THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

A Perspective of the Development and Use of Timber in the Built Environment of Australia and New Zealand

Keith Crews

Professor & Director

Australian Research Council - **Advance Timber** Industrial Transformation Research Hub

Historical Background

Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

Timber has been an essential and integral part of rural buildings and infrastructure since early European settlement

Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

Reliance on Timber

- European settlement - British building tradition of masonry construction
- Most buildings were designed to hide the wood, or use it for secondary buildings and rural structures

Even though it was distrusted by many, timber formed the “back-bone” of the early European settlement in both Australia and New Zealand

- All early bridges
- Wharf structures
- Wool sheds and storage
  - post & beam up to 6 stories high
- Most rural dwellings

Australian Government
Australian Research Council
The University Of Queensland
ADVANCE TIMBERHUB

Timber Bridges

Timber Bridges

Approx. 65% of the bridges in Australia are made from native hardwoods. Despite very little maintenance - most of these bridges have performed exceptionally well!

Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

Timber Wharf Infrastructure

Historically important; the main means of transporting goods for over 100 years

Wooloomooloo & Walsh Bay, Sydney – 100+ year old timber wharves

Busselton Jetty – first built 1865, 1841m long

Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

Timber Buildings

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Timber in the 20th Century

- The period between 1920 and 1940 saw “a period of intense development in research towards timber engineering technology”, notably by the CSIRO, with a focus on understanding and quantifying material properties
- At the same time there were also some limited applications of timber into larger span factory buildings – using simple glulam arch forms
- Timber infrastructure continued to play a critical role in the economies of rural communities
- During the period 1942 to 1945 the war necessitated reliance on wood as a major structural material, resulting in some amazing “temporary” buildings
- After the war, timber was generally displaced by steel as the preferred material for factory buildings, but with some notable exceptions

Australian Government
Australian Research Council
The University Of Queensland
ADVANCE TIMBERHUB

Timber during the period 1940 - 1960

Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

Timber in the 20th Century

- Despite the “lack of confidence” by designer professionals, timber has been the dominant structural material since early 1900’s for domestic buildings in Australia and New Zealand
- Wood cladding, has generally been more accepted in NZ (earthquakes!!), and rural parts of northern Australia
- In most of temperate, urban Australia the “Georgian principles” from the first British settlement live on, with brick veneer being the dominate type of construction

Australian Government
Australian Research Council
The University Of Queensland
ADVANCE TIMBERHUB

Timber in domestic construction

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Timber in domestic construction

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

1980's – the start of a "Timber Renaissance"

- Since the late 1970's & 1980's there have been a number of drivers that have led to acceptance of timber as a viable and competitive engineering material
- Threats to traditional "hardwood" supply
  - Many small industries
  - Need for change in management practices
  - Environmental "fears" about logging native forests
- Significant plantation pine resources becoming available
  - Small number of larger, focused companies
  - Modern, high through-put processing
  - Sustainable resource
- Glulam production and innovation in NZ

Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

New Zealand

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

New Zealand

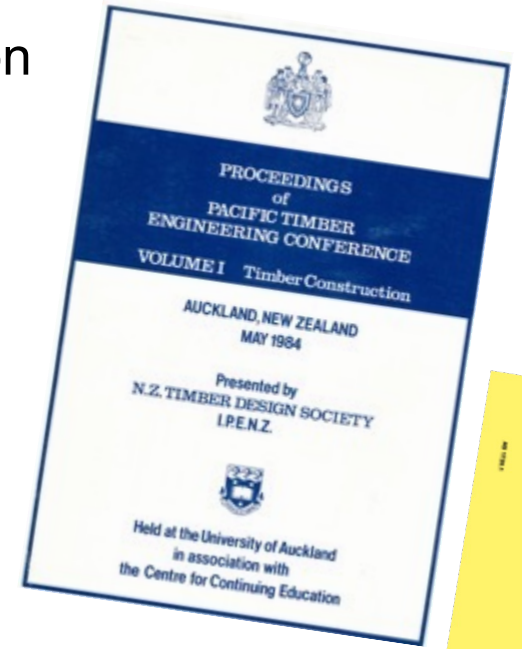
Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Catalysts for Change……

- Renewed interest in Timber Engineering and timber design for non residential buildings, stimulated by PTEC 1984
- Development of limit states design codes with a reliability basis
- Need to maintain, **NOT REPLACE** timber infrastructure
- Tertiary education programs targeting Architects & Engineers
- R&D projects by government and industry
- Stronger links to Europe, North America and NZ with associated “technology transfer”
- Focus on Research and development of reliable engineered wood products and connection systems
  - Glulam
  - LVL
  - Composite products eg: I beams
  - Ingrade + QC for plantation pine



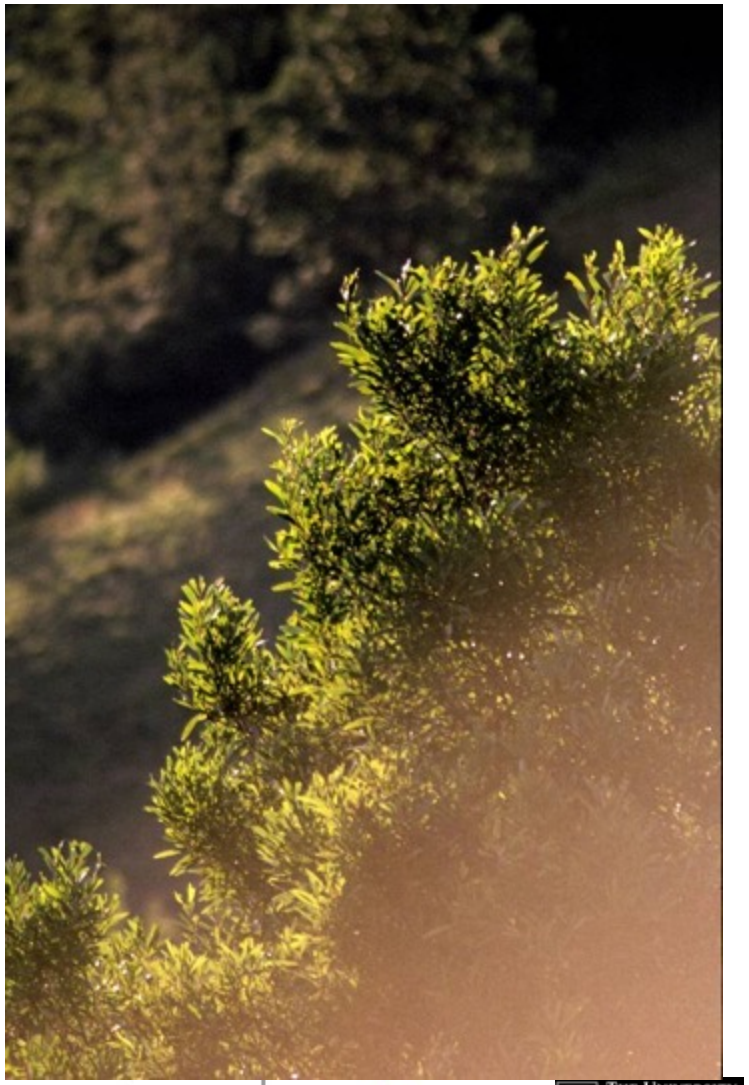
Australian Government
Australian Research Council

