

UNIVERSIDAD DE GRANADA

UIMA

Andalusian Structural Timber Research Unit

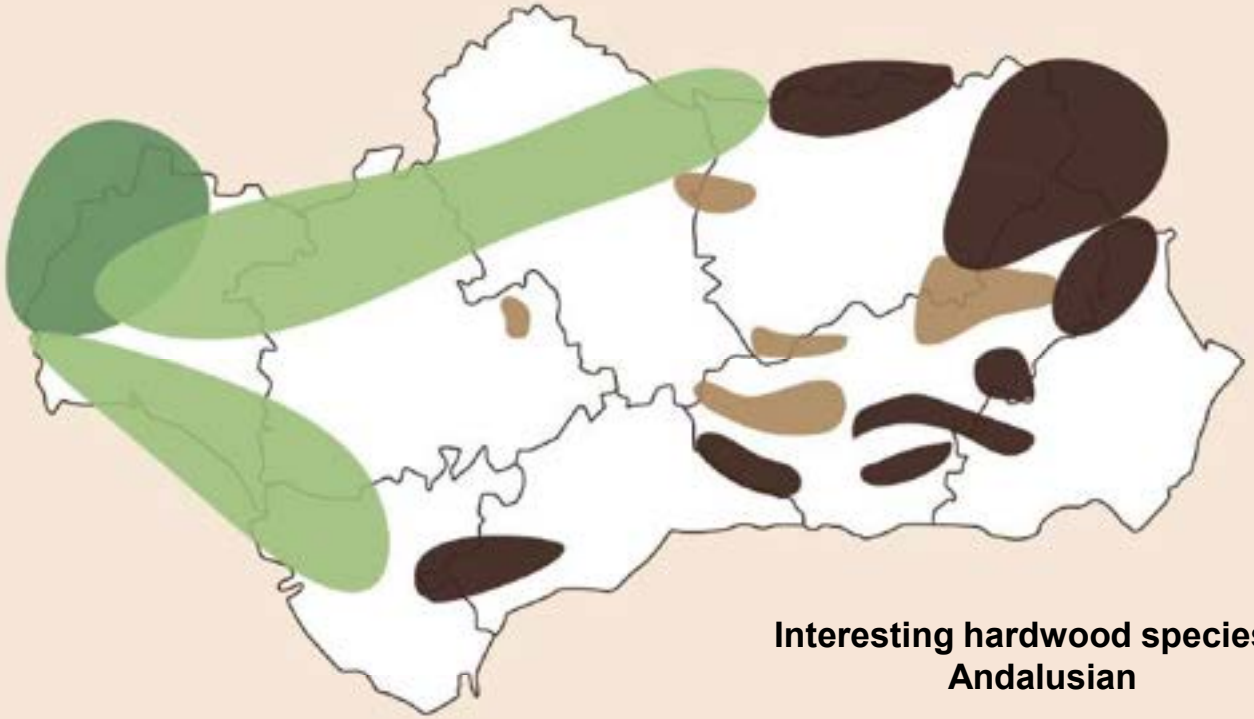
University of Granada (Spain)

- Research and innovation
- Transfer to the industry

Objective: To put in value the local timber resources







Interesting hardwood species in Andalusian

- Poplar
- Chestnut (Castanea sativa)
- Quercus canariensis → Algerian oak
- Ash (Fraxinus spp.)

9 researchers



ANTOLINO GALLEGO MOLINA



LAURA JIMÉNEZ GARCÍA



GABRIELE GIARDINO



FRANCISCO RESCALVO FERNÁNDEZ



ANA CRUZ VALDIVIESO



ADELAIDA MARTÍN MARTÍN



RAFAEL BRAVO FAREJA

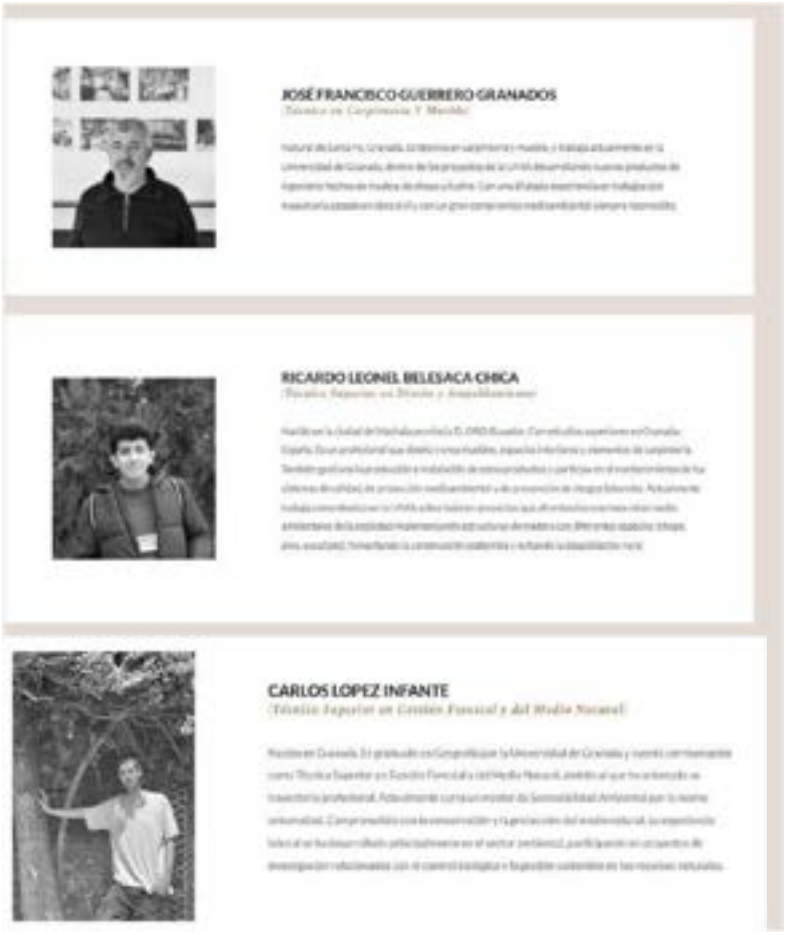


YAIZA FUENTES GARCÍA



ROBERTO PALMA GUERRERO

3 laboratory technicians



JOSÉ FRANCISCO GUERRERO GRANADOS

RICARDO LEONEL BELESACA CHICA

CARLOS LOPEZ INFANTE

Located at the new “Sustainability Campus” of the University of Granada

Old Sugar Factory (Azucarera de San Isidro) from 1901 (85.000 m2)

The first laboratory in this Campus









New life for the San Isidro Sugar Factory

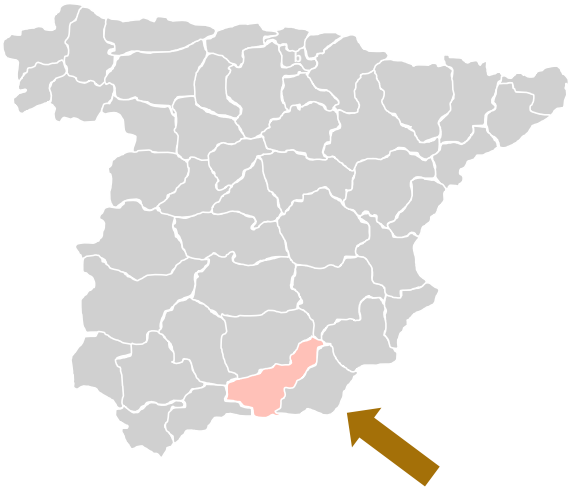




Where are we?









Offices: **We have made the furnitures with local timber**



Who we are?

