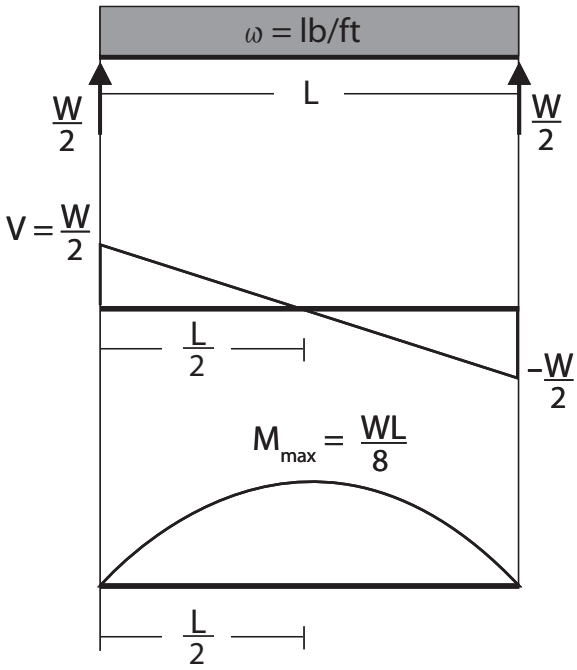
Structures II Review
Sept. 10, 2008

Distributed Load

$W = \omega \cdot L$ Note: can be 2 dimensionally analyzed.



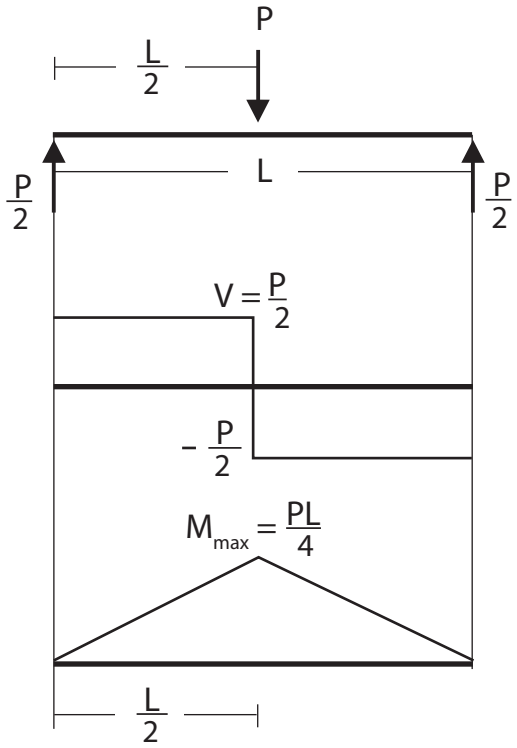
Free Body Diagram

V Shear Diagram

M Moment Diagram

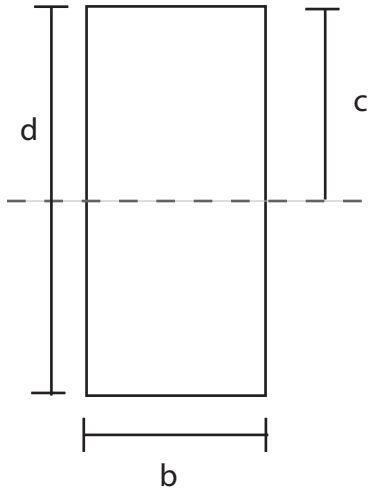
Deflection $\Delta = \frac{5WL^3}{384EI}$

Point Load



Deflection $\Delta = \frac{PL^3}{48EI}$

Moment of Inertia (rectangle): Units in^4



$$I = \frac{bd^3}{12}$$

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Timber Design - Check bending, shear, deflection and minimum bearing area

Total Load (TL) is determined by a load combination of various types of load sources.
Examples:
Dead load only
Dead load + live load
Dead load + 0.75(live load) +0.75(roof load)

For Homework #3 Problem 6.10 use:
TL = Dead load + live load

Equations and Variables	Units (English example)	Definition
ω	lb/ft^2	Load/span (distributed load)
TL	lb/ft^2	Total Load
L	ft	Length of span
o.c	ft	Off center distance
$W = (\omega)(L)(o.c)$	lb	Load
$W = (TL)(L)(o.c)$	lb	Load
$M_B = \frac{WL}{8}$	lb • ft	Bending moment
F_b	lb/in^2	Allowable stress in bending
$S = \frac{M_B}{F_b}$	in^3	Section modulus
$S = \frac{I}{c}$	in^3	Section modulus
$I = \frac{bd^3}{12}$	in^4	Moment of Inertia (rectangle)
b	in	Base length of cross section
d	in	Depth of cross section
c	in	Distance from neutral axis to extreem face
$F_b = \frac{M_B c}{I}$	lb/in^2	Allowable stress in bending
V= W/2	lb	Shear
$F_v = \frac{3V}{2A}$	lb/in^2	Shear Stress
$\triangle = \frac{PL^3}{48EI}$	in	Deflection - (Point load)
$\triangle = \frac{5WL^3}{384\ EI}$	in	Deflection - (Distributed load)
E	lb/in^2	Modulous of Elasticity
A= bd	in^2	Area

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Timber Design (Cont.)

If given stress in bending F_b, stress in shear F_v, stress in bearing F_{bg}, and the Modulus of Elasticity E.

Step 1:
Find your total load (TL). This may be given or you must choose what load factors will be best to use. For problem 6.10 in HW#3 use:
TL = dead load + live load

Step 2, Check Bending:
Use the following equations, where L=span, and o.c is your off center distance (also called center to center distance).

$$W = (TL)(L)(o.c)$$

$$M_b = \frac{WL}{8}$$

$$S = \frac{M_b}{F_b}$$

Since the S value calculated was based on the bending moment, use the table "section properties of glued laminated timber" and find an S value in each category (2-1/2, 3-1/8, 5-1/8) that is greater than the one calculated.

Step 3, Check Shear:
Use to following equations to find f_v(actual bending stress).

$$V = \frac{W}{2}$$

$$f_v = \frac{3V}{2A}$$

Compare f_v to F_v (allowable bending stress given in the problem).
Check: $\boldsymbol{f_v \leq F_v}$

Step 4, Check Deflection:
(note: max deflection equation can vary depending on if you are calculating for a foor, roof, etc.)

$$\Delta_{max} = \frac{L}{360}$$

$$\Delta_{distributed\ load} = \frac{5wL^3}{384EI}$$

Check: $\boldsymbol{\Delta_{max} \leq \Delta_{distributed\ load}}$

Step 5, Check Minimum Bearing Area:
Use the following equation where R= reaction (W/2) and F_{bg} = Stress in bearing

$$A = \frac{R}{F_{bg}}$$

Compare the Area calculated to the chosen members in step 2.