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Techlam Structural Laminated Flooring Span Tables.

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Design Features Statement

1 Introduction

This submission presents design span tables for Techlam GL10 grade structural laminated flooring. Strength, deflection, vibration and fire performance limitations are considered. Also typical performance specifications regarding installed moisture content and durability requirements are described.

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2 Structural Analysis

2.1 Reference Documents:

Structural analysis/design conforms to the following standards:

Table 1. Standards & Codes

NZS1170 [1]	New Zealand Standard: Structural Design Actions.
NZS 3603:1993 [2]	New Zealand Standard: Timber Structures.
EC5 [3]	Eurocode 5: Design of Timber Structures - Part 1-1: General - Common rules and rules for buildings.
Hamm et al, 2010 [4]	Floor vibration from Hamm et al, 2010 [4] are considered in addition to the above codes and standards.

2.2 Floor Thickness and Plank Size:

Five difference floor thicknesses are considered based on the manufacturers recommendations;

- 42mm
- 65mm
- 90mm
- 115mm
- 135mm

Table 2. Plank Thickness & Sizes

Thickness Range: 42 - 135 mm	 240mm **Width**	 300mm **Width**

240mm or 300mm wide tongue & grooved glue-laminated planks can be used for each floor thickness (with a minimum of 4 laminations per plank).

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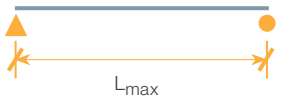
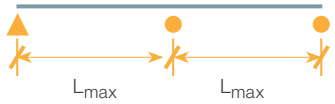
2.3 Floor Support Arrangement

Three floor arrangements are considered; single span, double span and a cantilever (see Table 3).

Span length limits for a double span floor will be conservative for continuous floors with more than two spans. For the cantilevered floor, the cantilever length limit ($L_{c,max}$) has been calculated assuming the back span is equal to the span limit for the single span ($L_{max\ (single\ span)}$).

Table 3. Floor Support Arrangements

Single span floor	Double span floor	Cantilevered floor
		
L_{max}	L_{max} L_{max}	$L_{max\ (single\ span)}$ L_{max}

2.4 Floor Loading

Load on the Techlam flooring is assumed to be dead load (G) and live load (Q) only:

Table 4. Floor Loading: Dead Loads & Live Loads

2.4.1 Dead loads, G:	2.4.2 Live loads, Q:
• Dead loads include the self-weight of the floor system and an allowance for superimposed dead load. • For the self-weight of the floor, the timber density is taken as 470 kg/m³ based on AS/NZS1170.1:2002. • Typical lower and upper bound superimposed dead loads of 0.2KPa and 0.5KPa are considered. • The upper bound is sufficient to account for 8mm tile flooring, 6mm cement board, ceiling runners and 13mm plasterboard ceiling lining.	• Four categories of live load are considered, each category corresponds to different occupancy types and floor use. • Both uniformly distributed and concentrated loads are applied (see Table 5). • The concentrated live load **(CLL)** is assumed to be distributed over a patch area of 350mm x 350mm, based on AS/NZS1170.1:2002. • It is assumed that 3-240mm planks resist the applied point load due to load sharing through the tongue and grooved joints.

Table 5. Specific Live Load Uses

Distributed Live Load, Qu (KPa)	Long-term factor for distributed load, ψ l	Concentrated Live Load, Qc (KN)	Long-term factor for concentrated load, ψ l	**Specific Use from AS/NZS 1170.1:200**		
1.5	0.4	1.8	0.4	Domestic and residential buildings.Self-contained dwelling, general areas.		
2	0.4	2.7	0.6	Non self-contained dwellings, general areas. Domestic and residential buildings.	**OR:** Self-contained dwelling, balconies, landings and roofs used for floor type activities.	
3	0.4	2.7	0.6	Office and work areas. Offices for general use and communal kitchens.		
5	0.6	4.5	0.6	Office/work areas: Commercial/ industrial/ institutional kitchens, factories,workshops and general industrial buildings.	**OR:** Areas where people congregate excluding areas subject to wheeled vehicles, drill halls, drill rooms, stages in public assembly areas.	**OR:** Warehouses or storage areas: Reading/file rooms, office storage space, vault/strong rooms and plant rooms.

The concentrated live load is assumed to be distributed over a patch area of 350mm x 350mm, based on AS/NZS1170.1:2002. It is assumed that 3-240mm planks resist the applied point load due to load sharing through the tongue and grooved joints.

2.5 Floor Strength Limitations

The floor strength is based on SG10 stress graded timber, with the characteristic stresses as shown in the table below. The bending and shear strength of the timber is enhanced by a parallel support factor (k_6) of 1.33.

For the single and double spans, it is conservatively assumed that the concentrated live load is applied at a discrete point (as opposed to being applied as a patch load). For the cantilever, the concentrated live load is assumed to be patch load over an area of 350mm x 350mm, based on AS/NZS1170.1:2002.