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

ADVANCE TIMBERHUB

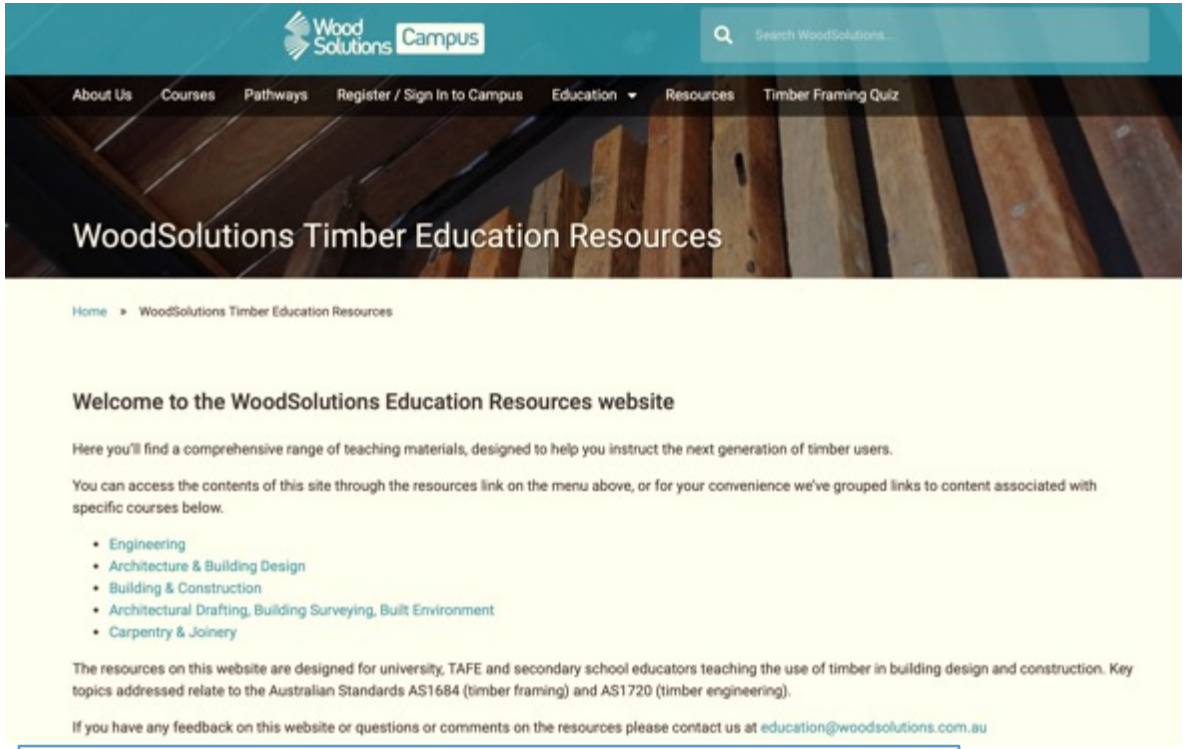
1990's - Education & Research Initiatives

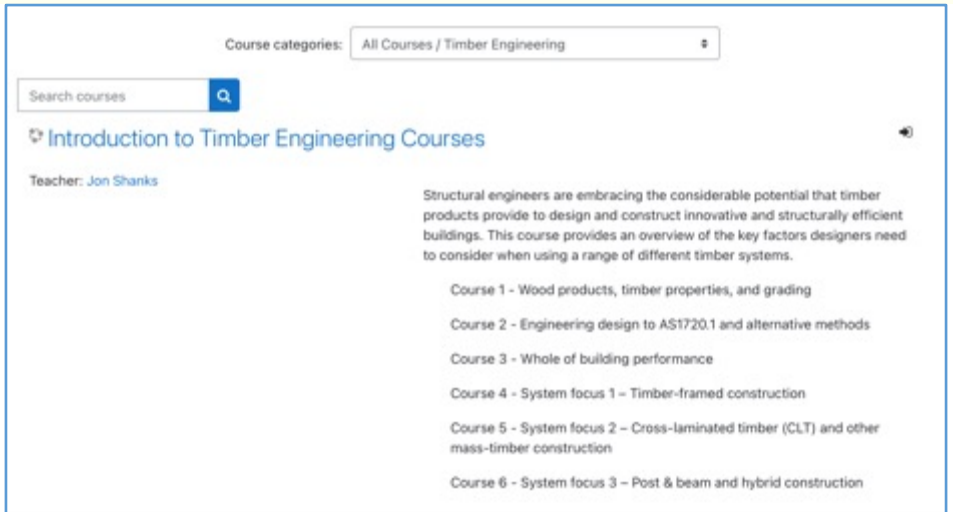
- Development of University Education resources
- Product development, testing and material characterisation
  - MGP in-grade study
  - EWP's, connections & prefabricated building systems
- Timber Bridges R&D
  - New bridges up to 25m span
  - Risk assessment of old bridges
  - Design detailing for durability
- Timber piles & utility poles R&D
  - NDE & assessment methods
  - Ingrade testing (full size)
- Reliability based methods for predicting Durability Performance

