Engineered wood products in New Zealand: Trends, perceptions and resources
Engineered wood products (EWPs)

What are EWPs?
BRANZ survey on EWP uptake and usage
EWP resources
- Codes and standards
- Manufacturer information
- BRANZ
- Universities
- Organisations
Summary and moving forward
What are EWPs?

Wide range of timber-composite materials and manufacturing possibilities
Primarily structural applications
- Laminated veneer lumber (LVL)
- Glue-laminated timber (glulam)
- Cross-laminated timber (CLT)
- Finger-jointed timber
Panel products

- Plywood
- Oriented strand board (OSB)
- Strandboard (NZ)
- Particleboard
- Fibre-cement

What are EWPs?
What are EWPs?

Composite products and systems
• I-joists
• Structural insulated panels (SIPs)
• Wood plastic composites (WPCs)
• Triboard (NZ)
• Timber concrete composites (TCC)
• Post-tensioned timber (Preslam)
• Stress-skin panels
• Box beams
BRANZ survey on EWP uptake and usage

- Survey in early 2019
- Collaboratively developed (Gary Raftery, Kate Bryson and BRANZ)
- 17 questions
- Nearly 500 respondents
- Wide range of participants
  - Architects and designers
  - Builders
  - Engineers
  - Government
  - Others
- Extensive comments included
- Outputs: Study Report SR453 *Usage and uptake of engineered wood products in New Zealand*
  
  www.branz.co.nz/pubs/research-reports/sr453/
BRANZ survey on EWP uptake and usage

- What EWPs are being used and for what applications?
- What are potential barriers to increased EWP usage?
- How can EWP update be increased?
- Major themes
  - Cost
  - Availability
  - Regulation
  - Information
  - Education
Primarily positive responses

Pros and cons of using EWPs
- Cost
- Stability and consistency
- Reduced waste
- Increased speed of construction
- Site alterations
- Compliance
- Lack of knowledge
- Durability and treatment options
- Environmental/carbon impacts
- Allowable substitutions
- Comparisons with other materials
- Options for prefabrication
Recommendations

- More information, education and tools – design and performance
- Develop detailed case studies
  - Economics (end to end)
  - Environmental impacts
  - Range of buildings
- Increased cost-effectiveness
- Update standards
  - Acceptable Solutions
  - Verification Methods
- Simplify compliance pathways
EWP resources – codes and standards

NZS 3604:2011 *Timber-framed buildings*
- Revision initiated
- Acceptable Solution

NZS 3603:1993 *Timber structures standard*
- Revision nearly completed

NZS 3602:2003 *Timber and wood-based products for use in building* and NZS 364:2003 *Chemical preservation of round and sawn timber*
- Revisions nearly completed
- Acceptable Solutions for durability and treatment
- Production standards

New Zealand Building Code (E2/AS1 etc.)
EWP manufacturers and fabricators

- Technical literature
  - Span tables
  - Carbon footprint
  - Durability
- Online design software
  - Different levels available

Component manufacturers

- Fastenings and fixings
- Literature and software
- New Zealand-specific information
EWP resources – BRANZ

- Website
- Publications
- Tools and calculators
- Life cycle and carbon evaluation tools
- Research
- MyBRANZ Knowledge
- Appraisals and CodeMark
EWP resources – BRANZ

BRANZ website (www.branz.co.nz)
BRANZ publications
• *Build* magazine
• Study reports
• Research Now (summaries)
• BRANZ bulletins
  • Corrosion (including geothermal)
  • Wall bracing
  • Connections
  • Timber treatment
• Building and design books
  • Multi-storey LTF guide
  • Selecting timber
  • Engineering basis of NZS 3604
BRANZ publications

- eLearning modules
  - Timber framing
  - Bracing
- Good Practice Guides
  - Timber cladding
- Evaluation methods
  - Mid-rise cladding (EM7)
  - Structural joints (EM1)
- Technical papers and recommendations
  - P21 evaluation procedure
  - Fire resistance of LTF walls and gusset connections
EWP resources – BRANZ

BRANZ publications
- Building Basics (series)
  - Minimising waste
  - Weathertightness
  - Compliance
- Level Sustainable Building Series
  - Floor coverings
  - Materials
- Previous seminars/webinars
  - Talking timber
  - Bracing
- Good Repair Guides (series)
BRANZ tools and calculators

- BRANZ Maps
  - Wind
  - Earthquake
  - Corrosion
  - Climate
- Lintels and beams calculator
  - Spreadsheet only
- B-RISK
  - Fire simulation
BRANZ life cycle and carbon evaluation tools

- LCAQuick
  - Life cycle assessment tool
  - Whole-of-life evaluation
  - EPD data
  - Integration with BIM data
  - Training and project support
  - Library of buildings
  - Comparisons
  - Impact factors
BRANZ life cycle and carbon evaluation tools