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For the single and double spans, it is conservatively assumed that the concentrated live load is applied at a discrete point (as opposed to being applied as a patch load). For the cantilever, the concentrated live load is assumed to be patch load over an area of 350mm x 350mm, based on AS/NZS1170.1:2002.

Table 6. Characteristic Stresses for Floor System

Stress Grade	Bending strength, f_b (MPa)	Shear strength, f_b (MPa)
MSG10	20	3.8

2.6 Floor Deflection Limitation

The following long-term deflection limits are applied for the different floor arrangements: The long-term load case of G+ψlQ is applied for both uniformly distributed and concentrated loads, with a creep factor (k_2) of 1.5 (as per section 8 in NZS3603:1992). Concentrated live loads are applied as per the floor strength checks.

Table 7. Deflection limitations for floor system

Floor arrangement	Deflection limi
Single span	$L_{max}/300$
Double span	$L_{max}/300$
Cantilevered	$L_{c,max}/150$

2.7 Floor Vibration Limitations

Floor Vibration is often a critical design consideration for timber flooring. The required vibration performance of a floor depends on its specific use and the sensitivity of the occupants. Hence, four different vibration performance levels are considered. These performance levels are based on New Zealand Standards [1], Eurocode 5 [3] and recent research [4]. The limiting requirements for each performance level are described in the following table:

Table 8. Floor Vibration Limits

Performance Level	Frequency Limit (Hz)	Deflection Limit for 1KN point load (mm)		
N/A			Vibration is not a concern; E.g. commercial and Industrial applications.	**Complies** with recommendations from New Zealand Standards.
Low	8	1	Occupants not sensitive to floor vibration; E.g. floor spans within one tenancy or unit.	
Medium	8	0.5	Occupants moderately sensitive to floor vibration; E.g. floor spans within one tenancy or unit.	**Exceeds** recommendations from New Zealand Standards.
High	8	0.25	Occupants highly sensitive to floor vibration; E.g. inter-unit/tenancy floors.	

(Live load is not considered when determining the natural frequency of the floor, based on recommendations from Hamm *et al*, 2010 [4].)

2.8 Fire Performance Limitations:

The fire resistance rating (FRR_{max}) for the floor systems are determined for the maximum allowable spans (L_{max}) and cantilever length ($L_{c,max}$).

It is assumed that only the underside of the floor is exposed to fire and that the char rate of the timber is 0.65mm/min.

3 Material Requirements

Glue laminated timber is to be grade GL10 New Zealand Radiata Pine as specified in accordance with AS/NZS1328:1998 Glued Laminated Structural Timber.

Timber is to be kiln dried to a moisture content of not greater than 15% at the time of lamination and installation.

Timber is to be for internal use only (fully protected from the weather and inside the building envelope).

All timber treatment is to comply with NZS 3640:2003 and AS/NZS1604.5:2002.

All timber shall be separated from concrete or external timber (e.g. bearers) using a damp proof membrane.

4 Span tables

The span tables for the three floor arrangements are given in Appendix A.

5 Disclaimer

Whilst every care has been taken to ensure that the above span tables are accurate, the authors/mlb Consulting Engineers take no responsibility for any errors or omissions or for any specifications or work based on its contents.

Furthermore, the designer must satisfy themselves that the design assumptions listed in this guide are appropriate for the intended floor system.

6 References

[1] NZS1170.0. (2002). Structural Design Actions - Part 0 - *General principles*, NZ Standards, Wellington.

[2] NZS3603. (1999). *Timber Structures Standard*, New Zealand Standards, Wellington.

[3] EC5. (1994). "*Eurocode 5: Design of Timber Structures - Part 1-1: General - Common rules and rules for buildings.*" ECS, Brussels, Belgium.

[4] Hamm, P., Richter, A., and Winter, S. (2010). "*Floor vibrations - new results.*" World Conference on Timber Engineering, Riva del Garda, Italy, pp. 10.

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GL10 Techlam Laminated T&G Flooring Span Tables // Single Span

