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PARTICLEBOARD AND MDF STRUCTURAL  
SHELVING DESIGN MANUAL

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# Introduction

The use of Particleboard and Medium Density Fibreboard (MDF) as shelving has become widespread from the early days of the industry in Australia . Reconstituted wood panels are well suited to industrial shelving systems because of their predictable and non-directional mechanical and physical properties, flat wear resistant surfaces, and most importantly, their economy.

The use of Particleboard and MDF as shelving is much broader than industrial storage systems. In homes and offices, Particleboard and MDF are used for bookshelves and in storage units. Kitchen cupboards made from these wood panels carry heavy loads of groceries and crockery; linen cupboards too can carry significant loads. In commercial and retail areas, wood panels feature as shelving for storage and display. Decorative finish may be just as important as structural properties.

For the purpose of this manual, a shelf is any horizontal element or surface that supports applied loads (excluding constructional elements such as floors and flat roofs).

Although the use of Particleboard and MDF in these applications is widespread, it is still common to see examples of misuse. The usual indication of this is excessive deflection. Although excessive deflection does not necessarily indicate a risk of collapse, it is unsightly and indicates insufficient knowledge of the structural behaviour of Particleboard and MDF.

The purpose of this design manual is to provide safe loads for various shelf spans and for the range of board types and thicknesses. This information is intended to assist architects, design engineers, as well as builders, furniture manufacturers, cabinet makers and shopfitters to use wood panels effectively in any shelving application. Information is also presented for several special cases, viz, book shelves and domestic cupboard shelves.

The design information presented in this manual is based on conventional bending theory for the particular shelf support details of each case and minimum properties values required by the current Australian Standards (AS/NZS 1859 Parts 1 and 2 and 1860 Part 1).

The information in this manual only applies to those products that carry one of the following EWPA certification marks :



## Installation

Shelving is treated as simply supported in this design manual. Therefore installation details do not need to be specified; shelving only needs to be laid over the supports and prevented from being dislodged. The effect of any fixing (nails, screws, clips) is not considered in this analysis.

## Notice to Purchaser

Flooring design data and methods in this Manual are based on sound engineering principles applied by an experienced consultant and on appropriate Australian Standards and Building Codes. The Manual is intended to assist engineers, designers, specifiers and experienced builders in designing and constructing particleboard floors for a variety of industrial, commercial and institutional buildings.

The Manual does not cover all aspects of flooring in these types of buildings. Successful performance of particleboard floors depends on many factors outside the control of the EWPAA. These include correct determination of floor loads, selection of particleboard floor systems to support these loads, details of joists or supporting framework, installation procedures, workmanship etc. EWPAA accepts no responsibility for, or in conjunction with, the quality of the completed systems or their suitability for any purpose other than that which is imposed by Australian State, Federal or Territory laws, and which is not capable of exclusion.

Particleboard suitable for use as structural flooring is manufactured by members of the EWPAA and is identified by the EWPAA stamp on each sheet (as shown in the "Introduction" section).



Wood Panel Shelving is economical to construct



...and can safely store a wide range of products

## Design Methodology

### Design Criteria

Goods stored on shelves produce bending and shear stresses in wood panel shelving. Both of these stresses must be kept below safe working limits. Deflection should be controlled as well; not for reasons of failure or fracture of the shelving (failure is prevented by limiting bending and shear stresses) but for aesthetics and perhaps serviceability. For example, excessive deflection of a bookshelf may prevent removal of books from the shelf below.

Most industrial shelving designers nominate Span/180 as the desired maximum initial deflection. However, surveys of industrial applications indicate that deflections vary widely, for several reasons:

- Actual loads less than design loads
- Uncertainty about material properties
- Long term creep
- Deflections not noticeable in some industrial applications

Because we are uncertain of the degree of deflection control required in particular cases we have presented maximum safe loads and the resulting deflection. If these deflections are excessive in particular cases the designer should then select details that will give lower deflections by using:

- Stiffer board
- Thicker board
- Shorter spans

## Loads

Safe Load Tables for shelving are based on Uniformly Distributed Loading (UDL). True Concentrated Loads, operating at centre span, are not considered to be applicable. Loads applied to shelving via four support legs would approximate the UDL condition for design purposes; patch loads can also be considered to approximate Uniformly Distributed Loading.

