

Dasso XTR
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Atlanta, GA 30336

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Testing of Dasso XTR Exterior Bamboo Deck Boards in Accordance with ICC-ES AC174

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



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INTRODUCTION:

This report presents the results of testing performed by Element Materials Technology - St. Paul (Element), on the Dasso XTR exterior bamboo deck boards. The scope of our work was limited to the following:

1. Receive bamboo samples for testing in accordance with ICC Evaluation Service's AC174 "Acceptance Criteria for Deck Board Span Ratings and Guardrail Systems (Guards and Handrails)" (AC174, January 2012).
2. Conduct tests listed in Table 1 in accordance with ICC-ES AC174.

Test Series
3.4 Flexural Test
3.6 Temperature and Moisture Test
3.8 Freeze and Thaw Test
3.9 Termite and Decay Test
3.10 Flame Spread Test
3.11 Duration of Load Test
4.0 Deck Board Performance Test
4.1.4 Mechanical Fastener Test

Table 1 – Test Series

3. Prepare a report of the test results in accordance with ICC-ES AC174/AC85 "Acceptance Criteria for Test Reports" (AC85, March 2013).

Our work was requested by Mr. Avery Chua of Dasso XTR and authorized on February 13, 2013 via email.

SUMMARY OF RESULTING ALLOWABLE LOADS:

The allowable loads shown in following tables are derived from ICC-ES AC174 guidelines.

Summary of Flexural Results 16" Splice Span Rating DassoXTR Exterior Bamboo Decking				
Test Application	Average Ultimate Load (lbf)	Percent Difference to Standard	Controlling 16" Splice Span Rating w/2.5 SF (PSF)	Span / Load Rating (in)/(psf)
Standard Splice (ref)	2,131	1.00	100	16/100
Standard (ref)	1,988	1.00		
Hot	2,113	1.06		
Cold	2,585	1.30		
Wet	2,385	1.20		
Freeze-Thaw	1,854	0.93		

Table 2 – Span Rating

Dasso XTR (AWPA) E1-09 Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites (AWPA 2012)							
ID	ANOVA	Mortality (%)	Average (%)	Weight Loss (%)	Average (%)	Ratings (0-10)	Average
1	1	10.00	11.00	6.80	8.13	8	8
2	1	11.25		6.16		8	
3	1	8.75		11.35		8	
4	1	10.50		7.39		8	
5	1	14.50		8.94		8	
6	2	5.00	5.35	37.92	34.81	0	0
7	2	6.75		30.97		0	
8	2	5.50		29.59		0	
9	2	5.00		35.28		0	
10	2	4.50		40.30		0	

* ANOVA - analysis of variance

ID 1-5 represent Bamboo samples, ID 6-10 represent the control samples.

Table 3 – Termite Resistance

Dasso XTR (AWPA) E10-12 Standard Method for Testing Wood Preservatives by Laboratory Soil-Block Cultures (AWPA 2012)					
Brown Rot Weight Loss Stats					
ANOVA ID	Substrate	Treatment	Decay	Weight Loss	LSD Group
1	Bamboo		GT	3.88	A
2	Bamboo		PP	3.93	A
3	Pine	Control	GT	50.86	B
4	Pine	Control	PP	47.57	B

White Rot Weight Loss Stats					
ANOVA ID	Substrate	Treatment	Decay	Weight Loss	LSD Group
1	Bamboo		IL	4.42	A
2	Bamboo		TV	4.45	A
3	Sweetgum	Control	IL	27.56	B
4	Sweetgum	Control	TV	40.11	C

* Gloeophyllum trabeum (GT), Postia placenta (PP), Trametes versicolor (TV) and Irpex lacteus (IL).

Table 4 – Decay Resistance

ASTM E84 DassoXTR Bamboo Decking Results	
Flame Spread	10
Smoke Developed	40
NFPA Class	A
IBC Class	A

Table 5 – Flame Spread

ASTM D7031 (Section 5.10.1) Creep Recovery Test Loading Over Splice 16" On-Center Spacing									
Sample ID	Applied Load (lb.)	Initial Reading (in)	24 Hr. Loaded Reading (in)	Initial Reading After Unloading (in) > 1 minute	Additional 24 Hr. Unloaded Reading (in)	Total Deflection (in)	Recovery Deflection (in)	Percent Recovery (%)	Average Percent Recovery (%)
1	335	0.3200	0.4130	0.3750	0.3560	0.0930	0.0570	61	79
2	335	0.3371	0.5915	0.3841	0.3745	0.2544	0.2170	85	
3	335	0.0920	0.3050	0.1450	0.1268	0.2130	0.1782	84	
4	335	0.2021	0.4032	0.3522	0.3409	0.2011	0.0623	31	
5	335	0.0410	0.2095	0.0865	0.0752	0.1685	0.1343	80	
6	335	0.1400	0.3335	0.1839	0.1630	0.1935	0.1705	88	
7	335	0.3320	0.5022	0.3755	0.3600	0.1702	0.1422	84	
8	335	0.0750	0.2329	0.1152	0.1070	0.1579	0.1259	80	
9	335	0.9450	0.0921	0.9865	0.9771	0.1471	0.1150	78	
10	335	0.0559	0.1400	0.0905	0.0860	0.0841	0.0540	64	
11	335	0.0721	0.1681	0.0949	0.0920	0.0960	0.0761	79	
12	335	0.2489	0.3390	0.2612	0.2565	0.0901	0.0825	92	
13	335	0.2429	0.3539	0.2700	0.2655	0.1110	0.0884	80	
14	335	0.4595	0.5870	0.4890	0.4828	0.1275	0.1042	82	
15	335	0.0231	0.1120	0.0490	0.0439	0.0889	0.0681	77	

* Data not used in average permanent deflection based on extreme variance from norm.

Table 6 – Creep Recovery

Duration of Load 16" Splice Span Rating DassoXTR Bamboo Decking		
Sample ID	Maximum Displacement (in)	Average Displacement (in)
1	0.128	0.078
2	0.084	
3	0.104	
4	0.119	
5	0.118	
6	0.052	
7	0.070	
8	0.096	
9	0.072	
10	0.073	
11	0.046	
12	0.046	
13	0.056	
14	0.063	
15	0.048	

Table 7 – Duration of Load

Stair Tread Application/Use	
Span / Load Rating (in/psf) ¹	16/100

1. No splice tested.

Table 8 – Stair Tread Application

Tiger Claw Hidden Fasteners with DassoXTR Exterior Bamboo Decking with Pressure Treated Joist	
Withdrawal/Uplift	51
Lateral (Parallel)	19

Table 9 – Hidden Fastener Values

Coefficient of Friction				
Sample Identification	Direction	Condition	Average Static COF	Average Sliding COF
Smooth Side	Parallel	Dry	0.478	0.305
		Wet	1.053	0.668
	Transverse	Dry	0.542	0.366
		Wet	0.99	0.611
Contoured Side	Parallel	Dry	0.459	0.285
		Wet	0.944	0.697
	Transverse	Dry	0.543	0.365
		Wet	1.091	0.847

Note: For transverse direction, 2 specimen panels were placed side by side in order to achieve required width.

Table 10 – Slip Resistance

SAMPLE DESCRIPTION:

The Dasso XTR exterior bamboo deck boards tested were identified as Dasso XTR Double Surface Bamboo Decking. Specifications were noted as 3/4" x 5-3/8" x 6'. A detailed shop drawing of the decking is provided in Appendix B of this report.

The tested Dasso XTR bamboo deck boards, as reported herein, were received from Dasso XTR via shipment from their warehouse facility located in Atlanta, GA on February 20, 2012; Element did not independently sample the materials. A total of one (1) pallet was received, which contained fifteen (15) boxes of five (5) six foot samples of bamboo decking in each, for a total of 75 samples. The sampled materials were placed in storage, and the individual components were then taken from the stored supply as needed.

