COMMERCIAL AND INDUSTRIAL FLOORING DESIGN

Everything you need to know about installing plywood as a flooring system for commercial and industrial applications

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Introduction

EWPAA structural plywood flooring has proved to be both safe and reliable when used in commercial and industrial buildings, and is easily designed to resist the high loading criteria required by the building codes. Its resilience and strength have been utilised in storage decks, truck floors and flooring in sporting complexes and agricultural buildings. Plywood flooring systems are a cost effective alternative to suspended floors in such applications.

EWPAA/JAS-ANZ branded 'Tested Structural' plywood is a fully engineered structural product manufactured to AS/NZS 2269 "Plywood-Structural" and is the only panel included in AS1720.1 "Timber Structures : Design Methods" which is often referred to as "the Timber Design Code".

The key to structural plywood's properties is that its manufacture involves cross-laminating timber veneers together using the permanent Type A phenolic bond.

The cross-lamination utilises timber's superior properties along the grain enabling stresses to be distributed in all directions in the panel. As structural plywood branded with the EWPAA/JAS-ANZ 'Tested Structural Plywood' certification mark is manufactured under the Engineered Wood Products Association of Australasia's third party audited quality control program, the performance and structural characteristics of the product is assured.

This design manual details the physical, mechanical and structural properties of the standard range of EWPAA/JAS-ANZ branded structural plywood, followed by load/span tables and the installation requirements for plywood flooring.

Benefits of structural plywood flooring

- **Safe and Reliable** - The EWPAA quality control program ensures safe and reliable panels with compliance to relevant Australian Codes.
- **Durability** - the permanent Type A bond has been proven to perform structurally for at least 50 years.
- **Assured Load Capacity** - As structural plywood has standardised and reliable structural properties, it can be designed to meet the high concentrated loads specified for commercial and industrial flooring in the Timber Design Code. Additionally, the floor can be designed as a structural diaphragm to transfer lateral loads within a structure.
- **Dimensional Stability** - Plywood's cross-laminated construction provides excellent dimensional stability under changes of moisture content. This is particularly advantageous if the flooring is exposed to the weather during installation.
- **Light Weight** - Plywood's superior strength and stiffness for its weight results in light-weight panels that are easy to install.
- **Impact Resistant** - Plywood's cross-laminated construction makes panels highly resistant to edge and impact damage. Additionally, fatigue from cyclic loads is not a problem.
- **Environmentally Friendly** - Plywood is made from a natural product, wood, which is a renewable resource, and requires limited use of energy in its manufacture.
- **Chain of Custody Certification is available** –
  Chain of Custody (CoC) tracks a wood or forest product from a sustainably managed origin in a certified forest through to its end use as a wood or forest product by the consumer. CoC covers all intermediate steps such as harvesting, transportation, primary and secondary processing, manufacturing, re-manufacturing, distribution and sales.

paa ENGINEERED WOOD Chain of Custody AS4707

Product details

To comply with the recommendations of this manual, the structural plywood must be branded with the EWPAA/JAS-ANZ 'Test Structural Plywood' certification mark. The EWPAA/JAS-ANZ certification mark ensures that the plywood has been manufactured under the EWPAA's third party audited, process control based, quality control program and assures compliance with Australian Standards AS/NZS 2269.0-2008 "Plywood-Structural Specifications" and AS1720.1-2010 "Timber Structures : Design Methods".

Tongued and Grooved Edges

Structural plywood is supplied with square edges, however, it may be specified with a tongue and groove along the length of the panel. Based on full scale testing the plastic T&G joint has a design capacity of 7.5kN concentrated imposed (live) load.

In applications where the concentrated load is 7.5kN or less, the T&G joint eliminates the need for nogging. Please note panel end joints must be supported by a sub-floor member. For design concentrated loads exceeding 7.5kN the T and G joint must be supported by a designed nogging.

Dimensions and Tolerances

The most common panel size of structural plywood is 2400 x 1200mm, while 2700 x 1200mm is becoming more widely available.

T&G panels 2250 x 1200mm for 450mm spaced joists are available in thicknesses to suit residential loadings. Other structural plywood panel sizes available on special order are :

- 2400mm x 900mm
- 1800mm x 1200mm
- 1800mm x 900mm
- 3000mm x 1200mm

The first dimension is the length of the panels along the face grain, the second being across the grain. The tolerance on length and width is ±1.5mm.

The standard structural plywood thicknesses for flooring are 12, 15, 17, 19, 21, 22, 25. Thicknesses over 25mm are normally against order. It is best to check both the thicknesses and panel sizes available through EWPAA plywood merchants. Thickness tolerances for structural plywood are :

Thickness	Tolerance
Sanded sheets over 7.5 mm thick up to and including 17.5 mm	±4%.
Sanded sheets over 17.5 mm thick up to and including 25 mm	±3%.
Un-sanded sheets	an additional thickness tolerance of +0.3 mm per sheet.

NOTE: For sanded sheets over 25 mm thick, the tolerance on thickness should be agreed between the manufacturer and the purchaser.

Tongued and grooved structural plywood is generally available in a range of panel sizes and thicknesses to suit residential dwelling applications.

Face and Back Grades

The standard face grade for structural plywood for flooring is 'C' which is a non-appearance grade with a solid surface. The standard grade for the back of the panel is 'D'. The D grade surface can contain open defects such as knot holes and splits. The effect of the natural defects has been taken into account in the derivation of characteristic strengths and elastic Moduli. The C grade face on structural plywood is suitable for direct covering with floor coverings such as vinyl.

Plywood Characteristics

Durability

All structural plywood manufactured to AS/NZS 2269.0 has the permanent Type A 'marine' bond. This bond is achieved using a phenolic adhesive which is distinctly dark in colour. The standard bond test for Type A gluelines is a 72 hour continuous boil in water, after which the plywood veneers are chiselled apart at the gluelines. In a well-made glueline, separation of the plies occurs through breaking of the wood itself and not by separation of the plies along the gluelines.

The pass requirement is at least 50% of the failure, after chiselling, is in the wood fibre (which indicates that the bond is at least as strong as the wood). This test for phenolic bonds has been proven to simulate over half a century of actual exposure without glueline breakdown.

Structural Plywood Flooring, Clear Finished, Shop Floor

Standard structural plywood flooring is not recommended for floors or decks permanently exposed to the weather. If permanent weather exposure is required contact the EWPAA for additional product and installation data.

Formaldehyde Emission

Formaldehyde is a colourless strong smelling gas. Formaldehyde occurs naturally in the environment and is emitted by processes such as combustion, decay and is emitted naturally by all timber species. The International Agency for Research on Cancer (IARC) a division of the World Health Organization has reclassified formaldehyde from a group 2A suspected carcinogen to a known carcinogen. It must be stressed that the cancer causing properties of formaldehyde are only evident at **very high** concentrations, hundreds of times greater than levels emitted from structural plywood.

The formaldehyde emission classes in the Australian/New Zealand Standards are detailed below. Products labelled with emission classes E_0 and E_1, have extremely low formaldehyde emissions.

Formaldehyde Emission Classes from Australian / New Zealand Standards

Emission Class	Formaldehyde Emission Limit (mg/l)	Formaldehyde Emission Limit (ppm)*
E_0	Less than or equal to 0.5	Less than or equal to 0.041
E_1	Less than or equal to 1.0	Less than or equal to 0.08
E_2	Less than or equal to 2.0	Less than or equal to 0.16
E_3	Greater than 2.0	Greater than 0.16

* Based on a test chamber volume of 10 litres, zero airflow during the 24hr test cycle, molecular weight of formaldehyde 30.03 and the number of microlitres of formaldehyde gas in 1 micromole at 101KPa and 298K.

EWPAA certified structural plywood is constructed with an A Bond phenolic glue line which is compliant with the E_0 classification, and well below acceptable exposure limits specified by Workplace Australia and do not constitute a health risk.

