

# Construction Methods A

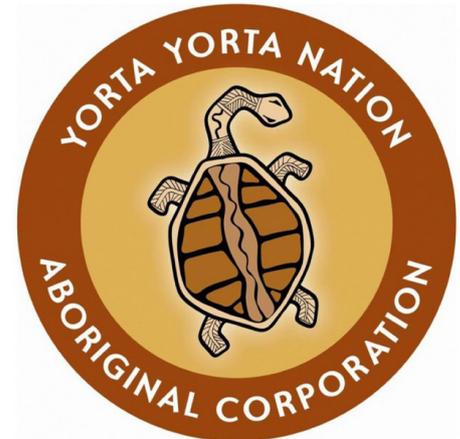
# Introduction

In the latter half of March 2021, students enrolled in Construction Methods A went to the community of Cummeragunja for four days to construct a series of concrete benches for a pavilion to be built as a space for elders of the community to pass down the oral traditions of the Yorta Yorta to the next generation.

**This document serves as an instructional series to inform you how these benches were built.**

It is important to note that these benches were built in and for an Indigenous Australian community. As the Yorta Yorta Nation Aboriginal Corporation notes, Cummeragunja was a “home which Yorta Yorta people were forced onto, then had to fight for when it was taken away from them until authorities controlled their lives so much that they had to leave... Yet Cummera meant nothing without the Yorta Yorta community that had lived there” (Yorta Yorta Nation Aborigi-

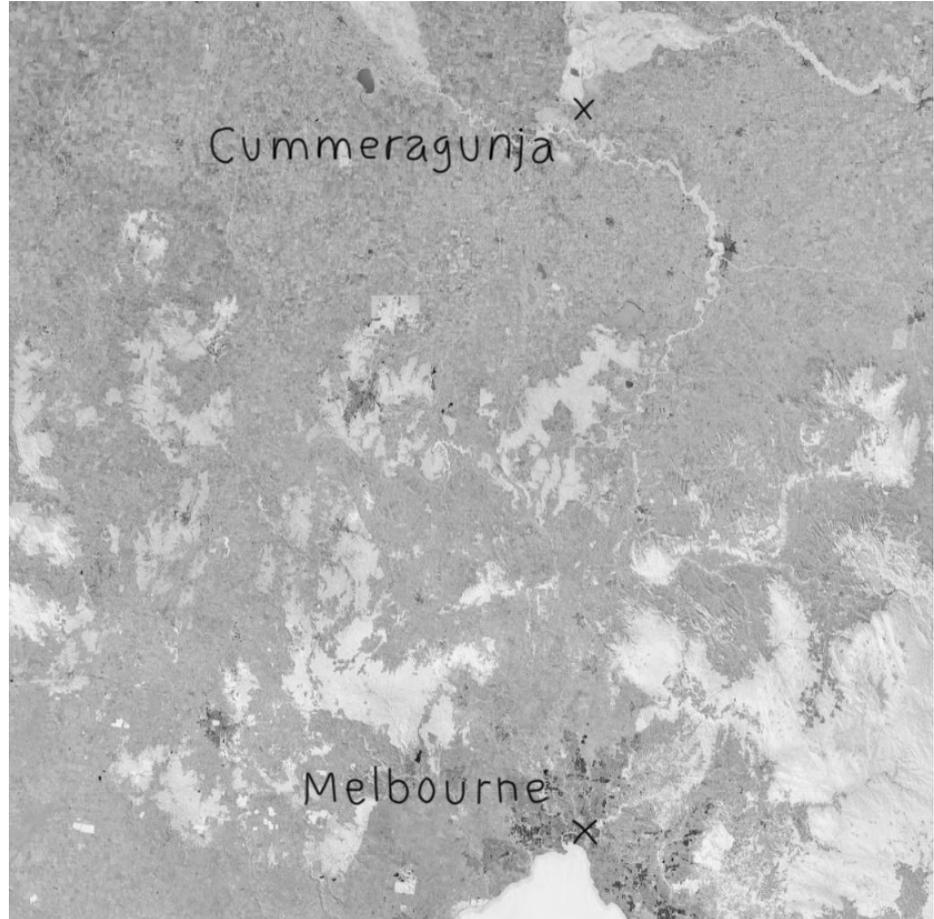
nal Council, 2019, p.8). It is a place with a complicated history, yet now has come to represent Aboriginal autonomy. If you are undertaking work for Aboriginal communities on their land, please ensure that you are receiving their informed consent at every step of the way, and that you are respectful of the autonomy and privacy that these communities have fought so hard for, and still fight to receive.



Source: YYNAC

# Geography

Cummeragunja is a Yorta Yorta nation community located across the Murray River in NSW from the Victorian town of Barham and is approximately 250 kilometers north of Melbourne. The site of the pavilion had already been marked out when we arrived, as the large concrete footings had already been put into place to the north of the community centre, and to the east of a cluster of homes and the west of the Murray river, and topographically was already rather flat. Climatically, according to the Bureau of Meteorology, Cummeragunja is a moderately warm climate with mild winters, having a mean daily temperature of 31°C in the hottest month of January and 13.5°C in the coldest month of July.



# Site

The footings themselves were either 1000mm or 500mm in depth and length, and were all 600mm in height, and featured untreated steel interfaces erupting from them at either 90° or 45° for the future attachment of the columns for the pavilion. The particular bench that we were tasked with constructing and that will be the focus of this manual was to be installed at the base of the 1000mm x 1000mm x 600mm footing which featured four untreated steel interfaces erupting at 45°



# Materials used

A concrete bench is actually composed of a very few number of materials, which were the following:

25 MPA Concrete

7mm Steel Reinforcement Mesh

75mm Bar Chairs

Tie Wires

# Tools Used

*All of the power tools that were used in Cumberagunja were battery operated. If you can use these instead of corded tools, it is highly recommended. Not only are they far more portable and much less of a hassle, but they drastically reduce tripping hazards and are therefore much safer on a congested site like Cumberagunja.*

Mitre Saw

Circular Saw

Hammer

Tape Measure

Shovel

Level

Clamp

Dumpy Level Leveling rod

Planer

Saw Stand

Angle Grinder

Concrete Float

# Fixings Used

*It is important to remember throughout construction the difference between your batten screws which have a head that sticks out when it has been fully drilled a surface, and your tek screws, which sit flush against the surface when installed. Remembering the difference between these two screws will ensure a headache free installation of your form-work and concrete bench.*

Tek Screws (65mm)

Batten Screws (65mm)

MGP10 Treated Pine (90x45)

Tri-Blocks

Pine Moulding (65x8)

Form Ply (17mm)

Star pickets + Hi-vis caps

Masking tape

# Notes on Safety

Hearing protection and safety goggles are mandatory. Do not wear loose fitting clothing or synthetic material. Tie your hair back. Gloves and leather boots are recommended.

Mitre Saw, Circular Saw, Planer, Angle Grinder: These tools have sharp moving elements; ensure that you keep all body parts as far away from them as is practical to do so; gloves are recommended. These tools are very loud and have shrapnel firing from them: **safety goggles and hearing protection are mandatory.**

Hammer: Take care not to hit either yourself or others.

