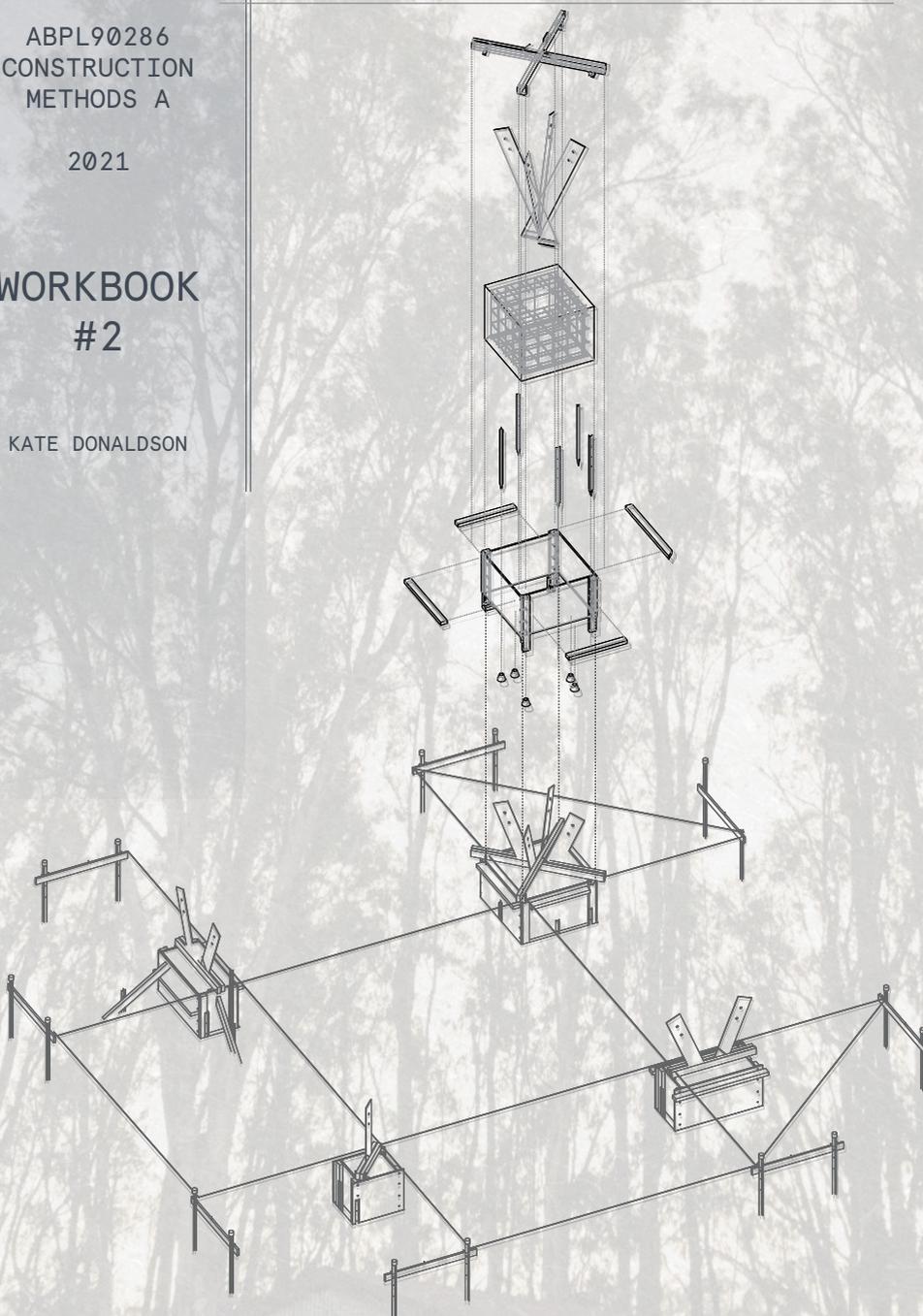


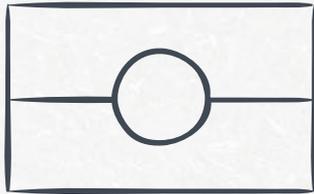
ABPL90286
CONSTRUCTION
METHODS A

2021

WORKBOOK #2

KATE DONALDSON





I wish to acknowledge that the work undertaken in this booklet occurred on Yorta Yorta Country. The project could not have taken place without the support and generosity of the Traditional Owners of Cummeragunja Reserve. I am grateful for their engagement and for welcoming us onto the unceded lands of their community to take part in this experience.

PROJECT TEAM

COMMUNITY LEADERS

Uncle Col Walker
May Andy Walker
David Atkinson
Coke Walker

STUDIO LEADERS

David O'Brien
Zoe Diacolabrianos
James Neil
Rob Briggs
Jack Hinkson

STUDENT MENTOR

Damien Cresp

ASHE STUDENTS

Narita Knowles,
Cheyanne Cooper,
Kobey Sincoe, Noah
Crantage, Leon
Johnson

MSD TEAM

Adam Legg,
Bronwen Main,
Marnie Henderson,
Perri Sparnon,
Yuan Liang,
Frank Guo,
Ognen Slavkovski,
Katherine Burns,
Marc McHenry,
Brittany Devlin,
Hugh Matthews,
Jinrui Liu, Maia
Guppy-Hall, Ellen
Bloor, Isabel
Roden, Morna Hu,
Christopher Ames,
Dirk Du Toit, Kate
Donaldson (ME),
Andrew Wilson,
Christine Chen,
Kristian Greif,
Christopher Weir,
Zhe Li

This workbook documents my experience and understanding of the construction process undertaken to lay the foundations for a pavilion at the Cummeraganja Mission in February 2020.

This process was not only formative for its lessons on systems of construction, but was also an eye-opening moment of my own design journey and understanding of country. The experience made me wonder, how can we approach design if we do not approach construction?



For a social reflection of the Cummeraganja experience, scan the QR code or follow the link here for a short photo montage: <https://youtu.be/i2-h0hGJxf8>

CONTENTS

INTRODUCTION	08–21	Vision and Site
STAGE 1	22–39	Formwork and Site Preparation
STAGE 2	40–57	Reinforcement and Cast
STAGE 3	58–73	Steel Brackets and pour
FINAL REFLECTION	74–79	Closing words



Keep an eye out for the faces to see how I was feeling at different stages of the construction process.

INTRODUCTION

Project vision and site

Before diving into construction, technical processes and systems of building, we must first understand and recognise the vision behind the project. We must learn about the design we are producing the foundations for, its location and its ultimate function which all impact the way it would be built. From the specific techniques, materials, toolkits or tectonic focus, this introduction starts our pavilion journey.



1. THE SITE



2. THE PLAN



3. TOOLKIT AND MATERIAL



PROJECT SITE

The project is situated on a bend in the Murrumbidgee River in New South Wales, within an Aboriginal Reserve on the unceded lands of Yorta Yorta Country. It lies near the Victorian town of Barmah and has a rich history stemming all the way from 1888. It was only in 1983 that title deeds for Cummeragunja were returned to the Yorta Yorta people through the *Yorta Yorta Land Council*. It is within this context that the project was positioned.

The specific site of construction is directly between the Cummeragunja Housing & Development Aboriginal Corporation (previously: Viney Morgan Aboriginal Medical Service) and the edge of the Murrumbidgee River. In these conditions, some of the major site considerations included:

- Build proximity to the edge of the river
- Depth of clay for footing design checks: uplift, sliding and overturning cannot occur.
- Bearing capacity of the soil
- Accessibility and centrality for community.
- Agreement with community and elders.



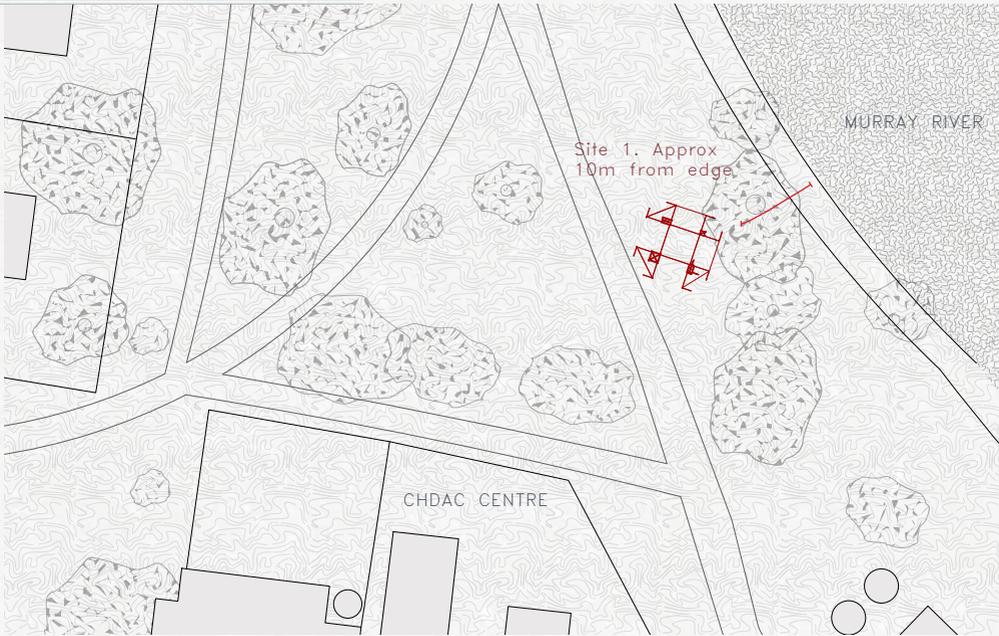
Top: views of build area
Bottom: CHDAC Centre



The Site: Cummeragunja Reserve (not to scale)
■ - location of build



 CONSTRUCTION SITE #1



36°01'40S, 144°57'42E

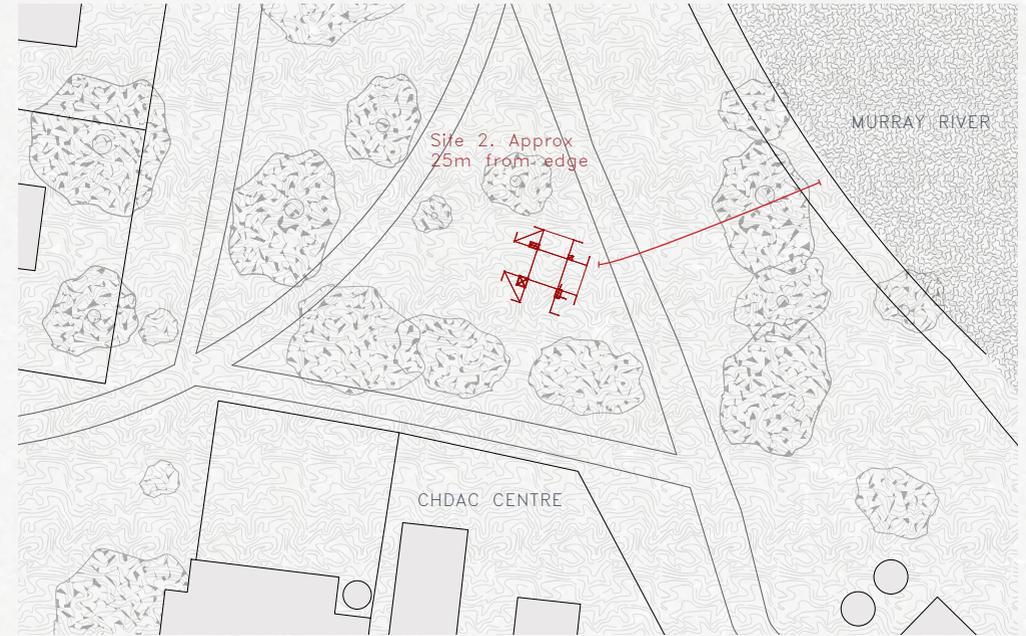
Initially, the vision was for the project to sit approximately 10m from the edge of the Murray River, spanning around an area that was already in use as a makeshift firepit and open gathering space. Towards the end of the first day on site, a resident emphatically expressed the issues of this approach with our group. Upon further deliberation with community leader Aunty May, it was decided that the following day, we would revise the site to across the dirt road.



