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Structural Formwork Plywood - Mechanical Properties & Grade F17 Structural Plywood Product Evaluation

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Checked and Authorised:

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on behalf of accessUTS Pty Ltd
for Besgrade Products Sdn Bhd

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1. INTRODUCTION

This report presents the results of mechanical testing for designation of grade properties, undertaken in accordance with AS / NZS 2269.1 – 2008.

The testing was requested by Mr Woei Shyong PEK, Executive Director from Besgrade Products Sdn Bhd and the tests were conducted in the Structural Testing Laboratory of the University of Technology, Sydney (Broadway Campus) as Job number: 2011002BES.

The tests were carried out by suitably trained technical officers of the Faculty of Engineering and Information Technology, UTS prior to being analysed / reported by Mr Peter Brown and then checked / authorised by Prof Keith Crews.

2. AIM:

To determine the relevant mechanical properties of the 18mm Formply, manufactured by Besgrade Products Sdn Bhd, which was supplied to UTS.

This report only gives the performance of the particular sheets supplied, due to no quality control certification obtained by the client at the time of testing, as well as no product identification or traceability to production lines.

3. PROCEDURE:

UTS has fabricated the test specimens in accordance with AS / NZS 2269.1, from 30 sheets of Plywood that were picked and supplied by Besgrade Products Sdn Bhd.

All specimens have been tested for the following properties in accordance with AS / NZS 2269.1, and analysed in accordance with AS / NZS 4063 and AS / NZS 2269-2. As required by AS 6669, the formwork plywood has been tested for:

1. bending parallel to grain
2. bending perpendicular to grain
3. moisture content

4. SUMMARY OF STRUCTURAL PROPERTIES

4.1 TARGET PROPERTIES FOR FORMPLY

Grade	F17
MoE	14000 MPa
f'_b	45 MPa

4.2 TEST RESULTS FOR FORMPLY – BENDING PARALLEL TO GRAIN

$E_{k, \text{mean}}$	17176 MPa
$R_{0.05}$	65.35 MPa
R_k	61.6 MPa
$R_{k, \text{norm}}$	69.4 MPa

4.3 TEST RESULTS FOR FORMPLY – BENDING PERPENDICULAR TO GRAIN

$E_{k, \text{mean}}$	16067 MPa
$R_{0.05}$	57.75 MPa
R_k	54.6 MPa
$R_{k, \text{norm}}$	62 MPa

5. MOISTURE CONTENT

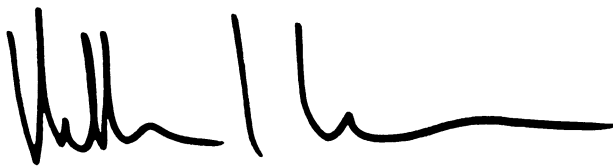
The results of 30 randomly selected samples of plywood for determination of oven dried moisture content in accordance with AS / NZS 2098.1, confirm an average m.c.of 7.4%.

6. CONCLUSIONS & CERTIFICATION OF PROPERTIES

When tested in accordance with AS / NZS 2269-1, and analysed in accordance with AS / NZS 4063 and AS/NZS 2269.2, the mechanical properties of the subject plywood product meet the performance requirements (defined in AS 1720.1) for:

- Formply - F17 for strength and F17 for stiffness.

Authorised Signatory:

A handwritten signature in black ink, appearing to read "Keith Crews".