Branding

All EWPAA quality controlled structural plywood is branded as follows:

- Manufacturer's Name or Brand
- The word 'Structural'
- Face grade, back grade and bond, e.g. CD-A bond
- Stress grade and Australian Standard AS/NZS 2269.0 e.g. F14 AS/NZS 2269.0
- The panel construction code, e.g. 20-30-7
- The EWPAA/JAS-ANZ 'Tested Structural Plywood' certification mark
- The Formaldehyde Emission amount, e.g. E_0

Structural Properties

Density

As timber is a natural material and a range of species are used to manufacture plywood the density can vary between panels. As a guide F11 stress grade plywood would average 550kg/m³ while F27 stress grade plywood would average 850kg/m³.

Workability

Structural plywood can be worked with conventional wood working tools. It can be cut, drilled, bored, planed and sanded with ease.

Due to its cross-laminated construction plywood panels can be generally nailed with hand or power driven nails to within 10mm of the edge without fear of splitting or other edge damage. Other wood based and brittle panel materials do not possess this property. This is a real advantage when fixing the panels to narrow timber sub-floor members as the edge damage factor is negligible.

Additionally, the cross-laminated construction imparts impact resistance to the structural plywood panels. Damage during transport, handling and site installation is therefore minimised. The resistance to handling damage is a real cost benefit.

Moisture Content & Dimensional Stability

Next to the durability of the Type A bond, the panel dimensional stability of structural plywood under moisture content and temperature changes is the most important characteristic. Because of its cross-laminated construction, plywood possesses superior dimensional stability characteristics under changes of moisture content compared to all other timber and wood based panels. **Table 1** details the average hygroscopic movement of structural plywood.

Equally significant is that because the natural wood structure is maintained during plywood manufacture all moisture movements in structural plywood for practical purposes can be considered **reversible.** When large floor areas are to be laid, the hygroscopic movement of the plywood flooring should be determined over the most likely practical moisture content range that the flooring would normally be subjected to by using the data in **Table 1**. The movement should be allowed for in the flooring design by leaving small movement joints at panel perimeters. For small floor areas, the gaps left between panels when laid by hand should accommodate normal hygroscopic movement.

Plywood Thickness (mm)	Plies	Direction*	Moisture Content Change			
			5% - 12%	12% - 17%	17% - Saturation	Average, 5% - Saturation
12	5	∥ ⊥	0.016 0.021	0.009 0.008	0.006 0.005	0.011 0.011
15	5	∥ ⊥	0.016 0.022	0.008 0.010	0.004 0.009	0.010 0.013
17	7	∥ ⊥	0.017 0.022	0.009 0.010	0.005 0.010	0.011 0.014
22	9	∥ ⊥	0.017 0.018	0.012 0.010	0.004 0.008	0.012 0.014

*Direction ∥ is along the face grain, Direction ⊥ is across the face grain

Table 1 – Movement (%) of structural plywood per % change of moisture content

Example
Determine the hygroscopic expansion across the grain of a 1200mm wide, 17mm thick structural plywood panel, when installed at 10% moisture content and used in a fully exposed application in which the plywood could become fully saturated with water. Assume fibre saturation is 28%.

As the range is from 10% - 28% the correct selection from **Table 1** is from the 'Average' column, and is 0.014% per % change of moisture content.

Total change in moisture content
=28% - 10%
=18%

Movement in mm of 1200mm panel width
= (0.014 / 100) x 1200 x 18

=3.0mm

Thermal Expansion

The average coefficient of **thermal expansion** for structural plywood is approximately 4.5 x 10^{-6}mm/mm/°C as compared with 11x10^{-6}mm/mm/°C for steel.

Stress Grades

Structural plywood is available in a range of stress grades depending on the species and quality of timber veneer used in the assembly. AS/NZS 2269.0 "Plywood-Structural : Specifications" provides for both visual and mechanical stress grading which are both equally reliable. The stress grade is marked on the back of each panel. The most common stress grades available are F8, F11 and F14, however, structural plywood with higher stress grades, F17, F22, F27 and F34 are available. The combination of stress grade and thickness for each application can be found using the Load Span Tables in this manual. For example, in a residential application and 15mm thick panel of F8 structural plywood is **structurally equivalent** as flooring to a 14mm thick panel of F11 structural plywood.

Allowable Strength and Elastic Moduli

Design capacities are obtained by modifying the characteristic capacities by factors appropriate to the service conditions and material type and application. The characteristic strengths and Moduli given in **Table 2** are applicable to structural plywood manufactured to the requirements of AS/NZS 2269.0 "Plywood-Structural : Specifications".

Table 2 gives the characteristic strengths and stiffness's for the full range of structural plywood stress grades. The Table is a reprint of Table 5.1 from AS 1720.1:2010.

Stress Grade	Characteristic Strength, MPa				Short duration average modulus of elasticity MPa	Short duration average modulus of rigidity MPa
	Bending	Tension	Panel Shear	Compression in the plane of the sheet		
	(f'b)	(f't)	(f's)	(f'c)	(E)	(G)
F34	90	54	6.0	68	21 500	1 075
F27	70	45	6.0	55	18 500	925
F22	60	36	6.0	45	16 000	800
F17	45	27	6.0	36	14 000	700
F14	36	22	5.5	27	12 000	625
F11	31	18	5.0	22	10 500	525
F8	25	15	4.5	20	9 100	455
F7	20	12	4.2	15	7 900	345

Table 2 Characteristic strengths and stiffness for structural plywood (Moisture content 15% or less).

Notes:

1. To establish design values the characteristic strengths and moduli must be modified in accordance with the factors in AS1720.1 "Timber Structures : Design Methods" Code.

2. The values in the above table are taken from the 2010 version of AS 1720.1. These values are non-normalised 5th percentile values and supersede the normalised values stated in AS/NZS 2269.0. All plywood marked with the EWPAA/JAS-ANZ 'Tested Structural Plywood' certification mark satisfy the AS 1720.1:2010 characteristic strengths and stiffness's described in AS 1720.1:2010

Section Properties

The method for determining the section properties, second moment or area (I) and section modulus (Z) is defined in AS/NZS 2269.0. The method is based on **parallel ply theory,** which assumes veneers with face grain direction parallel to the span are the sole contributors to strength and are the major contributors to stiffness. Veneers with grain direction in the cross direction, i.e. at right angles to the span, are assumed to make no contribution to strength and only a 3% contribution to stiffness.

Table 3 gives the section properties for the standard thicknesses and constructions of structural plywood specified in AS/NZS 2269.0. In the thicker plywoods, some manufacturers supply plywoods of slightly different constructions to those in AS/NZS 2269.0, consequently with differing section properties and load capacities.

Identification Code	Panel Thickness (mm)	Along the Grain		Across the Grain	
		I*	Z*	I	Z
12-24-5	12	115	19.0	33	8.3
13-30-5	13	165	24.5	35	8.3
15-30-5	15	225	29.5	65	13.0
17-24-7	17	285	33.5	120	19.0
17-30-5	17	305	35.5	120	20.0
19-24-7	19	360	38.0	190	26.5
19-24-9	19	380	39.5	200	26.5
19-30-7	19	450	46.5	155	21.5
21-30-7	21	555	52.5	240	29.5
21-24-9	21	565	51.5	300	33.5
24-30-8	24	800	66.0	385	40.5
25-30-9	25	900	70.5	475	46.5
26-24-11	26	990	74.0	590	51.5
27-30-9	27	1110	81.0	580	52.5
28-30-11	28	1210	86.5	595	51.5
31-24-13	31	1590	100.0	1020	74.0
33-30-11	33	1940	115.0	1150	81.0
36-24-15	36	2380	130.0	1630	100.0
39-30-13	39	3100	155.0	1990	115.0

*I = Second Moment of Area (mm^4/mm), Z = Section Modulus (mm^3/mm)

Table 3 Second moment of area and section moduli for structural plywoods

Panel Identification Codes

The panel identification code (otherwise known as the panel code or construction code) shown in **Table 3** uses the three key variables on which the section properties of structural plywood depend to identify and specify a panel.