Shovel: Watch for toes

Drill: These drills are very high powered and feature great deals of torque. Take care when drilling not to apply too much power especially as the screw reaches its biting point as the force will be redirected

through your wrist and arm and dislocations and/or breakages will likely eventuate. It is advised that use your body (most likely either thigh or torso) as a brace against the drill during operation to mitigate some of the risk of dangerous forces being directed through your arms.

## Site Preparation

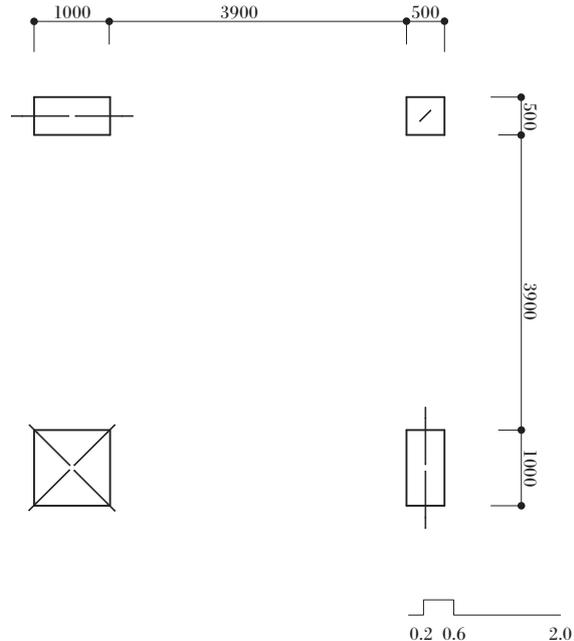
Clear away any detritus from the site, ensure that construction materials are at an accessible position, but one that would not impede movement throughout the construction site itself.

**A cleared site is a safe site.**

# Site measurement

Use a tape measure to confirm the dimensions of each of the concrete footings and their relations to one another. Set up the dumpy level at a point where you can roughly see each one of the three footings that will be the sites of the construction of the benches, and then have someone hold a leveling rod to the ground at the site of the benches. Ensure that the leveling rod aligns at the same number across each of the six sites of the bench and if it is not level, use a shovel to add, remove, flatten and/or compact the earth until the leveling rod is aligned across the sites. It is also necessary to use the leveling rod at different points within the site of each of the benches to ensure the ground is uniformly level.

*As the leveled earth acts as the **foundations** for this project, this step is crucial to having benches that are aligned in height, and to prevent difficulties further down the track with form-work not properly conforming to the ground line.*



Plan of existing footings, Cummeragunja  
Scale 1:100 @ A5

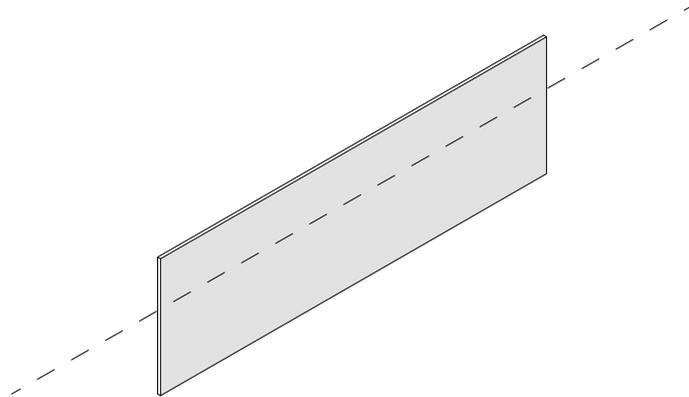
# Form-work design & Manufacturing

# Off-site preparation

The form-ply for our form-work was cut down to the roughly correct dimensions back at the University of Melbourne Parkville campus.

*Preparing your materials to be of the correct dimensions or closer to them is practical and efficient as it both frees time on-site for the construction, and reduces the size of the materials needed for transport.*

To prepare the form-work off-site, the most important step is to cut your form-ply to a **400mm height**. This is the most important preparatory step as, **while other dimensions of the concrete bench will differ, it will remain 400mm in height.**

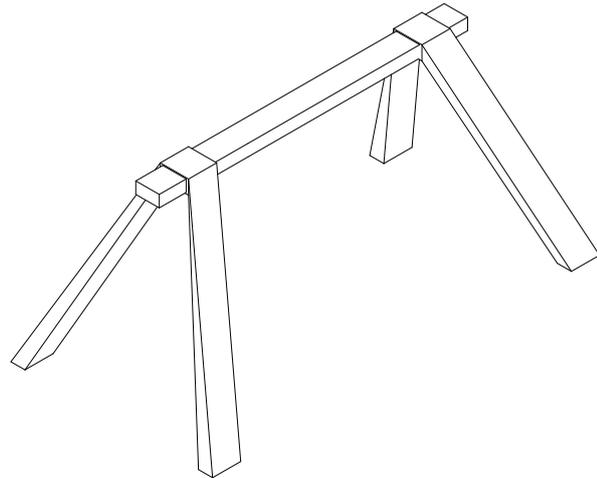


Cutting line 400mm from the longitudinal base of the form-ply

To cut the form-ply to the correct dimensions:

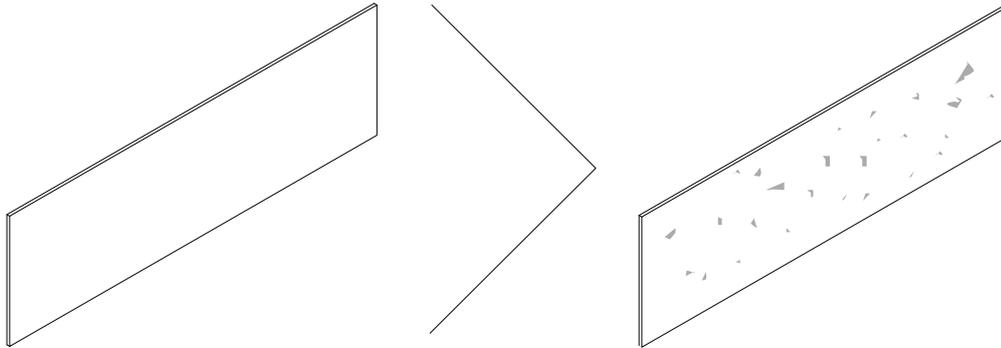
First, set up a saw stand. Ensure that you are on a flat surface and that the saw stand does not wobble.

*Our saw stands were particularly easy to work with as they used off-cuts of 90x45 timber to work with, meaning that they are highly portable.*



Second, choose a face for your form-ply.

