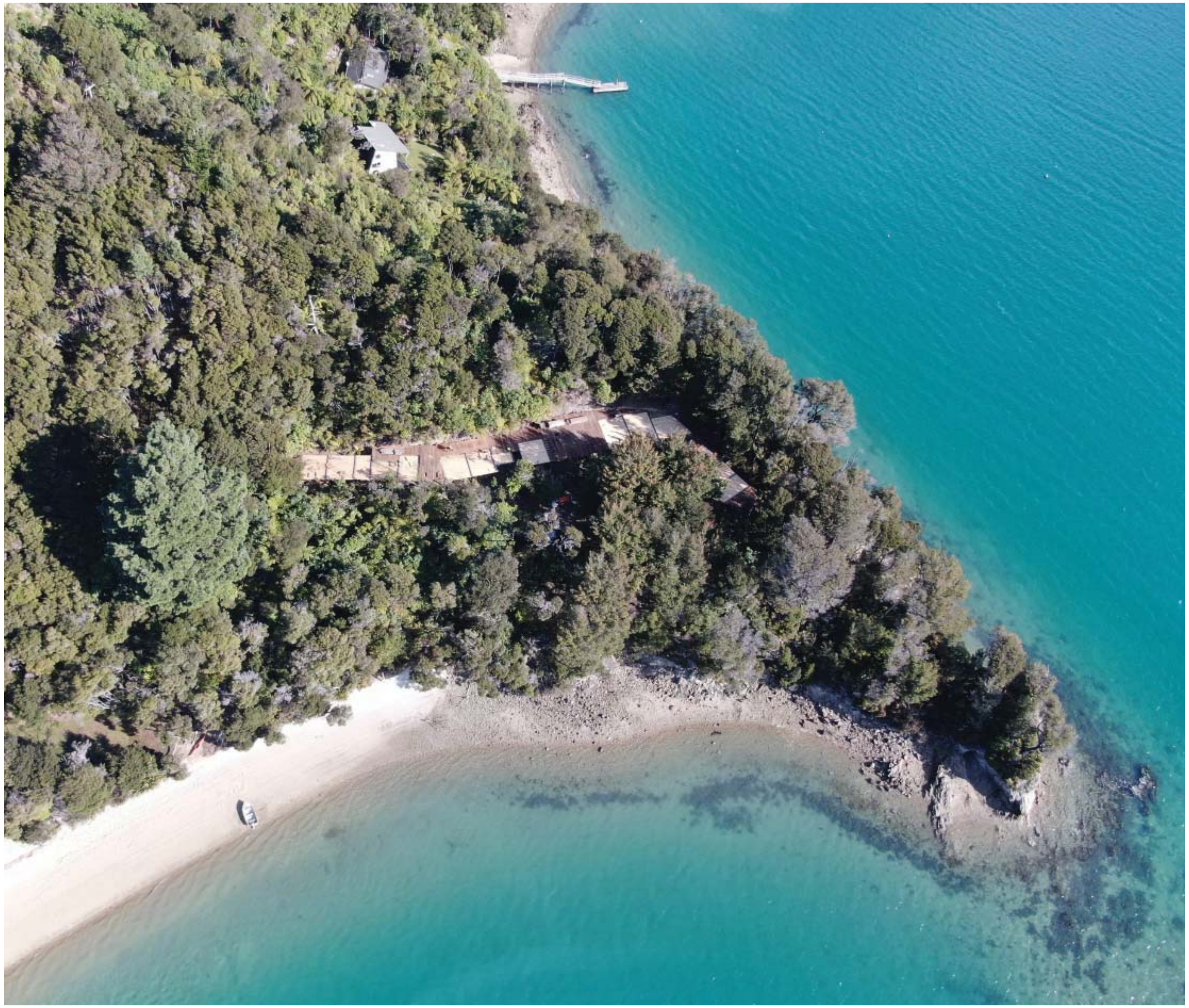


Fig. 3: Building site from above, September 2019.
Source: Seng Engineering Consultancy

SITE ESTABLISHMENT:

January 2019: In the beginning the building site was covered in bush. One week was spent clearing the site of vegetation to locate survey pegs which indicated the outline of the building footprint.

It was the first time we got a feel for the scale of the project we were about to begin. Once we had an excavator on site, tree stumps and roots could be removed.

The house is designed to be surrounded by the native bush, so it was important not to touch any trees that were outside the building footprint.

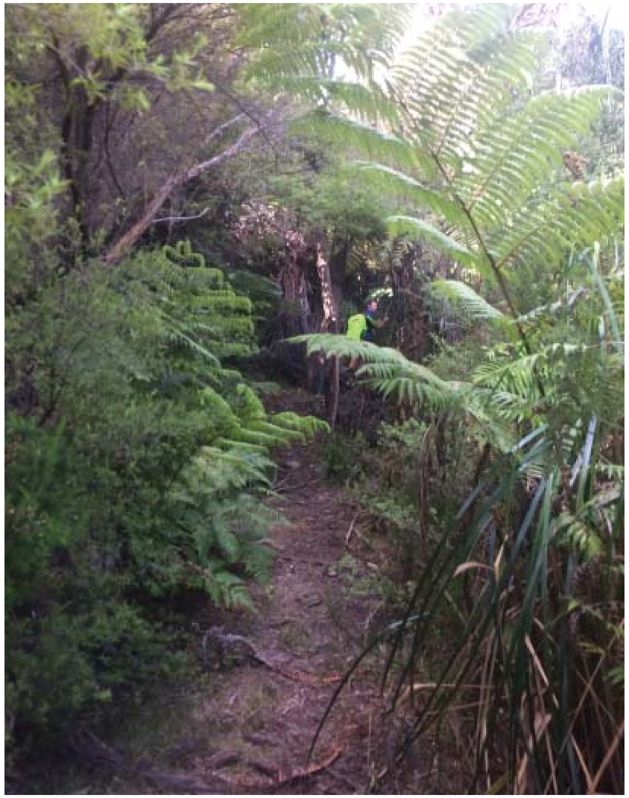


Fig. 4: Access to the site is up a narrow bush track.

Fig. 5: Clearing has begun as survey pegs see daylight.

Fig. 6: Survey pegs located in the bush.

Fig. 7: Beech tree indicating floor level of the house.

Fig. 8: Tree stump and roots being removed.

SET OUT & EARTHWORKS:

January 2019: Due to the site topography and shape of the house we were unable to do a traditional set out for the foundations. The surveyor provided a small peg for each of the 48 pile locations and a profile was built around each peg.

A benched track was cut the length of the site to give the excavator access to each of the pile locations. Piles were drilled 3 metres deep, and either 450mm or 600mm diameter depending on the S.E.D calculations.

It was important that the auger was drilling vertically, as the piles were often located on awkward gradients. My job was to make sure the auger was not wandering off its mark and communicating this back to the excavator operator.

Fig. 9: Individual profiles built around each pile location.

Fig. 10: Drilling each pile, and making sure the auger does not wander.

