STRUCTURES REPORT

ST21584-01-01

RESENE LVL SPAN TABLES FOR INTEGRA FLOORING

CLIENT
Resene Construction systems
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Amount Wellington
Auckland 1060
New Zealand

All tests and procedures reported herein, unless indicated, have been performed in accordance with the BRANZ ISO9001 Certification

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1. BACKGROUND

Resene has requested BRANZ develop a set of span tables for LVL joists for use in residential construction aligned with NZS3604:2011 [1] and their INTEGRA flooring system. Resene currently have span tables in their INTEGRA flooring system technical literature for SG8 timber joists and have requested similar span tables for Carter Holt Harvey HySPAN & HyJOIST members and Nelson Pine LVL11 joists.

2. OBJECTIVE

To produce three tables summarising LVL joist sizes and maximum spans for three recommended joist spacings of 360mm, 450mm, and 600mm to suit INTEGRA panel length of 1800 mm, to minimise cutting on site and material wastage. Table design will be in accordance with current standards NZS AS 1720.1:2022 [2] and AS/NZS 1170. 0-3 [3].

The tables will account specifically for the INTEGRA LWC floor panel weight of 44.5 kg/m2 and align with the scope of NZS3604:2011[1].

Live Load [kPa]	Span [m]	360 mm Joist spacing	450 mm Joist spacing	600 Joist spacing
1.5				
2.0				
3.0				

Each table will contain one of the following LVL products:

1. CHH Futurebuild hySPAN
2. CHH Futurebuild hyJOIST
3. Nelson Pine LVL11

Properties for the above products will be taken from the current online technical literature.

3. LVL JOIST PROPERTIES

3.1 Carter Holt Harvey hySPAN

HySPAN properties used for the design of the span tables have been taken from the *Futurebuild LVL specific engineering design guide: August 2019* [4] and are shown in the tables below.

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)	$\phi f_b Z_x$* (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

* ϕ = 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.

3.2 Carter Holt Harvey HyJOIST

HyJOIST properties used for the design of the span tables have been taken from the document *Structural Design with hyJOIST: July 2022* [5] and are shown in the tables below.

hyJOIST SECTION CODE	hyJOIST – PROPERTIES FOR STRUCTURAL DESIGN						
	JOIST MASS kg/m	EI_x 10^9 Nmm^2	EI_y 10^9 Nmm^2	GJ 10^6 Nmm^2	GA_w/f 10^6 N	ϕV_x kN	ϕM_x kNm
HJ200 45	2.8	308	7.8	1130	0.93	5.4	6.2
HJ240 45	3.0	491	7.8	1130	1.17	7.1	7.8
HJ240 63	3.8	670	21.4	1582	1.17	7.1	11.1
HJ240 90	5.4	968	62.5	2260	1.76	9.5	15.7
HJ300 45	3.4	834	7.8	1130	1.54	9.2	10.2
HJ300 63	4.1	1130	21.4	1582	1.54	9.5	14.4
HJ300 90	5.8	**1620**[1]	62.5	2260	2.34	11.1	20.4
HJ360 63	4.4	1718	21.4	1582	1.92	11.1	17.7
HJ360 90	6.2	**2350**[1]	62.5	2260	2.84	11.1	25.1
HJ400 90	6.5	**3000**[1]	62.5	2260	3.20	11.1	28.2

1. HJ300 90, HJ360 90 and HJ400 90 hyJOIST have had minor reductions applied to their respective EI_x values based on product mix changes and in-grade testing, effective product manufactured from July 2022.

Symbols & Definitions:

EI_x	Bending rigidity for bending about the x axis
EI_y	Bending rigidity for bending about the y axis
GJ	Torsional rigidity
GA_w/f	Shear rigidity for shear in the y direction and including an allowance for the form factor
ϕV_x	Design capacity in shear for shear in the y direction, assuming $\phi = 0.95$, $k_1 = 1.0$, and allowing for a 40 mm diameter hole in the web
ϕM_x	Design capacity in bending for bending about the x axis, assuming $\phi = 0.95$, $k_1 = 1.0$ & $k_8 \geq 0.6$

3.3 Nelson Pine LVL 11

Nelson Pine LVL11 properties used for the design of the span tables have been taken from the document *NP Specific engineering design guide v4: September 2022 [6]* and are shown in the tables below.