Dr Keith Crews

BE(hons) ME PhD AIWSc

MIABSE MIEAust FIAgrE CPEng NPER-3

Professor of Structural Engineering

7. SUMMARY OF ANALYSIS

7.2 PERPENDICULAR TO GRAIN BENDING

Method 1 lognormal distribution to the total data set				Method 2 (2P) Weibull distribution to a lower tail data set				Method 3 non parametric distribution for a data set				Method 4 ASTM D2915 - 03 non-parametric		Method 1					
Sample size	30	$f_{(0.05)}$	57.75 MPa	value	$f_{(0.05)}$	60.49 MPa	$f_{(0.05)}$	60.86 MPa	$f_{(0.05)}$	56.4 MPa	Sample size	30	$E_{(0.05)}$	12366 MPa	$E_{(0.50)}$	18001 MPa	$E_{(0.05)}$	12366 MPa	
mean	92.38	$\ln[f_{(mean)}]$	4.49 MPa	rank	15.0	85.48423	$f_{(mean)}$	92.4 MPa	rank value	1	mean	18010 MPa	mean $\ln(\text{samples})$	9.78 MPa	stdev	0.21 MPa	stdev	0.21 MPa	
note:		stdev	0.27 MPa	15%tile	5.35	65.67584	stdev	24.35 MPa			note:		Vr	27.0%	Vr	21.7%	Vr	21.7%	
Max no. of data points = 800		Vr	27.0%	MAX	15.0		Vr	26.4%			Max no. of data points = 800		$\Omega_{0.975}$	0.94	$\Omega_{0.975}$	0.92	sampling factor k_s	0.95	
		$\Omega_{0.975}$	0.94	slope (a)	0.1050		$\Omega_{0.975}$	0.92	char. strength $f_{0.05}$	55.7 MPa			char. strength $f_{0.05}$	54.2 MPa	char. strength $f_{0.05}$	56.4 MPa	char. strength $f_{0.05}$	54.2 MPa	
		char. strength $f_{0.05}$	54.2 MPa	intercept (b)	4.4145		char. strength $f_{0.05}$	56.7 MPa	method 1	sampling factor k_s	n/a	char. strength $f_{0.05}$	56.4 MPa	char. strength $f_{0.05}$	54.2 MPa	method 1	mean E_k	17502 MPa	
		sampling factor k_s	0.95				sampling factor k_s	0.94	method 2	sampling factor k_s	#VALUE!	char. strength $f_{0.05}$	56.4 MPa	method 2	mean E_k	17176 MPa	method 2	mean E_k	
		char. strength $f_{0.05}$	54.6 MPa				char. strength $f_{0.05}$	56.7 MPa											
		Rk(norm)	62.0 MPa																
note: use Ctrl "A" to clear data																			
no of value	fx values	percentile - p(i)	$p_i = (i-0.5)/n$	$\ln(fx)$	percentile - p(i)	$p_i = (i-0.5)/n$	$X_i = \ln(-\ln(1-p_i))$	$Y_i = \ln(f_i)$	percentile - p(i)	$p_i = (i-0.5)/n$	$(fx - \text{mean})^2$	Sample Size	Order Statistic ^a	percentile - p(i)	$p_i = (i-0.5)/n$	$\ln(E)$			
1	56.4	0.017	0.017	4.032	0.017	0.017	-4.086	4.032	0.017	0.017	1295	283	1	0.017	9.427				
2	61.0	0.050	0.050	4.111	0.050	0.050	-2.970	4.111	0.050	0.050	984	538	2	0.050	9.531				
3	65.0	0.083	0.083	4.175	0.083	0.083	-2.442	4.175	0.083	0.083	748	402	3	0.083	9.550				
