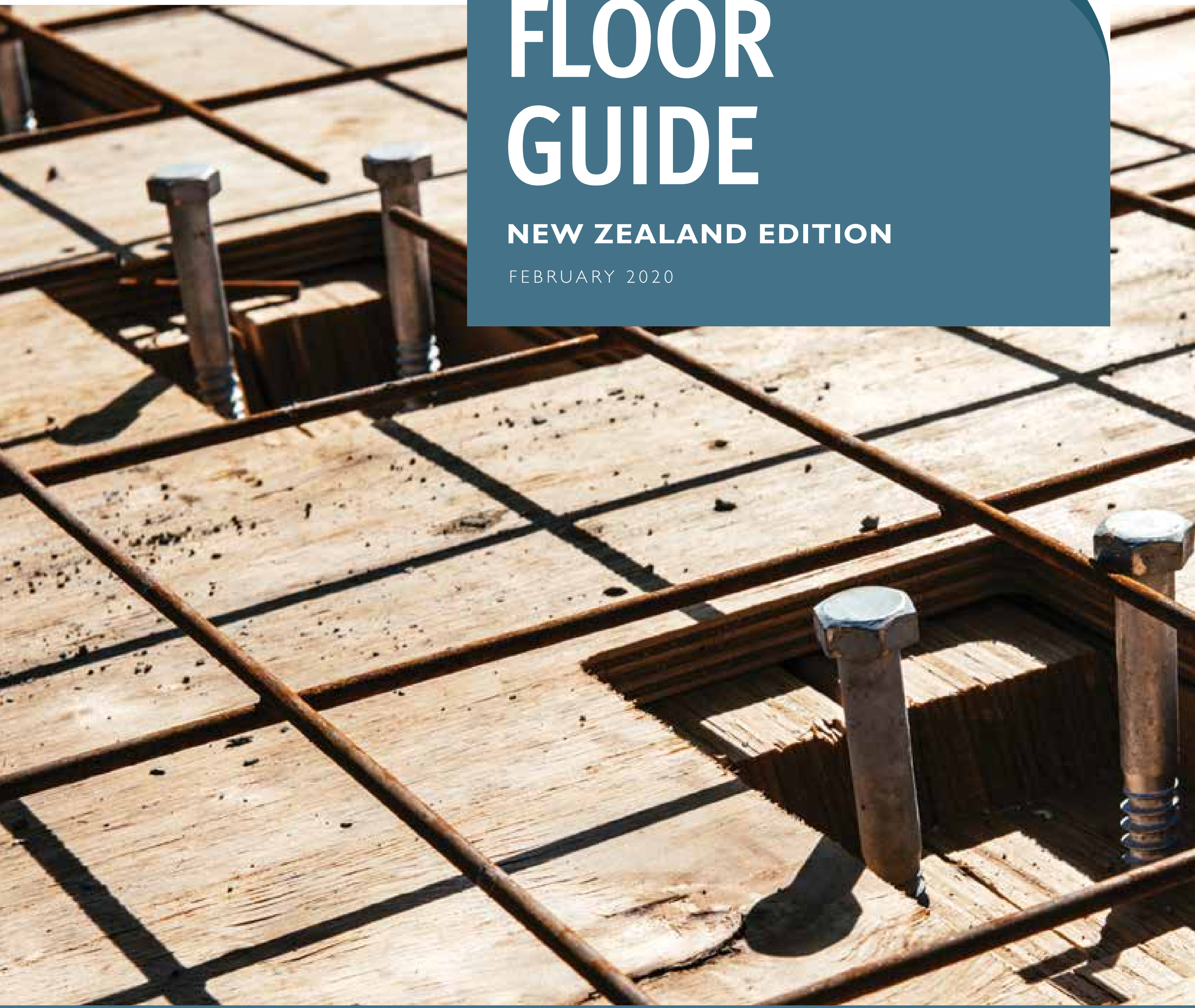
FUTUREBUILD® STRUCTURAL LVL hy ONE®
FUTUREBUILD® STRUCTURAL LVL hy SPAN®
FUTUREBUILD® LVL TRUSS CHORDS hy CHORD®
FUTUREBUILD® STRUCTURAL LVL BEAMS hy 90®
FUTUREBUILD® LVL ENGINEERED I-JOISTS hy JOIST®
FUTUREBUILD® LVL SCAFFOLD PLANKS hy PLANK®
FUTUREBUILD® LVL FORMWORK BEAMS tru FORM®
FUTUREBUILD® LVL FORMWORK EDGE BOARDS edge FORM®