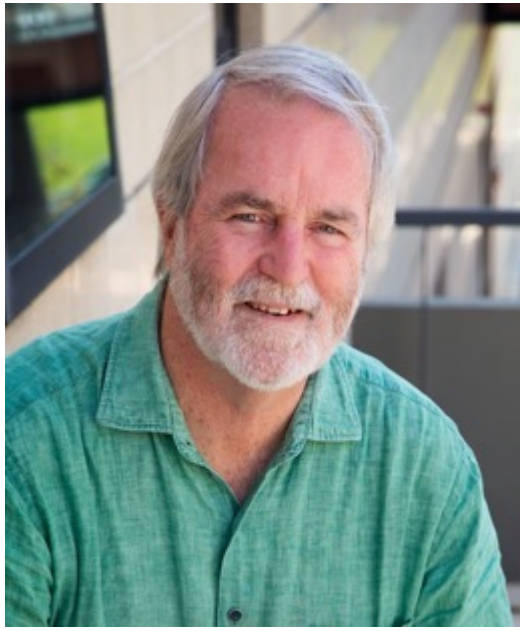


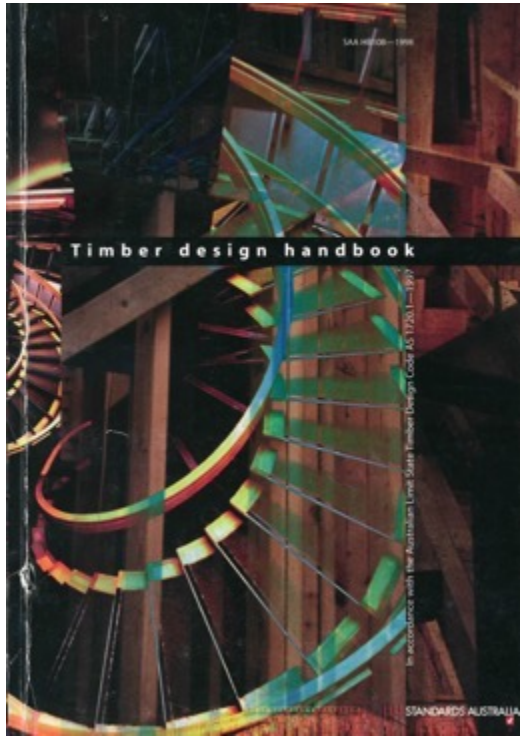
Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

1990's - Education Programs









Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Timber Bridges: 1990 - 2000

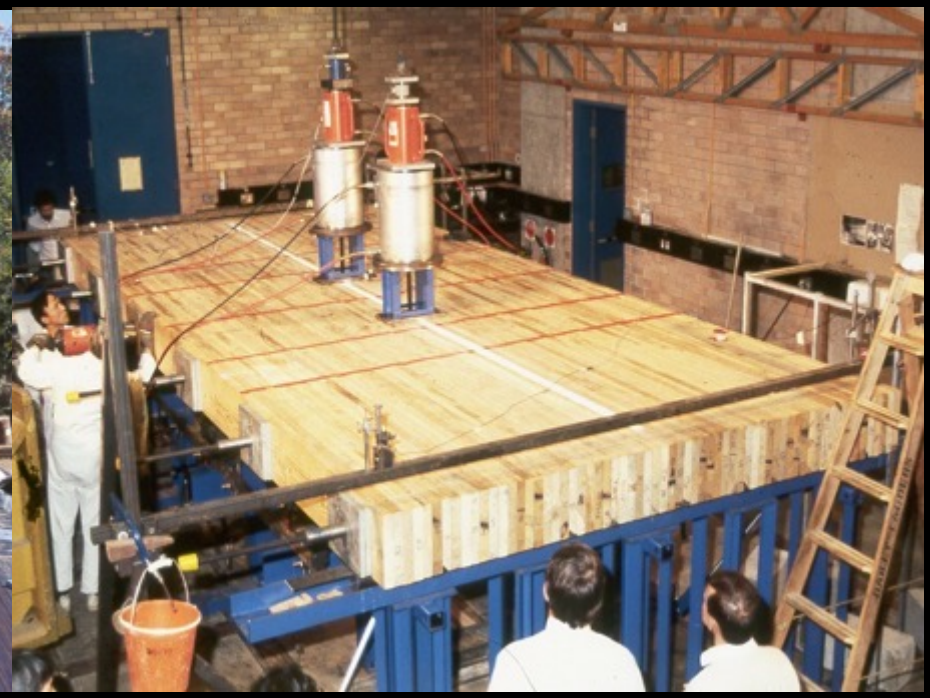
- Approx 65% of bridges in Australia are made from timber
- Most have an average age of 50+ years
- Most are in local government areas, mainly on secondary and low traffic roads
- Maintenance is often adhoc
- $2.5m spent on projects for:
  - Development of high performance superstructure systems,
  - Development of cost effective safe load capacity & risk assessment / SHM methods for existing bridges
  - Development of prefabricated bridge deck replacement systems using EWP's
  - Development of best practice detailing methods
  - Stochastic degradation models for predicting remaining life

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

SLT plate deck systems



Australian Government
Australian Research Council
The University Of Queensland
AUSTRALIA
ADVANCE TIMBERHUB

SLT Cellular deck systems

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Timber Utility Poles

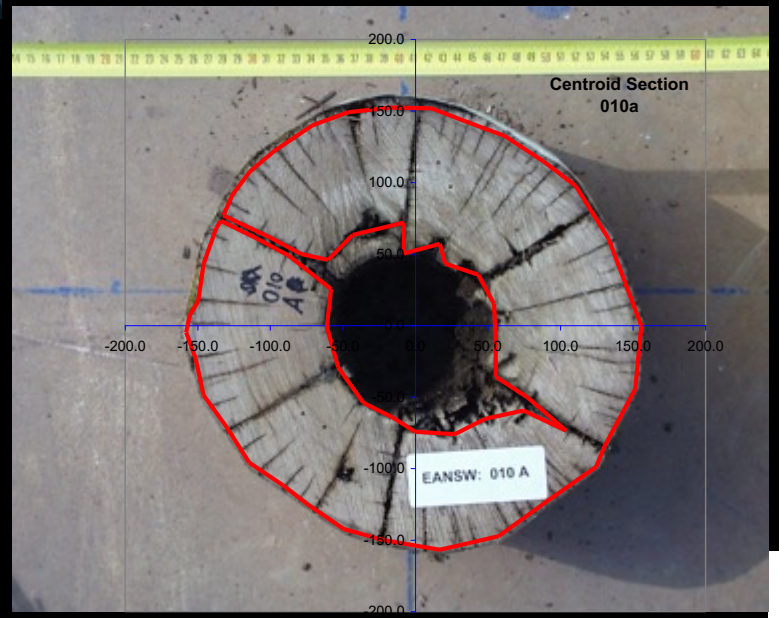
- 5 projects ($2m) involving extensive testing of new and old poles / girders
- Characteristic property data and failure mechanisms for over 1600 poles
- Approx 400 of these also involved critical review & assessment of 20 NDE technologies / methods for determining the section modulus
- This data is then used to develop statistically based strength prediction models

Australian Government
Australian Research Council

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

ADVANCE TIMBERHUB

Timber Utility Poles



Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

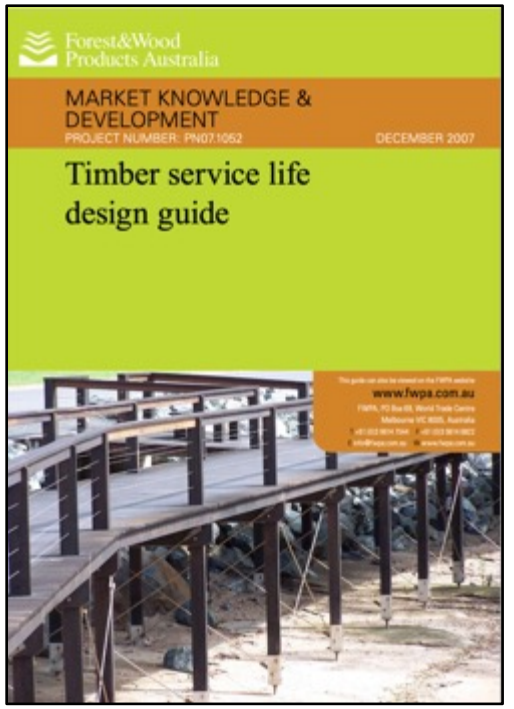
Durability and Reliable Performance

- Durability Design

  A 10-year, multi-million dollar ‘world first’ research project to develop a probabilistic durability design method for timber, funded by Forest & Wood Products Australia

