Shelf *spans* and deflection

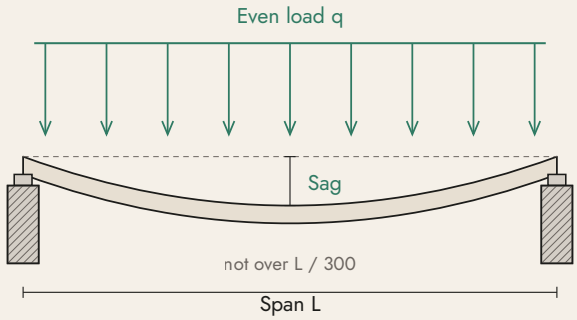
Starting spans for ten shelf constructions, the formula, lipped edges and 32 mm drilling. For a partner workshop to confirm.

Compliance guidance. The spans on this page are arithmetic from published material data under the assumptions stated, for a partner workshop to confirm. They are not engineered capacities and not a guarantee. Heavy loads, point loads, shelves in public areas, glass or stone shelves, wall-hung shelves and anything where a failure could injure someone need a structural engineer or a tested design. Guidance only, not engineering advice.

AT A GLANCE

Shelf (source of E)	E (N/mm²)	Span at 1.0 kN/m²	at 1.92	at 2.39
MDF.H 18 mm (a)	2,400	560	450	420
Chipboard P2 18 mm (b)	1,600	490	400	370
Chipboard P2 25 mm (b)	1,500	660	540	500
Birch ply 18 mm, face grain along span (c)	10,048	900	740	690
Birch ply 18 mm, face grain across span (c)	7,452	810	670	620
Birch ply 21 mm, face grain along span (c)	9,858	1,040	850	790
Solid white oak 20 mm (d)	12,300	1,060	870	810
Solid white oak 25 mm (d)	12,300	1,320	1,090	1,010
Solid white oak 30 mm (d)	12,300	1,560	1,300	1,210
Solid white ash 25 mm (d)	12,000	1,310	1,080	1,010

Longest span in millimetres, rounded down to 10: sag held to span/300 over the long term (initial sag to two thirds of that), bending only, a pin at each end, even load plus the shelf's own weight. Sources of E: (a) MDF.H data sheets, (b) P2 chipboard data sheets, (c) birch plywood data sheet, (d) US white oak and ash, Wood Handbook. 1.92 and 2.39 kN/m² are the US standard's 40 and 50 lb per sq ft; 1.0 is ours. A starting point for a partner to confirm.



Sag grows with the fourth power of the span and falls with the cube of the thickness.

A shelf as a beam: even load, a pin at each end, sag exaggerated. Original drawing by Make Bespoke Studio, not to scale.

THE ARITHMETIC

$\delta = 5\ w\ L^4 / (384\ E\ I)$; for an even load of q per square metre $\delta = 0.15625\ q\ L^4 / (E\ t^3)$. Example: 18 mm MDF.H, E = 2,400, L = 600 mm, load 1.92 plus own weight = 2.048 kN/m²: δ = 2.96 mm, span/203. Long-term sag taken as 1.5 times the first. Thickness 18 to 25 mm: stiffness x 2.7. 20 x 18 oak lip front and back on 18 mm MDF.H: stiffness x 1.55; 20 x 40: x 10.8.

32 MM SYSTEM (CONVENTION)

5 mm holes, 32 mm pitch, front row 37 mm from the front edge, rear row 37 mm from the rear edge, 12 to 14 mm deep. With rows n x 32 apart the side panel is 74 + 32n deep: 298 (n = 7), 330 (8), 362 (9). Ask the workshop which pins and how many; none of their capacities was read.

SPECIFICATION WORDING

SHELF CONSTRUCTION

Shelves [25] mm [solid oak / MDF.H with veneer], [20 x 40] mm solid lip bonded the full length of the front and back edges, maximum span between supports [800] mm. Design load [1.9] kN/m2 uniformly distributed, no point loads. Sag not to exceed span/[300] over the long term. The maker is to confirm by calculation from the stiffness of the board supplied, or by test, before production.

STIFFNESS DATA

Board: [MDF.H to BS EN 622-5], [18] mm, grain [along] the span. The maker is to state the modulus of elasticity in bending (BS EN 310) from the supplier's current data sheet and the calculation used.

ADJUSTABLE SHELVES

Adjustable shelves on [5] mm holes at [32] mm pitch in two rows, [37] mm from the front and rear edges, line-bored. [Four] [steel locking] pins per shelf, shelf [2] mm short of the internal width. Hole positions to drawing [number]. Shelf load and pin capacity to be confirmed by the supplier of the pins.

HEAVY OR SPECIAL LOADS

Shelves carrying more than [2.4] kN/m2, point loads or [glass / stone] are to be designed by [engineer / specialist] and tested before installation. Wall-hung shelves to have fixings designed for the wall construction.

TERMS USED

32 mm system

A cabinet-making convention of drilling rows of small holes at 32 mm spacing so shelves, hinges and runners can be fixed at standard positions.

Lipping

A thin strip of solid timber glued to the edge of a board to protect it, hide the core or give a solid look.

Deflection

How far a shelf or beam bends under load, measured as the distance its middle falls from a straight line between its supports. Often limited to a fraction of the span, such as span/300.

Modulus of elasticity (E)

A measure of a material's stiffness: the bigger the number, the less it bends under the same load. In bending it is measured on boards by the EN 310 test.

Creep

Extra sag that develops slowly under a steady load, as with books left on a shelf for years. The Wood Handbook says it can roughly equal the first deflection after several years.

STANDARDS AND SOURCES

- USDA Forest Products Laboratory, Wood Handbook FPL-GTR-282 (2021): Chapter 9, Table 9-1, p. 9-4; Chapter 5 Tables 5-3a, 5-6; Chapter 12 Table 12-1.
- Architectural Woodwork Standards, 1st edition (2009), Section 10 Casework: 1.2.21 shelf loading and deflection. US practice.
- Manufacturers' data sheets (two MDF.H, two P2 chipboard, one birch plywood), read 5 Nov 2026
- 32 mm cabinetmaking system (encyclopaedia article): a convention; catalogues not read.
- BS EN 16121, 16122, 14749, 310, 622-5: named only; not read.

Full guide: https://makebespoke.com/trade/technical/shelving-span-and-deflection. Make Bespoke Studio coordinates manufacture through its partner workshops. Figures are guidance only and your specification governs; some may be superseded, so contact the studio to verify.