Fig. 11: Benched track to access pile locations above and below.

Fig. 12: Excavator working amongst the profiles.

SUB FLOOR STRUCTURE:

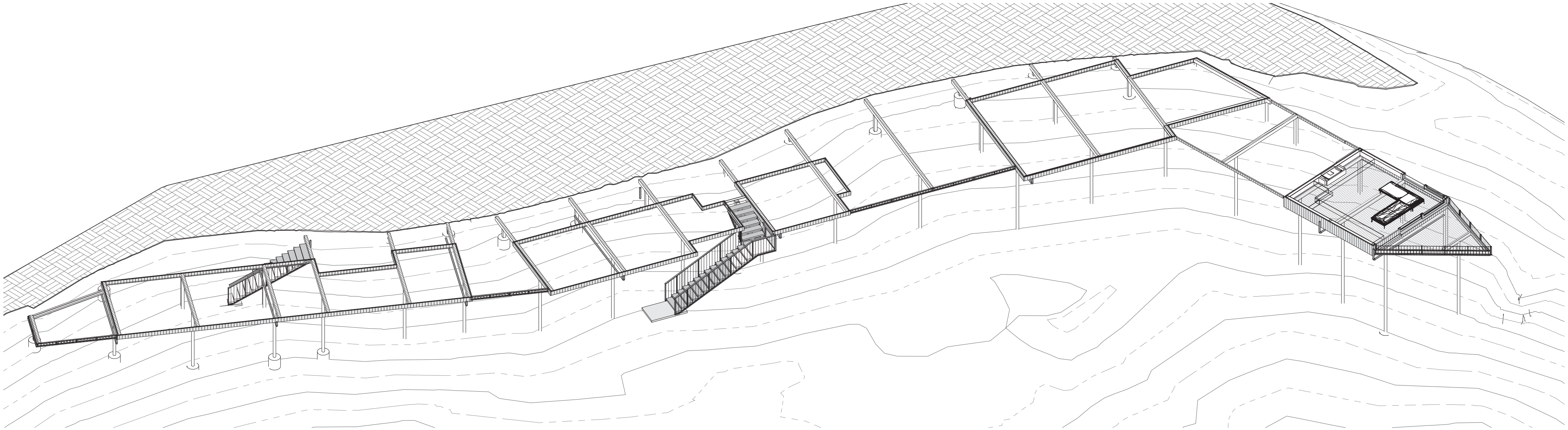


Fig. 13: Site plan showing the contours of the site and the set out of the 48 pile locations. Steel pile caps are cast into the concrete piles, then steel portal frames are welded to the pile caps.
Source: Jarrod Midgley Architect

FOUNDATIONS - PILES:

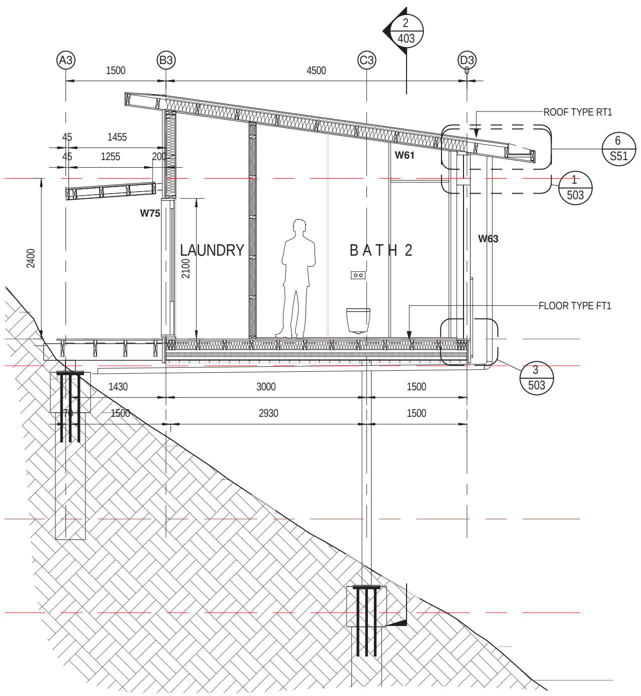


Fig. 14: Section showing sub floor steel portal frames sitting on pile caps hidden below ground level. Source: Jarrod Midgley Architect

February 2019: Rebar cages were lowered into each hole and a pile cap placed on top. A concrete pump pushed the concrete from sea level up to the pile locations, $36m^3$ of concrete was required. Once all 48 piles were poured the surveyor gave us an exact point where the steel portal legs would sit on each pile cap.

Each pile cap is at a different height relative to the F.F.L, Surveyors recorded these heights and fabrication of the sub-floor portal frames began.

Fig. 15: Pile cages being delivered to the building site.

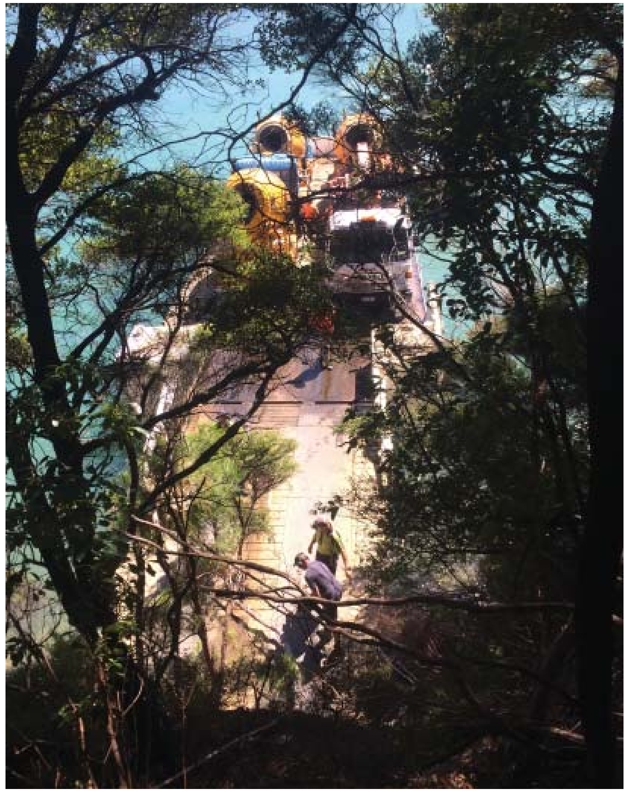


Fig. 16: Preparing the concrete pump line through the trees.