- The guide addresses specific hazards with respect to the service life of timber construction:
  - In-ground decay
  - Above-ground decay
  - Weathering
  - Termites
  - Corrosion
  - Marine borers

- Project Leader Dr Bob Leicester was awarded the Marcus Wallenberg Prize in 2000
  - for development of advanced probability theories to enhance fundamental understanding of the structural properties, fire performance, durability and safety of wood as a building material.



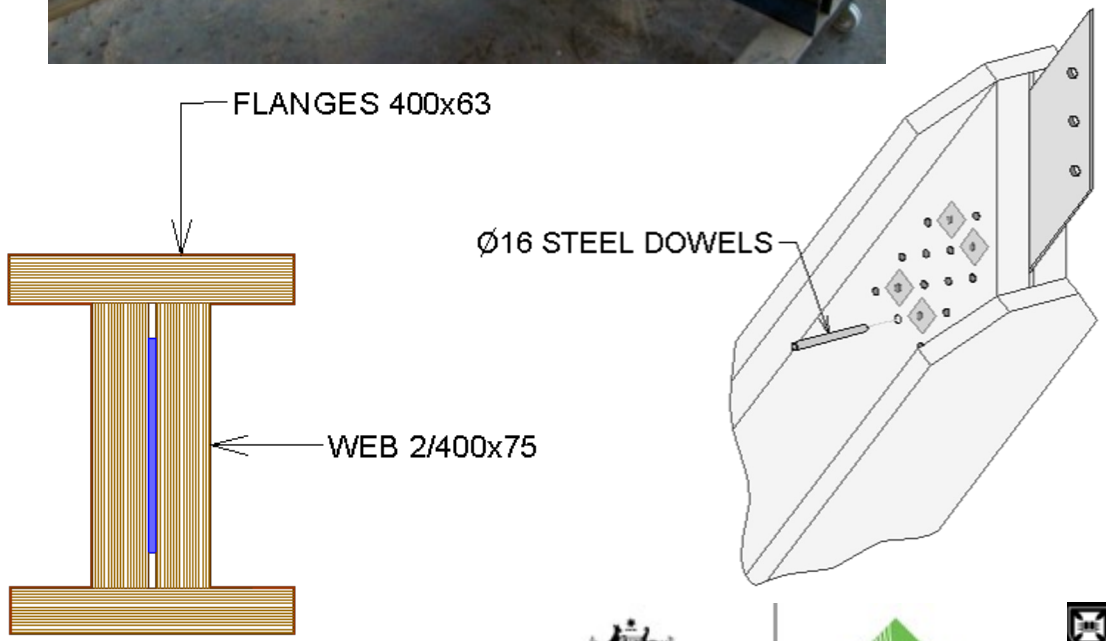
Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

1990 to 2007 - Research Programs

- Design Innovation
  - Long span roof structures
  - Connection systems
  - EWP's
- Timber building systems
- Recycled Timber



INTERNAL BRACE SECTION

Australian Government
Australian Research Council

The University Of Queensland
ADVANCE TIMBERHUB

Sydney Olympics 2000

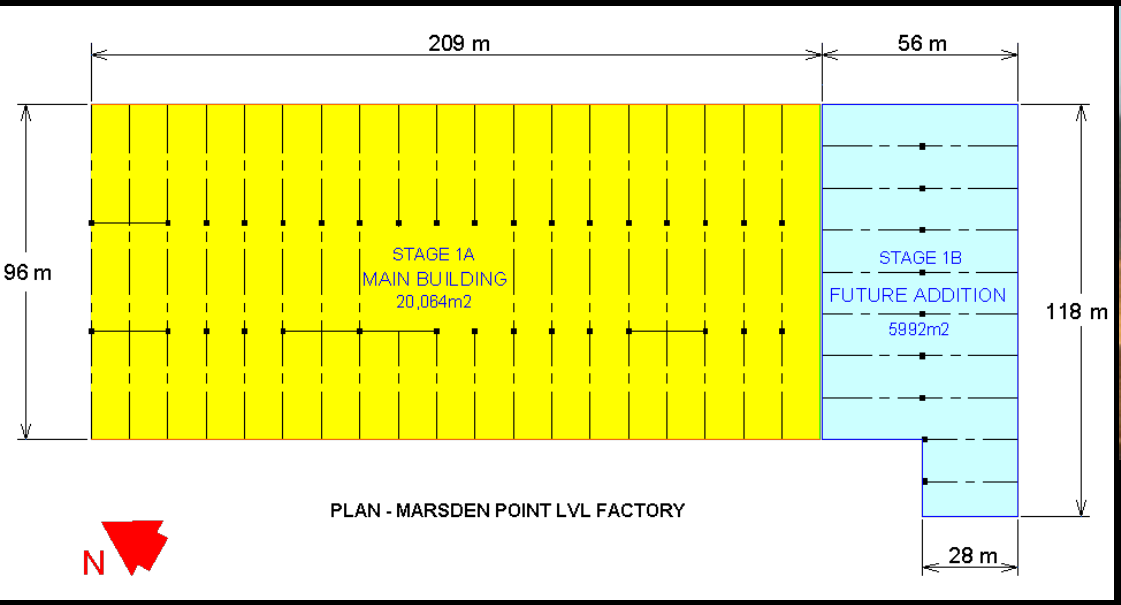
The Dome – 42m high & 95m diameter

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Marsden Point LVL Factory



PLAN - MARSDEN POINT LVL FACTORY

Industry Partner: B Hutchings - TimberBuilt P/L (2008)

Australian Government
Australian Research Council
The University Of Queensland
ADVANCE TIMBERHUB