## Supports

After surveying current practices, Safe Load Tables in this manual are all based on simply supported shelving. Occasionally screws or clips are used to locate shelving and prevent movement, but this does not represent fixed ends in an engineering sense. Three support cases are included:

- Single span (2 parallel supports)
- Multiple spans (3 or more parallel supports)
- Four edge support

## Design Properties

Design properties for Particleboard and MDF were determined from the minimum requirements of the current Australian Standard AS/NZS 1859 Part 1: Particleboard, Part 2: Medium Density Fibreboard and AS/NZS 1860 Part 1: Particleboard Flooring.

Design property values used to calculate Safe Load Tables were determined from an extensive research program carried out by the Timber & Wood Products Research Centre of the University of Central Queensland. Results were rechecked and updated by additional research projects carried out by the Caulfield Campus, Monash University with financial support from the EWPA and the Forest & Wood Products Research & Development Corporation. This work involved samples of a member's product which was considered to be typical of all manufacturers' products. Design properties derived from this testing have been conservatively interpreted to apply to the full range of EWPA member products.

## Long Term Effects

Load/Deflection Tables give safe loads and maximum deflections resulting from those loads. They are initial deflections and do not include any allowance for creep.

Creep in Particleboard and MDF would be expected to double initial deflections under temperate conditions of temperature and relative humidity. Temperate conditions include atmospheric conditions in southern Australia and also air conditioned interiors.

In tropical areas, with shelving exposed to the interior effects of weather cycles of temperature and relative humidity, the creep factor is three times initial deflection. If shelving is exposed to severe tropical weather conditions in protected exterior exposure, a creep factor of four should be used. Please note that in tropical areas, only Moisture Resistant (MR) Particleboard and MDF and Particleboard Flooring should be used as per the Product Specifications section ([click here](#)).

## Safe Load Tables

**Table 1 - Safe UDL for Shelving Supported on Two Parallel Supports**

The following table gives the safe Uniformly Distributed Loads (P) – (kPa) for shelving supported on two parallel supports and resulting deflection (Δ) – (mm)

Board Type	Thick (mm)	Span (mm)											
		450		600		750		900		1000		1200	
		P	Δ	P	Δ	P	Δ	P	Δ	P	Δ	P	Δ
Standard PB	12	2.4	3.8	1.4	6.6	0.9	10.3	0.6	14.8	0.5	17.3	0.4	26.3
	16	3.9	2.8	2.4	5.0	1.5	7.7	1.1	11.1	0.9	13.7	0.6	19.7
	18	5.4	2.4	3.1	4.4	2.0	6.9	1.4	9.9	1.1	12.2	0.7	17.6
MR PB	12	2.6	4.0	1.5	7.2	1.0	11.2	0.6	16.2	0.6	19.9	0.4	20.6
	16	4.6	3.0	2.6	5.5	1.7	8.4	1.1	12.0	1.0	14.9	0.6	21.5
	18	5.9	2.7	3.3	4.7	2.1	7.5	1.5	10.7	1.2	13.2	0.8	19.1
	25	9.4	1.6	5.3	3.9	3.4	4.5	2.3	6.4	1.9	7.9	1.3	11.4
	33	14.2	1.2	8.0	2.2	5.1	3.5	3.5	5.0	2.9	6.3	2.0	9.1
PB Flooring	19	8.1	2.5	4.6	4.5	2.9	7.0	2.0	10.0	1.6	12.4	1.1	17.9
	22	10.3	2.2	6.1	3.9	3.9	6.0	2.7	8.7	2.2	10.7	1.5	15.4
	25	14.0	1.9	7.9	3.4	5.0	5.3	3.5	7.6	2.8	9.4	2.0	13.5
MDF STD & MR	12	6.9	10.5	3.8	18.9	2.5	29.5	1.8	42.6	1.4	52.4	0.9	75.4
	16	12.3	8.0	6.9	14.2	4.5	22.1	3.1	31.9	2.5	39.4	1.8	56.9
	18	<b>13.3</b>	<b>5.2</b>	8.7	12.6	5.6	19.6	3.8	28.3	3.1	35.0	2.2	50.5
	25	<b>18.5</b>	<b>3.0</b>	<b>13.9</b>	<b>7.2</b>	9.2	12.2	6.4	17.5	5.2	21.6	3.6	30.8
	32	<b>23.7</b>	<b>1.7</b>	<b>17.8</b>	<b>4.0</b>	<b>14.2</b>	<b>7.8</b>	10.5	12.5	8.5	15.3	5.9	22.1

