

Increasing Stiffness of a Bookshelf

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Smaller internal forces in the bookshelf and a stiffer structure

- providing additional supports to the structure
- reducing spans of the structure or
- making a self-balanced system of forces in the structure before the forces are transmitted to the supports of the structure. (the separator tie is acting in tension thus balancing forces) [1]

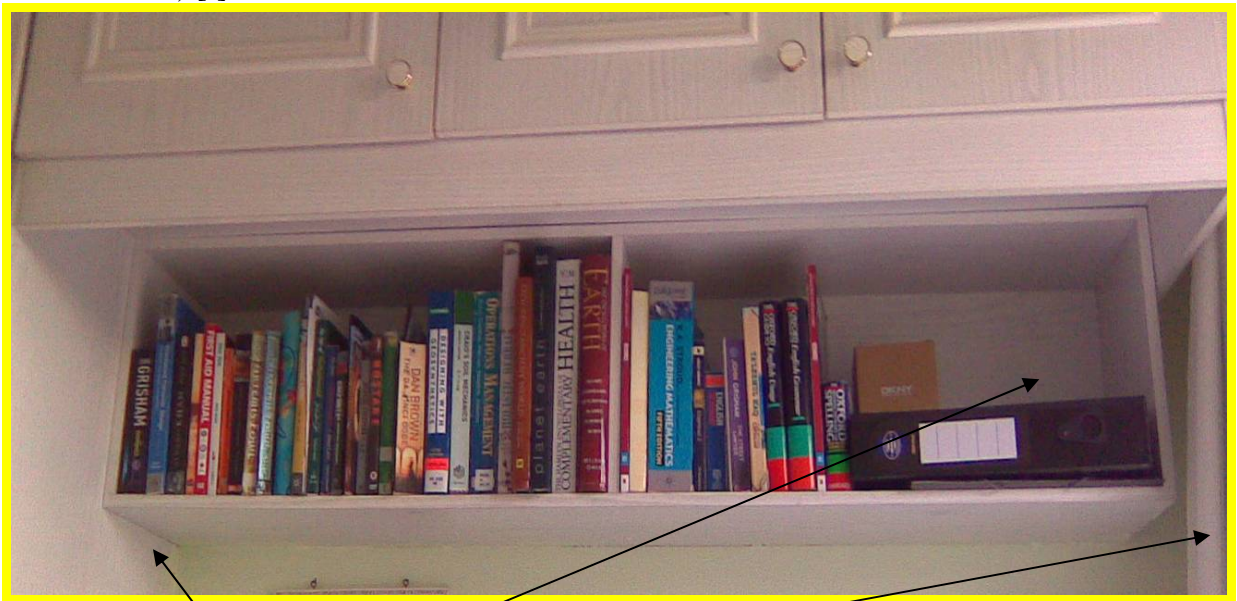


Figure 1 showing a book shelf in elevation view

The bookshelf is fixed from the back and sides but the bottom wood member takes the entire load. So the middle separator wood piece which is fixed, reduces the total deflection by halving the span and by reducing internal member forces.

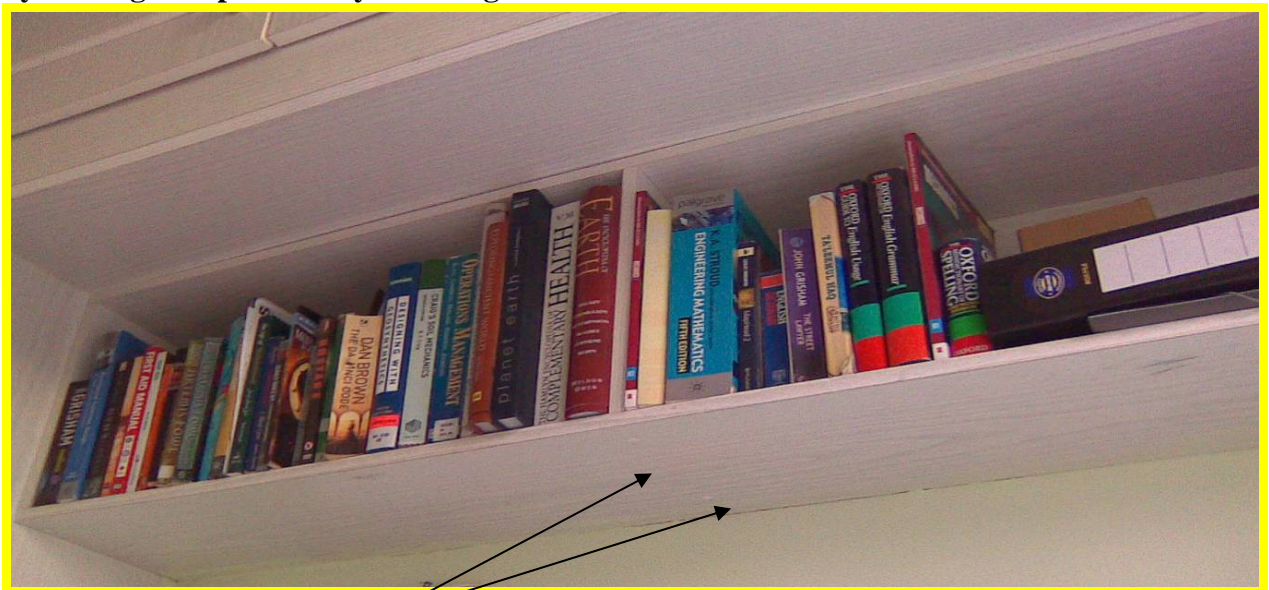


figure 2 showing screw fixes of internal member

If the vertical tie was not used:

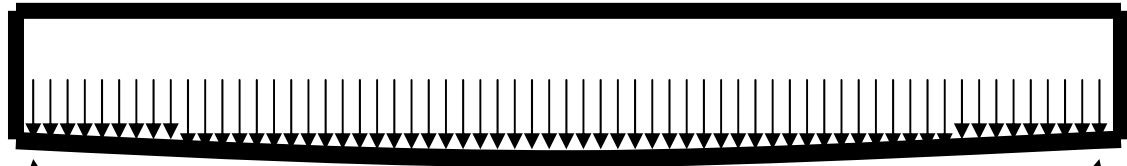


Figure 3 shows the exaggerated deflection if the separator were not present.

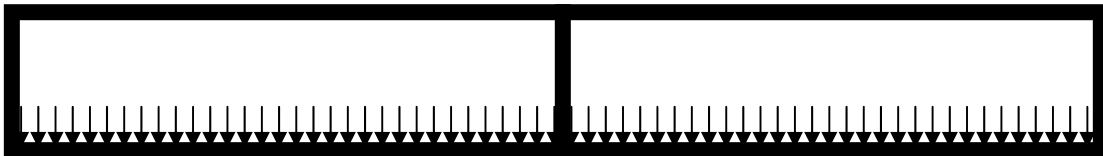
Hogging moment

Sagging moment

Hogging moment

- Load per unit length from books (w) N/m
- Length(l) metres
- So total bending moment is $wl^2/12$

When the vertical tie is used:



- Here the separator support increases stiffness by halving the span and decreasing internal member forces (also reducing deflection) [1].

So the vertical tie member in tension does not only act as a structural element but also acts as a book separator!

References [1] Ji TJ, Bell AJB, University of Manchester, *Seeing and touching structural concepts*, 19/05/2008