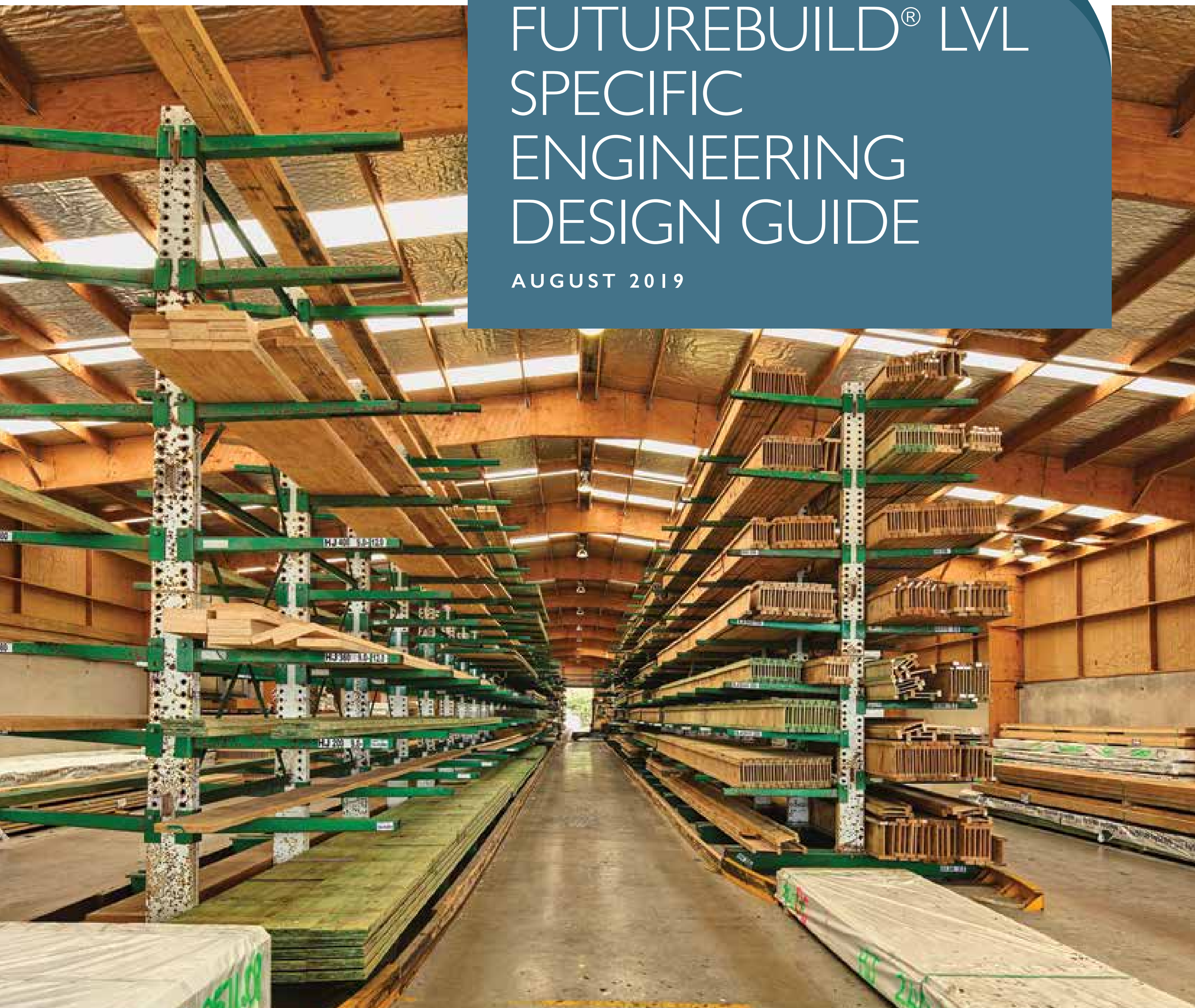
futurebuild® LVL

FUTUREBUILD® STRUCTURAL LVL hyONE®
FUTUREBUILD® STRUCTURAL LVL hySPAN®
FUTUREBUILD® LVL TRUSS CHORDS hyCHORD®
FUTUREBUILD® STRUCTURAL LVL BEAMS hy90®
FUTUREBUILD® LVL ENGINEERED I-JOISTS hyJOIST®
FUTUREBUILD® LVL SCAFFOLD PLANKS hyPLANK®
FUTUREBUILD® LVL FORMWORK BEAMS truFORM®
FUTUREBUILD® LVL FORMWORK EDGE BOARDS edgeFORM®

FUTUREBUILD® LVL SPECIFIC ENGINEERING DESIGN GUIDE

AUGUST 2019



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

FUTUREBUILD® LVL SPECIFIC ENGINEERING DESIGN GUIDE

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1.0 LAMINATED VENEER LUMBER

Laminated Veneer Lumber (LVL) is an engineered wood material with defined and reliable strength and stiffness properties. It is suited to a wide range of structural applications, including critical elements such as large span portal frames and primary or secondary beams in commercial buildings.

