



Consulting
Engineers

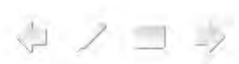


Multi-storey timber buildings and new-generation timber piling for the Christchurch CBD

Mark Batchelar & Mike Newcombe; **mlb** Consulting Engineers

Simon Woodward; Geotek Services Ltd

John Reelick; TTT Products



Structural Timber Design Specialists

www.mlb.co.nz



Introduction

Multi-storey timber buildings:



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- Deflections govern (reserve strength)





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Multi-storey timber buildings:

- Deflections govern (reserve strength)
- Can be designed to avoid loss of life and minimise financial loss
- Easy to identify post-event damage
- Repair is easily done (if necessary)





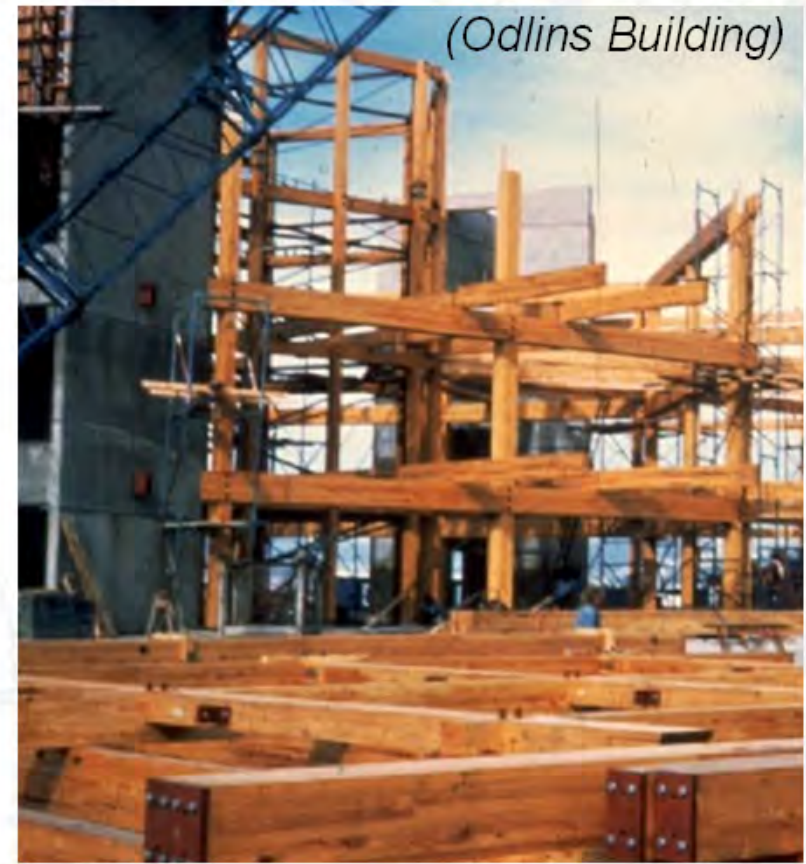
Introduction

Multi-storey timber buildings:
New Zealand

(Martin Square Apartments)



(Odlins Building)



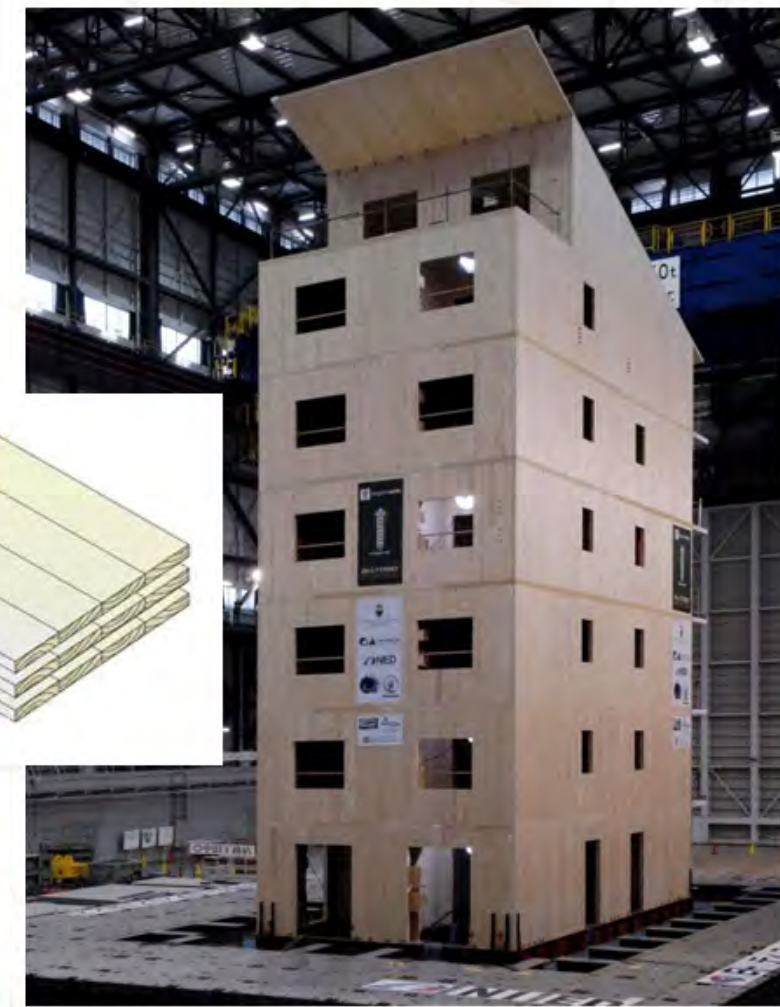
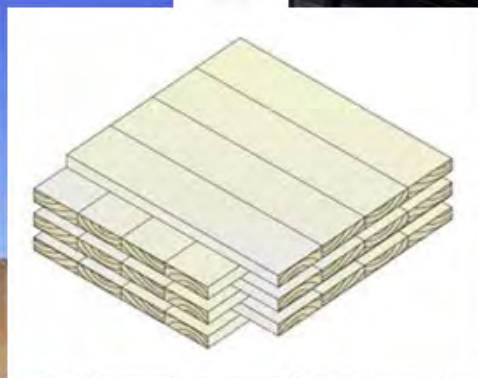


Introduction

Multi-storey timber buildings: Europe



(9-storey CLT Building, London)



(6-storey CLT Building, Sofie Project)





Introduction

Multi-storey timber buildings: North America



(NEES Wood capstone test)



For New Zealand:

- Solid timber
- Commercial buildings
 - Ruby's





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For New Zealand:

- Solid timber
- Commercial buildings
 - Ruby's
 - Designs for Christchurch





For Christchurch

There are options...



Glulam or
CLT



LVL



Rounds



Why use MS timber buildings?

- A national commodity
- Low energy (sustainable)
- Easy-to-build
- Rapid-to-build
- Fire performance
- Structural/seismic performance
- Reduced mass:
 - » Reduced seismic demand
 - » Reduced foundation demands



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How does it compare?

It depends...

- For a typical floor with a span 8m.
- Using Interspan Precast Concrete Floor
- Compared to the timber concept buildings

Superstructure	Concrete	Steel/concrete	Timber
Approx. weight (kPa)	5	4	2



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Superstructure	Concrete	Steel/concrete	Timber
Approx. weight (kPa)	5	4	2

So these timber buildings are approximately:

- 50% the mass of steel/concrete buildings.



What is the effect on foundations?

