

ACCOYA®

Performance Testing Summary



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1 INTRODUCTION

A new way of thinking about wood

Accoya represents a revolution in modified wood, bringing new design possibilities for architects, manufacturers and property owners.

The benefits of Accoya mean that timber projects can now be designed with absolute confidence. Accoya is a highly proven product with testing from many different perspectives, on a worldwide basis. Many tests have been conducted in real world conditions over many years.

This summary shows some of these results.

Accsys run an Approved Manufacturer Training Programme and we would encourage all manufacturers planning to use Accoya to contact their distributor or Accsys directly to arrange for this training programme. The Approved Manufacturer status also brings a number of benefits which support market activity.

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2 DURABILITY



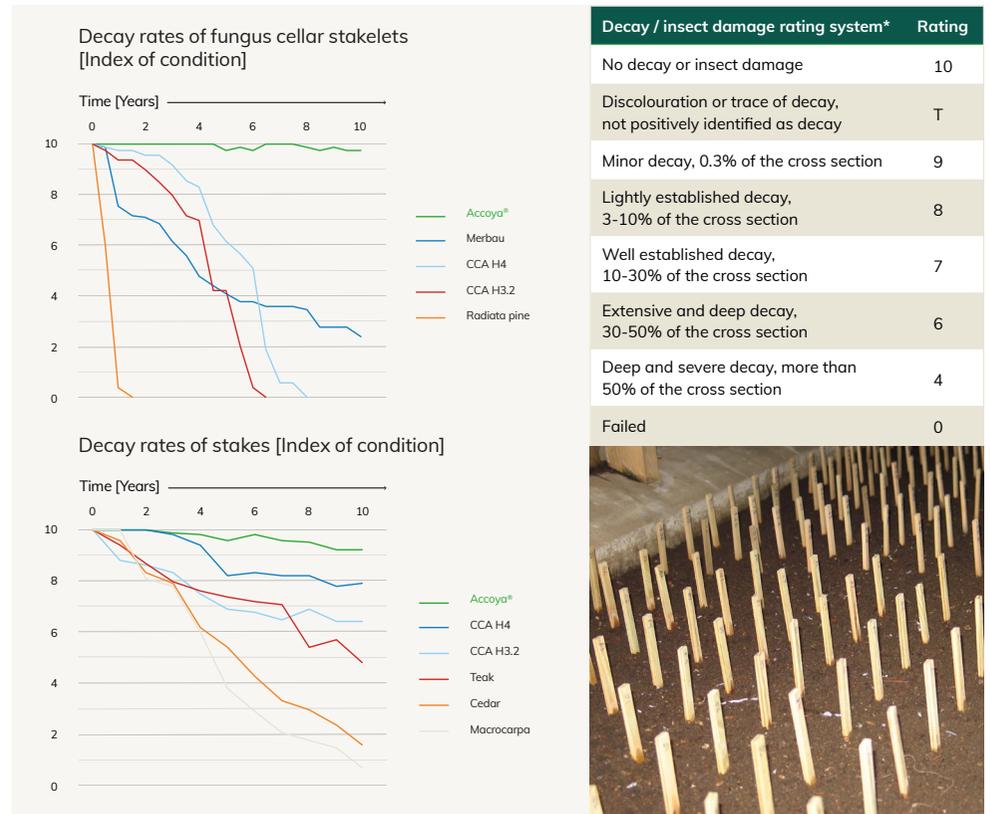
10 year durability comparison

Scion is a Crown research institute that specialises in research, science and technology development for the forestry, wood product, wood-derived materials, and other biomaterial sectors. Scion tested the durability of Accoya wood against other naturally durable and preservative treated timbers.

The rigorous tests run exposed timbers in accelerated decay chambers and in exterior ground contact tests at the Whakarewarewa site. The tests have run for 10 years and show Accoya outperforming Teak, Merbau, Cypress, Cedar and H3.2 (above ground, uncoated horizontal) and H4 (in ground contact) preservative (CCA) treated timbers, proving that Accoya has the highest possible durability classification.

*Based on ASTM D 1758

THIS TEST WAS CONDUCTED BY:



Decay / insect damage rating system*	Rating
No decay or insect damage	10
Discolouration or trace of decay, not positively identified as decay	T
Minor decay, 0.3% of the cross section	9
Lightly established decay, 3-10% of the cross section	8
Well established decay, 10-30% of the cross section	7
Extensive and deep decay, 30-50% of the cross section	6
Deep and severe decay, more than 50% of the cross section	4
Failed	0



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2 DURABILITY



5-year decay test

Timber Products Inspection (USA), the largest accredited agency under ALSC for wood related auditing programs, have performed decay tests of Accoya wood at their Gainesville (FL) exposure site.

Testing was done over a 5 year field trial period according to AWPA E7-09 in ground stake test and AWPA E18-06 ground proximity test. The results show Accoya wood to outperform high quality (FEQ) teak, western red cedar and African mahogany.