Panel Identification codes are expressed as XX-YY-ZZ. The “XX” values are the total thickness of plywood (mm), the “YY” values are the actual thickness (after drying and pressing) of the face veneer (mm x 10), and the “ZZ” values are the number of plies in the assembly.

For Example, The identification code “21-24-9 “ would be marked on a plywood panel that has the following characteristics :

- 21mm total thickness
- 2.4mm face veneer
- 9 plies in the panel

Flooring Design

The flooring and its support structure must be designed to meet the load/deflection criteria specified by the designer. This manual does not cover the design of sub-floor members. **Using standard 2400mm long structural plywood panels, joists are best spaced at 400mm or 480mm, or perhaps 600mm.** It may be possible for designers to optimise sub-floor member sizes by taking account of the composite stressed skin action achieved by connecting the structural plywood flooring to structural timber or steel joists.

Floor Loadings

Floor imposed (live) loads for a wide range of buildings and occupancies are given in Table 3.1 of AS/NZS 1170-2002 "Structural Design Actions – Part 1: Permanent, Imposed and other actions". The loading requirements of the Building Code of Australia are deemed to be satisfied by using this Code. As designers should make allowance for reasonable future changes to the use of buildings or individual rooms, **Table 4** provides a summary of general load requirements for buildings. It would be reasonable to design the flooring in a commercial building to meet imposed (live) loads of 5kPa and 4.5kN.

Flooring application	Uniformly Distributed Load (kPa)	Concentrated Load (KN)
Residential	1.5	1.8
Assembly Areas	3.0 - 5.0*	2.7 - 3.6
Offices	3.0	2.7*
Retail Sales Areas	4.0	3.6*
Office Storage Space, File Rooms	5.0	4.5
Public Corridors & Spaces	4.0 - 5.0	4.5*
Stages	7.5	4.5
General Storage	2.4 per meter of storage height	7.0*
Drill Rooms and Halls	5.0*	9.0*
Light Vehicle Traffic Areas (< 2,500Kg)	2.5	13*
Medium Vehicle Traffic Areas (> 2,500Kg And < 10,000Kg)	5.0	31*

*to be determined but not less than the given value.

Table 4 Summary of AS/NZS 1170.1 Floor imposed (live) Loads

It can be seen from **Table 8** that structural plywood has excellent distributed load capacity, thus it is obvious after reference to **Table 4**, concentrated imposed (live) loads will almost always control the flooring design process.

Occasionally the high localised concentrated imposed loads typical of small diameter hard wheels can cause localised abrasion of flooring surfaces. Thus it is good practice to use larger diameter and/or softer compound wheels to reduce the compressive stresses normal to the flooring surface.

Design Procedure

Once the allowable imposed (live) loads have been established, the plywood flooring designer has two options :

1. For uniformly distributed loads up to 3 kPa and concentrated loads up to 2.7 kN the designer may use Table 5. These loading limits are typical of residential applications and of some office assembly area applications. These less conservative and less stiff options have been derived from tests, and are included in the AS 1684 "Residential timer-framed construction" code.

Structural Plywood Thickness (mm)	Maximum Joist Spacing		
	F8	F11	F14
12	400	420	440
13	430	450	480
14	460	480	510
15	480	520	540
16	510	540	570
17	540	560	600
18	560	590	620
19	590	620	660
20	610	650	680
21	640	670	710
22	660	700	740

Table 5 - Maximum Allowable Joist Spacing for T&G Structural Plywood in Residential Building

Notes

- The above Table is based on tests and is included in Table 5.3 of AS 1684.2 - 2010 "Residential Timber-framed construction – Non-Cyclonic Areas".
- Suitable for occupancy requirements of uniformly distributed loads of up to 3kPa and concentrated loads no greater than 2.7kN.
- The structural plywood face grain runs perpendicular to the joists.
- All of the thicknesses shown are not always necessarily readily available.
- The joist spacing is the centre to centre distance between joists.
- The plywood face veneers must not be thinner than any of the inner veneers.

2. However the recommended option for the more highly loaded commercial and industrial floors requires the use of **Tables 6, 7, and 8**.

Fixing requirements

Structural plywood flooring may be fixed to the sub-floor with hand or power driven fasteners or a combination of mechanical fasteners and structural elastomeric adhesive for a more rigid squeak free system.

When mechanical fasteners are used without structural elastomeric adhesive the **recommended fastener spacing** is 150mm centres at panel ends and 300mm centres at intermediate joists. When elastomeric adhesive is used in conjunction with the mechanical fasteners the fastener spacing may be increased to 300mm centres at panel ends and 600mm centres at intermediate joists. Table 9 details the recommended fasteners.

Hand driven nails	2.8mm min. dia. flathead or bullet head nails of length at least 2.5 times plywood thickness
Gun driven nails	2.5mm min. dia. gun nails of length at least 2.5 times the plywood thickness
Screws to timber joists	No. 8 x 32mm self drilling countersunk wood screws - up to 20mm plywood No. 10 x 50mm self drilling countersunk wood screws - 21 to 40mm plywood
Screws to steel joists	No. 10 x 50mm countersunk self drilling metal screws - up to 30mm plywood No. 10 x 75mm countersunk self drilling metal screws - 31 to 40mm plywood Note that screws with a "wing tip" may be suitable for screwing to steel joists provided the screws offer the same withdrawal resistance as the equivalent self drilling metal screw. 
Adhesives	Structural elastomeric that meets the American Plywood Association Standard AFG-01 eg H.B. Fuller's 'Max-Bond', or 'Sturdi Bond', or Norton's 'Floormate'

Table 9 – Minimum Fastener Specifications

Notes

1. Fastener coatings should be selected to suit for application e.g. hot dip galvanised for chemical storage areas.
2. Plywood can be fixed within 10mm of its edges.
3. Structural elastomeric adhesive should be used where plywood is fixed to unseasoned timber joists.
4. When nailing to seasoned softwood sub-floor members deformed shank nails are recommended.
5. To minimise squeaks when fixing plywood to steel joists, the use of structural elastomeric adhesive is strongly recommended.

Preservative Treated Plywood and Fastener Corrosion

When fixing preservative treated plywood to the sub-floor, the fixings may react with the preservative treatment chemical used in the plywood and cause corrosion. EWPAA recommends the following to guard against fastener corrosion (This advice is general and specific information and advice must be sought from suppliers of fasteners, flashings, studs and joists) :

- Stainless fasteners and flashings (minimum 304 grade stainless steel) are recommended for use in contact with copper based preservatives ACQ, CCA and CuAz treated material in the following circumstances :
    - Coastal areas (within 5km of the coast);
    - High rainfall areas > 1000mm/year;
    - In buildings with little or no eve overhang;
    - Where there are potential moisture traps such as decking and exposed flooring, or where treated flooring is exposed for an extended period during construction;
- For metal studs and joists apply a prophylactic to contact surfaces to prevent galvanic reactions
- Stainless fasteners, flashings, studs and joists (minimum 316 grade stainless steel) are recommended for marine environments.
- Hot dip galvanised (minimum 42 microns of zinc coating) fasteners, flashings, studs and joists are recommended for :
    - LOSP treated products (excluding use in coastal areas);
    - Products treated with copper based preservatives (ACQ, CCA, CuAz) where:
        1. The building is protected by a eve overhang of minimum 600mm;
        2. Average rainfall does not exceed 1000mm;
        3. The building or structure is designed and built to exclude ‘moisture traps’ both during erection and in subsequent use.

Further information may be obtained from the main preservative chemical suppliers and can also be found on internet web sites, e.g. http://www.tpaa.com.au/fastenerscca.htm; http://www.branz.co.nz/cms;

Load Span Tables

Table 6 has been calculated for concentrated imposed (live) loads in accordance with the Timber Structures Code. The Table has been developed to satisfy the strength requirements of AS/NZS 1170.1 with an overriding serviceability limit of span/200 deflection at the required strength.