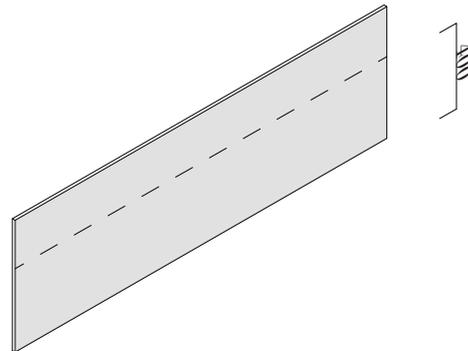
*If you are re-using your form-ply, this is especially important as one side of the form-ply may be dirtier than the other, or have had the smooth coating chipped away which will reduce the effectiveness of the form-ply in coming off without taking any of the concrete once it has set.*



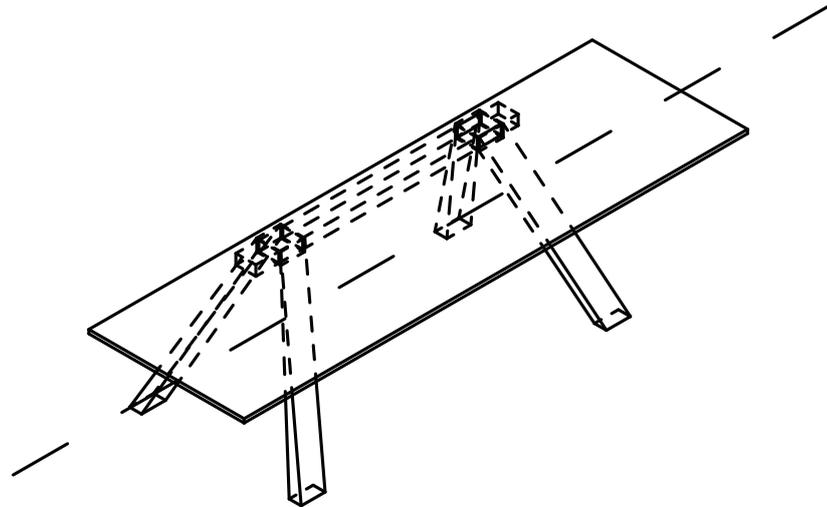
Choose a clean face over one that has been used previously, or that is damaged and chipped

Third, measure a line 400mm from the cleanest longitudinal side of the form-work.

*If the edge of your form-work is not flat, you may have to cut across it to ensure that your form-work will be even on both sides.*

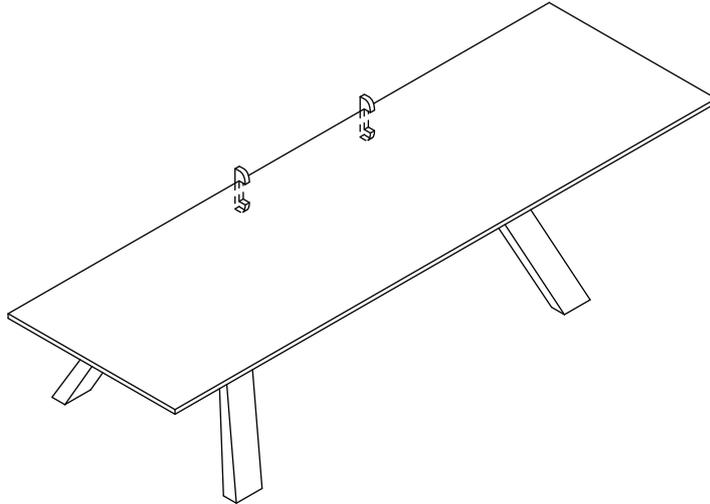


Forth, once you have drawn the cutting line, position the form-ply so that the cutting plane does not intersect with the saw stand, but instead floats over the edge.



Fifth, once positioned, clamp down the form-ply on both ends of the cutting axis.

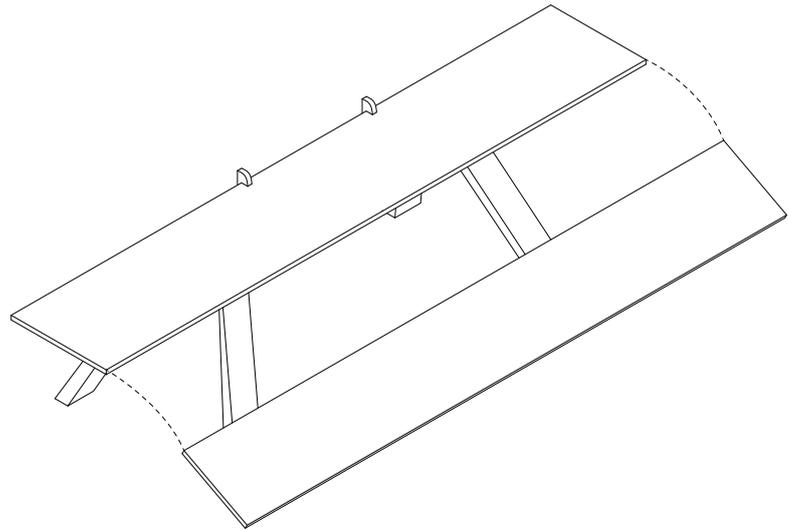
*Ensure that the clamps do not intersect with the cutting plane and will not impede you as you are cutting.*



Sixth, with a circular saw, position your body so that you are not standing with the saw in front of you, as the dust from cutting will be ejected from the rear of the saw. Start the saw before running it smoothly along the marked cutting line.

*Do not force the saw through the wood but let it move freely as it cuts.*

*Ensure as you near the end of the cutting line, either you or, preferably, someone else, can hold the off-cut side of the formly so that it does not fall to the ground, as this could damage the off-cut, and could cause a non-uniform tear along the cutting line.*



For our bench, you will need to do this with six spans of form-ply: four of these will be longitudinal spans, and two will be much shorter transverse spans.

We also cut the form-ply to approximate lengths and widths, but as I will discuss, this changed when we were on-site. I would recommend keeping the form-ply as un-cut as possible to allow for a flexible alteration to the dimensions upon arrival on-site and a final community consultation before the form-work is installed for the concrete pour.

The final dimensions for our final bench design is referenced, and can be consulted if you intend to make a 1:1 replica of our final design. However, the flexibility to prototype and adapt the form-work to the unforeseen requirements of the site, and the revised desires of the community cannot be understated.

*We re-cut our form-ply on-site after community consultation, so do not take the dimensions as necessarily gospel.*

**The spans of form-ply must be longer than the dimensions of the bench, necessarily, as if they are shorter, they will not adequately contain the mass of the concrete, or will give you a smaller bench than intended. It is recommended that you add at least 150mm to the spans given:**

Longitudinal spans:

2080x400 = Cut to 2230x400

2200x400 = Cut to 2350x400

2265x400 = Cut to 2415x400

2405x400 = Cut to 2555x400

Transverse spans:

480x400 (x2) = Cut to 630x400 (x2)

After cutting the form-ply to the correct height and approximate length and width (allowing enough space for flexibility on-site), it is necessary to install **walers** (horizontal bracing reinforcement) for the longitudinal span of the form-ply and **soldiers** (vertical bracing reinforcement) for the transverse span out of **90x45 MGP10 Timber**. This will act as a reinforcement to the form-work to prevent the mass of the concrete from bowing and possibly even rupturing the form-ply.

For this, you will need:

Batten screws (65mm)

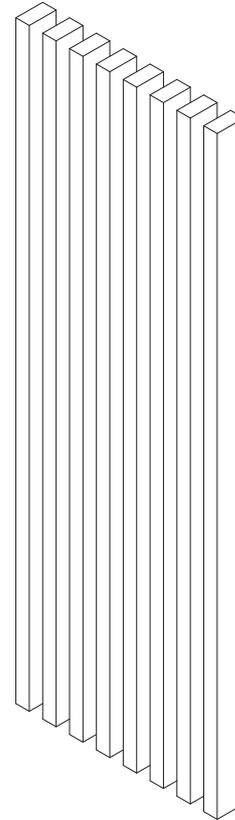
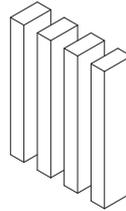
Drill

Form-ply (cut to approximate size)

MGP10 Treated Timber (90x45)

Mitre saw

Take measurements of your form-ply, you will need to cut two pieces of MGP10 for every one piece of your six pieces of form-ply, meaning that you will end up with eight walers and four soldiers.