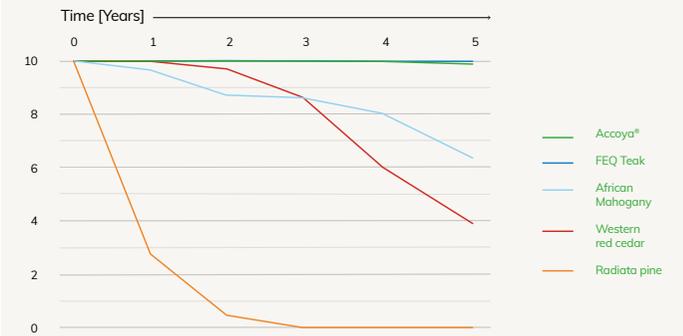


In Ground and Ground proximity testing, Gainesville, Florida

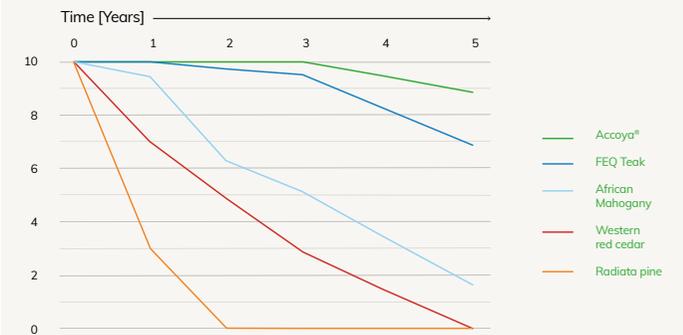
THIS TEST WAS CONDUCTED BY:



5 year decay rating (E18 ground proximity)



5 year decay rating (E7 ground contact)



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2 DURABILITY



Durability and strength test

Timber Products Inspection (USA) undertook a number of thorough and independent tests to analyse Accoya wood's durability, stability and strength performance characteristics in accordance with the USA's Window & Door Manufacturers Association (WDMA) requirements.

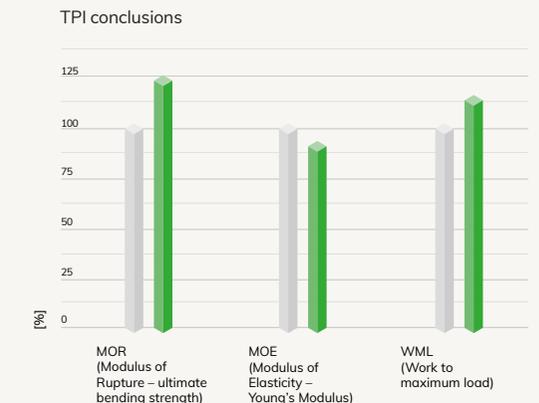
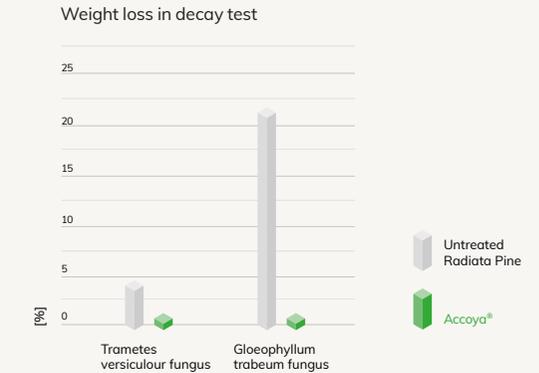
Accoya wood outperformed Radiata Pine in accelerated decay chambers highlighting its durability. The results showed that Accoya wood had a very low weight loss percentage for both brown rot (*Gloeophyllum trabeum*) and white rot (*Trametes versicolor*) fungi against such types of decay.

TP also evaluated mechanical properties. Overall, the properties of Accoya are essentially the same as those of the untreated (Radiata Pine) control.

The MOR and WML values of Accoya are slightly higher and the average MOE value of Accoya is slightly lower than that of untreated Radiata Pine unlike some wood modification techniques that cause significant reductions in strength.

The tests proved that Accoya meets WDMA's stringent rot resistance requirements, which means it's an ideal choice for windows and doors.

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2 DURABILITY



15 & 20 year canal lining test

Accoya wood's high performance was proven with two Dutch project tests in the Flevopolder near Almere, one installed in 1995 and one in 2000. The SHR institute in the Netherlands originally set up the tests and made detailed inspections at respective 15 and 20 year exposure periods in 2015.

These tests include acetylated wood alongside control wood, preservative treated wood and hardwood species used as a canal lining (fresh water exposure). These canal bank conditions are particularly punishing, especially at the waterline, since the wood is exposed to a combination of water, microbe rich soil and air (oxygen). Both trials show hardly any sign of rot, decay or fungal damage in acetylated wood –

highlighting its class 1 durability status and reinforcing the 25-year ground and fresh water contact warranty. From these test results, SHR concludes that the durability of acetylated wood in fresh water applications competes with highly durable hardwood species and professionally preserved wood.

THIS TEST WAS
CONDUCTED BY:



Accoya wood



Non-Accoya wood

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2 DURABILITY



20 year window L-joint test

BRE, with its main campus outside London UK is a world leading, multi-disciplinary, building science centre with a mission to improve buildings and infrastructure, through research and knowledge generation.