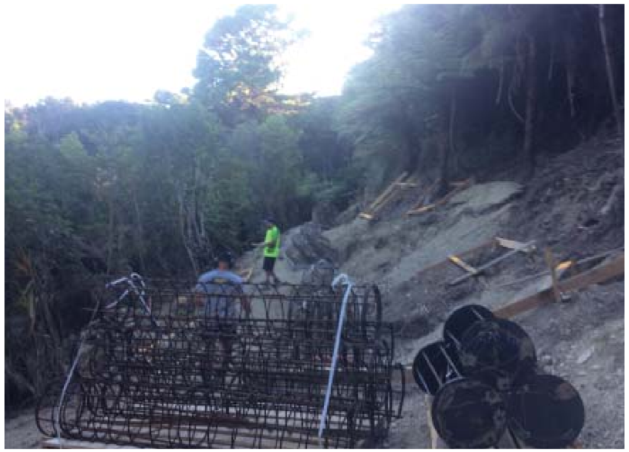


Fig. 17: Rebar cages on the left, and pile caps on the right.

Fig. 18: Three concrete trucks and a pump arriving to site.

STEEL PORTAL ASSEMBLY:

March 2019: The sub-floor steel portal frames were fabricated and painted in Blenheim and transported to David's yard in the Sounds with a house moving trailer.

Two portal frames were stood up, and bolted together with 250x45mm joists spanning in-between to create a freestanding 'module' that could be airlifted directly to site. The sub-floor structure is made up of ten modules.

As each portal leg was a different length, we had to build various temporary structures so that each module was sitting level which allowed beams and joists to be bolted to the portal frames.

Fig. 19: Temporary scaffolding is set up for each module.

Fig. 20: Modules stropped at lifting points ready for delivery.

Fig. 21: Steel mid flight.

Fig. 22: Modules 1 & 2 in place, module 3 being assembled.

Fig. 23: Modules ready for delivery from the Iroquois.

STEEL PORTAL DELIVERY:

April 2019: The modules were delivered directly to site by helicopter with each portal leg landing onto its corresponding pile cap.

The modules were aligned to a string, and the legs of each portal were plumbed up. The base plates on each portal leg were then welded to the pile caps below.

The sub-floor steel was an extremely critical part of the job with very little tolerance. I was impressed by the coordination of the different people involved; architect, engineer, surveyor, helicopter pilot, steelies and builders.

Fig. 24: Modules being lifted from David's yard.

Fig. 25: Module coming into land at St. Omer.

Fig. 26: Sub-floor modules sitting on the pile caps below ground level.

Fig. 27: Deck joists bolt efficiently to cleats on the portal frames.

Fig. 28: Standing at floor level for the first time.

DECKING:

April 2019: The next stage was to lay the 220m² of decks which gave us safe, working platforms. This also gave us staging areas to land materials with the helicopter.

The decking is a variety of Australian hardwoods which have been recycled from wharf piles in Lyttelton. The piles were bandsawn into 200mm x 25mm boards.

Using recycled hardwood provided some challenges as the boards were different widths and thicknesses. Care had to be taken around the butt joins for a tidy finish. The rustic look of the deck is contrasted well by the delicate plugs that conceal each fixing.

We completed the decks in May 2019 and shut down the building site for winter. We spent 3 months in David's workshop fabricating the exterior joinery. We resumed out on site in September 2019 when the C.L.T floor panels were ready for delivery.

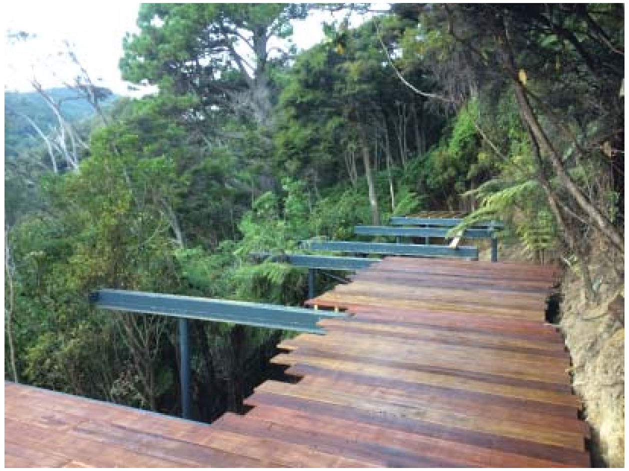


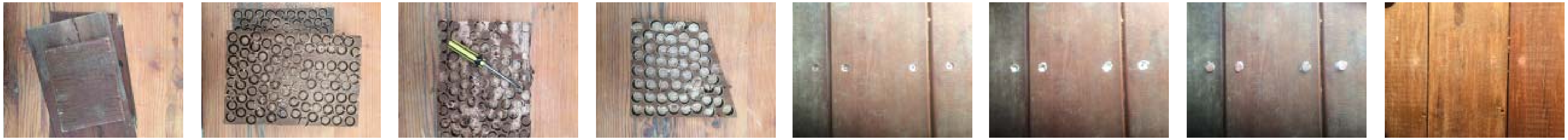
Fig. 29: Boards were left long to be cut with a rail saw later.

Fig. 30: A covered deck along the south side of the house will provide access to the bedrooms on the north.

Fig. 31: Decks provided safe working platforms as well as areas to land materials with the helicopter

Fig. 32: Imperfections of the timber contrast with the delicate plugs.

Fig. 33 - 40: 1. Collect offcuts, 2. Cut plugs, 3. Extract plugs, 4. Admire firewood, 5. Pre-drill and countersink fixings, 6. Glue holes, 7. Plug holes, 8. Sand and oil plugs.



SUB FLOOR - C.L.T:

Fig. 41: Helicopter delivering a Cross Laminated Timber (C.L.T) panel.

Fig. 42: Standing well clear until the panel is below head height, before it is carefully guided into place.

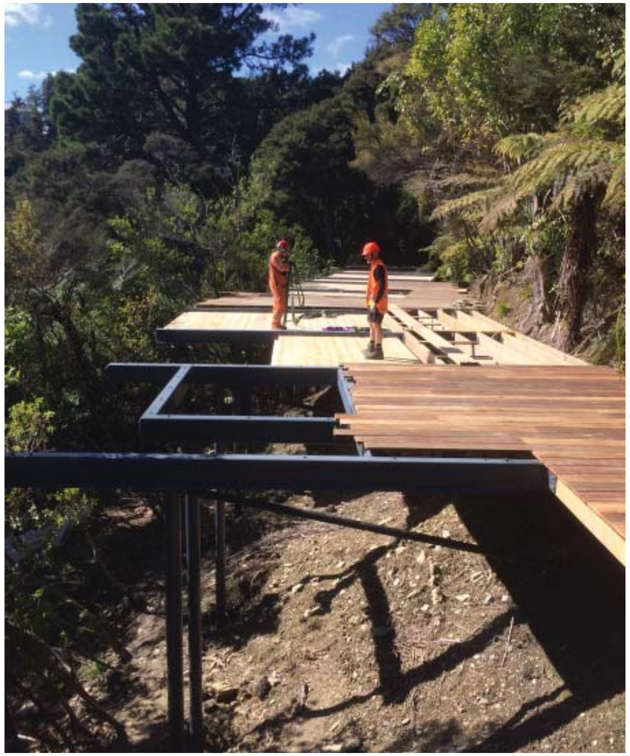


Fig. 43: Working our way through 29 panels. 270m² of floor area delivered in 2 hours.

