Determination 2016/025

Regarding the durability of New Zealand grown European oak timber to be used internally in a new dwelling at 350 Jones Road, Blenheim

Summary

This determination discusses the compliance of New Zealand grown European oak with Building Code Clause B2 Durability when used internally as structural framing and flooring.

1. The matter to be determined

1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004[1] ("the Act") made under due authorisation by me, John Gardiner, Manager Determinations and Assurance, Ministry of Business, Innovation and Employment ("the Ministry"), for and on behalf of the Chief Executive of the Ministry.

1.2 The parties are:

- the owners of the house, D Underwood and S Boyd, (the "applicants") who applied for this determination;
- Marlborough District Council carrying out its duties and functions as a territorial authority or building consent authority ("the authority").

1.3 The applicants have applied for a building consent for a new two-storey four-bedroom dwelling. Incorporated in the design of the dwelling is the use of New Zealand grown European oak timber, which is specified for use as flooring, floor joists, posts and beams in a centrally located double-height space in the dwelling.

1.4 This determination arises because the authority considered it did not have reasonable grounds to be satisfied that the proposal complies with certain clauses[2] of the Building Code (First Schedule, Building Regulations 1992). The matter to be determined[3] is therefore whether there is sufficient information available to establish on reasonable grounds that New Zealand grown European oak timber used as specified would comply with Clause B2 Durability.

1.5 In making my decision, I have considered the submissions of the parties and the other evidence in this matter. I have not considered any other aspects of the Act or of the Building Code, nor have I considered any other building elements other than in regards to compliance of the European oak timber flooring, floor joists, posts and beams.

[1] The Building Act, Building Code, compliance documents, past determinations and guidance documents issued by the Ministry are all available at www.building.govt.nz or by contacting the Ministry on 0800 242 243.
[2] In this determination, unless otherwise stated, references to sections are to sections of the Act and references to clauses are to clauses of the Building Code.
[3] Under section 177(1)(a) of the Act

2. The building work

2.1 The proposed building is a new two-storey, four-bedroom residential dwelling. European oak timber has been specified for use as flooring, floor joists, posts and beams in a centrally-located double-height space.

2.2 The flooring, floor joists, and beams are exposed on the underside of the floor and form the ceiling for the ground level. The posts are fully exposed. The timber members are generally oversized for appearance – for example 350x350mm beams, and 250x100mm joists.

2.3 Other structural timber members are Douglas fir and Pinus Radiata. The durability of these species is not a matter for this determination, which is limited to the durability of European oak only.

3. Background

3.1 The application for consent

3.1.1 The owner applied for a building consent (No. BC160144) on 23 February 2016.

3.1.2 On 23 March 2016 the authority emailed the applicant; an attachment (dated 17 March 2016) to that email listed those matters about which the authority required further information, including evidence about the durability of European oak. That information was requested again on 8 April 2016 and on 13 April 2016.

3.1.3 On 15 April 2016 the authority received from the applicants a supplier's data sheet for American white oak. On 29 April the authority received from the applicants further information about the durability of European oak:

- Extracts from a publication "The New Carpenter and Joiner"[4] presents the durability characteristics of various timber species.
- A paper published in the New Zealand Journal of Forestry: "Durability of New Zealand grown timbers"[5].
- Reference to New Zealand Standard NZS 3602 "Timber and Wood-based products for use in buildings".
- Information about American white oak and European white oak (alternative name for European oak) indicating the timber is classified as "Durable".
- Email correspondence from a Scion Research scientist and project leader.

The applicants also noted the historical use of European oak in buildings extending over several hundred years, including structural members in buildings dating from the 15th century in France and early 1900's in New Zealand.

3.1.4 The authority's response dated 10 May 2016 included a request for further information to clarify how the durability requirements will be met, and stated that without further information being provided it would decline the Building Consent. The authority said:

> The information received has been discussed with seniors and it was decided that [the authority] will not accept that the information provided meets the requirements of the New Zealand Building Code. Some of the information received is very outdated. The more recent information shows European Oak as having only 15-25 years' durability.

[4] *The New Carpenter and Joiner, Vol 1*. Boughton, R.V. (1958).
[5] *Durability of New Zealand grown timbers*, Page, D and Singh, T. (New Zealand Journal of Forestry Vol 5, No.4 February 2014)

> Information was also received for American White Oak which is not relevant to European Oak.
>
> [The authority] requires further information to clarify how durability will be met for European Oak.

3.1.5 The Ministry received the application for determination on 30 May 2016.

4. The submissions

4.1 In a submission dated 30 May 2016 the applicants provided the documents previous sent to the authority (see paragraph 3.1.3 above), extracts from a BRANZ publication "Selecting Timber", and set out the arguments for believing the oak met the durability requirements of the Building Code.