Site 1 views.



 CONSTRUCTION SITE #2



36°01'40S, 144°57'41E

It firstly felt like perhaps a bit of a shame to have to move the site after we had started digging. But upon reflection, this small setback (which we were able to make up!) was the best outcome for the desires of the community. In many ways, the project is also less vulnerable with this extended distance from the river and had minimal impact on the design and vision as it stands. An overall positive outcome for something that may have seemed negative.



Site 2 views.





Early design concepts and consultation as of 02.2021. Images from MSD Bower Studio.

The design project for the pavilion is an iterative and evolving process of collaboration with the community and elders at Cummeragunja. The design discussed here is at the time of building the foundations and is subject to change.

DESIGN CONSIDERATIONS:

Footprint

A small footprint on the land through the four nexus concrete pads.

Wastage

Use of materials at module sizes to reduce wasted offcuts as well as locally sourced materials.

Sustainability

Culturally and environmentally sustainable approach to materiality and site. The material selection, such as the red gum columns give the design a specific lifecycle timeline as if it were a breathing part of the land.

Function

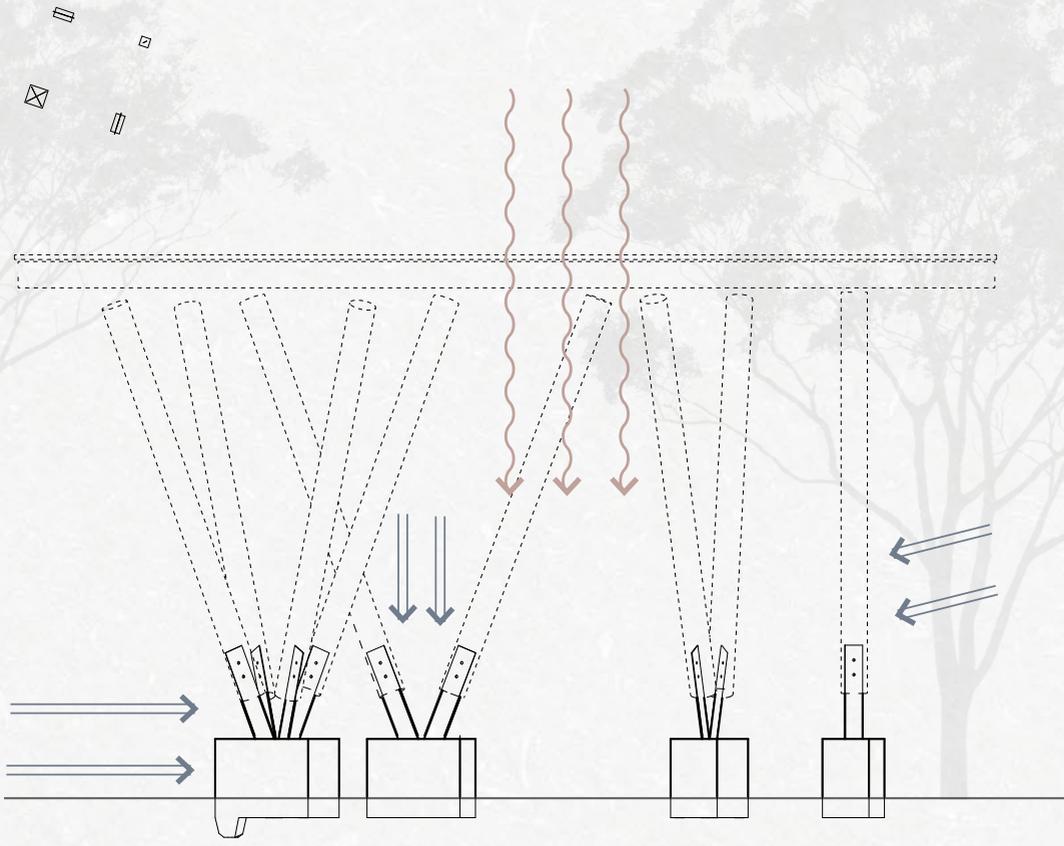
Design that meets the functional requirements of an open pavilion as specified by the resident community.

Collaboration

Participation and involvement of Traditional Owners to determine aesthetic design outcomes.



Render of...



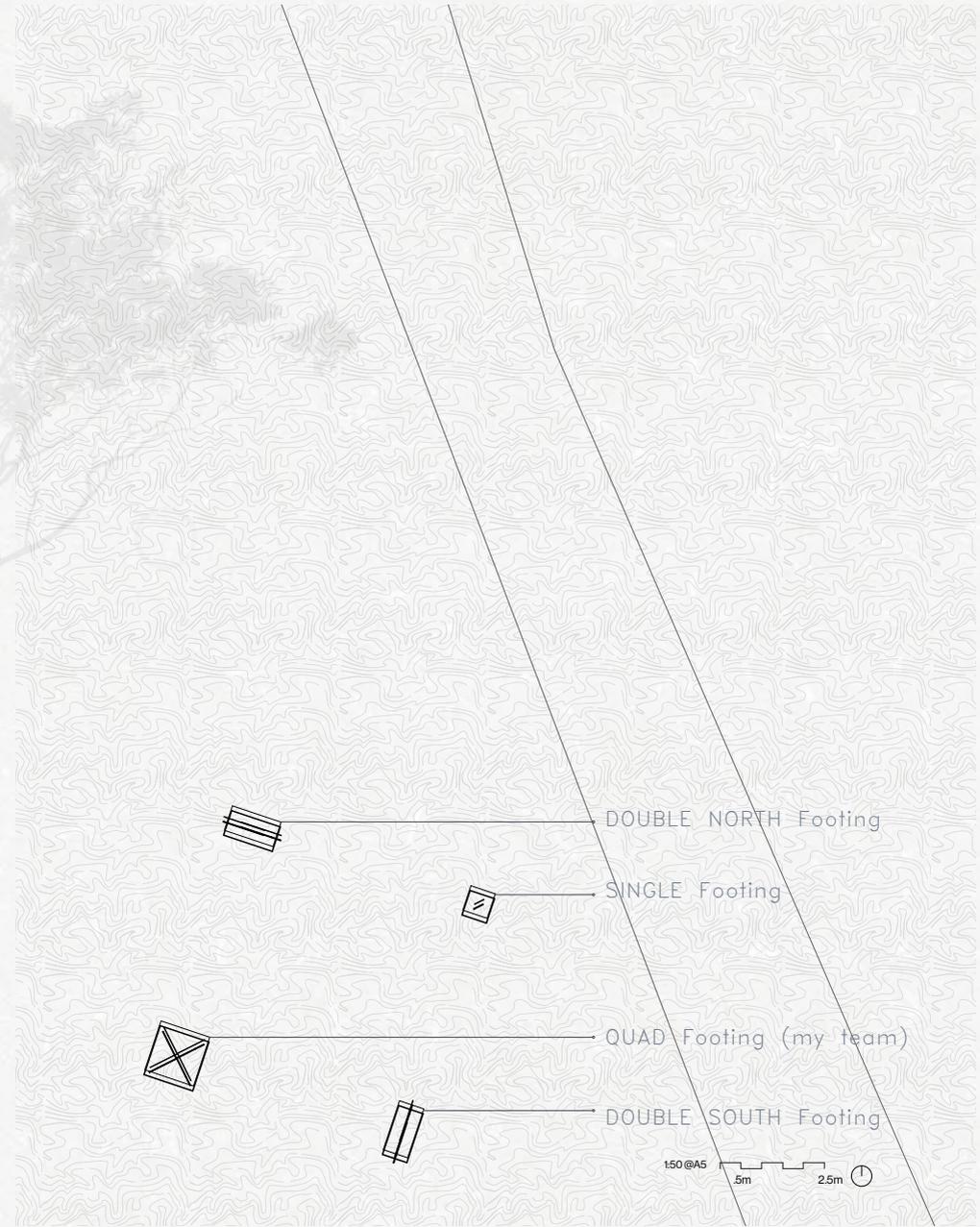
ENGINEERING AND CONSTRUCTION CONSIDERATIONS

Loads

The concrete pads we build must be able to withstand a range of lateral loads and environmental pressures. There cannot be uplift or sliding, overturning, bending nor bowing in order for the pavilion to successfully stand

Material Strength

Environmental Conditions





MATERIAL KIT OF PARTS

The specific design and construction requirements of the concrete pads dictate a specific response to materiality summarised in the following kit of parts:

MATERIAL

Bespoke flat faced steel brackets 200 x 8mm

ICON



Carter Holt Harvey 1200 x 595mm 17mm F14 FORMrite Formply



Concrete (25MPa cement + aggregate + water)



MGP10 Untreated Pine Timber Framing 90 x 45mm



Plastic reinforcing bar chairs 120mm



Red string line



Star Picket Steel Posts



Timber Tri-quad mouldings



8mm Whites Reo Mesh heavy duty sheets Group steel welded reinforcing mesh, 200mm squares



FIXING TYPES

65mm tek screws

ICON



65mm batten screws



steel brad nails



Whites Galvanised cut length tie wires



KEY MATERIALS TO BE USED IN LATER CONSTRUCTION:

Perforated steel roofing



Untreated red river gum timber poles



Steel braces





MATERIAL

ICON

Protective Eyewear



Protective Earwear



Shovel



Spade



Irwin Quick Grip Clamp



Fencing crow bar



Pencils



set square



Felling axe



Measuring tape



circular table saw



Concrete truck



Saw Horse



Craftright level



MATERIAL

ICON

Magnetic spirit level



Combination wrench



Cordless drill



Cordless Angle Grinder



level measure tripod



Drop Saw



Trowel



Claw hammer



rubber mallet

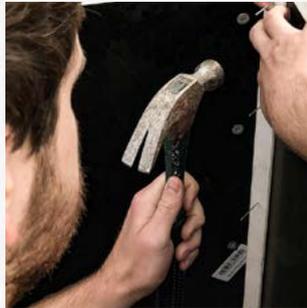
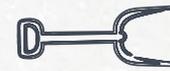
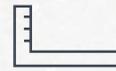


star picket cylinder cap



Wire cutters

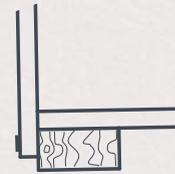




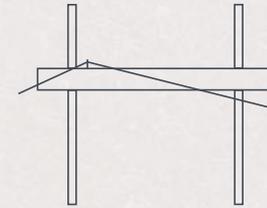
STAGE ONE

Formwork and Site Preparation

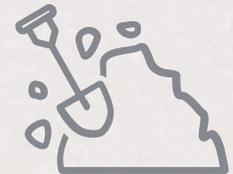
The first stage in the construction process was to put together our plywood boxes that would be the formwork for the concrete footings. This was completed in two stages for the Quad footing (my assigned team)—at University Campus and at Cummeragunja. Further preparation of the site and the subsequent digging stage also form part of stage one.