For the Christchurch CBD

- Strata of Sand, Silt and Peat usually with underlying Sandy Gravels
- Primary concern is limiting long-term and liquefaction induced settlements
- Many sites exclude shallow foundations
- Piles taken down to dense gravels



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This means:

- Reducing the building mass allows (roughly) a proportional reduction in the number of piles



Consider a case study

Café Valentino's

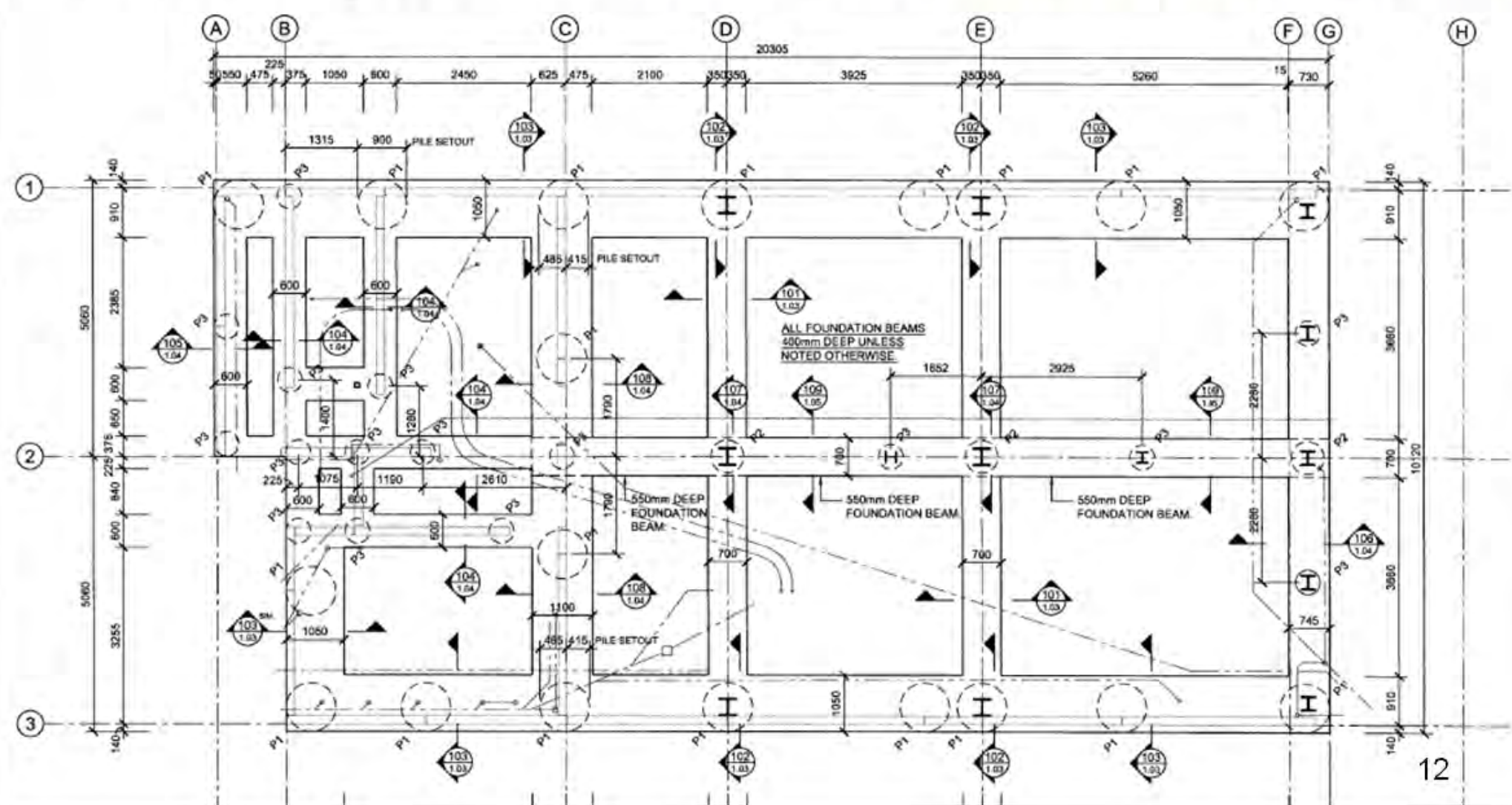


- Information provided by Di Lucas
- Geotechnical report by Geotech Consulting Ltd
- Structural foundation design by Constructure Engineering Ltd



Consider a case study

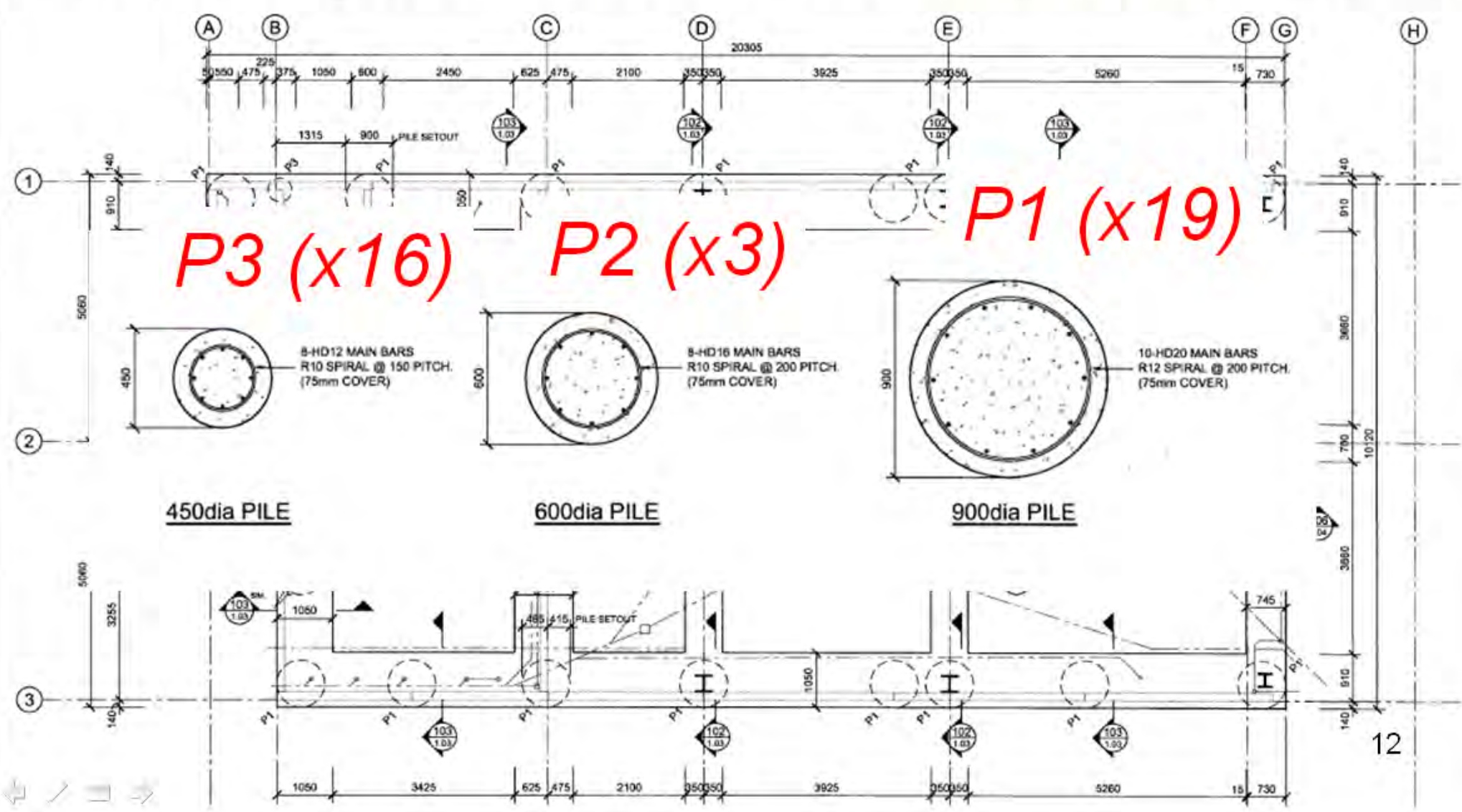
Original design: Constructure Structural Engineering