# TCC FLOOR GUIDE

## NEW ZEALAND EDITION

FEBRUARY 2020



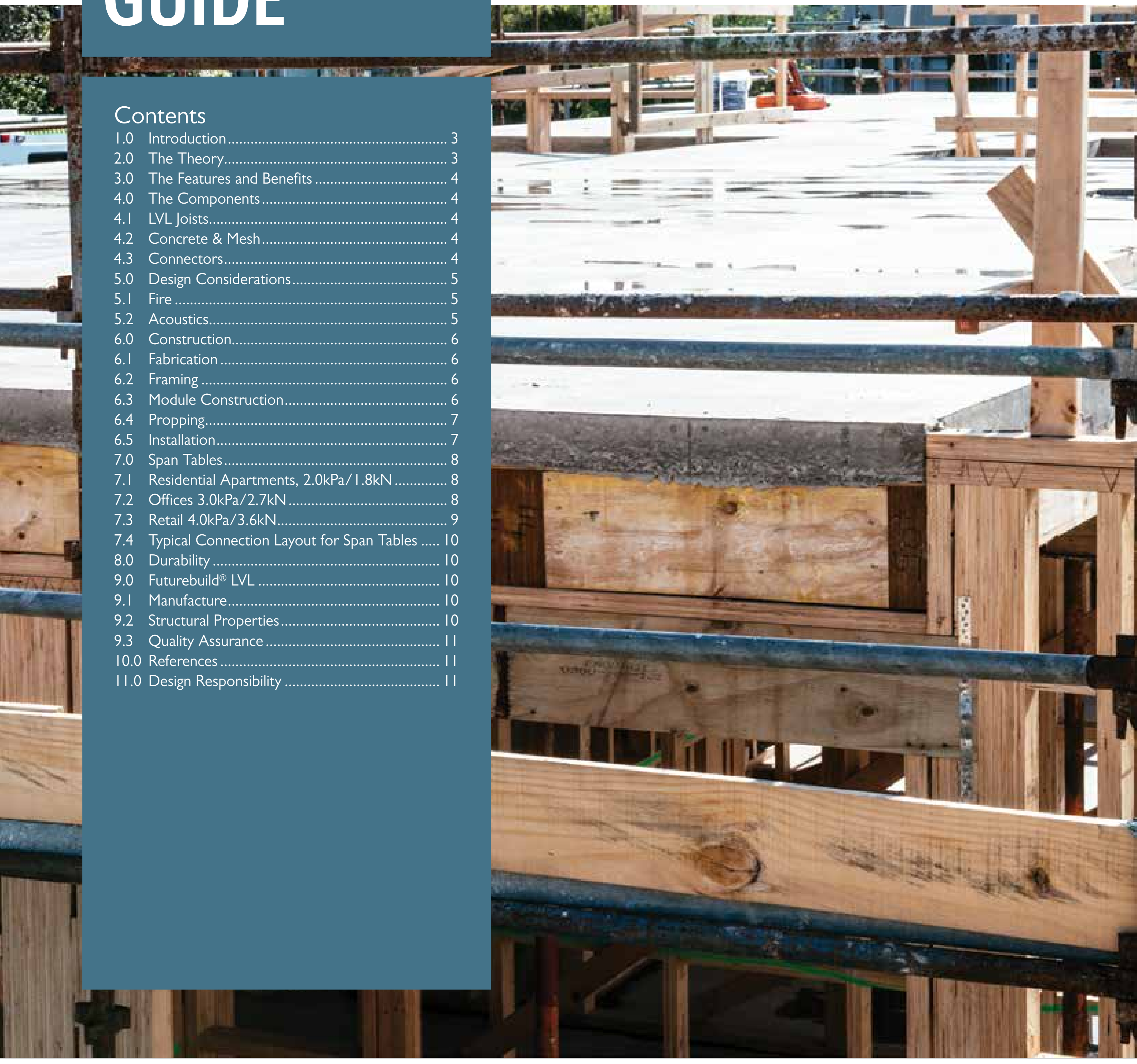
**Information contained within this manual is specific to the Futurebuild® LVL range of products and cannot be used with any other LVL products no matter how similar they may appear.**