1.1 FUTUREBUILD® LVL

Manufactured by Futurebuild® LVL in Northland, New Zealand, the Futurebuild LVL range is New Zealand's largest range of LVL. The Futurebuild LVL range of products features specific material property 'recipes'. As such the information contained within this literature is specific to the Futurebuild LVL range and must not be used with any other LVL products no matter how similar they may appear.

For designers Futurebuild LVL offers:

- Consistent structural performance with low variability.
- Third party certification of conformance with AS/NZS 4357 by the Engineered Wood Products Association of Australasia (EWPAA)[1].
- Long lengths and large cross-sectional dimensions.
- Dimensionally stable product, which is easily installed on site.

[1]Some products, including non standard I-Joists, may not carry EWPAA certification.

This literature contains general design information and material properties intended for use where members are specifically engineered for applications not covered by Futurebuild LVL product brochures. For design information for standard applications visit www.futurebuild.co.nz.

Futurebuild LVL products must be competently installed in accordance with good building practices and sound design principles to satisfy the requirements of the Building Act 2004, the New Zealand Building Code, and applicable New Zealand Standards. This is the responsibility of building owners and the design professionals and builders that they engage. This document contains information, limitations, and cautions regarding the properties, handling, installation, usage, and the maintenance of Futurebuild LVL products. However, to the maximum extent permitted by law, Futurebuild LVL assumes no legal liability to you in relation to this information.

When specifying or installing any Futurebuild LVL product visit www.futurebuild.co.nz or call 0800 585 244 to ensure you have current specification material and any relevant technical notes.

The information contained in this document is current as at August 2019. It is your responsibility to ensure you have the most up to date information available.

The information contained in this publication relates specifically to Futurebuild® LVL products manufactured by Carter Holt Harvey LVL Limited and must not be used with any other LVL manufacturer's product no matter how similar they may appear.

Alternative LVL products can differ in a number of ways which may not be immediately obvious and substituting them for Futurebuild LVL products is not appropriate and could in extreme cases lead to premature failure and/or buildings which do not meet the requirements of the New Zealand Building Code.

1.2 RESIDENTIAL BUILDINGS

Software for the design of members for use in residential construction can be downloaded from www.chhsoftware.co.nz.

1.2.1 designIT® for houses

designIT® for houses is a tool for building industry professionals involved in designing houses and similar structures using the Futurebuild® LVL range of engineered wood products and other selected materials. Quick and simple to use, subject to the terms of a licence agreement, the deceptively powerful designIT software is useful for the selection of beam sizes.

1.2.2 layITout® for houses

layITout® for houses is an integrated design and layout tool that allows users to enter a house plan, propose, and then design a floor joist or rafter layout for a fully integrated engineered system.

1.2.3 designIT site

designIT site is a smartphone app developed as a handy reference tool for the specifier or tradesman on the go. The designIT site app is a trimmed down version of designIT for houses.

1.2.4 floorIT site

floorIT site is a smartphone app to aid specifiers in the specification, selection and estimation of quantities for a range of flooring applications.

1.3 COMMERCIAL & INDUSTRIAL BUILDINGS

The Preliminary Design Service is an LVL focused initiative to provide design tools and specialised products for the development of portal frame structures using the Futurebuild LVL range of products. Futurebuild LVL solutions include software platforms, engineering design tools and advice, a commercial product range and a network of experienced pre-fabricators to provide cost effective LVL portal frames to the market.

To access the tools below visit www.chhsoftware.co.nz or call 0800 585 244 to speak to an experienced timber design engineer.

1.4 ENGINEERING DESIGN TOOLS

The following design tools are available for the Futurebuild LVL range.

1.4.1 Fully Worked Design Example

A fully worked design example of a portal frame structure including design computations, standards references and design and practical application tips. This example covers member design and specification, connections to and from secondary and primary framing members and lateral support components.

1.4.2 Engineering Support

We have an in-house engineering team consisting of Chartered Professional Engineers with many years of combined consultancy experience with an emphasis on Timber Engineering. They are available to speak to you about issues ranging from design and specification to the suitability of details for fabrication and erection advice.

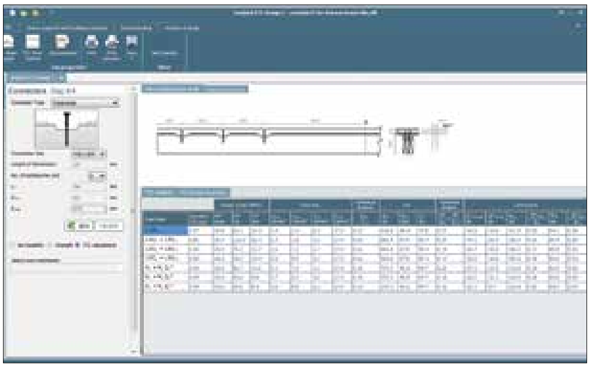
1.4.3 computeIT® Software Suite

The computeIT® software suite consists of software packages; computeIT for beams and computeIT toolkIT. It is designed to aid in the specification of heavy structural members and non-residential structural systems. It enables engineers, even those unfamiliar with the specifics of timber engineering to produce high quality, reliable specifications.