Consider a case study

Original design: Constructure Structural Engineering

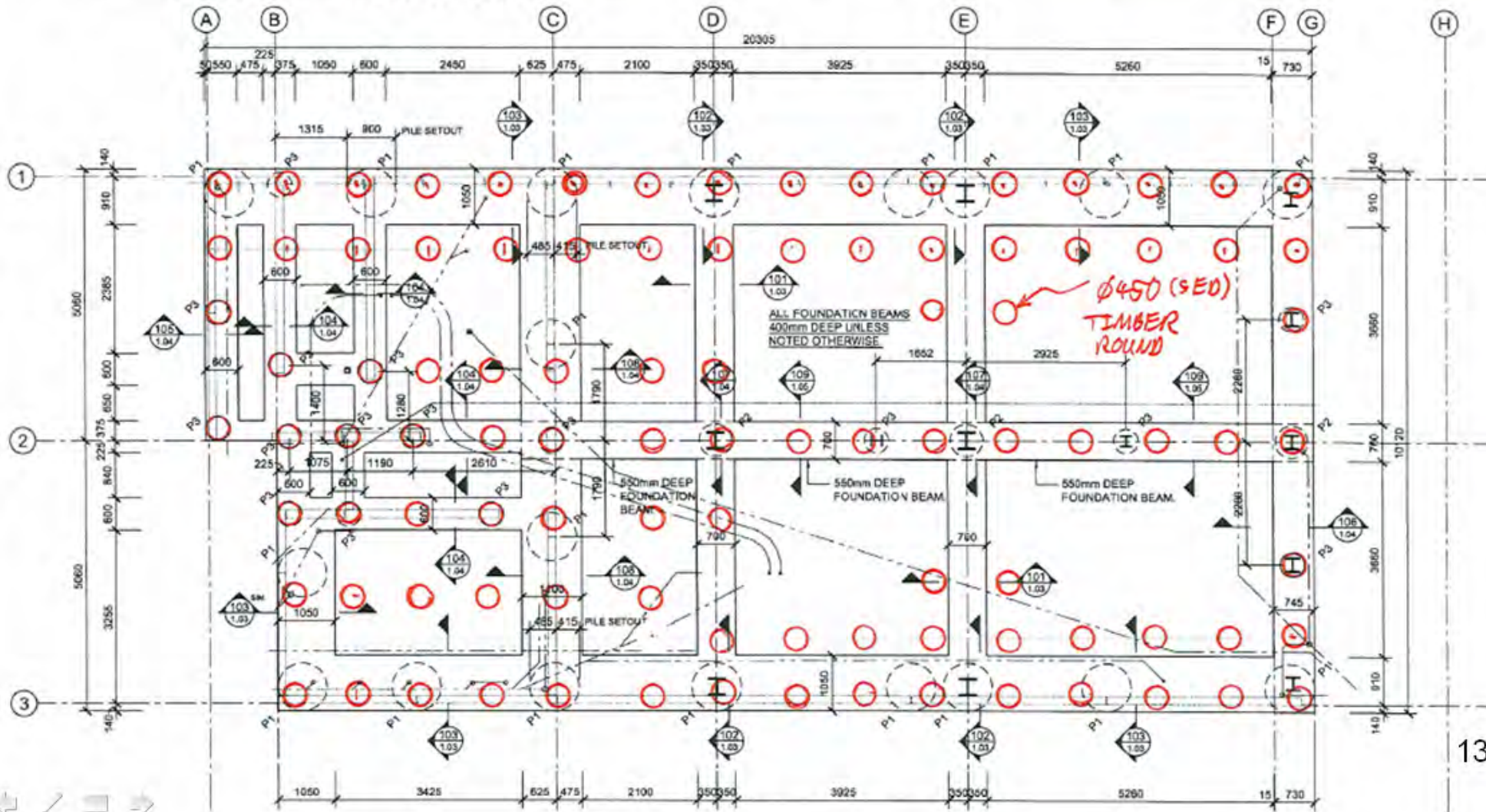




Consider a case study

Option 2: Timber piles

- Total = 98 Piles

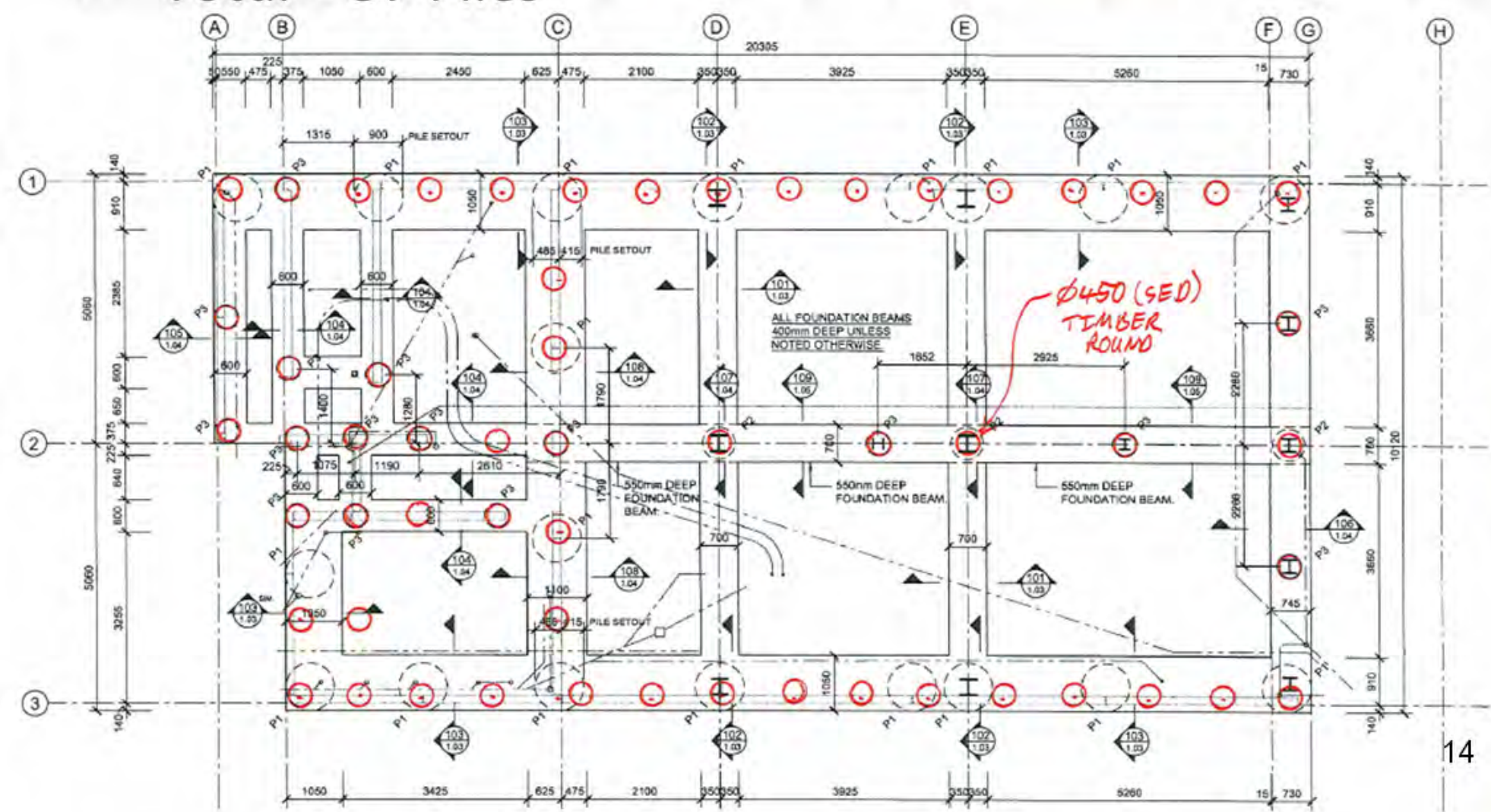




Consider a case study