Fig. 44: Panels viewed from below; C.L.T sits on 90x90x6mm EA which is welded to the portal frames.

Fig. 45: C.L.T panels act as a diaphragm providing horizontal bracing. Panels are fixed to steel bearers with 200mm coach bolts at 600 centres.

Fig. 46: Where C.L.T panels join they overlap one another. There is 10mm tolerance between steel bearer and C.L.T panel.

STRUCTURAL STEEL

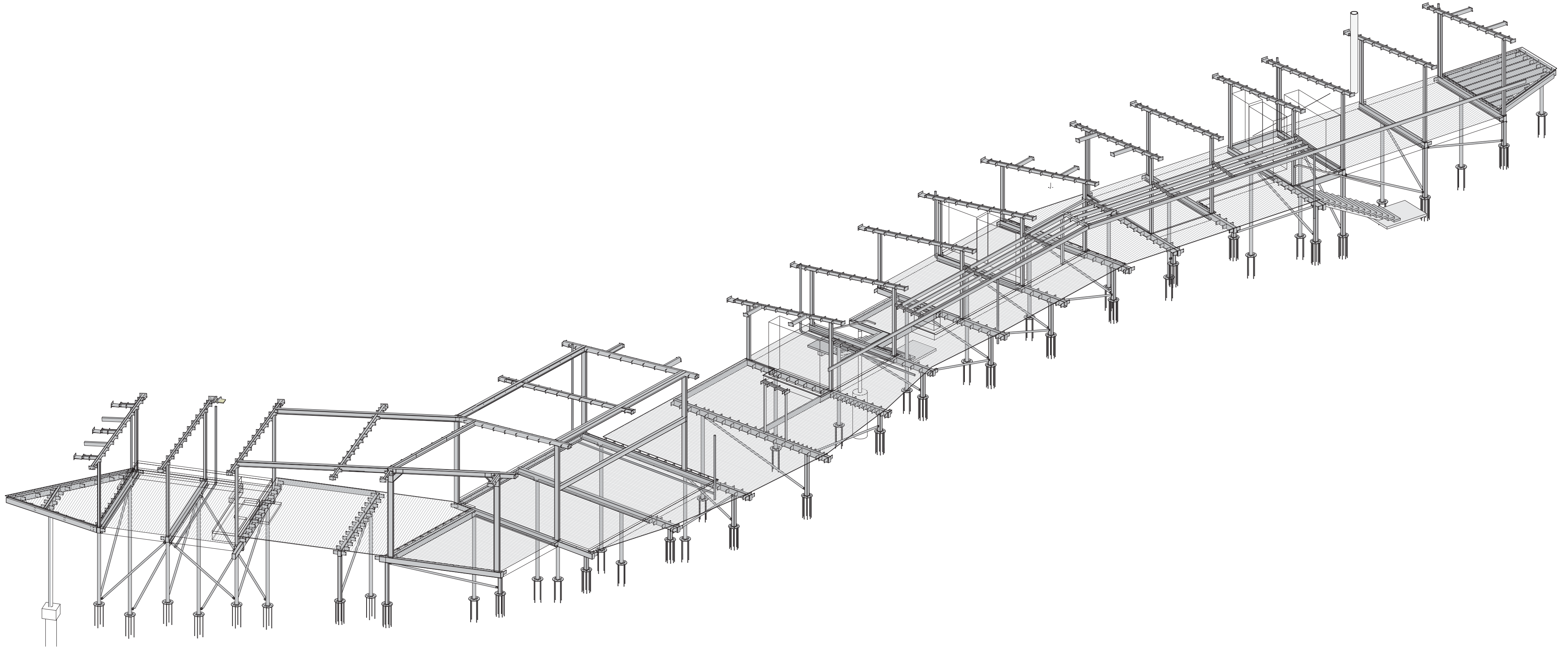


Fig. 48: Structural diagram showing sub-floor steel portal frames which are welded to the pile caps below ground. The next stage to be delivered is the main structure of the house above floor level. This is made up of steel portal frames with cantilevered beams and outriggers which creates a large roof overhang.
Source: Jarrod Midgley Architect

Previous page, Fig. 47: Aerial shot of the building footprint among the native bush. Decks (exterior spaces) and C.L.T floors (interior spaces).
Source: Seng Engineering Consultancy

STEEL PORTALS:

September 2019: After the C.L.T panels were installed another round of steel portal modules were prefabricated off-site and delivered direct to St. Omer. The steel is mostly 150x50 R.H.S, with some of the larger spans requiring 183UB or 200x100 R.H.S.

The four legged modules were straightforward to fabricate and deliver to site. Two portal frames were stood up and bolted to rafters spanning in-between.

Larger steel members meant that some 'modules' were overweight and beyond the 1200kg lifting capacity of the helicopter. As a result some modules had only one or two legs when delivered, the 'missing' legs were then welded on site.

Once delivered to site, modules were aligned to string lines. the portals were plumbed up and the base plates welded to the sub-floor steel below.

Fig. 49: Portal frames arriving at David's yard for prefabrication.

Fig. 50: One legged module being delivered to site.

Fig. 51: Four legged modules created by bolting 150x50 Hyspan rafters between two steel portal frames.

Fig. 52: Modules that exceeded weight limit had legs removed and required welding on site.

Fig. 53: Modules delivered on site. Steel outriggers will pick up flying rafters to create eaves.

ROOF FRAMING:

October 2019: Once the steel was delivered the remaining rafters were attached, purlins fixed and gutters formed.

There are 3 large low, single pitch roof structures, each at a different height and angle. 70x45mm purlins are fixed to hyspan rafters that are bolted to the steel portal frames. The T.P.O membrane sits on a 20mm strandboard substrate that is fixed to the purlins.

Steel outriggers provide fixing for the flying rafters which create a large roof overhang on all four sides of each roof. A large 300mm wide internal gutter has been designed to allow the gutters to be cleaned in a safe and easy manner from the roof which is 10 metres above ground.