FUTUREBUILD® LVL

# TCC FLOOR GUIDE

## Contents





# 1.0 INTRODUCTION

Timber Concrete Composite (TCC) floors represent a move to optimise the advantages of both Laminated Veneer Lumber (LVL) beams and a concrete screed/slab, combined using defined connection methods to provide composite action. Introduced to New Zealand in 2012, concrete screeds have been added to timber floors for decades in Europe where the natural weight of concrete has been used to provide acoustic benefits.

A natural progression is to provide a structural connection between the screed and the timber joists, allowing for an optimised structural solution with acoustic, fire and optimisation benefits.

This TCC Floor Guide, developed through the Structural Timber Innovation Company (STIC), provides design guidelines in relation to strength, stiffness and fire design. These guidelines have been applied to develop the TCC floors module in the Futurebuild® LVL all purpose beam analysis software package computeIT® for Beams, that enables Engineers to develop design solutions for a range of Engineered Wood Products, and also applied in the development of the span tables contained within this guide.

# 2.0 THE THEORY

Adopted from Eurocode 5, the TCC floor design methodology models the interaction between the concrete and the timber using "gamma" coefficients by developing a relative stiffness for the overall cross section for use in analysis. These coefficients have then been validated through testing for short term and long term loads.

Analysis of the composite section is then completed in accordance with the relevant design standards, including AS/NZS 1170.1: Structural Design Actions and AS 1720.1: Timber Structures. Specific duration of load factors and Natural Frequency (dynamic) equations have been developed based on an empirical methodology.



PRODUCT CERTIFIED tested STRUCTURAL LAMINATED VENEER LUMBER paa ENGINEERED WOOD

JAS-ANZ

# 3.0 THE FEATURES & BENEFITS

Futurebuild® LVL TCC floors have a number of features and benefits for end users, builders, designers and building owners alike. They include:

- Concrete screed for enhanced acoustic attenuation
- LVL for strength, stiffness and inherent fire resistance*
- Established, tested, and proven performance
- computeIT® design software for performance optimisation
- Lightweight, enabling use of conventional timber framing support*
- Easy to install, no specialist equipment required
- Cost effective*

* Subject to design considerations

# 4.0 THE COMPONENTS

## 4.1 LVL JOISTS

LVL makes an ideal choice for joists in TCC floors due to the nature of its manufacture. Being sawn from a nominal 1200mm wide billet, the joists are sawn so they are straight, true and dimensionally stable. Manufactured from individually graded veneers, Futurebuild LVL provides low variability and high reliability. A range of stiffnesses varying from 9.5GPa (hy90®) through to 16.0GPa (hyONE®) allows a high degree of optimisation depending on requirements of floor depth, floor performance, spanning capability or fire resistance.