Opt. 3: Timber superstructure and timber piles

- Total = 57 Piles





Round Timber Piles



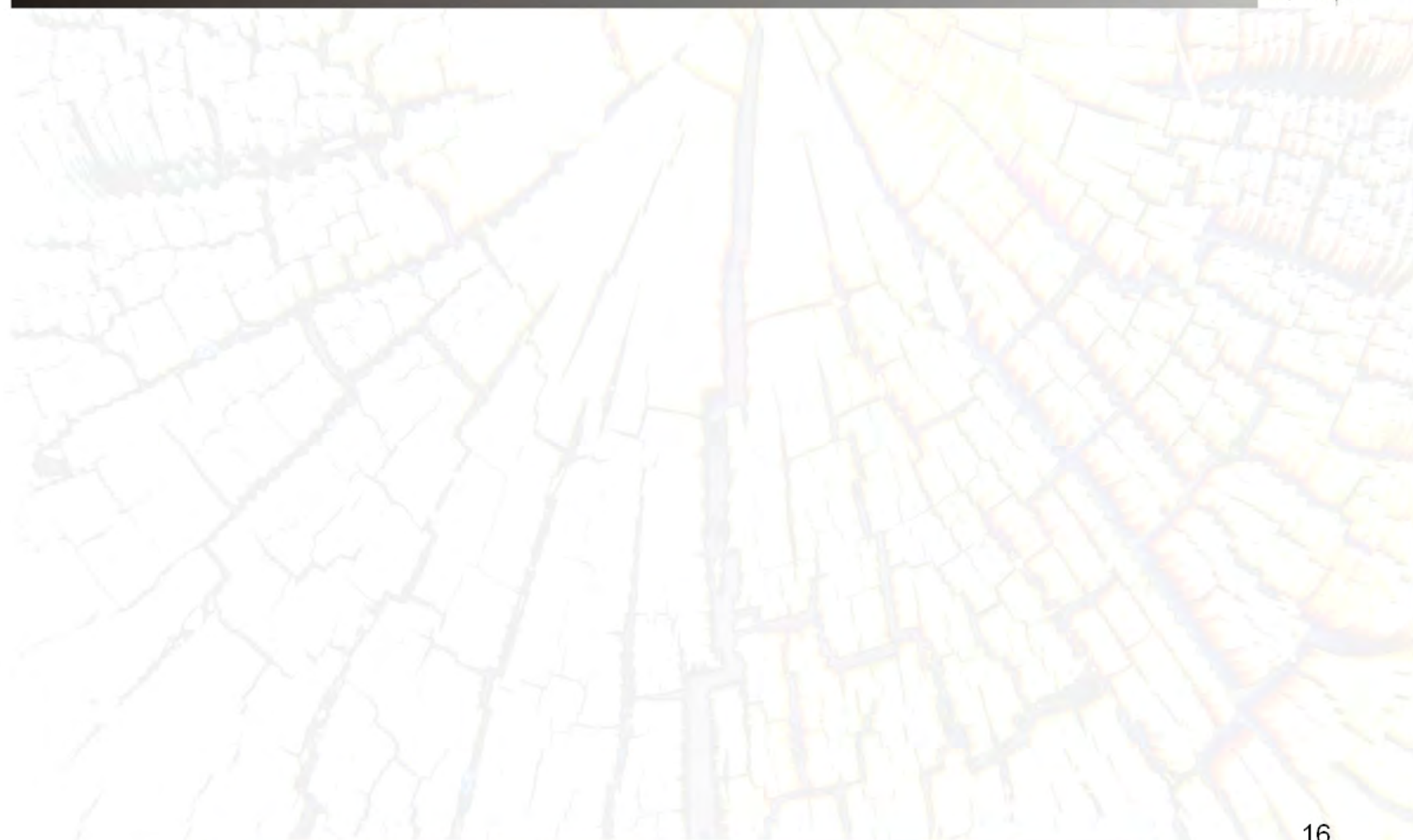


Round Timber Piles





Issues for timber piles

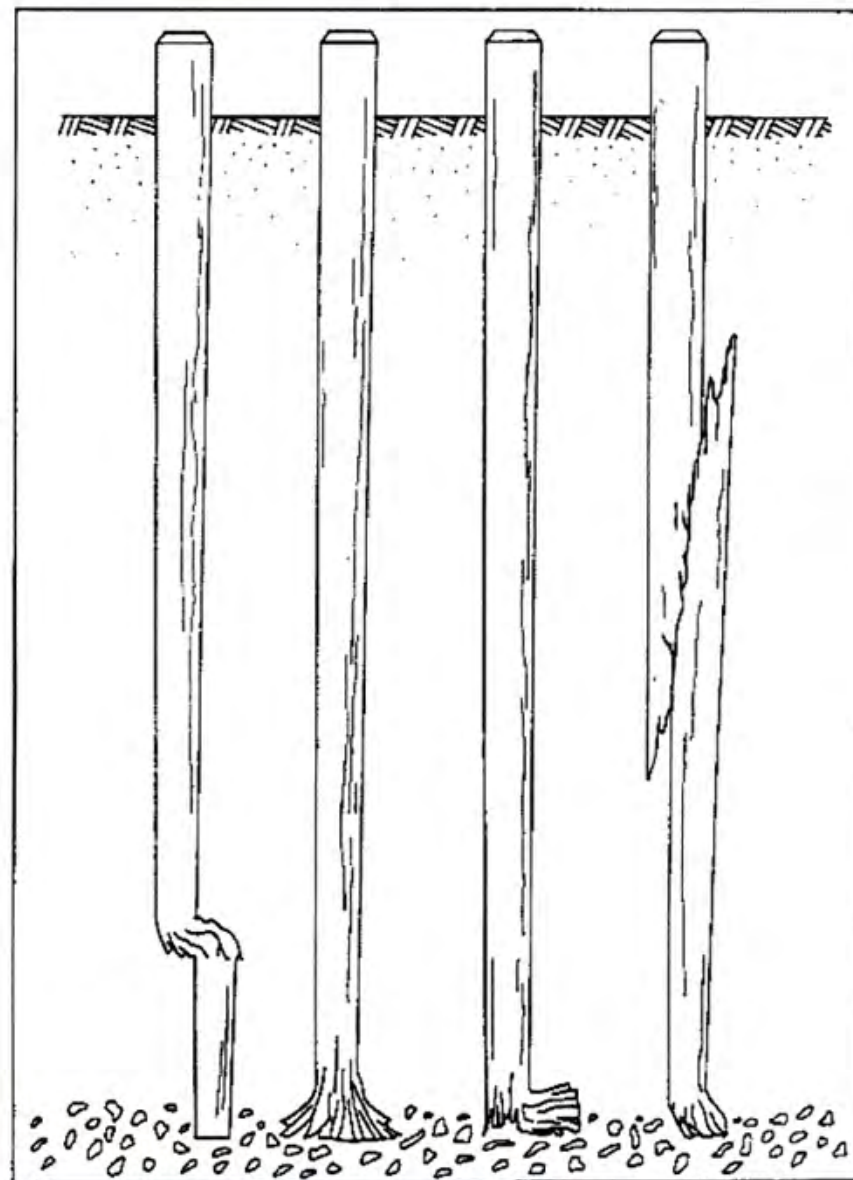




Issues for timber piles

Overdriving:

- *May occur in Chch*



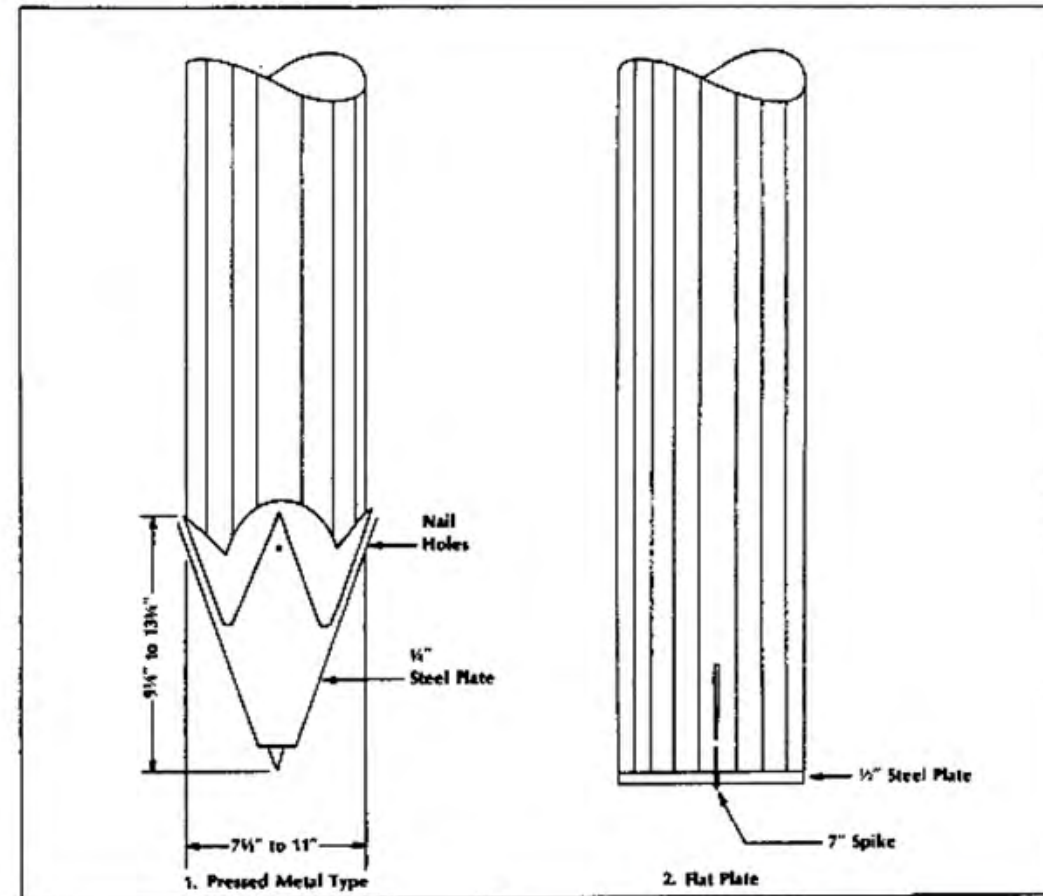
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Issues for timber piles

Overdriving:

- May occur in Chch
- Can armour pile tip

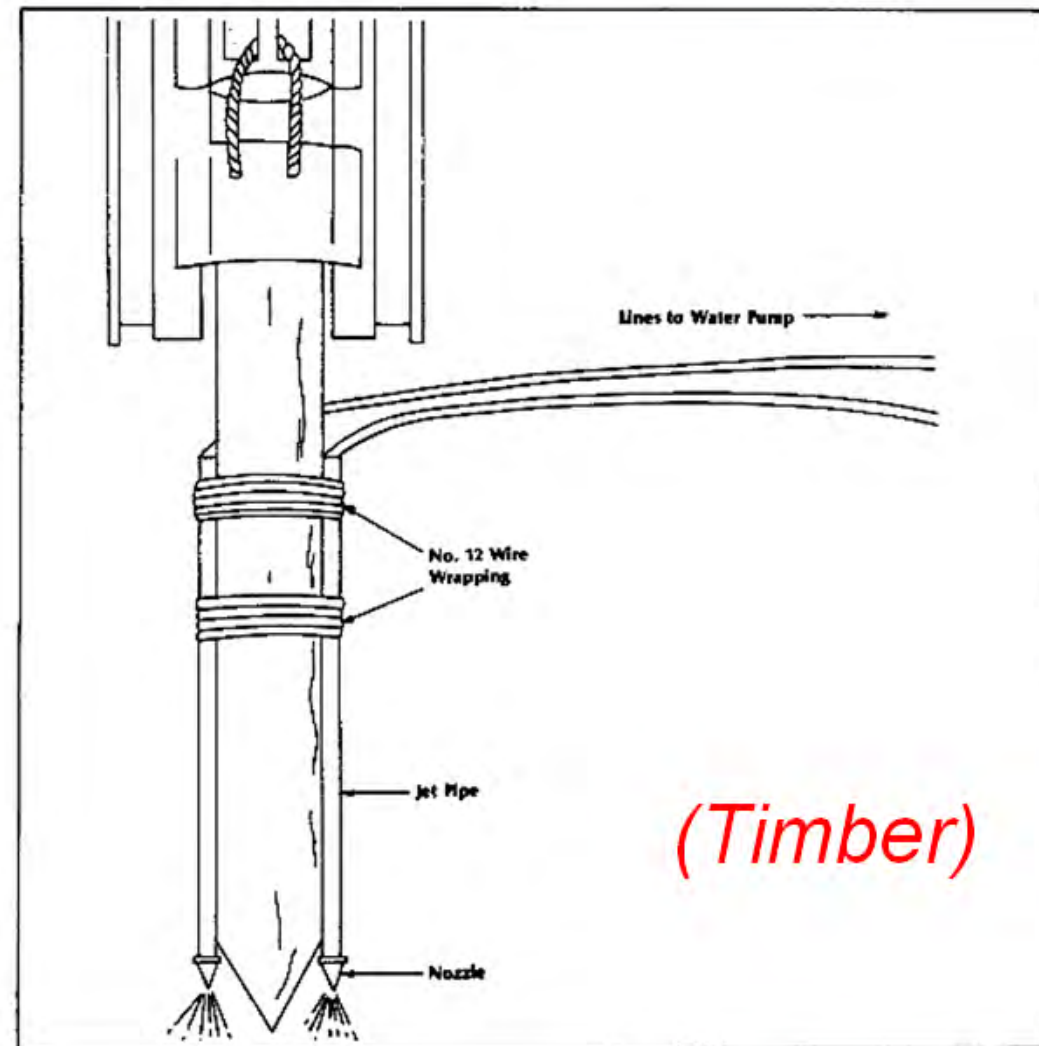




Issues for timber piles

Overdriving:

- *May occur in Chch*
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- *Can use water jetting...*