Loads in the above table that are highlighted **bold and blue** are limited by shear



**Table 2 - Safe UDL for Shelving Supported on Three or more Parallel Supports**

The following table gives the safe Uniformly Distributed Loads (P) – (kPa) for shelving supported on three or more parallel supports and resulting deflection ( Δ ) – (mm)

Board Type	Thick (mm)	Span (mm)											
		450		600		750		900		1000		1200	
		P	Δ	P	Δ	P	Δ	P	Δ	P	Δ	P	Δ
Standard PB	12	2.4	1.6	1.4	2.8	0.9	4.4	0.6	6.3	0.5	7.8	0.4	11.2
	16	3.9	1.2	2.4	2.2	1.5	3.3	1.1	4.8	0.9	5.8	0.6	8.5
	18	5.4	1.1	3.1	1.9	2.0	2.9	1.4	4.2	1.1	5.3	0.7	7.5
MR PB	12	2.6	1.7	1.5	3.0	1.0	4.7	0.6	6.9	0.6	8.5	0.4	12.2
	16	4.6	1.3	2.6	2.3	1.7	3.6	1.1	5.2	1.0	6.4	0.6	9.2
	18	5.9	1.1	3.3	2.0	2.1	3.2	1.5	4.5	1.2	5.7	0.8	8.2
	25	9.4	0.7	5.3	1.2	3.4	2.0	2.3	2.8	1.9	3.4	1.3	4.9
	33	14.2	0.5	8.0	1.0	5.1	1.5	3.5	2.2	2.9	2.7	2.0	3.9
PB Flooring	19	8.1	1.1	4.6	1.9	2.9	3.0	2.0	4.3	1.6	5.3	1.1	7.6
	22	10.3	0.9	6.1	1.6	3.9	2.6	2.7	3.7	2.2	4.6	1.5	6.6
	25	14.0	0.8	7.9	1.4	5.0	2.3	3.5	3.3	2.8	4.0	2.0	5.8
MDF STD & MR	12	6.9	4.4	3.8	7.9	2.5	12.3	1.8	17.7	1.4	21.8	0.9	31.3
	16	<b>9.5</b>	<b>2.6</b>	6.9	5.9	4.5	9.2	3.1	13.3	2.5	16.3	1.8	23.6
	18	<b>10.6</b>	<b>1.7</b>	<b>8.0</b>	<b>4.1</b>	5.6	8.1	3.8	11.7	3.1	14.5	2.2	20.9
	25	<b>14.8</b>	<b>1.0</b>	<b>11.1</b>	<b>2.4</b>	<b>8.9</b>	<b>4.7</b>	6.4	7.2	5.2	9.1	3.6	12.8
	32	<b>19.0</b>	<b>0.6</b>	<b>14.2</b>	<b>1.3</b>	<b>11.4</b>	<b>2.6</b>	<b>9.5</b>	<b>4.5</b>	<b>8.5</b>	<b>6.2</b>	5.9	9.2

Loads in the above table that are highlighted **bold and blue** are limited by shear

**Table 3(a) - Safe UDL for Standard Particleboard Shelving Supported on all Four Edges**

The following table gives the safe Uniformly Distributed Loads (P) – (kPa) for shelving supported on all four edges and resulting deflection ( Δ ) – (mm), a = The nominated shelf width.