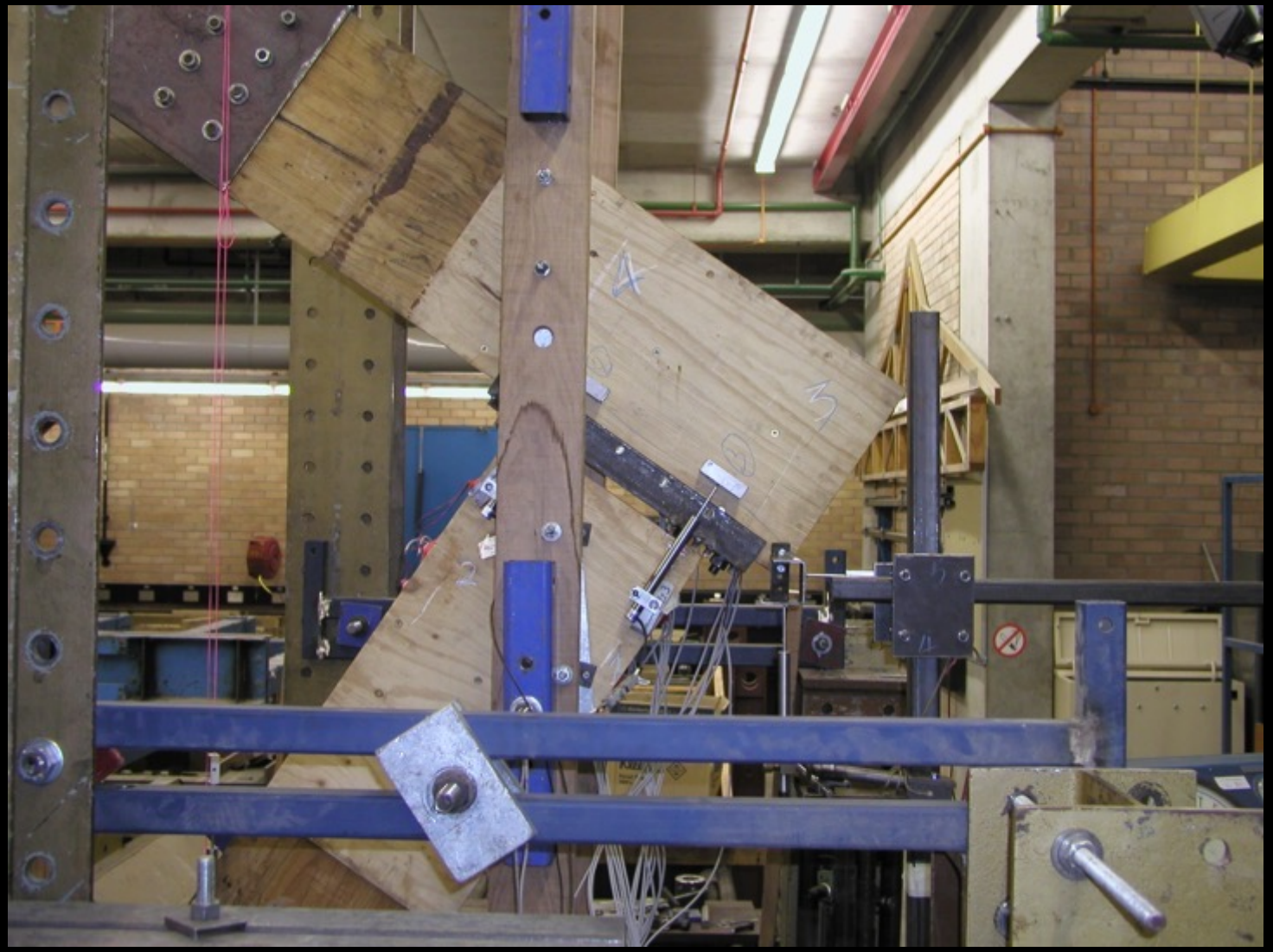
Building Exemplars

Australian Government
Australian Research Council

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

ADVANCE TIMBERHUB

Building Exemplars



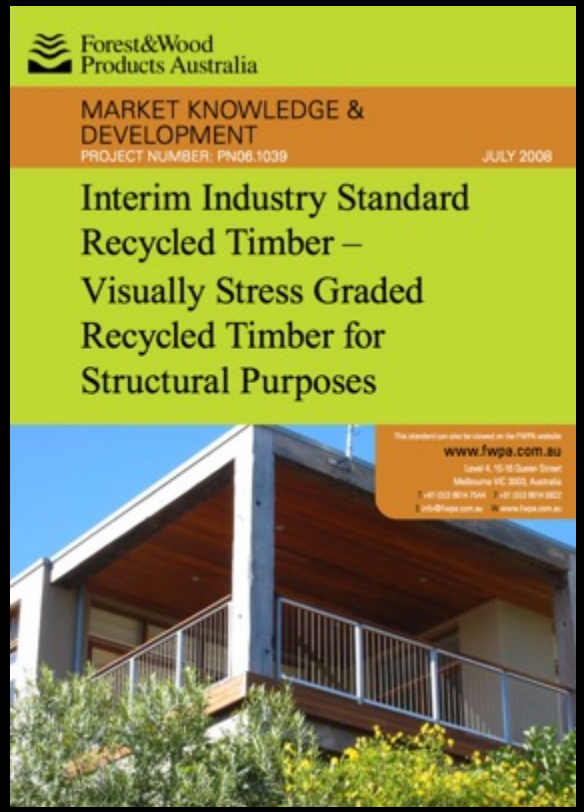
Industry Partner: B Hutchings - TimberBuilt P/L (2008)

Australian Government
Australian Research Council

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

ADVANCE TIMBERHUB

Recycled Timber



Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

R&D: Commercial Buildings: 2007 - now

- 3 major R&D projects:
  - FWPA (2007 – 2008)
  - STIC (2008 – 2013)
  - FWPA (2014 – 2017)
  - ARC Timber Hub (2018 – 2021; 2023 to 2027)
- Aim: “enablers” for timber solutions
- Considerable interest and “pull” from designers, developers & builders of commercial buildings
- Potential for
  - Timber - part of a “green solution” in new building projects
  - Engineered, prefabricated timber-based building systems
  - Circular economy drivers

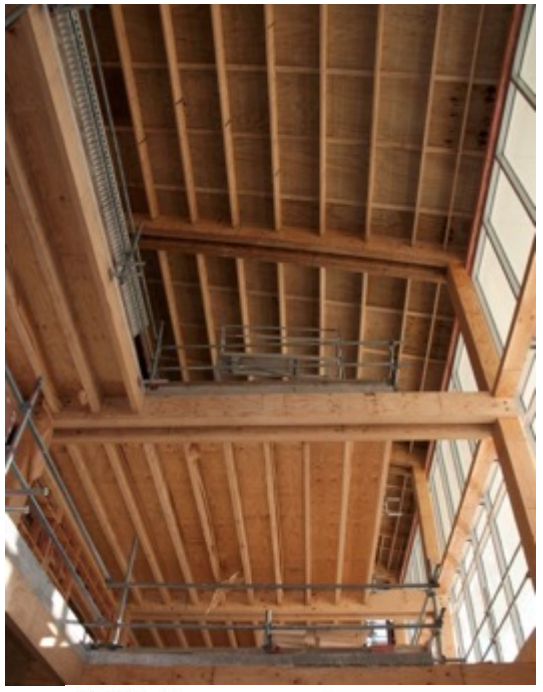
Australian Government
Australian Research Council