The boxes received did not have lot numbers, but noted a PO and production date. The package label on each of the cartons listed the following: PO: EWH12025D, Produce Date: 2012-10-29, Species: Bamboo Phyllostachyspubescens. The Model #, specification, country of origin and case weight were also listed on the carton label.

The following photograph shows the package label:



Photograph 1 – Typical Carton

FASTENER INSTALLATION:

Hidden screw fasteners were installed with this product for uplift/withdrawal and lateral fastener testing. The hidden fastener system supplied by Dasso XTR for this project was Tiger Claw hidden deck fasteners (TC120). No through-board fastener testing was conducted for this project.

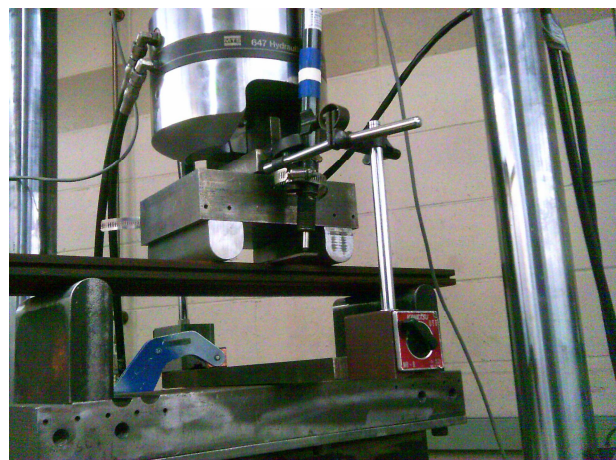
TEST PROCEDURES:

The tests were conducted in accordance with ICC-ES AC174 and the applicable provisions of ASTM D7032-10 "Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails)¹". The International Accreditation Service, Inc. (IAS) issued a Certificate of Accreditation TL-217, March 20, 2013, listing Element Materials Technology - St. Paul (Element) as an accredited laboratory for a scope of services that includes testing in accordance with AC174. The equipment used to apply the loads included a MTS system, hydraulic pump and cylinder (ram). The specific equipment used to measure the loads is listed on the test summary sheets in Appendix A, along with the calibration dates. All measurement equipment is calibrated at least annually, and the calibrations are traceable to the National Institute of Standards and Technology (NIST). Measuring equipment included load cells (force transducers), lvdt's and dial calipers. The test procedures were in accordance with the protocol listed in ASTM D7032. The following photographs show a typical flexural test configuration, stair tread configuration, and a typical duration of load test configuration. All tests were conducted in accordance with AC174 Section 3.

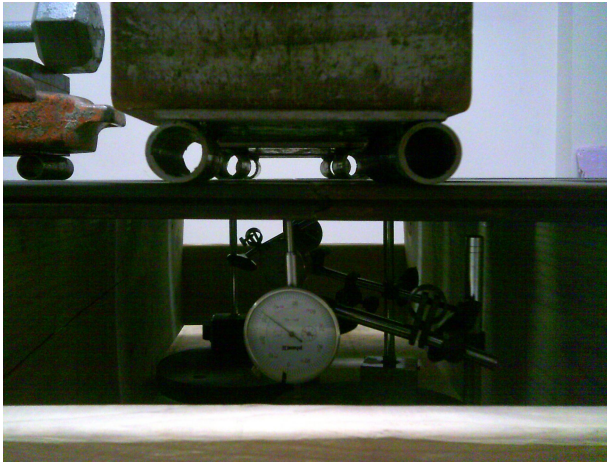
Testing was conducted to determine the flexural performance characteristics of the Dasso XTR exterior bamboo decking when installed having the tongue and groove end splice centered between the joist members while spaced at 16 inches on center, thus leaving the end joint splice 8 inches from the center of the joist member when used on the main decking surface. This installation is not applicable for stair tread applications.



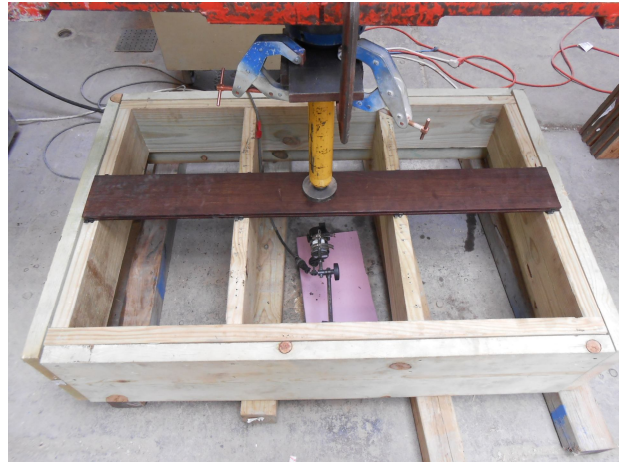
Photograph 2 – Typical Flexural Splice Test Configuration



Photograph 3 – Typical Flexural Test Configuration



Photograph 4 – Typical Creep Recovery/ Duration of Load Test Configuration



Photograph 5 – Typical Stair Tread Test Configuration



Photograph 6 – Typical Fastener Uplift/Withdrawal Test Configuration



Photograph 7 – Typical Fastener Lateral Load Test Configuration

TEST RESULTS:

Specific test series information and test data are summarized in the test data sheets presented in Appendix A of this report. Each table contains the test results, along with related data such as calculations for average ultimate load; load @ L/180, MOE, standard deviation, coefficient of variation, and failure modes. The test data is collated by product and test series.

The typical failure modes are depicted in the following photographs:

REMARKS:

The structural members used for the testing described herein were discarded upon completion. The remaining fasteners and associated items are subject to disposal thirty days from the date of this report.



Photograph 8 – Typical Flexural Failure Mode (SC)



Photograph 9 – Typical Flexural Failure Mode (LS)



Photograph 10 – Brown Rot Fungi Growth on Soil, but not on Bamboo Samples



Photograph 11 – Brown Rot Fungi Growth covering Untreated Controls

APPENDIX A – TEST DATA SUMMARY SHEETS


The test series data sheets are grouped together by type and are in the order corresponding to the test series listed in Table 1 of this report.

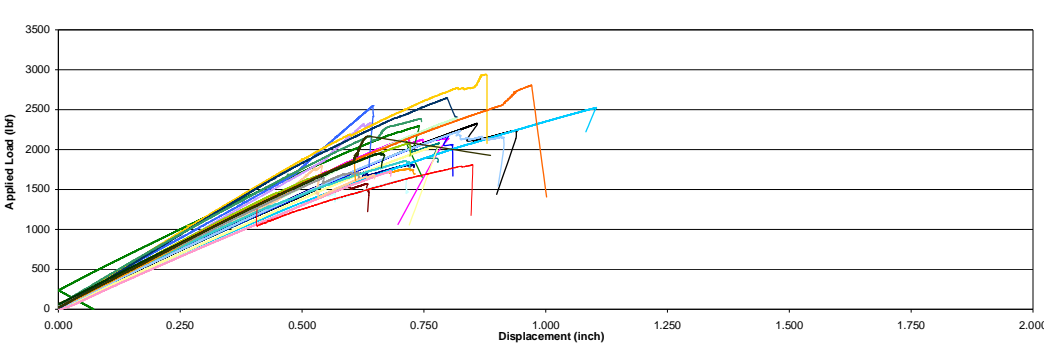
FLEXURAL TESTS

The Dasso XTR exterior bamboo deck boards were tested in flexure at the end splice, with the splice center in the 16" on center joist spacing. The end splice (tongue and groove) was located 8 inches from the center of the support. Tests were conducted to material samples directly from the cartons as received and used as the standard (reference). Similar test were performed on samples that were subjected to various environmental conditions. For this project the specimens were subjected to cold, hot, wet and freezing and thawing conditions. A temperature of -20 F was used for the cold condition, 125 F was the temperature for the hot condition. As a worst case the deck boards were fully submerged in water for the moisture test. The freezing and thawing was fully submerged in water, frozen to -20 F and then thawed at room temperature for three full cycles.