## 4.2 CONCRETE & MESH

A minimum concrete thickness of 75mm is recommended to allow for sufficient cover of the mesh. Mesh is required on all TCC floor systems to control concrete shrinkage. Concrete thickness can be adjusted to aid in the development of a suitable fire resistance – refer to computeIT for Beams software for alternate design solutions.

## 4.3 CONNECTORS

The connection between the concrete screed and LVL joists is critical in the overall floor performance. The span tables included in this brochure are based on the minimum effects of stiffness and strength of the three available connection methods listed below. computeIT for Beams allows the specific design of TCC floors relative to connection type and number of connectors.

Available connection options include:

- Trapezoidal notch with coach screw (refer Figure 1)
- Triangle notch with coach screw (refer Figure 2)
- 45° SFS screws (refer Figure 3)

Refer to computeIT for Beams for specific notch geometry and fastener size.

**Figure 1: Trapezoidal Notch**

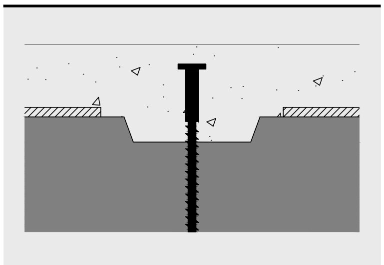


**Figure 2: Triangle Notch**

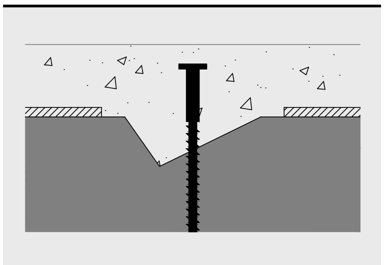
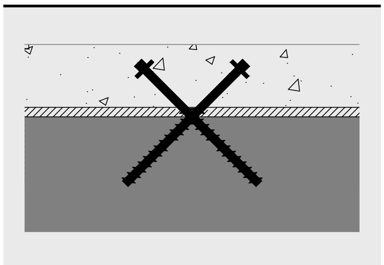


**Figure 3: 45° SFS Screws**



# 5.0 DESIGN CONSIDERATIONS

Strength, stiffness and dynamic performance are paramount to the overall floor performance of any flooring system. The consideration of fire resistance (subject to design requirements) and acoustic performance form part of a complete TCC floor solution. The following information is based on typical building material and processes.

## 5.1 FIRE

The Fire Resistance Rating (FRR) requirements in building systems relate to structural adequacy, integrity and insulation which may differ depending on building structure, materials and occupancy. The FRR requirements for building systems may also be handled passively by other fire proofing measures like sprinkler systems, fire resistant ceilings, etc. Where the TCC floor is required to provide a level of fire resistance the use of concrete slab of minimum thickness, as detailed in Table 1, will normally meet the requirements of integrity and insulation.

**Table 1: FRR Minimum Required Slab Thickness For Time**

| **Time (minutes)** | 30 | 60 | 90 | 120 |
|---|---|---|---|---|
| **Min. slab thickness (mm)** | 60 | 80 | 100 | 120 |

Design for the structural adequacy component of the Futurebuild® LVL members shall be based on concepts of charring in accordance with AS 1720.4 Timber Structures Part 4: Fire Resistance for Structural Adequacy of Timber Elements, confirmed as part of the STIC research program. Testing completed on concrete slabs notes that slabs thicker than 60mm retain sufficient compression strength for typical TCC floors to support fire loading.