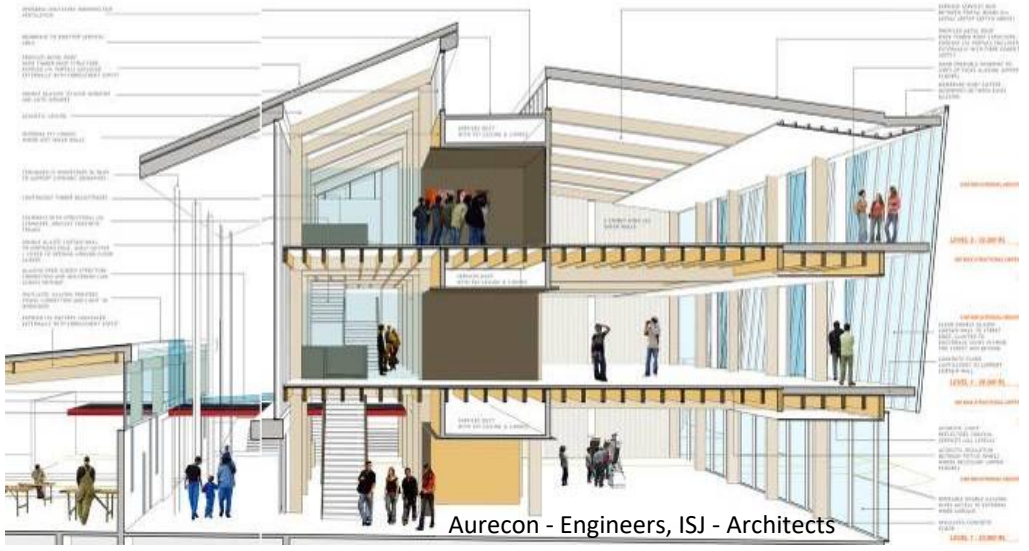
The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Market Development Focus

- STIC: research consortium of UA, UTS & UC
- 3 to 8 storey timber framed buildings
- Large spanning floor & roof structures for commercial & industrial buildings
- Gravity & Wind performance requirements
- Seismic performance requirements

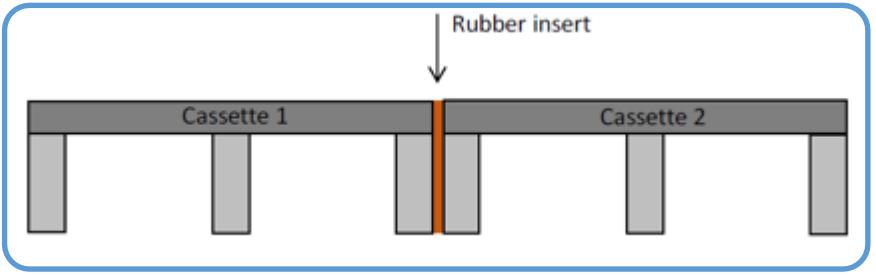




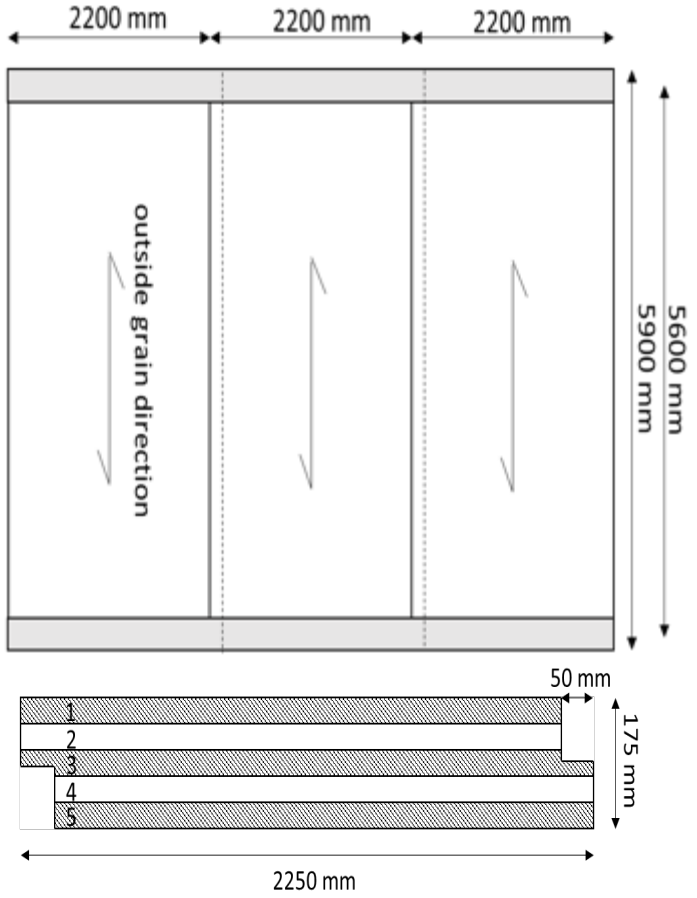
The BIG Floor Challenge - Dynamics:

Project focus:

- Long spans (up to 9m)
- Prefabrication
- CLT Plate hybrids
- LVL “cassette” floors
- National and international reference groups / liaisons



Experimental floor – Glulam cassettes



Experimental floor – CLT

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

The “rise” of CLT……..

2012: Forté

32.2m high - 10 stories

At the time of completion, it was the tallest timber apartment building in the world

