Supplement to

BUCKLING OF FLAT PLYWOOD PLATES IN COMPRESSION, SHEAR, OR COMBINED COMPRESSION AND SHEAR

Buckling of Long, Flat Plywood Plates Under Uniform Shear. Grain of Face Plies Inclined to Edges. Edges Clamped

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FOREST PRODUCTS LABORATORY
Madison 5, Wisconsin
In Cooperation with the University of Wisconsin

BUCKLING OF LONG, FLAT PLYWOOD PLATES UNDER UNIFORM SHEAR. GRAIN OF FACE PLIES INCLINED TO EDGES. EDGES CLAMPED[1]

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In Reports Nos. 1316, 1316-B, and 1316-C, values of the coefficient k in the formula for the buckling stress of long, flat plywood plates are given for a number of types of plywood under several conditions of loading. Most of the values are given for plates with simply-supported edges. Values of k for plates with clamped edges were found for only two types of plywood and for only three orientations of the grain of the face plies.

In certain investigations, values of k were needed for other types of plywood plates with clamped edges and under uniform shear. The results were needed for plates having the grain of the face plies at 45° to the edges. It was decided, for the sake of possible future needs, to have the calculations made for other angles of inclination of the face plies. The values of k are given in table 14.[3]

The necessary formulas are given here. They were obtained by the method used in deriving the formulas of case 2, section 4, Report No. 1316-B. Reference is made to the series of Reports Nos. 1316 to 1316-C for a discussion of the mathematical treatment, for the notation used and for the values of the elastic constants of Douglas-fir that were used in the calculations. It should be carefully noted that the angle θ is the angle between the grain of the face plies and a line perpendicular to the edges of the (infinitely) long plates.

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[1] This report is one of a series of progress reports prepared by the Forest Products Laboratory relating to the use of wood in aircraft. Results here reported are preliminary and may be revised as additional data become available.

[2] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[3] This table number is consecutive with those of Report No. 1316 and supplements A, B, C, D, and E.

The constant k_s is obtained from the formula

$$k_s = \frac{\pi^2}{18\gamma E_L}\left[R_1 + 8K_1 z^2 + 6K_1 \gamma^2 - 3K_6 \gamma\right]$$

where z and γ satisfy the simultaneous equations

$$z^4 = \frac{3}{16}\left[\gamma^4 + \frac{K_2 - K_5\gamma + R_1\gamma^2 - K_6\gamma^3}{K_1}\right]$$

$$z^2 = \frac{6K_2 - 3K_5\gamma + 3K_6\gamma^3 - 6K_1\gamma^4}{24K_1\gamma^2 - 4R_1}$$

Table 4.--Buckling of long plywood plates under uniform shear. Edges clamped. Values of k_s in the formula $q_{cr} = k_s E_1 h^2/a^2$; of γ, the slope of the wrinkles; and of $z = b/a$, the ratio of the half-wave length to the width

	θ = 0°			θ = 15°			θ = 30°			θ = 45°			θ = 60°			θ = 75°			θ = 90°		
	γ	z	k_s	γ	z	k_s	γ	z	k_s	γ	z	k_s	γ	z	k_s	γ	z	k_s	γ	z	k_s
One ply	±0.35	0.38	±3.43	0.44	0.37	1.91	0.63	0.43	1.21	0.89	0.57	0.87	1.18	0.82	0.70	1.39	1.19	0.67	±1.46	1.57	±0.82
	.....	....	.....	- .40	.50	-5.77	- .60	.78	-6.96	- .90	1.16	-5.70	-1.26	1.60	-3.28	-1.50	1.82	-1.52	.....	....	.....
Three ply (1:1:1)	± .39	.42	±3.59	.48	.42	2.18	.66	.49	1.47	.89	.64	1.13	1.11	.86	.98	1.21	1.10	.96	±1.26	1.36	±1.11
	.....	....	.....	- .43	.52	-5.68	- .61	.78	-6.73	- .90	1.15	-5.54	-1.22	1.52	-3.31	-1.34	1.59	-1.73	.....	....	.....
Three ply (1:2:1)	± .46	.49	±3.76	.55	.52	2.56	.71	.60	1.93	.89	.75	1.66	.99	.88	1.60	.99	.97	1.60	±1.04	1.10	±1.68
	.....	....	.....	- .48	.56	-5.40	- .64	.79	-6.22	- .90	1.13	-5.17	-1.13	1.36	-3.33	-1.14	1.30	-2.12	.....	....	.....
Five ply (1:1:1:1:1)	± .51	.55	±3.77	.61	.59	2.77	.75	.69	2.26	.89	.82	2.11	.91	.88	2.15	.88	.89	2.14	± .92	.98	±2.12
	.....	....	.....	- .52	.60	-5.10	- .66	.80	-5.74	- .90	1.10	-4.81	-1.06	1.25	-3.31	-1.02	1.13	-2.40	.....	....	.....
Nine ply (1:1:1:1:1:1:1:1:1)	± .59	.62	±3.82	.68	.68	2.92	.81	.80	2.64	.89	.90	2.74	.83	.87	2.96	.76	.80	2.89	± .80	.84	±2.67
	.....	....	.....	- .57	.65	-4.56	- .69	.82	-4.99	- .90	1.06	-4.26	- .98	1.10	-3.22	- .90	.97	-2.70	.....	....	.....
Infinite ply	± .68	.72	±3.24	.78	.81	2.90	.89	.94	3.00	± .90	.99	±3.52	.75	.84	3.99	.66	.72	3.78	± .68	.72	±3.24
	.....	....	.....	- .66	.72	-3.78	- .75	.84	-3.99	.....	....	.....	- .89	.94	-3.00	- .78	.81	-2.90	.....	....	.....