A Review of Timber Durability in Codes and Standards
- Implications for AS1604

Geoff Stringer
Technical Manager
Hyne & Son
Presentation Overview

- Why did AFPA Solid Wood Technical Committee undertake a review?
- What do customers want?
- Building Codes (Australia & NZ)
- BCA - Deemed to satisfy requirements
- FWPA Durability Design Project
- AS1604 Review
- Ideas
- Conclusion
AFPA Solid Wood Technical Committee
Durability Review Meeting

• Why conduct a review?
  – Structural model for timber
    (AS1748, AS4063, AS1720)
  – Durability model for timber
    (AS1604, AWPC protocols,?)
  – Continuing erosion of timber markets
  – Durability failures
  – Opportunities to increase timber markets?

• What do customers want?
What do customers want?

Professions of 339 Survey Respondents

- Building Designer 26%
- Builder 21%
- Engineer 11%
- Building Surveyor 9%
- Architect 6%
- Carpenter 7%
- Landscaper 3%
- Developer 1%
- Teacher 2%
- Other 14%

Survey data courtesy of Lesley Francis, Research Scientist, Queensland Department of Agriculture, Fisheries and Forestry.
Average service life expectations with routine maintenance, before significant repair/replacement.

Survey data courtesy of Lesley Francis, Research Scientist, Queensland Department of Agriculture, Fisheries and Forestry.
95%ile and Ave service life expectations with routine maintenance, before significant repair/replacement

Survey data courtesy of Lesley Francis, Research Scientist, Queensland Department of Agriculture, Fisheries and Forestry.
Perceived reliability of building products above-ground

Survey data courtesy of Lesley Francis, Research Scientist, Queensland Department of Agriculture, Fisheries and Forestry.
NZ Building Code

• Clause B2 Durability
  – **B2.3.1** *Building elements* must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the *specified intended life* of the *building*, if stated, or:
    50 years, 15 years, 5 years depending on,
    - whether the element relates to structural stability,
    - how easy the element is to replace, or
    - how detectable element failure is during normal maintenance

• Benefits to both NZ Industry and consumers
# Australian Building Codes Board

## Clause 2.4 (Table 1)

**Building Design Life**
- Short  1 – 15 years
- Normal  50 years
- Long  100 + years

**Component/System Design Life**
varies from 5, 10, 15, 25, 50, 100 depending on,
- repair/replacement cost
- ease of access to repair/replace
Building Code of Australia

National Construction Code Series
VOLUME ONE
Building Code of Australia 2011
Class 2 to Class 9 Buildings

National Construction Code Series
VOLUME TWO
Building Code of Australia 2011
Class 1 and Class 10 Buildings
BCA Objective relating to durability

Structure
Safeguard people and property from structural failure

BCA does not explicitly state Service Life

Service Life is implied via structure performance reqs. E.g. structures to withstand 1 in 50 year load events.
BCA – Deemed to Satisfy Building Solutions relating to Timber Durability

- AS 1720 Timber Structures – Design Methods
- AS 1684 Residential Timber-Framed Construction
- AS 3660 Termite Management
- Construction Timbers in Queensland

AS1604 ?
AS1720.1 Timber Structures
Design Method  Clause 1.4.4.5

- Structure and structural elements shall be designed and a maintenance program shall be specified to satisfy strength, stability and serviceability requirements, for the design life of the structure.

- Information available from,
  
  (a) All hazards  NAFI Timber Manual.
  (b) Fire  AS 1720.4.
  (c) Biological hazards  Termites, AS 3660,
                         Insects and fungi—AS 1604.1.
                         Marine organisms, CSIRO Publication
  (d) Timber for houses  Timber framing—The AS 1684 series.
  (e) Metal connectors  AS 4100.
  (f) Timber adhesives  AS 2754.1
APPENDIX B. Figure B1 gives general guidance on the natural durability class or appropriate level of preservative treatment (hazard level) required to give an acceptable service life for various applications.
AS3660 Termite Management

• APPENDIX C
  Naturally Termite Resistant Timbers

• APPENDIX D
  Preservative Treated Timber - AS1604
Construction Timbers in Queensland
(Qld Variation for Class 1, 10 buildings)

Queensland specific document,

- describes the properties of timbers used in Class 1 and Class 10 buildings, and
- provides recommendations for the appropriate and serviceable use of timbers in Queensland.

The durability issues facing buildings in Queensland are more significant than other parts of Australia with higher termite and decay hazards than other states.
Decay Hazard Zones in Queensland
# Building Members, Target Design Life

