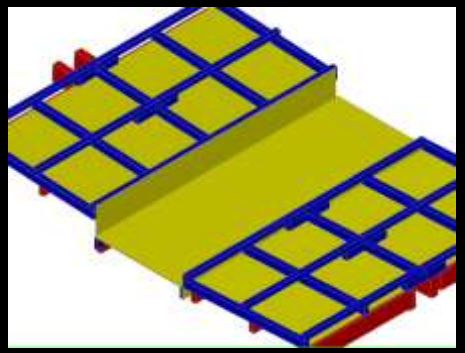
Panelisation

'Consisting of or characterised by prefabricated wall, floor, and roof sections that are shipped to and assembled at the building site'
thefreedictionary.com




The Story Of Roof Prefabrication And Installation At CoCA

ARROW INTERNATIONAL
Projects: Strategy and Delivery

August 2012

Dave Leppard

MASSEY UNIVERSITY

Background - Me

Fly Fisher
(Matt Watson Wannabe)

Snowboarder
(Shaun White/Travis Rice Wannabe)

Diver
(SCUBA Steve Wannabe)

Adventurer
(Bear Grylls Wannabe)

Fan Club – Teef the Border Collie/Frisbee Extraordinaire

Site Manager Arrow International

Background – Prefab at CoCA

- World First Seismic Design
- Post Tensioned LVL
- LVL/Precast Composite Floor Slabs
- Pre-Fab Curtain Wall
- Pre-Fab Roof

The Story Begins

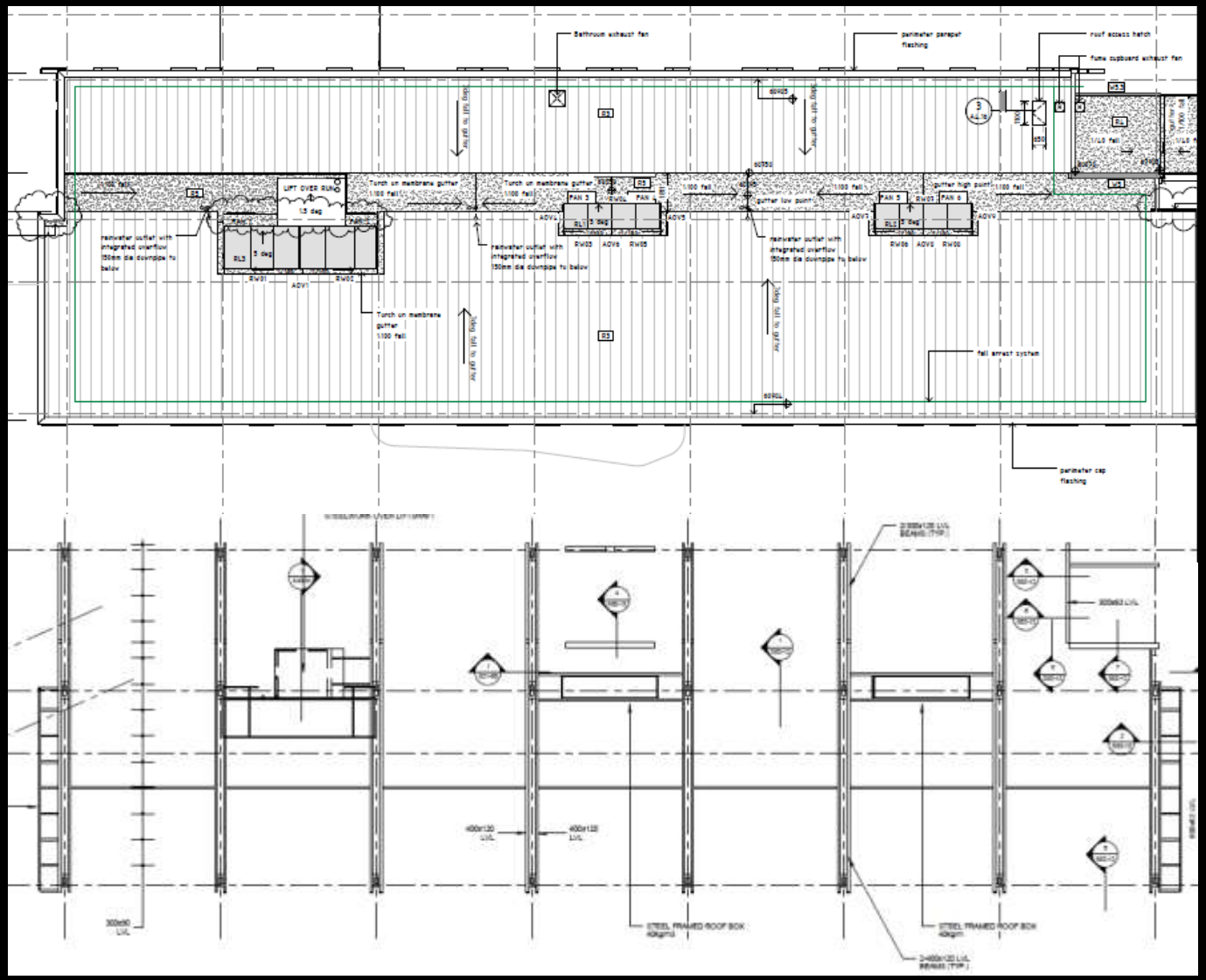
"We've had a cunning plan for this project where we could prefab the roof on the ground and crane it into place, I don't know if its possible but we want you to look into it, the drawings are in the folder, that will get you started" Peter Chisholm - Construction Manager c. April 2011

"OK, but here's my initial thoughts…

…I think you've got rocks in your head"
Dave Leppard - Site Manager c. 5 seconds later