UIMA

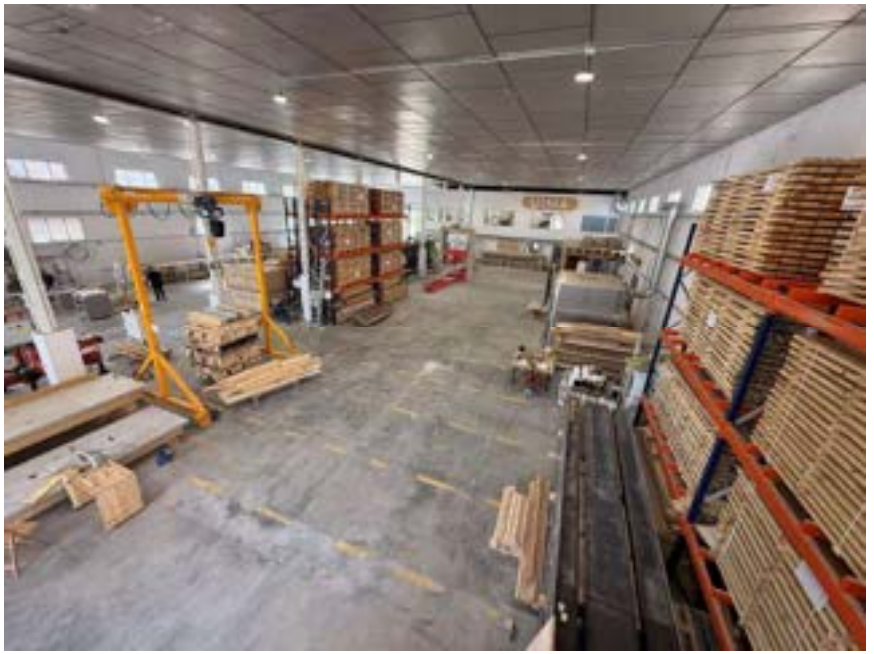


1200 m² facilities

From the tree to the final product



Industrial equipments



Sawmill WOODMIZER LT-40 WIDE

Logs up to 90 cm in diameter and 6 m long











Finger-joint gluing line

Semi-automatic line

Maximum finger-joint cross-section: 250 × 60 mm

Finger length: 15 and 20 mm







Roller glue spreader

Maximum working width: 1,300 mm

Suitable for boards and veneers

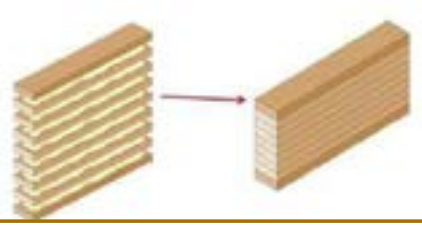
Feed speed: 22 m/min







Glued laminated timber beam presses



Beams up to 200 mm wide and 3 m long



Beams up to 200 mm wide and 10 m long. Modular configuration: 6 + 4 m



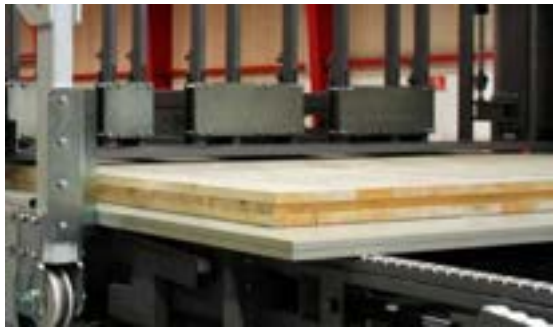
Hot platen press

90 tonnes of pressure

Panels up to 1.3 × 2.5 m. CLT or LVL









Universal testing machine

Load cell: 200 kN

Bending (3 m)



Shear (glue line)



Compression/Tension



Full-scale testing equipment

Load cell: 400 kN

Bending (10 m)

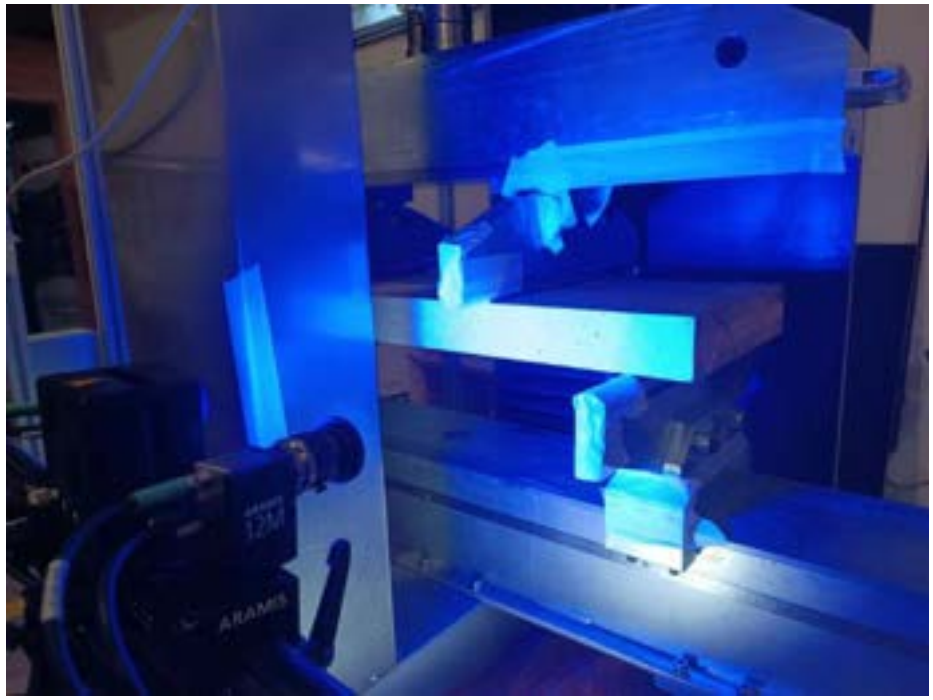


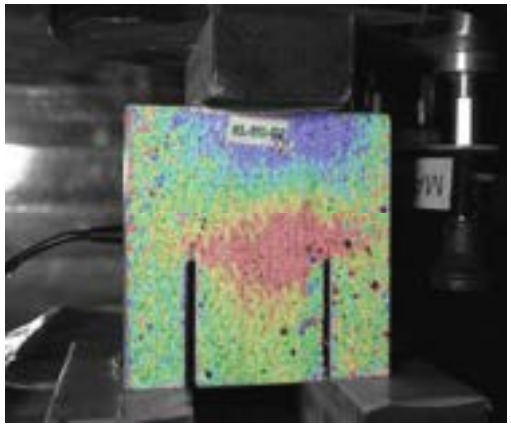
Shear

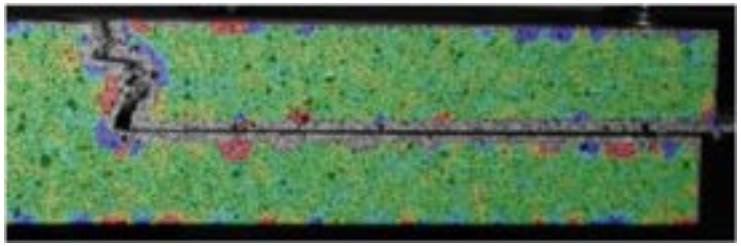


DIC MONITORING

Aramis 3D system.
Cameras of 12 MPx



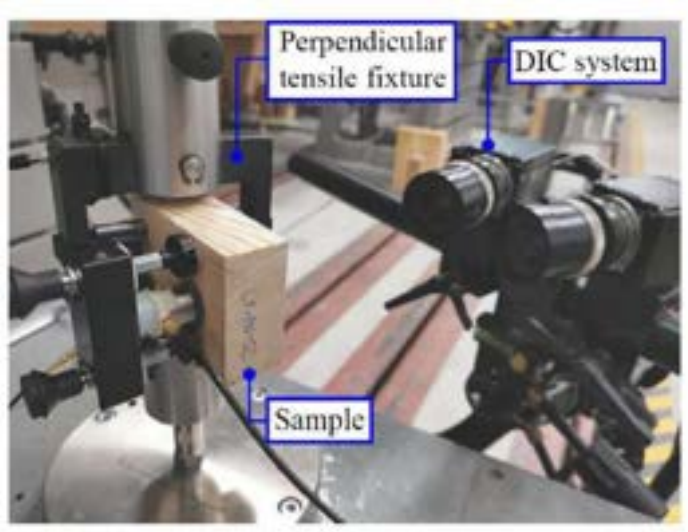




ACOUSTIC EMISSION MONITORING

Non-destructive technique based on the propagation of elastic waves through the material

Applicable to any material and size.