The environmental tests were conducted immediately after removal from their environment. Thus cold decking were tested cold, test were conducted within 5 minutes of being removed from the environmental condition. Results of this testing is shown on the following pages.


STANDARD SPLICE FLEXURAL (Reference):

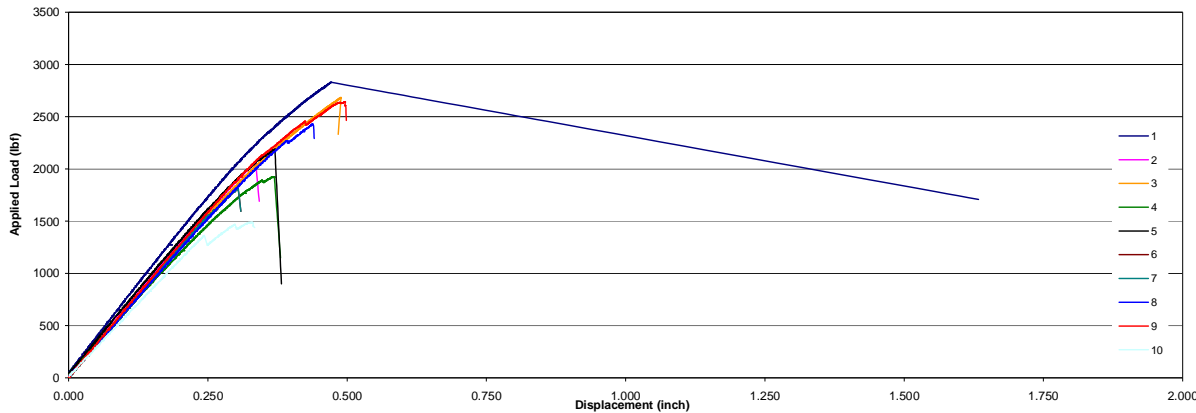
 Element Materials Technology + St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking ASTM D7032 Flexural Testing				Test Series: Flexural Test 16" O.C. over splice				
Setup and Installation Technician: S.Palodichuk, J.Ball			Test Equipment System No. MTA-04.1 Load Cell MTA-04.1 LVDT #1 CME-SPC-098 LVDT #2 CME-SPC-016			Calibration Date 12/3/2013 12/4/2013 3/4/2013 3/5/2013				
Test Specimen Data Bamboo Decking Span (in): 16 Load Span (in): 5.33 Thickness (in): 0.791			Notes: Standard bamboo decking members 16" span, loading over splice (splice 8" edge distance to support)			Calculations Based on Test Data No. of Test Samples, n: 28 Average Ultimate Load (lbf): 2131 Standard Deviation (lbf): 361 COV: 16.9% Average L/180 Load (lbf): 1358 Average Modulus of Elasticity (MOE) (ksi): 994				
Failure Modes: LS: Lateral Splitting SC: Split at Center Span										
Test No.	1	2	3	4	5	6	7	8	9	10
Test Date	03/11/13	03/11/13	03/11/13	03/11/13	03/11/13	03/11/13	03/11/13	03/11/13	03/11/13	03/11/13
Test Time	12:30 PM	12:56 PM	1:12 PM	1:30 PM	1:46 PM	2:03 PM	2:18 PM	2:34 PM	2:46 PM	2:58 PM
Ultimate Load (lbf)	1809	2157	1764	2297	2328	1573	2081	2174	2526	1637
Failure Displace (in.)	0.716	0.719	0.721	0.741	0.859	0.632	0.780	0.799	1.104	0.714
Failure Mode	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS
Test Duration (sec.)	64	61	58	64	68	52	62	61	85	56
Load @ L/180 (lbf)	281	294	1172	2472	1281	1188	1335	1316	1182	1137
Modulus of Elasticity (MOE)	966328	1043216	890272	1004168	822037	887527	935447	946505	882457	868725
Test No.	11	12	13	14	15	16	17	18	19	20
Test Date	03/11/13	03/11/13	03/11/13	03/11/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13
Test Time	3:12 PM	3:32 PM	3:38 PM	3:56 PM	9:09 AM	9:16 AM	9:20 AM	9:24 AM	9:27 AM	9:32 AM
Ultimate Load (lbf)	2400	2049	2233	1731	2334	1800	2550	1861	2090	2942
Failure Displace (in.)	0.818	0.780	0.824	0.682	0.641	0.540	0.645	0.714	0.721	0.877
Failure Mode	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS
Test Duration (sec.)	65	68	64	53	51	45	59	51	51	62
Load @ L/180 (lbf)	1383	1166	1300	1048	1516	1520	1664	1447	1508	1651
Modulus of Elasticity (MOE)	1003218	911967	944513	889037	1046925	927092	1097914	956004	1067059	1238266
Test No.	21	22	23	24	25	26	27	28		
Test Date	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13		
Test Time	9:36 AM	9:39 AM	9:44 AM	9:48 AM	9:53 AM	9:56 AM	10:00 AM	10:03 AM		
Ultimate Load (lbf)	1845	2808	1811	1716	2647	2386	1955	2169		
Failure Displace (in.)	0.604	0.971	0.851	0.615	0.796	0.743	0.662	0.635		
Failure Mode	LS	LS	LS	LS	LS	LS	LS	LS		
Test Duration (sec.)	44	68	58	46	58	54	55	57		
Load @ L/180 (lbf)	1386	1520	1562	1536	1552	1770	1390	1444		
Modulus of Elasticity (MOE)	1029793	1020971	1024951	990781	1227027	1156814	1004253	1042561		



Splice Standard Flexural (Reference)


STANDARD FLEXURAL:

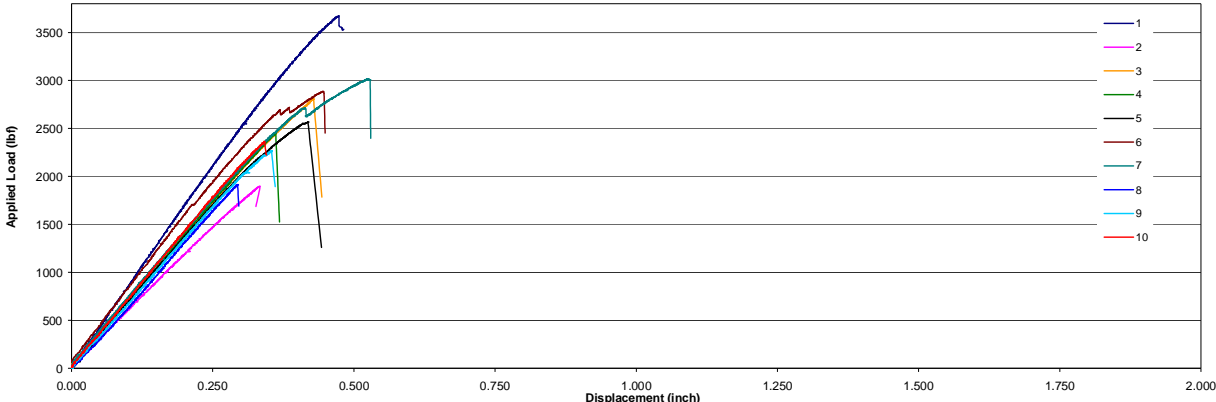
 Element Materials Technology + St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking ASTM D7032 Flexural Testing			Test Series: Flexural Test Base reference non-splice						
Setup and Installation Technician: S.Palodichuk, J.Ball				Test Equipment System No. MTA-04.1 Load Cell MTA-04.1 LVDT #1 CME-SPC-098 LVDT #2 CME-SPC-016		Calibration Date 12/3/2013 12/4/2013 3/4/2013 3/5/2013					
Test Specimen Data Bamboo Decking Span (in): 16 Load Span (in): 5.33 Thickness (in): 0.791				Calculations Based on Test Data No. of Test Samples, n: 10 Average Ultimate Load (lbf): 1988 Standard Deviation (lbf): 783 COV: 39.4% Average L/180 Load (lbf): 569 Avg Modulus of Elasticity (MOE) ksi: 2037		Notes:					
Failure Modes: LS: Lateral Splitting SC: Split at Center Span											
	Test No.	1	2	3	4	5	6	7	8	9	10
Test Date		04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13
Test Time		2:04 PM	2:35 PM	2:43 PM	2:50 PM	3:03 PM	3:13 PM	3:17 PM	3:20 PM	3:24 PM	3:27 PM
Ultimate Load (lbf)		2830	2060	2683	1925	2187	1810	1810	2431	2641	1492
Failure Displace (in.)		0.471	0.335	0.490	0.368	0.369	0.304	0.304	0.438	0.494	0.329
Failure Mode		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC
Test Duration (sec.)		45	40	46	34	39	30	36	41	48	30
Load @ L/180 (lbf)		657	604	569	557	610	540	540	544	566	502
Modulus of Elasticity (MOE)		2235122	2085402	2034920	1910530	2112774	2035699	2035699	2004371	2086284	1831302



