PARKLEX 1000 vs. PLYWOODS: A NOTE ON THE TEST RESULTS

PARKLEX 1000 is a prefinished exterior grade wood composite laminated wood panel with a bakelite core and double-face veneer siding and as such may be compared with plywoods intended for exterior use.

A series of tests on PARKLEX 1000 was conducted at AEWC (Advanced Engineered Wood Composites Center) in July 2001. The following properties were determined at AEWC, according to the testing program proposed earlier: 1) Density; 2) Moisture Content; 3) Water Absorption and Thickness Swelling; 4) Flexural Properties; and 5) Bond Durability. The tests and results are described in Research Report #AEWC 01-11 (Lech Muszynski, Rastislav Lagana and Stephen M. Shaler; Testing program for Parklex 1000. Advanced Engineered Wood Composites Center, University of Maine, Research Report #AEWC 01-11, July 2001).

The following comparison is based on general property values for sheathing-grade plywood published in FPL Wood Handbook 1999 (see appendix).

As it appears from the research summary table reproduced in the appendix, PARKLEX 1000 is much heavier than any traditional wood based panel product (see figure 1 in the appendix). It is nearly three times heavier than solid wood and typical plywoods (1.51 g/cc compared to 0.40 to 0.63 g/cc).

On the other hand, PARKLEX 1000 offers superior dimensional stability with practically negligible water absorption and thickness swelling after 24-hour immersion in water (both values fall well below 1%). Typical linear hygroscopic expansion value of 0.15% for plywoods given in Table 10-6 refers to swelling in plane direction, which was not measured at AEWC.

Flexural properties of PARKLEX 1000 with perpendicular grain orientation compare well to the average plywood (about 9 Gpa) while MOE for specimens with longitudinal grain orientation are substantially higher than the strongest plywoods (19 Gpa compared to maximum of 13.1 Gpa reported for plywoods).

The flexural strength (MOR) of PARKLEX 1000 for perpendicular oriented specimens is twice and for longitudinal oriented specimens four times that of the strongest plywoods (100 Mpa and 200 Mpa respectively when compared to maximum of about 50 Mpa reported for plywoods).

Exposure to wet condition does not significantly affect the flexural properties of PARKLEX 1000. While the MOE of soaked specimens is slightly lower than of dry specimens, the effect of soaking on bending strength seems to be reverse. The above is true for longitudinal and transverse specimens. Transverse specimens exhibit more linear behavior to failure in comparison to longitudinal specimens.

The PS-1 test for bond durability is designed so that the notched specimens exposed to conditions inducing accelerated aging of bond-lines are then subjected to shear test by tensile loading. After the test, the substrate vs. adhesive failure percentage is being evaluated. A high percent of substrate failure indicates quality bonding. Conversely, high percentage of adhesive failure is characteristic of poor bonding. Furthermore, decreases in percentage of the substrate failure after exposure to accelerated aging is used to assess durability of the bonding.

Unlike plywoods, PARKLEX 1000 is a composite made of two siding veneers bonded to the bakelite core. Thus, the substrate failure includes not only wood failure but also failures totally confined in the bakelite core while for plywoods only the wood failure is reported.

All but one specimen failed in shear in the bakelite core. Wood failure of 10% was observed only on one specimen subjected to two cycles of boiling. No adhesive failure was observed. This is equivalent to 100% substrate failure and indicates very strong and durable bonding between the core and the siding sheets.

The water soaked specimens exhibited higher resistance to shear. Resistance to shear of specimens subjected to two cycles of boiling did not change significantly. Given the high crosshead speed of the testing machine required by APA PS-1 6.1.5 the apparent increase of shear resistance after soaking may probably be explained by reduced brittleness of soaked veneer. The ultimate load obtained in these tests cannot be used for calculation of rolling shear strength comparable with the published data.

Conclusion

Our results confirm that PARKLEX 1000 is suitable for exterior applications, in terms of the material durability. Its mechanical performance is superior to commonly used construction plywoods. The material does not react to moisture in a significant way (almost no swelling).