1. FORMWORK



2. SITE SET OUT



3. DIGGING

Icon glossary p16-19

MATERIALS



FIXING TYPE



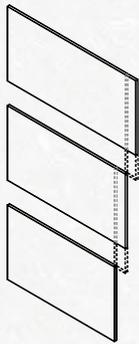
TOOLS



As the introductory stage for this construction project, putting together the plywood formwork proved to have its intricacies and nuances despite outwardly appearing like a simple task. Some issues encountered include overcutting materials, undercutting materials and correctly aligning elements for fixing.

1. CUTTING THE PLY

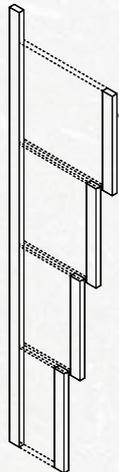
The plywood pieces were supplied at 1200 x 595mm. To form the Quad box we need 4 pieces, 2 x 1000mm (w - to cover studs) 2 x 1200mm (w - to cover studs)



Plywood is cut using a circular table saw

2. CUTTING THE STUDS

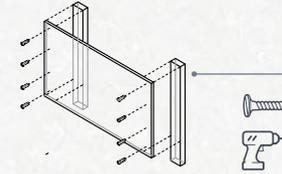
The 90 x 45mm timber extrusion must be cut to equal lengths of 800mm long (H), 200mm longer than the plywood which will extend below ground level.



Timber studs are cut using a drop saw

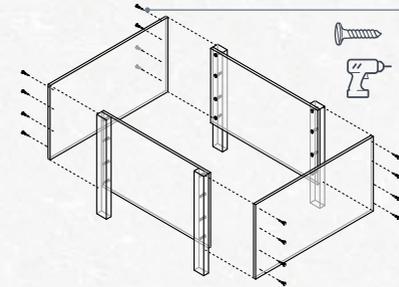
1:50 @ A5 .2m 1m

3. FIXING STUDS TO PLY #1 - INSIDE TO OUTSIDE (BATTEN)



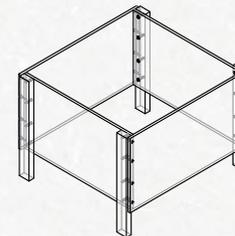
Using a cordless lithium battery drill, the 1000mm plywood pieces are connected to two timber studs respectively

4. FIXING STUDS TO PLY #2 OUTSIDE TO INSIDE (TEK)



Drill the 1200mm plywood pieces to the studs already connected to the plywood to form a box.

FINISHED QUAD FORMWORK



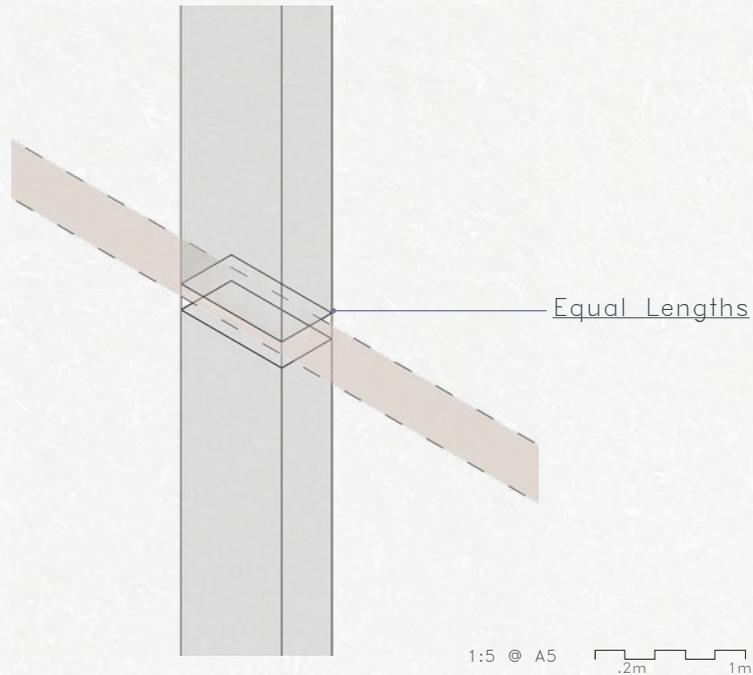
1:50 @ A5 .2m 1m



Initially, I was not very comfortable using the tools, even a drill is quite foreign to me and I could not get the screws to connect through the plywood straight which was frustrating. This seemed to improve over time.



KEY CONSIDERATIONS:



Timber Flush

The top of the Timber stud connected to the plywood should be flush with the edge to allow for trowelling during the concrete stage.

Screws

Tek screws should only be used from the outside of the cast, Batten screws can be used from the inside.

Equal Lengths

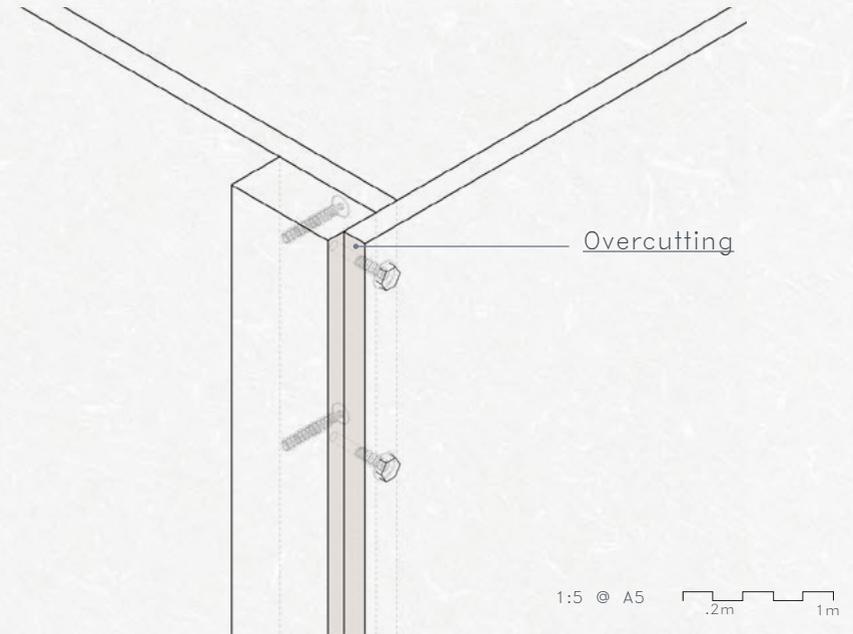
In using a tool like a drop saw, make allowance for the loss of material during the cut in calculations of stud length.



Due to our overcutting of the formwork, it was necessary for us to complete the formwork on site at Cummeragunja so that the plywood structure would not be compromised on the journey.



ISSUES ENCOUNTERED:



Overcutting

As shown in the detail above, we accidentally overcut the sides of the plywood by 50mm (1100mm total instead of 1200mm total). When calculating cutting depths, we did not take into account the thickness of the timber stud that the plywood needs to overhang for the strongest structural outcome.



Overcutting was, in hindsight, a pretty clear risk during the formwork building process. It quickly became clear that the overcutting of the ply sheets could have a rolling structural effect on later stages of construction.



FORMWORK WORKSITE AT UNIVERSITY



FORMWORK CONNECTING AT CUMMERAGUNJA

Note the use of clamps to assist during the fixing stage.



SITE SET OUT

MATERIALS



FIXING TYPE



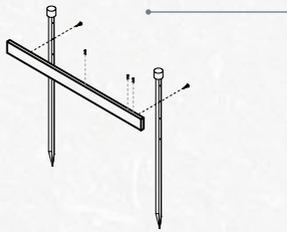
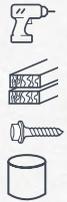
TOOLS



Following the preparation of the formwork, the site of the project must be set out with 'hurdles' and string guidelines to ensure that subsequent stages align correctly over the site.

Please note: I did not directly take part in the setup of string lines and hurdles. The following diagrams are based on observation, photographic records, discussion and research into site set out conventions.

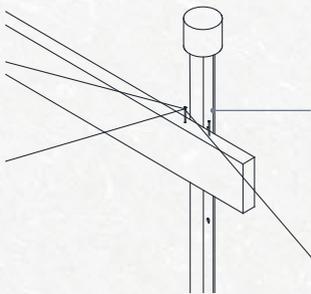
1. FIXING THE HURDLES



Hurdles are made by connecting a timber stud to two steel star pickets at the appropriate length. Nails are then set up where strings will attach as guidelines

1:50 @ A5 

2. COORDINATING STRING SET OUT

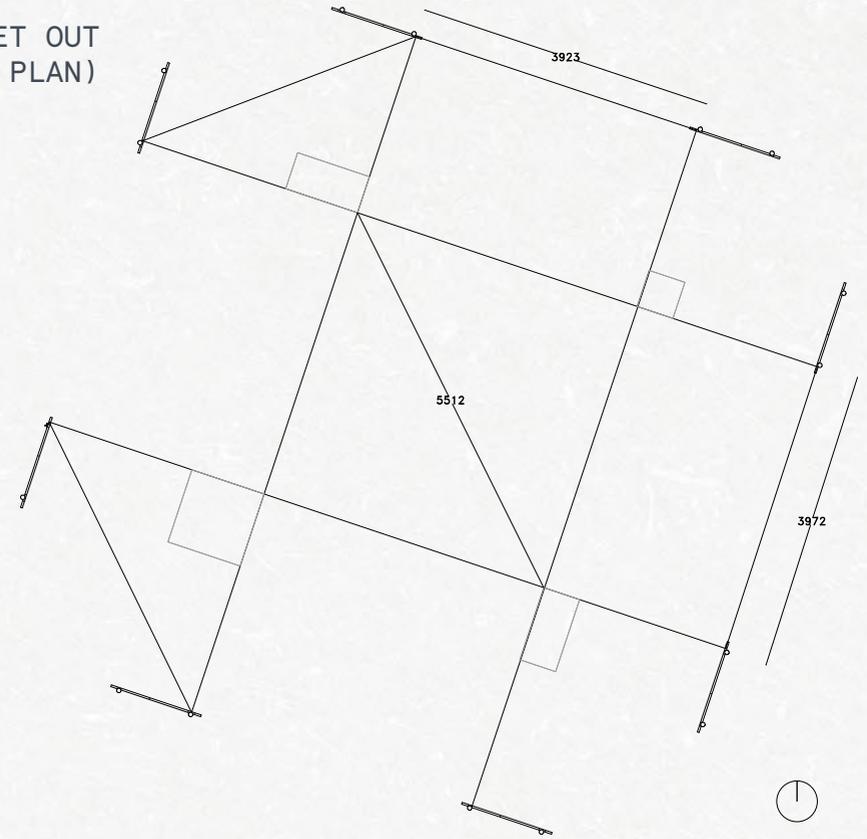


String lines are knotted around the hurdle nails to form taugt angles.

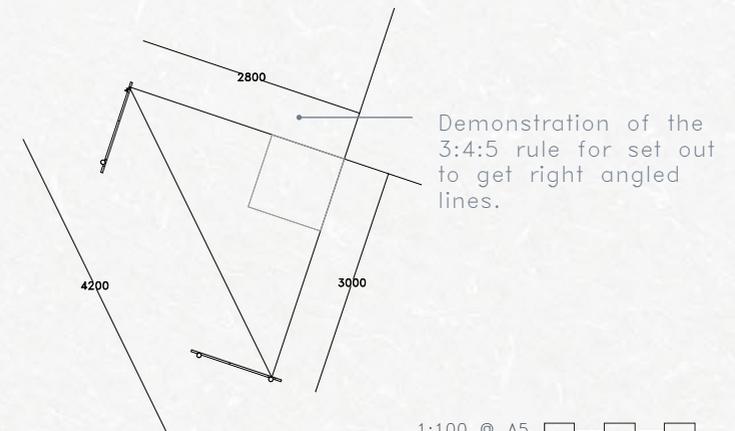
1:10 @ A5 



FINAL SET OUT (SITE 2 PLAN)



CORNER PORTION



Demonstration of the 3:4:5 rule for set out to get right angled lines.