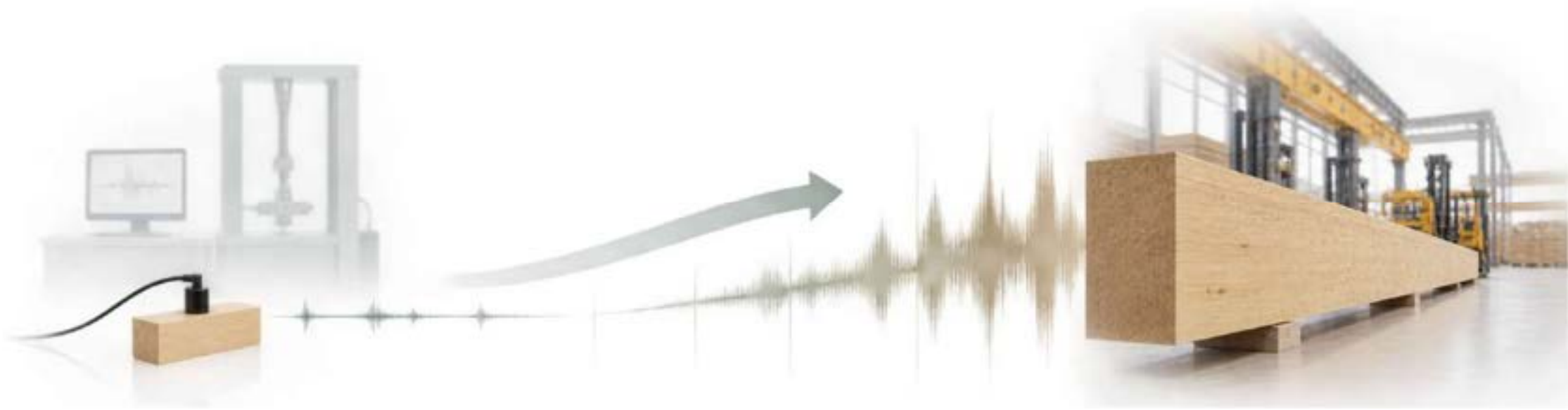






UIMA capabilities

From the laboratory to industrial-like conditions



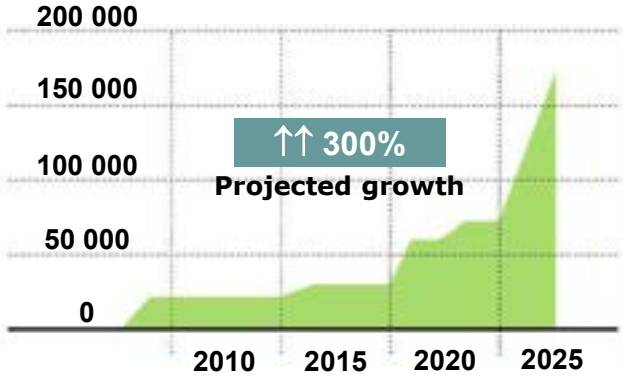
Background of poplar in Spain

Current situation

Poplar products in Granada offer low added value



CLT production capacity in Spain: historical data (2008–2023) and forecasts



Evaluate the viability for the use as EWP

Glued-laminated timber (GLT)



Cross-laminated timber (CLT)



Poplar: from grading to engineered timber

MC and Luisa Avanzo cultivars · Populus × euramericana

804
Different-sized boards

6
Plantations

3
River basins in Spain

Testing and strength grading: EN 408, EN 384 and EN 338.



Visual grading





Vibration testing



Tensile testing

Standardisation

Our research supported the standardisation of poplar for structural use in Spain

SPANISH VISUAL GRADING STANDARD

UNE 56546:2024

Includes the MC and
Luisa Avanzo cultivars

GRADED SAMPLE

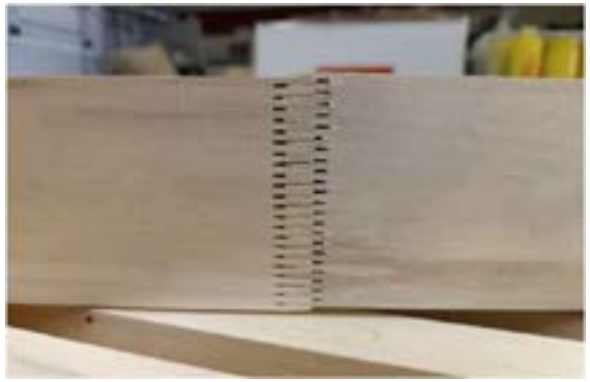
T10

Tensile strength class

UIMA

From graded boards to glulam beams

30 beams · MC at 9 and 15 years · Luisa Avanzo 9 years



Finger-jointing



Pressing 3-metre beams



Bending tests

We tested bending performance and the quality of the glue lines

Glulam: mechanical results

UIMA

Bending strength · Mean ± SD (MPa)



GL20h was reported for the glulam tested in the study

8 900–9 400 MPa

Mean bending modulus

378–404 kg/m³

mean density

Stiffness and density were similar across groups; younger MC had lower bending strength

Rolling shear tests in CLT panels

All-oak CLT



3 layers · 300 mm wide

Oak–poplar CLT



3 layers · 300 mm wide

Rolling shear is shear deformation across the grain in the cross layer.
We investigated its contribution to the overall panel response.

How does a poplar core change the bending and shear response of hardwood CLT?

LaBoMaP
LaBoratory of Materials and Processes

One panel, three complementary approaches

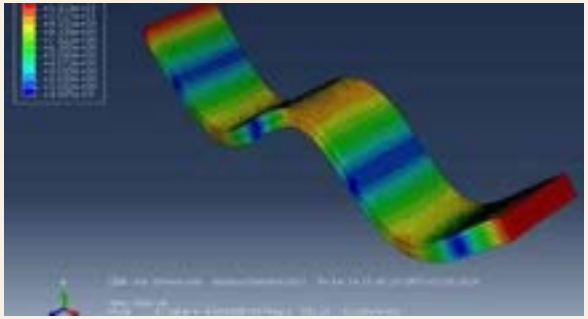
Vibration tests



Measure natural frequencies

Estimate dynamic E and G

Numerical model



Calibrate the model using measured frequencies

Identify model-based E and G

Static tests + DIC



Measure load and deformation

Estimate static E and G

The methods describe the same panel, but their estimates may differ

LaBoMaP
LaBoratory of Materials and Processes

Panel properties and relative differences

Three-layer panels · 300 mm wide · Mean values in MPa

Vibration tests

	All oak	Oak–poplar
E	11,616	10,497 **(–9.6%)**
G	650	354 **(–45.5%)**

Numerical model

	All oak	Oak–poplar
E	12,580	11,644 **(–7.4%)**
G	503	216 **(–57.1%)**

Static tests + DIC

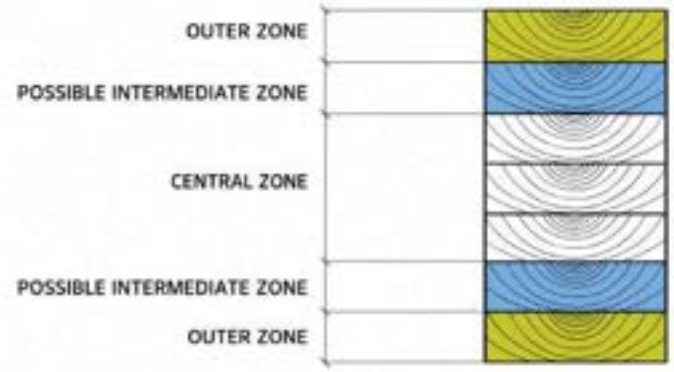
	All oak	Oak–poplar
E	10,545	9,327 **(–11.6%)**
G	113	70 **(–38.1%)**

E: bending modulus · G: effective shear modulus · Percentages relative to all oak

The relative reduction was greater in G than in E, while G estimates also depended on the method

Why combine species?

EN 14080 layout

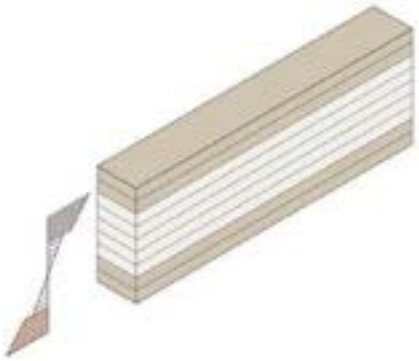


Different strength grades

Why not different species?



Mixed glued laminated timber beams









Smart
TIMBER

Species tested



Pine → **Forest-grown timber** → **-Medium/high density - Medium/high mechanical performance**



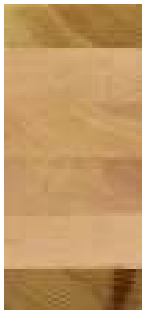
Poplar → **Valley-grown timber** → **-Low density -Low mechanical performance**



Eucalyptus → **Forest-grown timber** → **-High density - High mechanical performance**