In durability field testing to European Norm (EN) 330:1993 – which parallels American Wood-Preserver's Association (AWPA) E9 – simple mortice and tenon joints (L-joints) are assembled, coated and placed outside, with the coating over the joint deliberately broken to allow water ingress that might be encountered if a joint is open, damaged or poorly maintained. This test represents a worst case scenario for joinery products and requires the coated wood to be exposed to normal environmental factors.

In February 1998, L-joints were installed at the BRE Garston field exposure site (Watford, UK) facing the prevailing south westerly weather on an elevated test rig. The acetylated L-joints used were acetylated at the University of Wales, Bangor, to a lower acetyl content than Accoya wood, and still performed significantly better than the treated wood, which were degraded completely in 2014.

BRE concludes that Accoya wood would exceed the biological reference value (brv) and would be deemed to provide sufficient protection for long life window joinery.

THIS TEST WAS
CONDUCTED BY:

bre



The acetylated L-joints after 20 years of exposure

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3 TERMITE RESISTANCE



Formosan termite durability test

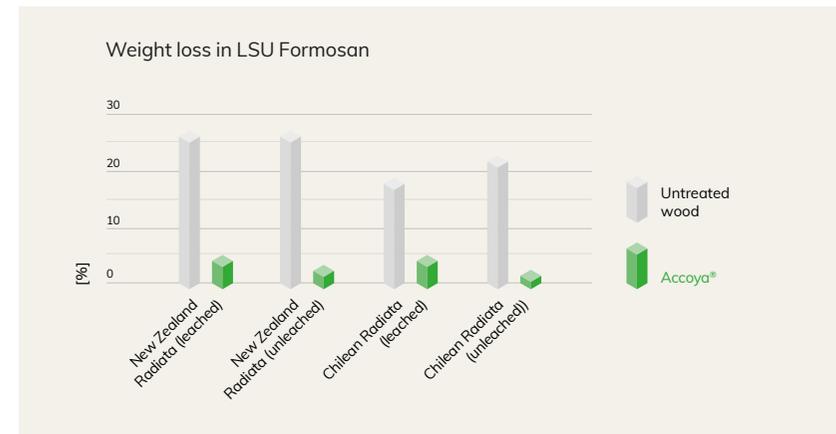
LSU AgCenter's Wood Durability Lab are a specialist in termite testing of wood products. *Coptotermes formosanus*, known as Formosan termites, are considered one of the world's most aggressive termite species.

Louisiana State University (LSU) conducted a Formosan termite 'choice' test according to AWPA E1-09 standard, using leached and un-leached both treated (acetylated) and untreated samples together with choice samples.

After 28 days of exposure, the samples were assessed on weight loss. The Accoya wood treatment, regardless of the wood specie, resulted in a consistent significant reduction in weight loss. Accoya wood was even as much as 22 times better than the untreated radiata (when measured by sample weight loss).

THIS TEST WAS
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LSU



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3 TERMITE RESISTANCE



5 year termite field trial data from Gainesville, Florida

Additional testing by TPI at their exposure sites in Gainesville Florida and Cost Rica demonstrate that Accoya performance exceeds that of high quality (FEQ) teak.

The results were developed over a 5 year field trial period in accordance with AWPA E7-09 in ground stake test and AWPA E18-06 ground proximity test. Performance level was used to support the qualification of Accoya for use in termite zones and 'in ground' application in the ICC ESR-2825 which confirms Accoya decking compliance with US Building Code.

THIS TEST WAS
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3 TERMITE RESISTANCE



Termite durability test, Australia – AFRC

Coptotermes acinaciformis is a widely encountered species of Australian termite distributed throughout mainland Australia and is responsible for greater economic loss than all the other Australian species of termites combined. Hazard Class 3 above ground testing was set up in Northern Territory, Australia according to the AWPA protocol by the Australian Forest Research Company.

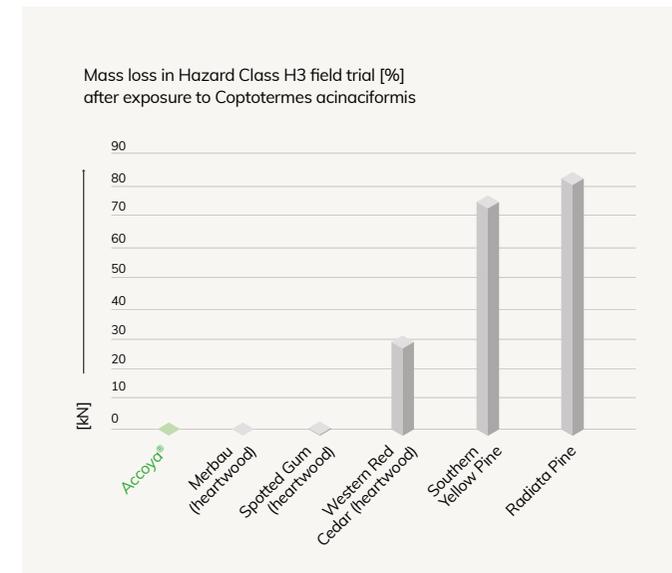
At the conclusion of the field trial all test specimens had evidence of contact by *C. acinaciformis*, and all untreated *Eucalyptus nitens* bait-wood, used as a susceptible and attractive food source for maintaining the presence of termites in exposure containers, had been destroyed. The majority of the susceptible sapwood test specimens were destroyed or severely attacked by *C. acinaciformis*. The mean mass loss of the untreated Radiata Pine Sapwood was 82.6%.