Length		a		1.25a		1.5a		1.75a		2a	
Thick	Width mm - a	P	Δ	P	Δ	P	Δ	P	Δ	P	Δ
12mm	450	6.2	2.7	4.5	3.0	3.6	3.1	3.2	3.2	3.0	3.3
	600	3.5	4.8	2.5	5.3	2.0	5.5	1.8	5.5	1.6	5.8
	750	2.3	7.5	1.6	8.2	1.3	8.5	1.2	8.6	1.1	9.1
	900	1.3	10.8	1.6	11.8	0.9	12.1	0.8	12.4	0.7	13.2
	1000	1.3	13.3	0.9	14.6	0.7	14.9	0.6	15.3	0.6	16.2
	1200	0.9	19.2	0.6	21.1	0.5	21.6	0.5	2.1	0.5	23.4
16mm	450	7.7	2.1	7.3	2.3	5.8	2.4	5.1	2.4	4.8	2.4
	600	6.2	3.6	4.5	3.9	3.6	4.0	3.2	4.1	3.0	4.4
	750	4.0	5.6	2.9	6.2	2.3	6.4	2.1	6.5	1.9	6.9
	900	2.8	9.2	2.0	8.8	1.6	9.1	1.4	9.3	1.4	9.9
	1000	2.3	10.0	1.6	11.0	1.3	11.4	1.2	11.6	1.1	12.2
	1200	1.5	14.4	1.2	15.8	0.9	16.3	0.8	16.5	0.7	17.6

Length		a		1.25a		1.5a		1.75a		2a	
Thick	Width mm - a	P	Δ	P	Δ	P	Δ	P	Δ	P	Δ
18mm	450	14.0	1.8	10.2	2.0	8.1	2.1	7.1	2.1	6.8	2.2
	600	7.8	3.2	5.8	3.5	4.9	3.6	4.1	3.7	3.8	3.9
	750	5.0	5.0	3.7	5.5	2.9	5.6	2.6	5.7	2.4	6.1
	900	3.5	7.2	2.5	7.9	2.0	8.1	1.8	8.3	1.7	8.8
	1000	2.8	8.9	2.1	9.8	1.6	10.1	1.4	10.2	1.4	10.9
	1200	2.0	12.8	1.4	14.1	1.2	14.8	1.0	14.8	0.9	15.7

**Table 3(b) - Safe UDL for MR Particleboard Shelving Supported on all Four Edges**

The following table gives the safe Uniformly Distributed Loads (P) – (kPa) for shelving supported on all four edges and resulting deflection (Δ) – (mm), a = The nominated shelf width.

Length		a		1.25a		1.5a		1.75a		2a	
Thick	Width mm - a	P	Δ	P	Δ	P	Δ	P	Δ	P	Δ
12mm	450	6.8	2.9	4.9	3.2	3.9	3.3	3.5	3.3	3.2	3.5
	600	3.8	5.3	2.8	5.8	2.2	6.0	1.9	6.1	1.9	6.4
	750	2.4	8.2	1.8	9.0	1.4	9.2	1.2	9.4	1.2	9.9
	900	1.7	11.8	1.2	12.9	1.1	13.3	0.9	13.5	0.8	14.3
	1000	1.4	14.3	1.0	17.0	0.7	16.8	0.7	16.7	0.6	17.7
	1200	1.0	20.9	0.7	22.9	0.5	23.7	0.5	24.0	0.5	25.5
16mm	450	12.1	2.2	8.8	2.4	7.0	2.5	6.2	2.5	5.8	2.7
	600	6.8	3.9	4.9	4.3	3.9	4.4	3.5	4.5	3.2	4.8
	750	4.4	6.2	3.2	6.8	2.5	7.0	2.2	7.1	2.1	7.5
	900	3.1	8.8	2.2	9.6	1.7	9.9	1.5	10.1	1.5	10.7
	1000	2.4	10.9	1.8	11.9	1.4	12.3	1.2	12.5	1.1	13.3
	1200	1.7	15.8	1.2	17.2	1.0	17.7	0.9	18.1	0.8	19.2
18mm	450	15.3	1.9	11.2	2.1	8.8	2.2	7.8	2.2	7.4	2.3
	600	8.7	3.4	6.3	3.8	4.9	3.9	4.4	4.0	4.1	4.2
	750	5.5	5.4	4.1	6.0	3.2	6.2	2.8	6.2	2.7	6.6
	900	3.8	7.8	2.8	8.6	2.2	8.9	1.9	9.0	1.9	9.5
	1000	3.1	9.9	2.3	10.6	1.8	10.9	1.6	11.1	1.5	11.7
	1200	2.2	13.9	1.5	15.3	1.2	15.7	1.1	16.0	1.0	16.9
25mm	450	24.1	1.2	17.8	1.3	14.1	1.3	12.5	1.3	11.7	1.5
	600	13.7	2.1	10.1	2.3	7.9	2.4	6.8	2.4	6.6	2.5
	750	8.8	3.3	6.4	3.5	5.1	3.6	4.5	3.7	4.2	4.0
	900	6.1	4.7	4.5	5.2	3.6	5.3	3.1	5.4	2.9	5.7
	1000	5.1	5.8	3.6	6.3	2.8	6.5	2.5	6.7	2.3	7.0
	1200	3.4	8.3	2.5	9.1	2.0	9.9	1.7	9.6	1.7	10.1
33mm	450	36.8	0.9	26.9	1.0	21.8	1.1	18.8	1.1	17.7	1.2
	600	20.8	1.7	15.2	1.8	12.3	1.9	10.6	1.9	9.9	1.9
	750	13.2	2.6	9.7	2.9	7.8	3.0	6.8	3.0	6.3	3.1
	900	9.2	3.7	6.7	4.1	5.4	4.2	4.7	4.2	4.4	4.5
	1000	7.6	4.6	5.5	5.0	4.5	5.2	3.9	5.3	3.6	5.5
	1200	5.2	6.6	3.8	7.2	3.0	7.5	2.6	7.6	2.5	8.0