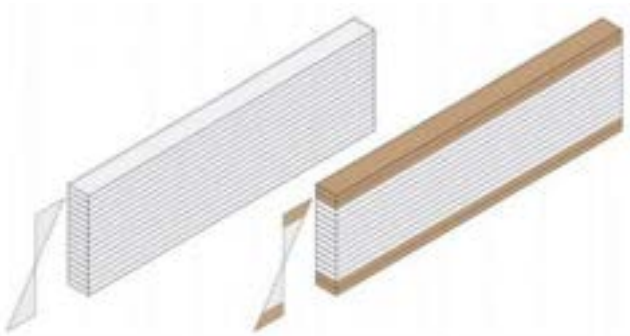
Species tested

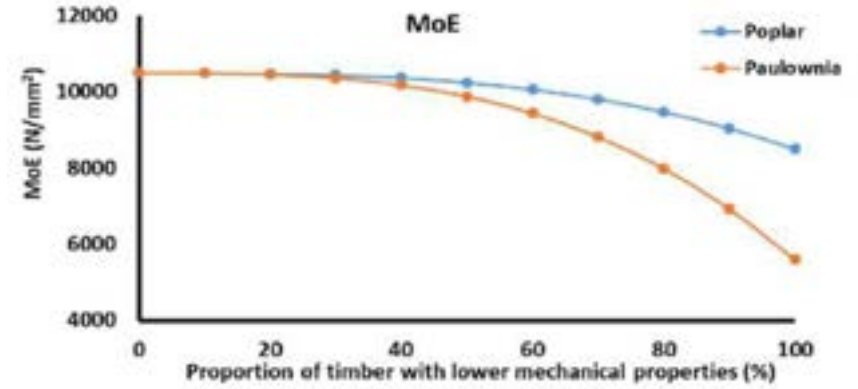


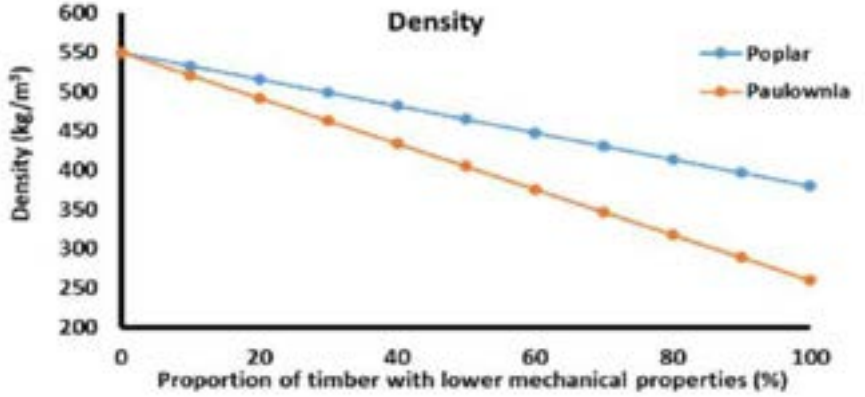
Primary specie

Secondary specie

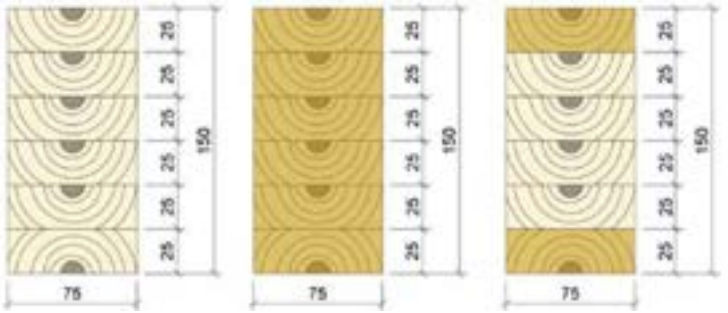
Primary specie

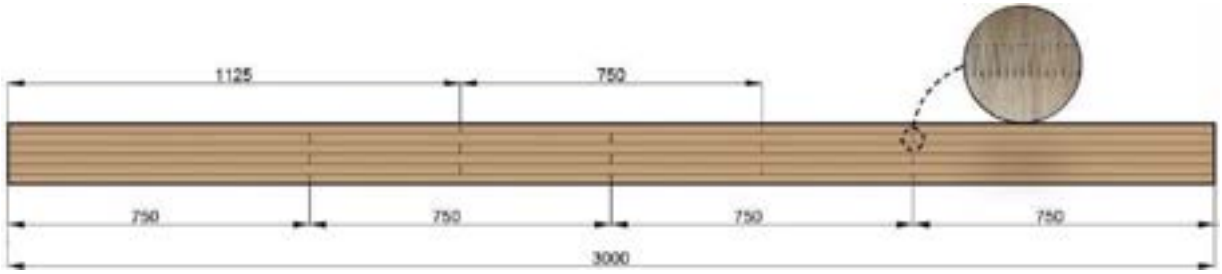


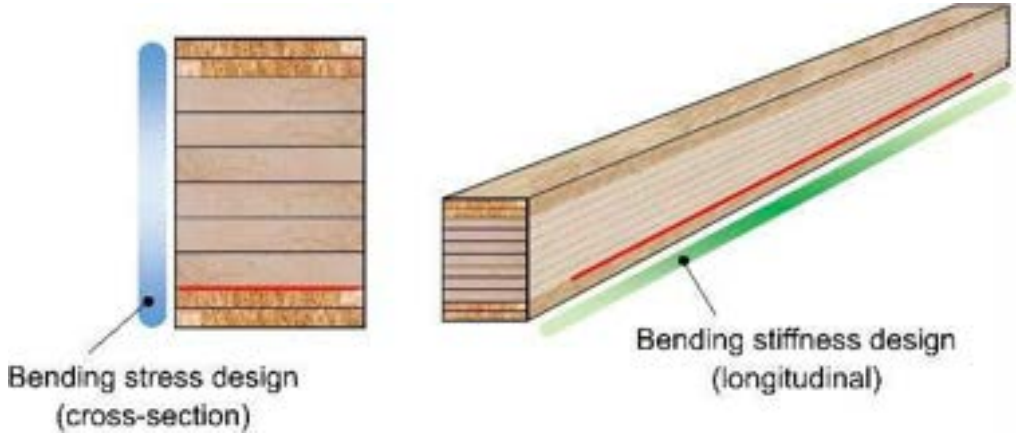




Beams design and testing







Beam optimisation

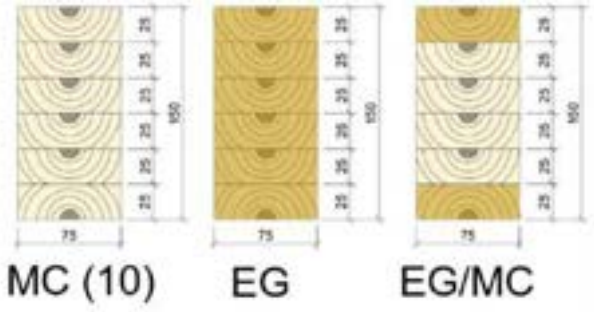
OBJECTIVE: Achieve the same modulus of elasticity in mono-species and mixed-species beams

Correlation between dynamic and static moduli of elasticity in timber boards

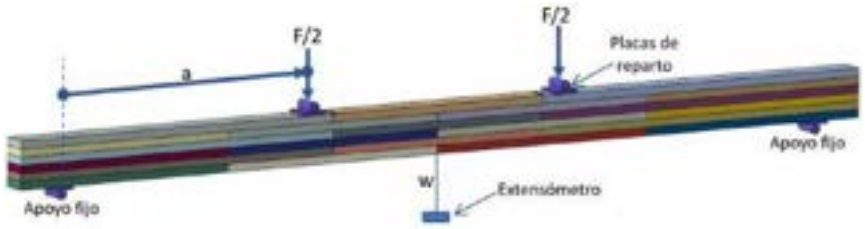




Bending tests
(control beams = random lamella placement)

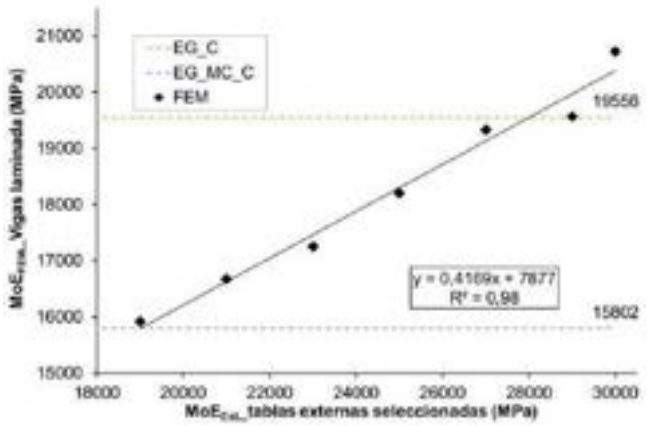


Parametric model based on mono-species and mixed-species control beams (non-optimised)