1:100 @ A5 



KEY CONSIDERATIONS:

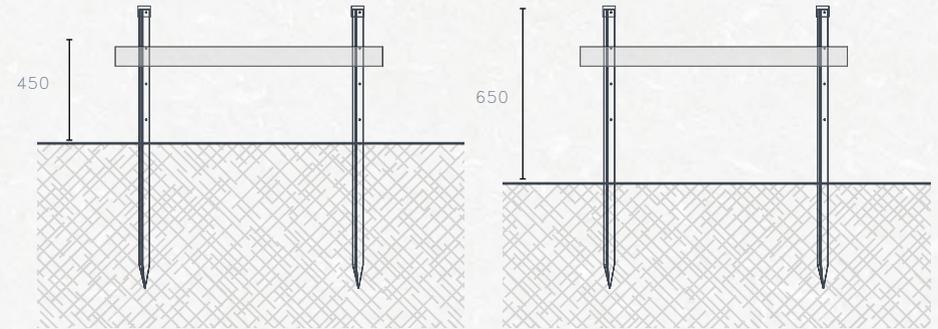
3:4:5

Using this ratio of lengths when wrapping around a corner will result in a neat right angled line for the concrete pads to be correctly leveled against. Sense checks of other diagonals (such as show in the previous plan) are also advisable.

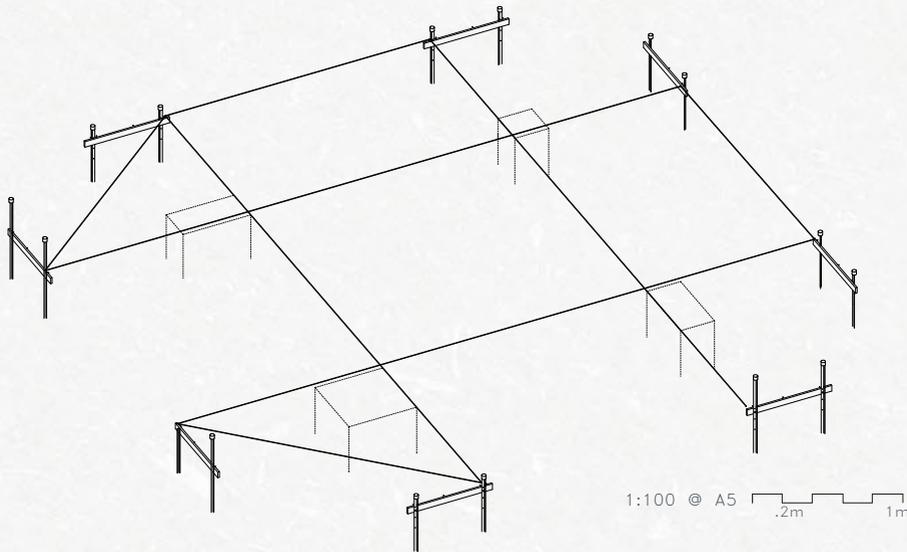
Height of hurdle

Due to our change of site after day #1, we experienced the importance of getting the hurdle heights correct. The top of the timber should be the gauge point for height calculations

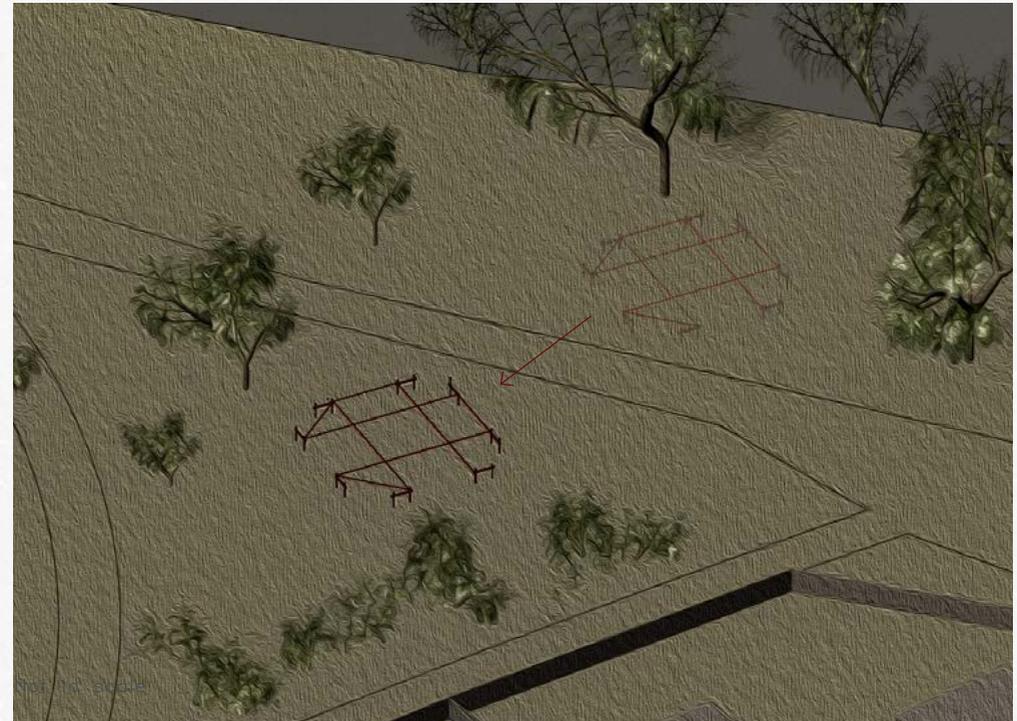
ISSUES ENCOUNTERED:



The move from site #1(left) to site #2 (right) impacted the height of the hurdles due to new digging depth parameters, as signed off by the engineering team.



FINAL SET OUT
(SITE 2 SW ISO)



TOOLS



BREAKING UP THE SOIL



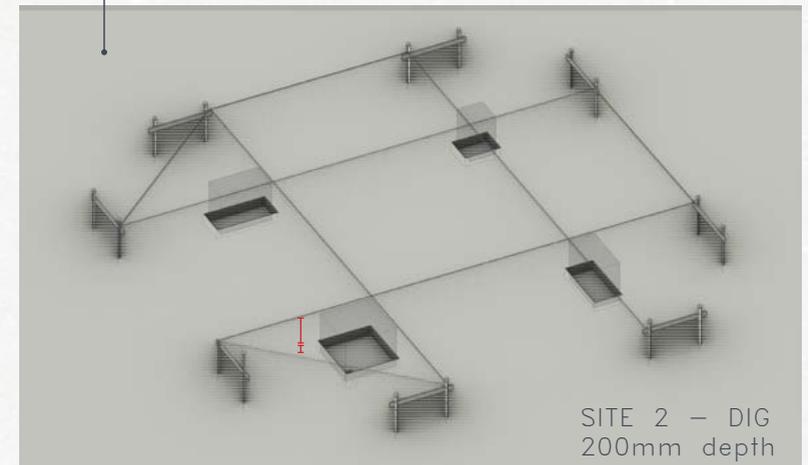
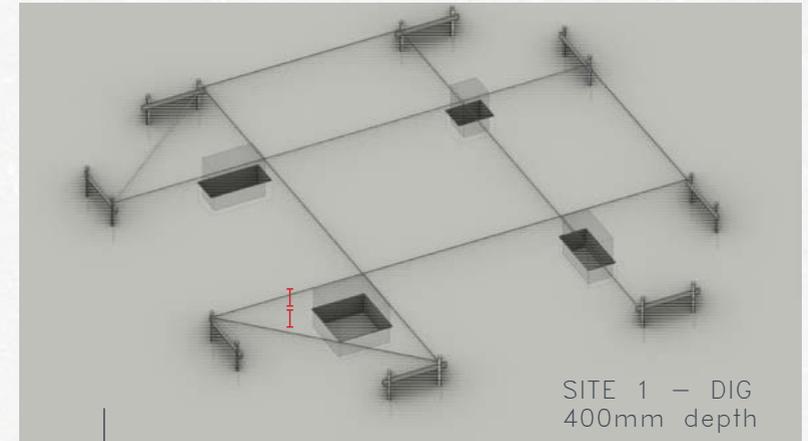
DIGGING



CHECKING DIMENSIONS AND CORRECTING



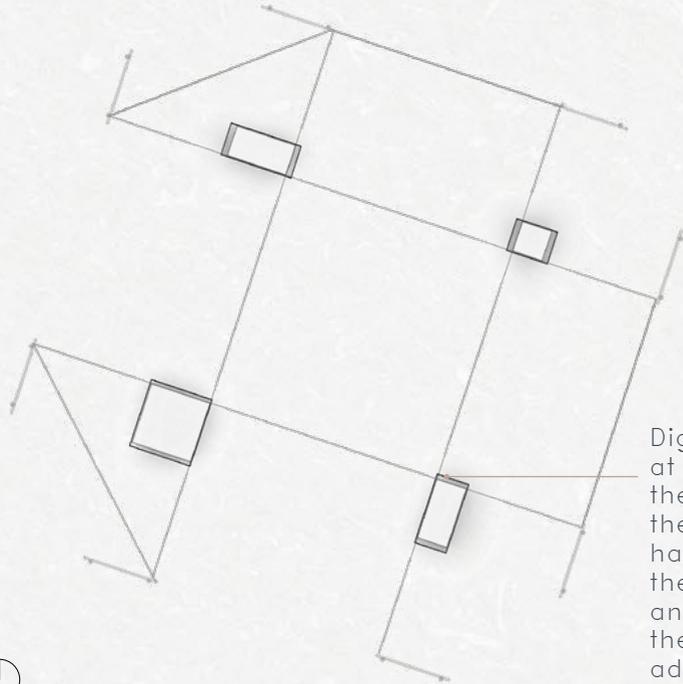
THE SITE CHANGE



It was a pleasant discovery that our second dig would be shallower than the first, if only for the time factor.



KEY CONSIDERATIONS:



Digging did not stop at the dimensions of the concrete pour, the hole would also have to accommodate the formwork box and timber studs and therefore needed some additional room.

