



**Title:** Impact bending strength of Accoya™ wood

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## Summary

Titan Wood B.V. appointed SHR Timber Research to determine the impact bending strength of Accoya™ wood according to DIN 52189. The technology behind Accoya™ wood is based on wood acetylation. In this investigation Accoya™ wood and the untreated original wood species, Radiata Pine, were tested as part of the research scheme for KOMO certification BRL 0605 “Modified Timber”.

This report shows that the impact bending strength of Accoya™ wood was not significantly different to that of (untreated) Radiata Pine. The average impact bending strength of untreated Radiata Pine was 48 kJ/m<sup>2</sup>, whereas the corresponding average impact bending strength for Accoya™ wood was found to be 50 kJ/m<sup>2</sup>. The deviation of the impact bending strength was slightly higher for Accoya™ wood than for the untreated Radiata Pine. The deviation of the impact bending strength between different acetylation batches was found to be low, considering the natural variability of this value in wood.

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## 1 Assignment

Titan Wood B.V. appointed SHR Timber Research to determine the impact bending strength of Accoya™ wood. The technology behind Accoya™ wood is based on wood acetylation, a chemical modification process that improves the dimensional stability, UV-stability and durability of wood. The process modifies the wood without the addition of toxic chemicals. Accoya™ wood's durability and dimensional stability can be determined after the acetylation process has taken place by analysing the wood's acetyl content.

In co-operation with a Dutch certification body, SKH, and research institute, SHR Timber Research, Titan Wood has established a research scheme to independently prove the quality of Accoya™ wood. This scheme consists of:

1. KOMO certificate BRL 0605 "Modified Timber". Here the emphasis is on the uniformity and reproducibility of the production process, as well as on Titan Wood's quality system.
2. Fulfilment of the (material) requirements as listed for in use of certified Dutch joinery (SKH Publication 97-04). Emphasis is on material properties, such as durability, dimensional stability and paintability.

In this research the impact bending strength of Accoya™ wood and the untreated (original) wood species, Radiata Pine, were tested as part of the research scheme described above.

## 2 Execution of the test

### 2.1 Identification and description of the samples

Sampling was performed according to BRL 0605 "Modified Timber" by Titan Wood. Accoya™ wood samples were taken from 3 batches produced in Titan Wood's pilot plant (15 samples per batch), originating from different boards. In total, 45 samples of Accoya™ wood and 15 samples of (untreated) Radiata Pine were tested, each with a dimension of 20 x 20 x 300 mm. The codes of the samples and the correlating batch numbers can be found in appendix 1.

### 2.2 Procedure

The impact bending strength was determined according to DIN 52189. The impact bending strength of Accoya™ wood and (untreated) Radiata Pine was tested according to the hammer method on specimens (defect free) with a cross section size of 20 x 20 mm. The energy (Newton) required to break the sample by the swing of the hammer is recorded. The impact bending strength is expressed as kJ/m<sup>2</sup>.

### 3 Results of the test

The averaged impact bending strength values of Accoya™ wood and untreated Radiata Pine are shown in table 1. All individual values can be found in appendix 2.

**Table 1.** The average impact bending strength (n=15) of Accoya™ wood and untreated Radiata Pine.

		Impact bending strength		65% RH; 20 °C	
				Density	Moisture content
batch number		[kJ/m <sup>2</sup> ]	[stdev]	[kg/m <sup>3</sup> ]	[%]
<b>Accoya™ wood</b>					
	LG118	48	14	535	4,2
	LG122	54	19	535	4,1
	LG123	47	19	508	4,1
<b>average</b>		<b>50</b>	<b>17</b>	<b>526</b>	<b>4,1</b>
<b>Radiata Pine</b>	Ref-LG122	<b>48</b>	<b>15</b>	<b>515</b>	<b>12,1</b>

### 4 Discussion and conclusion

Based on these research results, it can be concluded that the impact bending strength of Accoya™ wood was not significantly different from that of (untreated) Radiata Pine. The average impact bending strength of untreated Radiata Pine was 48 kJ/m<sup>2</sup> whereas the corresponding average impact bending strength of Accoya™ wood was found to be 50 kJ/m<sup>2</sup>. The deviation of the impact bending strength was slightly higher for Accoya™ wood compared to the untreated Radiata Pine. The deviation of the impact bending strength between different acetylation batches was found to be low, considering the natural variability of this value in wood.

## References

BRL 0605 (dated 31-01-2003). National Assessment Directive for the KOMO® Product Certificate Modified Timber. Stichting Keuringsbureau Hout SKH, Wageningen, the Netherlands.

SKH Publicatie 97-04 (Nieuw concept 13 april 2006). Beoordelingsgrondslag Houtsoorten voor toepassing in geveltimmerwerk; eisen en bepalingsmethoden. Stichting Keuringsbureau Hout SKH, Wageningen.

