Our ref: TS//F13226-2

25 November 2015

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John Alexander
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Royal Albert House
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Re: Assessment of the stability of 15mm-thick Accoya® cladding boards

Dear Mr Alexander,

The following sets out our findings to date (November 25th 2015). The trial has been ongoing at our High Wycombe site from September 2013 to the present date and is to continue until further notice.

We have renumbered the tables in this technical letter in numerical sequence, as the numbered tables in our previous technical letter referenced TC//F13226, December 2013, incorrectly omitted numbers 3, 8 and 9.

Background and Scope of work

BM TRADA was contacted by 'the Client', Accsys Technologies PLC to assess the stability of 15mm-thick, 195mm-wide tongue and groove profile cladding boards. BM TRADA understands that a number of these boards were manufactured from Accoya® (radiata pine that has been chemically modified through acetylation) whereas others identical in profile were manufactured from unmodified radiata pine. Mr Richard Mosson of James Latham Dudley delivered nine Accoya® and eleven unmodified radiata pine cladding boards all measuring 500mm in length, to BM TRADA's laboratories.

The following Scope of Work was agreed with 'the Client'.

The aim of this work is to provide an independent assessment of the stability of 15mm-thick Accoya® cladding boards. To do this BM TRADA will undertake the following:-

- To examine flatness of all boards supplied using a levelling table, calibrated straight edge and feeler gauges at the time of delivery. To examine individual boards for any distortion along their lengths and for cupping across their widths.

- All boards will be fixed horizontally to softwood battens at 400mm centres so they are orientated south-facing at 45°. Fixings will be located 20mm from board ends and 15mm from the lateral edges.

- The extent of cupping at specific locations across the widths of the boards will be examined every two weeks for a period of three months. Performance of Accoya® and unmodified radiata pine will also be compared.

- Splitting and checking around fixings will also be recorded for both Accoya® and unmodified radiata pine.

Test procedures

Testing commenced on August 29th, 2013.

Before exposure, the thicknesses of all cladding boards were measured at six locations (as shown in Diagram 1) using digital callipers. Distortion across the width of the boards in the form of cupping and along the lengths of boards in the form of bow or twist was assessed by examining whether individual cladding boards lay flush against a level surface and by measuring the maximum heights of any gaps between the undersides of the boards and the flat surface they were laid on.

All cladding boards were predrilled and fixed to the softwood battens at 400mm centres using stainless steel screws.

One pair of the Accoya® cladding boards was fixed so that the tongue of one was engaged in the groove of another and two fixed so that they were separated from each other (as shown in Diagram 2 and Photograph 1). The unmodified radiata pine cladding boards were set out in an identical manner.

All the cladding boards were installed uncoated in order to optimise the uptake and loss of moisture from the wood surfaces and set out so that they were South-facing and at 45°. This orientation was chosen so that the outer face of each cladding board was exposed to a greater level of solar radiation and therefore drying which would not be the case if they were installed at 90° to the horizontal. At the time of installation the weather was sunny with a temperature of 28°C.

Cupping in boards exposed on the rigs was assessed at weekly intervals by placing a straight edge across their widths at either end of each board and measuring the maximum gap between the straight-edge and board (see Photograph 2).

The thicknesses of individual cladding boards were assessed periodically throughout the trial to assess for swelling.

The weekly ranges of temperatures for the South East of the UK has been provided for the exposure period and the weather conditions at the time of each inspection recorded.

Diagram 1. Positions on the cladding boards where thickness was measured.