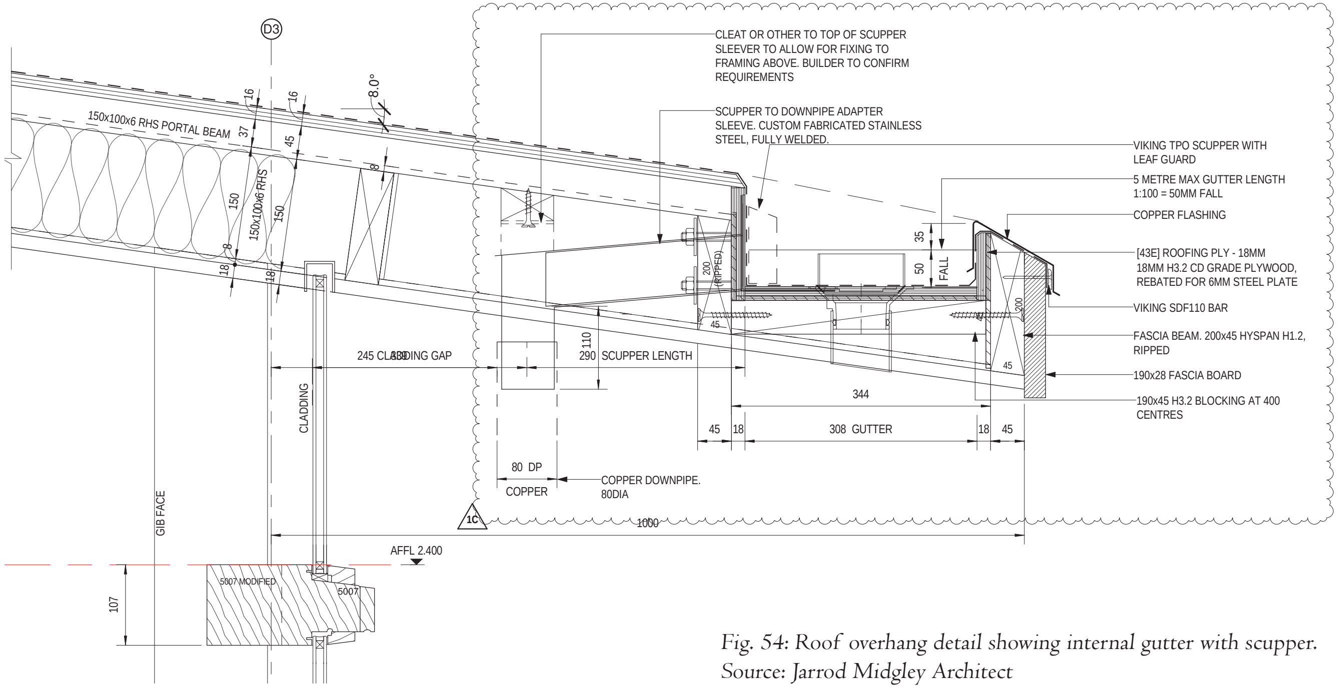


Fig. 54: Roof overhang detail showing internal gutter with scupper. Source: Jarrod Midgley Architect

Fig. 55: Purlins at 400 centres, gutter boxed ready for 19mm ply.

Fig. 56: Fixing 20mm strandboard substrate to purlins in preparation for the T.P.O membrane roof. Note the three different roof planes.

Fig. 57: T.P.O membrane roof with internal gutter, battens provide fixing to mount solar panels.

WALL FRAMING:

November 2019: The wall frames were pre-nailed in Blenheim and delivered to site. External walls are 140x45mm J frame, and internals are 90x45mm.

Wall frames were packed to string lines, plumbed up, and fixed to the steel portals and C.L.T floor panels. David and I had fabricated the exterior joinery the previous winter. We had to make the openings to match the as-built joinery unit sizes.

Once the wall framing was complete ecoply was fixed to create a rigid air barrier. Z flashings were used at the horizontal sheet joins, openings, edges and joins were all taped. Then castellated cavity battens were fixed at 480 centres, and cavity closure fixed at the base of the ecoply in preparation for cladding.

Fig. 58: Blocking around steel to provide fixing for linings.

Fig. 59: Busy details: horizontal flashing at ecoply joins, edges taped, joinery opening is taped. Joinery unit is installed followed by jamb flashing with a bead of silicone. Saddle flashings installed where steel protrudes building envelope.

Fig. 60: Wall frames ready to stand up.

Fig. 61: Wall frames in place, with openings for joinery units.

Fig. 62: Wall frames with R.A.B, and cavity battens ready for cladding.

TIMBER MILLING:

January 2019: The timber required for the exterior joinery and interior linings came from twelve, 100 year old elm trees that were sourced locally in Marlborough. The trees were felled and suitable logs for milling were identified and stockpiled.

The portable sawmill ran 7000 metres of Ex150x25mm for the flooring and ceiling linings. This was air dried outside for 12 months before being machined into a tongue and groove profile.

The exterior joinery required some larger sizes and a higher grade of timber, Approximately 600 metres of Ex200x50mm and Ex300x100 was milled. This timber spent 3 months in a humidification kiln to bring the moisture content down to 8%. It was before coming back to the workshop to begin fabrication in June 2019.

Working with the raw product has been great learning for me. I had the opportunity to gain valuable skills such as log optimisation on the mill, how the natural defects of wood can affect a piece of timber, and the importance of fillet stacking correctly timber. I consider these skills essential as a carpentry apprentice.

Fig. 63 - 69: Top row: Felling of elm trees, an excavator pushes the trees clear of power lines and roads. Trees are then cut up and millable logs are identified.

Middle row: Some logs were too large for the mill and were required to be split. A butt log loaded onto the Woodmizer ready to be sawn. Squaring up a log on the mill and removing sapwood.

Bottom row: Boards coming off the mill, targeting the best timber for use on the joinery. Timber is fillet stacked and strapped, ready to be moved under cover to air dry.

JOINERY FABRICATION:

June 2019: David and I spent 3 months in his workshop fabricating the door/window frames and the sashes. The window frames are elm with kwila sills, and the sashes are western red cedar.

Being a part of the entire joinery process was a privilege for a carpentry apprentice. I relished the opportunity to learn how to use the machines and seeing the timber come out the other side. Having the ability to read how a piece of timber will perform when it goes through a machine can have a huge effect on the finished product.

From cutting lists, square dressing, using the thicknesser, spindle moulder, mortise and tenon jointing, laminating, assembling frames; these skills are all very transferable to a carpentry apprentice.

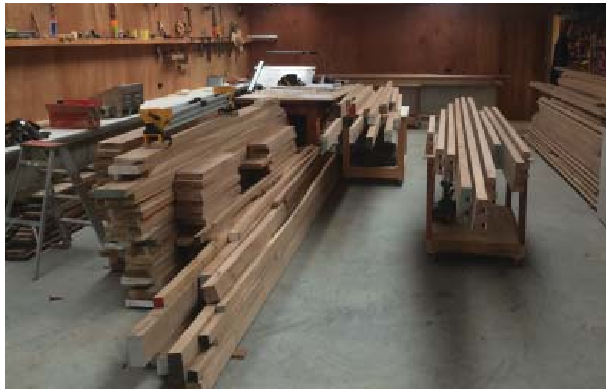







Fig 70 - 77: Top row: Cutting list and labeling so timber can be easily identified in the stack. Preparing jambs, mullions, transoms, heads and sills for the window frames.

Middle row: Using a jig inside the thicknesser to machining a 7 degree slope onto a transom. Cutting horns on the Kwila Sills, and sealing the end grains. Clamping up a 5 metre long transom.

Bottom row: Ripping elm for window mullions, P.P.E in use, gloves, earmuffs, mask and push stick. Transom housing rebated into a jamb. Notching the bottom of a jamb.