1.4.4 computeIT® for beams

computeIT® for beams is a beam analysis package that enables engineers to develop design solutions for a range of engineered wood products, including Timber Concrete Composite (TCC) Floors design using EXPAN® technology to provide composite action between concrete and Laminated Veneer Lumber (LVL). Developed by engineers for engineers, computeIT for beams allows engineers the flexibility of making design decisions using LVL based structural solutions. computeIT for beams provides users with an easy to use interface that allows engineers to:

- Enter complex beam design situations, including statically indeterminate beams and cantilevers.
- Enter a number of different load types including point loads, UDL's and trapezoidal/triangular loads.
- Enter beam restraint information for calculation of capacities in accordance with AS 1720.1:2010.
- Make engineering decisions based on engineering outputs including, deflection, bending moment and shear force diagrams.
- Design connections using a number of common connection details.
- Analyse a number of different members to produce cost effective design solutions.
- View graphical representations of beam geometry, loading and design action effect diagrams.
- Select loading combinations to AS/NZS 1170.
- Apply design actions from other members within a job.
- Create a job specific Engineering Analysis Report including designed members and connections.
- Optimise TCC Floor design using all three shear connections: trapezoidal notch with coach bolts, triangular notch with coach bolts and an un-notched shear connector using angled SFS screws.



computeIT® for Beams: TCC Floor Design - Analysis and Design.

1.4.5 computeIT toolkIT

computeIT toolkIT is a series of design tools to allow engineers the flexibility to quickly and easily design solid and box section structural beam and column members including moment resisting connections, beam and column members subject to combined actions, and purlins and girts.

Included in the computeIT toolkIT is Expan Quick Connect moment resisting connection design technology. The Quick Connect technology uses a threaded rod, washers and nuts for easy connection on site through factory fitted LVL sleeves. It also provides engineers with alternate moment resisting connections such as nail and screw rings used in portal frame solutions.

Developed by experienced timber design engineers using the most up to date information from design standards, the computeIT toolkIT provides users with the opportunity to:

- Design moment resisting connections with commonly available materials and connectors.
- Design solid and built up members subject to combined actions easily, considering the effects of alternate restraint options.
- Select loading combinations for analysis to AS/NZS 1170, with automatic selection of duration of load factor.
- Analyse different members to determine cost effective options
- Design solid and i-beam purlins and girts, including support and restraint details.
- Create a job specific Engineering Analysis Report including designed members and connections.

computeIT ToolkIT: Composite Member Design.

1.4.6 designIT® for commercial floors

designIT® for commercial floors gives building industry professionals a tool for designing commercial, industrial and other heavily loaded floors with the Futurebuild® LVL range of engineered wood products and other selected materials.

1.5 FUTUREBUILD® LVL PRODUCT RANGE

Futurebuild® LVL products for the commercial market include:

- hySPAN® sizes and gusset options to provide solid section solutions to 30m clear span.
  a. 900 x 90 hySPAN.
  b. 42mm X-BAND hySPAN sheets for gusset connection.
- Cross band (x-band) LVL for building spans over and above 30m where composite, built up sections may be required.
- Made to order composite plywood/LVL I-beams with design aids to suit.
- Thicknesses of Futurebuild LVL ranging from 28mm through to 90mm.

Table 1: Commonly Manufactured Futurebuild® LVL Thicknesses

Thickness	Available in 2 x-band	Available in 4 x-band
28mm	✓	
35mm	✓	
38mm	✓	
42mm	✓	✓
45mm	✓	✓
63mm	✓	✓
75mm		
90mm		

1.6 GRADES

There is a wide range of Futurebuild LVL products suitable for use in LVL structural systems including:

hyONE® (E=16.0GPa)
hySPAN® (E=13.2GPa)
hyCHORD® (E=11.0GPa)
truFORM® (E=10.7GPa), and
hy90® (E=9.5GPa)

These products are available for design and specification in any of the thicknesses specified[1], however for commercial applications we recommend the use of hySPAN for primary members and hyCHORD® or hyJOIST® for secondary members. These tend to be more efficient from a cost perspective.

For the complete range of Characteristic Design Properties refer to section 3.0.

[1]Lead times apply.