Standard Flexural (Reference)


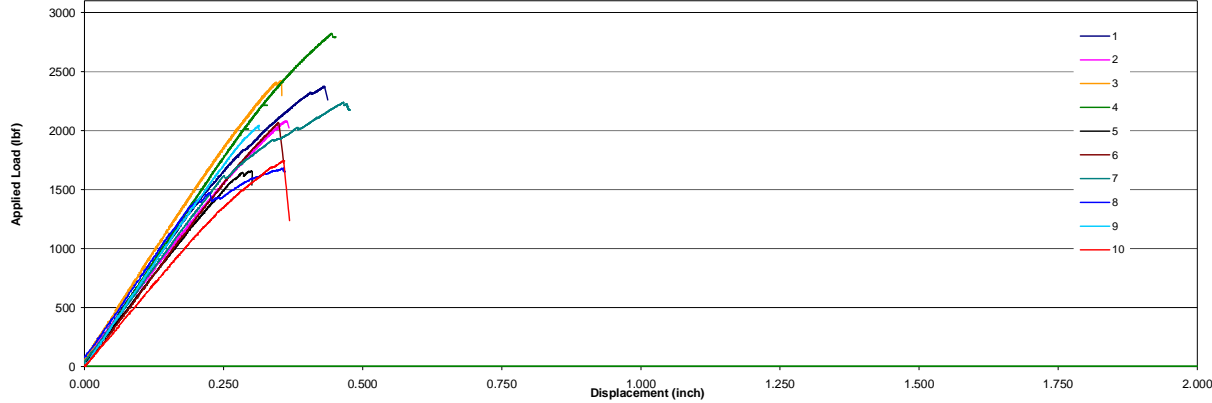
COLD FLEXURAL:

 Element Materials Technology + St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking ASTM D7032 Flexural Testing				Test Series: Flexural Test Cold (-20 F)					
Setup and Installation Technician: S.Palodichuk, J.Ball			Test Equipment System No. MTA-04.1 Load Cell MTA-04.1 LVDT #1 CME-SPC-098 LVDT #2 CME-SPC-016			Calibration Date 12/3/2013 12/4/2013 3/4/2013 3/5/2013					
Test Specimen Data Bamboo Decking Span (in): 16 Load Span (in): 5.33 Thickness (in): 0.791											
Notes: Samples tested while cold (-20 F)							Calculations Based on Test Data No. of Test Samples, n 10 Average Ultimate Load (lbf) 2585 Standard Deviation (lbf) 538 COV 20.8% Average L/180 Load (lbf) 634 Avg Modulus of Elasticity (MOE) 2292 ksi				
Failure Modes: LS: Lateral Splitting SC: Split at Center Span											
	Test No.	1	2	3	4	5	6	7	8	9	10
Test Date		04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13
Test Time		3:39 PM	3:43 PM	3:50 PM	3:53 AM	3:56 AM	4:01 PM	4:05 PM	4:08 PM	4:11 PM	4:17 PM
Ultimate Load (lbf)		3674	1895	2810	2454	2567	2886	3019	1915	2267	2363
Failure Displace (in.)		0.474	0.334	0.427	0.362	0.419	0.446	0.526	0.294	0.354	0.342
Failure Mode		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC
Test Duration (sec.)		47	34	41	34	39	41	48	36	36	34
Load @ L/180 (lbf)		757	538	618	611	614	751	661	547	593	645
Modulus of Elasticity (MOE)		2790304	1949867	2214112	2295386	2265656	2506028	2266203	2132019	2193598	2306435




Cold Flexural

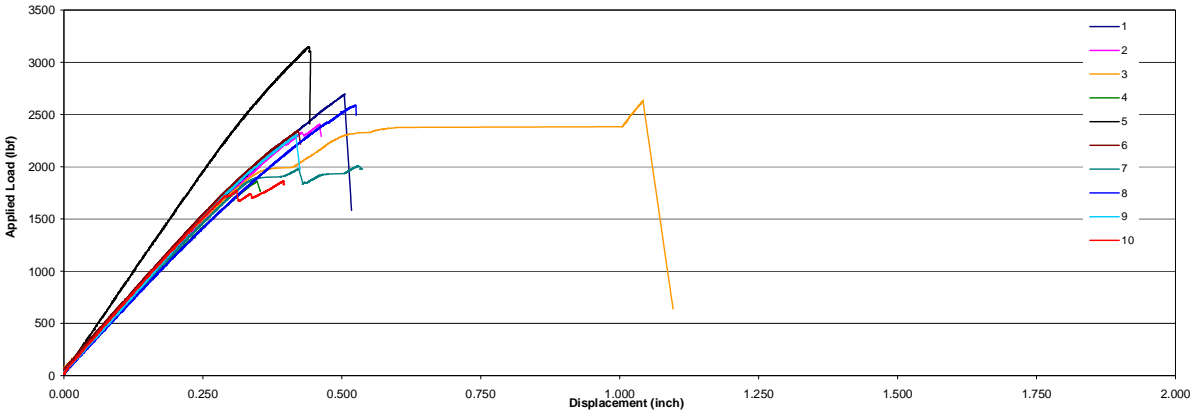
HOT FLEXURAL:

 Element Materials Technology - St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking ASTM D7032 Flexural Testing			Test Series: Flexural Test Hot (125 F)																																																																																																					
Setup and Installation Technician: S.Palodichuk, J.Ball				Test Equipment System No. MTA-04.1 Load Cell MTA-04.1 LVDT #1 CME-SPC-098 LVDT #2 CME-SPC-016		Calibration Date 12/3/2013 12/4/2013 3/4/2013 3/5/2013																																																																																																				
Test Specimen Data Bamboo Decking Span (in): 16 Load Span (in): 5.33 Thickness (in): 0.791				Notes: Samples tested while hot (125 F)				Calculations Based on Test Data No. of Test Samples, n: 10 Average Ultimate Load (lbf): 2113 Standard Deviation (lbf): 367 COV: 17.4% Average L/180 Load (lbf): 607 Avg Modulus of Elasticity (MOE) ksi: 2162																																																																																																		
Failure Modes: LS: Lateral Splitting SC: Split at Center Span				<table border="1"> <thead> <tr> <th>Test No.</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>8</th> <th>9</th> <th>10</th> </tr> </thead> <tbody> <tr> <td>Test Date</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> <td>04/04/13</td> </tr> <tr> <td>Test Time</td> <td>4:26 PM</td> <td>4:28 PM</td> <td>4:30 PM</td> <td>4:39 PM</td> <td>4:42 PM</td> <td>4:44 PM</td> <td>4:48 PM</td> <td>4:51 PM</td> <td>4:53 PM</td> <td>4:55 PM</td> </tr> <tr> <td>Ultimate Load (lbf)</td> <td>2374</td> <td>2080</td> <td>2419</td> <td>2821</td> <td>1660</td> <td>2068</td> <td>2238</td> <td>1681</td> <td>2044</td> <td>1743</td> </tr> <tr> <td>Failure Displace (in.)</td> <td>0.431</td> <td>0.362</td> <td>0.352</td> <td>0.445</td> <td>0.300</td> <td>0.348</td> <td>0.466</td> <td>0.357</td> <td>0.314</td> <td>0.358</td> </tr> <tr> <td>Failure Mode</td> <td>SC</td> <td>SC</td> <td>SC</td> <td>SC</td> <td>SC</td> <td>SC</td> <td>SC</td> <td>SC</td> <td>SC</td> <td>SC</td> </tr> <tr> <td>Test Duration (sec.)</td> <td>44</td> <td>35</td> <td>34</td> <td>45</td> <td>27</td> <td>36</td> <td>43</td> <td>33</td> <td>31</td> <td>34</td> </tr> <tr> <td>Load @ L/180 (lbf)</td> <td>630</td> <td>610</td> <td>708</td> <td>627</td> <td>557</td> <td>549</td> <td>594</td> <td>675</td> <td>619</td> <td>498</td> </tr> <tr> <td>Modulus of Elasticity (MOE)</td> <td>2232526</td> <td>2035612</td> <td>2422256</td> <td>2355507</td> <td>1972696</td> <td>2084451</td> <td>2121625</td> <td>2244873</td> <td>2299490</td> <td>1849643</td> </tr> </tbody> </table>				Test No.	1	2	3	4	5	6	7	8	9	10	Test Date	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	04/04/13	Test Time	4:26 PM	4:28 PM	4:30 PM	4:39 PM	4:42 PM	4:44 PM	4:48 PM	4:51 PM	4:53 PM	4:55 PM	Ultimate Load (lbf)	2374	2080	2419	2821	1660	2068	2238	1681	2044	1743	Failure Displace (in.)	0.431	0.362	0.352	0.445	0.300	0.348	0.466	0.357	0.314	0.358	Failure Mode	SC	SC	SC	SC	SC	SC	SC	SC	SC	SC	Test Duration (sec.)	44	35	34	45	27	36	43	33	31	34	Load @ L/180 (lbf)	630	610	708	627	557	549	594	675	619	498	Modulus of Elasticity (MOE)	2232526	2035612	2422256	2355507	1972696	2084451	2121625	2244873	2299490	1849643
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Hot Flexural


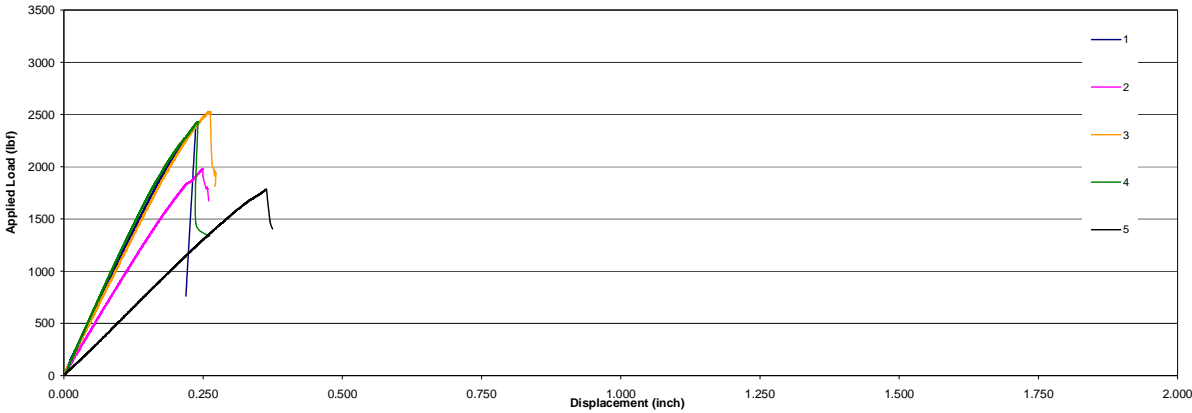
WET FLEXURAL:

 Element Materials Technology + St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking ASTM D7032 Flexural Testing			Test Series: Flexural Test Wet (submerged)						
Setup and Installation Technician: S.Palodichuk, J.Ball				Test Equipment System No. MTA-04.1 Load Cell MTA-04.1 LVDT #1 CME-SPC-098 LVDT #2 CME-SPC-016		Calibration Date 12/3/2013 12/4/2013 3/4/2013 3/5/2013					
Test Specimen Data Bamboo Decking Span (in): 16 Load Span (in): 5.33 Thickness (in): 0.791				Calculations Based on Test Data No. of Test Samples, n: 10 Average Ultimate Load (lbf): 2385 Standard Deviation (lbf): 405 COV: 17.0% Average L/180 Load (lbf): 574 Avg Modulus of Elasticity (MOE) ksi: 1862							
Notes: Samples tested while wet (surface dried)				Failure Modes: LS: Lateral Splitting SC: Split at Center Span							
	Test No.	1	2	3	4	5	6	7	8	9	10
Test Date		04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13	04/05/13
Test Time		8:22 AM	8:26 AM	8:28 AM	8:33 AM	8:36 AM	8:41 AM	8:43 AM	8:46 AM	8:49 AM	8:51 AM
Ultimate Load (lbf)		2694	2405	2635	1862	3145	2349	2009	2588	2304	1861
Failure Displace (in.)		0.504	0.461	1.042	0.347	0.442	0.422	0.529	0.523	0.417	0.395
Failure Mode		SC	SC	SC	SC	SC	SC	SC	SC	SC	SC
Test Duration (sec.)		48	43	48	34	42	40	40	52	38	40
Load @ L/180 (lbf)		559	536	586	557	708	597	540	531	551	579
Modulus of Elasticity (MOE)		1940973	1929189	652375	1858073	2558148	1955226	1922676	1848942	1947607	2002125



Wet Flexural

FREEZE - THAW FLEXURAL:

 Element Materials Technology + St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking ASTM D7032 Flexural Testing		Test Series: Flexural Test Freeze-Thaw																																																							
Setup and Installation Technician: J.Ball			Test Equipment System No. MTA-04.1 Load Cell MTA-04.1 LVDT #1 CME-SPC-098 LVDT #2 CME-SPC-016		Calibration Date 12/3/2013 12/4/2013 3/4/2013 3/5/2013																																																						
Test Specimen Data Bamboo Decking Span (in): 16 Load Span (in): 5.33 Thickness (in): 0.791			Calculations Based on Test Data No. of Test Samples, n: 5 Average Ultimate Load (lbf): 1854 Standard Deviation (lbf): 953 COV: 51.4% Average L/180 Load (lbf): 851 Avg Modulus of Elasticity (MOE) (ksi): 3072																																																								
Notes: Submerged, freeze and thaw, three cycle times. Tested in thawed condition.			Failure Modes: LS: Lateral Splitting SC: Split at Center Span																																																								
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Freeze - Thaw Flexural

TERMITE TEST

The Dasso XTR exterior bamboo deck boards were tested to AWPA E1-09 “Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites” (AWPA 2012) by the Wood Durability Lab, Louisianan Forest Products Development Center School of Renewable Natural Resources at LSU Agricultural Center in Baton Rouge, LA (reference report WDL-2013-03a, dated May 22, 2013). Based on the results presented, the Dasso XTR showed a performance of 8 out of 10 for resistance to Formosan Subterranean Termites. LSU conclusions noted testing successfully demonstrated that the bamboo product provided good protection from Formosan termites. Results of this testing is shown below.

