

Plywood

Given: Fitch beam, 2ea 2x12 w/ 1/4" Plywood Plate

Required: Determine available distributed load.

Assumptions: 2x12 wood is #2 Southern Pine $E = 1,400,000 \text{ psi}$
1/4" Plywood with S-2 Grade Stress Level & wood species
#2, $E = 1,500,000 \text{ psi}$
Also Assume the plywood is continuous length

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

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

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

$$w = \frac{(0.75)(384)(1,500,000)(27.73)}{(5)(232)^4}$$

$$w = 0.83 \text{ \#/in} = 9.96 \text{ \#/ft}$$

$$\begin{aligned} L &= 232" \\ E &= 1,500,000 \text{ psi} \\ I &= \frac{1}{12} b h^3 \\ &= \left(\frac{1}{12} \right) (0.25) (11)^3 \\ &= 27.73 \text{ in}^4 \end{aligned}$$

Calculation for 19'-4" = 232" #2 Southern Pine
 $E = 1,400,000 \text{ psi}$
 $I = \left(\frac{1}{12} \right) b h^3$

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

$$\begin{aligned} &= \left(\frac{1}{12} \right) (1.5) (11.25)^3 \\ &= 177.97 \text{ in}^4 \end{aligned}$$

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

Total Capacity of Fitch beam with Plywood 19'-4"

$$0.83 \text{ \#/in} + (2 \times 4.95 \text{ \#/in}) = 10.73 \text{ \#/in}$$

$$9.96 \text{ \#/ft} + (2 \times 59.44 \text{ \#/ft}) = 128.84 \text{ \#/ft}$$

Structural Glue Laminated beam from American Institute of Timber

$$3 \frac{1}{8}" \times 12 \frac{3}{8}" \text{ Capacity} = 361.7 \text{ \#/ft}$$

$$\text{Total Capacity Fitch beam \& Laminated beam} = 490.5 \text{ \#/ft}$$

ALLOWABLE STRESSES FOR PLYWOOD

TABLE 3

ALLOWABLE STRESSES FOR PLYWOOD (psi) conforming to Voluntary Product Standard PS 1-95 for Construction and Industrial Plywood. Stresses are based on normal duration of load, and on common structural applications where panels are 24" or greater in width. For other use conditions, see Section 3.3 for modifications.

| Type of Stress | | Species Group of Face Ply | Grade Stress Level ⁽¹⁾ | | | | |
|--|----------|---------------------------|-----------------------------------|-----------|-----------|-----------|-----------|
| | | | S-1 | | S-2 | | S-3 |
| | | | Wet | Dry | Wet | Dry | Dry Only |
| EXTREME FIBER STRESS IN BENDING (F_b) | | 1 | 1430 | 2000 | 1190 | 1650 | 1650 |
| TENSION IN PLANE OF PLYS (F_t) | F_b & | 2, 3 | 980 | 1400 | 820 | 1200 | 1200 |
| Face Grain Parallel or Perpendicular to Span (At 45° to Face Grain Use 1/6 F_t) | F_t | 4 | 940 | 1330 | 780 | 1110 | 1110 |
| COMPRESSION IN PLANE OF PLYS | | 1 | 970 | 1640 | 900 | 1540 | 1540 |
| Parallel or Perpendicular to Face Grain (At 45° to Face Grain Use 1/3 F_c) | F_c | 2 | 730 | 1200 | 680 | 1100 | 1100 |
| | | 3 | 610 | 1060 | 580 | 990 | 990 |
| | | 4 | 610 | 1000 | 580 | 950 | 950 |
| SHEAR THROUGH THE THICKNESS ⁽³⁾ | | 1 | 155 | 190 | 155 | 190 | 160 |
| Parallel or Perpendicular to Face Grain (At 45° to Face Grain Use 2 F_v) | F_v | 2, 3 | 120 | 140 | 120 | 140 | 120 |
| | | 4 | 110 | 130 | 110 | 130 | 115 |
| ROLLING SHEAR (IN THE PLANE OF PLYS) | | | | | | | |
| Parallel or Perpendicular to Face Grain (At 45° to Face Grain Use 1-1/3 F_s) | F_s | Marine & Structural I | 63 | 75 | 63 | 75 | — |
| | | All Other ⁽²⁾ | 44 | 53 | 44 | 53 | 48 |
| MODULUS OF RIGIDITY (OR SHEAR MODULUS) | | 1 | 70,000 | 90,000 | 70,000 | 90,000 | 82,000 |
| Shear in Plane Perpendicular to Plys (through the thickness) (At 45° to Face Grain Use 4G) | G | 2 | 60,000 | 75,000 | 60,000 | 75,000 | 68,000 |
| | | 3 | 50,000 | 60,000 | 50,000 | 60,000 | 55,000 |
| | | 4 | 45,000 | 50,000 | 45,000 | 50,000 | 45,000 |
| BEARING (ON FACE) | | 1 | 210 | 340 | 210 | 340 | 340 |
| Perpendicular to Plane of Plys | F_{cL} | 2, 3 | 135 | 210 | 135 | 210 | 210 |
| | | 4 | 105 | 160 | 105 | 160 | 160 |
| MODULUS OF ELASTICITY IN BENDING IN PLANE OF PLYS | | 1 | 1,500,000 | 1,800,000 | 1,500,000 | 1,800,000 | 1,800,000 |
| Face Grain Parallel or Perpendicular to Span | E | 2 | 1,300,000 | 1,500,000 | 1,300,000 | 1,500,000 | 1,500,000 |
| | | 3 | 1,100,000 | 1,200,000 | 1,100,000 | 1,200,000 | 1,200,000 |
| | | 4 | 900,000 | 1,000,000 | 900,000 | 1,000,000 | 1,000,000 |

(1) See pages 12 and 13 for Guide.

To qualify for stress level S-1, gluelines must be exterior and only veneer grades N, A, and C (natural, not repaired) are allowed in either face or back.

For stress level S-2, gluelines must be exterior and veneer grade B, C-Plugged and D are allowed on the face or back.

Stress level S-3 includes all panels with interior or intermediate (IMG) gluelines.

(2) Reduce stresses 25% for 3-layer (4- or 5-ply) panels over 5/8" thick. Such layups are possible under PS 1-95 for APA RATED SHEATHING, APA RATED STURD-I-FLOOR, UNDERLAYMENT, C-C Plugged and C-D Plugged grades over 5/8" through 3/4" thick.

(3) Shear-through-the-thickness stresses for MARINE and SPECIAL EXTERIOR grades may be increased 33%. See Section 3.8.1 for conditions under which stresses for other grades may be increased.