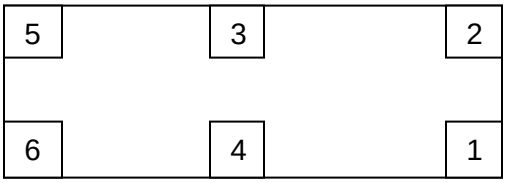
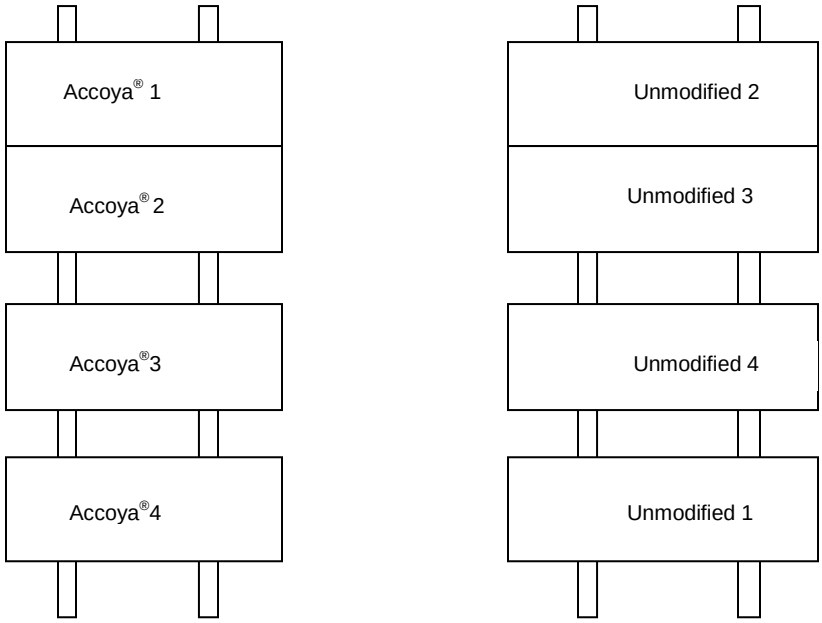
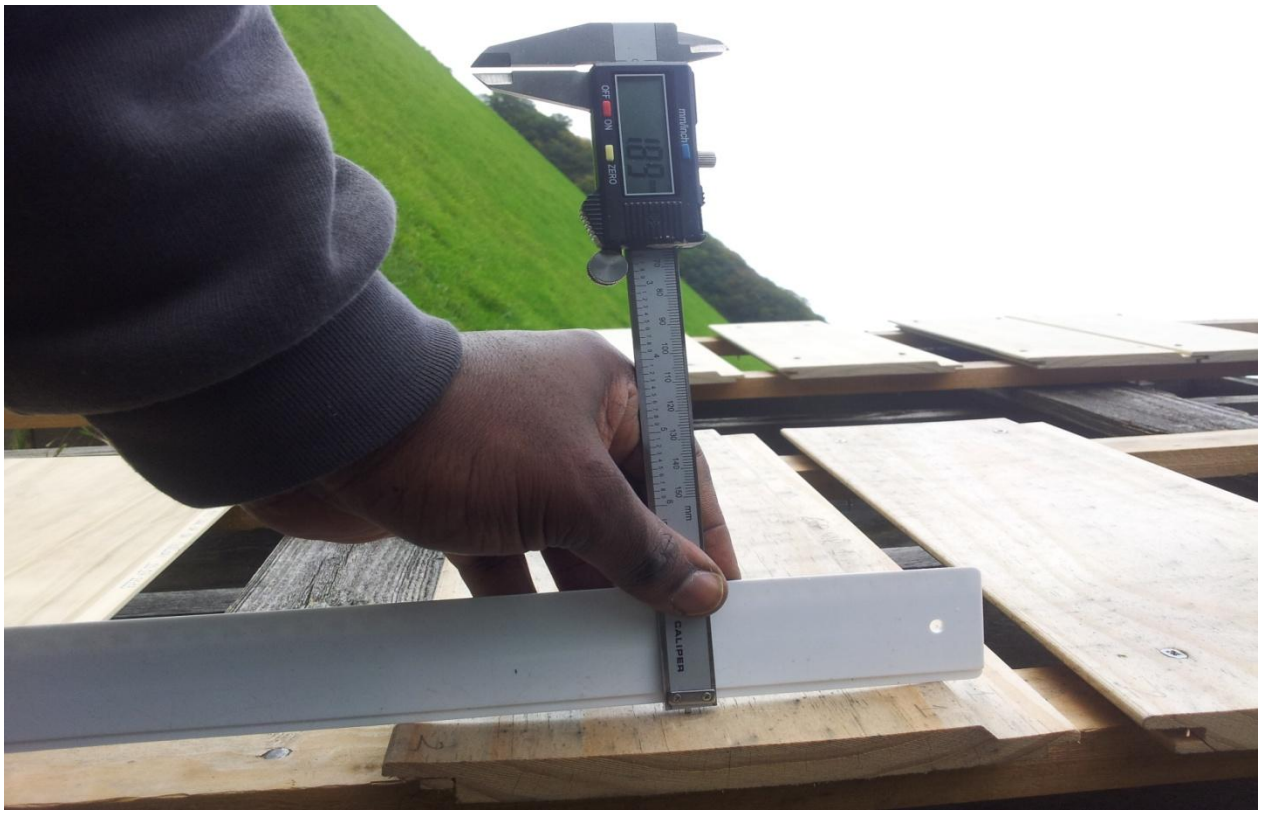