NP FRAME LVL 11 LIMIT STATE DESIGN CHARACTERISTIC VALUES (TABLE 2B)

PROPERTY		EDGE (MPa)	FLAT (MPa)
Modulus of Elasticity	MoE	11000	11000
Modulus of Rigidity	G	550	550
Bending Strength [1]	f'b	38.0	38.0
Tension Parallel to Grain [2]	f't	26.0	26.0
Compression Parallel to Grain	f'c	38.0	38.0
Compression Perpendicular to Grain	f'p	10.0	10.0
Shear	f's	5.0	3.0

[1] For 95mm in depth. Refer to Table 9 for adjustment factor above 95mm depth.

[2] For 150mm in depth. Refer to Table 9 for adjustment factor above 150mm depth.

NP FRAME LVL 11 SECTION SIZES AND DESIGN PROPERTIES (TABLE 3B)

SECTION SIZE (mm)	MASS (kg/m)	I_{xx} ($10^6 mm^4$)	EI_{xx} ($10^9 Nmm^2$)	Z_{xx} ($10^3 mm^3$)	$\phi f'bZ_{xx}$ (kNm)*
90 x 45	2.3	2.7	30	61	2.1
140 x 45	3.6	10.3	113	147	4.7
150 x 45	3.8	12.7	139	169	5.3
190 x 45	4.9	25.7	283	271	8.2
200 x 45	5.1	30.0	330	300	9.1
240 x 45	6.2	51.8	570	432	12.7
300 x 45	7.7	101.3	1114	675	19.1
360 x 45	9.2	175.0	1925	972	26.6
400 x 45	10.3	240.0	2640	1200	32.3
460 x 45	11.8	365.0	4015	1587	41.7

4. DESIGN METHODOLOGY AND LIMITATIONS

Excel spreadsheets were created for each joist type considering both strength and serviceability requirements as discussed above. Deflection limitations for long term loads were the governing design criteria with a few spans limited by the dynamic load limitation.

The following criteria have been satisfied for the joist sizes specified in the span tables.

Member design capacity for strength

Bending strength criteria in accordance with clause 3.2.1 NZS AS 1720.1:2022 [2]

$M_d \geq M^*$

Flexural shear strength in accordance with clause 3.2.5 NZS AS 1720.1:2022 [2]

$V_d \geq V^*$

Where M* and V* have been calculated for the following load cases in accordance with AS/NZS 1170.0:2002 [3]

1. 1.35G

2. 1.2G +1.5Q

G = integra self-weight 44.5 kg/m^2 + up to 20 kg/m^2 of ceiling or additional flooring weight.

Q is the live load 1.5 kPa, 2 kPa and 3 kPa.

$$M_d = \phi k_1 k_4 k_6 k_9 k_{12} f'_b Z \quad \ldots 3.2(2)$$

$$V_d = \phi k_1 k_4 k_6 f'_s A_s \quad \ldots 3.2(14)$$

Modification factors $k_1 - k_{12} = 1.0$

Factor k1 = 1.0 assumes that the LVL has an average moisture content of less than 15%.

Φ = 0.9 NZS AS 1720.1:2022 [2] ZZZ.3

Where f'_b, f'_s, A_s and Z are taken from the property tables.

Member design capacity for serviceability

For serviceability, load cases in accordance with AS/NZS 1170.0:2002 [3]

G + Ψ_sQ

G + Ψ_lQ

Where Ψ_s = 0.7 and Ψ_l = 0.4 from Table 4.1 AS/NZS1170.0:2002 [3]

j_1 = 1.0 for short term loads and j_2 = 2.0 for long term loads have been used for stiffness calculations. Table 2.4 AS/NZS 1720.1:2022 [2]

Design deflections for serviceability have been limited to SPAN/300 OR 15 mm.

Dynamic Criteria of a 1 KN load spread over 2 joists limiting the joist deflection to 2 mm.

