APA Technical Topics
TT-001B JANUARY 2013

Allowable Bearing Stress for APA Wood Structural Panels

Bearing stress is the compression stress perpendicular ($F_{c\perp}$) to the plane of the plies or the surface of the panel. As compression load is applied to panels (such as by columns, by heavy concentrated loads, or by reactions at supports), bearing stress is induced through the bearing area.

This document provides the results of bearing tests conducted on plywood and OSB specimens of different thicknesses sampled from various mills by *APA – The Engineered Wood Association*. The characteristic bearing stress for APA wood structural panels was derived based on the lower 95 percent confidence interval on the average bearing stress at a 0.04-inch deformation limit. With a standard adjustment factor of 1.67, the allowable bearing stress of 360 psi was confirmed for structural-use panels under dry-use conditions for typical floor and roof sheathing in which the bearing stress is important for design.

Test Method and Results

Bearing tests were conducted in accordance with the principles of ASTM D143, *Standard Test Methods for Small Clear Specimens of Timber*. All tests were carried out at the APA Research Center, Tacoma, Washington. Test loads corresponding to deformations of 0.02 inch and 0.04 inch were recorded. Bearing stress values for each specimen were calculated using the following equations:

$$F_{c\perp 0.02"} = \frac{P_{0.02"}}{A} \quad (1)$$

$$F_{c\perp 0.04"} = \frac{P_{0.04"}}{A} \quad (2)$$

Where:

$P_{0.02"}$ and $P_{0.04"}$ = load at 0.02-in. and 0.04-in. deformation (lbf), respectively
$F_{c\perp 0.02"}$ and $F_{c\perp 0.04"}$ = bearing stress at 0.02-in. and 0.04-in. deformation (psi), respectively
A = bearing area of metal loading block (4 in.^{2})

The bearing test results are summarized in Table 1 and the specific gravity values of the tested specimens are summarized in Table 2.

Characteristic Value and Allowable Bearing Stress Values

While bearing stresses derived on each panel type/thickness best reflect material capacity, the derivation of specific characteristic values per panel type/thickness has the potential to cause confusion in the marketplace. Furthermore, strength properties of wood structural-use panels are dependent on wood species, veneer grades, layups, densities, and other manufacturing variables. It is impractical to try to include all variables that could affect the bearing stresses of wood structural panels in an all-inclusive test program. Therefore, to account for the uncertainty associated with

sampling variations, the characteristic values used in the derivation of allowable bearing stresses were based on the lower 95 percent confidence interval (LCI) on the sample mean, as opposed to the sample mean. The LCI was calculated as follows:

$$LCI = \overline{X} - t_{(0.05,\, n-1)} \frac{s}{\sqrt{n}} \quad (3)$$

Where:

$\overline{X}$ = sample mean

$t_{(0.05,\, n-1)}$ = t-statistic based on α=0.05

s = sample standard deviation

n = sample size

Table 1. Results of bearing stress tests on plywood and OSB

	$F_{c\perp 0.02"}$ (psi)		
	3/8 PERF CAT OSB & Plywood	**19/32 PERF CAT OSB**	**23/32 PERF CAT OSB & Plywood**
Sample Size	200	50	289
Average	467	489	364
Standard Deviation	117	135	111
COV (%)	25.1	27.6	30.6
Max.	845	1,010	779
Min.	165	278	126
Lower 95% CI	451	451	351
	$F_{c\perp 0.04"}$ (psi)		
	3/8 PERF CAT OSB & Plywood	**19/32 PERF CAT OSB**	**23/32 PERF CAT OSB & Plywood**
Sample Size	200	50	289
Average	859	913	635
Standard Deviation	206	239	190
COV (%)	24.0	26.2	30.0
Max.	1,596	1,648	779
Min.	317	498	126
Lower 95% CI	831	847	613

Table 2. Specific gravities of tested plywood and OSB specimens

	3/8 PERF CAT OSB & Plywood	**19/32 PERF CAT OSB**	**23/32 PERF CAT OSB & Plywood**
Sample Size	200	50	289
Average	0.59	0.60	0.56
Max.	0.79	0.72	0.67
Min.	0.40	0.51	0.40
25th percentile	0.55	0.56	0.53

In order to simplify the design procedure, one single allowable bearing stress of 360 psi was chosen for wood structural panels regardless of panel type, grade and thickness, for use under dry-use conditions, as shown in Table 3.

Table 3. Allowable bearing stresses (Fc⊥) for plywood and OSB

	3/8 PERF CAT OSB & Plywood (psi)	19/32 PERF CAT OSB (psi)	23/32 PERF CAT OSB & Plywood (psi)
Characteristic Value	831	847	613
Allowable $F_{c\perp}$ (LF=1.67)[a]	***497***	***507***	***367***
Recommended Allowable Bearing Stress ($F_{c\perp}$)		***360***	

(a) In ASTM D2915 and ASTM D5456, a load factor of 1.67 is recommended in deriving the allowable bearing stress from the characteristic value, which in this case is the lower 95% confidence interval on the mean bearing stress at 0.04-inch deformation.

Conversion of Allowable Bearing Stress Values to 0.02-inch Deformation Basis

Use of reduced allowable bearing stresses may be appropriate where bearing deformation could affect load distribution or where total deformation of members must be closely controlled. A conservative design value for 0.02-inch deformation can be chosen as 50 percent of the allowable bearing stress at 0.04-inch deformation. If necessary, use the following regression equation, based on test data, to derive the design value for 0.02-inch deformation:

$$F_{c\perp 0.02"} = 0.51F_{c\perp 0.04"} + 28 \quad (4)$$

Service Moisture Conditions

The allowable bearing stress of 360 psi applies to panels under moisture conditions that are dry in service; that is, where equilibrium moisture content is less than 16 percent. Test results suggest that an adjustment factor of 1/5 be applied to the allowable bearing stress to derive wet allowable bearing stress for OSB panels, and an adjustment factor of 1/2 be applied to the allowable bearing stress to derive wet allowable bearing stress for plywood panels.

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Form No. TT-001B
Revised January 2013