Diagram 2. Arrangement of the Accoya® and the unmodified radiata pine cladding on the rigs.



Photograph 1. Arrangement of cladding on the rigs with boards fixed to the battens at 400mm centres.

Photograph 2. Method for measuring the maximum gap between the straight edge and the face of the board, using a straight edge and digital callipers.



Results

Table 1. Initial thicknesses of the boards & extent of cupping as received

Board sample code	Thickness (mm) at board position						Level of Distortion
	1	2	3	4	5	6	
Accoya® 1	15.20	14.88	15.12	14.99	15.22	15.06	No cupping or warping
Accoya® 2	15.29	14.88	14.98	15.00	15.20	14.97	No cupping or warping
Accoya® 3	15.28	15.55	15.05	14.99	15.18	15.31	No cupping or warping
Accoya® 4	15.24	15.30	15.18	14.94	15.42	14.97	No cupping or warping
Unmodified 1	15.19	14.99	15.14	14.99	15.26	15.00	1.76 mm cupping
Unmodified 2	15.27	15.01	15.15	14.96	15.15	14.94	1.62 mm cupping
Unmodified 3	15.22	15.00	15.21	15.04	15.15	14.95	1.32 mm cupping
Unmodified 4	15.26	15.11	15.10	15.00	15.23	15.08	0.78 mm cupping

Table 2. Level of distortion in the boards following one week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Sep 19th, 2013	Periods of rain	16	8	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					1.84	2.14
Unmodified 2					1.44	2.05
Unmodified 3					none	none
Unmodified 4					none	none

Table 3. Level of distortion in the boards following two week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Sep 27th, 2013	Sunny to partly cloudy	19	10	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					2.63	2.73
Unmodified 2					2.88	3.46
Unmodified 3					2.50	1.30
Unmodified 4					2.28	1.50

Table 4. Level of distortion in the boards following three week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Oct 1st, 2013	Mostly cloudy	17	12	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					none	none
Unmodified 2					none	none
Unmodified 3					none	none
Unmodified 4					none	none

Table 5. Level of distortion in the boards following five week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Oct 17th , 2013	Mostly sunny	12˚C	9˚C	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					1.70	2.31
Unmodified 2					2.01	1.85
Unmodified 3					0.74	none
Unmodified 4					1.15	1.23

Table 6: Level of distortion in the boards following seven week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Oct 31st , 2013	Periods of heavy rain	12	4	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					none	none
Unmodified 2					none	none
Unmodified 3					none	none
Unmodified 4					none	none

Table 7: Level of distortion in the boards following eight week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Nov 7th, 2013	Partly cloudy with scattered showers	11	3	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					none	none
Unmodified 2					none	none
Unmodified 3					none	none
Unmodified 4					none	none