Floor depth (mm)	Superimposed dead load (kPa)	Live load (kPa)	Live load (kN)	Vibration performance level (see page 7)							
				Not applicable		Low		Medium		High	
				$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)
42	0.2	1.5	1.8	2090	30	1290	45	1020	45	810	45
		2	2.7	1580			30				
		3	2.7	1580							
		5	4.5	1270		1270			30		30
	0.5	1.5	1.8	1900		1290	45		45		45
		2	2.7	1510			30				
		3	2.7	1510							
		5	4.5	1240		1240			30		30
65	0.2	1.5	1.8	3290	60	1990	60	1580	60	1260	60
		2	2.7	2800							
		3	2.7	2800							
		5	4.5	2240							
	0.5	1.5	1.8	3030							
		2	2.7	2620							
		3	2.7	2620							
		5	4.5	2170							
90	0.2	1.5	1.8	4400	90	2760	90	2190	90	1740	90
		2	2.7	4110							
		3	2.7	3850							
		5	4.5	3060							
	0.5	1.5	1.8	4090							
		2	2.7	3820							
		3	2.7	3660							
		5	4.5	2980							
115	0.2	1.5	1.8	5460	120	3530	120	2800	120	2220	120
		2	2.7	5210							
		3	2.7	4820							
		5	4.5	3870	90						
	0.5	1.5	1.8	5100	120						
		2	2.7	4910							
		3	2.7	4600							
		5	4.5	3770	90		90				
135	0.2	1.5	1.8	6270	120	4140	150	3280	150	2610	150
		2	2.7	6000							
		3	2.7	5570							
		5	4.5	4510			120		120		
	0.5	1.5	1.8	5880			150		150		
		2	2.7	5670							
		3	2.7	5320							
		5	4.5	4400			120		120		

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Refer to diagram 2.3 for Cantilevered Floor Support Arrangement - Page 5

GL10 Techlam Laminated T&G Flooring Span Tables // Double Span

Floor depth (mm)	Superimposed dead load (kPa)	Live load (kPa)	Live load (kN)	Vibration performance level (see page 7)							
				Not applicable		Low		Medium		High	
				$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)
42	0.2	1.5	1.8	2590	30	1440	45	1140	45	910	45
		2	2.7	1910							
		3	2.7	1910							
		5	4.5	1520			30		30		
	0.5	1.5	1.8	2400			45		45		
		2	2.7	1840							
		3	2.7	1840			30				
		5	4.5	1490					30		30
65	0.2	1.5	1.8	3960	60	2230	60	1770	60	1400	60
		2	2.7	3440							
		3	2.7	3440							
		5	4.5	2560							
	0.5	1.5	1.8	3730							
		2	2.7	3270							
		3	2.7	3210							
		5	4.5	2520	45						
90	0.2	1.5	1.8	5350	90	3080	90	2450	90	1940	120
		2	2.7	5020	60						90
		3	2.7	4550							
		5	4.5	3520							
	0.5	1.5	1.8	5060							
		2	2.7	4790							
		3	2.7	4390							
		5	4.5	3460			60				
115	0.2	1.5	1.8	6680	90	3940	120	3130	120	2480	150
		2	2.7	6300							120
		3	2.7	5730							
		5	4.5	4470			90				
	0.5	1.5	1.8	6340							150
		2	2.7	6020			120				
		3	2.7	5540							120
		5	4.5	4400			90				
135	0.2	1.5	1.8	7710	120	4620	150	3670	150	2910	150
		2	2.7	7290							
		3	2.7	6660							
		5	4.5	5220			120		120		
	0.5	1.5	1.8	7330							
		2	2.7	6980			150		150		
		3	2.7	6440							
		5	4.5	5140			120		120		

Refer to diagram 2.3 for Cantilevered Floor Support Arrangement - Page 5

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GL10 Techlam Laminated T&G Flooring Span Tables // Cantilevered

Floor depth (mm)	Superimposed dead load (kPa)	Live load (kPa)	Live load (kN)	Vibration performance level (see page 7)							
				Not applicable		Low		Medium		High	
				$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)	$L_{c,max}$ (mm)	FRR_{max} (min)
42	0.2	1.5	1.8	600	30	290	45	230	45	180	45
		2	2.7	400			30				
		3	2.7	400					30		30
		5	4.5	340							
	0.5	1.5	1.8	630			45		45		45
		2	2.7	420			30				
		3	2.7	420					30		30
		5	4.5	350							
65	0.2	1.5	1.8	1110	60	450	60	360	60	280	60
		2	2.7	700							
		3	2.7	700							
		5	4.5	530							
	0.5	1.5	1.8	1130							
		2	2.7	740							
		3	2.7	740							
		5	4.5	560							
90	0.2	1.5	1.8	1730	90	620	90	490	90	390	90
		2	2.7	1160							
		3	2.7	1140							
		5	4.5	840							
	0.5	1.5	1.8	1710							
		2	2.7	1200							
		3	2.7	1190							
		5	4.5	880							
115	0.2	1.5	1.8	2370	120	800	120	630	120	500	150
		2	2.7	1680							120
		3	2.7	1650							
		5	4.5	1220	90						150
	0.5	1.5	1.8	2300	120						
		2	2.7	1720							120
		3	2.7	1680							
		5	4.5	1260	90		90				
135	0.2	1.5	1.8	2860	120	930	150	740	150	590	150
		2	2.7	2130							
		3	2.7	2080							
		5	4.5	1560			120				
	0.5	1.5	1.8	2750			150				
		2	2.7	2140							
		3	2.7	2090							
		5	4.5	1590			120				

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Refer to diagram 2.3 for Cantilevered Floor Support Arrangement - Page 5

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