Dasso XTR (AWPA) E1-09 Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites (AWPA 2012)							
ID	ANOVA	Mortality (%)	Average (%)	Weight Loss (%)	Average (%)	Ratings (0-10)	Average
1	1	10.00	11.00	6.80	8.13	8	8
2	1	11.25		6.16		8	
3	1	8.75		11.35		8	
4	1	10.50		7.39		8	
5	1	14.50		8.94		8	
6	2	5.00	5.35	37.92	34.81	0	0
7	2	6.75		30.97		0	
8	2	5.50		29.59		0	
9	2	5.00		35.28		0	
10	2	4.50		40.30		0	

* ANOVA - analysis of variance

ID 1-5 represent Bamboo samples, ID 6-10 represent the control samples.

ANOVA ID	Mortality (%)	LSD	Weight Loss (%)	LSD	Ratings (0-10)	LSD
1	11.00	A	8.13	A	8	A
2	5.35	B	34.81	B	0	B

*ANOVA - analysis of variance

**Groups containing the same capital letter are not significant at a 95% confidence interval.

Treatment	ANOVA ID	Mortality (%)	LSD Group
Bamboo	1	11.00	A
Control	2	5.35	B

Charge ID	Sample ID	MC Sample
Bamboo	1 - 5	1mc-5mc
Control	6 - 10	6mc-10mc

Treatment	ANOVA ID	Weight Loss (%)	LSD Group
Bamboo	1	8.13	A
Control	2	34.81	B

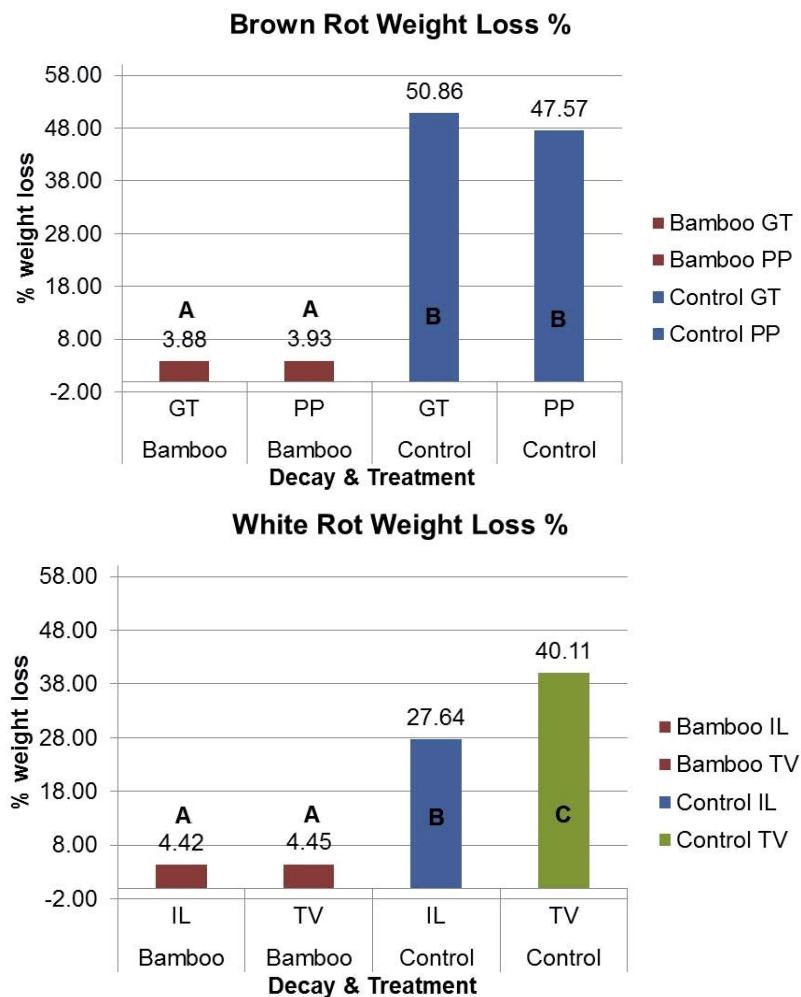
Treatment	ANOVA ID	Rating (0-10)	LSD Group
Bamboo	1	8	A
Control	2	0	B

**Groups containing the same capital letter are not significant at a 95% confidence interval.

DECAY TEST

The Dasso XTR exterior bamboo deck boards were tested to AWPA E10-12 “Standard Method of Testing Wood Preservatives by Laboratory Soil-Block Cultures” (AWPA 2012) by the Wood Durability Lab, Louisiana Forest Products Development Center School of Renewable Natural Resources at LSU Agricultural Center in Baton Rouge, LA. Testing of four Fungi groups (2) White rot and (2) Brown rot is being performed on the Dasso XTR bamboo decking. The samples were cut into approximately 19mm cubes. The test included 80 samples, 40 for white rot and 40 for brown rot testing, resulting in 4 groups. Samples were sterilized by gamma irradiation prior to testing. The test ran for 12 weeks for the brown rot decay and 24 weeks for the white rot decay. The data obtained was analyzed for resistance with means and standard deviations determined (SPSS 2013). The Least Significant Difference (LSD) mean separation tests procedure was used (Steel and Torrie 1980). If a treatment within a column contains the same letter as another, there is no significant difference at a 95% confidence level.

Test showed that the Dasso XTR bamboo flooring board provided excellent potential for decay resistance based on the testing conducted. The untreated control wood showed high weight loss; therefore, the fungi were considered to be of high vigor and the data was valid. Results of this testing is shown below.



Appendix I: Individual data for sample weight loss.

Brown rot weight loss for bamboo flooring								
ID	Fungus	Initial wt	MC	Cal. OD wt	Final OD wt	% Wt Loss	Mean	St. Dev.
1	GT	7.991	9%	7.331	7.050	3.84	3.88	0.61
2	GT	8.923	9%	8.186	7.799	4.73		
3	GT	8.505	9%	7.803	7.591	2.71		
4	GT	8.594	9%	7.884	7.611	3.47		
5	GT	8.236	9%	7.556	7.222	4.42		
6	GT	7.918	9%	7.264	6.979	3.93		
7	GT	8.316	9%	7.629	7.333	3.88		
8	GT	8.669	9%	7.953	7.662	3.66		
9	GT	8.726	9%	8.006	7.727	3.48		
10	GT	7.972	9%	7.314	6.975	4.63		
11	PP	8.168	9%	7.49	7.157	4.49	3.93	0.34
12	PP	8.478	9%	7.78	7.495	3.64		
13	PP	8.272	9%	7.59	7.253	4.43		
14	PP	8.455	9%	7.76	7.468	3.72		
15	PP	8.145	9%	7.47	7.182	3.89		
16	PP	8.401	9%	7.71	7.434	3.55		
17	PP	8.324	9%	7.64	7.325	4.08		
18	PP	7.786	9%	7.14	6.891	3.53		
19	PP	8.564	9%	7.86	7.544	3.98		
20	PP	8.494	9%	7.79	7.482	3.99		