DIN 52189 (1981). Prüfung von Holz; Schlagbiegeversuch; Bestimmung der Bruchschlagarbeit. DIN Deutsches Institut für Normung, Berlin, Germany.

**Appendix 1      Sampling, codes and batch numbers**

<b>Impact bending strength test Titan Wood</b>				
<b>Sample overview</b>				
<b>Accoya™ wood Acetylated Radiata Pine</b>				<b>Reference Radiata Pine</b>
	<b>Batch LG118</b>	<b>Batch LG122</b>	<b>Batch LG123</b>	<b>References</b>
1	LG118 RP2	LG122 RP1	LG123 RP2	REF - LG122 RP1
2	LG118 RP4	LG122 RP3	LG123 RP3	REF - LG122 RP3
3	LG118 RP5	LG122 RP5	LG123 RP4	REF - LG122 RP5
4	LG118 RP6	LG122 RP6	LG123 RP5	REF - LG122 RP6
5	LG118 RP7	LG122 RP8	LG123 RP6	REF - LG122 RP8
6	LG118 RP9	LG122 RP9	LG123 RP8	REF - LG122 RP9
7	LG118 RP11	LG122 RP10	LG123 RP9	REF - LG122 RP10
8	LG118 RP13	LG122 RP11	LG123 RP10	REF - LG122 RP11
9	LG118 RP14	LG122 RP13	LG123 RP11	REF - LG122 RP13
10	LG118 RP15	LG122 RP14	LG123 RP12	REF - LG122 RP15
11	LG118 RP16	LG122 RP15	LG123 RP14	REF - LG122 RP16
12	LG118 RP17	LG122 RP16	LG123 RP15	REF - LG122 RP17
13	LG118 RP20	LG122 RP17	LG123 RP16	REF - LG122 RP20
14	LG118 RP21	LG122 RP20	LG123 RP18	REF - LG122 RP21
15	LG118 RP22	LG122 RP21	LG123 RP19	REF - LG122 RP22



**Appendix 2 Detailed test results**

Board	Dimensions			Impact		Impact bending strength	65% RH; 20 °C	
	Length	Width	Height				Density	Moisture content
	[mm]	[mm]	[mm]	[kgf*m]	[J]		[kg/m3]	[%]
LG118 RP2	300	20,23	20,15	2,62	25,7	63,1	499	4,2
LG118 RP4	300	20,20	20,15	1,03	10,1	24,8	561	4,2
LG118 RP5	300	20,14	20,13	2,20	21,6	53,2	521	4,1
LG118 RP6	300	20,15	20,16	1,20	11,8	29,0	559	4,1
LG118 RP7	300	20,23	20,25	1,80	17,7	43,1	521	4,0
LG118 RP9	300	20,18	20,30	2,82	27,7	67,5	532	4,1
LG118 RP11	300	20,16	20,15	2,39	23,4	57,7	551	4,1
LG118 RP13	300	20,15	20,16	1,14	11,2	27,5	615	4,0
LG118 RP14	300	20,16	20,17	1,88	18,4	45,4	524	4,3
LG118 RP15	300	20,22	20,27	2,37	23,2	56,7	515	4,3
LG118 RP16	300	20,26	20,25	2,22	21,8	53,1	561	4,1
LG118 RP17	300	20,29	20,06	2,25	22,1	54,2	517	4,2
LG118 RP20	300	20,06	20,11	2,68	26,3	65,2	519	4,3
LG118 RP21	300	20,22	20,21	1,53	15,0	36,7	551	4,4
LG118 RP22	300	20,08	20,10	1,45	14,2	35,2	474	4,7
<b>Avg</b>						<b>47,5</b>	<b>535</b>	<b>4,2</b>
<b>Stdev</b>						<b>14,1</b>	<b>33</b>	<b>0,2</b>