Table 7, similarly to **Table 6**, meets the strength requirements of AS/NZS 1170.1 for concentrated imposed loads. However, the span/300 deflection criteria used in **Table 7** will result in a stiffer plywood floor. **Table 7** should be used in preference to **Table 6** where a more stringent stiffness criteria is required. For example, where the flooring is to be subjected to both human and vehicular traffic, or where flooring aesthetics are important.

Finally, **Table 8** provides the uniformly distributed imposed load capacity for structural plywood. The Table is again developed to satisfy the strength criteria of AS/NZS 1170.1 with an overriding serviceability limit of span/200 deflection. This need only be checked for flooring carrying exceptionally high UDL's. In cases where the loading is long term, i.e. permanent load with j_2=2, then the recommended approach is to double the design load before making the selection from the tabulations.

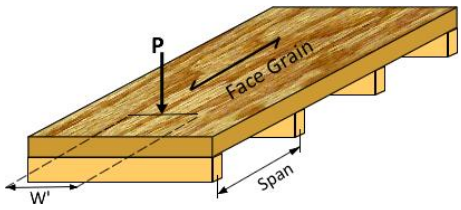
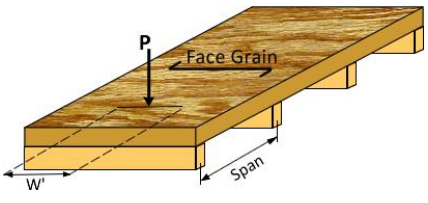
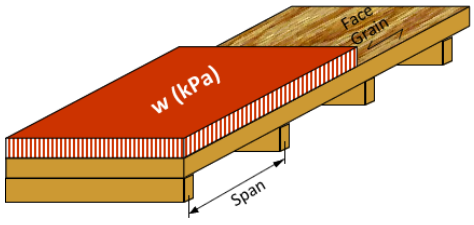
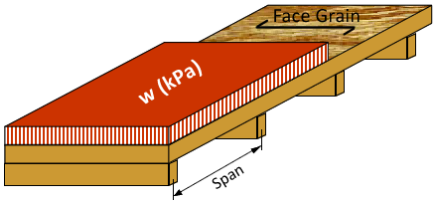
Deflection / Strength Limits

The tables are developed with an overriding strength limit. That is, the tables are developed with the following methodology :

1. Determine how much load needs to be applied to the plywood, to cause a deflection of the deflection limit (eg. Span / 300).
2. Determine the lower value of the bending moment and shear strength limits.
3. If the load from step 1 is less than the load from step 2, display the load from step 1.
4. If the load from step 1 exceeds the load from step 2, then display the load from step 2, and colour the cells orange to indicate that a strength limit state was reached before the deflection limit.

Face Grain Direction

The load span tables are divided into "Parallel To Span" and "Perpendicular To Span". This refers to the face grain direction, in relation to the span of the panel :

	Parallel To Span	Perpendicular To Span
Concentrated Load		
Uniformly Distributed Load		

Design Criteria

- Tables 6, 7 and 8 were calculated using limit state design in accordance with AS1720.1 and using the following assumptions:

  ϕ = 0.85 for primary members in structures other than houses. Note that 0.85 is considered to be conservative for most commercial and industrial flooring applications.

  k_1 = 0.80 for uniformly distributed imposed load
  = 0.94 for concentrated imposed loads, and

  J_2 = 1.0

- The flooring is in a dry interior environment (Moisture Content is less than or equal to 15%).

- The concentration (live) loads are treated as a line load with a distribution width (w') of:

  - 400mm for 12mm plywood
  - 450mm for 15, 17 and 19mm plywood
  - 520mm for 21 and 24mm plywood
  - 600mm for 26mm and thicker plywood.

- The structural plywood is continuous over at least two spans.

- All plywood end joints must be supported by a structural member.

- For spans not exceeding 600mm, nogging is not required to support plastic T&G edge joints for imposed (live) loads up to 7.5kN.

- Concentrated imposed (live) loads, being transient, have a shorter accumulated duration than distributed loads, justifying the differing values for k_1.

- With concentrated loads and UDL's specified in the Structural Design Actions Code, the important criteria is strength, thus a deflection limit of span/200 is reasonable as a minimum acceptable deflection criteria.

- The span/300 criteria for concentrated loads meet the suggested serviceability limit state criteria of AS/NZS1170.0: 2002 "Structural Design Actions", and should be used where a more stringent stiffness criteria is required.

If your design has any of the following :

- A floor that is a primary structural element in a structure intended to fulfil an essential service or post disaster function;
- Imposed loads lasting longer than 5 days (which affects creep and strength); or
- A high moisture content environment, such as an exposed wet area or tropical climate.

You cannot use the following tables !

The "EWPAA Design Toolbox" software can calculate tables for any design requirements, and is available for free download from the EWPAA Web Site. This software is meant for use by experienced professional designers only, and can only be used if this manual has been fully rea and understood.

Example Using the Tables

Note, if you need assistance with the basic formulae used in this example, please see the "Basic Formulae" section at the end of this manual.

Design :
Say we are designing a floor, and we know that our worst case loading requirement will be a 4 wheeled trolley that when fully loaded will carry 650kg. Joists are at 450mm centres, and we want to minimise the deflection, so that the trolley moves smoothly over the floor. The plywood panels will be laid across the joists, thus the face grain will be parallel to span.

Solution:
Because we want to minimise the deflection, we will choose a maximum deflection of Span / 300 (so we will use Table 7). In this case the maximum deflection would be 450 / 300 = 1.5mm.

Our Trolley weighs 650kg. Assuming we have relatively small diameter wheels, this can be converted to a maximum point load as follows :

Weight / wheel	= 650 / 4	= 163Kg.
Force / wheel	= 163 x 9.8	= 1.597 kN, say 1.6kN.

Thus, we are designing for a point load of 1.6kN.

We now need to find the plywood panel that will support this weight. This is easily done by looking down the "450" column, until we find a value of 1.6kN. Reading across will give us the correct plywood panel and stress grade.

As an example, the following is an excerpt from table 7, containing the information we want :

		Parallel To Span						
Panel Code	**Stress Grade**	**300**	**400**	**450**	**480**	**600**	**800**	**900**
15-30-5	**F8**	2.3	1.3	1.0	0.9	0.6	0.3	0.3
	F11	2.6	1.5	1.2	1.0	0.7	0.4	0.3
	F14	3.0	1.7	1.3	1.2	0.8	0.4	0.3
	F17	3.5	2.0	1.6	1.4	0.9	0.5	0.4
	F22	4.0	2.3	1.8	1.6	1.0	0.6	0.4
	F27	4.6	2.6	2.1	1.8	1.2	0.7	0.5
	F34	5.4	3.0	2.4	2.1	1.4	0.8	0.6

Thus, an F17, 15-30-5 plywood panel will be applicable for our design. Note that there are many other solutions to this example. The solution you choose will depend on plywood availability, and other factors important to you.