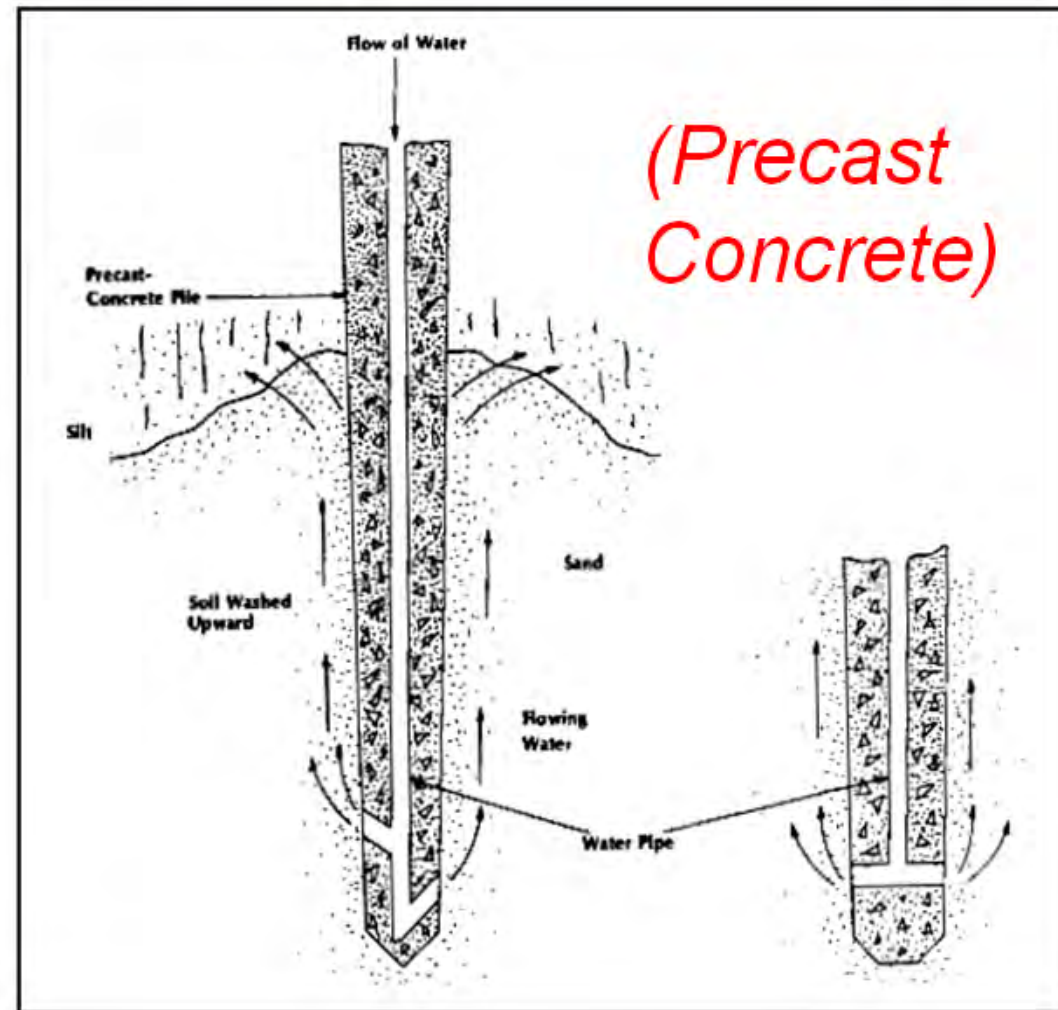




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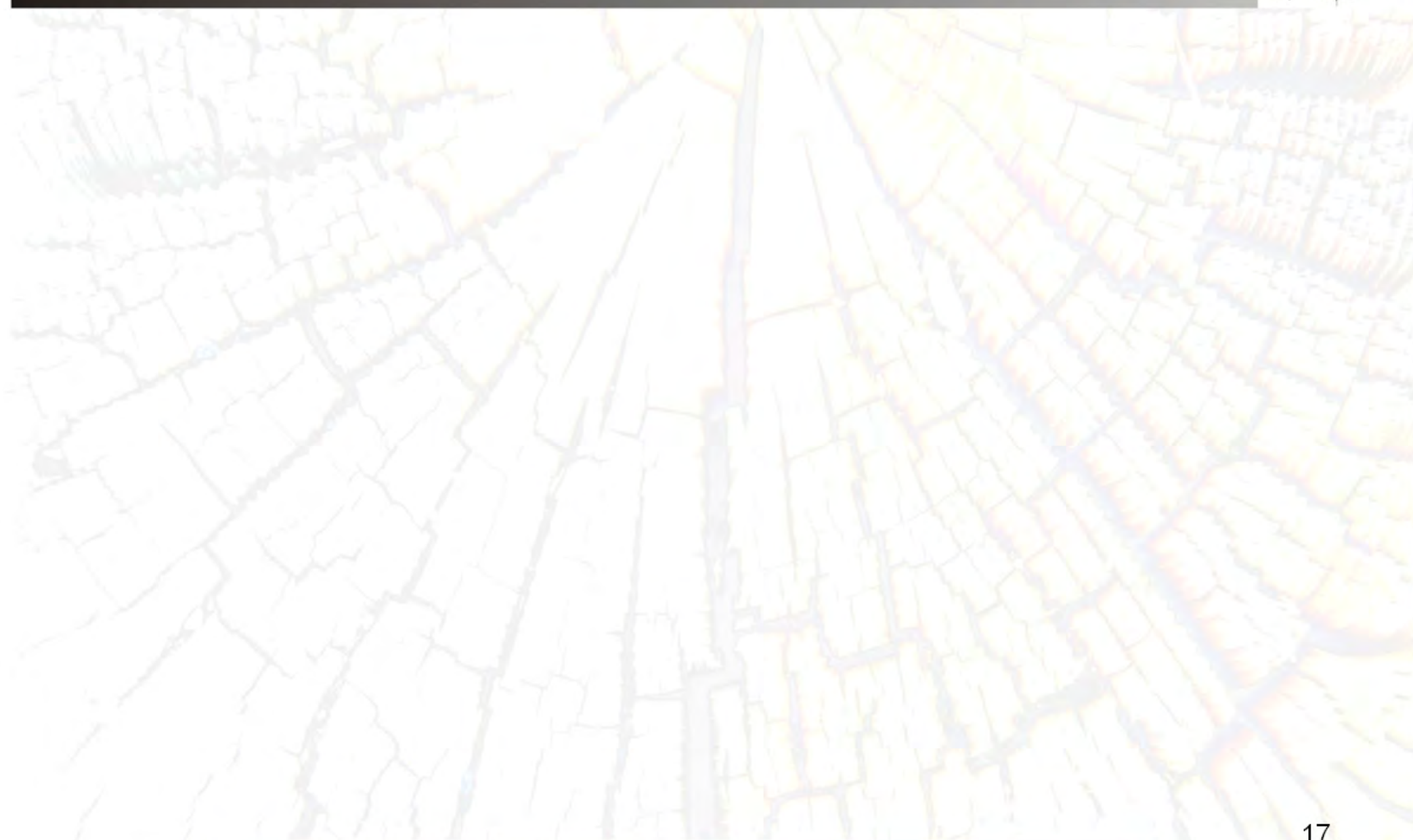
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Our Proposal





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Use hollow timber rounds:

- *Up to 18m long*





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- *Use Hitman and/or camera to inspect*



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Our Proposal

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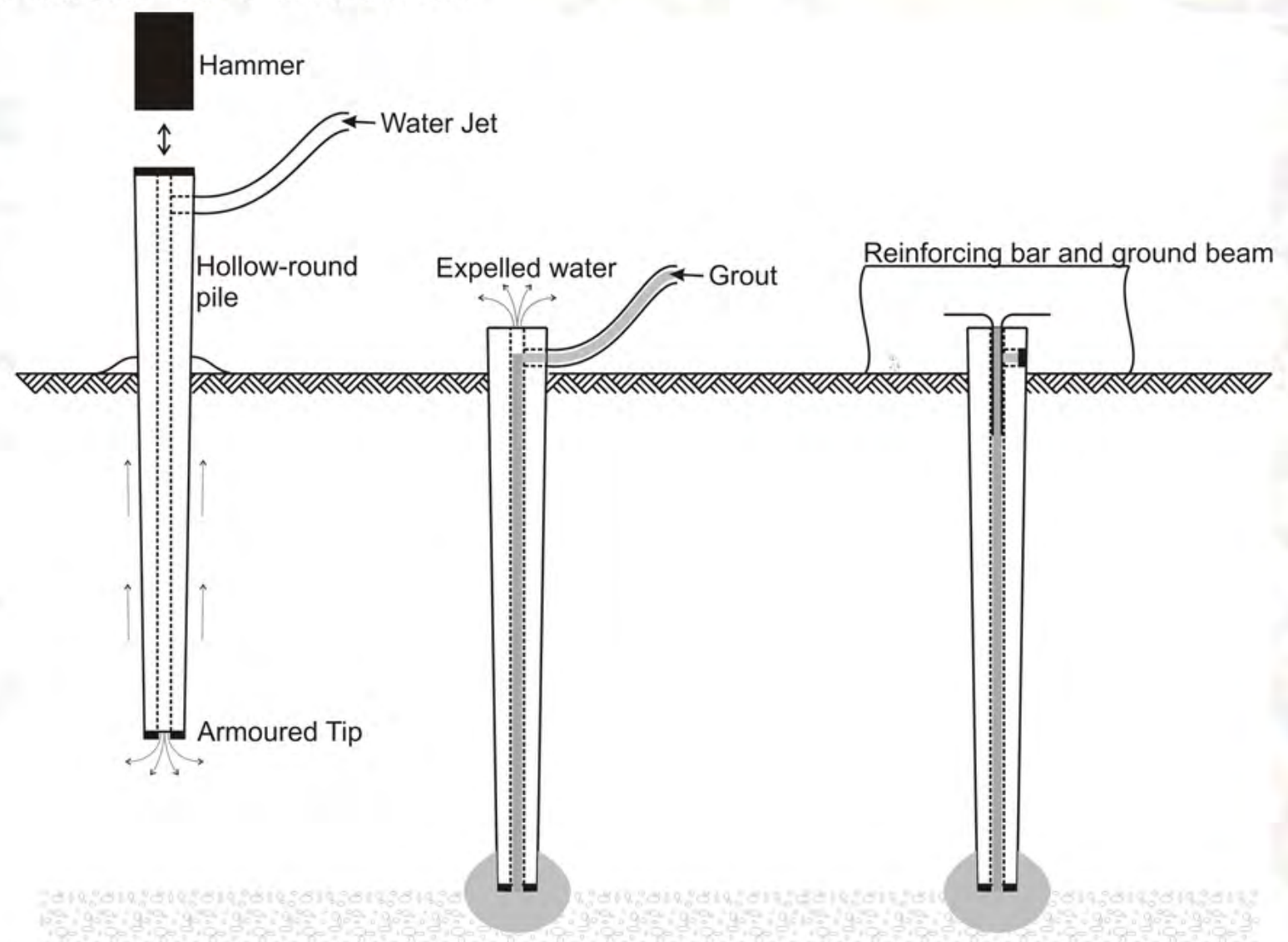
- *Up to 18m long*
Armour pile tip
- *Use water jetting*
through central core
- *Use Hitman and/or*
camera to inspect
- *Grout after driving*