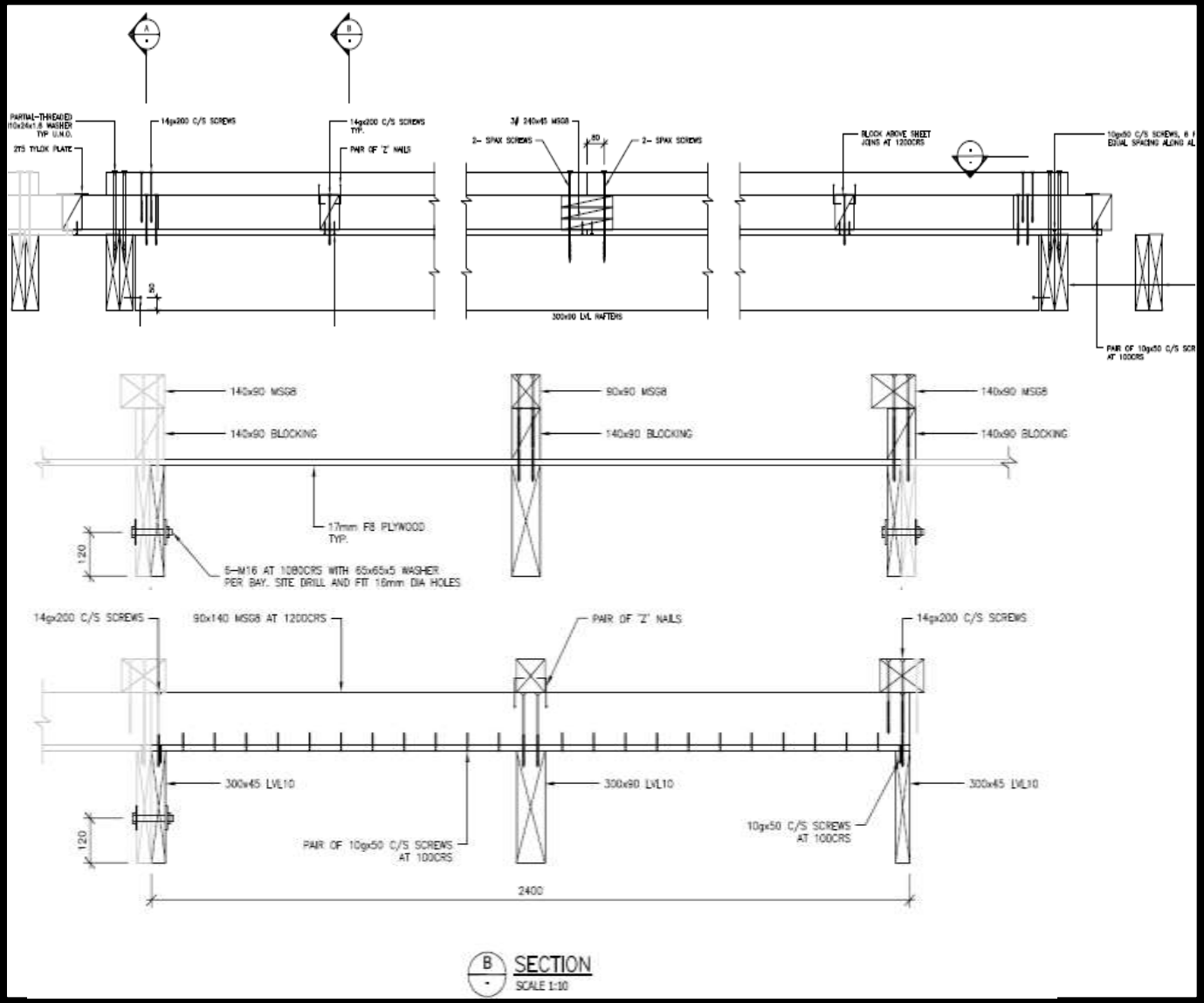
The Plans

- Approx. 55m x 17m
- Metal profile roof, torch on gutter
- LVL column precast & panel connections
- Skylights, fans, etc.
- Generic at grid lines



The Details

- Big, heavy & complicated
- Plywood is a structural diaphragm and interior ceiling lining
- Split at grid lines and at gutter



The Story Nearly Ends

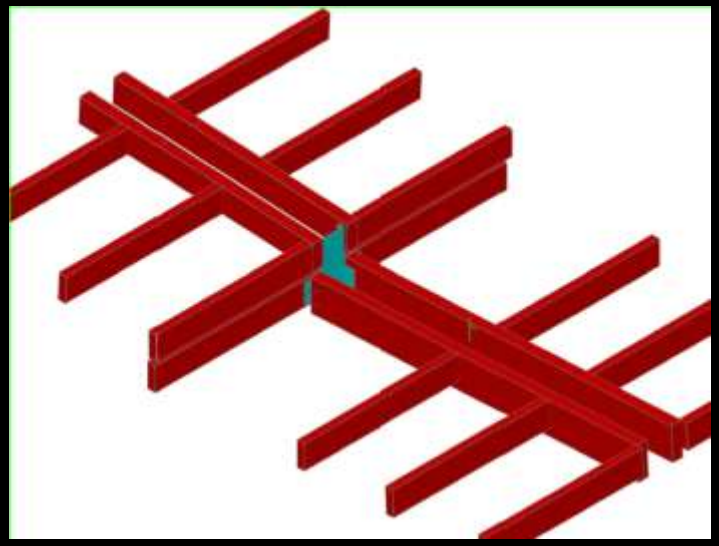
"Pete, my initial thoughts are unchanged, it will have to be split at the grid lines, but it still looks like the better option to do it in-situ, the finished ply details allow no tolerances, it could be done, but it could be really messy and there would be zero ways to fix it" Dave Leppard – Site Manager c. 1 day after initial conversation

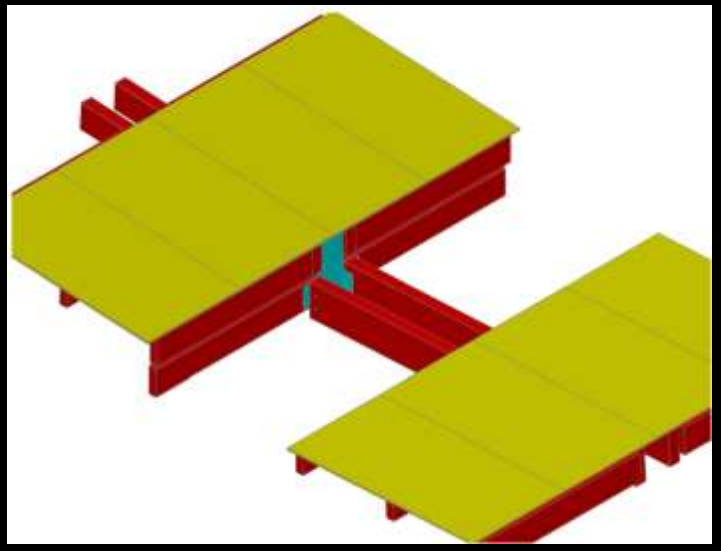
"So you say it could be done, look into it further, the way I see it, it will be highly beneficial" Peter Chisholm – Construction Manager c. 5 seconds later