Table 6 :
Allowable Concentrated Imposed (Live) Loads (kN), Deflection Limit of Span/200

Panel Code	Stress Grade	Parallel To Span							Perpendicular To Span						
		300	400	450	480	600	800	900	300	400	450	480	600	800	900
12-24-5	F8	1.6	0.9	0.7	0.6	0.4	0.2	0.2	0.4	0.3	0.2	0.2	0.1	0.1	0.0
	F11	1.8	1.0	0.8	0.7	0.4	0.3	0.2	0.5	0.3	0.2	0.2	0.1	0.1	0.1
	F14	2.1	1.2	0.9	0.8	0.5	0.3	0.2	0.6	0.3	0.3	0.2	0.1	0.1	0.1
	F17	2.4	1.3	1.1	0.9	0.6	0.3	0.3	0.7	0.4	0.3	0.3	0.2	0.1	0.1
	F22	2.7	1.5	1.2	1.1	0.7	0.4	0.3	0.8	0.4	0.3	0.3	0.2	0.1	0.1
	F27	3.2	1.8	1.4	1.2	0.8	0.4	0.4	0.9	0.5	0.4	0.4	0.2	0.1	0.1
	F34	3.7	2.1	1.6	1.4	0.9	0.5	0.4	1.1	0.6	0.5	0.4	0.3	0.1	0.1
15-30-5	F8	2.9	1.9	1.5	1.3	0.9	0.5	0.4	1.0	0.6	0.4	0.4	0.2	0.1	0.1
	F11	3.6	2.2	1.8	1.5	1.0	0.6	0.4	1.1	0.6	0.5	0.4	0.3	0.2	0.1
	F14	4.2	2.5	2.0	1.8	1.1	0.6	0.5	1.3	0.7	0.6	0.5	0.3	0.2	0.1
	F17	5.2	3.0	2.3	2.1	1.3	0.7	0.6	1.5	0.9	0.7	0.6	0.4	0.2	0.2
	F22	6.0	3.4	2.7	2.4	1.5	0.8	0.7	1.7	1.0	0.8	0.7	0.4	0.2	0.2
	F27	7.0	3.9	3.1	2.7	1.7	1.0	0.8	2.0	1.1	0.9	0.8	0.5	0.3	0.2
	F34	8.1	4.6	3.6	3.2	2.0	1.1	0.9	2.3	1.3	1.0	0.9	0.6	0.3	0.3
17-24-7	F8	3.3	2.4	1.9	1.7	1.1	0.6	0.5	1.8	1.0	0.8	0.7	0.5	0.3	0.2
	F11	4.1	2.8	2.2	2.0	1.3	0.7	0.6	2.1	1.2	0.9	0.8	0.5	0.3	0.2
	F14	4.7	3.2	2.5	2.2	1.4	0.8	0.6	2.4	1.4	1.1	0.9	0.6	0.3	0.3
	F17	5.9	3.8	3.0	2.6	1.7	0.9	0.7	2.8	1.6	1.3	1.1	0.7	0.4	0.3
	F22	7.6	4.3	3.4	3.0	1.9	1.1	0.8	3.2	1.8	1.4	1.3	0.8	0.5	0.4
	F27	8.8	5.0	3.9	3.4	2.2	1.2	1.0	3.7	2.1	1.7	1.5	0.9	0.5	0.4
	F34	10.3	5.8	4.6	4.0	2.6	1.4	1.1	4.3	2.4	1.9	1.7	1.1	0.6	0.5
19-24-7	F8	3.7	2.8	2.4	2.1	1.4	0.8	0.6	2.6	1.6	1.3	1.1	0.7	0.4	0.3
	F11	4.6	3.5	2.8	2.5	1.6	0.9	0.7	3.2	1.9	1.5	1.3	0.8	0.5	0.4
	F14	5.4	4.0	3.2	2.8	1.8	1.0	0.8	3.7	2.1	1.7	1.5	1.0	0.5	0.4
	F17	6.7	4.7	3.8	3.3	2.1	1.2	0.9	4.5	2.5	2.0	1.7	1.1	0.6	0.5
	F22	9.0	5.4	4.3	3.8	2.4	1.4	1.1	5.1	2.9	2.3	2.0	1.3	0.7	0.6
	F27	10.4	6.3	5.0	4.4	2.8	1.6	1.2	5.9	3.3	2.6	2.3	1.5	0.8	0.7
	F34	12.2	7.3	5.8	5.1	3.2	1.8	1.4	6.8	3.8	3.0	2.7	1.7	1.0	0.8
19-30-7	F8	4.6	3.4	3.0	2.7	1.7	1.0	0.8	2.1	1.3	1.1	0.9	0.6	0.3	0.3
	F11	5.7	4.2	3.5	3.1	2.0	1.1	0.9	2.6	1.5	1.2	1.1	0.7	0.4	0.3
	F14	6.6	4.9	4.0	3.5	2.3	1.3	1.0	3.0	1.8	1.4	1.2	0.8	0.4	0.3
	F17	8.2	5.9	4.7	4.1	2.6	1.5	1.2	3.6	2.0	1.6	1.4	0.9	0.5	0.4
	F22	11.0	6.8	5.4	4.7	3.0	1.7	1.3	4.2	2.3	1.8	1.6	1.0	0.6	0.5
	F27	12.2	7.8	6.2	5.4	3.5	2.0	1.5	4.8	2.7	2.1	1.9	1.2	0.7	0.5
	F34	12.2	9.1	7.2	6.3	4.1	2.3	1.8	5.6	3.1	2.5	2.2	1.4	0.8	0.6
21-30-7	F8	6.0	4.5	4.0	3.7	2.4	1.4	1.1	3.3	2.4	1.9	1.7	1.1	0.6	0.5
	F11	7.4	5.5	4.9	4.4	2.8	1.6	1.3	4.1	2.7	2.2	1.9	1.2	0.7	0.5
	F14	8.6	6.4	5.7	5.0	3.2	1.8	1.4	4.8	3.1	2.5	2.2	1.4	0.8	0.6
	F17	10.7	8.0	6.7	5.9	3.8	2.1	1.7	6.0	3.7	2.9	2.5	1.6	0.9	0.7
	F22	14.3	9.7	7.6	6.7	4.3	2.4	1.9	7.4	4.2	3.3	2.9	1.9	1.0	0.8
	F27	15.6	11.2	8.8	7.8	5.0	2.8	2.2	8.6	4.8	3.8	3.4	2.1	1.2	1.0
	F34	15.6	13.0	10.3	9.0	5.8	3.2	2.6	10.0	5.6	4.4	3.9	2.5	1.4	1.1
25-30-9	F8	9.2	6.9	6.1	5.8	4.6	2.6	2.0	5.0	3.7	3.3	3.0	1.9	1.1	0.9
	F11	11.5	8.6	7.6	7.1	5.3	3.0	2.3	6.2	4.6	4.0	3.5	2.2	1.3	1.0
	F14	13.3	10.0	8.8	8.3	6.0	3.4	2.7	7.2	5.4	4.5	4.0	2.5	1.4	1.1
	F17	16.6	12.5	11.1	10.4	7.0	4.0	3.1	9.0	6.7	5.3	4.6	3.0	1.7	1.3
	F22	21.5	16.6	14.3	12.6	8.0	4.5	3.6	11.9	7.6	6.0	5.3	3.4	1.9	1.5
	F27	21.5	19.4	16.5	14.5	9.3	5.2	4.1	13.9	8.8	7.0	6.1	3.9	2.2	1.7
	F34	21.5	21.4	19.2	16.9	10.8	6.1	4.8	17.9	10.3	8.1	7.1	4.6	2.6	2.0
27-30-9	F8	10.6	8.0	7.1	6.6	5.3	3.2	2.5	6.9	5.1	4.6	4.3	2.9	1.7	1.3
	F11	13.2	9.9	8.8	8.2	6.5	3.7	2.9	8.5	6.4	5.7	5.3	3.4	1.9	1.5
	F14	15.3	11.4	10.2	9.5	7.4	4.2	3.3	9.9	7.4	6.6	6.1	3.9	2.2	1.7
	F17	19.1	14.3	12.7	11.9	8.7	4.9	3.9	12.4	9.3	8.1	7.1	4.5	2.6	2.0
	F22	23.2	19.1	17.0	15.5	9.9	5.6	4.4	16.5	11.7	9.2	8.1	5.2	2.9	2.3
	F27	23.2	22.3	19.8	17.9	11.5	6.4	5.1	19.3	13.5	10.7	9.4	6.0	3.4	2.7
	F34	23.2	23.2	23.1	20.8	13.3	7.5	5.9	23.2	15.7	12.4	10.9	7.0	3.9	3.1
33-30-11	F8	15.1	11.3	10.1	9.4	7.5	5.5	4.4	10.6	7.9	7.0	6.6	5.3	3.3	2.6
	F11	18.7	14.0	12.5	11.7	9.3	6.4	5.0	13.1	9.8	8.7	8.2	6.5	3.8	3.0
	F14	21.8	16.3	14.5	13.6	10.8	7.3	5.8	15.2	11.4	10.1	9.5	7.6	4.3	3.4
	F17	27.2	20.4	18.1	17.0	13.6	8.5	6.7	19.1	14.3	12.7	11.9	9.0	5.0	4.0
	F22	28.4	27.2	24.2	22.6	17.3	9.7	7.7	25.4	19.0	16.9	15.8	10.3	5.8	4.6
	F27	28.4	28.3	28.2	26.4	20.0	11.2	8.9	28.3	22.2	19.7	18.5	11.9	6.7	5.3
	F34	28.4	28.3	28.3	28.3	23.2	13.1	10.3	28.4	28.3	24.5	21.5	13.8	7.8	6.1