Your long spans of timber will be installed horizontally, while your short spans will sit vertically

Arrange the pairs of walers and soldiers and cut them together in pairs on a mitre saw to ensure that they are the same size.

For your walers and soldiers, you should only cut them to be the same length as your final desired concrete benches, not to the length of the form-ply.

Longitudinal spans:

2080x400

2200x400

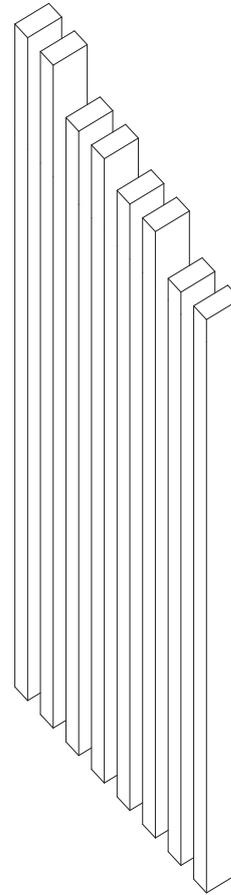
2265x400

2405x400

Transverse spans:

400 (x4)

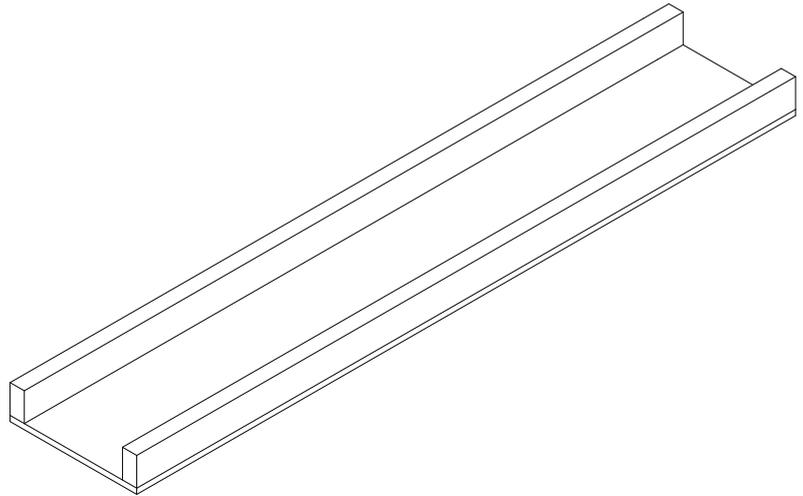
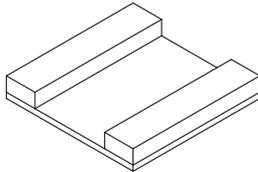
*Remember that these dimensions were revised in Cummera. Leave yourself the flexibility to re-adjust your design after community consultation.*



Walers cut to correct size

Now, arrange the pairs with their relevant piece of form-ply so that they are sitting horizontal (if they are walers) or vertical (if they are soldiers).

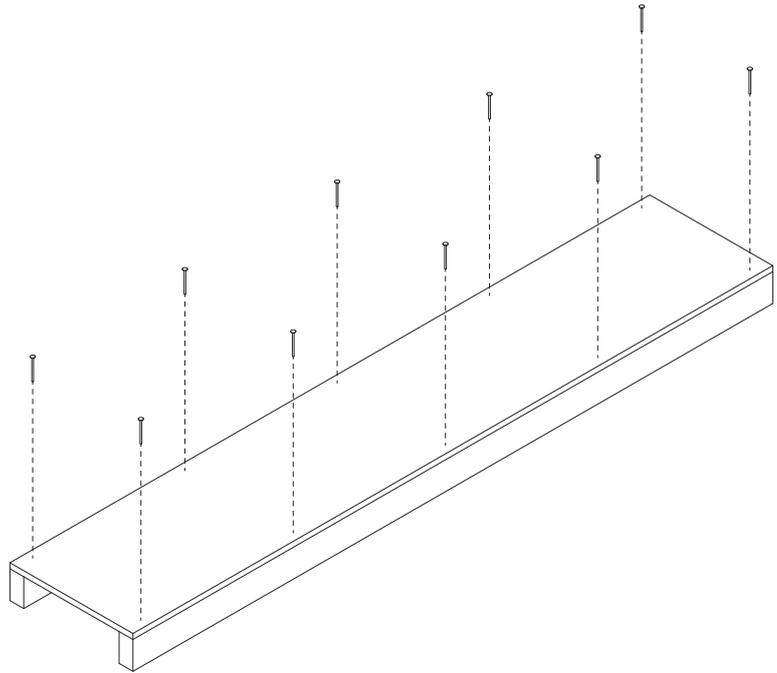
*For affixing the soldiers and walers into the form-ply, it is necessary to use batten screws, as these can be used to drill the form-ply into the timber, while tek-screws would either cause blemishes in the concrete if they were affixed from the same side, or would not bite sufficiently into the form-ply if installed from the MGP10 side and/or would risk emerging through the other side of the form-ply into the concrete.*



Soldiers (left) and Walers (Right) in place

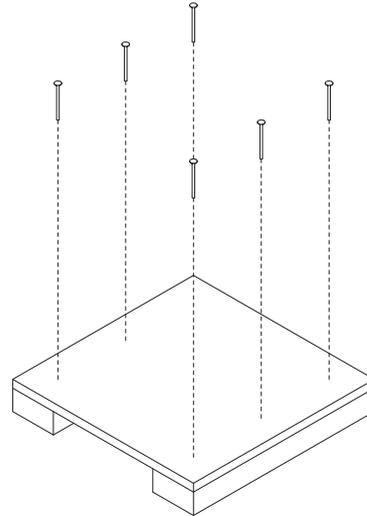
For the longitudinal spans of form-ply, position each of the respective pieces of timber along the edge of the longways side that is intended not to come into contact with the concrete, ensuring that it is the 45mm face of the timber span is resting on the form-ply. This increases the tensile strength of the span, and reduces the chances of bending under the force of the concrete pressing against the form-ply.

From the side of the form-ply that does not have the timber, measure 25mm in from the top and 50mm in from the side and drill a batten screw into each corner. Then drill another three batten screws equidistantly along the length of the top and bottom 25mm from the edges.



For the transverse spans, to install the two 400mm timber soldiers into each of the faces of form ply, position the 45mm face of the timber along the 400mm edges of the form-ply, and then drill the 65mm batten screws 50mm from the edges of the form ply, with a third batten screw installed in halfway along each span.