4.2 The applicants submitted the following (in summary):

- According to the BRANZ publication[6], timber classified as durable or moderately durable would be suitable; the publication describes European oak as durable.
- The oak timbers are located in a dry internal environment that is unlikely to exceed 18% moisture content.
- All oak timbers are located within the building envelope and where they can be monitored visually.
- The home is a new build where there is no evidence of borer.
- The European oak will be brush treated with a proprietary timber preservative.
- The New Zealand Journal of Forestry paper "Durability of New Zealand grown timbers" and the New Carpenter and Joiner book both show European oak to be at least as durable as Rimu which is acceptable under NZS 3602[7].
- Oak floors are used throughout New Zealand and there are numerous suppliers.
- The durability of European oak can be compared with, and either is comparable to or exceeds, the durability of other species that are accepted through NZS 3602.
- European oak timber has a long history of use, citing as examples use as structural members in West Minster Hall, London (500 years old) and Eglise Saint-Girons a 15th century church in France, and Olveston House in Dunedin since 1906.
- An opinion from a Scion Research timber preservation expert:

> We have only done one stake test of NZ grown *Quercus robur* [English oak] here and the results indicate that the heartwood has a durability rating of 2 (durable) in ground contact. The heartwood is generally regarded as durable-very durable in Europe hence there should be no problem with it being used for framing timber or for flooring. The sapwood is susceptible to borer damage hence it should not be used for structural components.

[6] *Selecting Timber: a guide to choosing timber for use in building*, Wierenga, J and Black, R (BRANZ 2011)
[7] New Zealand Standard NZS 3602:2003 Timber and wood-based products for use in building

4.3 The authority acknowledged the application for determination and in its submission dated 2 June 2016 made the following points (in summary):

> [The authority] does not accept the evidence to date provides the necessary compliance with B1 and B2 for the structural members proposed …
>
> … the European oak referred to in the documentation has actually been grown in New Zealand. [The authority] therefore submits that the performance of that Oak would be very hard to confirm without a formal testing regime undertaken by a recognised testing body.

4.4 A draft determination was issued to the parties on 21 June 2016.

4.5 In a response dated 29 June 2016, the authority accepted the draft noting that

> …[the authority] will expect all other timber components used in the structure to comply fully with requirements of [clause] B2 … Any deviation from the approved documents will require an amendment to cover any change.

4.6 The applicants responded on 30 June 2016, accepting the draft and noting a typographic error that has subsequently been amended.

5. Discussion

5.1 The legislation

5.1.1 The relevant clause of the Building Code is B2.3.1(a), which sets the performance requirements that building elements, including those providing structural stability, must comply with.

5.1.2 Section 19 of the Act provides various means as establishing compliance with the Building Code, including but not limited to compliance with the relevant Acceptable Solution (B2/AS1).

5.2 The Acceptable Solution B2/AS1

5.2.1 Paragraph 3.2.1 of the Acceptable Solution B2/AS1 states:

> The following Standards form an Acceptable Solution for B2/AS1 meeting the durability requirements of timber and wood-based building elements,
>
> a) NZS 3602[8] Part 1 as modified by Paragraph 3.2.2.
>
> b) NZS 3640[9] as modified by Paragraph 3.2.3.
>
> c) NZS 3604[10], with reference to NZS 3602 (and NZS 3640), as modified by Paragraph 3.2.1 a) and b) above.

(Refer to Appendix B for the modifications noted above. The modifications to NZS 3602 relate to the use of Radiata pine and Douglas fir.).

NZS 3602

5.2.2 B2/AS1 provides for the use of NZS 3602, as modified by the Acceptable Solution, as a means of establishing compliance.

5.2.3 Table 1 in NZS 3602 sets out the requirements for wood-based building components to achieve a 50-year durability performance:

- Table 1C (Members protected from the weather but exposed to ground atmosphere): permits heartwood Macrocarpa for floor joists and bearers, and

[8] NZS 3602:2003 Timber and Wood-based products for use in building Part 1
[9] NZS 3640:2003 Chemical Preservation of round and sawn timber
[10] NZS 3604:2011 Timber framed buildings

Macrocarpa and Rimu for flooring, without treatment, and Pinus Radiata for those applications but with preservative treatment to H1.2.

- Table 1E (Members not exposed to weather or ground atmosphere and in dry conditions) permits untreated Macrocarpa for mid-floor framing (which I also take to include flooring) and Pinus Radiata treated to H1.2.

5.3 Analysis

5.3.1 Taking into account the above, I make the following comments in regard to the use of New Zealand grown European oak timber in the proposed dwelling:

5.3.2 The proposed use is internal, dry, and falls within the caveats typically made regarding the durability of timbers. I note that the BRANZ publication comments that the most important influence on timber used in building is its moisture content, and that even timber with a natural durability rating of "Perishable/non-durable" has an expected durability in excess of 50 years if fully protected from moisture. There is no indication from the authority that the proposed design would not comply with other provisions of the Building Code that would compromise the durability of these timber members, specifically E2 External Moisture or E3 Internal Moisture.

5.3.3 I have considered the argument that the timbers are visible and easily inspected if necessary. Whilst that might enable early action to be taken should timber decay be noticed, the Building Code requires structural members to be durable for at least 50 years with only normal maintenance. Should damage be observed, I do not consider any action that might be taken to repair these members as being normal maintenance.

5.3.4 As a basis for establishing the use of European oak as an alternative solution, the suitability of the timber with respect to durability in certain circumstances can be inferred by comparison with the durability of other species that are referenced in documents that are regularly used to base compliance with the Building Code.