### Table 3(c) - Safe UDL for Shelving constructed from Particleboard Flooring Supported on all Four Edges

The following table gives the safe Uniformly Distributed Loads (P) – (kPa) for shelving supported on all four edges and resulting deflection ( $\Delta$ ) – (mm), a = The nominated shelf width.

Length		a		1.25a		1.5a		1.75a		2a	
Thick	Width mm - a	P	$\Delta$	P	$\Delta$	P	$\Delta$	P	$\Delta$	P	$\Delta$
19mm	450	21.0	1.8	15.4	2.0	12.1	2.1	10.7	2.1	10.1	2.2
	600	11.8	3.2	8.6	3.6	6.8	3.7	6.1	3.8	5.7	4.0
	750	7.6	5.1	5.5	5.6	4.4	5.8	3.9	5.9	3.6	6.2
	900	5.3	7.3	3.8	8.0	3.0	8.2	2.7	8.4	2.5	8.9
	1000	4.3	9.1	3.1	9.9	2.5	10.0	2.2	10.4	2.1	11.0
	1200	3.0	13.0	2.2	14.3	1.7	14.6	1.5	15.0	1.4	15.8
22mm	450	28.2	1.6	20.6	1.7	16.2	1.8	14.4	1.8	13.5	1.9
	600	15.8	2.8	11.6	3.1	9.1	3.2	8.1	3.2	7.6	3.4
	750	10.1	4.4	7.4	4.8	5.9	4.9	5.2	5.0	4.9	5.3
	900	7.0	6.3	5.1	6.9	4.1	7.1	3.6	7.3	3.4	7.7
	1000	5.7	7.8	4.2	8.6	3.3	8.8	2.9	9.0	2.7	9.5
	1200	4.0	11.2	2.9	12.3	2.3	12.6	2.0	12.9	1.9	13.7
25mm	450	36.0	1.4	26.6	1.5	21.0	1.6	18.6	1.6	17.5	1.7
	600	20.5	2.5	15.0	2.7	11.8	2.8	10.2	2.8	9.8	3.0
	750	13.1	3.9	9.6	4.2	7.6	4.3	6.7	4.4	6.3	4.7
	900	9.1	5.6	6.7	6.1	5.3	6.3	4.7	6.4	4.4	6.8
	1000	7.4	6.9	5.4	7.5	4.2	7.7	3.8	7.9	3.5	8.3
	1200	5.1	9.9	3.7	10.8	3.0	11.2	2.6	11.4	2.5	12.0

**Table 3(d) - Safe UDL for Standard and MR MDF Shelving Supported on all Four Edges**

The following table gives the safe Uniformly Distributed Loads (P) – (kPa) for shelving supported on all four edges and resulting deflection ( $\Delta$ ) – (mm). a = The nominated shelf width.