Brown rot weight loss for pine controls								
ID	Fungus	Initial wt	MC	Cal. OD wt	Final OD wt	% Wt Loss	Mean	St. Dev.
1	GT	4.170	12%	3.72	2.042	45.15	50.86	9.35
2	GT	4.009	12%	3.58	1.544	56.87		
3	GT	3.586	12%	3.20	1.367	57.31		
4	GT	3.889	12%	3.47	2.394	31.05		
5	GT	3.728	12%	3.33	1.861	44.09		
6	GT	3.682	12%	3.29	1.170	64.41		
7	GT	3.599	12%	3.21	1.467	54.35		
8	GT	4.044	12%	3.61	1.901	47.35		
9	GT	3.599	12%	3.21	1.406	56.25		
10	GT	4.119	12%	3.68	1.772	51.82		
11	PP	3.560	12%	3.18	1.899	40.26	47.57	9.99
12	PP	3.881	12%	3.47	1.638	52.73		
13	PP	3.744	12%	3.34	1.505	54.98		
14	PP	3.504	12%	3.13	1.354	56.72		
15	PP	4.061	12%	3.63	1.573	56.62		
16	PP	4.174	12%	3.73	2.525	32.25		
17	PP	3.634	12%	3.24	1.469	54.73		
18	PP	3.769	12%	3.37	1.728	48.65		
19	PP	3.806	12%	3.40	1.741	48.77		
20	PP	3.727	12%	3.33	2.330	29.98		

White rot weight loss for bamboo flooring								
ID	Fungus	Initial wt	MC	Calc. OD wt	Final OD wt	% Wt Loss	Mean	St. Dev.
21	IL	8.329	9%	7.641	7.33	4.07	4.42	0.60
22	IL	7.832	9%	7.185	6.835	4.88		
23	IL	8.565	9%	7.858	7.529	4.18		
24	IL	8.527	9%	7.823	7.357	5.96		
25	IL	8.729	9%	8.008	7.661	4.34		
26	IL	7.412	9%	6.800	6.508	4.29		
27	IL	8.782	9%	8.057	7.701	4.42		
28	IL	7.812	9%	7.167	6.872	4.12		
29	IL	8.010	9%	7.349	7.049	4.08		
30	IL	8.023	9%	7.361	7.074	3.89		
31	TV	8.695	9%	7.98	7.633	4.31	4.45	0.57
32	TV	8.814	9%	8.09	7.769	3.92		
33	TV	8.436	9%	7.74	7.413	4.22		
34	TV	7.941	9%	7.29	6.934	4.82		
35	TV	7.351	9%	6.74	6.441	4.49		
36	TV	9.264	9%	8.50	8.158	4.01		
37	TV	8.510	9%	7.81	7.356	5.78		
38	TV	8.349	9%	7.66	7.349	4.06		
39	TV	8.714	9%	7.99	7.608	4.83		
40	TV	7.952	9%	7.30	6.999	4.06		

White rot weight loss for sweetgum controls								
ID	Fungus	Initial wt	MC	Calc. OD wt	Final OD wt	% Wt Loss	Mean	St. Dev.
21	IL	3.699	12%	3.30	2.294	30.54	27.64	4.35
22	IL	3.634	12%	3.24	2.107	35.06		
23	IL	4.122	12%	3.68	2.674	27.34		
24	IL	3.785	12%	3.38	2.605	22.92		
25	IL	4.051	12%	3.62	2.888	20.15		
26	IL	3.529	12%	3.15	2.292	27.26		
27	IL	3.544	12%	3.16	2.218	29.91		
28	IL	4.023	12%	3.59	2.730	24.00		
29	IL	3.604	12%	3.22	2.299	28.55		
30	IL	3.591	12%	3.21	2.222	30.70		
31	TV	4.327	12%	3.86	2.240	42.02	40.11	1.97
32	TV	3.798	12%	3.39	2.027	40.23		
33	TV	3.686	12%	3.29	2.075	36.95		
34	TV	3.952	12%	3.53	2.018	42.81		
35	TV	3.728	12%	3.33	2.053	38.32		
36	TV	3.774	12%	3.37	2.018	40.11		
37	TV	4.171	12%	3.72	2.159	42.03		
38	TV	3.763	12%	3.36	2.001	40.44		
39	TV	3.636	12%	3.25	2.029	37.50		
40	TV	3.799	12%	3.39	2.012	40.68		

FLAME SPREAD TEST

The Dasso XTR exterior bamboo deck boards were tested to ASTM E84-12 "Standard Method of Test for Surface Burning Characteristics of Building Materials" by QAI Laboratories in Tulsa OK, (reference report TJ1188, dated April 10, 2013). Based on the results presented, the Dasso XTR showed a flame spread of 10 and Smoke Development of 40. Using C NFPA and IBC Classifications the Dasso XTR bamboo decking would have an A Class rating for both NFPA and IBC.

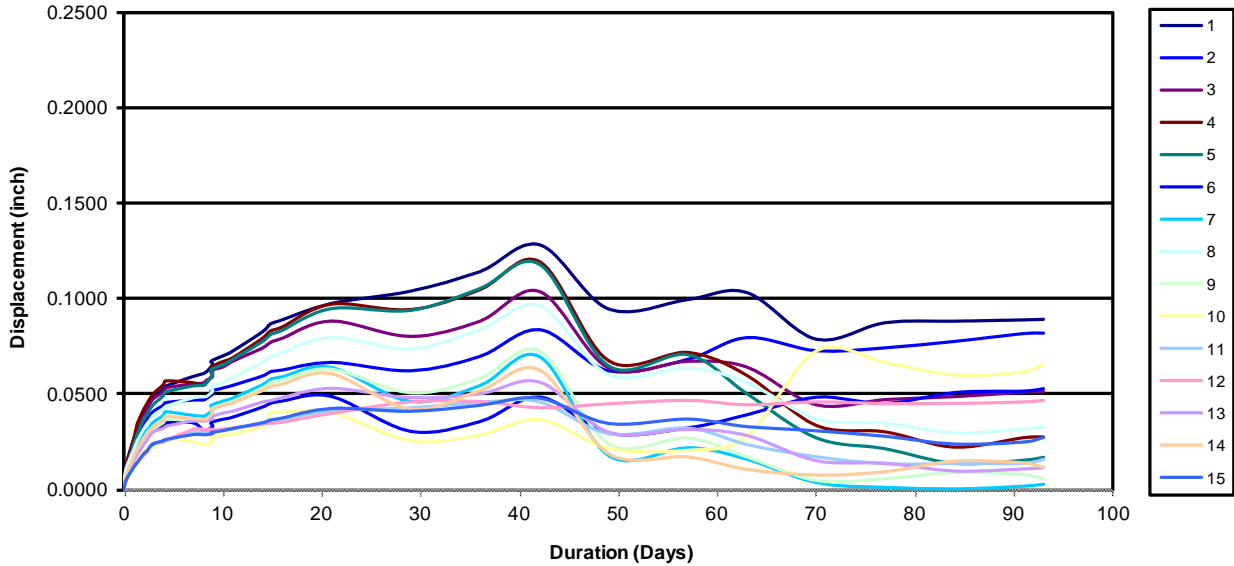
CREEP RECOVERY

15 samples of the Dasso XTR exterior bamboo deck boards were subjected to the creep recovery test in accordance to Section 5.10.1 of ASTM D7031-11 "Standard Guide for Evaluating Mechanical and Physical Properties of Wood Plastic Composite Products". A load of 335 pounds (200 pounds-per-square foot) was placed in a two-point loading centered on the mid-span of the specimens. For this test the end splice of the Dasso XTR exterior bamboo was situated at the center (mid-span) of the 16 inch on center spacing. It was derived that the samples averaged a 79 percent recovery from the applied load. Based on our understanding of the criteria this satisfies the requirements.