Table 8: Level of distortion in the boards following nine week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Nov 19th, 2013	Sunny and cold	5	-3	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					2.04	2.57
Unmodified 2					1.17	1.28
Unmodified 3					none	none
Unmodified 4					1.76	1.56

Table 9: Level of distortion in the boards following eleven week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Dec 3rd, 2013	Cold and cloudy with brief periods of sunshine with a few scattered showers.	8	1	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					none	none
Unmodified 2					none	none
Unmodified 3					none	none
Unmodified 4					none	none

Table 10: Level of distortion in the boards following thirteen week's exposure

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Dec 17th, 2013	Briefly sunny to partly cloudy with scattered showers.	8	2	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					none	none
Unmodified 2					none	none
Unmodified 3					none	none
Unmodified 4					none	none

Table 11: Level of distortion in the boards following an exposure period of 2 years, 2 months and 6 days.

Board sample code	Date checked	Weather Conditions	Temperature in ˚C		Variations in (mm)	
			High	Low	Left	Right
Accoya® 1	Nov 25th 2015	Cold, partly cloudy with scattered showers.	9	6	none	none
Accoya® 2					none	none
Accoya® 3					none	none
Accoya® 4					none	none
Unmodified 1					2	2.12
Unmodified 2					1.33	0.62
Unmodified 3					1.17	1.02
Unmodified 4					none	none

Discussion of findings

This final report presents the provisional findings from our field-trial designed to compare the stability of 15mm-thick 195mm wide cladding boards. The data presented is for the testing period September 19th 2013 to November 25th 2015, exposed on the 45° rig.

Initial examination of both sets of radiata pine cladding boards at the time of receipt confirmed both sets of boards to be 15mm in thickness and 195mm in width (refer to table 1). Both sets of cladding were plain cut (i.e. flat sawn) (refer to end grain visible in photograph 2).

Initial measurements detected no form of distortion (i.e. no cupping) in the Accoya® cladding boards although a certain degree of cupping was observed in all four unmodified radiata pine cladding boards.

When the boards were inspected over the exposure period date, the extent of cupping was found to vary in the unmodified cladding boards depending on the weather conditions, with cupping more pronounced during drier and warmer periods. Cupping is known to be more pronounced in wider and thinner boards that have been flat sawn. Radiata pine is known to be a medium movement species. (European redwood and European whitewood are another two species suitable for cladding with the characteristic medium movement).

At the time of our last examination on the morning of November 25th 2015, no cupping was detected in any of the Accoya® cladding boards. This is despite the cladding being exposed for a period over 2 years, uncoated (and with exposed end grain) which would be expected to promote uptake and loss of moisture from the boards and the boards being exposed at 45 ˚ where there are exposed to changing weather at the outer face whereas the inner face is protected.

Two individual (Accoya® or unmodified) (fifth) cladding boards were installed to the test rig at a south facing 45° angle. This was installed on November 20th 2013 to determine if the application method promoted extra cupping of the cladding boards since these are not restrained by engagement of the tongue in the grove of an adjacent fixed board.

There was no evidence of splits or checks around the stainless steel fixtures used to secure the boards at quarter points over the entire testing period which was September 19th 2013 to November 25th 2015.

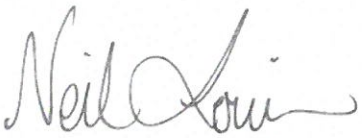
Conclusion

Based on our findings and observations over the entire testing period (September 19th 2013 to November 25th 2015) BM TRADA concludes that:-

1. Evidence of cupping was identified in unmodified radiata pine boards measuring 15mm thick and 195mm wide when exposed outdoors at the field test site during periods of dry/sunny and wet weather shows this test method promotes cupping.

2. Since no cupping could be detected in Accoya® cladding boards of identical dimensions exposed to the same conditions for a period of 2 years and 2 months, then BM TRADA is of the opinion that Accoya® cladding of 15mm thickness is likely to remain free from detectable distortion over its life.

Authorisation

	Issued by:	**Under the authority of:**
Signature:		
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