Length		a		1.25a		1.5a		1.75a		2a	
Thick	Width mm - a	P	$\Delta$	P	$\Delta$	P	$\Delta$	P	$\Delta$	P	$\Delta$
12mm	450	17.9	7.6	13.0	8.3	10.6	8.7	9.2	9.0	8.4	9.2
	600	10.1	13.8	7.3	15.5	5.9	15.6	5.2	16.0	4.8	16.6
	750	6.4	21.4	4.7	23.4	3.8	24.2	3.3	24.9	3.0	25.4
	900	4.5	30.9	3.2	33.9	2.7	35.1	2.3	35.7	2.1	36.5
	1000	3.6	38.6	2.6	41.0	2.2	43.6	1.9	44.3	1.7	44.8
	1200	2.5	54.5	1.9	60.5	1.5	61.2	1.2	62.4	1.1	63.3
16mm	450	<b>23.7</b>	<b>3.7</b>	<b>19.8</b>	<b>4.6</b>	17.7	5.5	16.5	6.8	15.1	6.9
	600	18.5	10.3	13.0	11.1	10.6	11.7	9.3	11.9	8.5	12.3
	750	11.5	16.2	8.3	17.4	6.5	18.3	5.9	18.6	5.4	19.2
	900	8.0	23.4	5.8	25.4	4.7	26.3	4.1	26.6	3.7	27.6
	1000	6.4	28.7	4.7	31.3	3.8	32.9	3.3	33.4	3.0	33.9
	1200	4.5	41.3	3.2	44.5	2.6	46.8	2.3	47.9	2.1	48.6
18mm	450	<b>26.7</b>	<b>2.9</b>	<b>22.2</b>	<b>3.6</b>	<b>20.0</b>	<b>4.2</b>	<b>18.6</b>	<b>4.6</b>	<b>17.8</b>	<b>4.9</b>
	600	<b>20.0</b>	<b>6.9</b>	16.5	10.0	13.4	10.4	11.6	10.5	10.7	11.0
	750	14.6	14.3	10.5	15.5	8.6	16.1	7.4	16.5	6.9	17.2
	900	8.9	18.3	7.3	22.3	5.9	23.4	5.2	24.0	4.8	24.8
	1000	8.0	25.8	5.9	27.7	4.9	29.0	4.2	29.4	3.8	30.4
	1200	5.7	37.0	4.2	40.4	3.3	41.6	2.9	42.5	2.7	44.4
25mm	450	<b>37.0</b>	<b>1.7</b>	<b>30.9</b>	<b>2.1</b>	<b>27.8</b>	<b>2.4</b>	<b>25.9</b>	<b>2.6</b>	<b>24.7</b>	<b>2.8</b>
	600	<b>27.8</b>	<b>4.0</b>	<b>23.2</b>	<b>5.0</b>	<b>20.9</b>	<b>5.8</b>	<b>19.4</b>	<b>6.3</b>	18.5	6.8
	750	<b>22.2</b>	<b>5.8</b>	17.4	9.7	14.3	9.9	12.43	10.2	11.4	10.7
	900	16.6	12.9	12.1	14.0	9.9	14.8	8.6	15.0	7.9	15.6
	1000	13.7	15.8	9.9	17.5	8.0	17.8	7.0	18.2	6.4	18.8
	1200	9.3	22.5	6.7	24.4	5.5	25.8	4.9	26.4	4.4	26.7
32mm	450	<b>47.4</b>	<b>1.0</b>	<b>39.5</b>	<b>1.2</b>	<b>35.6</b>	<b>1.4</b>	<b>33.2</b>	<b>1.5</b>	<b>31.6</b>	<b>1.6</b>
	600	<b>35.5</b>	<b>2.2</b>	<b>29.6</b>	<b>2.8</b>	<b>26.7</b>	<b>3.2</b>	<b>24.8</b>	<b>3.5</b>	<b>23.7</b>	<b>3.8</b>
	750	<b>28.4</b>	<b>4.4</b>	23.7	7.4	19.1	7.6	16.5	7.6	15.3	8.0
	900	22.4	9.6	19.6	9.8	16.1	10.3	14.3	10.5	12.9	10.8
	1000	22.0	11.1	16.0	12.2	13.1	12.7	11.3	13.0	10.4	13.4
	1200	15.3	16.1	11.2	17.6	9.1	18.3	7.8	18.6	7.2	19.3