JOINERY FABRICATION:

July 2019: Once the window frames were assembled we moved onto the sashes and the solid doors. There were various shapes, sizes, and openings to construct. Working with cedar was very easy compared to the elm.

Learning about tolerances between frames and sashes, assembling a sash so that it is square, and fitting the hardware to the units were some of the interesting moments for me. The units remained in storage for 3 months while we completed the walls and roof out on site.







Fig. 78 - 84: Top row: Installing bottom rollers on a sash. Installing top guides on a sash. Cutting beads to sashes read for glazing on site.

Middle row: Solid cedar doors in fabrication, mortise joined, with a negative detail run on the spindle moulder. Sashes made over size, ready to be cut to opening sizes.

Bottom row: Fitting of opening sashes and fixed sashes to window frames. Joinery units receiving a coat of oil and being placed into storage in the workshop.

JOINERY INSTALLATION:

December 2019: The joinery units included opening doors, bi-fold doors, fixed panes, sliding doors, and overwall sliders so there were lots of unique details throughout this process. Some of the larger units are 5m wide and 4m high. Many of the units have no head and the glazing goes up into the ceiling so that the roof appears to be floating.

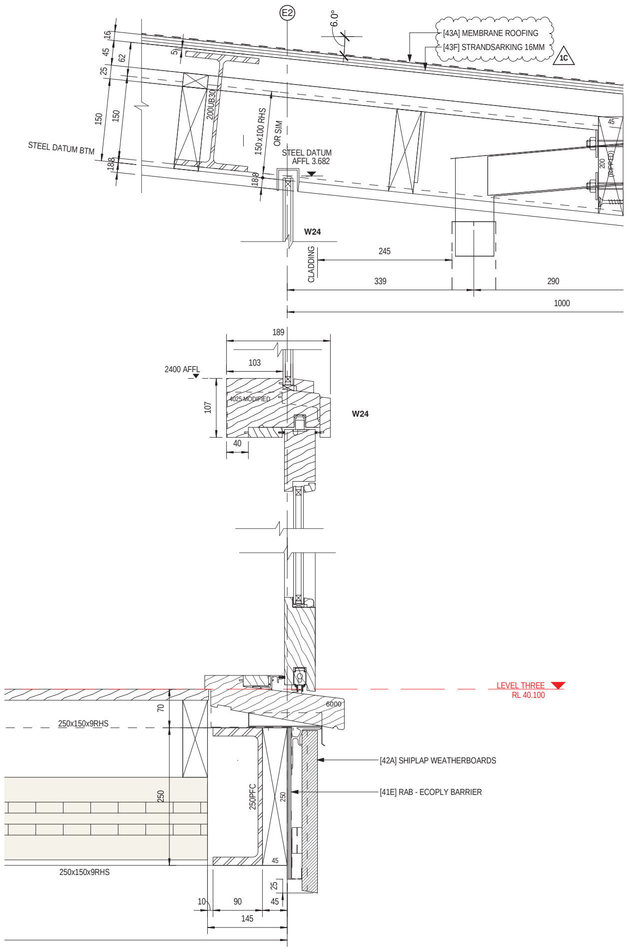


Fig. 87: Detail showing the unit at F.F.L, and channel in the ceiling. Source: Jarrod Midgley Architect

Fig. 85: Solid cedar doors provide access to bedrooms and bathrooms.

Fig. 86: Most of the joinery units have no head. The glazing is received by an aluminium channel above the ceiling line.

Fig. 88: Getting the transom height the same for all the units was critical. Copper sill trays are below each unit.

Fig. 89: Glass has been installed and buildings are weathertight.

CLADDING:

February 2020: The exterior of the house is clad in vertical ship lap weather boards which are rough sawn Lawson Cypress.

There is over 5000 lineal metres of weather boards which have a 10mm negative detail and are fixed with 90mm silica bronze rose head nails.

I thoroughly enjoyed the cladding process. Learning about board selection, removal of defects and optimisation of off-cuts all contributed to my cladding education.

Unique details around external corners, internal corners, into joinery units, saddle flashings, boxing around steel all required thought and attention to detail.

Fig. 88: Cladding on either side of the main staircase.

Fig. 89: Installation of over wall tracks and rollers for joinery units outside the cladding line.

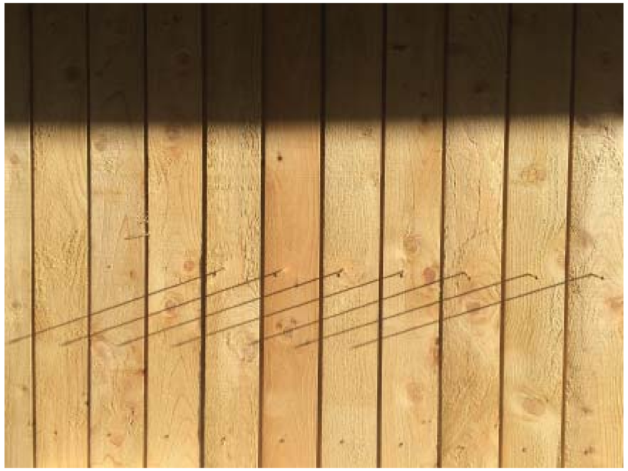


Fig. 90: Cladding in the early morning light

Fig. 91: Weatherboards are 4600mm long in some places.

Fig. 92: Cladding into the joinery units.

WORKING WITH SUB-TRADES:

Being a part of a job such as St. Omer requires a lot of planning, and many contractors became involved early on in the design phase. I was fortunate to be included in these discussions and got to see the benefits of early contractor involvement and how that can positively influence a project.

The drain layer, plumber, roofer, electrician all had their say in the design phase on how the best to approach the design of the services out at St. Omer

Selecting materials and construction methods that allow for efficient delivery has been key to the success of the project so far. For example, the helicopter has a maximum lift of 1200kg. This had a large impact on the structural design and how steel members would be delivered and connected.

Off-site prefabrication of structural steel also had health and safety benefits as freestanding units could be delivered directly to site.

Currently we are working with various sub trades on site before the interior linings and floor substrates are installed.

Fig. 93: Pre-wire and pipe out is underway

Fig. 94: Typically we get a material drop every 4-6 weeks, we only have one staging area where they can be landed. This deck can get very crowded with all the materials from different trades, it also requires precise flying from the helicopter pilot.

Fig. 95: The house among the trees, Structural sub-floor to mitigate contours of the site

WHERE TO FROM HERE:

As at April 2020, we have the exterior of the house is 95% complete, with only soffits and downpipes needed before the scaffolding can be dismantled. Then we can move onto completing the interior, we will be working with the various sub-trades for the rest of the year and aim to be completed in December 2020.

David and I are 15 months into this 2 year project. It is slow, meticulous work and small milestones are enjoyed along the way. I am extremely proud to be working, learning and overcoming the challenges at St. Omer. The final product will be something unique and handcrafted.