<table>
<thead>
<tr>
<th>Building member</th>
<th>Environment</th>
<th>Target design life (yrs)</th>
<th>Building member</th>
<th>Environment</th>
<th>Target design life (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>architraves</td>
<td>protected</td>
<td>15</td>
<td>floor</td>
<td>non-structural or overlay</td>
<td>15</td>
</tr>
<tr>
<td>balusters</td>
<td>exposed</td>
<td>50</td>
<td>foundation timbers</td>
<td>in-ground</td>
<td>50</td>
</tr>
<tr>
<td>barge boards</td>
<td>exposed</td>
<td>15</td>
<td>framing (wall, floor, roof)</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>batens</td>
<td>between stumps, under lining or cladding, external wall</td>
<td>5</td>
<td>framing (wall, floor, roof)</td>
<td>greenhouse</td>
<td>15</td>
</tr>
<tr>
<td>beams</td>
<td>exposed</td>
<td>50</td>
<td>hardwoods</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>bearers</td>
<td>exposed</td>
<td>50</td>
<td>joinery (non-structural)</td>
<td>exposed</td>
<td>15</td>
</tr>
<tr>
<td>binders and braces</td>
<td>protected</td>
<td>50</td>
<td>joists</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>boards (non-structural)</td>
<td>exposed</td>
<td>15</td>
<td>landings</td>
<td>exposed</td>
<td>15</td>
</tr>
<tr>
<td>bracing</td>
<td>exposed</td>
<td>50</td>
<td>lattice panels</td>
<td>exposed</td>
<td>5</td>
</tr>
<tr>
<td>brackets</td>
<td>protected</td>
<td>50</td>
<td>lining</td>
<td>exposed</td>
<td>15</td>
</tr>
<tr>
<td>capping</td>
<td>exposed</td>
<td>15</td>
<td>lintels</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>carved work</td>
<td>exposed</td>
<td>15</td>
<td>mouldings</td>
<td>exposed</td>
<td>15</td>
</tr>
<tr>
<td>cladding</td>
<td>exposed</td>
<td>15</td>
<td>Mullions</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>columns</td>
<td>exposed</td>
<td>50</td>
<td>newel posts</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>decking</td>
<td>structural, commercial and industrial foot traffic</td>
<td>50</td>
<td>pergolas</td>
<td>framing</td>
<td>15</td>
</tr>
<tr>
<td>doors</td>
<td>exposed</td>
<td>15</td>
<td>plates, top and bottom</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>eaves, soffits</td>
<td>protected</td>
<td>15</td>
<td>poles, posts</td>
<td>house/deck, in-ground</td>
<td>50</td>
</tr>
<tr>
<td>end-stops</td>
<td>exposed</td>
<td>15</td>
<td>purlins</td>
<td>protected</td>
<td>50</td>
</tr>
<tr>
<td>engineered products</td>
<td>exposed</td>
<td>50</td>
<td>rafters and ridges</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td>fascias</td>
<td>exposed</td>
<td>15</td>
<td>railings, non-structural</td>
<td>exposed</td>
<td>15</td>
</tr>
<tr>
<td>fences, gates</td>
<td>palings</td>
<td>5</td>
<td>railings, structural</td>
<td>exposed</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>posts</td>
<td>15</td>
<td>retaining walls</td>
<td>non-structural, &lt;1m high</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>rails</td>
<td>15</td>
<td>reveals</td>
<td>protected</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>sills</td>
<td>15</td>
<td>sheathing, non-structural, non-bracing</td>
<td>exposed</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sill</td>
<td>foundation</td>
<td>50</td>
</tr>
</tbody>
</table>

## CTIQ

- 71 year development
- 1939 Pamphlet No.1 QFS
- 1964 Pamphlet No.5 QFS
- 1991 Tech. Pam. No.5 QFS
- 2006 CTIQ DPIF & TQ
- 2010 CTIQ (Rev.) Qld.Govt.
FWPA Design for Durability Project

- Project completed in 2007 after 8 years research
- An engineering approach to durability design
- Durability Design Software – Timber Life
- Timber service life design guide
- Draft AS1720.5 Engineering Design
  - Decay
    - Above ground
    - In ground
  - Marine borers
  - Fasteners
Marine Borer Data

Figure 6.3.1. Marine borer hazard zones. Zone G is the most hazardous.
Corrosion of Fasteners in Timber

Figure 7.2.1.1  Embedded corrosion hazard zone map. Zone C is most hazardous

Figure 7.3.1.1  Coastal Hazard Zones. Zone E has the greatest hazard.
Decay Data

Figure 4.3.1 In-ground decay hazard zones

Figure 5.3.1. Above-ground decay hazard zones. Zone D is most hazardous
AS1604 What’s good?

- Well established product standard for preservative treated timber
- Simple design method i.e. "Hazard Class System"
- Accepted widely by users and industry
- Allows process innovation by not prescribing the preservative treatment process.
AS1604 What needs improvement?

- Durability solutions are not compatible with the BCA “implied” durability requirements,
  - Service life performance is not stated
    - Basic customer question “How long will it last?” - Unanswered
  - Numerous factors affecting durability hazards and material resistance are not covered. E.g. detailing, finish, maintenance
- Durability solutions may be inferior to other materials
- Timber joints and connector durability is not mentioned
- Structural Vs non-structural use is not adequately covered
- Untreated timber is not covered
- Hazard class design method is “flat earth”
Durability of Timber Joints?
Structural V Non-structural?

AS1604 for H3 treated wood currently allows envelope treatment of durability class 4 heartwood, regardless of its content within the timber member. i.e. the piece could be 100% heartwood.