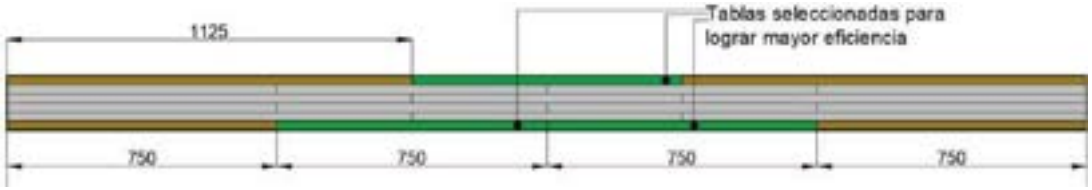
Results

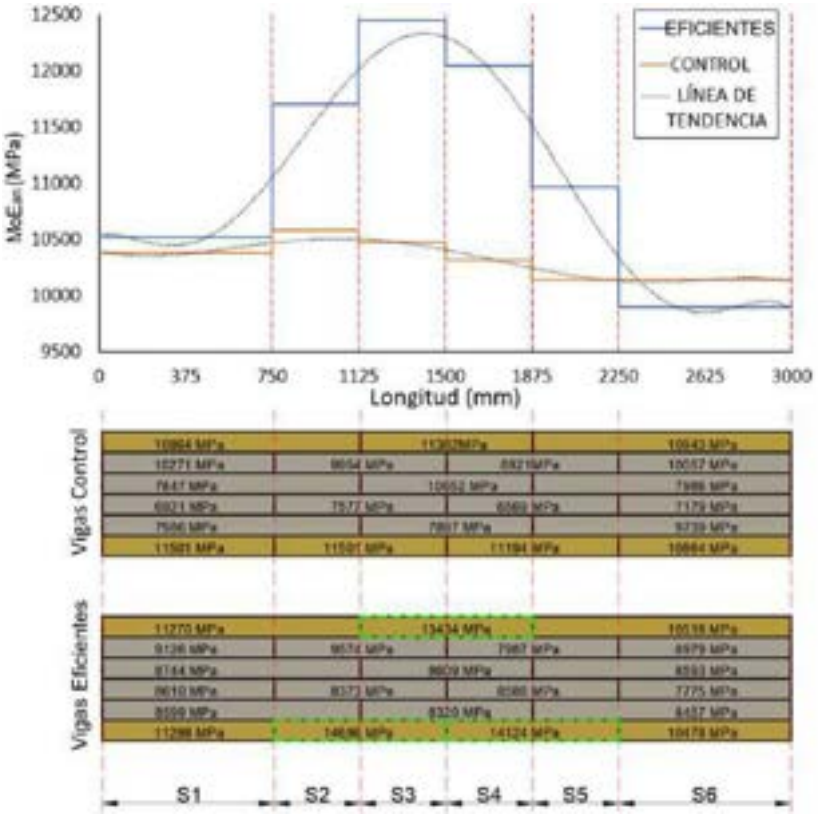
OBJECTIVE: Achieve the same modulus of elasticity in mono-species and mixed-species beams



Mono-especies

Combined





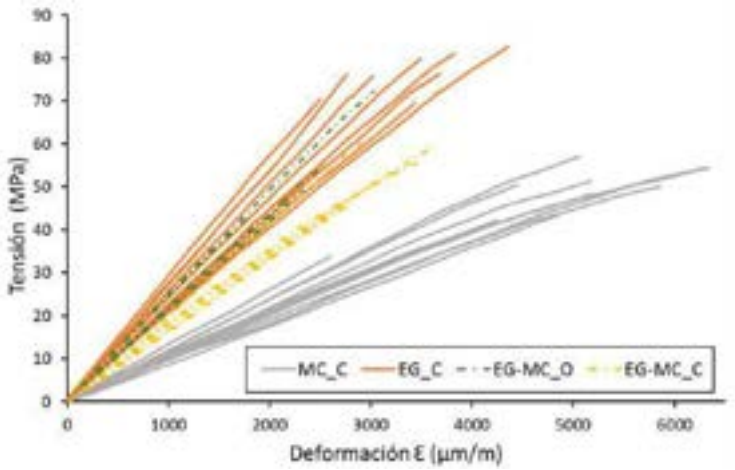
Results

Mechanical properties	EG_C Average	EG-MC_O Average
Stiffness (N/mm²)		
$MoE_{din,\ l}$	21944 ± 1551	14768 ± 405
$MoE_{din,\ t}$	20635 ± 1788	18616 ± 880
MoE_{est}	**19556 ± 787**	**19042 ± 307**
MoE_{FEM}	20487 ± 541	19795± 459
Strength (N/mm²)		
MoR	**72 ± 10**	**53 ± 11**
Density (kg/m³)		
ρm	**813 ± 47**	**545 ± 24**

Mono-especies | Combined

Mono-especies respect to optimized combined beam

+3% MoEest | **+35% MoR** | **+49% density**





Failure caused by the poplar lamella immediately beneath the eucalyptus lamella reaching its ultimate strength.

TIMBER CONCRETE COMPOSITES

Timber-concrete slabs (MCLamBS)