5. SPAN TABLES

Single Span - CHH hySPAN Floor Joists				
Live Load (kPa)	**Span (m)**	**360 mm joist spacing**	**450 mm joist spacing**	**600 mm joist spacing**
1.5	**3.0**	HS150x45 HS150x63	HS150x45 HS150x63	HS150x45 HS150x63
	3.3	HS170x45 HS150x63	HS170x45 HS150x63	HS170x45 HS150x63
	3.6	HS170x45 HS150x63	HS170x45 HS150x63	HS200x45 HS200x63
	3.9	HS200x45 HS200x63	HS200x45 HS200x63	HS200x45 HS200x63
	4.2	HS200x45 HS200x63	HS200x45 HS200x63	HS240x45 HS200x63
	4.5	HS240x45 HS200x63	HS240x45 HS200x63	HS240x45 HS200x63
	4.8	HS240x45 HS240x63	HS240x45 HS240x63	HS300x45 HS240x63
	5.1	HS240x45 HS240x63	HS300x45 HS240x63	HS300x45 HS240x63
	5.4	HS300x45 HS240x63	HS300x45 HS240x63	HS300x45 HS300x63
	5.7	HS300x45 HS240x63	HS300x45 HS300x63	HS360x45 HS300x63
	6.0	HS300x45 HS300x63	HS360x45 HS300x63	HS360x45 HS300x63
2.0	**3.0**	HS150x45 HS150x63	HS150x45 HS150x63	HS170x45 HS150x63
	3.3	HS170x45 HS150x63	HS170x45 HS150x63	HS170x45 HS150x63
	3.6	HS200x45 HS150x63	HS200x45 HS150x63	HS200x45 HS200x63
	3.9	HS200x45 HS200x63	HS200x45 HS200x63	HS200x45 HS200x63
	4.2	HS200x45 HS200x63	HS200x45 HS200x63	HS240x45 HS200x63
	4.5	HS240x45 HS200x63	HS240x45 HS200x63	HS240x45 HS240x63
	4.8	HS240x45 HS240x63	HS240x45 HS240x63	HS300x45 HS240x63
	5.1	HS240x45 HS240x63	HS300x45 HS240x63	HS300x45 HS300x63
	5.4	HS300x45 HS240x63	HS300x45 HS300x63	HS300x45 HS300x63

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	5.7	HS300x45 HS240x63	HS300x45 HS300x63	HS360x45 HS300x63
	6.0	HS300x45 HS300x63	HS360x45 HS300x63	HS360x63
3.0	**3.0**	HS150x45 HS150x63	HS150x45 HS150x63	HS170x45 HS150x63
	3.3	HS170x45 HS150x63	HS170x45 HS150x63	HS200x45 HS200x63
	3.6	HS200x45 HS150x63	HS200x45 HS200x63	HS200x45 HS200x63
	3.9	HS200x45 HS200x63	HS200x45 HS200x63	HS240x45 HS200x63
	4.2	HS200x45 HS200x63	HS240x45 HS200x63	HS240x45 HS240x63
	4.5	HS240x45 HS200x63	HS240x45 HS240x63	HS300x45 HS240x63
	4.8	HS240x45 HS240x63	HS300x45 HS240x63	HS300x45 HS300x63
	5.1	HS300x45 HS240x63	HS300x45 HS300x63	HS300x45 HS300x63
	5.4	HS300x45 HS300x63	HS300x45 HS300x63	HS360x45 HS300x63
	5.7	HS300x45 HS300x63	HS360x45 HS300x63	HS360x45 HS360x63
	6.0	HS360x45 HS300x63	HS360x45 HS300x63	HS360x63

Single Span - CHH hyJOIST Floor Joists				
Live Load (kPa)	**Span (m)**	**360 mm joist spacing**	**450 mm joist spacing**	**600 mm joist spacing**
1.5	**2.8**	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.0	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.3	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.6	HJ 200 X 45	HJ 200 X 45	HJ 240 X 45
	3.9	HJ 200 X 45	HJ 240 X 45	HJ 240 X 45
	4.2	HJ 240 X 45	HJ 240 X 45	HJ 300 X 45 HJ 240 X 63
	4.5	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 90
	4.8	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 90	HJ 300 X 63 HJ 240 X 90
	5.1	HJ 300 X 45 HJ 240 X 90	HJ 300 X 63 HJ 240 X 90	HJ 300 X 63
	5.4	HJ 300 X 63 HJ 240 X 90	HJ 300 X 63	HJ 360 X 63 HJ 300 X 90
	5.7	HJ 300 X 63	HJ 360 X 63 HJ 300 X 90	HJ 360 X 90
	6.0	HJ 360 X 63 HJ 300 X 90	HJ 360 X 90	HJ 360 X 90
2.0	**2.8**	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.0	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.3	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.6	HJ 200 X 45	HJ 200 X 45	HJ 240 X 45
	3.9	HJ 200 X 45	HJ 240 X 45	HJ 240 X 45
	4.2	HJ 240 X 45	HJ 240 X 45	HJ 300 X 45 HJ 240 X 63
	4.5	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 90
	4.8	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 90	HJ 300 X 63 HJ 240 X 90
	5.1	HJ 300 X 45 HJ 240 X 90	HJ 300 X 63 HJ 240 X 90	HJ 300 X 63
	5.4	HJ 300 X 63 HJ 240 X 90	HJ 300 X 63	HJ 360 X 63 HJ 300 X 90
	5.7	HJ 300 X 63	HJ 360 X 63 HJ 300 X 90	HJ 360 X 90