For Single Spans, reduce the allowable concentrated loads by 40%

This table is recommended for use in those applications where floor stiffness is not critical for flooring aesthetics and/or general usage. Table 7 should be used where a more stringent stiffness criteria is required.

Table 7 :
Allowable Concentrated Imposed (Live) Loads (kN), Deflection Limit of Span/300

		Parallel To Span							Perpendicular To Span						
Panel Code	**Stress Grade**	**300**	**400**	**450**	**480**	**600**	**800**	**900**	**300**	**400**	**450**	**480**	**600**	**800**	**900**
12-24-5	**F8**	1.0	0.6	0.5	0.4	0.3			0.3	0.2	0.1	0.1	0.1	0.0	0.0
	F11	1.2	0.7	0.5	0.5	0.3			0.3	0.2	0.2	0.1	0.1	0.0	0.0
	F14	1.4	0.8	0.6	0.5	0.3			0.4	0.2	0.2	0.2	0.1	0.1	0.0
	F17	1.6	0.9	0.7	0.6	0.4	0.2		0.5	0.3	0.2	0.2	0.1	0.1	0.1
	F22	1.8	1.0	0.8	0.7	0.5	0.3	0.2	0.5	0.3	0.2	0.2	0.1	0.1	0.1
	F27	2.1	1.2	0.9	0.8	0.5	0.3	0.2	0.6	0.3	0.3	0.2	0.2	0.1	0.1
	F34	2.5	1.4	1.1	1.0	0.6	0.3	0.3	0.7	0.4	0.3	0.3	0.2	0.1	0.1
15-30-5	**F8**	2.3	1.3	1.0	0.9	0.6	0.3	0.3	0.7	0.4	0.3	0.3	0.2	0.1	0.1
	F11	2.6	1.5	1.2	1.0	0.7	0.4	0.3	0.8	0.4	0.3	0.3	0.2	0.1	0.1
	F14	3.0	1.7	1.3	1.2	0.8	0.4	0.3	0.9	0.5	0.4	0.3	0.2	0.1	0.1
	F17	3.5	2.0	1.6	1.4	0.9	0.5	0.4	1.0	0.6	0.5	0.4	0.3	0.1	0.1
	F22	4.0	2.3	1.8	1.6	1.0	0.6	0.4	1.2	0.7	0.5	0.5	0.3	0.2	0.1
	F27	4.6	2.6	2.1	1.8	1.2	0.7	0.5	1.3	0.8	0.6	0.5	0.3	0.2	0.1
	F34	5.4	3.0	2.4	2.1	1.4	0.8	0.6	1.6	0.9	0.7	0.6	0.4	0.2	0.2
17-24-7	**F8**	2.9	1.6	1.3	1.1	0.7	0.4	0.3	1.2	0.7	0.5	0.5	0.3	0.2	0.1
	F11	3.3	1.9	1.5	1.3	0.8	0.5	0.4	1.4	0.8	0.6	0.5	0.4	0.2	0.2
	F14	3.8	2.1	1.7	1.5	1.0	0.5	0.4	1.6	0.9	0.7	0.6	0.4	0.2	0.2
	F17	4.5	2.5	2.0	1.7	1.1	0.6	0.5	1.9	1.1	0.8	0.7	0.5	0.3	0.2
	F22	5.1	2.9	2.3	2.0	1.3	0.7	0.6	2.1	1.2	1.0	0.8	0.5	0.3	0.2
	F27	5.9	3.3	2.6	2.3	1.5	0.8	0.7	2.5	1.4	1.1	1.0	0.6	0.3	0.3
	F34	6.8	3.8	3.0	2.7	1.7	1.0	0.8	2.9	1.6	1.3	1.1	0.7	0.4	0.3
19-24-7	**F8**	3.7	2.1	1.6	1.4	0.9	0.5	0.4	1.9	1.1	0.9	0.8	0.5	0.3	0.2
	F11	4.2	2.4	1.9	1.6	1.1	0.6	0.5	2.2	1.3	1.0	0.9	0.6	0.3	0.2
	F14	4.8	2.7	2.1	1.9	1.2	0.7	0.5	2.5	1.4	1.1	1.0	0.6	0.4	0.3
	F17	5.6	3.2	2.5	2.2	1.4	0.8	0.6	3.0	1.7	1.3	1.2	0.7	0.4	0.3
	F22	6.4	3.6	2.9	2.5	1.6	0.9	0.7	3.4	1.9	1.5	1.3	0.8	0.5	0.4
	F27	7.4	4.2	3.3	2.9	1.9	1.0	0.8	3.9	2.2	1.7	1.5	1.0	0.6	0.4
	F34	8.6	4.9	3.8	3.4	2.2	1.2	1.0	4.6	2.6	2.0	1.8	1.1	0.6	0.5
19-30-7	**F8**	4.6	2.6	2.0	1.8	1.1	0.6	0.5	1.6	0.9	0.7	0.6	0.4	0.2	0.2
	F11	5.3	3.0	2.3	2.1	1.3	0.7	0.6	1.8	1.0	0.8	0.7	0.5	0.3	0.2
	F14	6.0	3.4	2.7	2.4	1.5	0.8	0.7	2.1	1.2	0.9	0.8	0.5	0.3	0.2
	F17	7.0	4.0	3.1	2.7	1.8	1.0	0.8	2.4	1.4	1.1	0.9	0.6	0.3	0.3
	F22	8.0	4.5	3.6	3.1	2.0	1.1	0.9	2.8	1.6	1.2	1.1	0.7	0.4	0.3
	F27	9.3	5.2	4.1	3.6	2.3	1.3	1.0	3.2	1.8	1.4	1.3	0.8	0.5	0.4
	F34	10.8	6.1	4.8	4.2	2.7	1.5	1.2	3.7	2.1	1.7	1.5	0.9	0.5	0.4
21-30-7	**F8**	6.0	3.7	2.9	2.5	1.6	0.9	0.7	2.8	1.6	1.3	1.1	0.7	0.4	0.3
	F11	7.4	4.2	3.3	2.9	1.9	1.1	0.8	3.3	1.8	1.4	1.3	0.8	0.5	0.4
	F14	8.6	4.8	3.8	3.4	2.1	1.2	1.0	3.7	2.1	1.7	1.5	0.9	0.5	0.4
	F17	10.0	5.6	4.5	3.9	2.5	1.4	1.1	4.3	2.4	1.9	1.7	1.1	0.6	0.5
	F22	11.5	6.4	5.1	4.5	2.9	1.6	1.3	5.0	2.8	2.2	1.9	1.2	0.7	0.6
	F27	13.2	7.5	5.9	5.2	3.3	1.9	1.5	5.7	3.2	2.5	2.2	1.4	0.8	0.6
	F34	15.4	8.7	6.8	6.0	3.8	2.2	1.7	6.7	3.7	3.0	2.6	1.7	0.9	0.7
25-30-9	**F8**	9.2	6.9	5.4	4.8	3.0	1.7	1.4	5.0	2.9	2.3	2.0	1.3	0.7	0.6
	F11	11.4	7.9	6.3	5.5	3.5	2.0	1.6	5.9	3.3	2.6	2.3	1.5	0.8	0.7
	F14	13.3	9.0	7.1	6.3	4.0	2.3	1.8	6.8	3.8	3.0	2.7	1.7	1.0	0.8
	F17	16.6	10.6	8.3	7.3	4.7	2.6	2.1	7.9	4.5	3.5	3.1	2.0	1.1	0.9
	F22	21.4	12.1	9.5	8.4	5.4	3.0	2.4	9.1	5.1	4.0	3.5	2.3	1.3	1.0
	F27	21.5	13.9	11.0	9.7	6.2	3.5	2.8	10.5	5.9	4.7	4.1	2.6	1.5	1.2
	F34	21.5	16.2	12.8	11.3	7.2	4.1	3.2	12.2	6.8	5.4	4.8	3.0	1.7	1.4
27-30-9	**F8**	10.6	7.9	6.7	5.9	3.8	2.1	1.7	6.9	4.4	3.5	3.1	2.0	1.1	0.9
	F11	13.2	9.8	7.7	6.8	4.3	2.4	1.9	8.5	5.1	4.0	3.5	2.3	1.3	1.0
	F14	15.3	11.2	8.8	7.7	5.0	2.8	2.2	9.9	5.8	4.6	4.0	2.6	1.5	1.2
	F17	19.1	13.0	10.3	9.0	5.8	3.3	2.6	12.1	6.8	5.4	4.7	3.0	1.7	1.3
	F22	23.2	14.9	11.8	10.3	6.6	3.7	2.9	13.8	7.8	6.1	5.4	3.5	1.9	1.5
	F27	23.2	17.2	13.6	11.9	7.6	4.3	3.4	16.0	9.0	7.1	6.2	4.0	2.2	1.8
	F34	23.2	20.0	15.8	13.9	8.9	5.0	3.9	18.6	10.4	8.3	7.3	4.6	2.6	2.1
33-30-11	**F8**	15.1	11.3	10.1	9.4	6.6	3.7	2.9	10.6	7.9	6.9	6.1	3.9	2.2	1.7
	F11	18.7	14.0	12.5	11.7	7.6	4.3	3.4	13.1	9.8	8.0	7.0	4.5	2.5	2.0
	F14	21.8	16.3	14.5	13.5	8.6	4.9	3.8	15.2	11.4	9.1	8.0	5.1	2.9	2.3
	F17	27.2	20.4	17.9	15.8	10.1	5.7	4.5	19.1	13.5	10.6	9.4	6.0	3.4	2.7
	F22	28.4	25.9	20.5	18.0	11.5	6.5	5.1	25.4	15.4	12.2	10.7	6.8	3.8	3.0
	F27	28.4	28.3	23.7	20.8	13.3	7.5	5.9	28.3	17.8	14.1	12.4	7.9	4.4	3.5
	F34	28.4	28.3	27.5	24.2	15.5	8.7	6.9	28.3	20.7	16.3	14.4	9.2	5.2	4.1