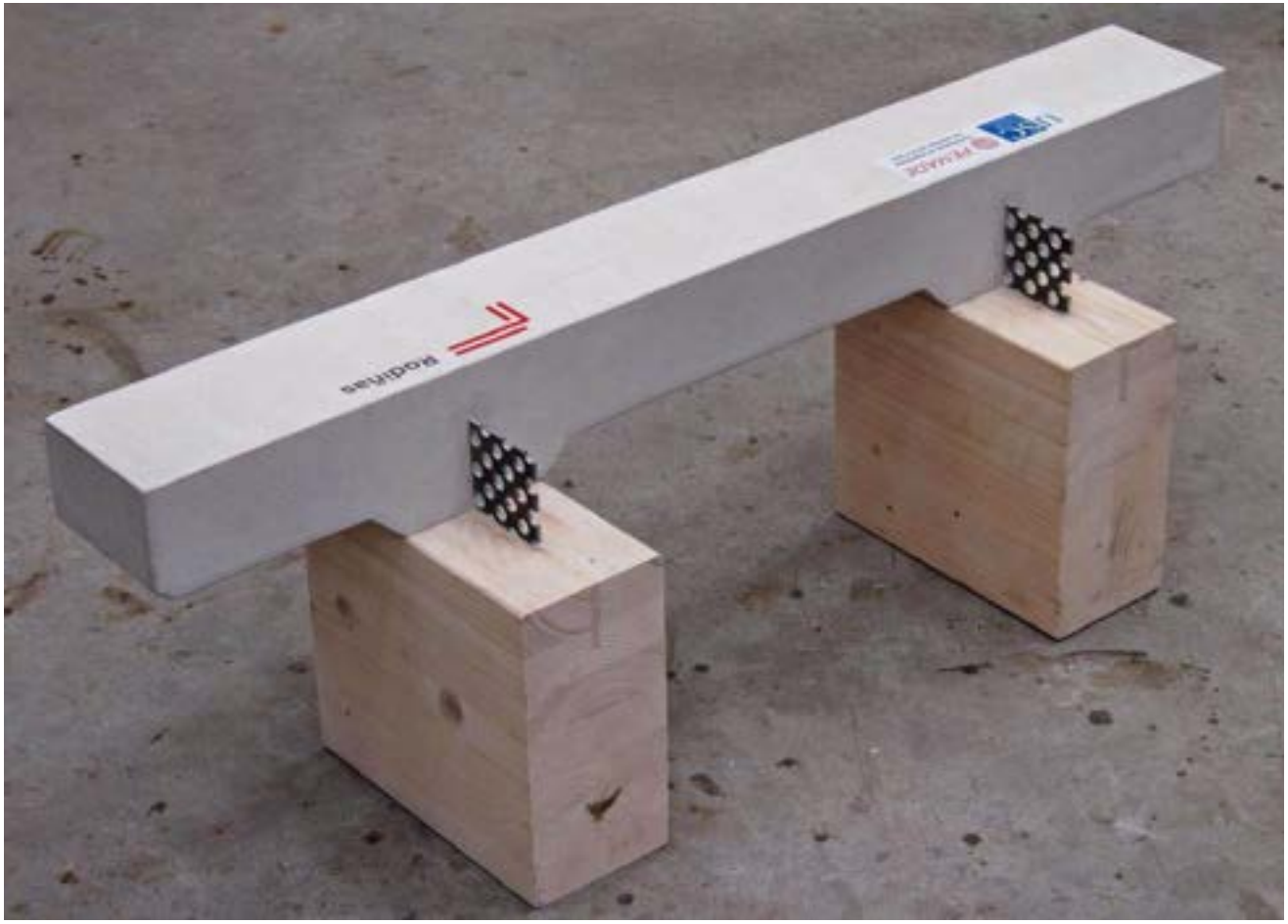


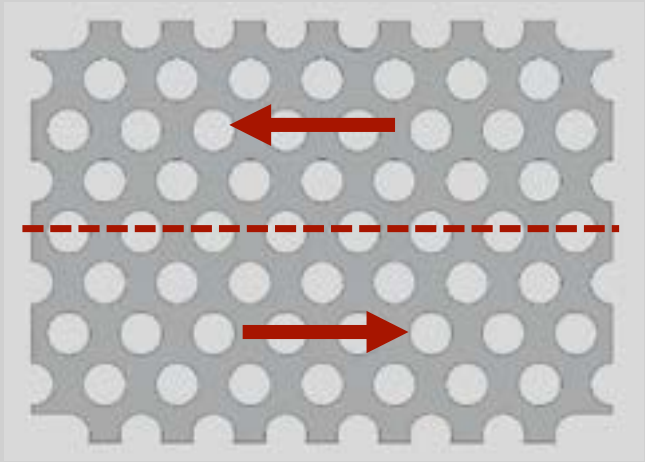
LIFE WOOD FOR FUTURE

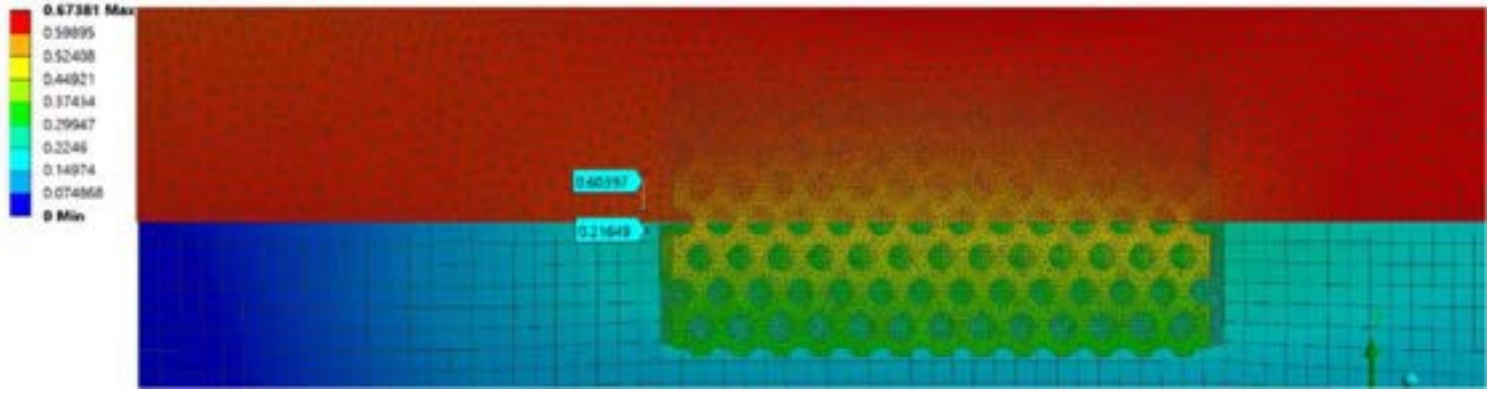
- **Decrease weight respect to only concrete floors in more than 40%**
- **Increase acoustic isolation and fire resistence respect to only wood floors**
- **Decrease construction time in more than 65 % respect to in situ concrete solutions**
- **The product is suitable for large spans**
- **Decrease carbon foot print in more than 70 %**
- **Decrease the used water in more tan 40%**

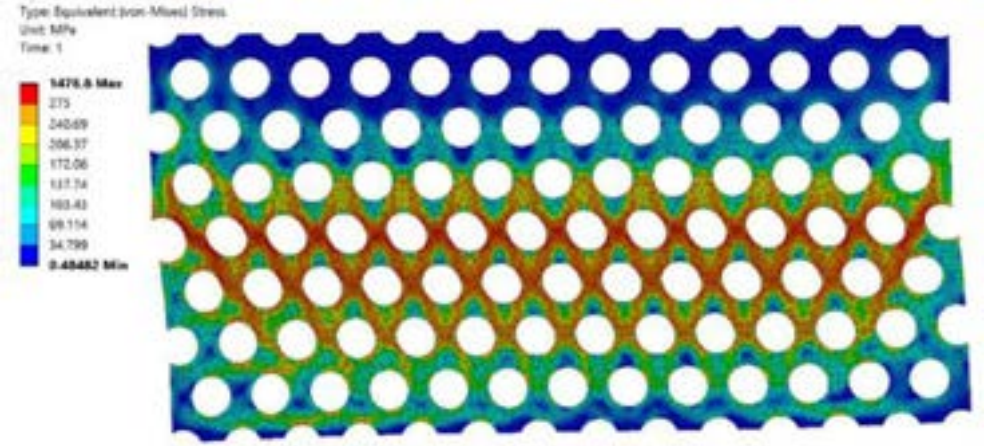


Conection: Metalic perforated plate

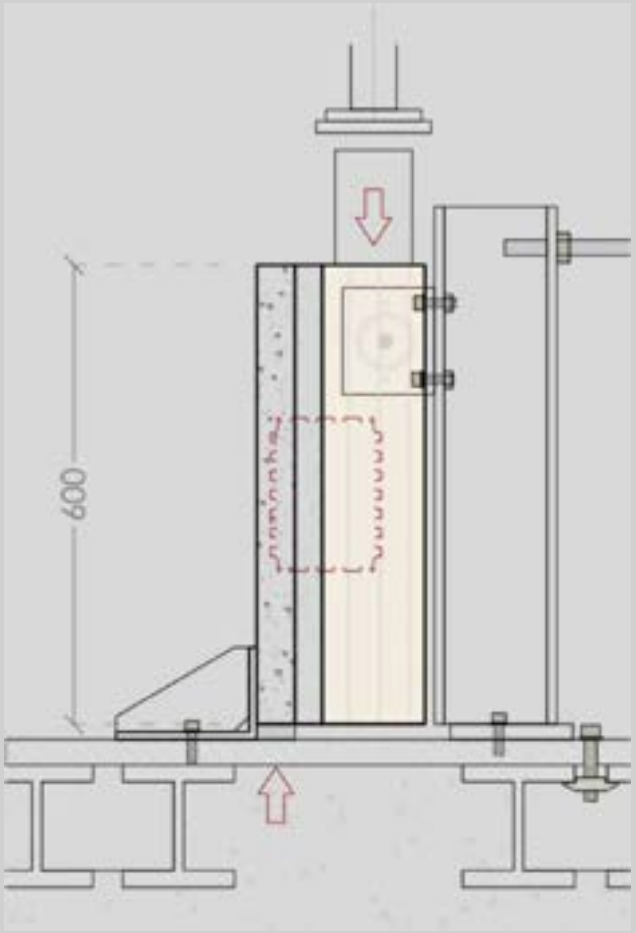




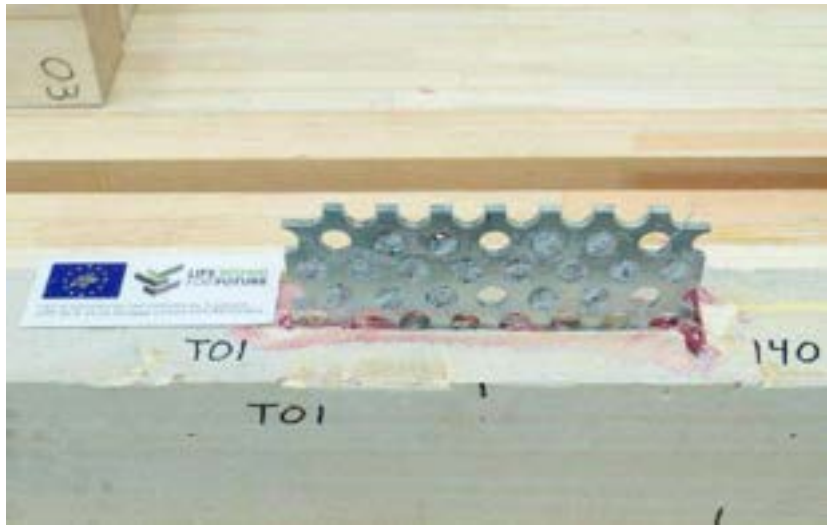

0.67381 Max
0.59895
0.52408
0.44921
0.37434
0.29947
0.2246
0.14974
0.074868
0 Min
0.40197
0.21649

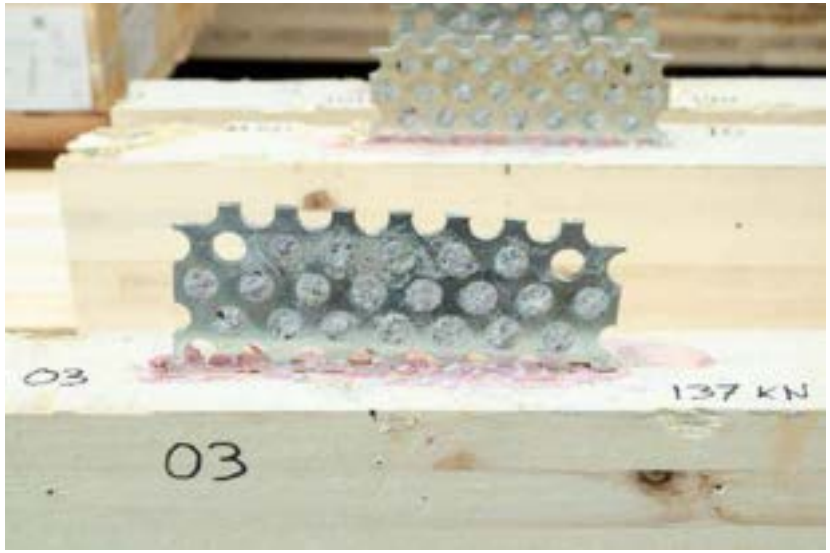

Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1
1470.6 Max
275
240.69
206.37
172.06
137.74
103.43
69.114
34.799
0.48482 Min