Merbau and Spotted Gum Heartwood were highly resistant to attack by *C. acinaciformis*. In contrast, the mean mass loss for Western Red Cedar was 28.6%.

All of the Accoya materials performed similarly to Merbau and Spotted Gum Heartwood, having mean mass losses ranging from 0.2% to 0.7%. Any attack by *C. acinaciformis* largely consisted of minor localised grazing on the surfaces of test specimens. The Accoya materials investigated in this study would be expected to perform well against termites in Australia when used in locations south of the Tropic of Capricorn.

Additional testing run at AFRC, in accordance with AWPA protocol, include performance evaluation in fungal decay testing alongside Spotted Gum, a durability class 1 rated timber and density of 1,050kg/m³. Accoya performance matched Spotted Gum.

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3 TERMITE RESISTANCE



Termite attack and decay trial – Thailand

A test conducted by the Environmental Research Centre; Naresuan University involved setting up ground stake tests at sites around Thailand.

Test stakes were Accoya, Teak and Makha. After 6 years Accoya demonstrated significantly higher performance than Makha hardwood and high-quality Burmese Teak.

This superior performance relative to Burmese Teak corroborates termite and decay evaluation tests reported in earlier pages of this brochure in Florida and New Zealand.



Makha



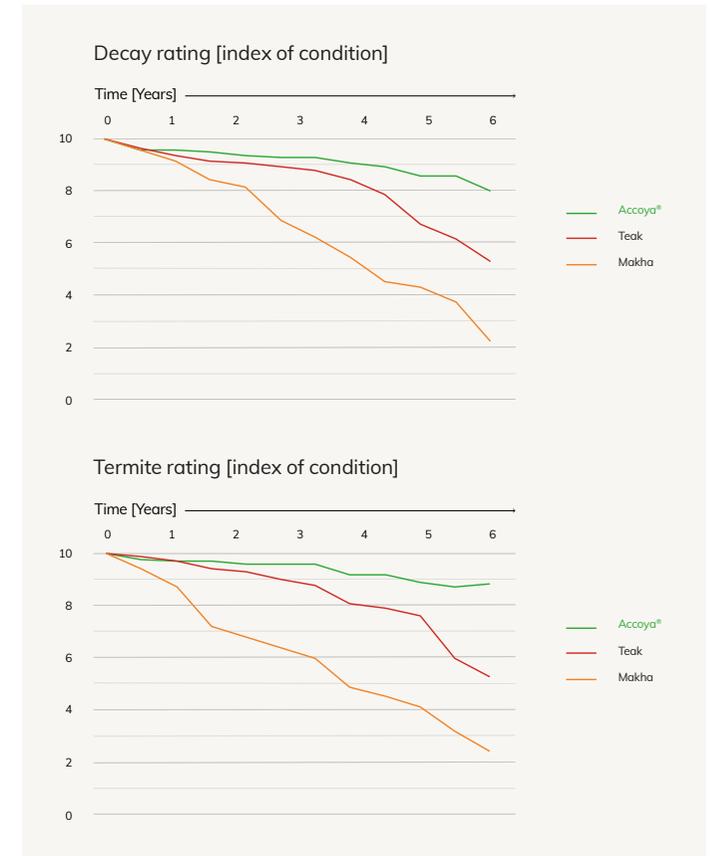
Accoya wood



Teak

Failure conditions in termite rating of Makha wood for Ubonratchathani province, 72 Months Inspection.

THIS TEST WAS
CONDUCTED BY:



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4 FINISH



10 year coating test at Teknos

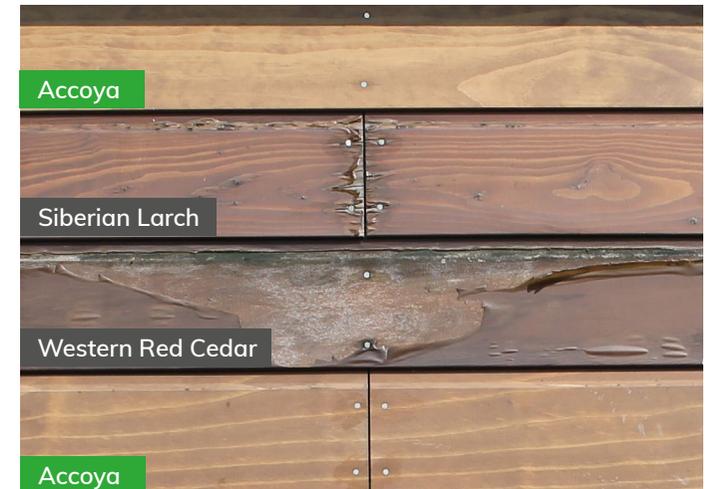
A weathering test was set up by Teknos (UK) Ltd, a leading coatings company supplying products to the factory applied window, door and cladding industry across Europe. The test began in March 2009 to obtain natural weathering performance data, end grain sealing, face fix detail and profile design impact of three different timber substrates (coated) and on different cladding profiles. Apart from Accoya – Western Red Cedar (WRC) and Siberian Larch were included in the test rig.