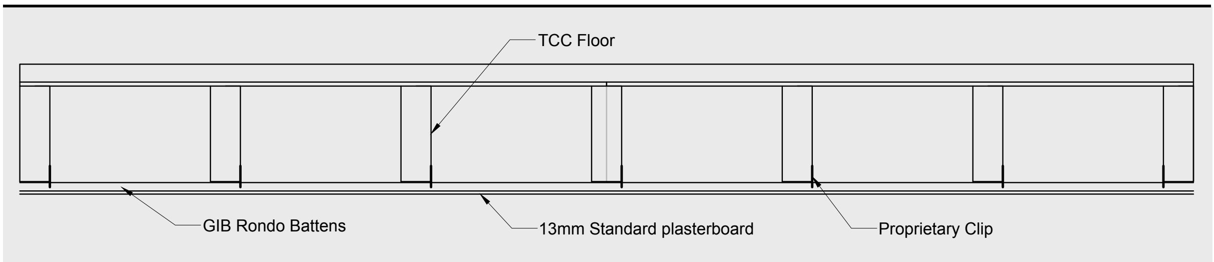
Refer to computeIT® for Beams for specific notch geometry and fastener size.

## 5.2 ACOUSTICS

Like fire, acoustic attenuation relating to both airborne sound, referred to as Sound Transmission Class (STC), and impact sound, referred to as Impact Insulation Class (IIC) can be provided through passive measures like acoustic ceilings, resilient connections between members, acoustic underlays, or acoustic insulation. The mass and thickness of concrete for the slab is particularly useful in providing a level of acoustic attenuation for airborne sound resistance.

Futurebuild® LVL TCC Floors have been third party assessed for acoustic attenuation. STC ratings of 60 have been confirmed as being achievable for TCC floor systems having a minimum joist spacing of 600mm centres, where the ceiling construction includes a minimum 13mm standard plasterboard fixed to GIB Rondo metal ceiling battens, and supported by proprietary clips fixed directly to the floor joists. The ceiling cavity is to include R1.8 insulation (i.e. 75mm thick fibreglass of minimum density 9.6kg/$m^3$) to complete the STC solution.

**Figure 4: Typical Floor/Ceiling Construction For Acoustic**




Bare TCC floors have an IIC class of 40, however with the addition of acoustic underlays and floor toppings, IIC ratings exceeding 60 are achievable incorporating a number of floor coverings and acoustic underlays including ceramic tiles, cork, timber, cushioned vinyl and carpet.

# 6.0 CONSTRUCTION

Construction of TCC floor systems typically involves the supply of prefabricated floor units to site for direct installation on wall framing. This process requires the coordination between fabricators and builders on site, followed by concrete supply. This section covers some practical tips around fabrication, framing, propping and installation.

## 6.1 FABRICATION

Futurebuild® LVL recommend that TCC floors be supplied as prefabricated units for direct installation on site. The supply of prefabricated floor systems assists with on-site construction time: deliver and install one day, pour concrete the next.

**Photo 1: Fabricated Trapezoidal Notch**

**Photo 2: Fabricated Section (ex. Plywood Formface)**

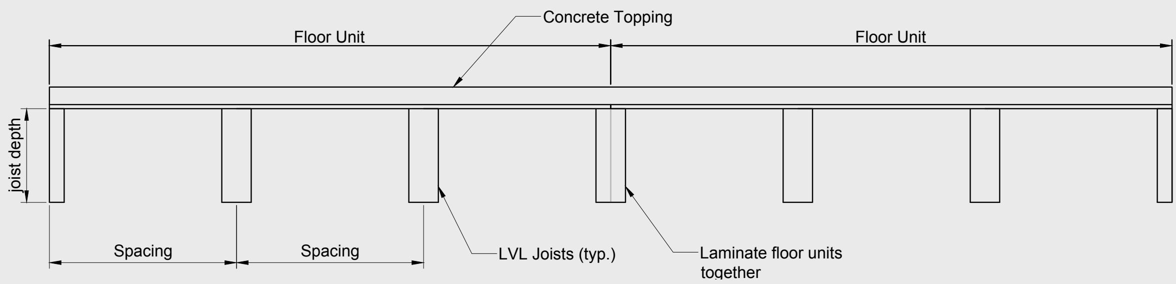
## 6.2 FRAMING

The use of TCC floors reduces the weight of floors when compared to concrete only floor systems and enables, subject to design verification, the use of traditional timber (or Futurebuild® LVL) framing for support.