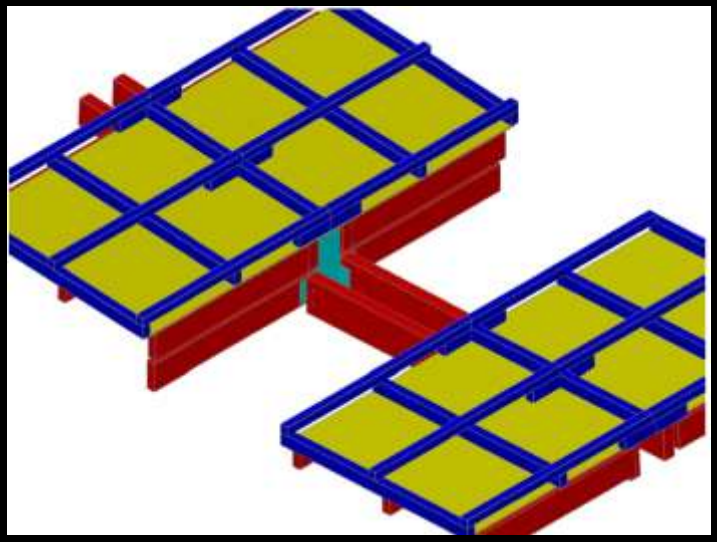
The Process

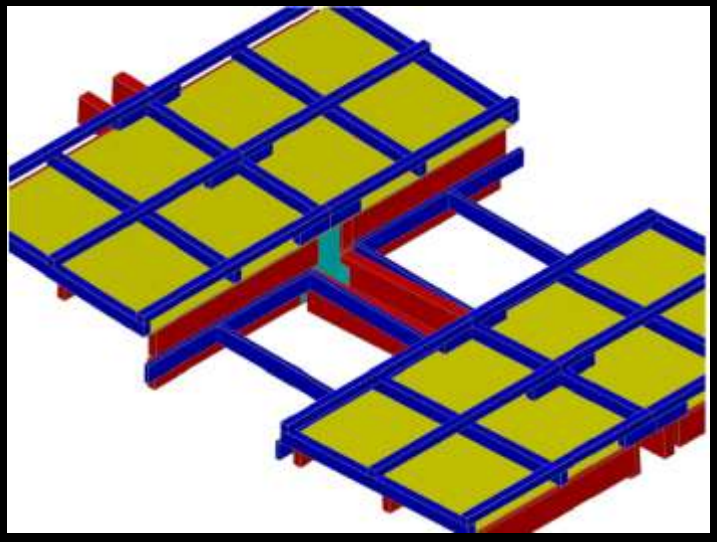
- Break it up into a list of simple questions
  - What are the problems?
  - Why – is it actually worth it?
  - How to build it, pull it to bits and put it back together accurately, safely and successfully?
  - Who will be required?
  - Where can it be done?
  - When – lead times, program, etc.
- Get others to ask questions also, as they may see something you overlook