1.7 CROSS BANDED FUTUREBUILD LVL (X-BAND)

Cross banded LVL is generally used for one of two different reasons:

- Dimensional stability, where sections exhibit a depth to breadth ratio of >10. The x-bands restrict the movement of moisture across the section effectively removing the cupping phenomenon.
- The creation of connections, where the direction of the grain of the members being connected drives the nail spacing of the member (as typically applied in a plywood gusset).

There are also some other practical and theoretical reasons why cross bands are generally required in the creation of built up sections.

These reasons include:

- Additional crosswise stiffness – The x-bands provide additional stiffness and strength across the grain. Typically, LVL is no different to timber in the fact that the cells run in the direction of the grain meaning that timber can be relatively easily broken across the grain. The existence of cross bands effectively ties these together. This is also advantageous from a practical perspective when handling product that can be up to 18.2m long as it increases the sturdiness of the sections.
- X-bands enhance the shear capacity of 'panels', the cross laminates break up the tubular structure and provide additional resistance to shear. It should also be noted that the webs of a box beam are components that are required to carry shear, as well as bending and compression.

1.8 PURLIN DESIGN

Purlin design in LVL buildings is currently limited to readily available I-joists and solid sections. Typically I-joists have weight, strength (lateral restraint) and stiffness advantages over solid section purlins, however for smaller bays, solid sections can have installation advantages.

The software package computeIT® toolkIT includes the ability to design and specify Futurebuild LVL products as purlins and girts.

Table 2: Purlin Span Guidance

Product	Span
hyJOIST® (Composite plywood and LVL I-beam)	> 7.0m
hySPAN® (Solid LVL section)	< 7.0m
SG (Solid pine sections)	< 4.8m

1.9 MADE TO ORDER I-BEAM

Futurebuild® LVL has the ability to provide made to order composite plywood/LVL I-beam. The standard hyJOIST® range was developed to target use in floor joists in houses with purlin spans up to 10.0m. hyJOIST may not be suitable for purlin spans above 10.0m.
Contact us for more information.

1.10 PRE-FABRICATION NETWORK

Pre-fabricators develop cost effective supply solutions using the Futurebuild LVL range (including specific design products) in 100mm increments.

Contact us to discuss your options.

1.11 NON STANDARD SIZES & LENGTHS

For commercial quantities, specific engineering designed product can be manufactured in sections up to 1200mm deep in thicknesses from 28mm thick through to 90mm thick, and in lengths up to 18.2m long. Practical limitations apply to the supply of product such as limiting cupping by keeping depth to breadth ratios at a maximum of 10 for non-cross banded LVL. Minimum order quantities and larger lead times apply to non-standard product. Contact us for more information.

1.12 FUTUREBUILD® LVL RANGE SPECIFICATIONS

Futurebuild LVL products are manufactured in accordance with AS/NZS 4357 and have the structural design properties specified in Tables 7, 9, 11 and 13. The following information relates to general Futurebuild LVL production.

Table 3: Veneer Structural Design Properties

Veneer Properties	
Thickness	3-4mm
Joints Face	Scarf
Joints Other	Lap/Scarf
Moisture	
Moisture Content at Time of Leaving Mill	8-15%
Nominal Dimensional Tolerances	
Depth	-0mm, + 2mm
Thickness (<90)	-0mm, + 2mm
Thickness (≥90)	-2mm, + 2mm
Mass	
Mass (approximate)	600kg/m^3
Adhesive & Bond	
Refer AS/NZS 2098 & AS 2754	Phenolic adhesive Type “A” (marine) bond

2.0 GENERAL DESIGN CONSIDERATIONS

Design responsibility relies with the building owner and the professionals that the owner engages. The Specifier for the project must ensure that Futurebuild® LVL is an appropriate product for their individual project. The Specifier must also provide their own specific design or detailing for any areas that fall outside the scope and specifications of this literature.

2.1 CHARACTERISTIC STRESSES

The Futurebuild LVL characteristic stresses published are determined in accordance with Section 4 of AS/NZS 4063.2:2010 and so comply with the provisions of the New Zealand Building Code through clause 2.3, and further noted in commentary clause C2.3 in NZS 3603.

Note that:

- Characteristic Stresses may be different for use on flat or on edge as detailed.
- Modules of Elasticity (MOE) is a mean value which includes an allowance for shear deformation.
- Because of the low variability of LVL a lower bound E is not required for most applications, however where required, the lower 5th percentile Modulus of Elasticity may be taken as 0.85 E.
- Selection of Characteristics Stress Values should take into account the allowance for the representativeness of the sample population, allowance for levels of control of process and quality, amongst other things.

Substitution with similar properties from alternate manufacturers may not provide the calculated design performance. The characteristic stresses of Futurebuild® LVL products are not for use with products from alternative manufacturers.

2.2 STRENGTH REDUCTION FACTOR Ø

The strength reduction factor for calculating the Design Capacity of Structural Members should be taken from Table 4 below, extracted from Table 2.1 AS1720.1-2010.