## 6.3 MODULE CONSTRUCTION

TCC floor modules are manufactured with 'half' joists on the outside of modules to allow for jointing on site once moved into position. The joists are then joined with fully threaded screws to provide a level of fire resistance. Refer to design documentation for further information.

**Figure 5: Typical Floor Module**



## 6.4 PROPPING

TCC floors can be designed to be installed without propping during the concrete pour, however propping can be both useful and important in controlling creep and limiting long term deflection. Futurebuild® LVL recommends mid-span propping of TCC floor systems.

## 6.5 INSTALLATION

TCC floor units supplied to site on hiab can be lifted into place, with mesh and connectors installed on site. The concrete slab may then be poured to complete floor units (refer Photo 5 and 6). Temporary bracing and support may be required prior to installation, refer to the Project Engineer for further advice.

**Photo 3: TCC Floor Delivery & Installation**

**Photo 4: TCC Floor Delivery & Installation**

**Photo 5: TCC Floor with Mesh Installed**

**Photo 6: TCC Floor Laying Concrete Slab**

# 7.0 SPAN TABLES

The following span tables have been developed using the computeIT® for Beams TCC Floor Design Module based on defined loading and serviceability limits as noted. These tables should be used as a guide by design professionals and confirmed as suitable for the project in question.

**Deflection Limits Applied in Span Tables**

| | |
|---|---|
| **Permanent load** | Span/400 |
| **Live Load** | Span/480 |
| **Natural Frequency** | > 8.0 Hz |

## 7.1 RESIDENTIAL APARTMENTS 2.0kPa/1.8kN

**Design Loading**

| | |
|---|---|
| **Super Imposed Dead Load** | 50kg/m$^2$ |
| **Live Load** | 2.0kPa/1.8kN |
| **Slab Thickness** | 80mm |
| **Minimum Bearing** | 62mm |
| **Formface** | 17mm F8 plywood |

**Table 2: TCC Floor Span Tables for Residential Apartments, 2.0kPa/1.8kN**

| Size & Product | Joist Spacing (mm) 600[1] | 675[2] | 800[1] | 900[2] |
|---|---|---|---|---|
| | Maximum Span (m) | | | |
| **240 x 90 hySPAN[3]** | 5.8 | 5.6 | 5.4 | 5.2 |
| **240 x 126 hySPAN[4]** | 6.2 | 6.0 | 5.8 | 5.6 |
| **300 x 90 hySPAN[3]** | 6.8 | 6.6 | 6.3 | 6.1 |
| **300 x 126 hySPAN[4]** | 7.2 | 7.1 | 6.7 | 6.5 |
| **400 x 90 hySPAN[3]** | 8.2 | 8.0 | 7.8 | 7.5 |
| **400 x 126 hySPAN[4]** | 8.6 | 8.4 | 8.1 | 8.0 |

1. To suit 2400 x 1200mm plywood formface
2. To suit 2700 x 1200mm plywood formface
3. 90mm Joists with 45mm Joists at module joints.
4. 126mm Joists factory laminated from double 63mm sections. 63mm Joists at module joints.

## 7.2 OFFICES 3.0kPa/2.7kN

**Design Loading**

| | |
|---|---|
| **Super Imposed Dead Load** | 100kg/m$^2$ |
| **Live Load** | 3.0kPa/2.7kN |
| **Slab Thickness** | 80mm |
| **Minimum Bearing** | 62mm |
| **Formface** | 17mm F8 plywood |