For Single Spans, reduce the allowable concentrated loads by 40%

Table 7 is recommended for calculated vehicular loads where human reactions to vehicular traffic are considered significant.

Table 8 :
Allowable Uniformly Distributed Imposed (Live) Loads (kPa), Deflection Limit of Span/200

		Parallel To Span							Perpendicular To Span						
Panel Code	**Stress Grade**	**300**	**400**	**450**	**480**	**600**	**800**	**900**	**300**	**400**	**450**	**480**	**600**	**800**	**900**
12-24-5	**F8**	19.1	10.7	8.5	7.4	4.5	1.9	1.3	8.3	4.3	3.0	2.5	1.3	0.5	0.4
	F11	23.7	13.3	10.5	9.2	5.2	2.2	1.5	10.3	5.0	3.5	2.9	1.5	0.6	0.4
	F14	27.5	15.5	12.2	10.7	5.9	2.5	1.8	12.0	5.7	4.0	3.3	1.7	0.7	0.5
	F17	34.4	19.3	15.3	13.4	6.9	2.9	2.0	15.0	6.7	4.7	3.9	2.0	0.8	0.6
	F22	45.9	25.8	18.7	15.4	7.9	3.3	2.3	18.1	7.6	5.4	4.4	2.3	1.0	0.7
	F27	46.4	30.1	21.6	17.8	9.1	3.8	2.7	20.9	8.8	6.2	5.1	2.6	1.1	0.8
	F34	46.4	34.7	25.1	20.7	10.6	4.5	3.1	24.3	10.3	7.2	5.9	3.0	1.3	0.9
15-30-5	**F8**	29.7	16.7	13.2	11.6	7.4	3.7	2.6	13.1	7.3	5.8	4.9	2.5	1.1	0.8
	F11	36.8	20.7	16.3	14.4	9.2	4.3	3.0	16.2	9.1	6.9	5.7	2.9	1.2	0.9
	F14	42.8	24.0	19.0	16.7	10.6	4.9	3.4	18.8	10.5	7.9	6.5	3.3	1.4	1.0
	F17	53.5	30.0	23.7	20.8	13.3	5.7	4.0	23.5	13.2	9.2	7.6	3.9	1.6	1.2
	F22	58.0	40.1	31.6	27.8	15.4	6.5	4.6	31.4	15.0	10.6	8.7	4.5	1.9	1.3
	F27	58.0	43.4	36.9	32.4	17.8	7.5	5.3	36.6	17.4	12.2	10.1	5.1	2.2	1.5
	F34	58.0	43.5	38.6	36.2	20.7	8.7	6.1	47.1	20.2	14.2	11.7	6.0	2.5	1.8
17-24-7	**F8**	33.7	19.0	15.0	13.1	8.4	4.7	3.3	19.1	10.7	8.5	7.4	4.7	2.0	1.4
	F11	41.8	23.5	18.6	16.3	10.4	5.4	3.8	23.7	13.3	10.5	9.2	5.4	2.3	1.6
	F14	48.6	27.3	21.6	18.9	12.1	6.2	4.3	27.5	15.4	12.2	10.7	6.2	2.6	1.8
	F17	60.7	34.1	26.9	23.7	15.1	7.2	5.1	34.4	19.3	15.2	13.4	7.2	3.0	2.1
	F22	65.7	45.5	35.9	31.6	19.5	8.2	5.8	45.9	25.8	19.5	16.1	8.2	3.5	2.4
	F27	65.7	49.2	41.9	36.8	22.6	9.5	6.7	53.5	30.1	22.5	18.6	9.5	4.0	2.8
	F34	65.7	49.3	43.8	41.0	26.2	11.1	7.8	65.6	37.3	26.2	21.6	11.0	4.7	3.3
19-24-7	**F8**	38.3	21.5	17.0	14.9	9.5	5.3	4.2	26.7	15.0	11.8	10.4	6.6	3.1	2.2
	F11	47.4	26.7	21.1	18.5	11.8	6.6	4.8	33.1	18.6	14.7	12.9	8.2	3.6	2.5
	F14	55.1	31.0	24.5	21.5	13.7	7.7	5.5	38.4	21.6	17.0	14.9	9.5	4.1	2.9
	F17	68.9	38.7	30.6	26.9	17.1	9.1	6.4	48.0	27.0	21.3	18.7	11.4	4.8	3.4
	F22	73.4	51.6	40.8	35.8	22.9	10.4	7.3	64.0	36.0	28.4	24.9	13.0	5.5	3.9
	F27	73.4	55.1	47.6	41.8	26.7	12.0	8.5	73.4	42.0	33.1	29.1	15.1	6.4	4.5
	F34	73.5	55.1	48.9	45.9	33.1	14.0	9.8	73.4	54.0	41.5	34.2	17.5	7.4	5.2
19-30-7	**F8**	46.8	26.3	20.8	18.3	11.7	6.5	5.1	21.6	12.1	9.6	8.4	5.4	2.5	1.8
	F11	58.1	32.6	25.8	22.6	14.5	8.1	6.0	26.8	15.1	11.9	10.4	6.6	2.9	2.1
	F14	67.3	37.9	29.9	26.3	16.8	9.4	6.9	31.1	17.5	13.8	12.1	7.7	3.4	2.4
	F17	73.5	47.4	37.4	32.9	21.0	11.4	8.0	38.9	21.9	17.3	15.1	9.3	3.9	2.8
	F22	73.5	55.1	48.9	43.8	28.0	13.0	9.1	51.9	29.2	23.0	20.2	10.6	4.5	3.1
	F27	73.5	55.1	48.9	45.9	32.7	15.0	10.6	60.6	34.0	26.9	23.6	12.3	5.2	3.6
	F34	73.5	55.1	48.9	45.9	36.7	17.5	12.3	73.4	43.8	33.8	27.9	14.3	6.0	4.2
21-30-7	**F8**	52.9	29.7	23.5	20.6	13.2	7.4	5.8	29.7	16.7	13.2	11.6	7.4	3.9	2.8
	F11	65.6	36.9	29.1	25.6	16.3	9.1	7.2	36.8	20.7	16.3	14.3	9.1	4.6	3.2
	F14	74.4	42.8	33.8	29.7	19.0	10.6	8.4	42.8	24.0	19.0	16.6	10.6	5.2	3.7
	F17	81.2	53.5	42.3	37.1	23.7	13.3	9.9	53.4	30.0	23.7	20.8	13.3	6.1	4.3
	F22	81.2	60.9	54.1	49.5	31.6	16.0	11.3	71.3	40.0	31.6	27.8	16.4	6.9	4.9
	F27	81.2	60.9	54.1	50.7	36.9	18.5	13.0	81.1	46.7	36.9	32.4	19.0	8.0	5.6
	F34	81.2	60.9	54.1	50.7	40.5	21.6	15.1	81.1	60.1	47.4	41.7	22.1	9.3	6.5
25-30-9	**F8**	71.0	39.9	31.5	27.7	17.7	9.9	7.8	38.3	21.5	17.0	14.9	9.5	5.3	4.2
	F11	80.5	49.5	39.1	34.4	22.0	12.3	9.7	47.4	26.7	21.0	18.5	11.8	6.6	5.1
	F14	88.6	57.5	45.4	39.9	25.5	14.3	11.3	55.1	31.0	24.4	21.5	13.7	7.6	5.8
	F17	96.7	71.9	56.8	49.9	31.9	17.9	14.1	68.9	38.7	30.6	26.8	17.1	9.6	6.8