Table 4: Strength Reduction Factors

Structural Timber Material	**Application of Structural Member**		
	Category 1	Category 2	Category 3
	Structural members for houses for which failure would be unlikely to affect an area[1] greater than $25m^2$; OR Secondary members in structures other than houses	Primary structural members in structures other than houses; OR Elements in houses for which failure would be likely to affect an area[1] greater than $25m^2$	Primary structural members in structures intended to fulfil essential services or post disaster function
	Value of Strength Reduction Factor Ø		
Structural Plywood – AS/NZS 2269.0	0.95	0.85	0.75
Structural Laminated Veneer Lumber – AS/NZS 4357.0	0.95	0.90	0.80

[1]In this context area should be taken as plan area.

2.3 DURATION OF LOAD FACTOR

Duration of load factors k_1 for strength and k_2 for stiffness should be as for solid timber in accordance with NZS 3603, Clause 2.7, Modification factors, k_1 and k_2 for duration of load.

2.4 BEARING AREA

Bearing area factor k_3 is as per NZS 3603.

2.5 LOAD SHARING

Load sharing factors $k_4 = k_5 = k_6 = 1.0$.

Therefore Futurebuild® LVL is much less variable than sawn lumber, the load sharing relationships in NZS 3603 do not hold.

For example, two pieces of LVL from a batch have very similar strengths whereas in timber k_4 , k_5 , k_6 recognise that a random stronger piece supports a random weaker piece. Lamination factors do not apply.

2.6 STABILITY

Stability factor k_8 – as per NZS 3603. Appendix C of NZS 3603 provides alternate solutions for the determination of slenderness coefficients for beams where built up sections are used, or where the distribution of design action effects may provide more accurate, less conservative, results.

2.7 TEMPERATURE

LVL may be affected when it is exposed to consistent temperatures above 55˚C. Specific consideration should be taken for building systems where temperatures exceed 55˚C.

Refer to the Technical Note "Design for Durability and Moisture", downloadable from www.futurebuild.co.nz.

2.8 MOISTURE CONTENT

Where LVL is used in an environment that raises the average moisture content above 15% for periods of 12 months or more, refer to the modification factor k_{14} in NZS 3603, figure 6.1.

Under these conditions LVL may be subjected to a decay hazard.

Refer to the Technical Note "Design for Durability and Moisture", downloadable from www.futurebuild.co.nz.

For use in dry conditions where moisture content remains below 15%, no modification is required.

2.9 FACE GRAIN ANGLE

When a design includes cut, sloped or curved edges, the grain orientation factors k_{15} (for strength) and k_{16} (for stiffness) should be taken from Table 5.

For stiffness, k_{16} has the same value as k_{15} for tension, but the angle is assessed as the average of the two cut edges.

Table 5: Grain Orientation Factor k_{15} and k_{16} for Cut Edges

Angle of Cut Edge (°)	0	3	5	10	15	20	30	45
Edge in Tension	1.00	0.92	0.80	0.50	0.31	0.21	0.11	0.06
Edge in Compression	1.00	0.97	0.93	0.79	0.65	0.55	0.42	0.32

Futurebuild LVL is made from thin parallel laminated veneers. It is very strong along the grain, but stress perpendicular to the grain should be avoided just as in solid timber. Wide sections must be handled carefully. The use of cross banded LVL provides significant advantages where tapering, chamfering and notching is to be considered.

2.10 SIZE FACTOR

The characteristic values for bending and tension shall include consideration of the section size for which they are intended to apply. The characteristic values for the Futurebuild LVL range for bending and tension shall be modified as follows:

- For beam sections of depth 95mm or less – no adjustment.
- For beam sections of depth exceeding 95mm – multiply the published characterised value for bending by $(95/d)^{0.154}$, where d is the depth of the beam.
- For tension members with width 150mm or less – no adjustment.
- For tension members with the largest cross-sectional dimension exceeding 150mm – multiply the published characterised value for tension by $(150/d)^{0.167}$, where d is the largest cross-sectional dimension of the tension member.

2.11 JOINT GROUP

The joint strength group is dependent on the Futurebuild® LVL product, the type of fastener and the grain orientation at the joint.

Table 6 is to be read in conjunction with NZS 3603 Table 4.1: Classification of timber species for joint design.

Table 6: Classification of LVL Products for Joint Design

Product	Nails & Screws in Lateral Load	Type 17 Screws in Lateral Load	Nails & Screws in Withdrawal		Type 17 Screws in Withdrawal	Bolts & Coach Screws in Lateral Load Driven into Face	
			Edge	Face	Edge & Face	Parallel to Grain	Perpendicular to Grain
hyONE®	J5	J4	J4	J4	J3	J3	J1
hySPAN®	J5	J4	J4	J4	J3	J3	J1
hyCHORD®	J5	J4	J4	J4	J3	J3	J2
hy90®	J5	J4	J4	J4	J4	J4	J3
hyJOIST® (flange)	J5	J4	J4	J4	not suitable		

The higher performing joint strength groups for Futurebuild LVL are due to the interlocking effect of adjacent veneers aligned at small angles.