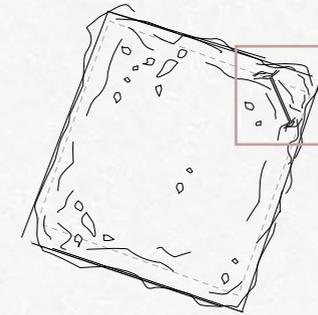


- hitting clay
- engineering loads
- proximity to water

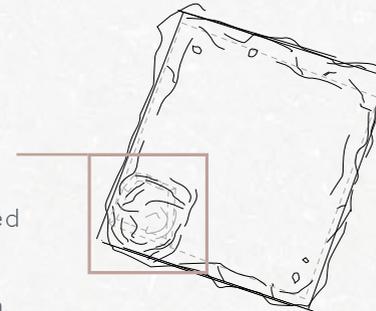
1:100 @ A5 .5m 2.5m



QUAD ISSUES ENCOUNTERED:



PVC pipe hit at first dig site



Soft soil hit at second dig site at level where clay was expected (200mm). We needed to keep digging ~200mm extra. The engineers cleared the extra dig

1:25 @ A5 .2m 1m

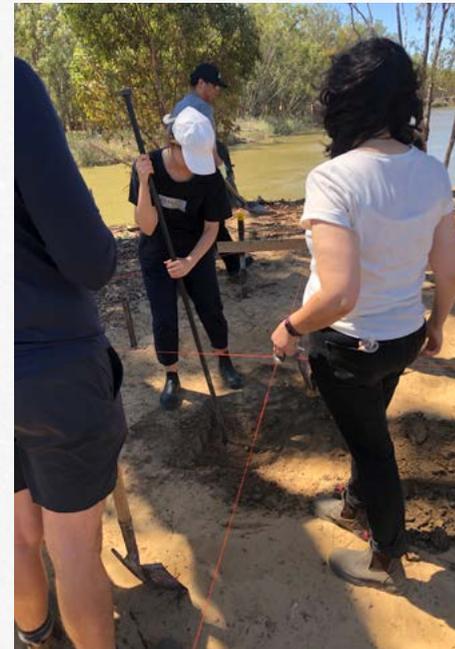
- hitting the pipe
- soft soil – digging further
- lining up to site guides
- breaking hard areas



It was almost funny that twice we hit something unexpected in our digs. If a little annoying at first, they did not prove to be major obstacles (particularly with reference to site 2)



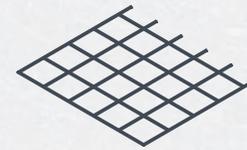
Misc. digging views



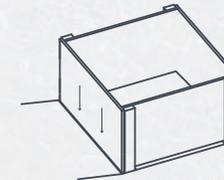
STAGE TWO

Reinforcement and placing

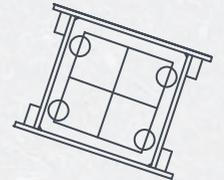
Stage Two of the foundation project continues with construction of the mesh reinforcement cage that will create an additional strengthening network within the concrete cast. Following this, the formwork box and newly built reinforcement is ready to be placed in the digs.



1. CONSTRUCTING
REINFORCEMENT CAGE



2. PLACING FORMWORK



3. PLACING REINFORCEMENT

BUILDING REINFORCEMENT CAGE

MATERIALS



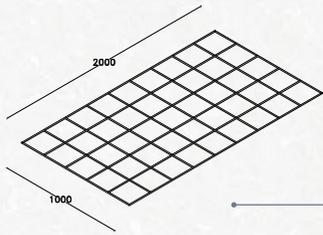
FIXING TYPE



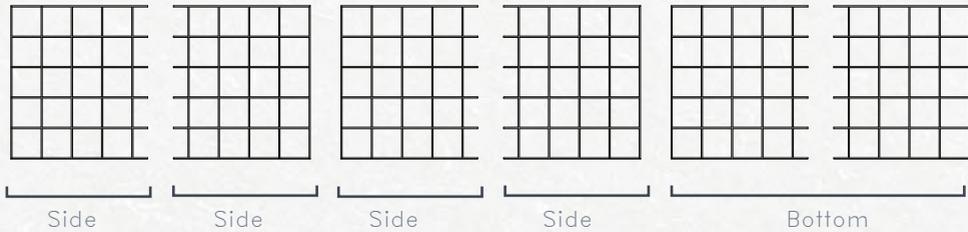
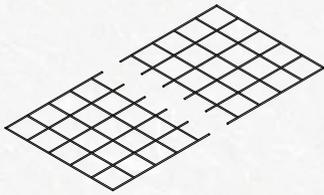
TOOLS



CUTTING MESH SHEET

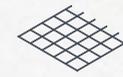


Plywood is cut using a cordless angle grinder



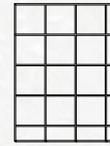
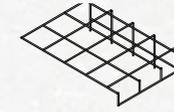
6 CUT PIECES FOR QUAD

1:50 @ A5 .2m 1m



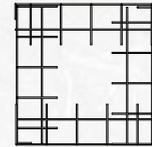
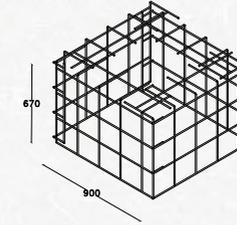
ISO

PLAN

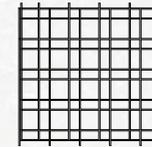
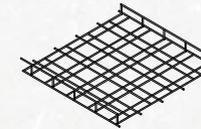


BENDING SHEETS

Bending allows the sheets to fold over for fixing and creates the right dimensions without wastage



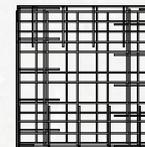
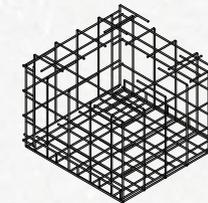
JOINING SIDES

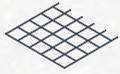


DOUBLE LAYER BOTTOM



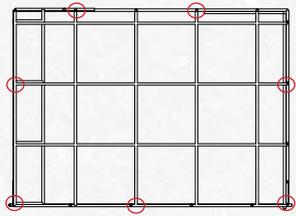
COMPLETE BOX



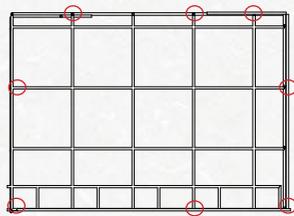


KEY CONSIDERATIONS:

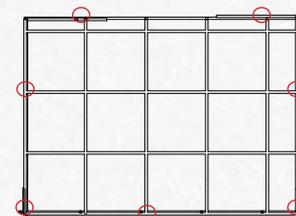
WIRE CONNECTION PLACEMENT:



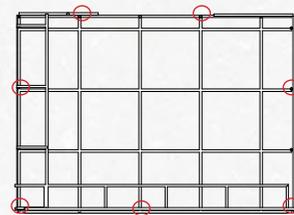
NORTH ELEVATION



EAST ELEVATION



WEST ELEVATION



SOUTH ELEVATION

Concrete Cover

There needs to be a 50mm clear cover between the steel and edge of concrete cast to prevent rusting and potential structural compromise (75mm at bottom)

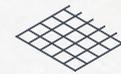
Slit in middle

Gap in top of the cage for the steel bracket placement.

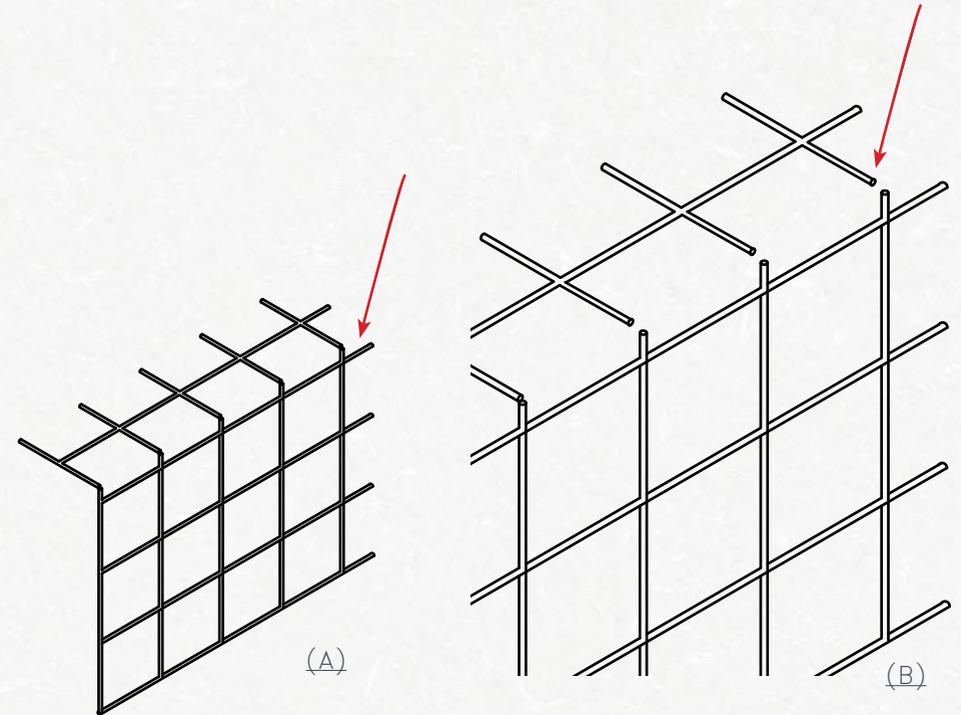
Double layer at bottom of cage

Wire connections

Wire fixings should be twisted tightly around the join at regular intervals.



ISSUES ENCOUNTERED:



Bending sides (A)

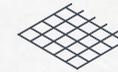
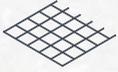
When bending sides, once the welding broke apart. It was of not structural consequence luckily.

Overcutting (B)

One side was overcut such that it does not lap the edge with a bend. It took a bit of correcting through wire fixings



It was really satisfying to see the cage form despite the missteps, which were themselves manageable for a good overall outcome.



Cutting and securing the mesh





PLACING FORMWORK

MATERIALS



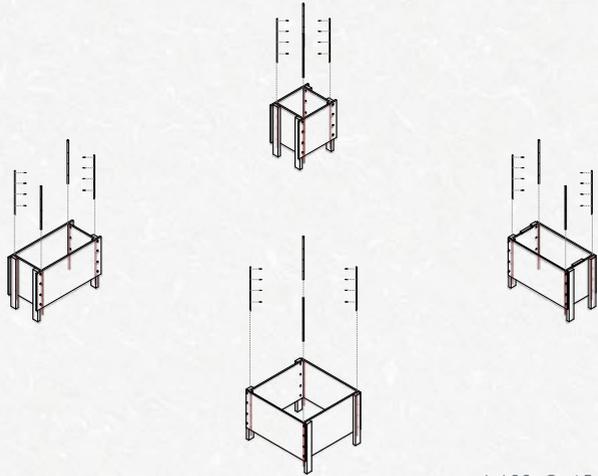
FIXING TYPE



TOOLS



ADDING TRI-MOULD



SW ISO

1:100 @ A5
0.5m 2.5m



SECTION THROUGH QUAD

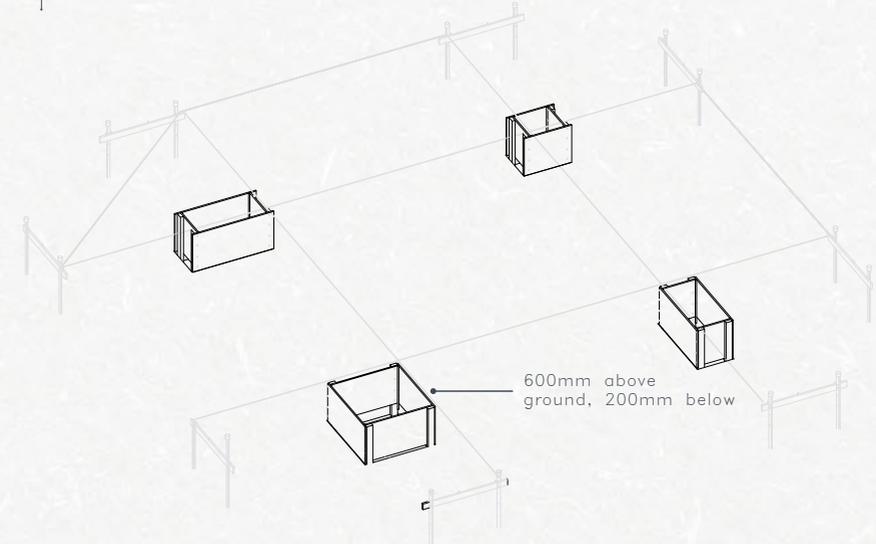
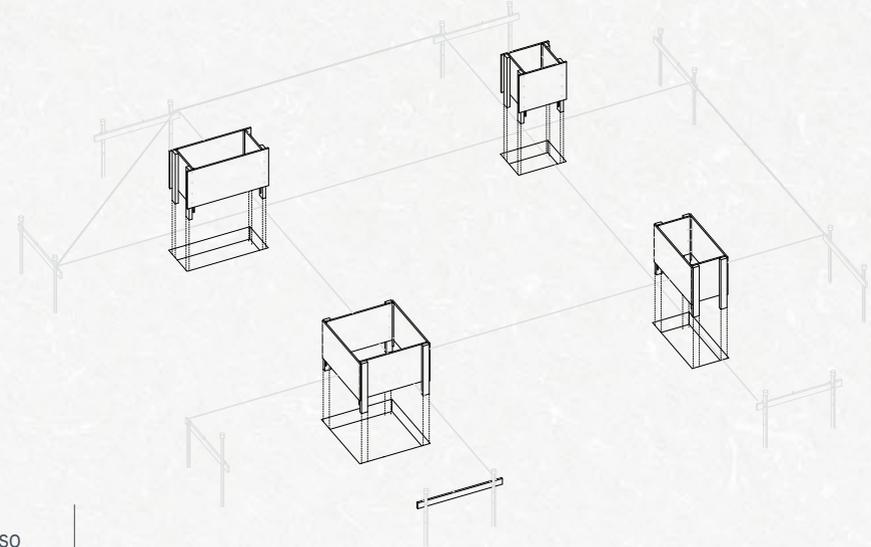


1:25 @ A5

Tri-moulds are necessary to slightly chamfer the edge of the concrete once poured to prevent cracking.