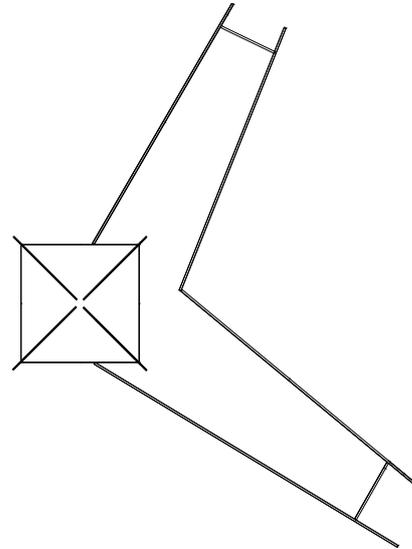
*These shorter spans of form-ply do not need the same reinforcement as they are not sufficiently lengthy that they are at any real risk of bowing under the pressure of the concrete if properly installed.*



# On-Site Preparation

This bears repeating: community consultation is a necessary and integral part of the design process. **The community's informed consent is important to attain not just at the beginning of the process, but it is to be sought and reiterated throughout.**

The initial form-work dimensions had been previously discussed between David O'Brien and stakeholders in the Cummeragunja community. Uncle Col, an elder in the community who acted as a key intermediary throughout the entire process, requested that the benches were to be constructed in a boomerang shape, which also resolves the form logically. Further, he requested that allusions to Cummer's history and landscape be incorporated to the design, which was to be included in the form of motifs referring to the weatherboard construction of the old schoolhouse, and sand, reeds and fishscale motifs to be included in reference to the breadbasket of the community: the adjacent Murray river.



After the site has been prepared and cleared, the local community is to be consulted with the presence of the form-ply on-site. Using clamps to hold them in place, erect the form-ply in the positions that your preparatory design has stipulated, bearing in mind that these designs may be altered in the community engagement process, and that this is a natural step.

David O'Brien had previously consulted the community through the use of a scale model, which was useful for illustrating and conveying the overall idea of the project, how light would fall on the benches through the perforated steel roof, and the arrangement of the benches in space. However, when form-ply is installed into space, with the use of clamps to keep them upright, you will be able to demonstrate the form of the benches in situ at a 1:1 scale.

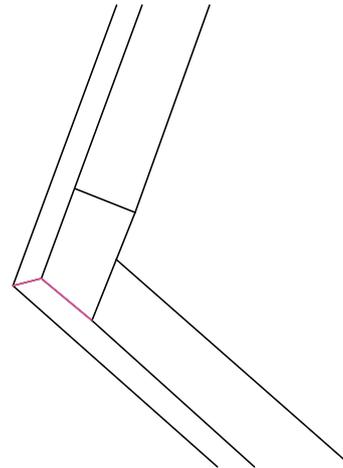
In our case, we workshopped our bench design with David, a Cummera local. With his presence we were able to move the benches around and play with angles, demonstrating to him various possible iterations of the overall design. This was ben-

eficial as even though the finalised design was very close to the original design of the form-work that we had cut off-site back in Melbourne, refinements had been made. More importantly though, it justified to David, a community stakeholder that they were getting the most appropriate iteration of the design.

*Here, it can be seen that the design and manufacturing of the form-work were not two distinct processes, but were in fact interconnected.*

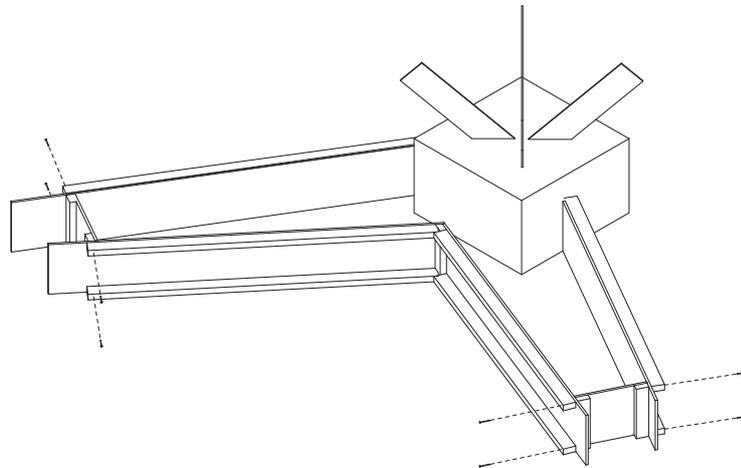
Once the on-site placement of the benches has been confirmed with the informed consent of the community elders, make any necessary steps to re-adjust the lengths of the form-work in accordance with the steps issued above, and then re-clamp them into place.

You may find that your benches are not oriented at 90° angles, and as such your form-ply does not neatly sit at the correct angles. If this is the case, take a plane saw and carefully run the plane saw down the length of the form ply until it sits flush at the correct angles and, if necessary, cut a piece of MGP10 Timber with the plane saw and install it with a drill and 65mm tek screws to facilitate the correct alignment of the form-ply.



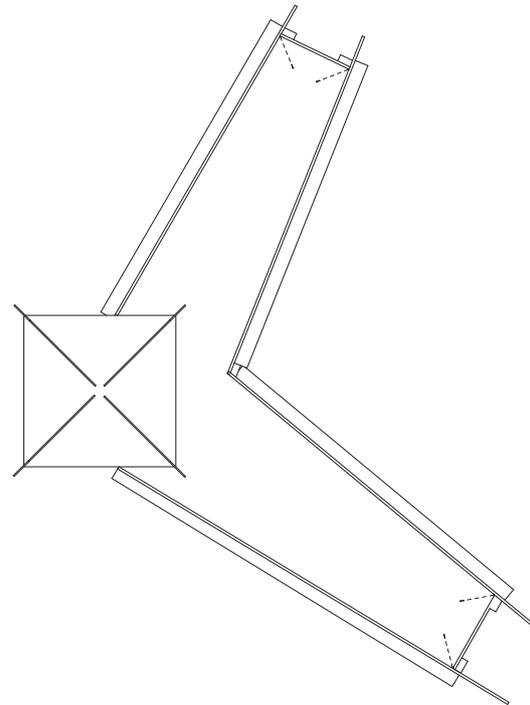
Detail highlighting angles that may need to be planed in construction for a proper fit (highlighted in a flamboyant pink)

When you have clamped your form-ply into the correct positions, use 65mm tek screws and a drill to attach the form-ply panels together. This should be done by affixing the transverse ends of the form-ply that conform to the longitudinal long-ply in place through the use of 65mm tek screws and a drill, being careful to ensure that you are installing the tek-screws through the soliders into the transverse form-ply



In the corners between the form-ply panels but not the corners between the form-ply panels and the concrete footings, using a hammer and wood-working nails, hammer a tri-block into each of corner of the bench, with the exception of where the benches meet and the angles of the connecting form-ply faces is greater than  $180^\circ$ .