2.12 FIRE RESISTANCE

The method for calculating the fire resistance of LVL products is described in NZS 3603 section 9. This method is applicable for sections at least 90mm in all dimensions. Recommendations derived from a testing programme on Futurebuild LVL at the University of Canterbury are:

- The design method used for predicting the fire performance of Futurebuild LVL exposed to post-flashover fires is to use the experimentally found char rate β = 0.72mm/minute to determine a reduced cross-section, and design using normal temperature properties without considering a heat-affected layer of wood below the char line.
- Design using the char rate β = 0.65mm/minute (complying with NZS 3603) to calculate a reduced cross section which can be used with normal temperature properties, with an allowance for a 7.5mm zero-strength layer of Futurebuild LVL below the char line.

This data has not been tested on, and is not applicable to LVL made by other manufacturers.

3.0 CHARACTERISTIC PROPERTIES

3.1 STANDARD SECTION SIZES & CHARACTERISTIC MATERIAL PROPERTIES

We manufacture five Futurebuild® LVL product lines for structural applications, each with specific properties and section sizes.

FUTUREBUILD® STRUCTURAL LVL
hySPAN®

hySPAN® is our most versatile LVL product: it has high structural properties and is available in the largest range of sizes and lengths. hySPAN is typically specified for structural beams and is also used for lintels, rafters and floor joists in residential structures.

FUTUREBUILD® STRUCTURAL LVL BEAMS
hy90®

hy90® is a LVL product manufactured primarily for lintels or beams to fit within 90mm light timber frame walls. It has lower structural properties than hySPAN but its thickness offers better member stability when used as long span structural beams or columns.

FUTUREBUILD® STRUCTURAL LVL
hyONE®

hyONE® is a 90mm thick high stiffness LVL product manufactured primarily for lintels or floor beams where large spans or depth restrictions apply.

FUTUREBUILD® LVL TRUSS CHORDS
hyCHORD®

hyCHORD® is available in smaller section sizes to match ordinary kiln-dried timber. hyCHORD is primarily specified as roof truss chords, but can also be used for lintels, rafters, purlins, floor joists, wall studs or other members where smaller section sizes are required.

FUTUREBUILD® LVL ENGINEERED I-JOISTS
hyJOIST®

hyJOIST® is an engineered 'I-beam' utilising LVL flanges and a plywood web. It is ideally suited to floor joist and rafter applications due to its light weight, straightness and the ability to cut large holes through the web (e.g. for services or ventilation).

3.2 hySPAN® LIMIT STATE DESIGN CHARACTERISTIC PROPERTIES

Table 7: Characteristic Limit State Design Stresses and Elastic Moduli for hySPAN®

Property		Edge MPa	Flat MPa
Modulus Of Elasticity	E	13,200	13,200
Modulus Of Rigidity	G	660	660
Bending	f_b[1]	50.0	42.0
Tension Parallel to Grain	f_t[2]	30.0	30.0
Compression Parallel to Grain	f_c	42.0	42.0
Shear In Beams	f_s	4.6	3.5
Bearing Perpendicular to Grain	f_p	12.0	12.0
Joint Group		**See Table 6**	

Size Factors:
[1]For beams exceeding 95mm – multiply the published characteristic value for bending by $(95/d)^{0.154}$ where d is the depth of the beam.
[2]For tension members with the largest cross-sectional dimension exceeding 150mm – multiply the published characteristic value for tension by $(150/d)^{0.167}$, where d is the largest cross sectional dimension of the tension member.

Table 8: hySPAN Section Sizes, Properties and Design Capacities

Dimensions (mm x mm)	Mass (kg/m)	I_{xx} (10^6mm^4)	Z_{xx} (10^3mm^3)	J (10^6mm^4)	EI_x (10^9Nmm^2)	$Øf_bZ_x$* (kNm)
150 x 45	4.2	12.7	169	3.7	167	7.1
170 x 45	4.7	18.4	217	4.3	243	8.9
200 x 45	5.6	30.0	300	5.2	396	12.0
240 x 45	6.7	51.8	432	6.4	684	16.9
300 x 45	8.4	101	675	8.3	1337	25.5
360 x 45	10.0	175	972	10.1	2309	35.6
400 x 45	11.2	240	1200	11.3	3168	43.3
150 x 63	6.0	17.7	236	9.2	234	9.9
200 x 63	7.8	42.0	420	13.4	554	16.9
240 x 63	9.4	72.6	605	16.7	958	23.6
300 x 63	11.7	142	945	21.7	1871	35.6
360 x 63	14.1	245	1361	26.7	3233	49.9
400 x 63	15.6	336	1680	30.0	4435	60.6
450 x 63	17.6	478	2126	34.2	6315	75.3
600 x 63	23.4	1134	3780	46.7	14969	128.1

* Ø = 0.9, for category 2 applications (Refer to Table 4).

hySPAN® is readily available in lengths up to 13.2 metres. Contact us for availability of non-standard sizes and lengths.