OK for an easily replaceable, non-structural member with an expected short service life, but is it OK for critical structural member, not easily replaceable with a 50 year service life?
AS1604 What else needs improvement?

- Decay hazard within building envelope is not covered
- Unacceptable delays and costs in amending AS1604 due to changed SA business model and Std. content
- Prescriptive chemical levels are stated rather than product performance
- Product brands make no durability performance claim, unlike structural timber branding
- TM/6 is an approval body for new preservatives, unnecessarily duplicating the APVMA role
- Innovators have to declare treatment innovations
- Protection against weathering is outside the scope
Durability of Timber Joints?
Durability Design Failure?
Branding of Timber?

**Structural Product**

- MGP Grade
- Engineering properties

“How strong is the product?”

**Durable Product**

- Durability resistance?
- Durability properties?

“How long will the product last?”

Design Action V Structural Capacity

Design Action (Hazard) V Durability Capacity

Structural Reliability

Durability Reliability?
What if structural timber was branded using the same principles as AS1604?

i.e. Timber branded with the design action rather the material capacity

Maybe SNOW GRADE, LIVE LOAD GRADE, EARTHQUAKE GRADE, DEAD LOAD GRADE

Maybe we could come up with a load class system and simply use L1, L2, ..., L6
95%ile and Ave service life expectations with routine maintenance, before significant repair/replacement

Survey data courtesy of Lesley Francis, Research Scientist, Queensland Department of Agriculture, Fisheries and Forestry.
IDEAS?

• Clear statements about durability performance?
• Alternative Branding for Durability?
• Durability Grades?
• Durability solutions that meet BCA requirements?
• AS1604 - primary Durability Standard in Australia?
• AS1604 - secondary to a Head Durability Std?
• Construction Timbers in Australia?
• Your ideas?
Alternative Durability Brand?

Should we state durability claims on the product?

**Treated Product**
- e.g. 50 year service life
- in a H3 Hazard when used
- in accordance with Durability Standard AS1604?

**Untreated Product**
- e.g. 50 year service life
- in a H0 Hazard when used
- in accordance with Durability Standard AS1604?

Customer Confidence in Product? Market Growth?
Product performance warranty/ guarantee?
Durability credibility with professional designers?
# Durability Grades

<table>
<thead>
<tr>
<th>Category</th>
<th>Hazard Class</th>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>H2</td>
<td></td>
<td>“This product is suitable in this standard hazard”</td>
</tr>
<tr>
<td>Interim</td>
<td>H3 50</td>
<td>AG50</td>
<td>“This product will give 50 years of reliable service in this standard hazard”</td>
</tr>
<tr>
<td>Future</td>
<td></td>
<td>AG50</td>
<td>“95% of this product will have sufficient decay resistance to standard above ground fungi species, to achieve a service life in excess of 50 years. Where the decay hazard varies then other service lives may be calculated using AS1720.5 design methods.”</td>
</tr>
</tbody>
</table>
## AS1604 Secondary Durability Standard

### State Building Legislation

### Building Code of Australia

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Structure, Damp &amp; Weatherproofing, Health &amp; Amenity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Statement</td>
<td>Resist loads, water and deteriorating agents</td>
</tr>
<tr>
<td>Performance Req.</td>
<td>Withstand stress &amp; deteriorating agents and prevent water entry</td>
</tr>
</tbody>
</table>

### AS XXXX Durability Head Standard

- a) sets timber service lifes
- b) sets durability performance requirements
- c) covers products/elements/systems
- d) covers structural & non-structural applications

### Chemical treated timber

- Untreated Timber
- Modified Timber
- Glued Timber
- Timber Joints
- Detailing, finishing, maintenance

### Hazard Class

- AS1604
- AS5604

### Product Req’ts

<table>
<thead>
<tr>
<th>Codemark</th>
<th>Eng. Certif</th>
<th>Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS1720 (Parts 1, 4, 5)</td>
<td>AS1684</td>
<td>AS3660</td>
</tr>
<tr>
<td>Const. timbers in Qld</td>
<td>AS XXXX Durability Head Standard</td>
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<table>
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<tr>
<th>Hazard Class</th>
<th>AS1604</th>
<th>AS5604</th>
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</thead>
<tbody>
<tr>
<td>Product Req’ts</td>
<td></td>
<td>?</td>
</tr>
</tbody>
</table>

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FIEA - Wood Preservation 2012
CONCLUSIONS

- The timber durability system is not well aligned to
  - timber designer/customer expectations
  - BCA requirements
  - reliability based design principles
- Numerous options are available to improve the current durability system
- FWPA Design for Durability Project is showing the way
- AS1604 has an important ongoing role, but needs to evolve
- A Durability Head standard with a scope that covers the entire timber durability system should be considered
- An improved durability system will provide opportunities to increase timber markets
Further Information


• Construction Timbers in Queensland

• Wood Solutions - Technical Design Guides - Timber service life design - design guide for durability,

• Wood Solutions – Timberlife Software,

• FWPA Design for Durability Project Reports (10 Documents),

• AS1720.1 Timber Structures – Design Methods Clause 1.4.4.5

• AS1684 Residential Timber-Framed Construction. Appendix B
THANK YOU