- **BRANZ CO₂NSTRUCT**
  - Embodied carbon and energy only
  - EPD data
  - Updated annually
  - Variable data quality

Projects underway

- **MACC tool**
  - Residential
  - Systems data
- **Dashboard tool**
  - Comparisons
  - Top five materials
- **Early decision-making tool**

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### Table: Embodied Carbon and Energy Data for Metal - Steel

<table>
<thead>
<tr>
<th>Material</th>
<th>Embodied carbon (kg CO₂eq/kg)</th>
<th>Embodied energy (total) MJ (NCV)/kg</th>
<th>Embodied energy (non-renewable) MJ (NCV)/kg</th>
<th>Source</th>
<th>Data quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel, bar (Pacific Steel)</td>
<td>3.77</td>
<td>55.88</td>
<td>50.20</td>
<td>8.3</td>
<td>A</td>
</tr>
<tr>
<td>Steel, coil (Pacific Steel)</td>
<td>3.75</td>
<td>52.65</td>
<td>47.40</td>
<td>8.3</td>
<td>A</td>
</tr>
<tr>
<td>Steel, rod (Pacific Steel)</td>
<td>3.78</td>
<td>53.95</td>
<td>47.70</td>
<td>8.3</td>
<td>A</td>
</tr>
<tr>
<td>Steel, wire (Pacific Steel)</td>
<td>3.90</td>
<td>56.23</td>
<td>49.40</td>
<td>8.3</td>
<td>A</td>
</tr>
<tr>
<td>Steel, structural, columns and beams (BlueScope Steel)</td>
<td>2.85</td>
<td>31.86</td>
<td>31.50</td>
<td>8.4</td>
<td>A</td>
</tr>
<tr>
<td>Steel, primary (galvanised, both sides, 0.02 mm each, coating class 2275), profile metal sheet, generic all profiles, 0.4 mm BMT</td>
<td>3.74</td>
<td>47.45</td>
<td>42.80</td>
<td>9.1</td>
<td>A</td>
</tr>
<tr>
<td>Steel, primary (galvanised, coating class 2275), cold rolled profile metal sheet, trough section 56mm deep at 305mm c/c, 0.71 BMT</td>
<td>3.30</td>
<td>40.96</td>
<td>36.80</td>
<td>8.1</td>
<td>A</td>
</tr>
</tbody>
</table>
Transition to a Zero-Carbon Built Environment programme

- New Zealand whole-building whole-of-life framework
- Opportunities to contribute
- Website coming
- Resource hub in planning stages
- One-stop shop
- Eco Design Advisor
  - www.ecodesignadvisor.org.nz

Research programme:
- Building LCA: www.branz.co.nz/buildinglca
- BRANZ CO₂NSTRUCT: www.branz.co.nz/co2nstruct
- LCAQuick: www.branz.co.nz/lcaquick
- LCA case studies: www.branz.co.nz/pubs/case-studies/lcaquick/
- Contacts: david.dowdell@branz.co.nz, casimir.macgregor@branz.co.nz

EWP resources – BRANZ
BRANZ fire resistance and performance research

- B-RISK
  - Recent enhancement to support fire design of exposed mass timber in enclosures
  - Considers contribution of burning timber surfaces to the fuel load
  - Enclosure fires dependent on ventilation and fuel load – includes growth, fully developed and decay phases of fire
  - Calculates expected depth of charring in the enclosure fire
BRANZ fire resistance and performance research

• Global technical guidelines on the fire safe use of wood in buildings
  • International state-of-the art guidance
  • Information for fire and structural engineers, architects, regulatory authorities
  • Fire resistance, reaction to fire, connections etc.
• Experts contributing from 10 countries
• New Zealand main contributors – Andy Buchanan (editor, author) and Colleen Wade (author)
• Planned publication 2022
• Fire-safe densified housing research programme
BRANZ fire resistance and performance research

- Fire-safe use of timber
  - Developing calculation models to predict fire temperatures versus time in mass timber enclosures and depth of char
  - Facilitating fire resistance testing of post-tensioned beam column connection with Canterbury University
- Investigating the impact of various amounts of timber linings on the early fire hazard development
BRANZ fire resistance and performance research
• Combustible façades fire safety
  • Managing external fire spread risk
  • How do different test methods and classification criteria compare?
  • How should the potential external fire spread contributions of typical combustible materials (e.g. timber and EWPs) to external fire spread be controlled?