SW ISO



600mm above ground, 200mm below

PLACING FORMWORK

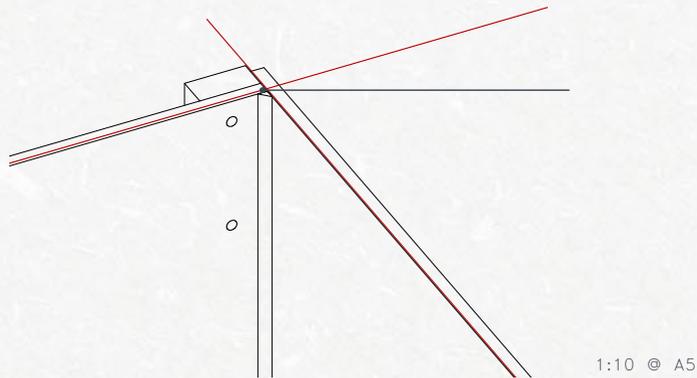
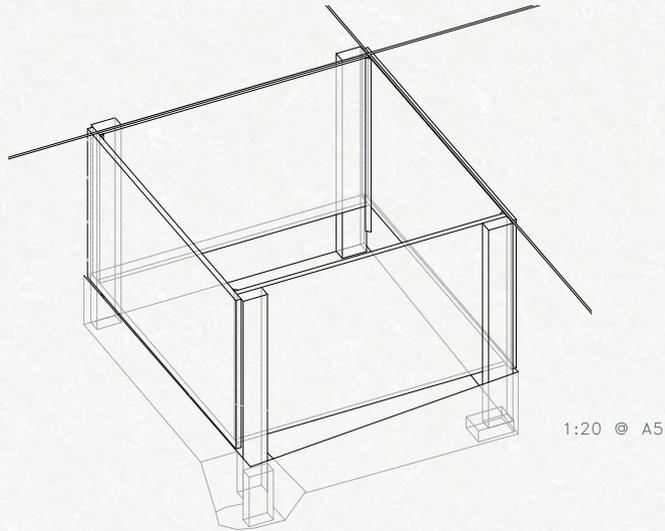
1:100 @ A5
0.5m 2.5m



In what seemed like an easy task, cutting the trimould pieces to size, I somehow managed to undercut one of the lengths (a common theme in this process). Luckily, a tetris-ing of two short pieces solved the problem very easily.



KEY CONSIDERATIONS:

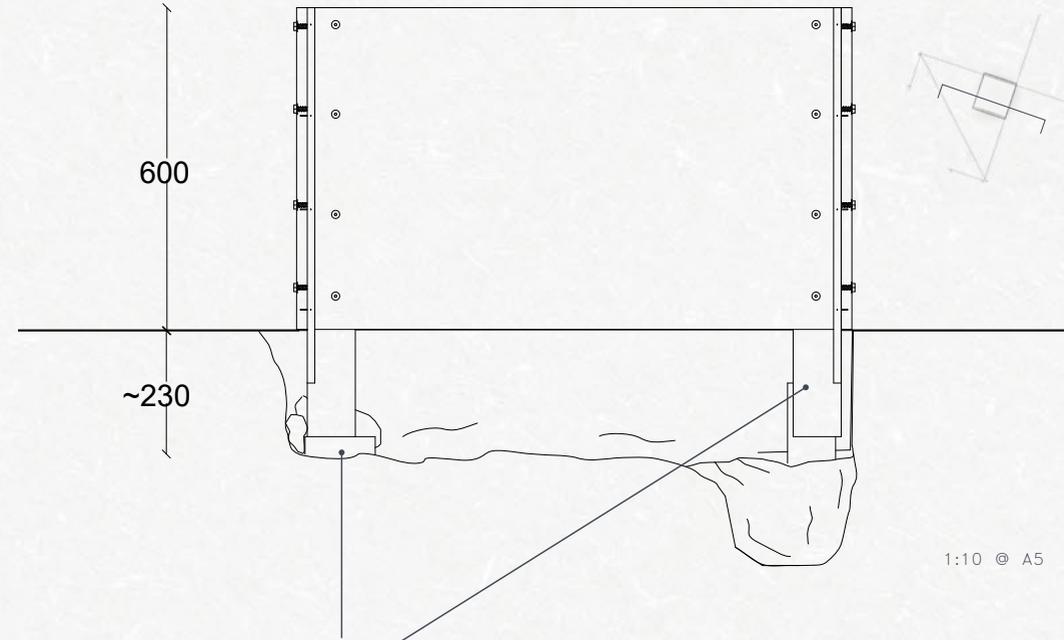


Leveling

Corrections where necessary to align with inner corner of site string lines and level measures



ISSUES ENCOUNTERED:



Extra timber

Due to the uneven footing situation one end of the Quad, we had to correct the formwork height with additional timber steps.

Space for studs

more space needed to be dug on corners for timber studs.



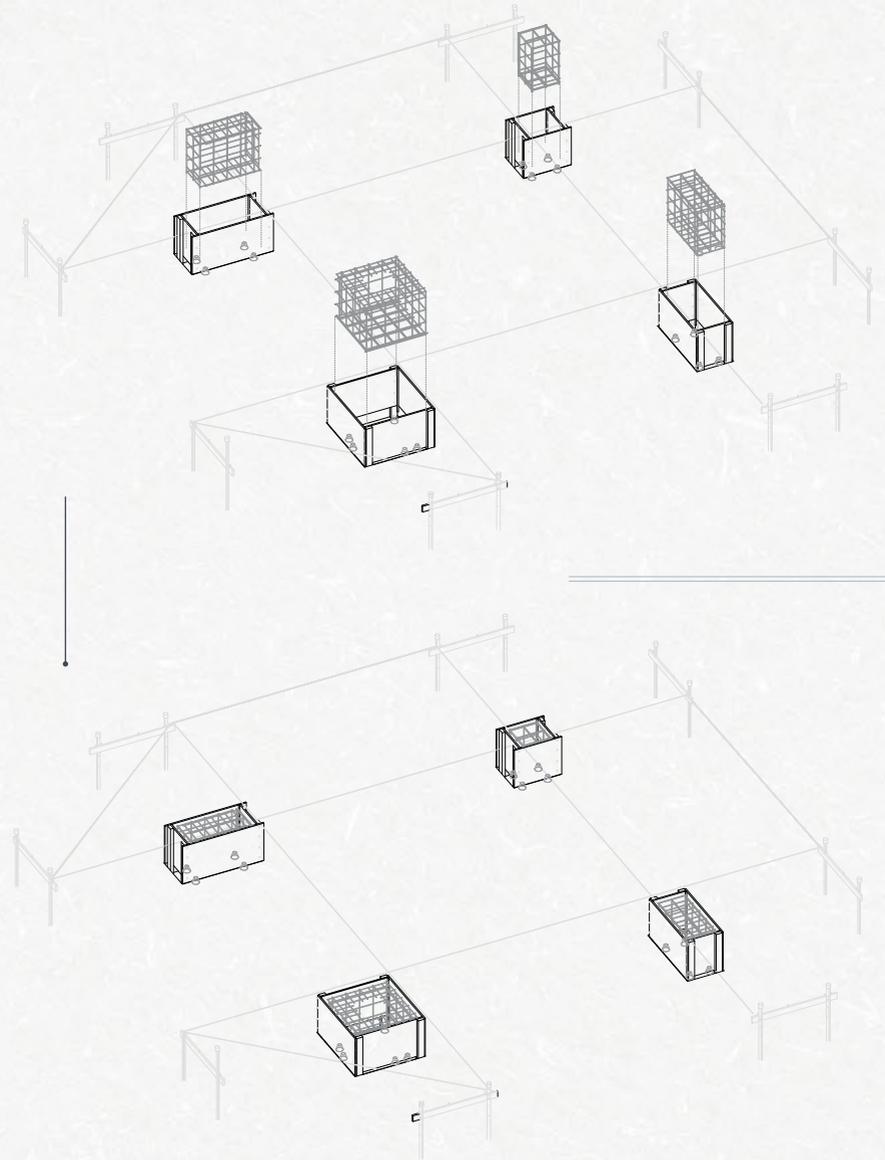
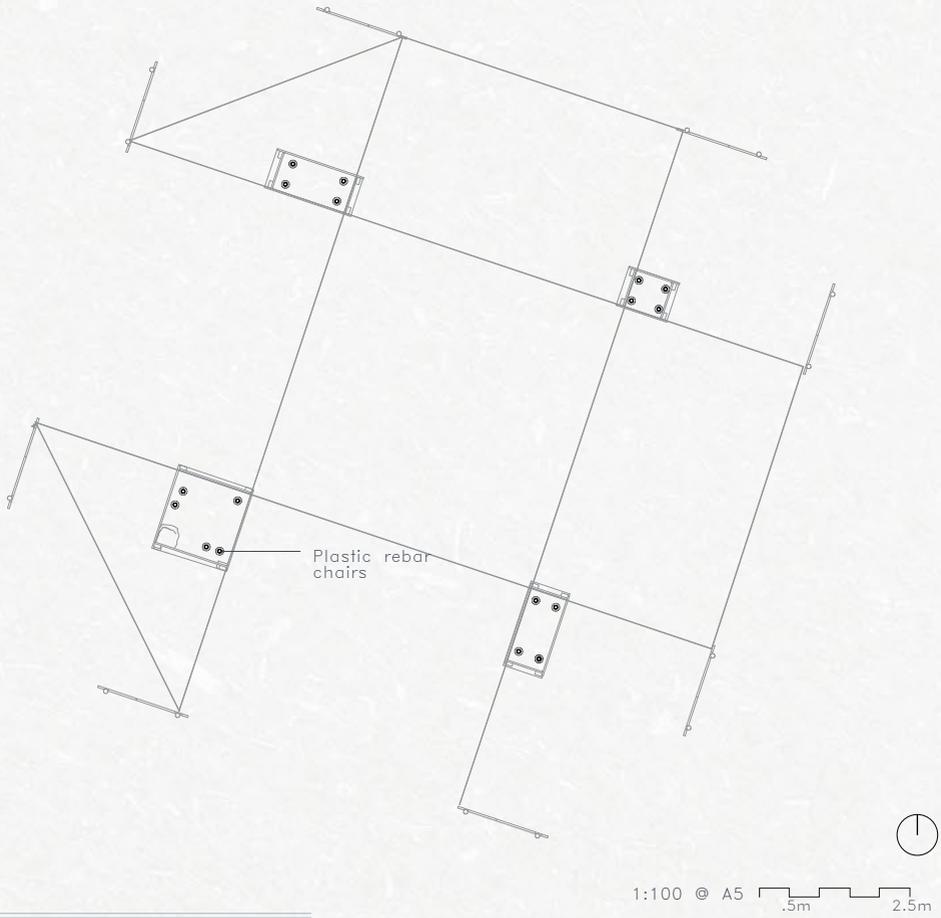


PLACING REINFORCEMENT CAGE

MATERIALS



TOOLS



Adding plastic chairs while lowering the cage. We had to play around with placement a bit due to our strange footing outcome.