Acknowledgement: Lend Lease

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

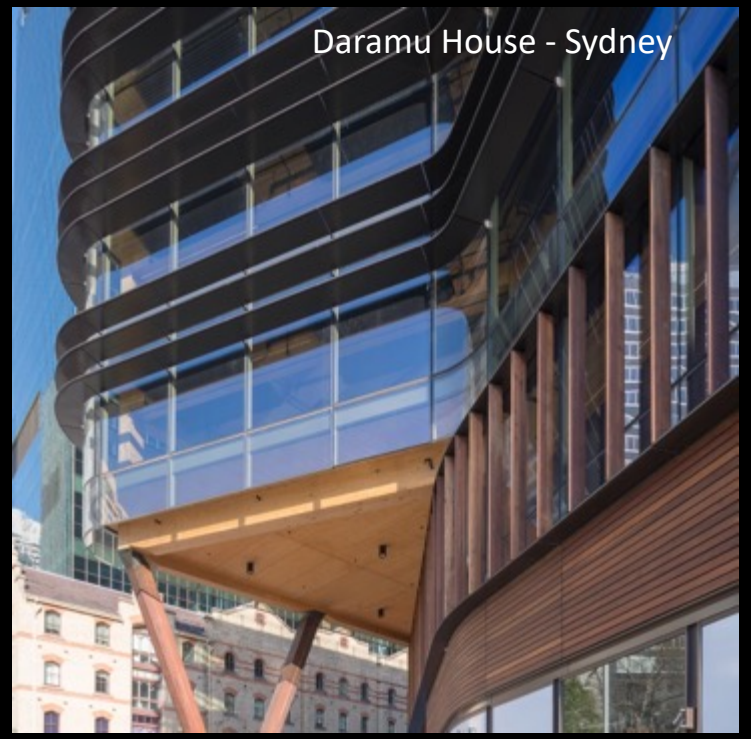
Engineered Timber in Australia today

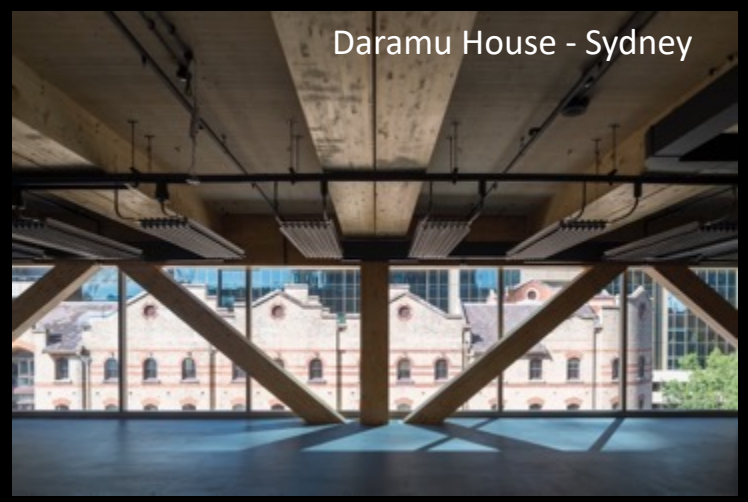
2015: School of Business - UTS
TCC floor span 12m

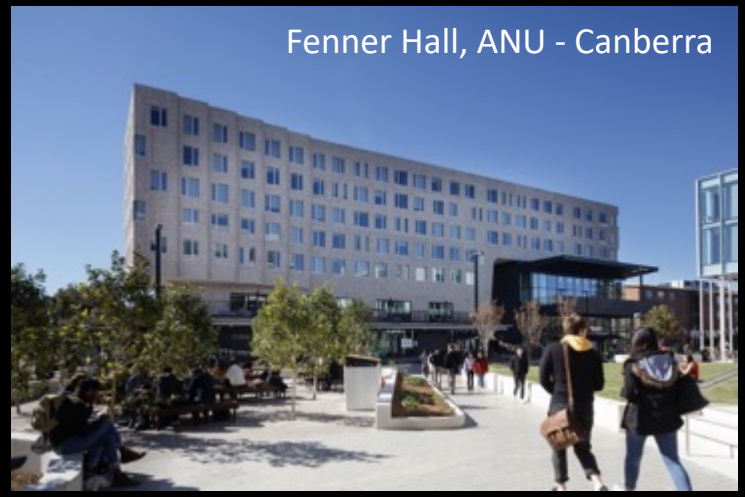
Acknowledgements: Frank Gehry, Lend Lease & ARUP

Australian Government
Australian Research Council
The University Of Queensland
ADVANCE TIMBERHUB

Engineered Timber in Australia today







Acknowledgement: Lend Lease

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Mass Timber in Australia today

2018: 25 King St

52m high - 10 stories

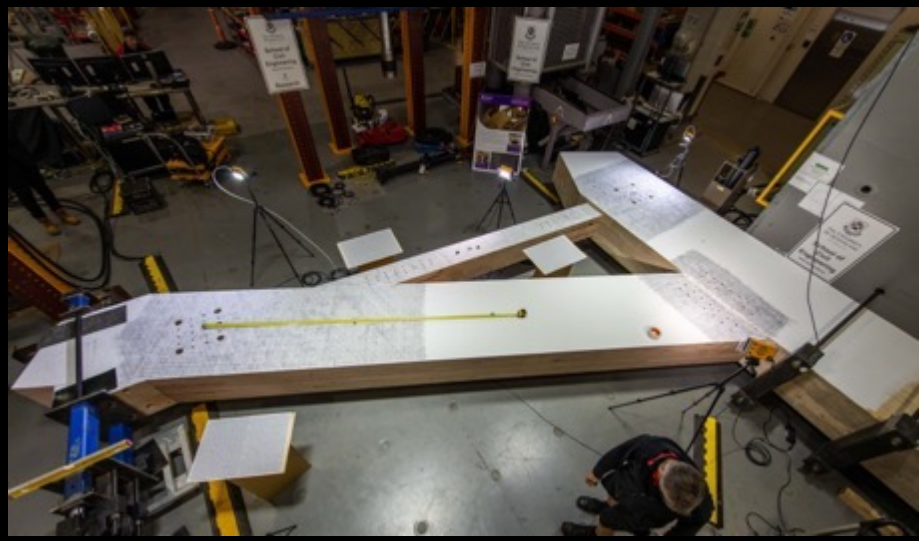
Acknowledgements: Aurecon & Lend Lease

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Mass Timber in Australia today



2023: Murdoch Uni – Boola Katitjin

16,000m2, extending up to four stories high and 180 metres long

Acknowledgements: Aurecon & Murdoch Univ.

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

Engineered Timber in Australia today

2023-25: Atlassian

40 stories high Atlassian Central will be the world's tallest hybrid timber building with a glass and steel façade. It's designed for 50% less embodied carbon and 100% renewables.