Our Proposal

Hollow timber rounds:





Test piles

- 10m long
- 350mm SED





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- Vibrated into peat
- Further testing to be done...





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Approximate costs

Some QS figures for Chch:

Pile system	Installed Cost (\$)
RC concrete - 600mm Diameter - 18m long	\$9600
Screw pile – 18m long	\$6000
Steel UC (not galvanised)	\$5200
Rock column – 18m long	\$3000
Timber pile – 450mm SED – 18m long (treated & grouted)	\$1960



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- *For a given vertical load - 18m timber piles are approximately 40% the cost of RC concrete piles*



Conclusions

- *Light-weight timber structures can reduce foundation demands*



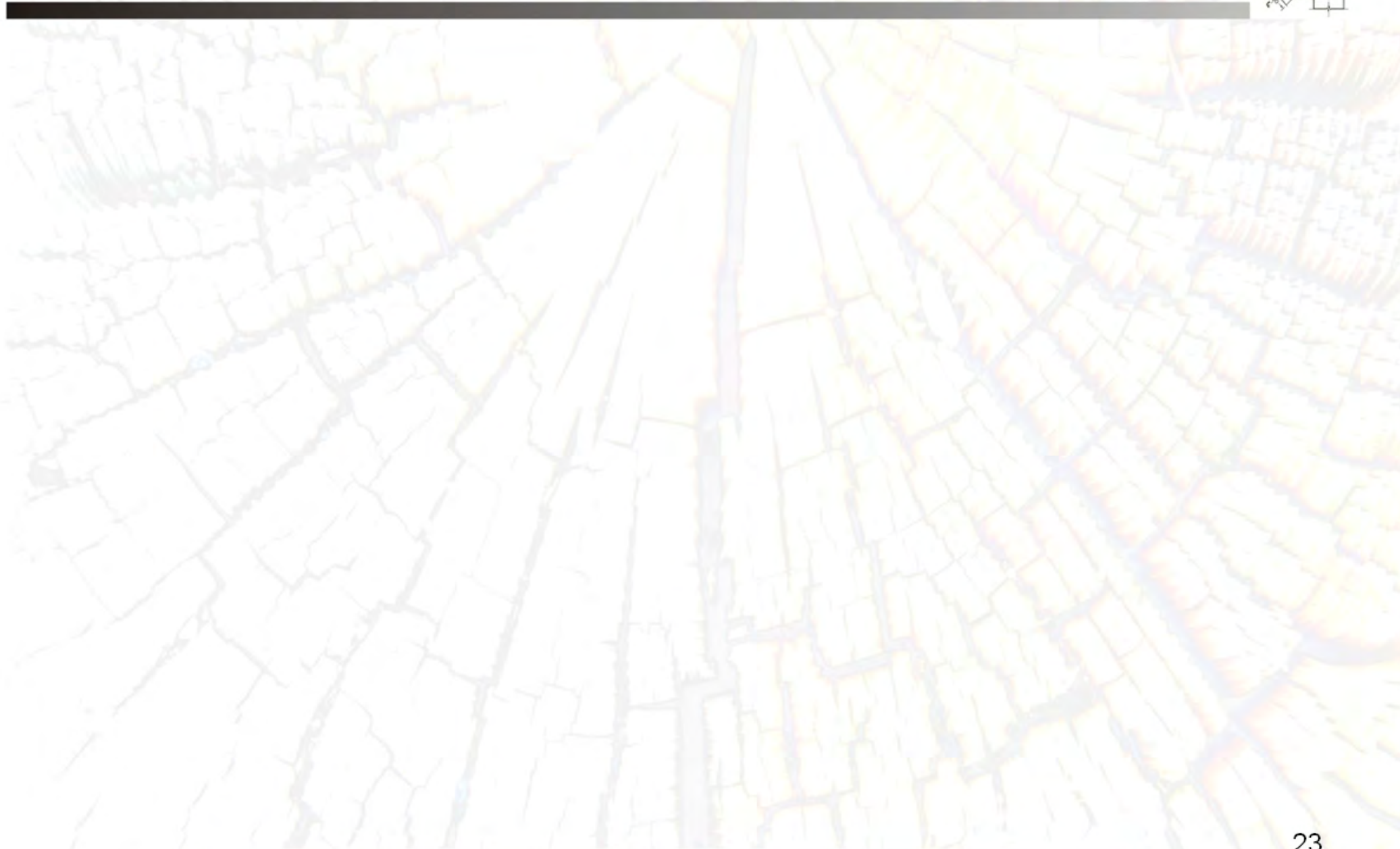
Conclusions

- *Light-weight timber structures can reduce foundation demands*
- *Hollow timber piles are appropriate for Canterbury:*
 - *Water jetting allows easier installation with less vibration*
 - *Enables easy connection to the building ground floor structure*
 - *Cement grouting potentially increases end-bearing capacity*
 - *High flexibility accommodates lateral spreading*