APPENDIX

Table 1 Summary Test Results

Characteristics	Standards and test methods	Values
Density (10mm)	ASTM D 2395 Method A	1.51 g/cc
Moisture Content	ASTM D 4442 Method A	2.1%
Water Absorption (24 h/23°C)	ASTM D 1037 Method B	0.34% by mass
		0.56% by volume
Thickness Swelling		0.59%
Flexural Properties	ASTM D 1037	
Modulus of Elasticity		
veneer parallel to long dimension	dry	19.0 GPa (2,756,000 psi)
	soaked	18.0 GPa (2,611,000 psi)
veneer perpendicular to long dim.	dry	9.0 GPa (1,305,000 psi)
	soaked	8.7 GPa (1,261,000 psi)
Bending Strength (MOR)		
parallel to long direction	dry	193 MPa (28,000 psi)
	soaked	200 MPa (29,000 psi)
perpendicular to long direction	dry	93 MPa (13,500 psi)
	soaked	108 MPa (15,700 psi)
Bond Durability	APA PS-1 6.1.5	
maximum load	reference	2.58 kN (580 lb-f)
	vacuum/pressure soaked	3.47 kN (780 lb-f)
	boiled (2 cycles)	2.68 kN (600 lb-f)

ASTM Testing Performed at AEWC Advanced Engineered Wood Composites Center, University of Maine.

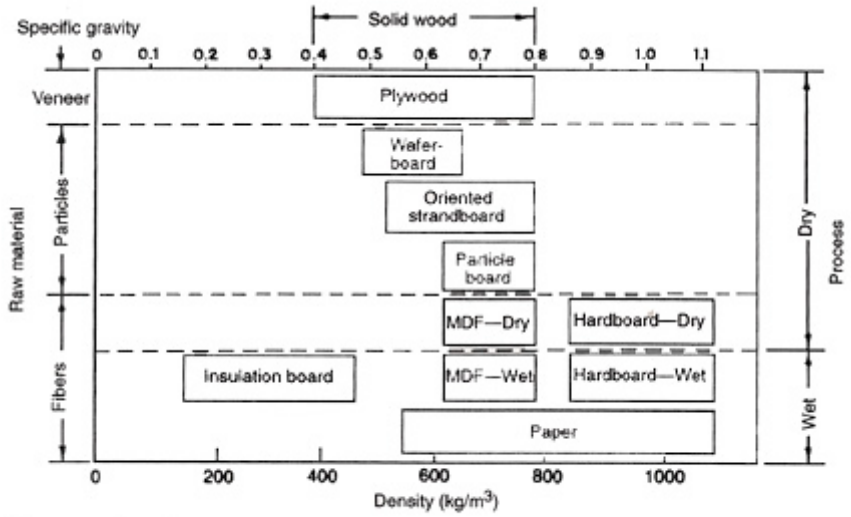

Figure 10–2. Classification of wood composite boards by particle size, density, and process type (Suchsland and Woodson 1986).

Table 10-6. General property values for sheathing-grade plywood[a]

Property	Value	ASTM test method[b] (where applicable)
Linear hygroscopic expansion (30%-90% RH)	0.15%	
Linear thermal expansion	6.1 x 10^{-6} cm/cm/°C (3.4 x 10^{-6} in/in/°F)	
Flexure		
Modulus of rupture	20.7-48.3 MPa (3,000-7,000 lb/in^2)	D3043
Modulus of elasticity	6.89-13.1 GPa (1-1.9 x 10^6 lb/in^2)	
Tensile strength	10.3-27.6 MPa (1,500-4,000 lb/in^2)	D3500
Compressive strength	20.7-34.5 MPa (3,000-5,000 lb/in^2)	D3501
Shear through thickness (edgewise shear)		
Shear strength	4.1-7.6 MPa (600-1,100 lb/in^2)	D2719
Shear modulus	0.47-0.761 GPa (68-110 x 10^3 lb/in^2)	D3044
Shear in plane of plies (rolling shear)		D2718
Shear strength	1.7-2.1 MPa (250-300 lb/in^2)	
Shear modulus	0.14-0.21 GPa (20-30 x 10^3 lb/in^2)	

[a]All mechanical properties are based on gross section properties of plywood panels, with stress applied parallel to grain direction of face plies where applicable. Note: Data are not to be used in developing allowable design values. Information on engineering design methods for plywood courtesy of APA-The Engineered Wood Association, Tacoma, WA.

[b]Standard methods of testing strength and elastic properties of structural panels are given in ASTM standards (see References).

From Forest Products Laboratory. 1999. Wood Handbook - wood as an engineering material. Gen. Tech. Rep. FPL-GTR-113, Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 463 p.