Answers- Build a Model

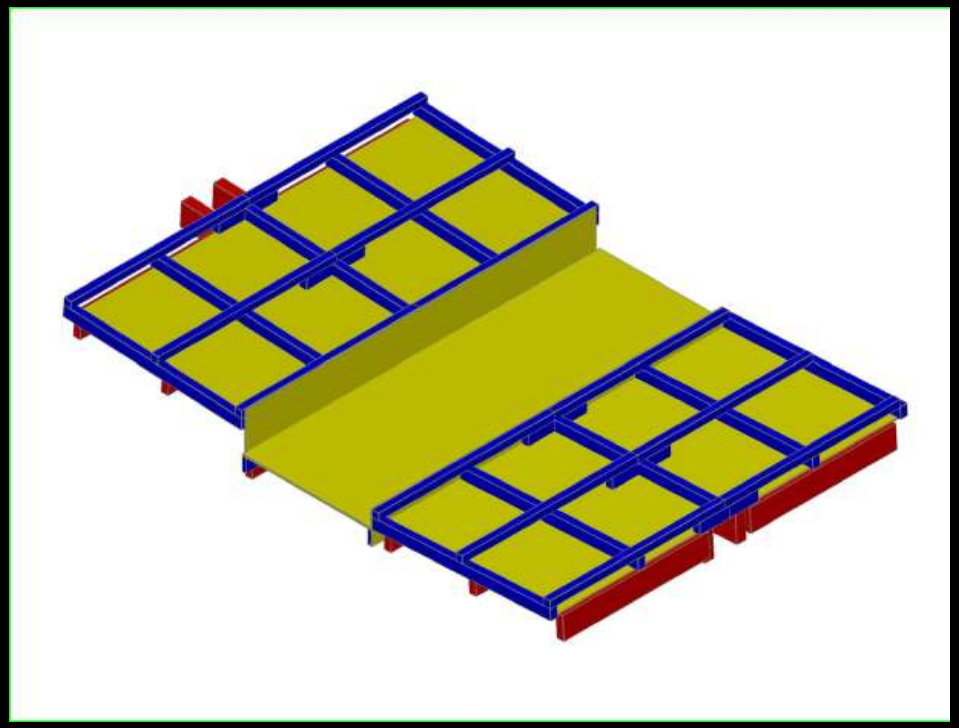


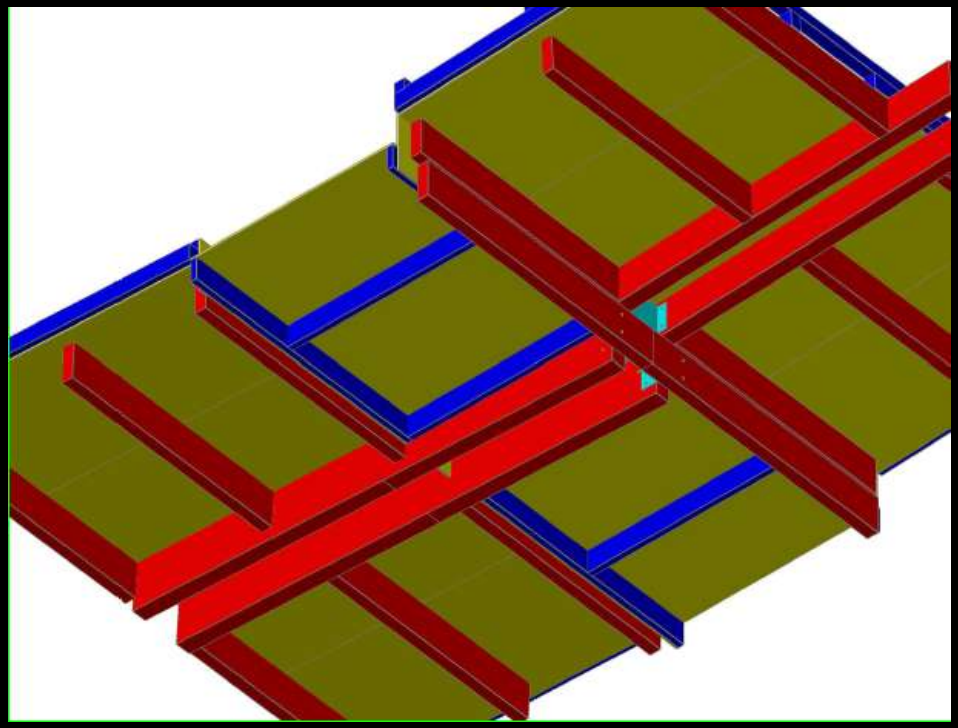






Answers - Build a Model

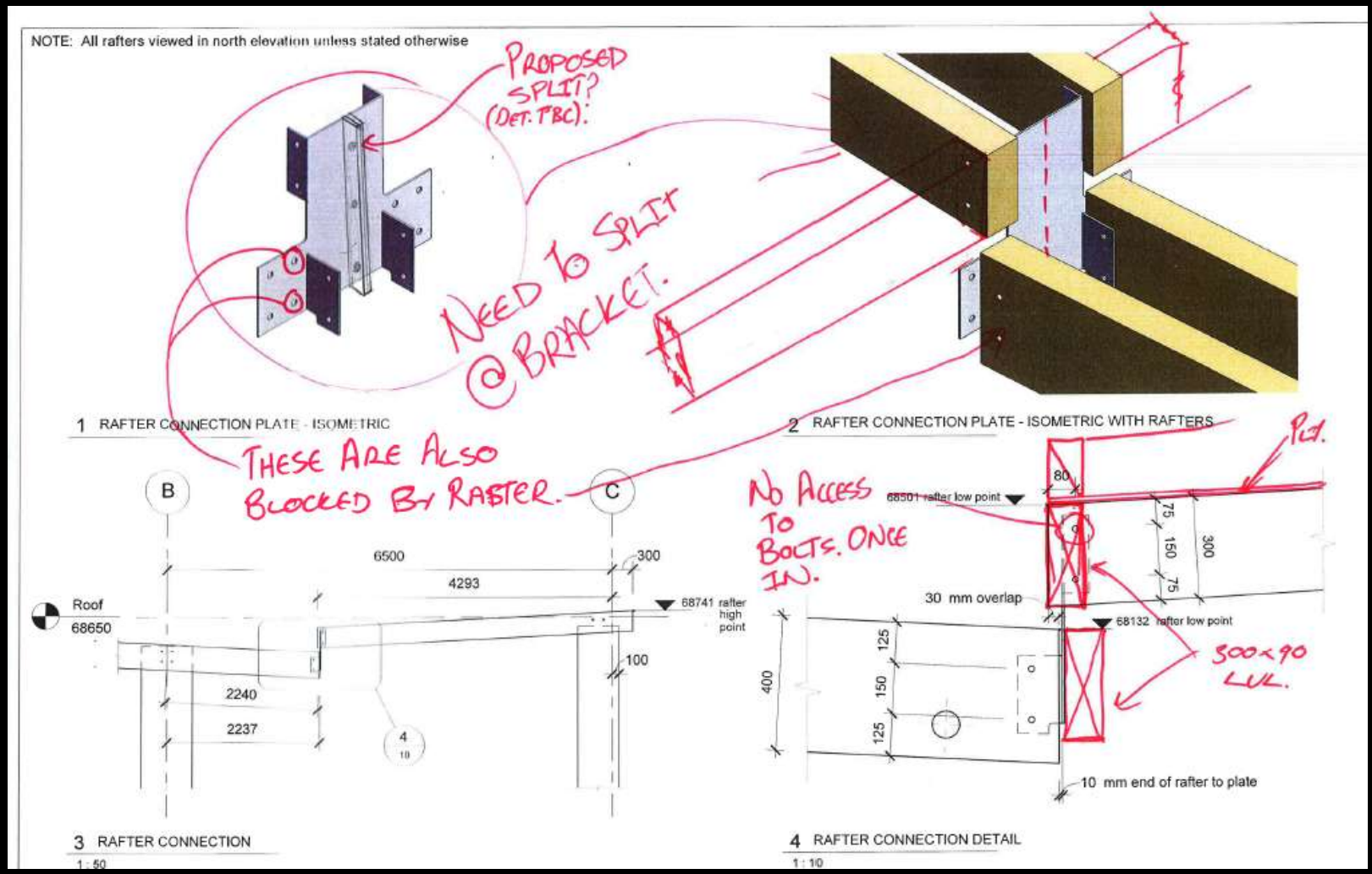




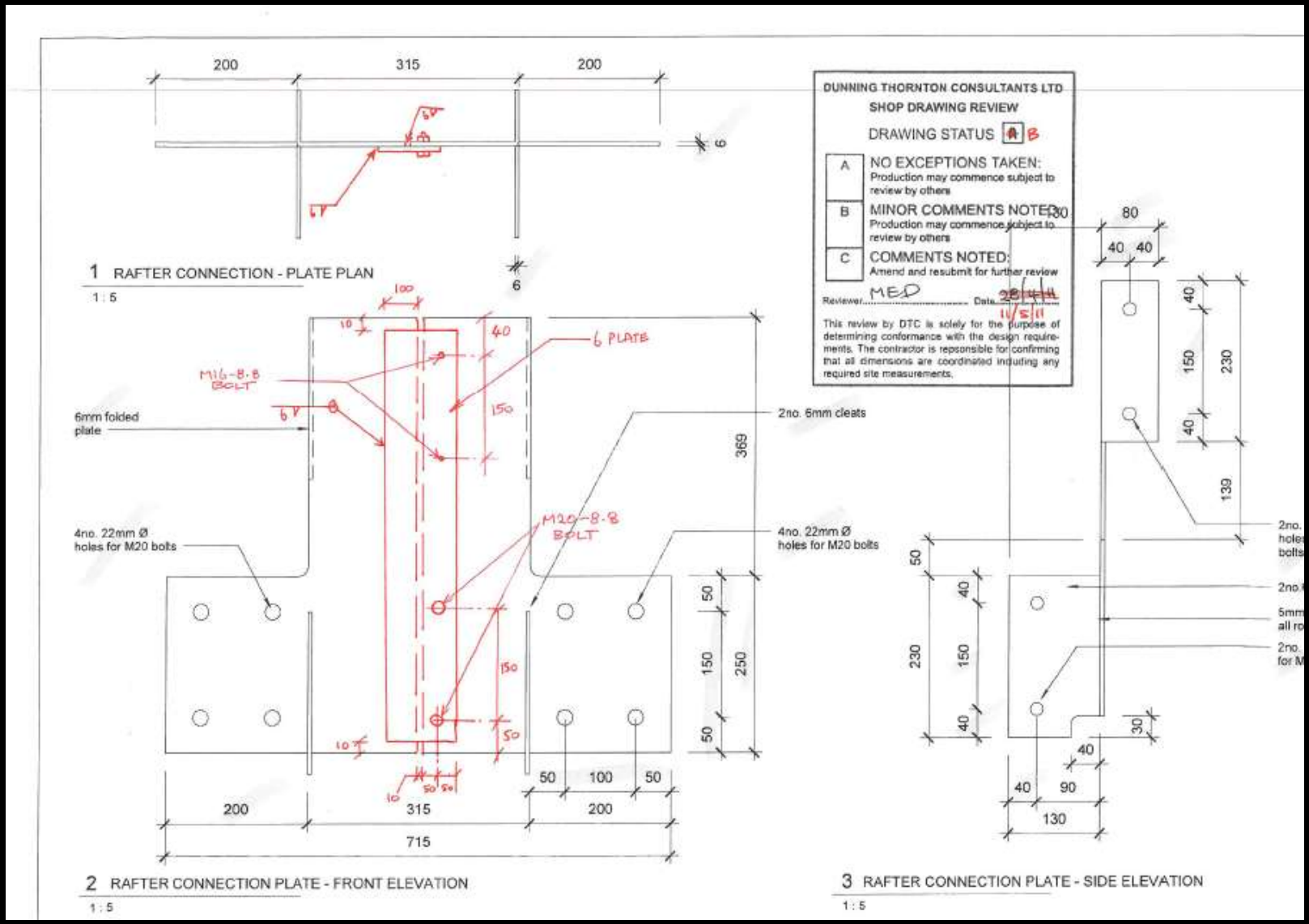
Early Answers

- What are the issues?
  - Needs to split at the gutter - problem
  - Needs to split at the gridline / rafter plate connection - problem
  - Waterproofing, ply can’t get wet - problem
  - The roof and the structure will need to be constructed with the utmost accuracy
  - Lifting, transport, installation, safety?
  - Area available – Where will it fit?
- Answers lead to more questions that need more answers