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>BS 8414-2</th>
<th>NFPA 285</th>
<th>Implication</th>
</tr>
</thead>
</table>
| Fire size      | ~ 3 MW    | ~ 1.3 MW | • 1.3 MW is not representative of a ventilation-limited fire for the compartment and opening geometry  
                |           |          | • Not consistent with C/VM2 design fire requirement |
| Heat exposure  | ~ 75 kW/m²| ~ 40 kW/m²| • Some materials of known fire risk not sufficiently challenged with NFPA 285  
                |           |          | • 40 kW/m² does not meet C/VM2 design fire requirement |
EWP resources – BRANZ

BRANZ fire resistance and performance research

• Does timber framing contribute to external fire spread?
  • Large-scale experiments
  • Encapsulation approaches
  • Comparisons to fire behaviour in real buildings

Evaluating lining encapsulation robustness with furnace tests

Large-scale experiments to evaluate encapsulation/timber contributions

Fire behaviour in real buildings
BRANZ materials research

- Structural adhesives
  - 50-year durability requirement
  - Polyurethane-based (PUR) adhesives
- Ageing regime
- FTIR spectroscopy
- Differences in composition
- Differences in ageing cycles
- Screening test established
- Mechanical testing
- Treatment effects
- Delamination, shear and fracture energy
- Conference paper available – full results later this year
BRANZ materials research

- Effects of geothermal environments
  - Timber products and fastenings
- Durability within wall cavity and subfloor spaces
  - Catalogue of building environmental profiles
- Specifications and maintenance
- Structural insulated panels (SIPs) – durability, fire and seismic performance
  - Test methods and compliance pathways
BRANZ materials research

• Towards durable timber structures I and II
  • Baseline database – moisture dynamics in timber
  • Metal corrosion and dimensional changes
  • Preservative leaching
  • Chemical and structural timber degradation
  • Accelerated testing methods for NZBC compliance
• Develop modelling systems
• Verification Methods
• Whole-building focus

BRANZ structures research

- Seismic performance of SIPs
  - Quantify and qualify lateral load performance
- Compliance pathways
- LTF multi-storey guideline
- Seismic design of low-rise and mid-rise hybrid residential buildings
  - Guidance and detailing
  - Podium structures
  - Terraced buildings
  - Hybrid bracing systems
  - Feeds into NZS 3604 revision
- Sloping site foundations
  - Guidance developing and upcoming project
EWP resources – BRANZ

MyBRANZ Knowledge
• Profile creation
• Personalised responses

Appraisals and CodeMark
• List of products and systems
• Specific applications
• Full NZBC consideration
• Technical literature
• Appraisals – BRANZ administered
• CodeMark – externally audited
EWP resources – other publications

STIC and Expan – series of design guides
• Post-tensioned timber
• Timber concrete composite floors
• Long-span roofs
• Quick-Connect and rivets
• Floor diaphragms
• EWPs and fabrication
• Fire performance
• [https://www.ptlnz.com/](https://www.ptlnz.com/)

New Zealand Timber Design Guide (Andy Buchanan)


Images provided by Minghao Li
High-capacity mixed-angle screwed connections in CLT

- Combining 45° and 90° screws – high initial stiffness and displacement capacity
- Repaired screwed connections with epoxy

Images provided by Thomas Wright
Coupled CLT walls using steel beams

Images provided by Ben Moerman
Recent publications


Recent publications


EWP resources – University of Auckland

- CLT floors
- Seismic dampers for timber lateral load resisting systems (LLRS)
  - Connections to CLT walls
  - Numerical analysis
  - Ductility – flag-shaped hysteresis
EWP resources – AUT

• Resilient slip friction joints (RSFJ)
• Used with LVL, glulam, CLT, etc.
• Multi-storey applications
• Collaboration with others
  • University of Auckland
  • EQC
  • MBIE
  • Tectonus
• Fully functional buildings following 2500-year event
EWP resources – other organisations

- New Zealand Timber Design Society (TDS)
  - Technical literature
    - Website and journal
    - Calculators
    - Worked examples
- Wood Processors and Manufacturers Association of New Zealand (WPMA)
  - Series of timber design guides (NZ Wood)
- New Zealand EPD
EWP resources – other organisations

- WoodWorks NZ
- Scion
  - Durability
  - Processing
  - Sustainability
  - Innovation in timber
- Engineering New Zealand
  - Technical groups
  - SESOC, NZSEE, General Practitioners Group

Images provided by Ged Finch
EWP resources – other organisations

- Wood Solutions (Australia)
  - www.woodsolutions.com.au
  - Design guides
  - Webinars/podcasts
  - Design assistance
- Think Wood and WoodWorks (North America)
  - www.thinkwood.com
  - www.woodworks.org
- Canadian Wood Council (Canada)
  - www.cwc.ca
- TRADA (UK)
  - www.trada.co.uk
Survey and webinar
• Areas for improvement
• Abundance of resources
• What else is needed?
• Follow-up survey?
• Maybe a centre ...

Ministry for Primary Industries – Timber Design Centre
• Current call for registrations of interest
• Timber advisory service
• Accelerate use of low carbon products in buildings
• Knowledge dissemination
• Mid-rise, mass timber, off-site construction etc.
• Increase use of timber in domestic construction
Thank you

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