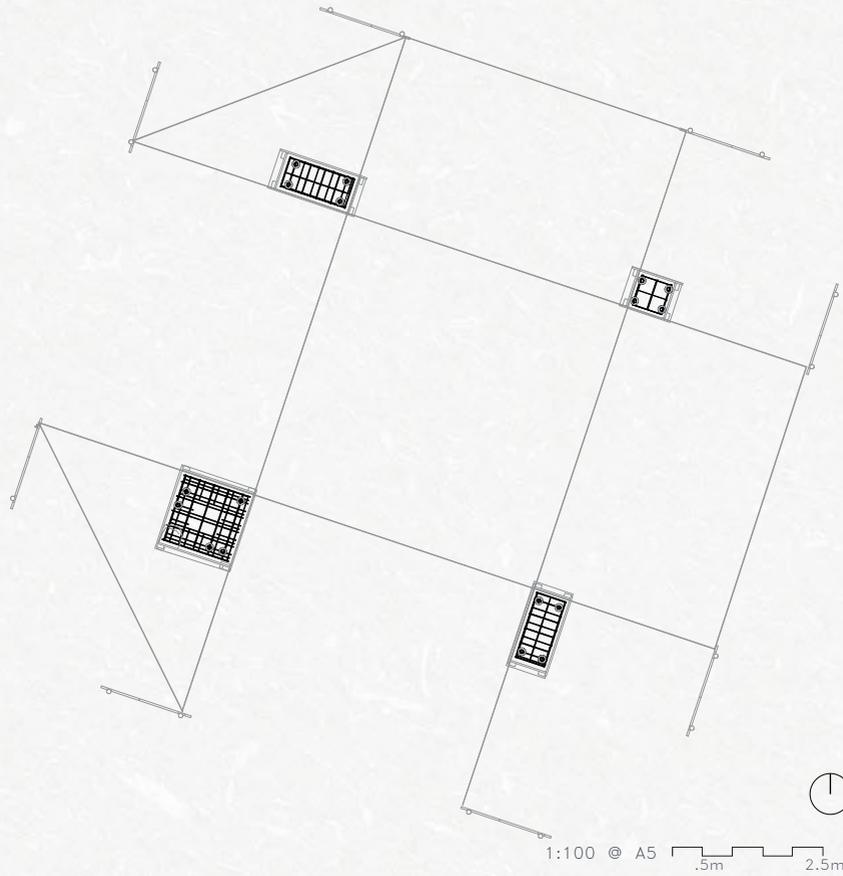
PLACING REINFORCEMENT

1:100 @ A5 0.5m 2.5m

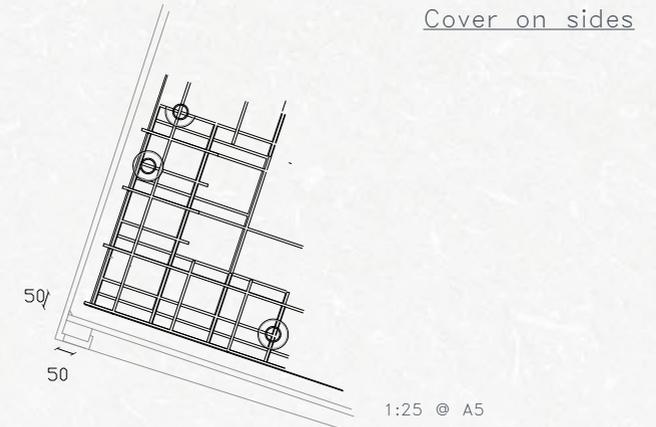


KEY CONSIDERATIONS:

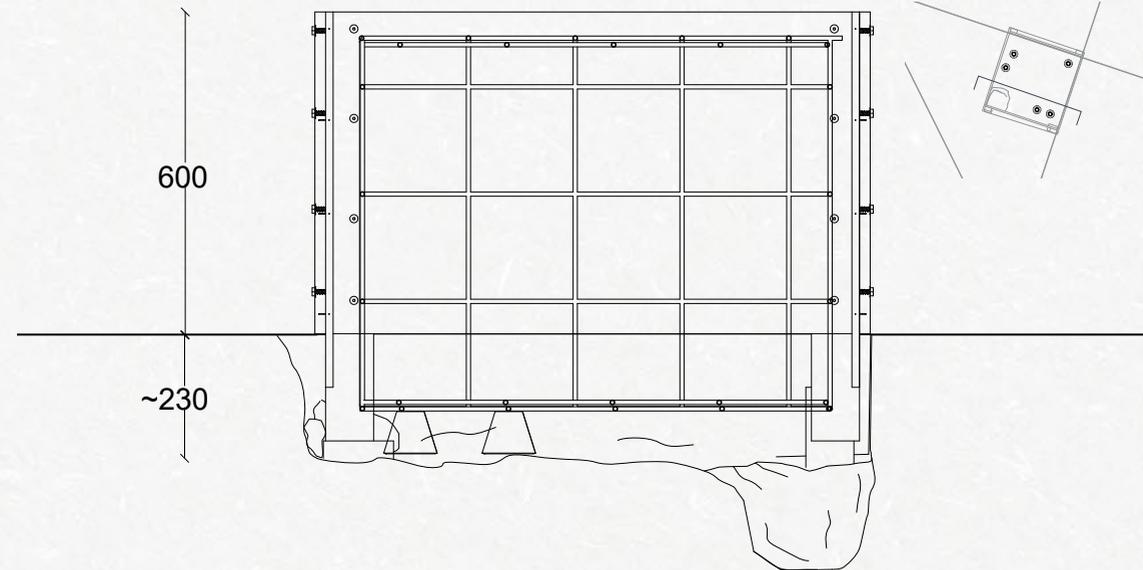
ISSUES ENCOUNTERED:



Cover on sides
Need to ensure there is sufficient cover on the sides and top and bottom of the reinforcement within the plywood box.



Cover on sides



Level on chairs
The reinforcement should sit level on chairs. We had to correct their placement due to the deeper corner we have.

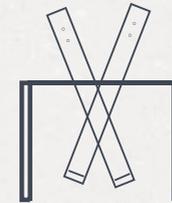
STAGE THREE

STEEL BRACKETS AND POUR

With the formwork and reinforcement now positioned for casting, the next stage is to place the steel brackets, finalise the bracing systems to support the formwork and later pour the concrete. By this stage, I was feeling more confident using tools and ready to see the concrete in the formwork.



1. LEVELING

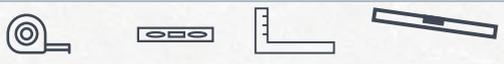


2. PLACING STEEL BRACKETS



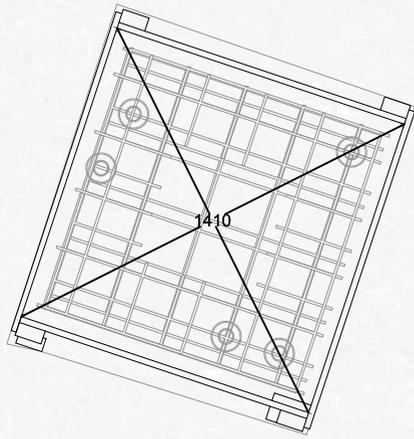
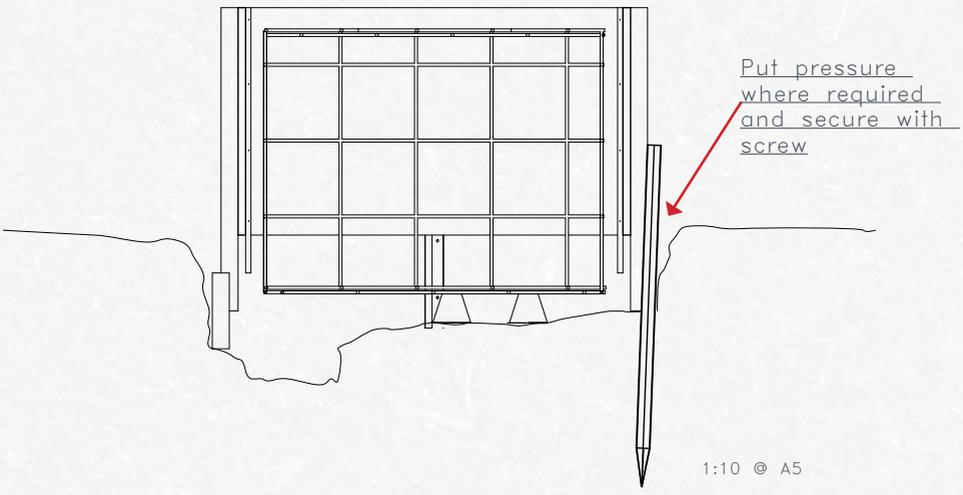
3. THE POUR

MATERIALS 

TOOLS 

The formwork and reinforcement has now been placed, but before the steel brackets can be coordinated in preparation for casting, the system must be properly leveled and aligned.

KEY CONSIDERATIONS:



At the Quad, we noticed that our plywood formwork was not square but rather was sitting slightly askew laterally. To correct this we used star pickets in deliberate places to gently realign the sides.



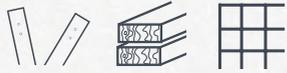
Checking diagonals

Checking against site guides

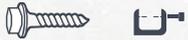
Pickets for bracing and leveling

PLACING STEEL BRACKETS

MATERIALS



FIXING TYPE

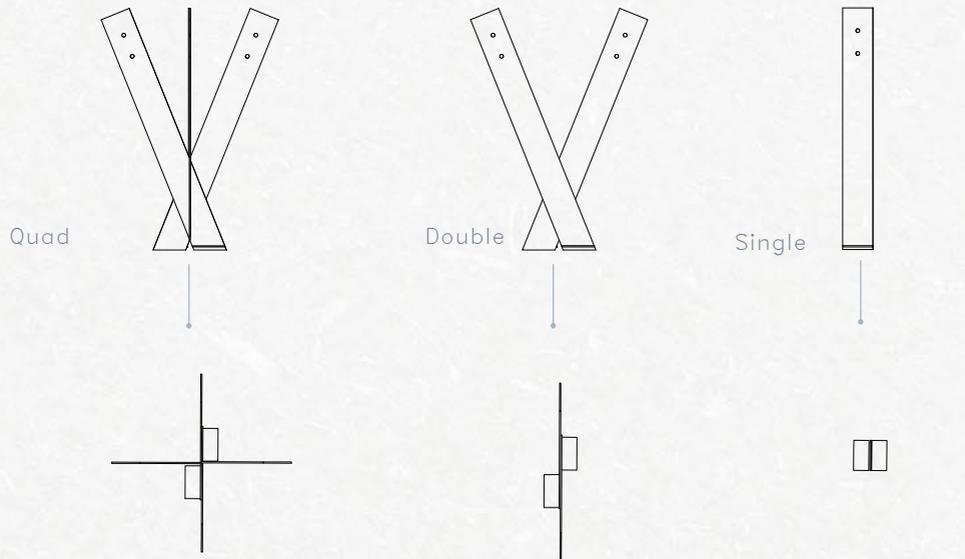


TOOLS



A critical moment after leveling and coordinating the formwork and reinforcement is placing the steel brackets, which form the bracing support for timber columns and roofing to come. It is therefore vital that the steel are correctly aligned for load carrying and distribution purposes.