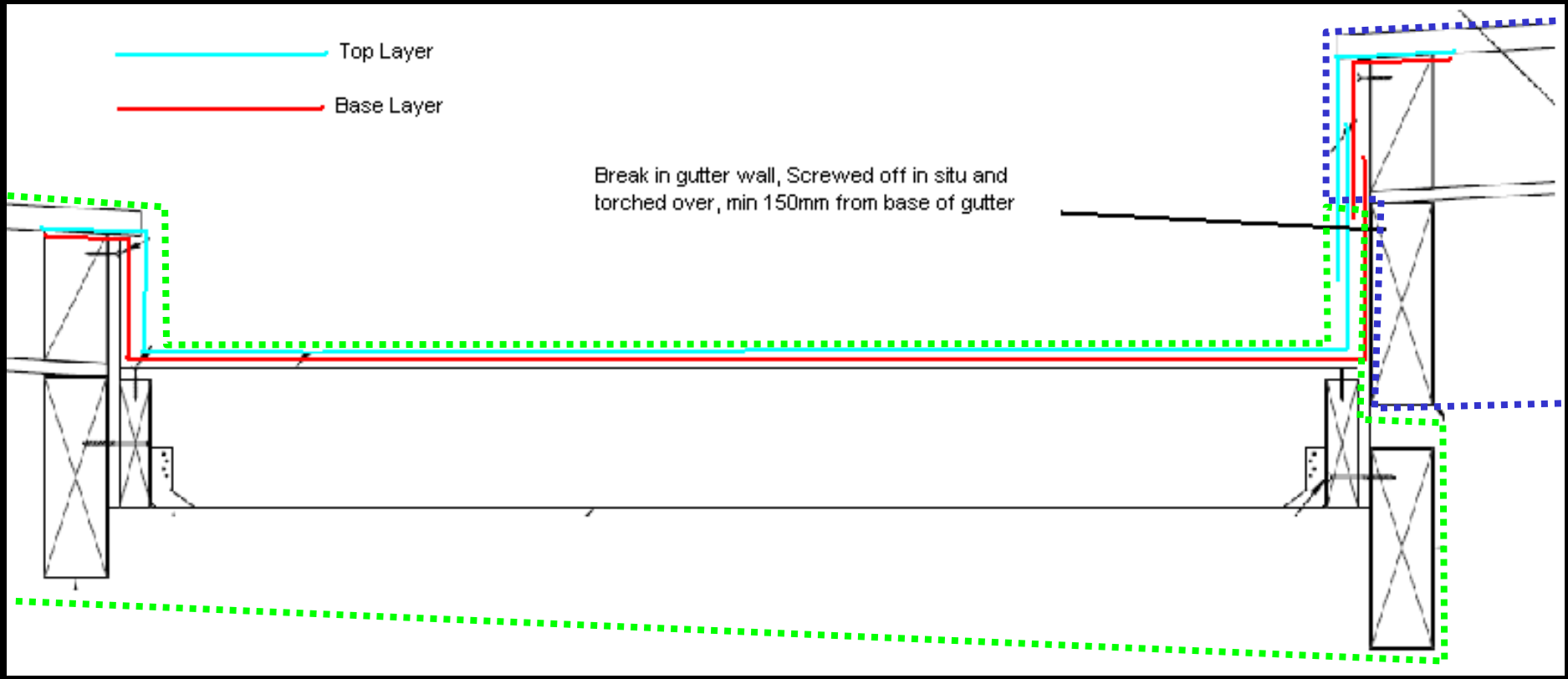
Answers- Detail Changes



Answers- Detail Changes

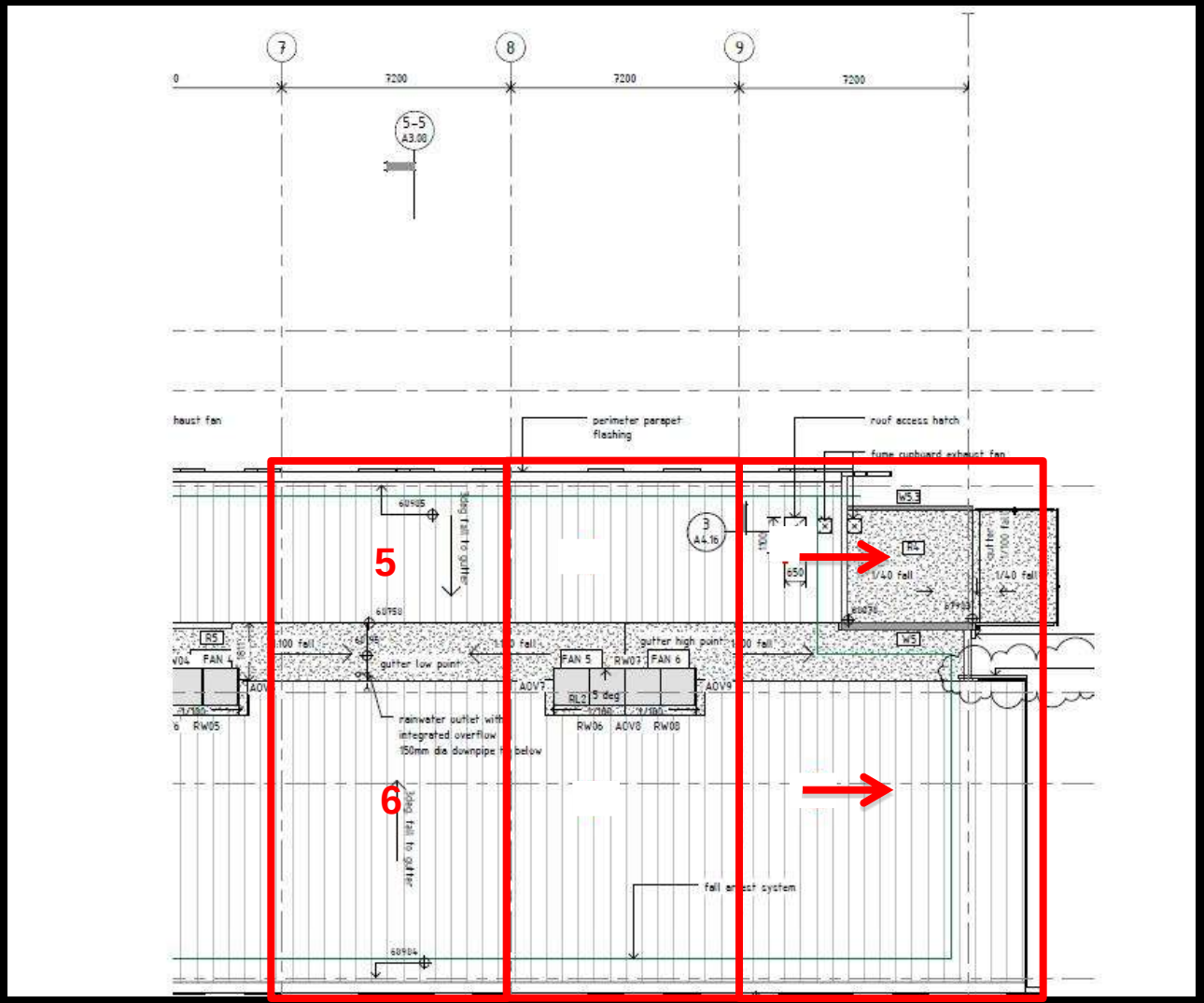


Answers- Splitting the Gutter



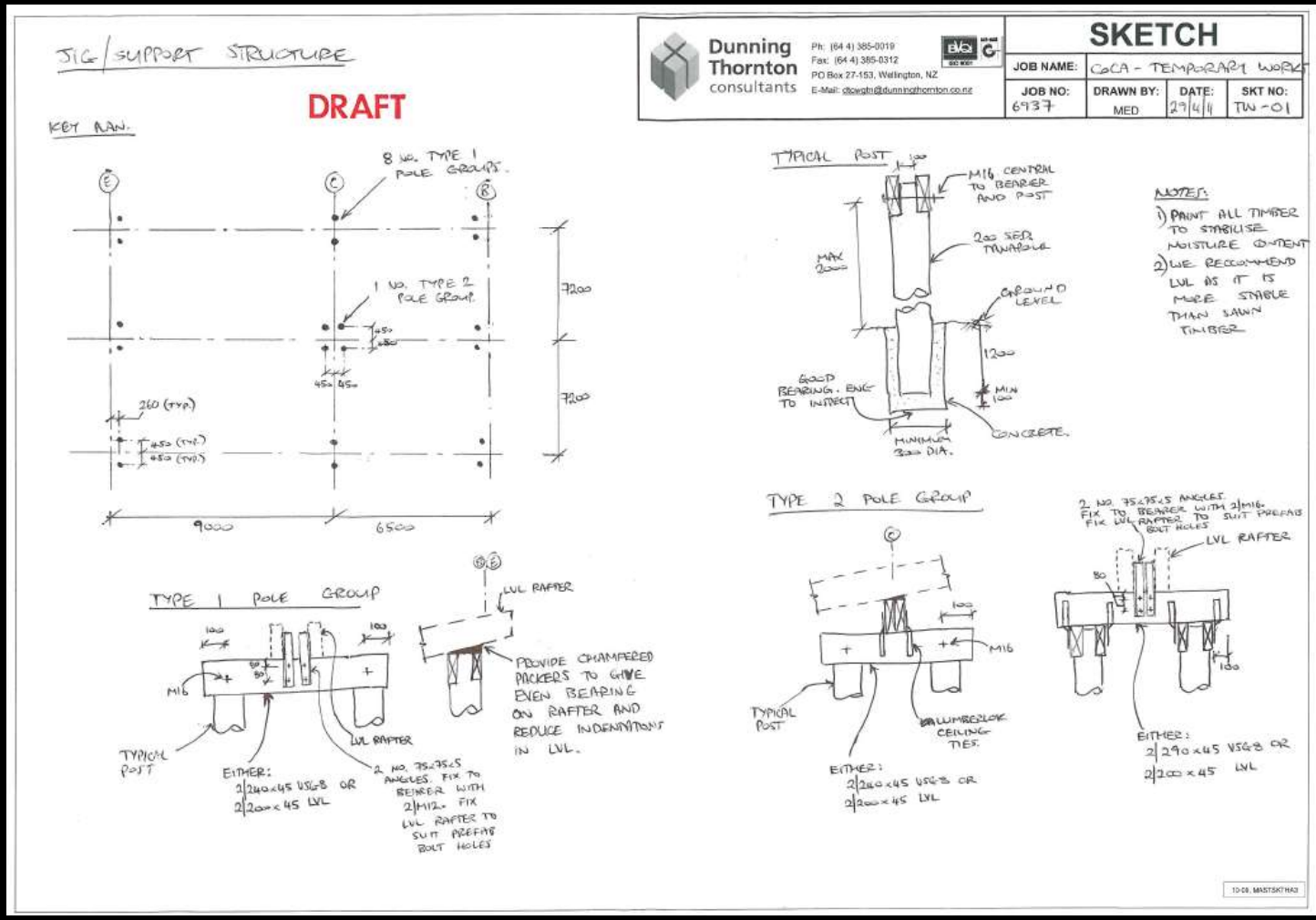
Answers – Accuracy At The Joins

1. Build two segments at a time to line up with each other
2. When Complete Remove 1&2 and install in-situ