*This step will ensure that the corners of the benches are chamfered, and cause less of a risk of injury through the removal of its sharp edges.*

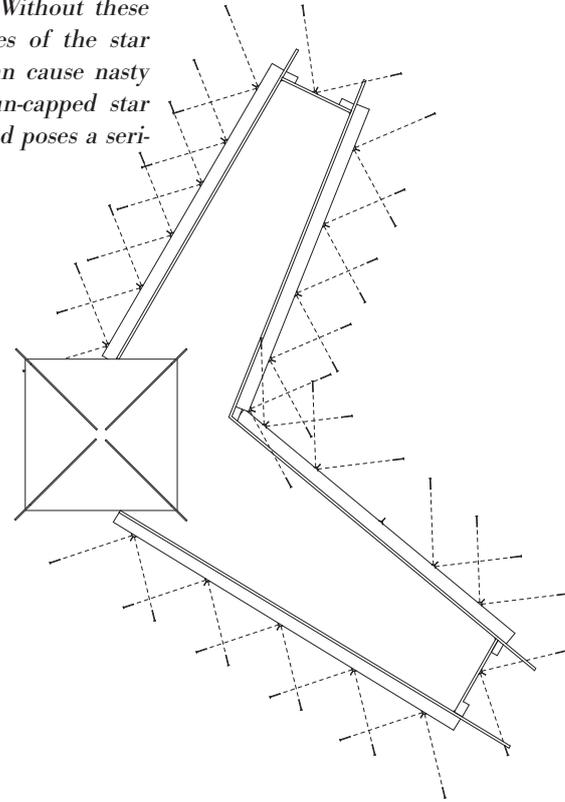


Install star pickets so that they are at the middle of each of the four longitudinal spans of form-ply, hammering them into the ground until they sit at or just above the 400mm height of the form ply, and ensuring they have been installed with their wider, flatter side (the one with the different, more obtuse angle than the other two) flush with the form ply.

Once the star picket has been installed, fit it in place with tek screws drilled through the screw holes in the star picket into the walers, being sure not to install them directly into the form-ply.

Once you have installed this reinforcement at all the middle spans of the form-ply, do so again at the ends of all of the longitudinal spans, the transverse spans are not long enough to require this installation. You may think that this step is overkill, but as you will see, the mass of the concrete is immense, and it is necessary to install as much reinforcement as possible to minimise the calamitous risk of a blowout.

*Ensure that you cap every star picket that you install into the earth. Without these caps, the sharp metal edges of the star pickets are exposed, and can cause nasty injuries. Additionally, an un-capped star picket is not very visible, and poses a serious tripping hazard.*

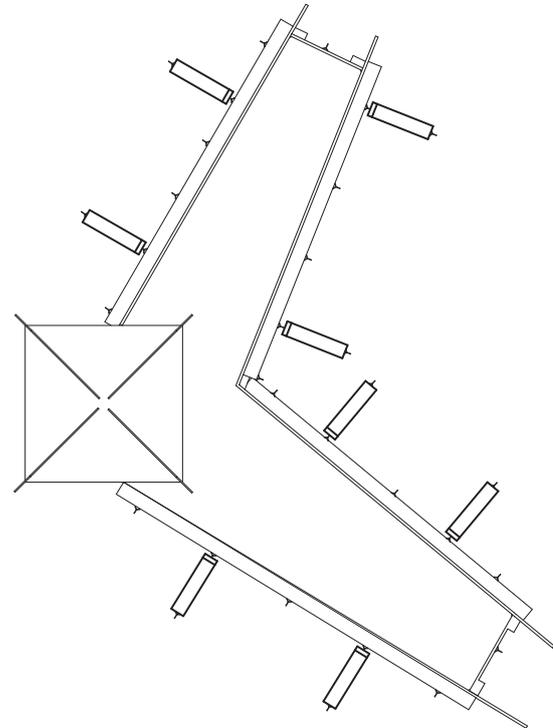


If possible, use off-cuts of MGP10 timber, or cut to size: approximately 450mm, which will be used as a timber re-inforcement.

*You do not want this to be too short as it will not be a functional reinforcement, or too long, as it may prove to be a hazard on-site.*

Place the timber so that it is touching the reinforcing star pickets that have been installed halfway along the longitudinal spans of form-ply at one end, and the ground at the other, and ensuring that the timber is firmly in place, install a star picket at the other end of the timber where it meets the ground until the star picket has been sunk into the earth and sits relatively close to the timber.

*Ensure that there is no movement in the timber and that it has been firmly wedged in place, you can test this by putting your foot on the timber and gradually applying your weight to it, if you feel any movement you may need to pull out the star picket and install it closer to the form-ply.*



As a last step of preparation for your formwork, grab a roll of masking tape and cover the holes of the batten screws that are exposed to where your concrete pour will occur.

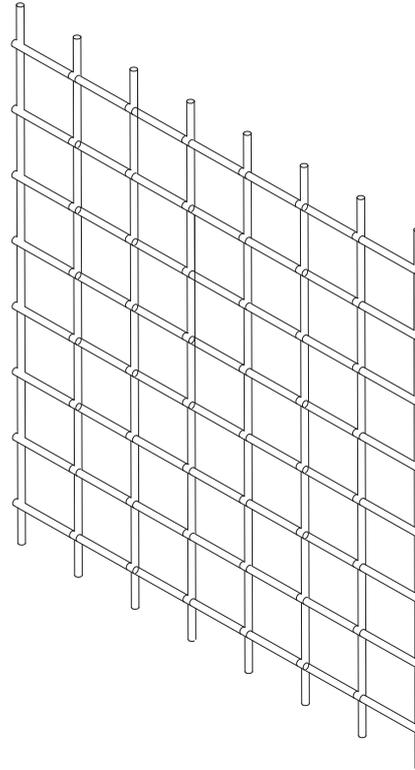
*This will help keep the threading clean and enable for an easier re-use of the fixing on another project.*

# Reinforcement

Concrete is infamous as a material for its weakness to tensile forces relative to its strength under compressive forces. To minimise the materials exposure to the former, it is necessary to install steel reinforcement, which massively reduces concrete propensity to crack under these tensile loads by acting as reinforcement to hold it in place.

For this step of the process, you will first need to have your **7mm steel reinforcement mesh**. You will then need to measure the finalised dimensions of your bench and cut the steel reinforcement with an **angle grinder** to sit in an area a minimum of 50mm from the edge of the bench.

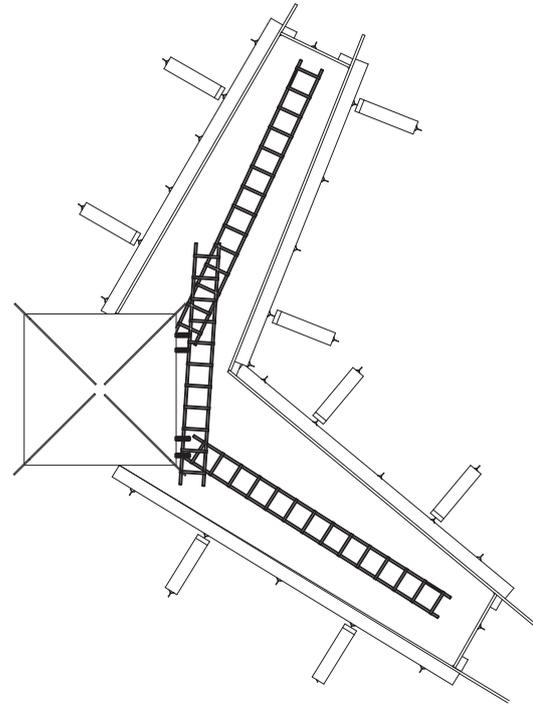
*It is important to ensure at least 50mm, as this is both in accordance with government regulations, and is in best practice as it ensures that the reinforcement will not become exposed with the erosion of the concrete over time, which can lead to both the risk of injury to people using the space, and can cause concrete cancer through allowing water into the steel reinforcement within.*



Once you have measured and cut your reinforcement to size, cut a second piece of reinforcement in duplicate, and put this to the side, this will be used to reinforce the bench from the top.