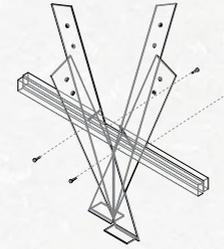
THREE STEEL BRACKET TYPES: ELEVATION + PLAN



1:50 © A5 .2m 1m

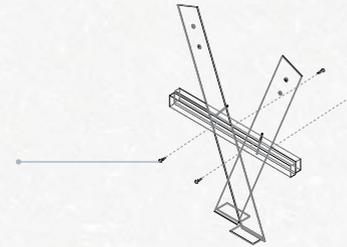
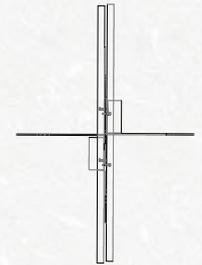


ISO

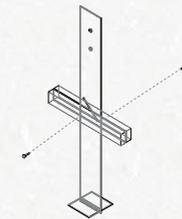


Quad

PLAN



Double



Single



offcut of steel reinforcement between timber bracing and steel bracket

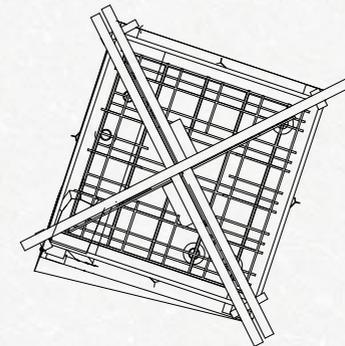
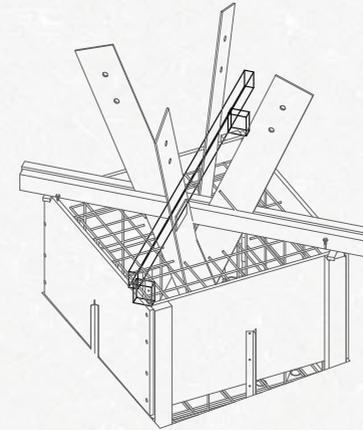
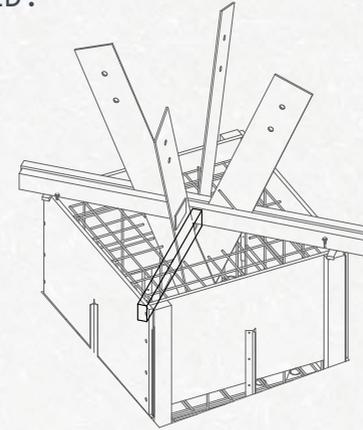


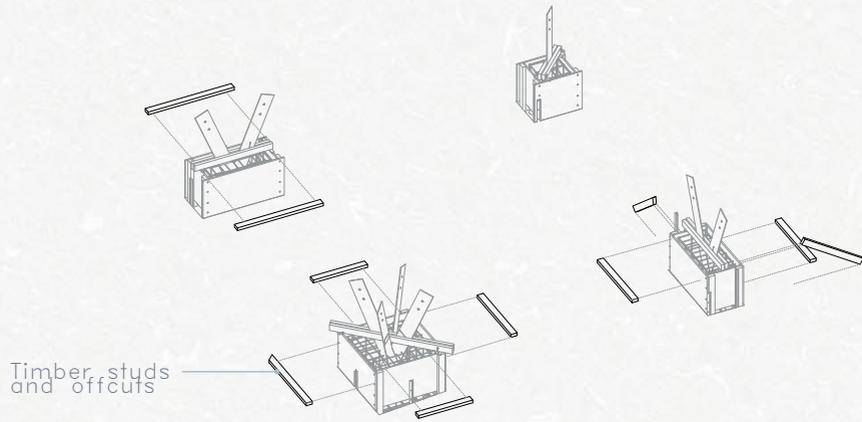
50mm above reinforcement



ISSUES ENCOUNTERED:

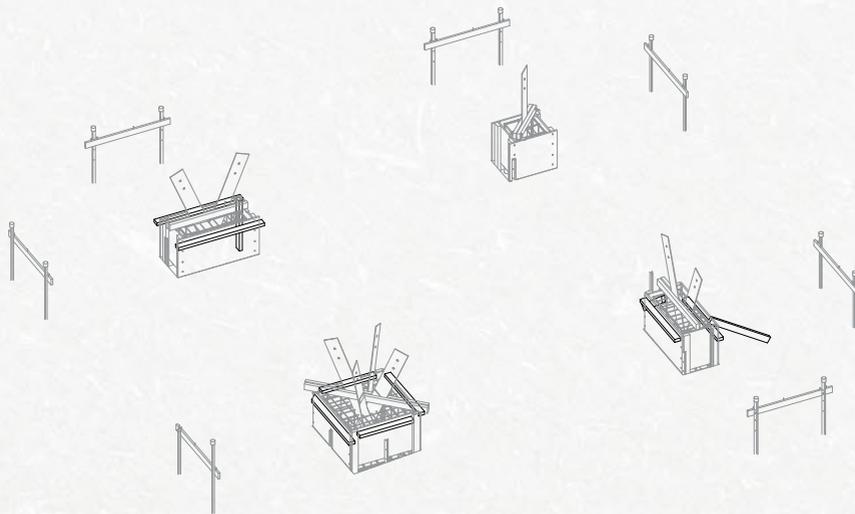
Additional lateral brace needed for Quad





SW ISOMETRIC: EXPLODED ADDITIONAL BRACING

1:100 @ A5 .5m 2.5m



SW ISOMETRIC: SECURED ADDITIONAL BRACING
FIXED FROM INSIDE WITH BATTEN SCREWS

1:100 @ A5 .5m 2.5m



At this point I was nervous that regardless of the bracing, our overcutting of the formply at stage 1 of this process would ultimately spell downfall during the pouring stage.

MATERIALS



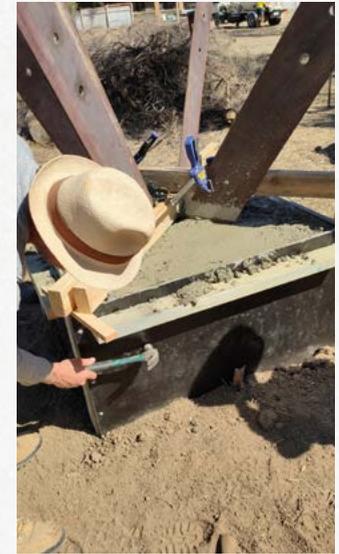
TOOLS



Once the steel brackets are leveled and additional bracing has been secured in the form of star pickets and timber braces, it is time for the cast to be poured. For the specifications of our footings, we required 25MPa cement which usually has a compressive strength at 28 days and is considered for basic structural concrete purposes.

The pouring happens quickly so the key considerations during the pour are:

- bowing
- bubbling over
- breaking formwork
- smooth top, trowelling technique



Concrete bubbling over, this is less of a concern than the formwork bowing out



Hammering to settle the concrete



With the largest footing pad, those of us on the Quad were a bit nervous about the potential for our formwork to break or bow under the pressure of the concrete pour. We even added some last minute additional star pickets to alleviate the risk. Luckily this was enough and the pour was a success, with our formwork maintaining its form and only requiring some manual leveling corrections where the steel brackets had shifted through the force of the pour.



Trowelling for a smooth finish





After removing the timber bracing around the steel brackets, I felt most proud of what we accomplished. Seeing all four concrete pads with the smoothed concrete tops that we had been working towards for the week. It felt like we had succeeded.



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FINAL REFLECTION

Summary personal thoughts

Overall, I can hinge my learnings from the Cummeragunja foundation work around the themes of construction, teamwork and participation.





REFLECTION ON CONSTRUCTION

Design and construction are often treated as separate entities and modes of thinking in current pedagogical trends. Experiences such as the Cumeragunja Project prove that this should not and cannot be the case. Each construction choice impacts the design and vice versa and there must be full and continuous dialogues between them. For example, one of the focal areas of the design as it stands is the locally sourced timber poles that will form the structural columns of the pavilion. This ultimately dictates how we consider the construction of each concrete pad and the crucialness of accuracy and rigour in the leveling and alignment process to provide the necessary structural based for these poles. The detail, time and process of corrections is also something that was key. When we overcut the formply, what were the domino corrections or over



REFLECTION ON PARTICIPATION

From the first day of construction on site at Cumeragunja Mission, it was clear that community participation and engagement was a critical cornerstone of the project. It is one thing to hear in the classroom that the process has been a team effort between residents and the MSD Team, it is entirely another to be on the site of the build and feel the impact we would be having on the spatial quality of the town. Speaking to residents and hearing their stories, I could listen all day and it was an honour to feel welcomed into their mission. It was also eye opening to encounter someone against the project and witness the proper corrections to maintain the participatory quality of the project. Finally, it was also a pleasure to witness the enfranchising of young ASHA kids from the area too and I hope that they felt welcomed and empowered on site with us.



REFLECTION ON TEAMWORK

At every point of the construction process, from connecting the formwork to pouring the concrete, teamwork and communication was central to success. Many hands make light work, and with the Quad being the largest foundation pad, this was very important.



One key moment that comes to mind where teamwork and communication was particularly crucial, was in leveling the final formwork system we had created before the ultimate concrete pouring. It was only with all hands on deck that we were able to achieve alignment within the quad.



A less technical but just as important part of the offsite experience was building friendships with a cohort that I have known for a year but met rarely due to COVID-19. Scan the QR Code for a slideshow capturing some of the more casual, social aspects of the journey.

FINAL WORDS:

The experience at Cummeragunja Reserve and throughout Construction Methods A has been filled with learning and camaraderie, but more than anything it has been a journey to developing respect for the construction process and for Country. It has shown me the power and importance of participatory design, inclusion, dialogue and working together. I have seen the necessity of teamwork, accuracy and consideration for place and site. The Aboriginal Community of the Reserve and ...

I hope to return to the site someday and see how the project developed. What happens now will be an exciting evolution of design, but I know is that the foundations will be strong,

Opposite: taken at dusk at Morning Glory Resort. To me, it captures the aura of the experience and the raw beauty of the land we often fail to see.



References:

- <https://bowerstudio.msd.unimelb.edu.au/projects/2021-cummeragunja-nsw>
- <http://koorihistory.com/cummeragunja>
- <https://www.vaccho.org.au/om/our-membership/associate-members/chdac/>
- <https://www.pavingexpert.com/setout01>

PHOTOGRAPHS TAKEN ON SITE BY MYSELF OR PROJECT TEAM.

ABPL90286
CONSTRUCTION
METHODS A

2021

KATE DONALDSON



THE UNIVERSITY OF
MELBOURNE