Acknowledgements: BVN & Shop Architects

Australian Government
Australian Research Council

ADVANCE TIMBERHUB

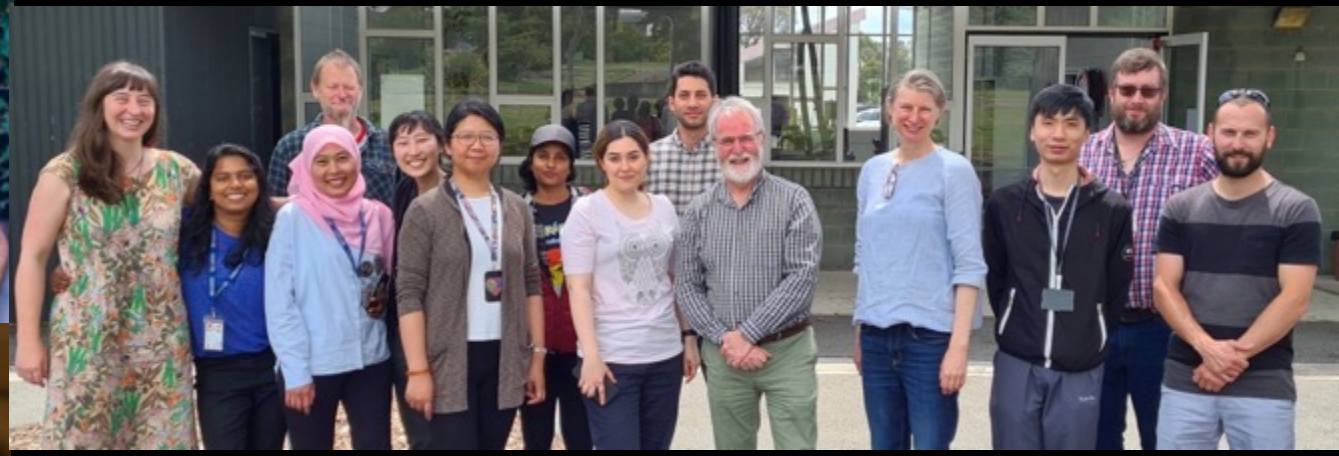
Where we are today, has been made possible by the dedicated work of many people, working together, over the past 40 plus years

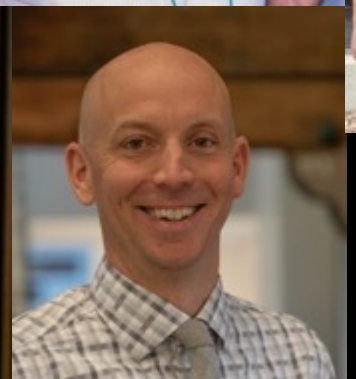










Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB

What have we learnt?

1. The importance of long-term friendships and effective collaborations – both locally and internationally
2. The need for a long term, wholistic view and understanding of the timber and construction industries
3. Education and needs driven R&D is critical for a “timber future”
4. The need for vertical integration of the timber supply chain for both domestic housing and multi-story commercial buildings
5. In Australia a “step change” occurred in 2012, with the Forte CLT project; Lend Lease imported technical expertise from Europe
6. **DesignMake** was a global first state-of-the-art factory merging CLT processing and frame production lines; using CNC technologies, “file to factory” and LEAN principles. These initiatives have been a major catalyst for changes in Australia & NZ over the past 10 years

Australian Government
Australian Research Council
The University Of Queensland
ADVANCE TIMBERHUB

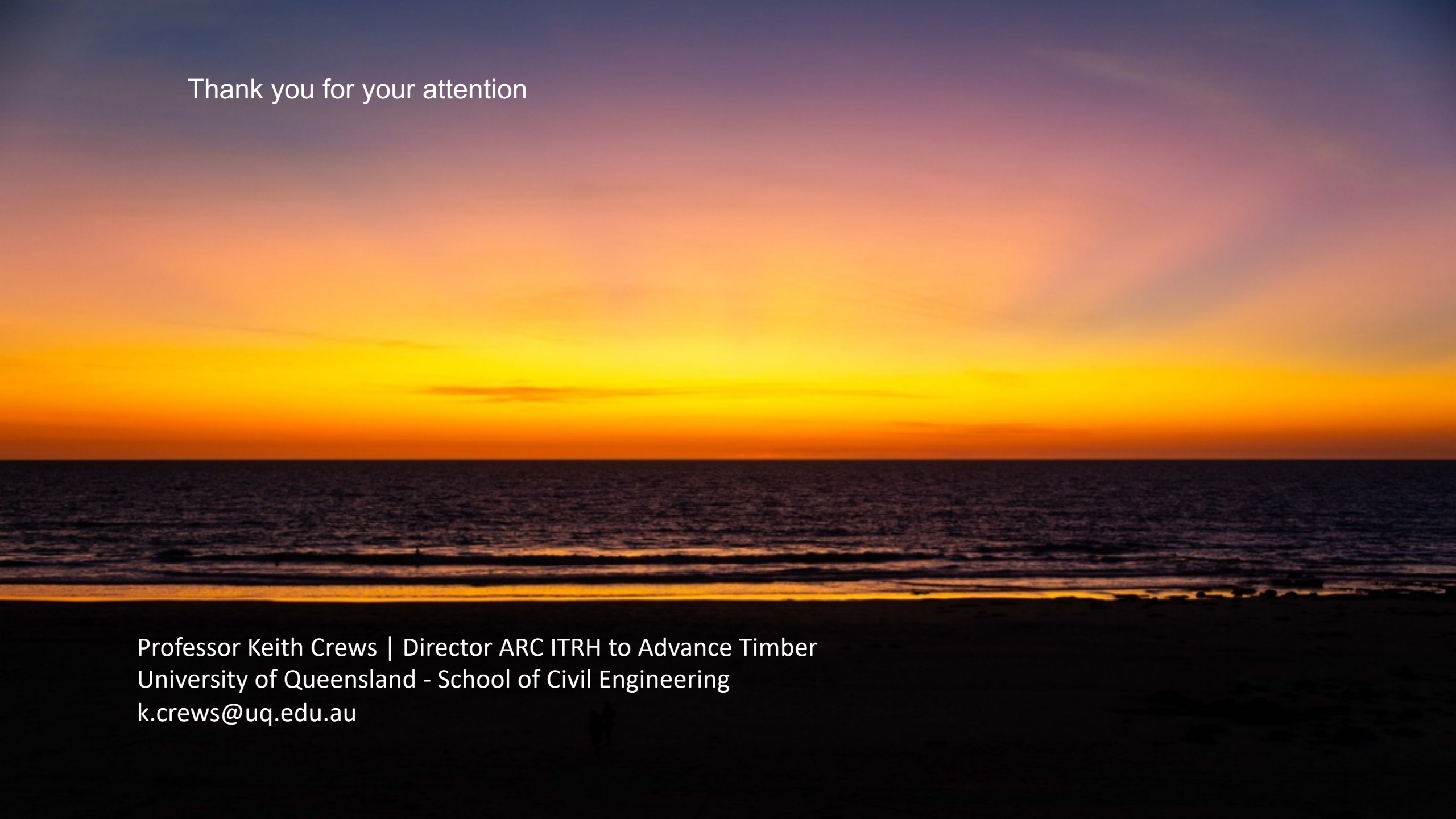
A Perspective – the past 10 years……

Karl-Heinz Weiss brought together the right partners and teams for designing and delivering new solutions for timber applications; He has been at the forefront of innovation for timber in Australia for the past 10+ years

Australian Government
Australian Research Council

The University Of Queensland
AUSTRALIA

ADVANCE TIMBERHUB



Professor Keith Crews | Director ARC ITRH to Advance Timber
University of Queensland - School of Civil Engineering
k.crews@uq.edu.au