After 10 years of natural exposure, without any form of maintenance, the Accoya boards have confirmed the superior long-term performance in virtually all respects compared to the unmodified Western Red Cedar and Siberian Larch timber substrates, even more so in the most unfavourable conditions. Accoya wood showed excellent stability, which has served to significantly reduce splitting and fissuring at board ends, prevented distortion and fissuring around fixings. The coating on boards

made from Western Red Cedar and Siberian Larch have now lost all of their protective functionality whereas on the Accoya boards the coating had yet to show any significant deterioration effects after ten years of unbroken weathering exposure and has retained its full protective function. The test shows that the expected lifetime of the coating can be extended by as much as three times compared to when unmodified softwoods are used as a substrate.

THIS TEST WAS
CONDUCTED BY:

bmtrada



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4 FINISH



12 year service life

To validate extended maintenance periods, renowned coating company Remmers set up window and door test rigs on their German premises in 2006.

Based on these test results combined with case studies around the world, Remmers have issued a maintenance schedule for their fully factory-finished coatings on Accoya joinery up to 10 years for translucent and up to 12 years for opaque finishes.

THIS TEST WAS
CONDUCTED BY:



The test rigs after 10 years of exposure



No coating degradation visible

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4 FINISH



8 year face laminated Accoya window test

Two window frames made from face laminated Accoya/ Pine/Pine wood were installed in the BRE Window Joinery Test building in June 2012, facing South to maximise solar irradiance. One window frame was coated with a translucent finish, and one with an opaque white finish.

Additionally, tests have been completed at IFT Rosenheim, Germany according to standard methods for 2.0m length scantling stability and adhesive bond delamination resistance. The tests have been completed for Accoya-

Pine-Pine and Accoya-Spruce-Spruce combination. IFT is the leading institute for window and door performance in Germany. The scantlings met both requirements. Reports are available upon request.



THIS TEST WAS
CONDUCTED BY:



After 8 years of exposure, these windows on exposure at BRE were inspected on;

- › **General condition:** Appearance excellent
- › **Joint condition:** Excellent, joints tight, coating intact, no evidence of movement or opening
- › **Bead condition:** Excellent
- › **Coating condition:** Excellent, bright, no signs of deterioration. Some yellowing on interior surfaces.*
- › **Operation:** Movement of opening light was easy

This resulted in Accoya being awarded an 'excellent' overall rating (9/10).

* When wiped with a wet sponge it picked up some brown pigment suggesting the coating is eroding gradually with time.

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4 FINISH

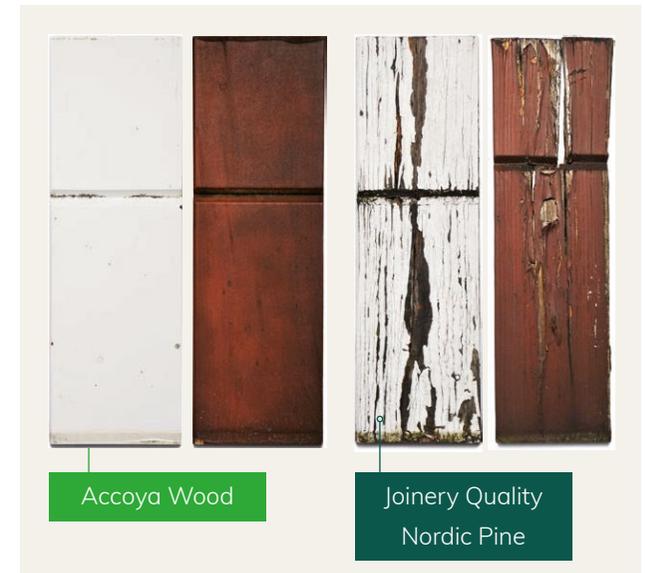
9.5 year external coatings test

Independent testing institute, SHR Timber Research in the Netherlands, conducted a comprehensive coatings test on Accoya and untreated wood with opaque and film forming paints and stains.

Accoya wood constantly demonstrated better coating performance and superior coating adhesion in both wet and dry conditions. The white opaque performed extremely well, requiring

no maintenance after 9.5 years – which is an important benefit in the long-term life cost of the product and ensures that Accoya has a superior whole life cost compared to competing materials.

THIS TEST WAS CONDUCTED BY:



External coating comparison



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5 CERTIFICATION

Accoya in structural applications – DIBt

Deutsches Institut für Bautechnik (DIBt) plays a pivotal role in the construction industry. Its approvals and assessments ensures the safety of construction works. The German building approval ('Zulassung') relates to Accoya sawn wood, for use as structural timber.

The allowable dimensions of Accoya wood are (may be used both flat and upright):

- › **Width: 100 – 250mm**
- › **Thickness: 25 – 100mm**

Accoya wood may be used for exterior load-bearing constructions in service classes 1 to 3. Outdoor use is allowed up to use class 3.2 providing that dirt deposits in, for example, wood cracks or on connecting parts, is prevented. When used in use class 3.2, a professional design (preventing water capillaries, end-grain sealing / protection) are of particular importance. Accoya lumber may only be used in structures loaded

statically or quasi-statically. Fatigue-relevant stresses are to be excluded.