Board	Dimensions			Impact		Impact bending strength	65% RH; 20 °C	
	Length	Width	Height				Density	Moisture content
	[mm]	[mm]	[mm]	[kgf*m]	[J]		[kg/m3]	[%]
LG122 RP1	300	20,10	20,57	2,59	25,4	61,5	568	3,9
LG122 RP3	300	20,16	20,17	2,33	22,9	56,2	531	3,9
LG122 RP5	300	20,06	20,11	1,70	16,7	41,3	491	4,1
LG122 RP6	300	20,21	20,23	4,18	41,0	100,3	592	4,3
LG122 RP8	300	20,12	20,12	2,32	22,8	56,2	523	4,0
LG122 RP9	300	20,13	20,20	2,41	23,6	58,1	514	4,2
LG122 RP10	300	20,09	20,16	2,24	22,0	54,3	562	4,2
LG122 RP11	300	20,18	20,10	2,73	26,8	66,0	497	5,0
LG122 RP13	300	20,18	20,19	2,05	20,1	49,4	506	4,1
LG122 RP14	300	20,21	20,45	1,88	18,4	44,6	523	4,2
LG122 RP15	300	20,16	20,15	2,30	22,6	55,5	566	4,1
LG122 RP16	300	20,11	20,29	3,24	31,8	77,9	538	4,1
LG122 RP17	300	20,05	20,32	1,10	10,8	26,5	566	4,3
LG122 RP20	300	20,11	20,05	1,01	9,9	24,6	481	4,1
LG122 RP21	300	20,15	20,15	1,80	17,7	43,5	569	3,7
<b>Avg</b>						<b>54,4</b>	<b>535</b>	<b>4,1</b>
<b>Stdev</b>						<b>18,8</b>	<b>34</b>	<b>0,3</b>

Board	Dimensions			Impact			65% RH; 20 °C	
	Length	Width	Height	Impact		Impact bending strength	Density	Moisture content
	[mm]	[mm]	[mm]	[kgf*m]	[J]	[kJ/m2]	[kg/m3]	[%]
LG123 RP2	300	20,22	20,23	1,57	15,4	37,7	492	3,9
LG123 RP3	300	20,18	20,24	1,61	15,8	38,7	486	4,2
LG123 RP4	300	20,12	20,12	2,09	20,5	50,6	504	4,3
LG123 RP5	300	20,16	20,16	2,28	22,4	55,0	494	4,1
LG123 RP6	300	20,12	20,25	2,80	27,5	67,4	541	3,7
LG123 RP8	300	20,18	20,11	1,17	11,5	28,3	568	4,2
LG123 RP9	300	20,24	20,15	2,05	20,1	49,3	500	4,2
LG123 RP10	300	20,16	20,23	1,32	12,9	31,8	501	3,9
LG123 RP11	300	20,17	20,25	1,98	19,4	47,6	522	4,0
LG123 RP12	300	20,15	20,13	1,41	13,8	34,1	435	4,2
LG123 RP14	300	20,20	20,19	1,63	16,0	39,2	500	4,1
LG123 RP15	300	20,21	20,22	2,89	28,4	69,4	555	4,1
LG123 RP16	300	19,78	20,35	3,02	29,6	73,6	544	4,4
LG123 RP18	300	20,08	20,07	2,21	21,7	53,8	508	4,0
LG123 RP19	300	20,21	20,21	1,27	12,5	30,5	474	3,9
					<b>Avg</b>	<b>47,1</b>	<b>508</b>	<b>4,1</b>
					<b>Stdev</b>	<b>14,6</b>	<b>34</b>	<b>0,2</b>

Board	Dimensions			Impact			65% RH; 20 °C	
	Length	Width	Height	Impact		Impact bending strength	Density	Moisture content
	[mm]	[mm]	[mm]	[kgf*m]	[J]	[kJ/m2]	[kg/m3]	[%]
REF - LG122 RP1	300	20,19	20,18	2,21	21,7	53,2	527	12,1
REF - LG122 RP3	300	20,15	20,14	1,66	16,3	40,1	485	12,6
REF - LG122 RP5	300	20,18	20,12	1,90	18,6	45,9	499	12,3
REF - LG122 RP6	300	20,22	20,10	2,70	26,5	65,2	432	12,2
REF - LG122 RP8	300	20,21	20,18	1,74	17,1	41,9	575	11,9
REF - LG122 RP9	300	20,18	20,11	2,11	20,7	51,0	435	11,9
REF - LG122 RP10	300	20,18	20,15	2,80	27,5	67,6	503	11,9
REF - LG122 RP11	300	20,22	20,10	2,21	21,7	53,3	531	12,0
REF - LG122 RP13	300	20,13	20,22	1,49	14,6	35,9	433	11,5
REF - LG122 RP15	300	20,18	20,12	2,07	20,3	50,0	448	12,2
REF - LG122 RP16	300	20,25	20,21	3,37	33,1	80,8	535	11,9
REF - LG122 RP17	300	20,25	20,24	1,13	11,1	27,0	517	11,6
REF - LG122 RP20	300	20,24	20,08	1,58	15,5	38,1	427	12,9
REF - LG122 RP21	300	20,05	20,16	1,01	9,9	24,5	500	12,8
REF - LG122 RP22	300	20,26	20,20	1,90	18,6	45,5	466	12,3
					<b>Avg</b>	<b>48,0</b>	<b>515</b>	<b>12,1</b>
					<b>Stdev</b>	<b>15,0</b>	<b>46</b>	<b>0,4</b>