3. Shuffle 3&4 to where 1&2 was
4. Build 5&6 using 3&4 as a guide, repeating these steps through to segments 13&14

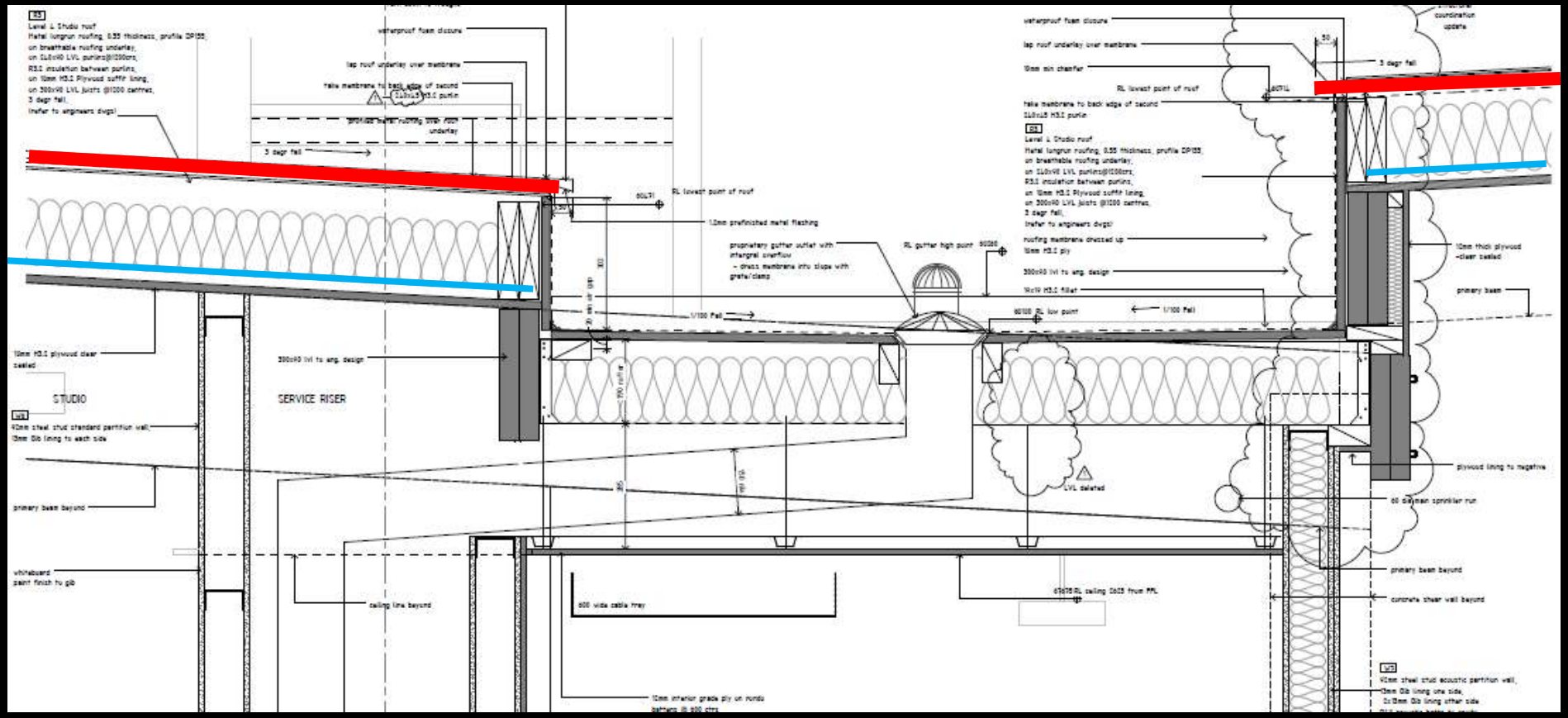


Answers – The Jig

- Engineer designed to mimic 2 grid segments of structure <u>exactly</u>
- Could not move under weight of roof
- Professional surveyor involvement