5.3.5 I have considered the uses permitted for various species in NZS 3602, which is referenced with modifications as an Acceptable Solution in B2/AS1. In particular, Rimu and Macrocarpa are included as having suitable durability for use as flooring and floor members in NZS 3602, without preservative treatment. I also note that the exposure in Table 1C (Members protected from the weather but exposed to ground atmosphere) is more severe than would be the situation proposed by the applicants.

5.3.6 The evidence provided in the paper published in the New Zealand Journal of Forestry,"Durability of New Zealand grown timbers", is that European oak is at least as durable as Rimu and Macrocarpa. Table 1 of the paper classifies the in-ground natural durability (based on 50mm square stakes of heartwood timber) of European oak as Class 2 (durable) 15-25 years, compared with Class 3 (moderately durable) 5-15 years for Macrocarpa, Rimu, and Pinus Radiata; noting Macrocarpa and Rimu to be towards the upper end of that range, and Pinus Radiata to be towards the lower end.

5.3.7 It follows that European oak could be substituted in those situations where NZS 3602 permits the use of Rimu or Macrocarpa. I note that this assumption applies to the durability of heartwood material only.

5.3.8 The authority commented that the European oak referred to has been grown in New Zealand, and that the performance of that oak would require a formal testing regime by a recognised testing body. I note, however, that the Scion data (both the published research paper and opinion from its scientist) does relate to New Zealand

grown timber and I consider this addresses the concern expressed by the authority regarding testing by a recognised testing body.

5.3.9 I note the comment from the Scion Research timber preservation expert regarding the susceptibility of sapwood to borer damage, and the intention of the applicants to surface treat the members with an insecticide to mitigate the risk of borer infestation.

5.4 Conclusion

5.4.1 I consider the evidence available provides me with reasonable grounds to be satisfied that the New Zealand grown European oak in its proposed use as flooring, floor joists, posts and beams in an internal double-height space in the building will meet the requirements of the Building Code with respect to Clause B2 Durability.

5.4.2 It is emphasised that each determination is conducted on a case-by-case basis. Accordingly, the fact that a particular timber species has been established as being code-compliant in relation to particular building work does not necessarily mean that the species will be code-compliant in another situation.

6. The decision

6.1 In accordance with section 188 of the Building Act 2004, I hereby determine that New Zealand grown European oak timber for use as flooring, floor joists, posts and beams as specified for this house will comply with the Building Code Clause B2 Durability.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 7 July 2016.

John Gardiner
Manager, Determinations and Assurance

Appendix A: The legislation

A1. The relevant sections of the Act:

> **19 How compliance with building code is established**
>
> (1) A building consent authority must accept any or all of the following as establishing compliance with the building code:
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> (a) compliance with regulations referred to in section 20:
>
> (b) compliance with an acceptable solution:
>
> (ba) compliance with a verification method:

A2. Clause B2.3.1 of the Building Code:

> **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:
>
> (a) the life of the building, being not less than 50 years, if:
>
> (i) those building elements (including floors, walls, and fixings) provide structural stability to the building, or
>
> (ii) those building elements are difficult to access or replace, or
>
> (iii) failure of those building elements to comply with the building code would go undetected during both normal use and maintenance of the building.

Appendix B: The Acceptable Solution and Standards

B.1 Relevant paragraphs of Acceptable Solution B2/AS1 modifying referenced Standards:

3.2.2 Modification to NZS 3602

3.2.2.1 Level of treatment references to Radiata pine and Douglas fir solid timber in Table 1 categories ‘C’, ‘D’ and ‘E’ and Table 2 category ‘B’ shall be replaced by Tables 1A and 2A below. Table 1A and Table 2A are to be read with NZS 3602 sections 108 to 111 inclusive, with the amendments in Paragraph 3.2.2.3 below.

Other references to Radiata pine, Douglas fir solid timber and engineered wood products in NZS 3602, including Table 1 categories ‘A’, & ‘B’; Table 2 category ‘A’; and Table 3 are unaltered.

Laminated veneer lumber (LVL) treated using LOSP borne azoles as specified for H3.1 in NZS 3640 Table 6.2 satisfies the minimum treatment requirement of H 1.2.

3.2.3 Amendments to NZS 3640.

3.2.3.1 Delete comment C3.1 and replace with the following as normative text:

3.1.1 NZBC clause B2.3.1 refers to minimum durability requirements for building elements. Timber used for structural purposes is required to be durable in-service for the life of the building, being not less than 50 years unless the building has a specified intended life.

This is applicable to hazard classes H1.2, H3.2, H4, H5, and H6. Structural timber refers to timber that has been graded to characteristic strength and stiffness properties.

The minimum requirement for a H1.2 treatment for timber framing is to provide protection in-service but the preservative treatment is not designed for extended exposure to elevated moisture content.

Timber used for non-structural purposes, such as H1.1 and H3.1 is required to be durable in-service for a minimum of 5 years and 15 years respectively.

3.2.3.2 Delete clause 6.3.1.1 and replace with:

6.3.1.1 Complete sapwood penetration shall be achieved.