**Table 3: TCC Floor Span Tables for Offices 3.0kPa/2.7kN**

| Size & Product | Joist Spacing (mm) | | | |
|---|---|---|---|---|
| | 600[1] | 675[2] | 800[1] | 900[2] |
| | Maximum Span (m) | | | |
| **240 x 90 hySPAN[3]** | 5.4 | 5.2 | 4.9 | 4.7 |
| **240 x 126 hySPAN[4]** | 5.7 | 5.6 | 5.3 | 5.1 |
| **300 x 90 hySPAN[3]** | 6.3 | 6.1 | 5.8 | 5.6 |
| **300 x 126 hySPAN[4]** | 6.7 | 6.5 | 6.2 | 6.0 |
| **400 x 90 hySPAN[3]** | 7.8 | 7.6 | 7.2 | 6.9 |
| **400 x 126 hySPAN[4]** | 8.3 | 8.1 | 7.7 | 7.5 |

1. To suit 2400 x 1200mm plywood formface
2. To suit 2700 x 1200mm plywood formface
3. 90mm Joists with 45mm Joists at module joints.
4. 126mm Joists factory laminated from double 63mm sections. 63mm Joists at module joints.

## 7.3 RETAIL 4.0kPa/3.6kN

**Design Loading**

| | |
|---|---|
| **Super Imposed Dead Load** | 100kg/m$^2$ |
| **Live Load** | 4.0kPa/3.6kN |
| **Slab Thickness** | 80mm |
| **Minimum Bearing** | 62mm |
| **Formface** | 17mm F8 plywood |

**Table 4: TCC Floor Span Tables for Retail 4.0kPa/3.6kN**

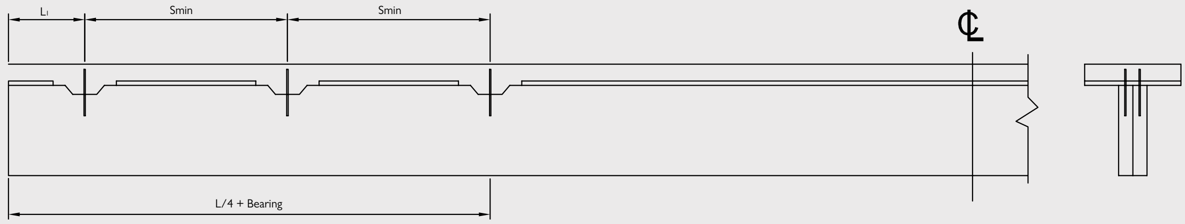
| Size & Product | Joist Spacing (mm) | | | |
|---|---|---|---|---|
| | 600[1] | 675[2] | 800[1] | 900[2] |
| | Maximum Span (m) | | | |
| **240 x 90 hySPAN[3]** | 5.2 | 5.0 | 4.8 | 4.6 |
| **240 x 126 hySPAN[4]** | 5.6 | 5.4 | 5.1 | 4.9 |
| **300 x 90 hySPAN[3]** | 6.1 | 5.9 | 5.6 | 5.4 |
| **300 x 126 hySPAN[4]** | 6.5 | 6.3 | 6.0 | 5.8 |
| **400 x 90 hySPAN[3]** | 7.6 | 7.3 | 7.0 | 6.7 |
| **400 x 126 hySPAN[4]** | 8.1 | 7.9 | 7.5 | 7.3 |

1. To suit 2400 x 1200mm plywood formface
2. To suit 2700 x 1200mm plywood formface
3. 90mm Joists with 45mm Joists at module joints.
4. 126mm Joists factory laminated from double 63mm sections. 63mm Joists at module joints.

## 7.4 TYPICAL CONNECTION LAYOUT FOR SPAN TABLES

All span tables have been developed using three connectors per end as detailed below (refer Figure 6), the spacing of connectors is critical to performance and should form part of any specification, where all connectors are to be placed within the end quarter of the beam. The number of connectors can affect both strength and stiffness. Designs may be optimised using computeIT® for Beams software.