3.3 hy90® LIMIT STATE DESIGN CHARACTERISTIC PROPERTIES

Table 9: Characteristic Limit State Design Stresses and Elastic Moduli for hy90®

Property		Edge MPa	Flat MPa
Modulus Of Elasticity	E	9,500	9,500
Modulus Of Rigidity	G	475	475
Bending	f_b[1]	34.0	30.0
Tension Parallel to Grain	f_t[2]	22.0	22.0
Compression Parallel to Grain	f_c	36.6	36.6
Shear In Beams	f_s	4.6	2.6
Bearing Perpendicular to Grain	f_p	12.0	12.0
Joint Group		**See Table 6**	

Size Factors:
[1]For beams exceeding 95mm – multiply the published characteristic value for bending by $(95/d)^{0.154}$ where d is the depth of the beam.
[2]For tension members with the largest cross-sectional dimension exceeding 150mm – multiply the published characteristic value for tension by $(150/d)^{0.167}$, where d is the largest cross sectional dimension of the tension member.

Table 10: hy90 Section Sizes, Properties and Design Capacities

Dimensions (mm x mm)	Mass (kg/m)	I_{xx} (10^6mm^4)	Z_{xx} (10^3mm^3)	J (10^6mm^4)	EI_x (10^9Nmm^2)	$Øf_bZ_x$* (kNm)
150 x 90	8.4	24.8	330	21.5	235	9.4
200 x 90	11.2	58.7	587	32.8	557	16.0
240 x 90	13.4	101	845	41.9	963	22.4
300 x 90	16.7	198	1320	55.6	1881	33.8
360 x 90	20.1	342	1901	69.2	3250	47.4
400 x 90	22.3	469	2347	78.3	4459	57.6

* Ø = 0.9, for category 2 applications (Refer to Table 4).

hy90® is available in lengths up to 7.2 metres. Contact us for availability of non-standard sizes and lengths.

3.4 hyONE® LIMIT STATE DESIGN CHARACTERISTIC PROPERTIES

Table 11: Characteristic Limit State Design Stresses and Elastic Moduli for hyONE®

Property		Edge MPa	Flat MPa
Modulus Of Elasticity	E	16,000	16,000
Modulus Of Rigidity	G	800	800
Bending	f_b [1]	65.0	52.0
Tension Parallel to Grain	f_t [2]	30.0	30.0
Compression Parallel to Grain	f_c	48.0	48.0
Shear In Beams	f_s	4.6	3.2
Bearing Perpendicular to Grain	f_p	12.0	12.0
Joint Group		**See Table 6**	

Size Factors:
[1]For beams exceeding 95mm – multiply the published characteristic value for bending by $(95/d)^{0.154}$ where d is the depth of the beam.
[2]For tension members with the largest cross-sectional dimension exceeding 150mm – multiply the published characteristic value for tension by $(150/d)^{0.167}$, where d is the largest cross sectional dimension of the tension member.

Table 12: hyONE Section Sizes, Properties and Design Capacities

Dimensions (mm x mm)	Mass (kg/m)	I_{xx} (10^6mm^4)	Z_{xx} (10^3mm^3)	J (10^6mm^4)	EI_x (10^9Nmm^2)	$Øf_bZ_x$* (kNm)
240 x 90	13.4	101	845	41.9	1622	42.9
300 x 90	16.7	198	1320	55.6	3168	64.7
360 x 90	20.1	342	1901	69.2	5474	90.6
400 x 90	22.3	469	2347	78.3	7509	110.0

* Ø = 0.9, for category 2 applications (Refer to Table 4).

hyONE® is available in lengths up to 7.2 metres. Contact us for availability of non-standard sizes and lengths.

3.5 hyCHORD® LIMIT STATE DESIGN CHARACTERISTIC PROPERTIES

Table 13: Characteristic Limit State Design Stresses and Elastic Moduli for hyCHORD®

Property		Edge MPa	Flat MPa
Modulus Of Elasticity	E	11,000	11,000
Modulus Of Rigidity	G	550	550
Bending	f_b[1]	40.0	40.0
Tension Parallel to Grain	f_t[2]	25.2	25.2
Compression Parallel to Grain	f_c	32.6	32.6
Shear In Beams	f_s	4.4	2.5
Bearing Perpendicular to Grain	f_p	11.1	11.1
Joint Group		**See Table 6**	

Size Factors:
[1]For beams exceeding 95mm – multiply the published characteristic value for bending by $(95/d)^{0.154}$ where d is the depth of the beam.
[2]For tension members with the largest cross-sectional dimension exceeding 150mm – multiply the published characteristic value for tension by $(150/d)^{0.167}$, where d is the largest cross sectional dimension of the tension member.