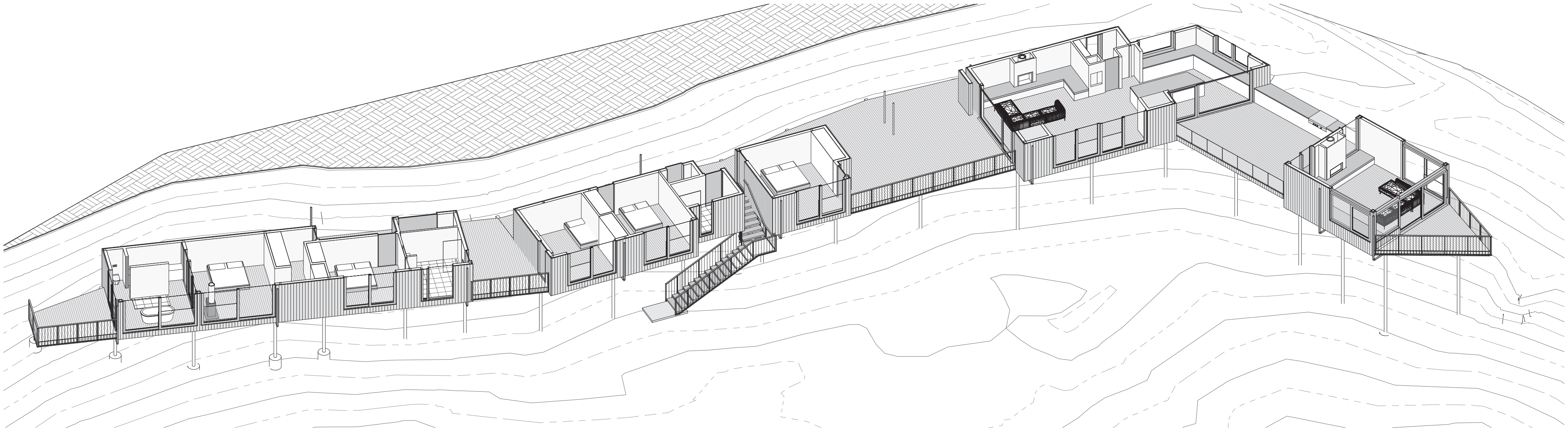


Fig. 96: 3d cutaway showing the two bedroom/bathroom wings on the left with kitchen, living, and dining spaces on the right.
Source: Jarrod Midgley Architect

Following page: Fig. 97: Kenepuru Sound from St. Omer, April 2020.
Source: Seng Engineering Consultancy

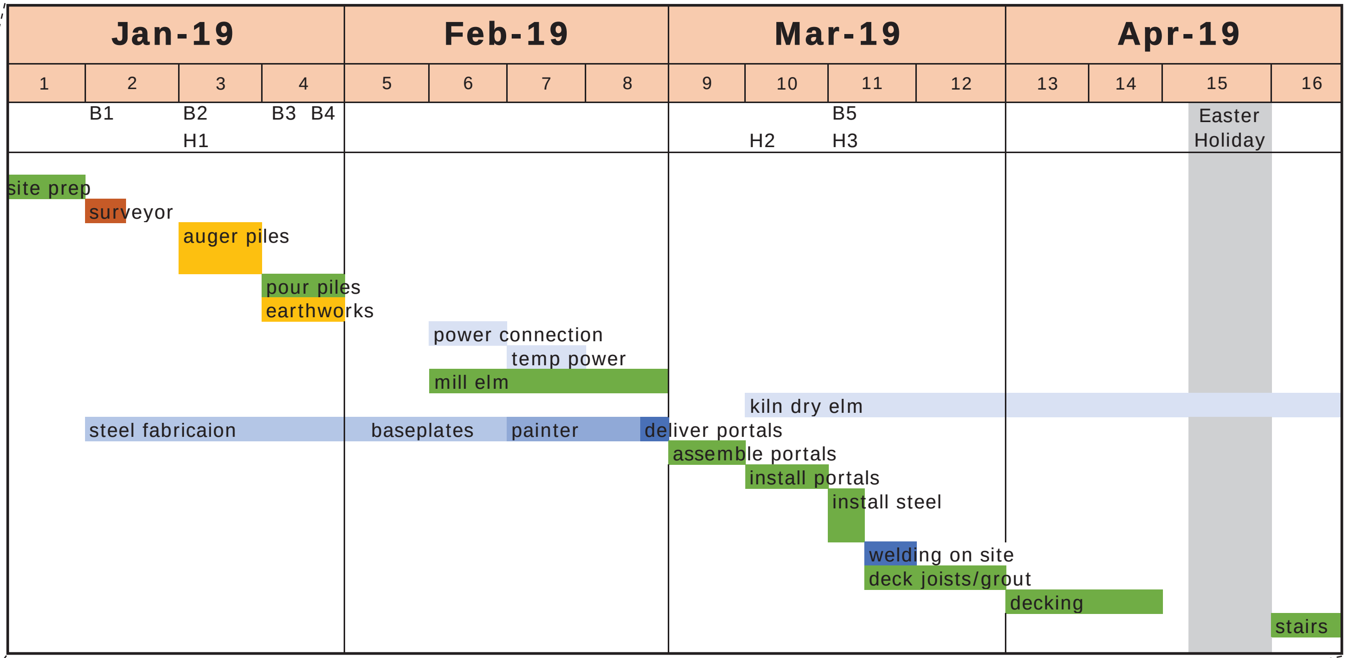
APPENDIX – PROJECT TIMELINE:

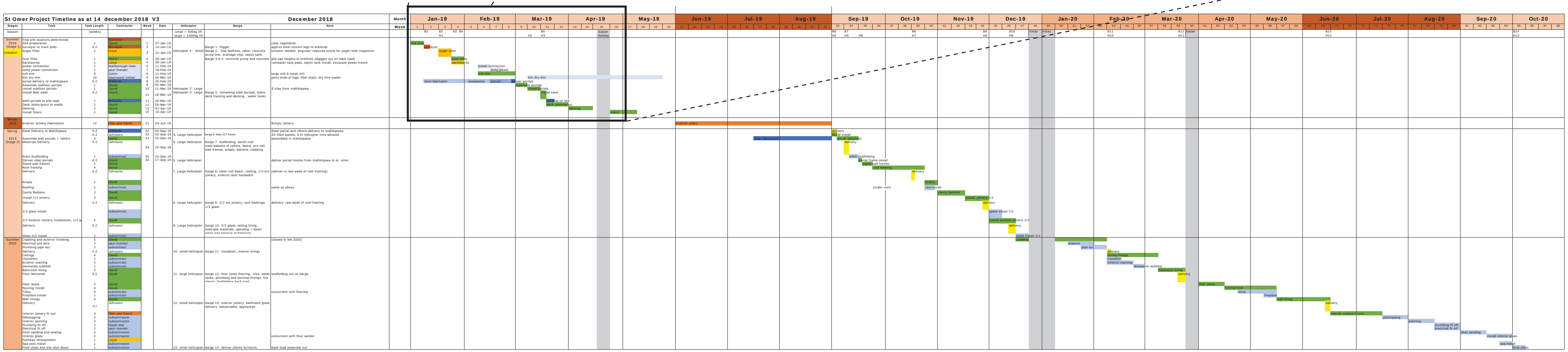
The following pages show some of early input I had in the procurement stage of the project.