Ideally, you will have three off cuts of steel reinforcement around 300mm in length that can be reused, but if not, cut three 300mm lengths with an **angle grinder**. Then **drill** three 150mm deep holes that are 7mm thick into the form-ply side of the concrete footings at a height of 75mm from ground level. Install the 300mm steel starter bars into these holes ensuring that they are snug in place.

*These will starter bars will be affixed to the reinforcement mesh to act as an additional way to reduce the threat of the concrete cracking under the tensile loads of the movement of the earth.*

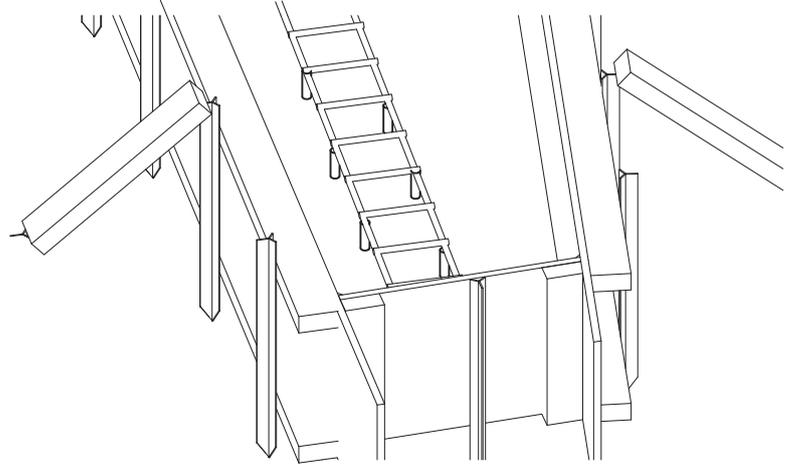


Be sure to affix your starter bars and steel reinforcement together

With one of your two sets of reinforcement mesh, place it to conform to the shape of the form ply under a bed of 75mm bar chairs. You will only need to place a bar chair alternating under each transverse intersection of the steel mesh along its length to sufficiently hold it in place. Once the steel reinforcement has been put into place, affix each sheet to one another using tie wires, and additionally tie wire the reinforcement to the starter bars.

*Bar chairs are important as without them, the steel reinforcement would simply be forced to the bottom when the concrete is poured, where it would be exposed to moisture and would be useless as it would not be sufficiently immersed in the concrete to reinforce the concrete against tensile loads.*

*Keep your duplicate set of steel reinforcement in a good, easily accessible location, as it will need to be installed quickly once the concrete is poured.*



Your starter bars only need to sit on alternating sides of the longitudinal span of the reinforcement

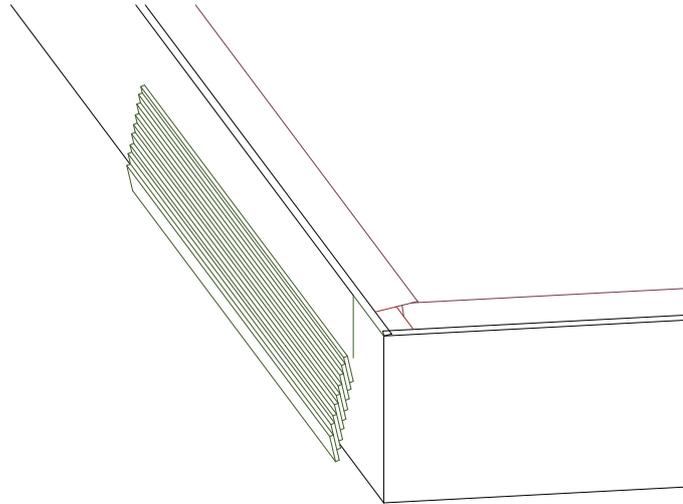
# Concrete Patterns

Four concrete patterns were chosen to be installed into the form-work to represent the culture and history of Cummeragunja. Our group was to install the weatherboard pattern, and others were selected to create patterns of reeds, fish scales, or the sand of the River Murray.

Grab your **65x8 pine moulding**. With a **mitre saw** cut into uniform lengths of 1000mm.

With each of these spans and nail with a **hammer** and **woodworking nails**, into place in the form-ply from 150mm from the top and minimum 150mm from the sides to the ground, ensuring that it resembles the inverse of a weatherboard pattern.

*By installing the point moulding so that is the reverse of the weatherboard pattern, the concrete, when poured, will fill the negative space and set in the correct pattern. It can be easy to put the pattern in incorrectly if you are not paying attention.*



# Concrete Pour

Once your form-work has been installed and reinforced, you will need to organise for a concrete truck to arrive on-site with enough **25MPA Concrete** to fill the volume of your form-work. Ensure that the site has been cleared of construction materials and tools and that there is a clear path to the form-work for the concrete truck.

*Our site was a large, clear lot, so this step was relatively straightforward, however, on a more congested or smaller lot, this step may prove logistically challenging and require greater foresight.*

When the truck has arrived make sure that no one is in the way of the truck, it will need to reverse into position and therefore the driver will have minimal visibility of people standing behind their vehicle. In my own experience, it was surprisingly easy to find yourself in that position.

Communication with the driver as they reverse into position is important, they are moving heavy machinery that could easily damage construction equipment, material or the site itself.

*to agitate the walls and then the concrete within.*

The trough that the concrete pours out of will need to be situated above the form-work. When it is in place confirm with the concrete operator and they will start the pour.

*When the concrete pours it is necessary to communicate with the pourer to ensure that the form-work is not overfilled. Additionally, you may need to use a spade to disperse the concrete more evenly across the volume. While this is occurring, you will also need to start agitating the form-work through repeatedly tapping it with a hammer, preferably across multiple places throughout. This is an important step, as it will cause the heavier sediment to settle towards the bottom of the concrete and the lighter sediment to rise to the top, allowing for the face of the concrete to appear more uniform and whole. You do not need to hit the form-work with force, just enough*

When the concrete has finished being poured to fill the volume of the form-work, use a spade to ensure a rough uniformity across your surface, and then take the second of the two duplicate reinforced steel meshes and place them on top of the wet concrete before forcing them into the body of the concrete with your boot, or a spade.

Take a **concrete float** and continually glide the float across the top of the concrete, ensure that the leading edge is not driving into the wet concrete, you will need to do this for quite a while to ensure a uniform appearance and may need to add small amounts of water to ensure that the concrete is wet long enough for you to continue to do this. While you are doing this, and the concrete is still wet, take an **edging tool** to finish the edges of the bench so that there is not a sharp edge on the bench when people use it in the future.