600


T10


03
T01
140
T01


03
137 KN
03

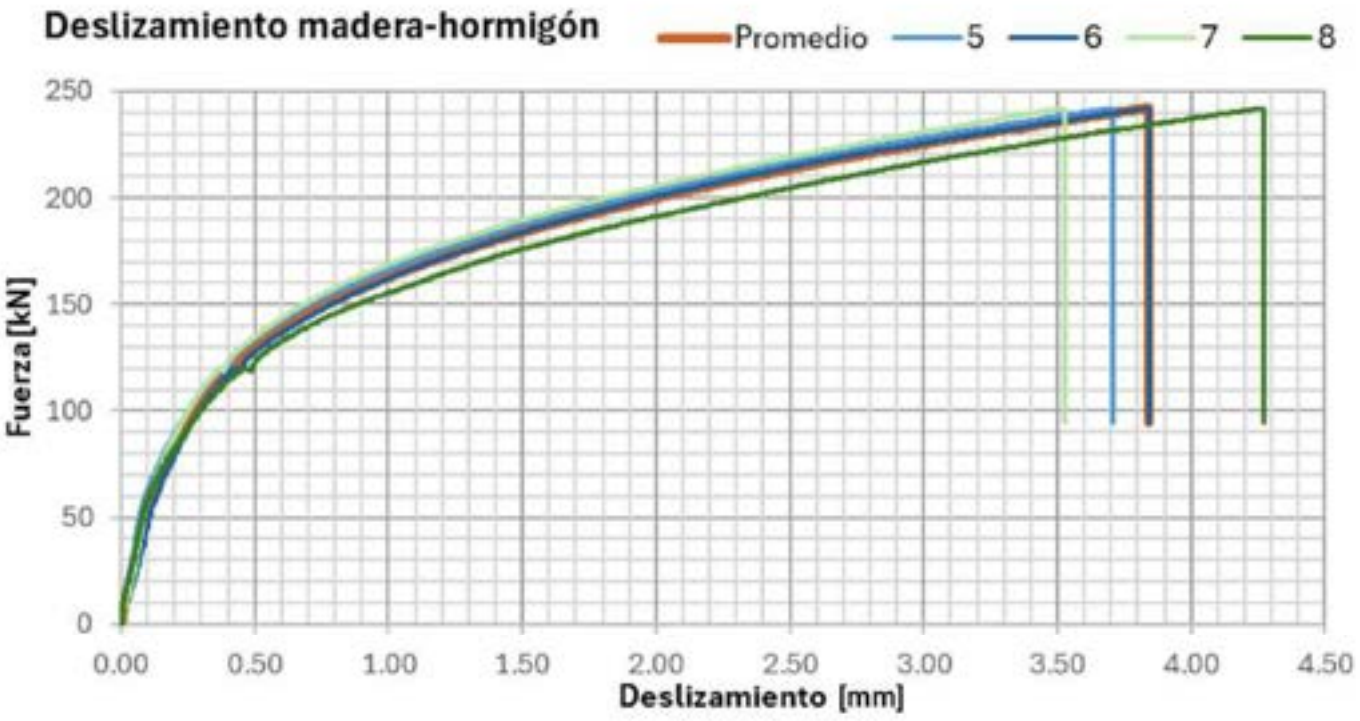


HIGH BENDING STRENGTH AND STIFFNESS

FAILURE IN THE TIMBER:
HIGH STRUCTURAL SAFETY



EXCELLENT TIMBER–CONCRETE CONNECTION PERFORMANCE: VERY LOW SLIP






Life

MANUFACTURING

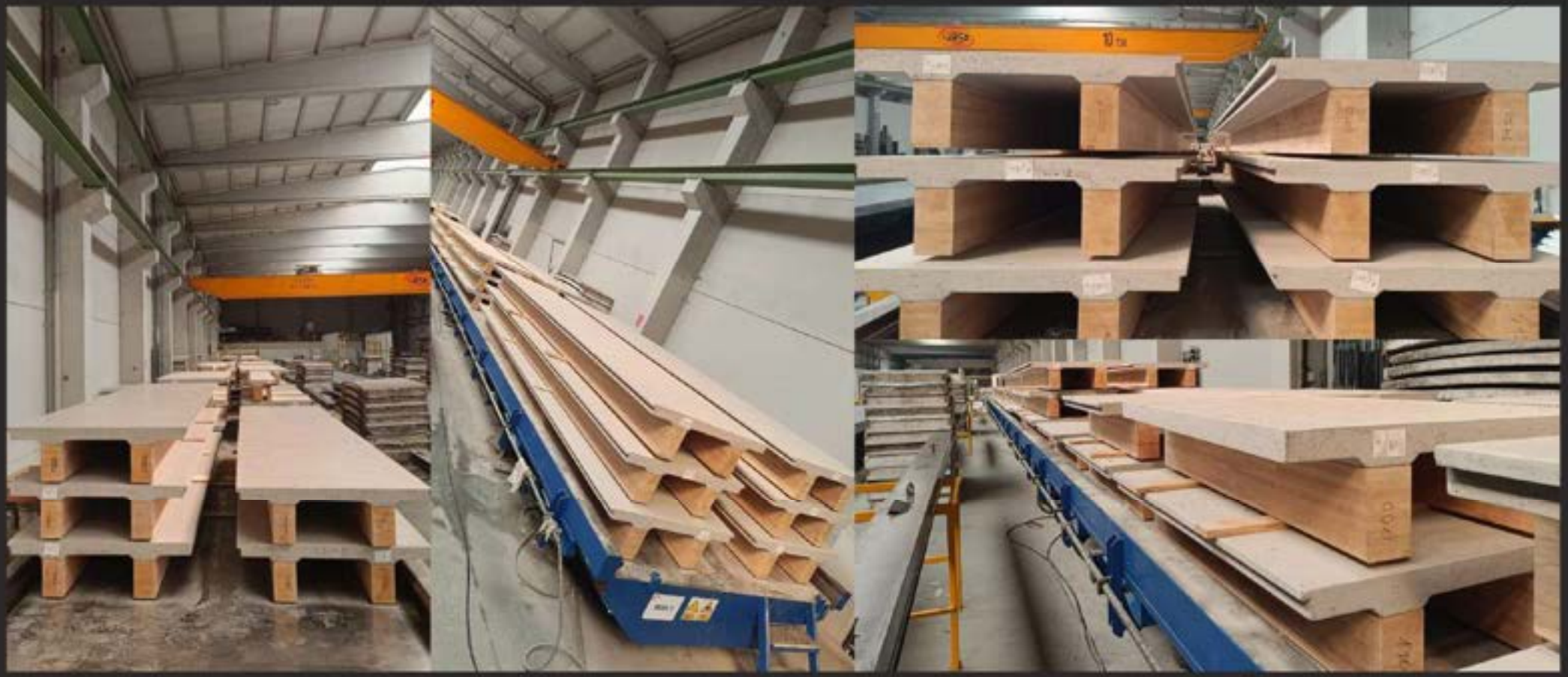








MANUFACTURING











DEMONSTRATION IN A BUILDING RENOVATION PROJECT

PAZO PIÑEIRO, ARES, A CORUÑA

Jorge Salgado







LIFE
TIMBER
FOR ALL

LIFE TIMBER FOR ALL

Development of a range of timber–concrete composite products

OB2 OB3 OB6



Rod-Compact: Spans: 5–7 m



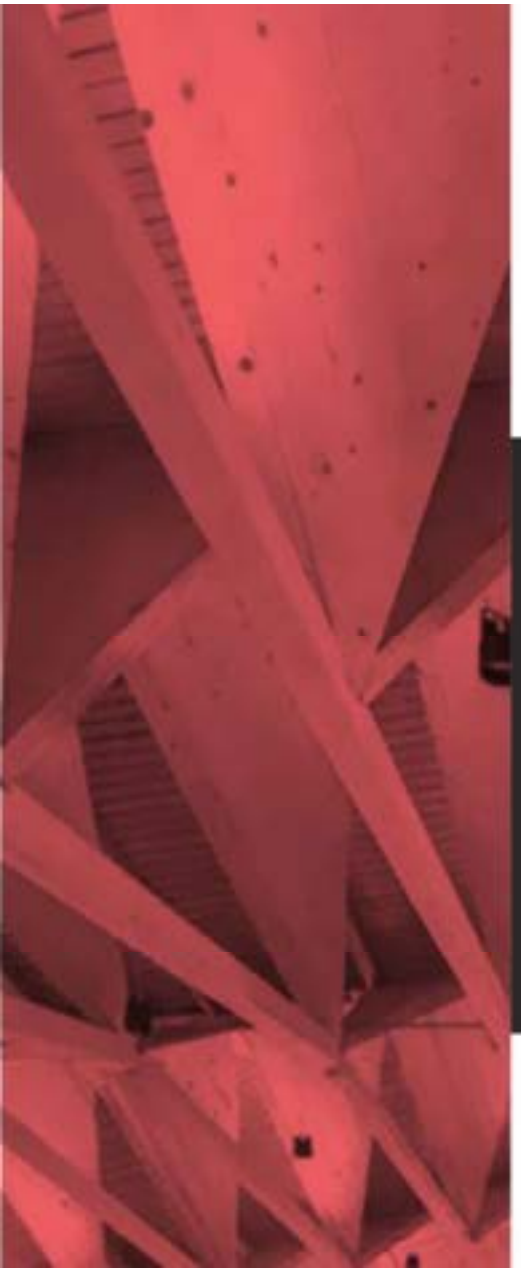
Rod-Alveo: Spans: 6–10 m



Rod-Box: Spans: 8–12 m
Rod-BoxTens: Spans: 10–18 m

WP3 **Optimised structural solutions and assessment of mechanical properties**

WP4 **Optimised construction solutions and performance assessment**
Acoustic + Hygrothermal + Fire performance