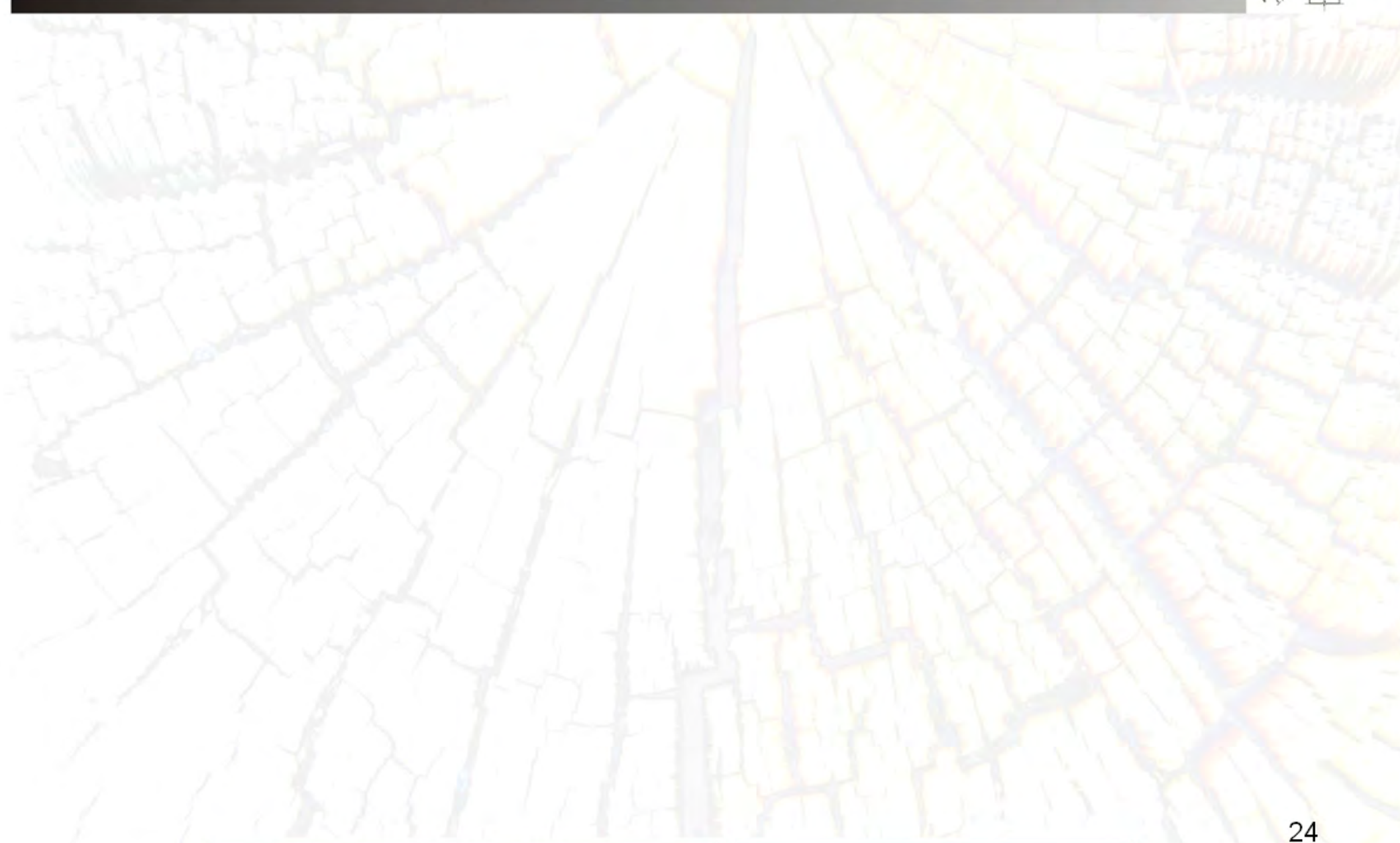
Questions?







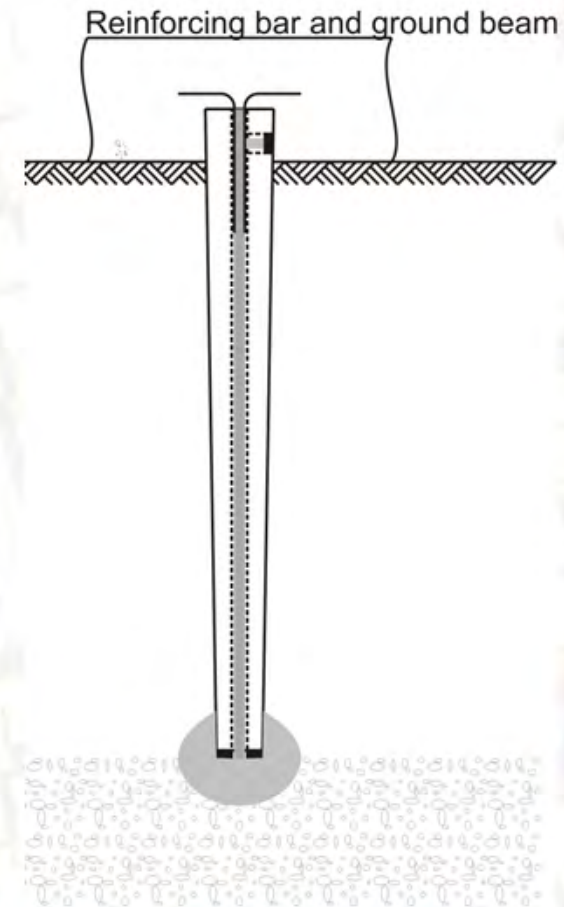
CCA Leaching





CCA Leaching

- *Encapsulation of end-grain is most important*





CCA Leaching

- *Encapsulation of end-grain is most important*
- *Plastic coatings*





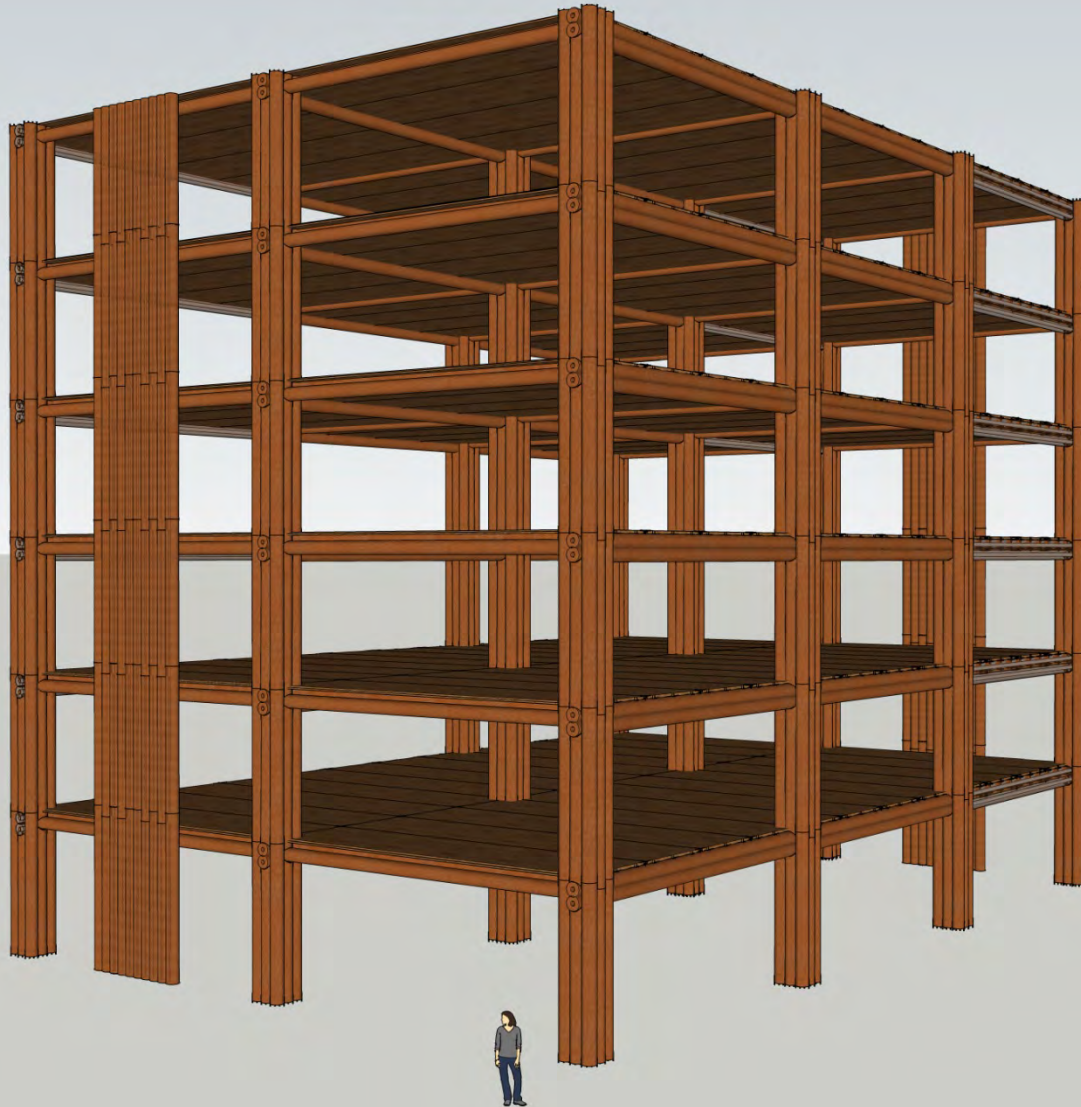
CCA Leaching

- *Encapsulation of end-grain is most important*
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Ground floor slabs?





Ground floor slabs?





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