*Floating the concrete takes a surprisingly long time, and patience is rewarded. You do not want your concrete to dry too quickly, and on a hot day, you may need to cover it with a moistened shade cloth.*

*On our pour, we had a blow-out where the form-ply meets the concrete footing. This is one of the most likely places to happen as the form-ply is only held in place through a reinforced star picket.*

*A blow-out is easy to notice if you are paying attention, but it is quiet, meaning that it is important to maintain eyes on the form-work in this critical stage of construction. Combating a blow-out is a team sport. In my case, I, and another, attempted to hold the form-work as close to in place as possible as a third party found an extra piece of 90x45 timber lying around and was able to wedge it between the form-ply and a newly installed star picket, forcing the form-ply upright again. Concrete is an immensely dense material, and when it is wet, it wants to expand outwards towards the earth. If I and another had not gotten to the form-work in time, and additionally if a third person had not braced the form-ply with a timber reinforcement, then the blow-out would have been severe, possibly to the point of requiring for the destruction of the consequential mess, and a reconstruction of the entire bench.*

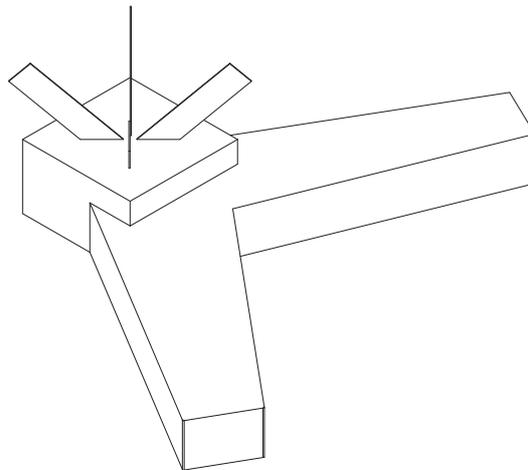
# Removing the Form- Work

It is necessary to wait at least 24 hours for the concrete to set enough to allow for it to stand without the assistance of the form-work, though this will vary according to the ambient temperature of the site throughout the time it takes to set. In the case of the setting reed pattern, we removed the form-work earlier than we otherwise would have, late in the afternoon of the day that we poured the concrete so that the concrete did not set behind the mould to the extent that it would have torn away more than the pattern upon removal. It is important to note that while the concrete will become strong enough to stand by itself after 24 hours, it will not yet have set long enough to be load bearing, and every effort should be undertaken to avoid putting it under stress.

*As concrete is quite a sloppy liquid when it is poured in place, it is likely that it will get on your pre-existing footings and the untreated steel. If this is the case, simply attach a sanding disk to your angle grinder and these stains should easily come off.*

After three days, your concrete should be

set enough that you can enjoy sitting on your lovely bench!



Reflections on place,  
sustainability, and  
community

Firstly I would like to acknowledge how much of a privilege that it was to be able to work at Cummeragunja and to hear from Uncle Col about his history and the history of Cummeragunja generally. It is a naturally beautiful place on the Murray River and surrounded by tall red gum trees. Additionally, it has an important place in the history of the Yorta Yorta peoples, and hearing about it from Uncle Col and reading about Cummera subsequently has been illuminating into both the extent and depravity of the white suppression of the Yorta Yorta peoples, and their resilience in the face of adversity.

Despite working with and for the Yorta Yorta people, and designing benches which emphasised their continuing and mutually sustaining relationship with the land, I am surprised that the material that we used by a gross majority in our construction was concrete which, in its current form, is deeply unsustainable. Concrete is largely composed of sand, whose mining practice is notorious internationally for its labor exploitation in nations with minimal en-

vironmental regulations (Pearce, 2014), and within Australia it has been well established that sand mining has been historically devastating to the biodiversity of the regions that the sand has been extracted from (Lloyd et. al, 2002, p.28). Further, concrete has been estimated to contribute 8% of global CO2 emissions (Zero Carbon Australia, 2018, p12). This is relatively damning and I think it would have been appropriate to mention this at some stage throughout the process, especially since this subject is Construction Methods A, and by virtue of that fact is setting grounding us in believing that concrete is the most fundamental of construction practices, paving the way for another generation of architects to perpetuate environmental harm through their material decisions.

I found this further perplexing as the locally sourced red gum that are used as the spans which would support the weight of the perforated steel roof would have been possible as alternatives to create wooden benches. Or failing that, wood as a material in general would have been more suitable due to its being at least tangen-

tially referential to the existing material environment. Constructing the pavilion out of wood would have been one way in which the pavilion could be disassembled in a non-destructive manner, whereas with concrete, when it is in, there is no practical way of removing it for re-use. This annihilates the possibility of a sustainable disassembly of the building either when the land is more needed for other uses, or if the land is threatened by the outside, but real, possibility of erosion from the proximate Murray River.

I also found this generic use of material questionable as in my discussions with James, the builder who assisted us during our time at Cummera, he spoke at length of his work with rammed earth which is a more similar material to concrete than wood, but is far more sustainable and would appropriately reference the context by literally appearing to come from the earth. While a rammed earth construction would require a reworking of the design to protect it from the erosive effects of rain, it would be more appropriate contextually, more sustainable, and importantly for a

university project, could be a real contribution to architectural science. I would refer to the 2014 rammed earth vault constructed by students at ETH Zurich in collaboration with Martin Rauch (Salis, p.212-216). Considering that we had a construction specialist at hand who was working contemporaneously with this material, it feels like a very real missed opportunity, though I understand that this may be outside of the feasibility of the project itself.

Despite any raised eyebrows I may have about the suitability of concrete as the fundamental construction material that we worked with in our time at Cumberagunja, the ability to witness and work with concrete as it was turned from being indiscrete to a series of unique entities was informative. I was shocked with just how plastic concrete was as it was being poured and even afterwards. The ability to save the benches from blowing out surprised me in that while I fought the concrete from spilling out of the side of the form-work its immense mass seemed unstoppable, and yet we were able to fight it back into position through teamwork. This was also

surprising as it showed how construction was participatory even in stages where you wouldn't have thought that to be the case: we were able to amend our construction mistake before it became permanent.

In writing this manual, I wanted to emphasise the fluidity of the design and construction process prior to the concrete being poured. Witnessing David O'Brien discuss the various design iterations of the bench with David, a Cummera local, was a stimulating example of the potentials of 1:1 models being able to very quickly and flexibly show alternative design possibilities, and for these possibilities to be far less abstract than were they to be shown on a piece of paper, or even as a digital model. While after our conversation with David, we were left with a resolution very similar to the original, not only had we justified to David that the design was the strongest possible version, but we had found that extra one percent that made the design just a little bit more friendly and comfortable. In this case, we refined the walking path between the two benches located between the 1000x1000 and 1000x500 footings to the

west end of the site. This experience also demonstrated the privilege of working with relatively small communities, as in city environments such as our own in Melbourne, where there are many more stakeholders in any work, community consultation is a far more grueling and bureaucratic process, while in this small, relatively homogenous community building on private land, the ability to consult informally and quickly is liberating and reduces the possibility of the end result being simply a design by committee.

This course was also contextually valuable as it was the first time that I had ever met my cohort in person. Working in person with these people helped immensely as it made me realise the efficiency of in person encounters and the flexibility of working on-site where both the designers and materials are present. More importantly though, I was able to spend time with these magnificent people at the questionably attractive Barmah Pub; I'd recommend the Barmah Parma.

Writing back this lengthy account has

made me realise that when you make every step of the construction process discrete, there are a phenomenal number of steps to be completed even for something as simple as the construction of a concrete bench can be broken down into dozens of steps in which decisions and mistakes can be made which can dramatically alter the final outcome. In a way, after constructing this, it seems a miracle that the outcome ever looks in any way similar to the initial design! Though I am sure that if you were to ask a professional to build something as opposed to a group four weeks deep into their university course, the outcome would be far more standardised. That said, this construction process has made me understand that misunderstandings and mistakes are fundamental parts of human existence and interaction, and hopefully in my time as an architect I will remember that.

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