Loads in the above table that are highlighted **bold and blue** are limited by shear

## Notes relating to Safe Load Tables

1. Note that Tables give the permissible loads and the resulting deflection. Inclusion of deflection figures does not imply that they will be acceptable in particular cases. In particular, MDF has higher allowable bending strength than Particleboard, which results in higher safe loads. MDF stiffness is similar to Particleboard so the higher loads result in excessive deflection in many cases. Publishing these excessive deflections does not imply endorsement, but rather they allow the designer to determine lower loads that will result in acceptable deflection - see Example 2.
2. Linear interpolation is permitted within Tables.
3. In Tables 3(a) – 3(d) safe loads and corresponding deflections are given for the nominated shelf widths and various lengths given as multiples of the width. The values a, 1.25a, 1.5a, 1.75a and 2a become 600, 750, 900, 1050, and 1200mm for the 600mm wide case.
4. For shelf lengths longer than twice the width, loads and deflections remain practically the same. That is, for lengths beyond 2a, use the 2a figures.
5. Safe loads and resulting deflections are controlled by bending in most cases; loads and deflections are controlled by shear in the cases indicated in Tables 1, 2 and 3(d).

## Conversion Factors

1 Pa	1 N/m <sup>2</sup>
1 kPa	1000 N/m <sup>2</sup>
1 kg Force	9.8 N
1 kg/ m <sup>2</sup>	9.8 Pa
1 psi	6.89 kPa
1 psf	47.88 Pa



Particleboard and MDF have the strength and stiffness for industrial shelving

# Product Specifications

Particleboard and MDF suitable for use as shelving include Standard and MR types, as well as Particleboard Flooring, manufactured to meet the minimum requirements of Australian Standards. Specific applications include:

## **Standard Particleboard and MDF**

Suitable for industrial shelving and for shelving requiring surface decorative treatment (wood veneer or low pressure melamine overlays). These products should not be used in tropical areas.

## **MR Particleboard and MDF**

Suitable for industrial shelving or for shelving requiring surface decorative treatment. MR products are intended for use in tropical areas or where there is a risk of high humidity conditions.

## **Particleboard Flooring**

Suitable for loads encountered in domestic and some industrial flooring. It is thus very suitable for industrial shelving. Particleboard Flooring is not suitable for surface overlays such as wood veneers or low pressure melamine.

# Design Procedure

Shelving design involves the following steps:

1. Determine the design load for the shelving.
2. Determine or identify the support arrangements (two supports or continuous over three or more supports or four edge supports) and select the appropriate Safe Load Table.
3. For the design load, determine a range of options for board type, board thickness, shelf span and initial deflections.
4. Decide any long-term shelf deflection limitations, select an appropriate creep factor (Long Term Effects Section – [click here](#)) and calculate short term maximum deflection.
5. Review shelving options to meet deflection limits, discard those with excessive values and select other options if necessary. Note that linear interpolation is permitted between spans in the Tables and that the load/deflection relationship is linear between spans for the same board type and thickness.
6. Select one of the options based on environment, economy and any physical constraints.

# Design Examples

## Example 1

**Design industrial shelving to support 3kPa load for 900mm x 1800mm shelves supported on four edges.**

Check Tables 3 (a), 3(b), 3(c) and 3(d) for solutions.

### MR Particleboard

- 33mm will carry 4.4kPa with 4.5mm deflection

### Particleboard Flooring

- 22mm will carry 3.4kPa with 7.7mm deflection
- 25mm will carry 4.4kPa with 6.8mm deflection

### Standard and MR MDF

- 18mm will carry 4.8kPa with 24.8mm deflection
- 25mm will carry 7.9kPa with 15.6mm deflection
- 32mm will carry 12.9kPa with 10.8mm deflection

If there is no deflection limit then all the above panels will carry the load; unless the job is in a tropical area, then MR or Flooring products are required. However deflection limits normally apply – see Example 2.

## Example 2

**What is the solution in Example 1 for a long-term deflection limit of Span/180?**

Span/180 is 10mm final deflection in this case. If the creep factor is 2, initial deflection limit is 5mm. Check the deflection for the above solutions, if the maximum load is 3kPa.