I had the opportunity to build a timeline and identify a critical path for the project. Each sub-trade and task is included in a sequential order, and lead times for off-site work is identified in the timeline.

This allowed an estimated project completion date to be identified and important milestones to be planned.

The timeline also enabled David and I to estimate the number of helicopter and barge deliveries required across the job, we could then put a dollar figure on this in our estimate.





Top right: Fig. 98: Zoom in of timeline, B = barge, H = helicopter.
Above: Fig 99: Full project timeline with subcontractor input

APPENDIX - ESTIMATION:

We set up an estimation template well before the job commenced, this was updated as quotes from sub-trades and suppliers came in.

This gave the clients a clear breakdown of costs and where the money was spent, and gave them the opportunity for value engineering and changes.

We were able to use information from the project time line to work out helicopter/barge estimates, and travel to site over the two years.

When we began out on site, a template was set up to track the costs of the build against this estimate. This produces a monthly payment claim, and allows the budget to be tracked very closely against actual spend.

Being so involved with the project from an early stage has allowed me to get to know the project very well. I can understand the build from construction, project management, design, and budget perspectives.

Estimate December 2018 - Version 2					
	Timbercraft Construction	Job: St Omer Bach	Client:		
			Sum Allowed		
#	Item	Notes	Stage 1	Stage 2	Combined Total
1.1	P&G - insurance	Contract works insurance			
1.2	P&G - travel boat and vehicle	Stage 1: 5 months, stage 2: 14 months			
1.3	P&G - Health + Safety	Setup			
1.4	P&G - Site Establishment/Shut Down	Toilet, site office, R/W collection, generator, pruning			
1.5	P&G - Small deliveries and water taxis				
1.6	P&G - dump fees				
1.6	P&G - tarpaulins				
1.7	P&G - project co-ordination	2hr/week			
1.8	P&G - contract administration	1/hr week			
	Total P&G				
2.1	Helicopter	13 helicopters (see breakdown)			
2.2	Barge deliveries	Stage 1: 7 barges. Stage 2: 8 barges.			
	Total Transport				
3	Scaffolding	Erect, hire, dismantle			
4.1	Electricity establsishment				
4.2	Trenching and back filling				
4.3	Temporary power				
5.1	Earthworks - site access				
5.2	Earthworks - basement excavation				
5.3	Earthworks - auger access track				
12	Exterior timber joinery	Includes glass (see breakdown)			
13	Interior joinery	kitchen, laundry, fixed furniture items			
14	Glazing	splashbacks, mirrors, screens etc.			
15	Gibstopping				
16	Glass ballustrades	supply and install			
17	Interior painting				
18	Exterior staining				
19.1	Roofing + Flashings	Supply and install			
19.2	Downpipes + Spouting	Supply and install			
20	Spa pool				
21.1	Fireplaces and chimneys	Family Room			
21.2		Living Room			
21.3		Pizza Oven			

	Subtotal		$ -	$ -	$ -
	margin		$ -	$ -	$ -
	Subtotal	(including margin)	**$ -**	**$ -**	**$ -**
	GST	15%	$ -	$ -	$ -
	Total		**$ -**	**$ -**	**$ -**
	Contingency		$ -	$ -	$ -
	Total (including contingency)		$ -	$ -	$ -

Fig. 100: Initial budget estimate showing breakdown of all costs for each stage. Figures have been removed for privacy.

APPENDIX - SITE SHED:

As David and I are based out at St. Omer for 2 years, we needed a suitable site shed. So one of my first tasks at beginning of the job was to design and build a site shed. Using the size of a piece of plywood as a starting point, the shed has a modular design and is made up of prefabricated 1.2m x 2.4m panels. I enjoyed having David as my apprentice for this task.

The shed will be relocated on site and re-purposed into a plant room to house batteries for the solar system and the switch gear for the off grid systems.

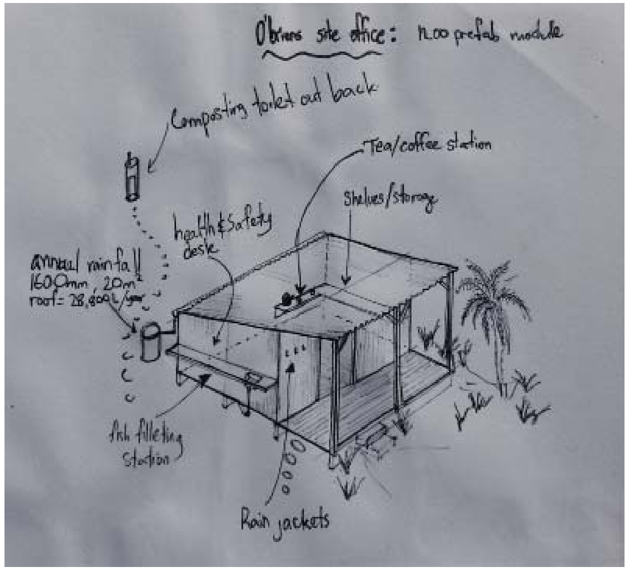


Fig. 101: Site shed concept sketch.

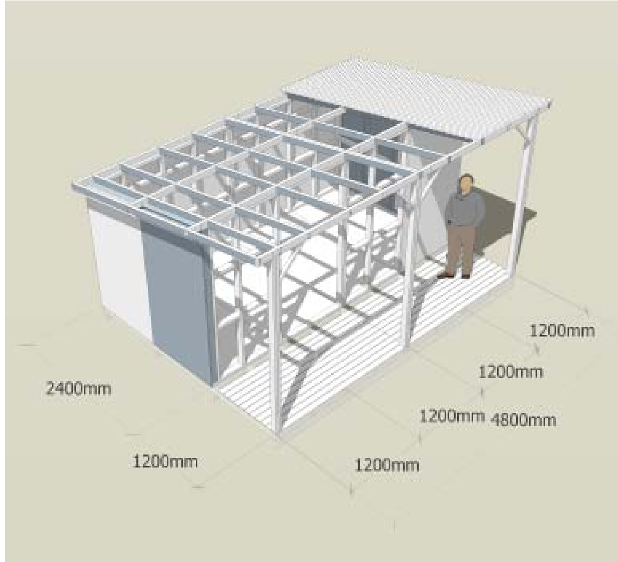


Fig. 102: 3D model of shed and prefabricated panels

Fig. 103: Panel fabrication at the workshop.

Fig. 104: Delivery of shed to St. Omer.

Fig. 105: Standing up the panels.

Fig. 106: Finished site shed and secure lock up.

Following page: Fig. 107: St. Omer bach in the bush, April 2020. Source: Seng Engineering Consultancy