

Steel

Given: Fitch beam, 2x12 w/ 11" x 1/4" steel plate
Fitch beam = 19'4" with distributed load.

Required: Determine available distributed load

Assumptions: 2x12 wood is #2 Southern Pine $E = 1,400,000$ psi
11" x 1/4" steel plate ASTM-A36 $E = 29,000,000$ psi

Calculation for 19'-4" = 232" steel plate
Maximum allowable deflection = $232 \div 240 = 0.96$ (max 0.75 = 9)

$$y_{\max} = \frac{5wL^4}{384EI} \quad \left(@ \quad x = \frac{L}{2} \right)$$

$$x = \frac{232''}{2} = 116''$$

$$L = 232''$$

$$E = 29,000,000 \text{ psi}$$

$$I = \frac{1}{12}bh^3 = \frac{1}{12}(0.25)(11)^3 = 27.73 \text{ in}^4$$

$$w = \frac{y_{\max}(384EI)}{5L^4}$$

$$w = \frac{(0.75)(384)(29,000,000)(27.73)}{(5)(232)^4}$$

$$w = 15.99 \text{ \#/in} = 191.87 \text{ \#/ft}$$

Calculation for 19'-4" = 232" 2x12 #2 Southern Pine
Max deflection = 1.28" $E = 1,400,000$ psi

$$I = \frac{1}{12}bh^3$$

$$w = \frac{(0.75)(384)(1,400,000)(177.97)}{(5)(232)^4}$$

$$= \frac{1}{12}(1.5)(11.25)^3 = 177.97$$

$$w = 4.95 \text{ \#/in} = 59.44 \text{ \#/ft}$$

Total capacity 2x12 Fitch beam with steel plate 19'-4"

$$15.99 \text{ \#/in} + 2(4.95 \text{ \#/in}) = 25.89 \text{ \#/in}$$

$$191.87 \text{ \#/ft} + 2(59.44 \text{ \#/ft}) = 310.75 \text{ \#/ft}$$

Structural Glue laminated beam From American Institute of Timber

$$3\frac{1}{8}'' \times 12\frac{3}{8}'' \text{ capacity} = 361.7 \text{ \#/LF}$$

$$\boxed{\text{Total Capacity both Fitch \& Lamin.} = 622.45 \text{ \#/LF}}$$