4	65.6	0.117	0.117	4.183	0.117	0.117	-2.087	4.183	0.117	0.117	719	325	4	0.117	9.556				
5	65.7	0.150	0.150	4.185	0.150	0.150	-1.817	4.185	0.150	0.150	713	265	5	0.150	9.561				
6	67.3	0.183	0.183	4.209	0.183	0.183	-1.597	4.209	0.183	0.183	631	215	6	0.183	9.578				
7	68.1	0.217	0.217	4.221	0.217	0.217	-1.410	4.221	0.217	0.217	589	175	7	0.217	9.587				
8	68.1	0.250	0.250	4.221	0.250	0.250	-1.246	4.221	0.250	0.250	589	146	8	0.250	9.597				
9	69.8	0.283	0.283	4.245	0.283	0.283	-1.099	4.245	0.283	0.283	512	125	9	0.283	9.620				
10	73.0	0.317	0.317	4.290	0.317	0.317	-0.966	4.290	0.317	0.317	377	102	10	0.317	9.648				
11	75.4	0.350	0.350	4.323	0.350	0.350	-0.842	4.323	0.350	0.350	288	85	11	0.350	9.711				
12	81.3	0.383	0.383	4.398	0.383	0.383	-0.727	4.398	0.383	0.383	123	72	12	0.383	9.716				
13	82.9	0.417	0.417	4.418	0.417	0.417	-0.618	4.418	0.417	0.417	90	62	13	0.417	9.728				
14	84.6	0.450	0.450	4.438	0.450	0.450	-0.514	4.438	0.450	0.450	60	55	14	0.450	9.730				
15	85.5	0.483	0.483	4.448	0.483	0.483	-0.415	4.448	0.483	0.483	48	49	15	0.483	9.732				
16	93.5	0.517	0.517	4.538	0.517	0.517	-0.319	4.538	0.517	0.517	1	43	16	0.517	9.753				
17	98.0	0.550	0.550	4.585	0.550	0.550	-0.225	4.585	0.550	0.550	31	38	17	0.550	9.754				
18	101.7	0.583	0.583	4.622	0.583	0.583	-0.133	4.622	0.583	0.583	87	32	18	0.583	9.756				
19	102.8	0.617	0.617	4.632	0.617	0.617	-0.042	4.632	0.617	0.617	108	27	19	0.617	9.771				
20	104.4	0.650	0.650	4.649	0.650	0.650	0.049	4.649	0.650	0.650	145	23	20	0.650	9.805				
21	108.1	0.683	0.683	4.683	0.683	0.683	0.140	4.683	0.683	0.683	246	20	21	0.683	9.809				
22	109.4	0.717	0.717	4.695	0.717	0.717	0.232	4.695	0.717	0.717	290	18	22	0.717	9.835				
23	110.7	0.750	0.750	4.707	0.750	0.750	0.327	4.707	0.750	0.750	335	16	23	0.750	9.865				
24	111.3	0.783	0.783	4.712	0.783	0.783	0.425	4.712	0.783	0.783	358	14	24	0.783	9.876				
25	115.0	0.817	0.817	4.745	0.817	0.817	0.529	4.745	0.817	0.817	509	12	25	0.817	9.937				
26	115.4	0.850	0.850	4.749	0.850	0.850	0.640	4.749	0.850	0.850	532	10	26	0.850	10.046				
27	125.3	0.883	0.883	4.831	0.883	0.883	0.765	4.831	0.883	0.883	1085	9	27	0.883	10.084				
28	127.0	0.917	0.917	4.844	0.917	0.917	0.910	4.844	0.917	0.917	1196	8	28	0.917	10.196				
29	135.6	0.950	0.950	4.910	0.950	0.950	1.097	4.910	0.950	0.950	1866	7	29	0.950	10.240				
30	143.8	0.983	0.983	4.968	0.983	0.983	1.410	4.968	0.983	0.983	2642	6	30	0.983	10.257				