As with most timber species, Accoya wood meets the requirements of normal flammable building materials class B2 (DIN 4102-1).

In the design of Accoya components the characteristic strength, stiffness and density of strength class C22 apply for Accoya of A1 quality, and C16 values apply for Accoya of A2 quality (according to EN 338). The certificate also gives details of components and connections, maintenance and servicing, according to EN standards.

THIS TEST WAS
CONDUCTED BY:



Accoya decking in Cambridge, UK



The U mark indicates that Accoya is certified under the German certification system for solid wood in structural applications

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5 CERTIFICATION



Product certification – FCBA



FCBA are the national centre for Wood Expertise and testing in France.

The 2015 certificate of conformity, part of the FCBA CCMQ 39/14 control agreement, was issued following rigorous test procedures that characterizes the physical, mechanical and biological performance of Accoya wood.

Extensive evaluations were carried out by the FCBA for more than two years, particularly in terms of mechanical strength, dimensional stability, resistance to fungi and insects as well as its Brinell hardness.

One of the requirements of the Control Agreement attestation is also the performance of initial quality checks and regular audits in order to verify the consistency and consistency of the Accoya process.

Subsequent application certifications have been conducted by FCBA for use of Accoya in Decking (terraces) and windows. These are available on request.

THIS CERTIFICATION WAS CONDUCTED BY:



INSTITUT TECHNOLOGIQUE

	Property	Value
Mechanical	Bending strength (EN 408) › 20°C / 65% RH › Upright test orientation	5-percentile characteristic values: › Modulus of elasticity: 5290 MPa › Bending strength: 22.4 MPa <i>(The acetylation process does not affect the mechanical properties)</i>
	Brinell hardness (EN 1534)	23.4 MPa (20°C / 65% RH) 15.1 MPa (20°C / 12% RH)
	Impact resistance (DIN 52189-1)	Average bending strength: 50 kJ/m ² <i>(No loss of impact bending strength by the acetylation process)</i>
	Screw holding capacity (EN 320)	Better than compared to unacetylated Radiata Pine
Physical	Density (BRL 0605)	Average: 500 kg/m ³ (20°C / 65% RH) Characteristic: 417 kg/m ³
	Dimensional stability (BRL 0605)	Average shrinkage: › Radial: 0.7% › Tangential: 1.5%
	Water uptake (EN 317)	82.5% after 91 days of immersion
	Equilibrium moisture content (BRL 0605)	Average EMC during drying at 20°C: › 7.5% at 95% RH › 4.5% at 65% › 2.5% at 35% RH
	Thermal conductivity (EN 12664)	0.12 W/m-K
Biological	Resistance against fungi (EN 113 / ENV 807) after leaching (EN 84) (Dry rot, soft rot and white rot)	› Durability class 1 (NF EN 350) › Material suitable for use classes 1 to 4 (EN 335)
	Termite resistance: › Choice test (EN 117 amended): › Forced feeding test (EN 118):	The material is not degraded by European subterranean termites The material is not an appropriate source of food The material is susceptible to termite degradation
	Resistance against wood boring insect larvae (EN 46-1)	Material not degraded by wood boring insect larvae