**Figure 6: Typical Connection Layout**




$L_1$ = 300 + bearing (mm)
$S_{min}$ = (L/4-300)/2 (mm)

# 8.0 DURABILITY

Futurebuild® LVL is manufactured to meet the requirements of the New Zealand Building Code Clause B2 Durability. As such, if the product is used in accordance with Futurebuild® LVL specifications and good building practices, and treated to the levels prescribed in NZS 3602, Timber and Wood based Products for Use in Building, it will comply with the requirements of the NZ Building Code. Futurebuild LVL may be supplied untreated for mid-floor framing (excluding boundary joists) in accordance with NZS 3602 Table 1, Reference 1E.2.

# 9.0 FUTUREBUILD® LVL

Futurebuild LVL is manufactured for use in residential, industrial and commercial projects alike. The following information is generic across the Futurebuild LVL product range.

## 9.1 MANUFACTURE

Futurebuild LVL is manufactured by using phenolic adhesive to laminate radiata pine veneer, in a continuous assembly in which the grain direction of all veneers is orientated in the longitudinal direction. It is pressed as a 1200mm nominal width continuous billet in various standard thicknesses, docked to any specified length and then ripped into standard widths for use as structural beams, etc.

## 9.2 STRUCTURAL PROPERTIES

The structural properties for Futurebuild LVL have been determined by testing in accordance with the requirements of AS/NZS 4357 and section 4 of AS/NZS 4063.2:2010 and so comply with the provisions of the NZ Building Code through clause 2.3 in NZS 3603. Refer to the Futurebuild LVL Specific Engineering Design Guide for engineering design information.

## 9.3 QUALITY ASSURANCE

Futurebuild® LVL is manufactured in a fully quality controlled process, independently third party audited by the Engineered Wood Products Association of Australia (EWPAA). The EWPAA certifies Futurebuild LVL manufactured at its Marsden Point, New Zealand mill.

Participation and compliance with the requirements of the EWPAA's process is based on a quality control scheme that includes product testing and monitoring of properties. It provides the basis for the EWPAA's Product Certification of Futurebuild LVL as conforming to the requirements of AS/NZS 4357 (Structural Laminated Veneer Lumber). Conformance with AS/NZS 4357 ensures that Futurebuild LVL is suitable for structural applications in accordance with NZS 3603 Timber Structures Standard and NZS 3604 Timber Framed Buildings.

The EWPAA's product certification scheme is accredited under the government Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

# 10.0 REFERENCES

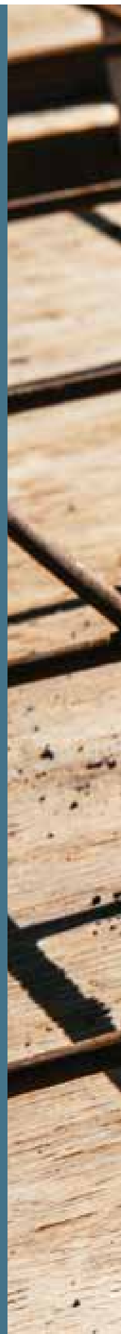

- AS/NZS 1170.0:2002 Structural Design Actions Part 0: General Principles
- AS/NZS 1170.1:2002 Structural Design Actions Part 1: Permanent, imposed and other actions
- AS 1720.1:2010 Timber Structures Standard
- Futurebuild LVL Specific Engineering Design Guide
- Timber Concrete Composite Flooring Systems Structural Timber Innovation Company, Gerber, Crews, Shresthma, 2012
- computeIT® for Beams software, www.chhsoftware.co.nz


# 11.0 DESIGN RESPONSIBILITY

The attached information has been developed based on typical loading and support information. Structural, fire and acoustic information may vary from project to project and should be verified by an engineer involved in the project.

Design responsibility lies with the building owner and the professionals that they engage. The specifier for the project must ensure that the details in the specification for their individual projects are appropriate for the intended application.

futurebuild LVL



Private Bag 92-106
Victoria Street West
Auckland 1142
New Zealand

Freephone: 0800 585 244

www.futurebuild.co.nz
www.chhsoftware.co.nz