<b>33mm MR PBD</b>	3kPa would give 3.1mm deflection
<b>22mm Flooring</b>	3kPa would give 6.8mm deflection
<b>25mm Flooring</b>	3kPa would give 4.6mm deflection
<b>25mm MDF</b>	3kPa would give 5.9mm deflection
<b>32mm MDF</b>	3kPa would give 2.5mm deflection

Solutions are 25mm Particleboard Flooring, 33m MR Particleboard or 32mm MDF (STD or MR).

## Example 3

**What is the solution for Example 2 for tropical areas?**

Only MR or Flooring Panels should be used. Creep factor is 3, so initial deflection limit is 3.3mm. Solutions to achieve this deflection limit are 33mm MR Particleboard and 32mm MR MDF.

## Example 4

**Design industrial shelving to carry goods with a mass of 750kg on shelving 800mm x 2700mm. Shelving is supported on four edges.**

Determine Uniformly Distributed Load in kPa

$$750\text{kg} = 7350\text{N}$$

$$\text{Shelf Area} = 2.16 \text{ m}^2$$

$$\text{Load} = 3.4 \text{ kPa}$$

Now proceed as in Examples 1, 2 or 3.

Remember to interpolate between 750mm and 900mm for the 800mm shelf width.

## Special Cases

### Book Shelves

Bookshelves can be designed from the Safe Load Tables (Tables 1, 2 and 3) with the help of the following load figures:

Loading from books depends on their size and the shelf width. Typical book loadings are:

- 2.0 kPa for large, A4 sized books
- 1.7 kPa for text books, 170-200mm wide
- 1.4 kPa for paperbacks, 140mm wide

These loads assume that book width and shelf width are the same. If the shelf width is greater than book width then the loads above can be reduced by the book to shelf width ratio.

### Domestic Shelving

Typical loads on household shelving are:

<b>Kitchen Cupboards</b>	1.2kPa (122kg load per m <sup>2</sup> )
<b>Wardrobes</b>	0.75kPa (77kg load per m <sup>2</sup> )
<b>Linen Cupboards</b>	1.2kPa (122kg load per m <sup>2</sup> )
<b>Laundry Shelves</b>	2.0kPa (204kg load per m <sup>2</sup> )
<b>Storage or Garage Shelves</b>	2.5kPa (255kg load per m <sup>2</sup> )

Select panel thickness and span for different support arrangements from Tables 1, 2 and 3.



## Special Case Design Examples

Select the appropriate shelving panels for text books (170mm wide). Shelf width is 250mm, with a single span of 900mm. Deflection should be limited to Span/180 (ie. 5mm) to accommodate long term effects.

Text book load is 1.7 kPa. Reduce this by the width ratio 170/250 ie. Load is 1.2kPa. From Table 1 the possibilities are:

<b>18mm STD Particleboard</b>	Safe load is 1.4kPa giving	9.9mm deflection
<b>18mm MR Particleboard</b>	Safe load is 1.5kPa giving	10.7mm deflection
<b>25mm MR Particleboard</b>	Safe load is 2.3kPa giving	6.4mm deflection
<b>16mm MDF (STD and MR)</b>	Safe load is 3.1kPa giving	31.9mm deflection
<b>18mm MDF (STD and MR)</b>	Safe load is 3.8kPa giving	28.3mm deflection
<b>25mm MDF (STD and MR)</b>	Safe load is 6.4kPa giving	17.5mm deflection

Calculate deflection under the actual load of 1.2kPa (ie multiply deflection by the ratio of design load to the safe load) and select the solution complying with the required maximum deflection of 5mm.

25mm MR Particleboard or 25mm MDF (STD or MR) will satisfy this requirement. Other board thicknesses will support the books safely but will produce noticeable (and in some cases, excessive) deflection.

## Health & Safety Information

Refer to the Material Safety Data Sheet (MSDS) from the manufacturer. These are generally available from the manufacturers web sites. Refer to the back page for a list of these web sites.

## Revision History

Revision	Changes	Date	Who
3	Revised with new certification marks.	06-02-2012	MB
2	Changed to stand alone document format as a part of the EWPA / AWPA merger.	17-05-2010	MB
1	Initial Release – Content released on the Woodpanels web site.		

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