DATA ENTRY:

Properties Perpendicular to Grain

Calculate Properties

Current Date: 02-Sep-11

Software version: 1-2; July 24 2008

year:	test series:	specimen:	date:	time:	sample no:	Specimen				Stiffness				Strength				Last 30 specimens ranked
						mm	mm	kN	mm	kN	kN	N/mm	MPa	MPa	MPa			
0	2011002					ave width:	def @ 20%	P @ 20%	def @ 40%	P @ 40%	P max	P/Δ	MOE	MOR				
01					-2011002-01	300	5.17	0.54	15.70	1.49	5.222	90.8	10640	65.7	58.8			
02					-2011002-02	300	3.15	0.53	11.52	1.49	5.415	114.3	13392	68.1	58.8			
03					-2011002-03	300	3.82	0.55	13.20	1.50	4.484	101.1	11850	56.4	58.8			
04					-2011002-04	300	4.01	0.55	12.26	1.48	5.415	113.1	13256	68.1	73.3			
05					-2011002-05	300	3.65	0.53	11.94	1.50	5.171	116.9	13702	65.0	73.3			
06					-2011002-06	300	3.59	0.53	11.93	1.49	4.851	115.8	13570	61.0	73.3			
07					-2011002-07	300	2.89	0.52	9.05	1.48	6.797	155.4	18215	85.5	76.3			
08					-2011002-08	300	3.92	0.54	11.67	1.50	6.73	123.5	14468	84.6	76.3			
09					-2011002-09	300	3.55	0.54	10.94	1.48	6.46	127.2	14909	81.3	76.3			
10					-2011002-10	300	3.08	0.53	9.61	1.48	6.59	145.4	17036	82.9	80.2			
11					-2011002-11	300	2.01	0.55	6.45	1.45	9.14	203.8	23883	115.0	80.2			
12					-2011002-12	300	2.74	0.52	9.64	1.49	8.801	140.9	16516	110.7	80.2			
13					-2011002-13	300	2.56	0.53	9.50	1.49	5.213	138.5	16236	65.6	81.6			
14					-2011002-14	300	2.14	0.55	6.89	1.45	10.78	191.3	22415	135.6	81.6			
15					-2011002-15	300	2.69	0.53	8.88	1.47	7.434	152.5	17867	93.5	81.6			
16					-2011002-16	300	1.74	0.51	7.42	1.49	8.17	174.4	20439	102.8	82.3			
17					-2011002-17	300	2.07	0.52	7.57	1.50	8.849	178.8	20956	111.3	82.3			
18					-2011002-18	300	2.28	0.51	8.03	1.48	8.70	167.9	19678	109.4	82.3			
19					-2011002-19	300	2.72	0.52	9.35	1.48	8.59	145.5	17049	108.1	83.2			
20					-2011002-20	300	3.19	0.55	10.53	1.49	5.35	128.0	15006	67.3	83.2			
21					-2011002-21	300	2.87	0.55	9.22	1.50	5.802	149.6	17531	73.0	83.2			
22					-2011002-22	300	2.66	0.51	8.71	1.46	7.79	156.0	18288	98.0	86.4			
23					-2011002-23	300	2.37	0.51	8.17	1.47	8.304	164.5	19280	104.4	86.4			
24					-2011002-24	300	2.42	0.55	7.79	1.49	9.179	176.7	20713	115.4	86.4			
25					-2011002-25	300	3.74	0.96	8.45	1.97	11.432	214.6	25149	143.8	92.7			
26					-2011002-26	300	2.06	0.52	6.78	1.49	10.095	204.8	24006	127.0	92.7			
27					-2011002-27	300	1.80	0.49	6.82	1.50	9.965	201.9	23657	125.3	92.7			
28					-2011002-28	300	1.80	0.49	6.88	1.49	8.09	196.1	22983	101.7	95.6			
29					-2011002-29	300	3.86	0.53	12.59	1.49	6.00	109.3	12809	75.4	95.6			
30					-2011002-30	300	4.10	0.54	12.80	1.48	5.55	107.2	12563	69.8	95.6			

AS/NZS 4063 CALCULATIONS: - for last 30 test specimens

Stiffness	target MOE	Strength	target MOR
COV	Ek, mean	R0.05	COV
	12000		Rk
			Rk, norm
			40

INSTRUCTIONS:

- enter the first 30 test results in columns 2 to 10 (yellow to left)
- press the "Calculate Properties" button (above)

The relevant properties are displayed below

- enter each subsequent set of results for each test specimen and press the "Calculate Properties" button after each data set is entered

This will then calculate properties based on the last 30 test specimens

The current data set is always the lowest line of numbers

4.6%	13341	OK	58.8	12.3%	55.3	67.4	OK
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Perpendicular