	6.0	HJ 360 X 63 HJ 300 X 90	HJ 360 X 90	HJ 360 X 90
3.0	**2.8**	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.0	HJ 200 X 45	HJ 200 X 45	HJ 200 X 45
	3.3	HJ 200 X 45	HJ 200 X 45	HJ 240 X 45
	3.6	HJ 200 X 45	HJ 200 X 45	HJ 240 X 45
	3.9	HJ 200 X 45	HJ 240 X 45	HJ 300 X 45 HJ 240 X 63
	4.2	HJ 240 X 45	HJ 240 X 45	HJ 300 X 45 HJ 240 X 63
	4.5	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 90
	4.8	HJ 300 X 45 HJ 240 X 63	HJ 300 X 45 HJ 240 X 90	HJ 300 X 63
	5.1	HJ 300 X 45 HJ 240 X 90	HJ 300 X 63	HJ 360 X 63 HJ 300 X 90
	5.4	HJ 300 X 63	HJ 360 X 63 HJ 300 X 90	HJ 360 X 63
	5.7	HJ 360 X 63 HJ 300 X 90	HJ 360 X 63 HJ 300 X 90	HJ 360 X 90
	6.0	HJ 360 X 63 HJ 300 X 90	HJ 360 X 90	HJ 400 X 90

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Single Span – NP LVL 11 Floor Joists				
Live Load (kPa)	**Span (m)**	**360 mm joist spacing**	**450 mm joist spacing**	**600 mm joist spacing**
1.5	**2.8**	150 x 45	150 x 45	190 x 45
	3.0	190 x 45	190 x 45	190 x 45
	3.3	190 x 45	190 x 45	190 x 45
	3.6	190 x 45	190 x 45	200 x 45
	3.9	200 x 45	200 x 45	240 x 45
	4.2	240 x 45	240 x 45	240 x 45
	4.5	240 x 45	240 x 45	240 x 45
	4.8	240 x 45	240 x 45	300 x 45
	5.1	300 x 45	300 x 45	300 x 45
	5.4	300 x 45	300 x 45	360 x 45
	5.7	300 x 45	300 x 45	360 x 45
	6.0	300 x 45	360 x 45	360 x 45
2.0	**2.8**	150 x 45	150 x 45	190 x 45
	3.0	190 x 45	190 x 45	190 x 45
	3.3	190 x 45	190 x 45	190 x 45
	3.6	190 x 45	190 x 45	200 x 45
	3.9	200 x 45	200 x 45	240 x 45
	4.2	240 x 45	240 x 45	240 x 45
	4.5	240 x 45	240 x 45	300 x 45
	4.8	240 x 45	300 x 45	300 x 45
	5.1	300 x 45	300 x 45	300 x 45

	5.4	300 x 45	360 x 45	360 x 45
	5.7	300 x 45	360 x 45	360 x 45
	6.0	360 x 45	360 x 45	400 x 45
3.0	**2.8**	150 x 45	190 x 45	190 x 45
	3.0	190 x 45	190 x 45	190 x 45
	3.3	190 x 45	190 x 45	200 x 45
	3.6	190 x 45	200 x 45	240 x 45
	3.9	200 x 45	240 x 45	240 x 45
	4.2	240 x 45	240 x 45	300 x 45
	4.5	240 x 45	300 x 45	300 x 45
	4.8	240 x 45	300 x 45	300 x 45
	5.1	300 x 45	300 x 45	360 x 45
	5.4	300 x 45	360 x 45	360 x 45
	5.7	360 x 45	360 x 45	400 x 45
	6.0	360 x 45	360 x 45	400 x 45

6. REFERENCES

[1] NZS 3604:2011. “Timber framed buildings”. Standards New Zealand, Wellington, New Zealand.

[2] NZS AS 1720.1:2022 “Timber structures Part 1: Design methods” Standards New Zealand, Wellington, New Zealand.

[3] AS/NZS 1170. “Structural design actions; Part 0 General principles, Part 1 Permanent, imposed and other actions, Part 2 Wind actions”. Standards Australia, Sydney, Australia.

[4] *Futurebuild LVL specific engineering design guide: August 2019.*

[5] *Carter Holt Harvey Structural Design with HyJOIST: July 2022.*

[6] *Nelson Pine Specific engineering design guide v4: September 2022.*