Table 14: hyCHORD Section Sizes, Properties and Design Capacities

Dimensions (mm x mm)	Mass (kg/m)	I_{xx} (10^6mm^4)	Z_{xx} (10^3mm^3)	J (10^6mm^4)	EI_x (10^9Nmm^2)	$\varnothing f_b Z_x$* (kNm)
90 x 45	2.4	2.73	60.8	1.9	30.1	2.2
140 x 45	3.8	10.3	147	3.4	113	5.0
190 x 45	5.1	25.7	271	4.9	283	8.8

* Ø = 0.9, for category 2 applications (Refer to Table 4).

hyCHORD® is available in lengths up to 7.2 metres. Contact us for availability of non-standard sizes and lengths.

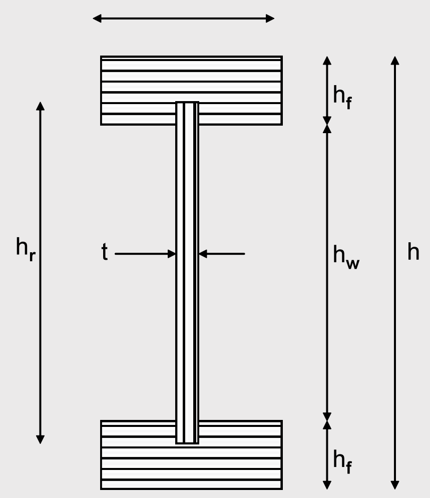
3.6 hyJOIST® SECTION GEOMETRY

Table 15: hyJOIST® Section Geometry

hyJOIST® Product Code	Overall Depth h (mm)	Flange Width b (mm)	Flange Thickness h_f (mm)	Nominal Web Thickness t (mm)	Web Height h_r (mm)	Distance Between Flanges h_w* (mm)	Mass (kg/m)
HJ200 45	200	45	45	9	139	110	3.2
HJ240 45	240	45	45	9	179	150	3.4
HJ240 63	240	63	45	9	179	150	4.4
HJ240 90	240	90	45	12	179	150	5.9
HJ300 45	300	45	45	9	239	210	3.8
HJ300 63	300	63	45	9	239	210	4.8
HJ300 90	300	90	45	12	239	210	6.2
HJ360 63	360	63	45	9	299	270	5.1
HJ360 90	360	90	45	12	299	270	6.6
HJ400 90	400	90	45	12	339	310	6.8

hyJOIST® is available in lengths up to 13.2 metres.
* Note for practical purposes (e.g. maximum web penetration size) web clear height should be reduced by 2 - 3mm to account for flange thickness tolerances.

Figure 1: hyJOIST® Section Terminology



Structural Design with hyJOIST®

The designIT® software enables a significant amount of specific design to be carried out which utilises strength and rigidity properties determined from extensive testing of each hyJOIST® section. There may however be some instances where engineers wish to carry out their own specific design. For these applications we have developed computeIT® for beams. computeIT for beams allows users to design hyJOIST in beam applications taking into account timber engineering phenomena such as shear deflection, creep and restraint considerations, whilst still allowing engineers to make design decisions based on deflection, bending moment and shear force diagrams. To download computeIT for beams visit www.chhsoftware.co.nz.

4.0 REFERENCES

- New Zealand Building Code.
- AS/NZS 4357.0:2005 Structural laminated veneer lumber – Specifications.
- AS/NZS 4357.1:2005 Structural laminated veneer lumber – Methods of test for manufacturer of dimensions and shape.
- AS/NZS 4357.2:2006 Structural laminated veneer lumber – Determination of structural properties – Test methods.
- AS/NZS 4357.3:2006 Structural laminated veneer lumber – Determination of structural properties – Evaluation methods.
- AS/NZS 4357.4:2005 Structural laminated veneer lumber – Determination of formaldehyde emissions.
- NZS 3603:1993 Timber Structures Standards.
- AS 1720.1-2010 Timber structures – Design methods.
- AS/NZS 4063.2:2010 Characterisation of structural timber – Determination of characteristic values.
- AS 1649-2001 Timber – Methods of test for mechanical fasteners and connectors – Basic working loads and characteristic strengths.

5.0 LIMITATIONS

The information contained in this document is current as at August 2019 and is based on data available to Futurebuild® LVL at the time of going to print.

All photographic images are intended to provide a general impression only and should not be relied upon as an accurate example of Futurebuild LVL products installed in accordance with this document or NZ Building Code compliance documents.

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futurebuild LVL

Private Bag 92108
Victoria Street West
Auckland 1142
New Zealand

Freephone: 0800 585 244

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