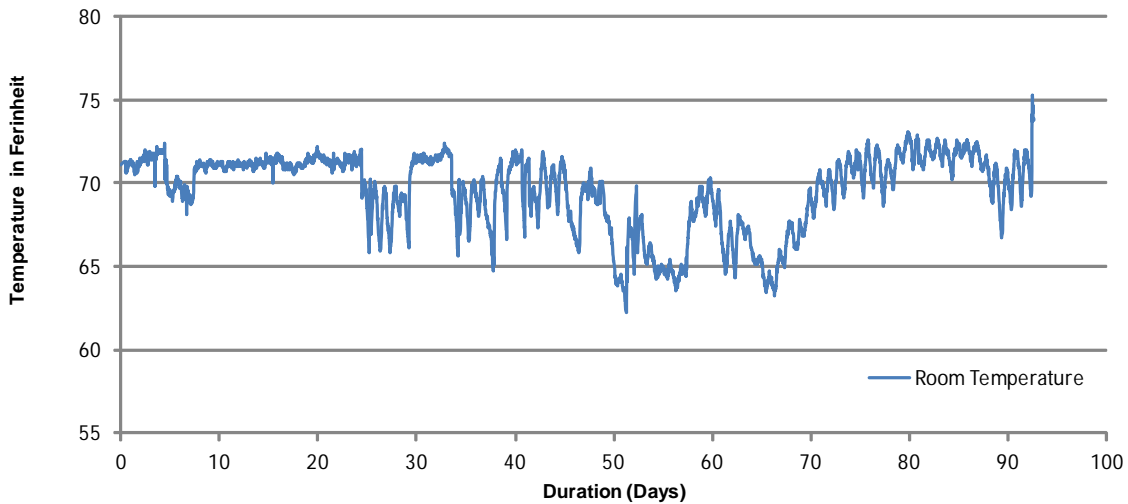
DURATION OF LOAD TEST

The Dasso XTR exterior bamboo deck boards were tested for duration of load in accordance to Section 5.10.2 of ASTM D7031-11 "Standard Guide for Evaluating Mechanical and Physical Properties of Wood Plastic Composite Products". Testing was conducted on 15 samples. A load of 335 pounds (200 pounds-per-square foot) was applied. The maximum displacement seen was 0.128" with an average displacement of 0.079". For a few days, at about 40 days into the testing some equipment was placed at our facility and coincides with the peak increase and peaking change on the following graph. The displacement indicates a leveling trend at about the 80 day duration.

**Duration of Load Displacement Over End Splice 16" Span
70°F Temperature
(Applied Load: 335 lbf, 200 PSF)**



Duration of Load Temperature Over End Splice 16" Span




STAIR TREAD LOAD TEST

The Dasso XTR exterior bamboo deck boards were tested for use as stair treads. Testing was conducted in accordance with Section 4 of ICC-ES AC174 and was found to be in compliance with the requirements for stair tread use.

FASTENER TEST


The Dasso XTR exterior bamboo deck boards were tested with a hidden fastener system form Tiger Claw hidden fasteners, the TC120 for withdrawal/uplift and lateral (parallel) values. Testing was conducted by placing the fasteners as prescribed by the manufacture in four locations on one Dasso XTR bamboo deck board with a load being applied uniformly to the underside of the board between 16" on center joist members for the uplift test. For the lateral test four TC120 clips were fastened as prescribed by the manufacture to the bamboo decking. A load was applied to the length of the deck board and a maximum load was recorded. The results of this testing is shown in the following pages.

FASTENER – WITHDRAWAL/UPLIFT:

 Element Materials Technology + St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking Fastener Withdrawal/Uplift Testing			Test Series: Fastener Test Withdrawal/Uplift	
Setup and Installation Technician: S.Palodichuk			Test Equipment System No. CME-SPC-903 Load Cell CME-SPC-401		Calibration Date 10/2/2012 6/6/2012	
Test Specimen Data Bamboo Decking Span (in): 16 Thickness (in): 0.791						
Notes: 4 fasteners tested per test.				Calculations Based on Test Data No. of Test Samples, n: 5 Average Ultimate Load (lbf): 511 Standard Deviation (lbf): 257 COV: 50.2%		
Failure Modes: BC: Bent Clip FP: Fastener Pull-out						
	Test No.	1	2	3	4	5
Test Data						
Test Date	05/01/13	05/01/13	05/01/13	05/01/13	05/01/13	05/01/13
Test Time	2:30 PM	2:44 PM	3:01 PM	3:11 PM	3:23 PM	
Ultimate Load (lbf)	546	596	707	644	576	
Failure Displace (in.)	N/A	N/A	N/A	N/A	N/A	
Failure Mode	SC	SC	SC	SC	SC	
Test Duration (sec.)	86	102	72	57	45	

Fastener Withdrawal/Uplift

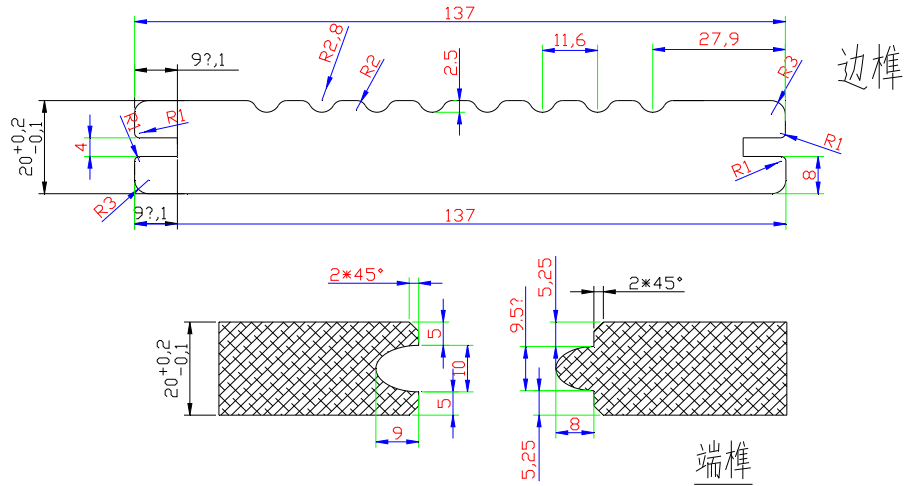
FASTENER – LATERAL:

 Element Materials Technology + St. Paul Project No. ESP012661P		Test Sample: DassoXTR Bamboo Decking Fastener Lateral Testing			Test Series: Fastener Test Lateral	
Setup and Installation Technician: N. Holderbaum			Test Equipment System No. CME-SPC-903 Load Cell CME-SPC-401		Calibration Date 10/2/2012 6/6/2012	
Test Specimen Data Bamboo Decking Span (in): 16 Thickness (in): 0.791						
Notes: 4 fasteners tested per test.				Calculations Based on Test Data No. of Test Samples, n 5 Average Ultimate Load (lbf) 189 Standard Deviation (lbf) 172 COV 91.0%		
Failure Modes: BC: Bent Clip CS: Clip Slipping FP: Fastener Pull-out						
Test No.	1	2	3	4	5	
Test Data						
Test Date	05/02/13	05/02/13	05/02/13	05/02/13	05/02/13	
Test Time	11:38 AM	1:12 PM	1:42 PM	1:59 PM	2:10 PM	
Ultimate Load (lbf)	515	148	180	139	151	
Failure Displace (in.)	N/A	N/A	N/A	N/A	N/A	
Failure Mode	CS	CS	CS	CS	CS	
Test Duration (sec.)	116	125	97	45	83	

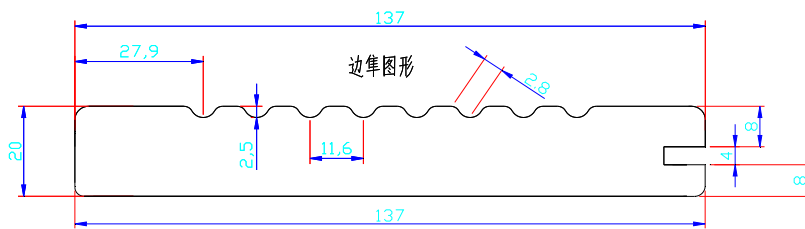
Fastener Lateral

APPENDIX B – PRODUCT DRAWINGS:

X I R 20G 2



XTR 20G 1



MOSO 户外板尺寸图