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5 CERTIFICATION

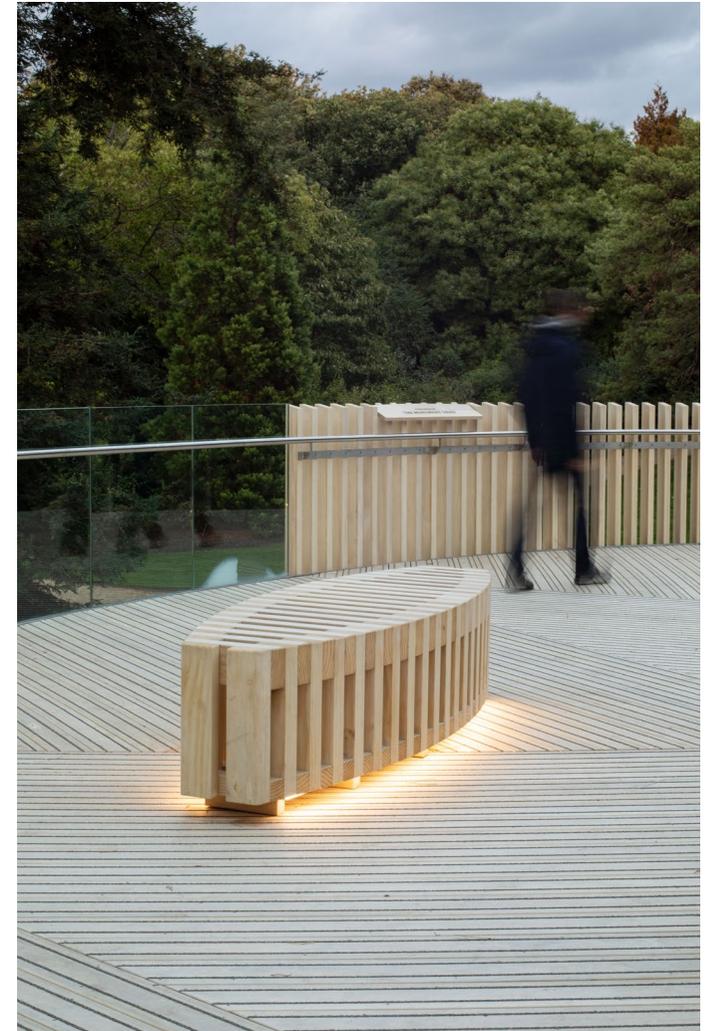
ICC ESR decking certification

ICC-ES is a USA based institute specialised in technical evaluations of building products, components, methods, and materials.

They have evaluated the compliance of Accoya wood with the International Building Code (IBC), the International Residential Code (IRC) and the ICC-700 National Green Building Standard™ for use in decking, porch flooring and stair threads, resulting in an Evaluation Report.

The ICC-ESR report states that typical applications for Accoya wood products are among the highest use categories defined by AWPAs. The service condition UC4A is general use in ground contact and fresh water contact and includes above ground applications with ground contact type hazards or that are critical or hard to replace.

THIS CERTIFICATION
WAS CONDUCTED BY:



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5 CERTIFICATION

Flame spread and smoke development testing

Southwest Research Institute undertook Flame Spread Tests and Smoke Developed Tests in accordance with the standard test method for surface burning characteristics of building materials NFPA 255 (ASTM E84, UL 723 & UBC 8-1).

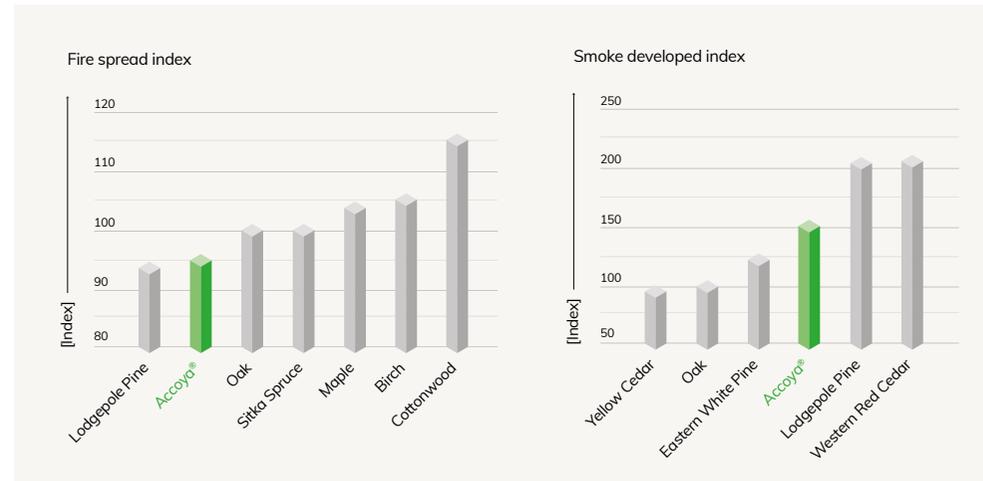
The conclusion of the Flame Spread Test results is that Accoya wood can be classified within the range of standard timber species and achieves Class C in this US rating system.

THIS TEST WAS CONDUCTED BY:



Flame Spread Classification	Flame Spread Index
Class I (or A)	0 – 25
Class II (or B)	26 – 75
Class III (or C)	76 – 200

*Please see Accoya Performance Testing Summary for European classification D in EN14915



*Data source: USDA(United States Department of Agriculture) Wood Handbook. Lower numbers equal less flame spread or smoke.

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6 THERMAL AND SURFACE



Thermal gain on decks – Japan

Thermal gain on decks and terraces is a particular issue in the summer season. A thermogram image analysis was arranged in Japan with the Hiroshima Prefectural Technology Research Institute to assess differences between Accoya, thermally modified wood and three variants of commercial WPC decking.

The ambient temperature during the testing of all decks was 32°C. Deck board dimensions were comparable for all three types:

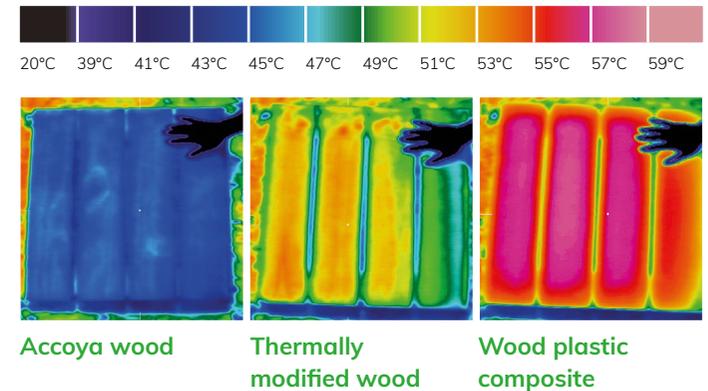
- › **Accoya: 26 x 140mm**
- › **Thermally modified wood: 26 x 140mm**
- › **WPC: 26 x 145mm**

The thermographs clearly indicate thermal gain in Accoya is substantially less than the alternatives tested.