	F22	96.7	72.5	64.4	60.4	42.5	23.8	18.3	91.8	51.6	40.7	35.8	22.9	11.0	7.7
	F27	96.7	72.5	64.4	60.4	48.3	27.8	21.1	96.6	60.2	47.5	41.8	26.7	12.7	8.9
	F34	96.7	72.5	64.4	60.4	48.3	35.0	24.6	96.6	72.4	61.1	53.7	34.3	14.8	10.4
27-30-9	**F8**	78.3	45.9	36.2	31.8	20.4	11.4	9.0	52.9	29.7	23.5	20.6	13.2	7.4	5.8
	F11	87.0	56.9	44.9	39.5	25.2	14.2	11.2	65.5	36.8	29.1	25.6	16.3	9.1	7.2
	F14	95.7	66.1	52.2	45.8	29.3	16.4	13.0	76.1	42.8	33.8	29.7	19.0	10.6	8.3
	F17	104.4	78.3	65.2	57.3	36.6	20.6	16.2	95.2	53.5	42.2	37.1	23.7	13.3	10.3
	F22	104.4	78.3	69.6	65.2	48.9	27.4	21.6	104.4	71.3	56.3	49.5	31.6	16.8	11.8
	F27	104.4	78.3	69.6	65.2	52.1	32.0	25.2	104.4	78.2	65.7	57.7	36.9	19.4	13.6
	F34	104.4	78.3	69.6	65.2	52.1	39.1	30.3	104.4	78.2	69.5	65.1	47.4	22.5	15.8
33-30-11	**F8**	95.7	65.3	51.6	45.4	29.0	16.3	12.8	81.4	45.8	36.2	31.8	20.3	11.4	9.0
	F11	106.3	79.7	64.0	56.2	36.0	20.2	15.9	100.9	56.8	44.8	39.4	25.2	14.1	11.1
	F14	117.0	87.7	74.3	65.3	41.8	23.4	18.5	116.9	65.9	52.1	45.7	29.2	16.4	12.9
	F17	127.6	95.7	85.0	79.7	52.2	29.3	23.1	127.6	82.4	65.1	57.2	36.6	20.5	16.2
	F22	127.6	95.7	85.0	79.7	63.7	39.1	30.9	127.6	95.6	85.0	76.3	48.7	27.3	21.6
	F27	127.6	95.7	85.0	79.7	63.7	45.6	36.0	127.6	95.7	85.0	79.7	56.9	31.9	25.2
	F34	127.6	95.7	85.1	79.7	63.8	47.8	42.4	127.6	95.7	85.0	79.7	63.7	41.0	31.3

Basic Formulae

The following are the basic formulae needed to use the tables.

Force

- A force is simply a push or a pull.
- The standard unit of force is Newton (N).
- Force is often expressed in "kilo-newtons"(kN). 1 kN = 1000 N
- **Force (N) = Mass (kg) x Acceleration (ms^{-2})**

Weight

- The term "weight" is another way of saying "the force due to gravity". Units are Newtons.
- Gravity is a form of acceleration, and at sea level, is approximately $9.8ms^{-2}$.
- **Weight (N) = Mass (kg) x 9.8.**

Pressure

- Pressure is the force per unit area, exerted by a force on a surface.
- The standard unit of pressure is Pascals (Pa).
- Pressure is often expressed in "kilo Pascals" (kPa). 1 kPa = 1000Pa
- **Pressure = Force (N) / Area (m^2)**

Example 1 - Calculate the worst case load under each wheel of a forklift.

If a 4 wheeled forklift weights 1000 kg and can lift 2000 kg, and has a worst case weight distribution of 80-20 over the front wheels, the following is how one determines the concentrated loads under each wheel :

Total Weight = (1000 + 2000) x 9.8
= 29400 N
= 29.4 kN

Under worst case conditions, 80% of the weight is over the front 2 wheels. Thus, the following is the weight under each front wheel :

= (29.4 x 0.8) / 2
= 23.52 / 2
= 11.76 kN per wheel

The weight under each rear wheel is :

= (29.4 x 0.2) / 2
= 5.88 / 2
= 2.94 kN per wheel

Example 2 - Calculate the pressure of a water tank.

If a square water tank is 2m x 2m, and contains 3000L of water, calculate the pressure under the water tank. Assume 1L of water weighs 1 kg.

Area = 2 x 2
= $4m^2$

Weight = 3000 x 9.8
= 29,400 N
= 29.4 kN

Pressure = 29,400 / 4
= 7350 Pa
= 7.35 kPa

Revision History

Revision	Changes	Date	Who
6	• Update Logos and member list	08-02-2012	MB
5	• Update Logos to correct JAS-ANZ version • Made several grammatical corrections. • Changed design to be in accordance with AS 1720.1:2010 • Updated values in Tables 6, 7 and 8 to be in accordance with AS 1720.1:2010. • Added a section on fastener corrosion when using preservative treated plywood.	17-11-2011	MB
4	• Complete reformat. • Changed load span table layout, and added more constructions. • Modified Fixings section. • Added “Basic Formulae” section. • Added a section to aid in interpreting the tables. • Added a section on formaldehyde.	04-11-2008	MB
1	Initial Release		

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