Answers – Waterproofing



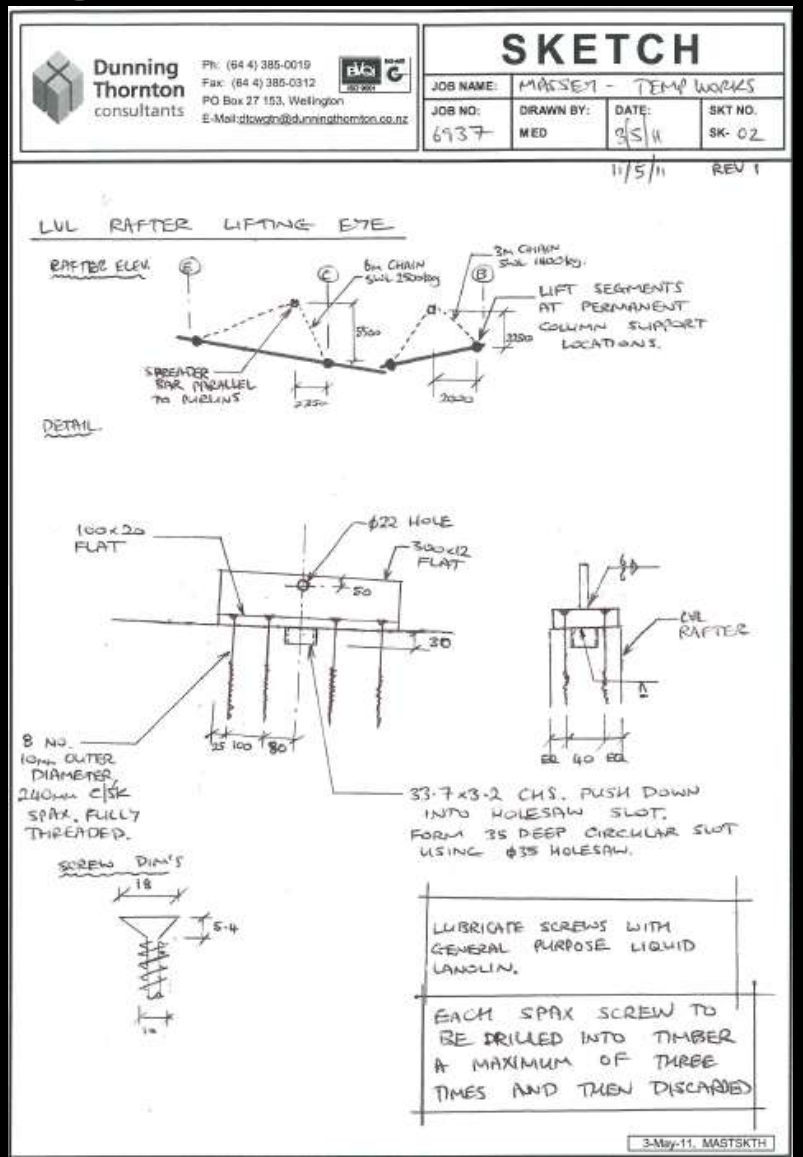
Polythene over ply, prior to framing

Corrugated Galv. Roofing, once framing complete

Answers – Lifting Points

- Engineer Design
- Needs to load beams in the manner they are designed to be loaded in their actual use
- Design SWL of 4500kg with correct safety factor
- Need to be re-usable

- No corners to be cut here, any failure could be catastrophic



Answers – Moving to site

Written Methodology

- A plan for all involved
  - Should have answers to all the questions prior to anyone asking them
- Issued to Arrow project staff, trades and consultants for comment
- Full buy in required from all parties

- Resulted in an 8 page, step by step guide to prefab, move and install the roof

Client Sign Off

- An Estimated P&G Cost Comparison was submitted

Comparative values when comparing the roof build insitu versus prefabrication				
Item		Allowance	Allowance	Comments
Programme	Estimated time to construction roof on ground	55 days		As per current construction programme
	Estimated time to construction roof insitu	71 days		30 % longer
Cranes	Cranes	Insitu	Prefab	Comments
	Crane would have been required on site 50% of the roof construction time, when built insitu. So 36 days x 9hrs x $180 per hr	$ 58,320.00	$ -	Hourly rate used $180
	Crane allowance for prefabing roof on ground	$ -	$ 22,500.00	Hourly rate used $157 average between hiab rate at $120 per hr and larger crane @$250 ph
Water proofing	Temporary water proofing	$ 8,000.00	$ 8,000.00	Required either way to protect ply wood
Other	Roller door	$ 3,400.00	$ 3,400.00	Would be required either way or the cost of temporary water proofing for insitu would have been more
	Jig set up costs	$ -	$ 15,490.00	
	Saving on P & G	$ 35,200.00	$ -	16 days of additional P& G
Totals		$104,920.00	$ 49,390.00	

$105k in-situ vs. $50k to pre-fab

Plan in Action – At the Jig

Plan in Action – At the Jig

Plan in Action – The Shuffle

Pick up 1&2

Take 1&2 for installation

Move 3&4 to where 1&2 was

Build 5&6 next to 3&4

Plan in Action – A to B

Plan in Action - Installation

Plan in Action - Installation

Plan in Action - Installation

Plan in Action - Accuracy

Plan in Action – Waterproofing

- Pre finished plywood and LVL ceiling
- Installed with 3 coats of clear
- Polythene installed under edges of metal roofing to keep batts dry & to stop water ingress from the sides

Lessons Learned

- It is as much about the planning as it is the implementation
- Check everything, double check as accuracy has to be millimetre perfect
- Importance of toolbox talks and buy in from subs
- Prefab as close to the building as possible
- Bigger area to prefab more at once would be better
- You become an expert by the end
- Keep a good crew - Bill Stockman, Pete Chisholm, Tom Watson, Wendy Jacob – Arrow Site Crew
  - Use good and open minded subs

Facts and Figures

- It was worth it - Comparison prefab vs. in-situ
  - P&G Cost - ~ $60k vs. est.$105k - 57%
  - Time to build roof – 60days vs. est. 90days – 66%
  - Program Benefits to overall Project – est. 2months – 12%

- Safety Benefits
  - Time spent working a height - 7days vs. est. 90days – 8%
  - Less time spent doing high risk works - less complacency
  - Eliminating fall from height hazard – A laugh vs. A fatality
  - Less time completing high risk works – Justifies using more expensive but more suitable contractors

Moving Forward

- The light has been seen!!!
  - Due to the successes with pre-fabbing at CoCA and other projects, we now look at all our projects differently – Added Value to Clients

Moving Forward

- We prefabbed 3 of 4 timber framed roofs at CoCA - Our builder saw the benefits and wanted to pre-fab.
  - Tender rates were for in-situ win-win, Arrow time – Builder $

  - The builder now looks to pre-fab, checks the risks and finds a way to overcome them – Changed Mind-Set For Subs

The Story End's – For Now

"We built the roof in the wrong spot, it was it faster, safer and easier to do than building it in-situ. All it required was asking questions and getting the right answers. People say it was a clever way to build it… …it was the only way to build it"...

Dave Leppard – Site Manager and pre-fabrication convert

"Yeah, but you pretty much called me a …"

Pete Chisholm – Construction Manager