This low level of thermal gain, combined with in-situ benefits derived from Accoya's dimensional stability provide deck boards which are truly 'barefoot friendly'. In-situ benefits derived from Accoya stability are the boards resisting cupping and remaining flat, the fixings not being stressed and remaining flush, and finally, the boards not suffering splintering with prolonged weathering.

THIS TEST WAS CONDUCTED BY:

Hiroshima Prefectural Technology research Institute Japan



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Improved thermal performance

Thermal value is a critical aspect in window and door design. The thermal conductivity of the wood (lambda value) makes a significant contribution to the overall window frame calculated thermal value.

Accoya thermal conductivity has been assessed by IFT Rossenheim, Germany in accordance with EN1226: 2001 and then developed into the required declared value format, under the most rigorous European assessment methods by the EN ISO 10456: 2008 procedure for determination of declared and design thermal values.

In comparison to other standard wood types for joinery, Accoya thermal conductivity is:

- > Superior to softwood by 8%
- > Superior to hardwood by 30%

These improved levels provide options in design, in terms of achieving a higher U-Value for the same window design by switching timber type, or alternatively using a more preferred aesthetic or production friendly design without significantly compromising energy efficiency.

Accoya is regularly used to achieve A rated windows under the UK's BFRC Window Energy Rating Program where other woods in the same design would not meet this standard.

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6 THERMAL AND SURFACE

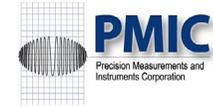
Thermal conductivity – ASTM C177

Precision Measurements and Instruments Corporation (PMIC) measured the thermal conductivity (lambda value) of Accoya wood and sapele test specimens according to ASTM standard C177, with the so-called guarded hot-plate method in a dry nitrogen environment.

The results show the thermal conductivity of Sapele, a tropical hardwood species, to be 36% higher than that of Accoya wood. Choosing Accoya wood for the construction of windows and doors will have a significant positive effect on the total thermal performance and therefore the energy balance of your home.

Wood species	Thermal conductivity
Accoya	0.1022 W/m-K
Radiata pine	0.1284 W/m-K
Sapele	0.1741 W/m-K

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6 THERMAL AND SURFACE

Hardness and wear test

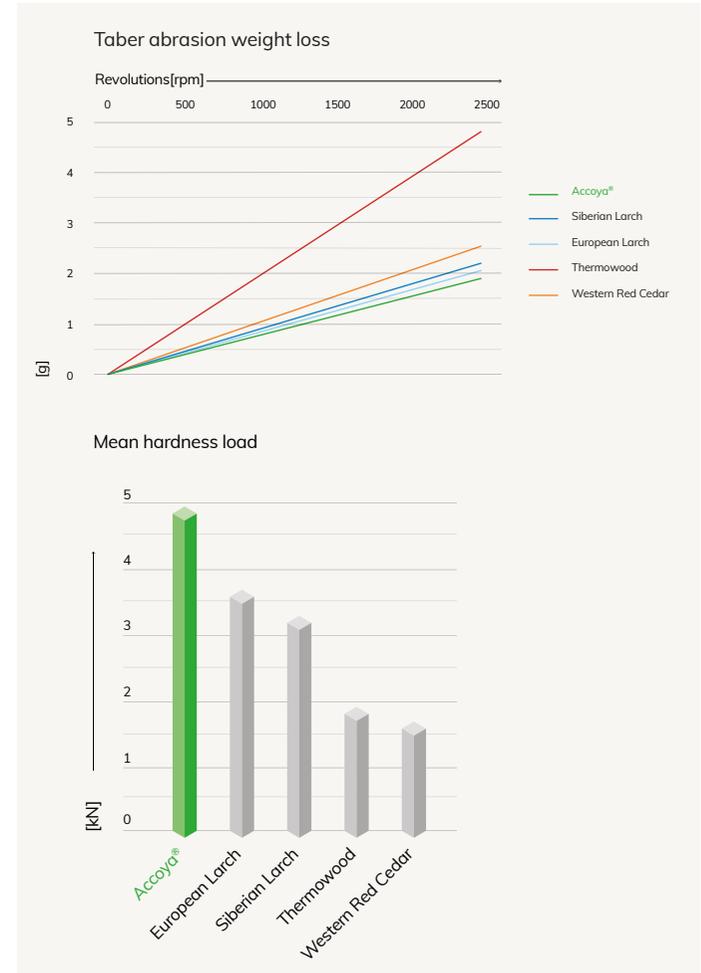
Independent testing from leading timber research institute, BM Trada, proved that Accoya wood can withstand harsh, abrasive environments.

BM Trada’s testing showed that hardening that occurs as a result of the Accoya process results in greater resistance to indentation than Western Red Cedar and two types of Larch. This is particularly useful when making specification choices for cladding and ground floor exterior products.

Separate scuffing and mechanical abrasion tests carried out by BM Trada show that Accoya wood is just as good, if not better than the two types of Larch, and significantly better than Western Red Cedar.



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CONTACT

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