IBEROLAM

Timber & Technology

Empresa de Base Tecnológica (spin-off) de la Universidad de Granada

MADERA ESTRUCTURAL

Soluciones y servicios

"No plantamos árboles para construir con madera, **construimos con madera para plantar más árboles**"

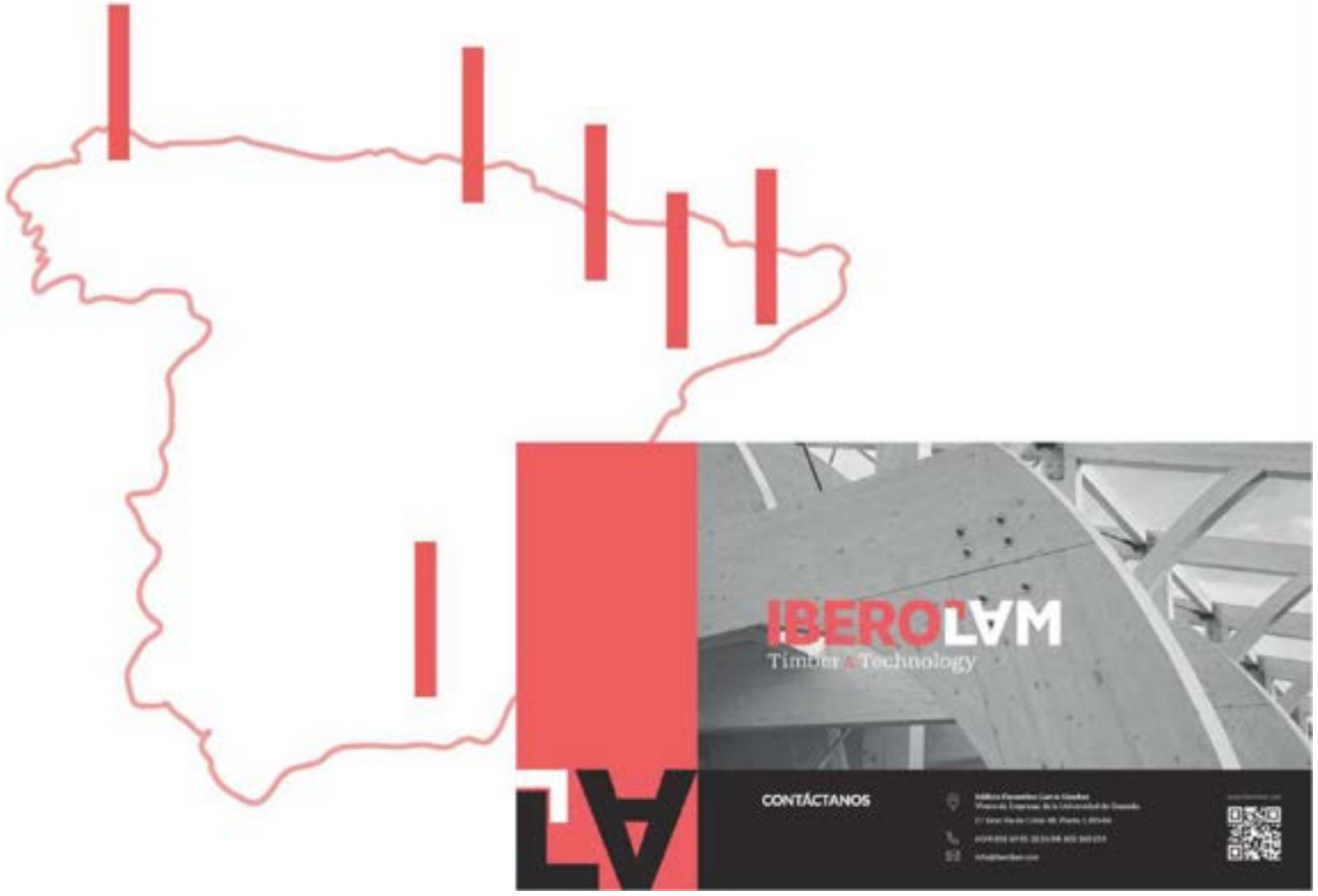
Spin-Off

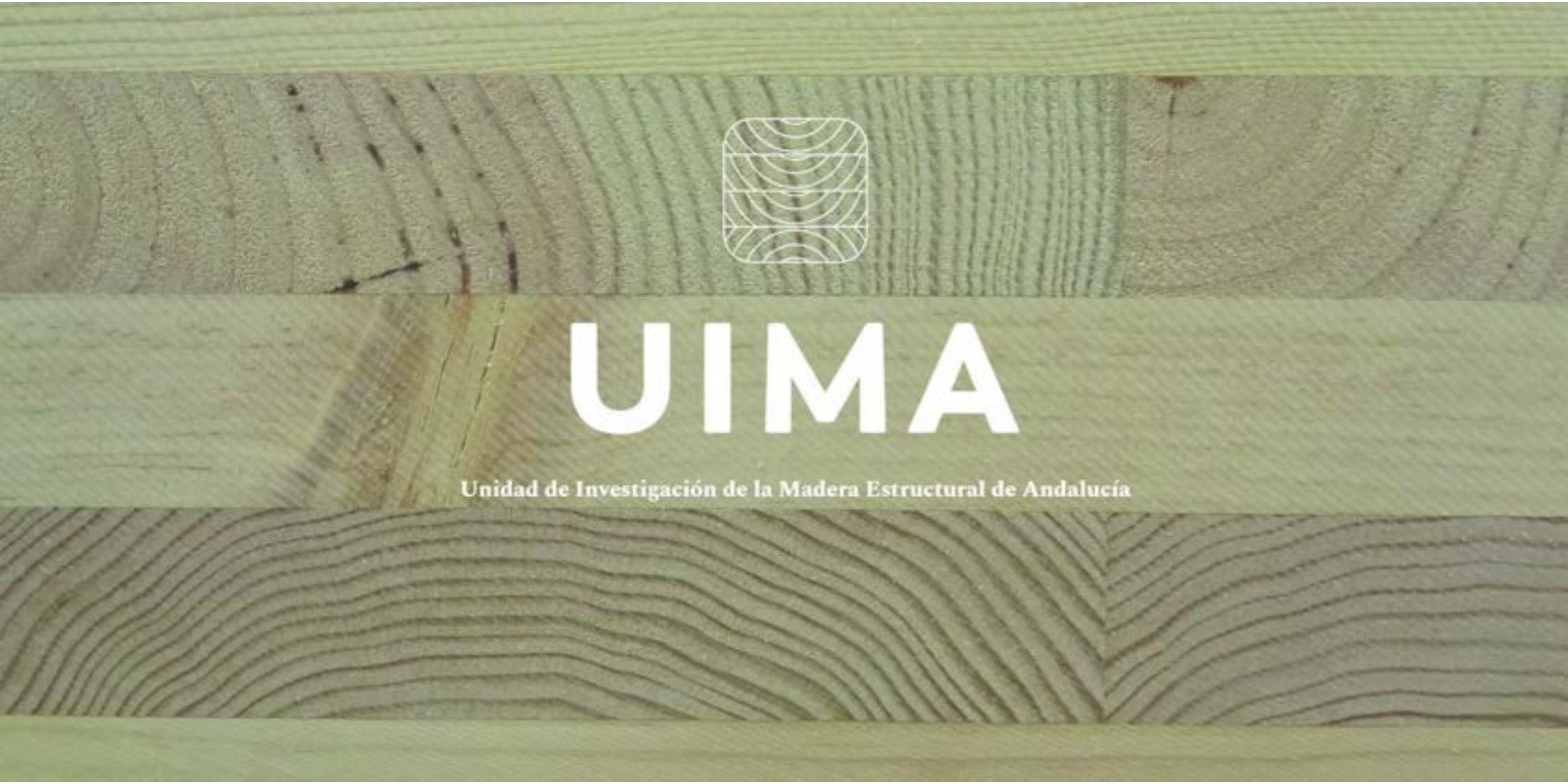
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LAM
Timber
Technology


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Timber Technology
CONTÁCTANOS


UIMA
Unidad de Investigación de la Madera Estructural de Andalucía