THE FUTURE ENVELOPE

TOWARDS ZERO CARBON BUILDINGS

15-16 December 2022 Bolzano/Bozen

Development Process of a Biobased Envelope in the European Project BASAJAUN

MARTA FUENTE GONZALEZ

BASAJAUN

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 862942

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Collaborations

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Development Process of a Biobased Envelope in the European Project BASAJAUN

BASAJAUN

Sustainable Wood Construction fostering Rural Development and Urban Transformation

Horizon 2020 IA
grant no. 862942
Call LC-RUR-11Part B

Oct 2019 – Sep 2023
Total budget 12.2 M€
Total EC grant 10M€

Consortium
30 partners in
12 countries

Coordinator
Tecnalia Research and Innovation
Javier.GarciaJaca@tecnalia.com

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Buildings can be transformed from a carbon source into carbon sinks by using more wood products and smart construction

The goal is to demonstrate how wood construction chains can be optimized to foster both rural development and urban transformation whilst being connected with sustainable forest management in Europe.

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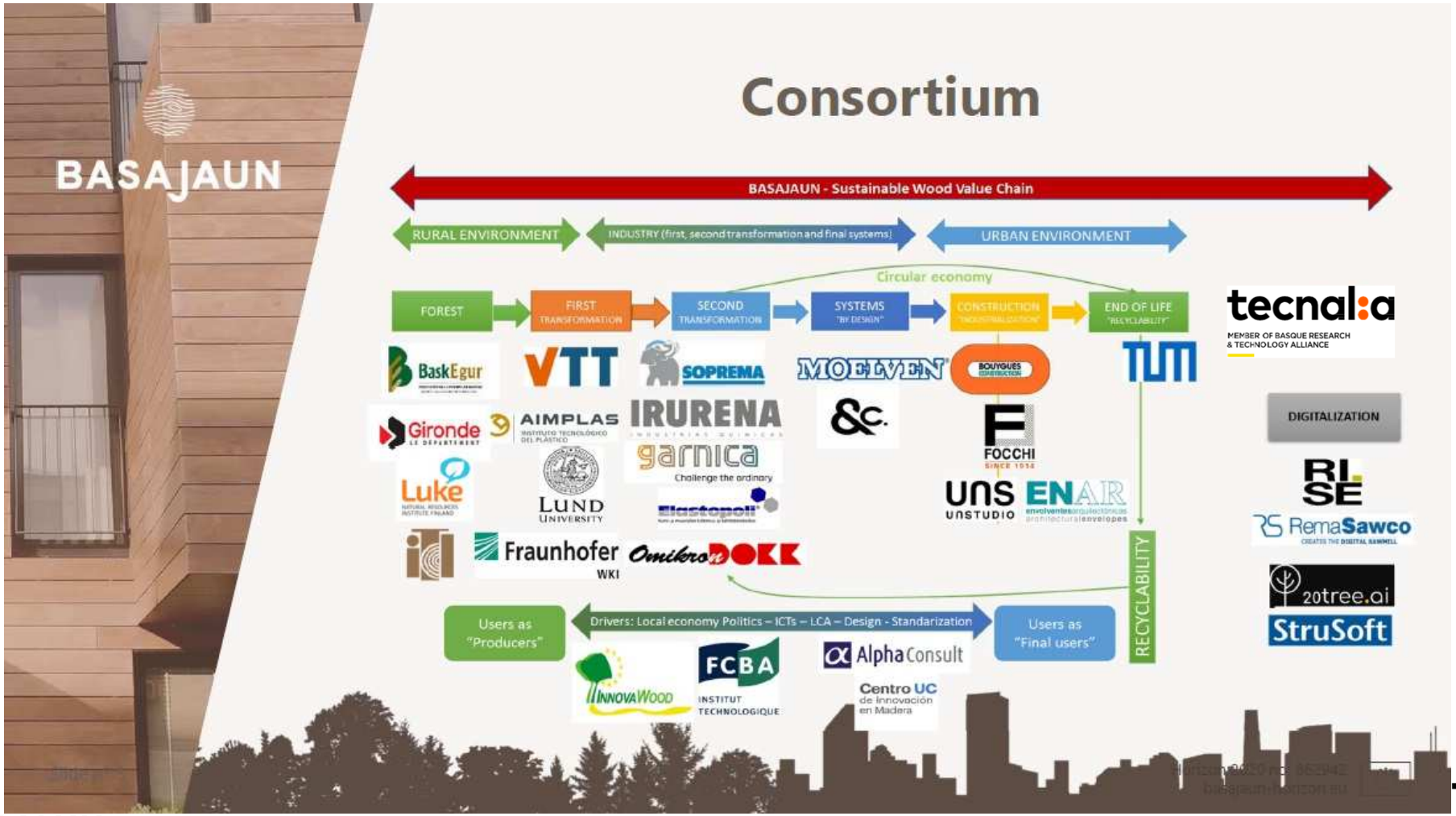

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Development Process of a Biobased Envelope in the European Project BASAJAUN

Development Process of a Biobased Envelope in the European Project BASAJAUN

In this project we want to make better use of wood or wood derivatives and try to apply it in more places than is usually done in a real building:

- Structure
- All the components of the facade, including the profiles, with a wooden base.
- Roof: a new development of sandwich panels has been carried out, with insulation derived from wood chips, internally reinforced (for mechanical properties)

Different construction elements have been developed, especially façades and roofs.

- Performance has been analyzed.
- Tests have been carried out.
- Assembly and execution modes have been studied.
- All industrialized.
- Implemented in a demo building.

Basajaun Façade System Design

Basajaun Façade components prototypes

- Façade requirements
- Façade Performance Targets
- Façade system design

Façade tests

- Performance analysis
- Acoustic
- Fire
- Mechanical simulations
- Thermal and hygrothermal

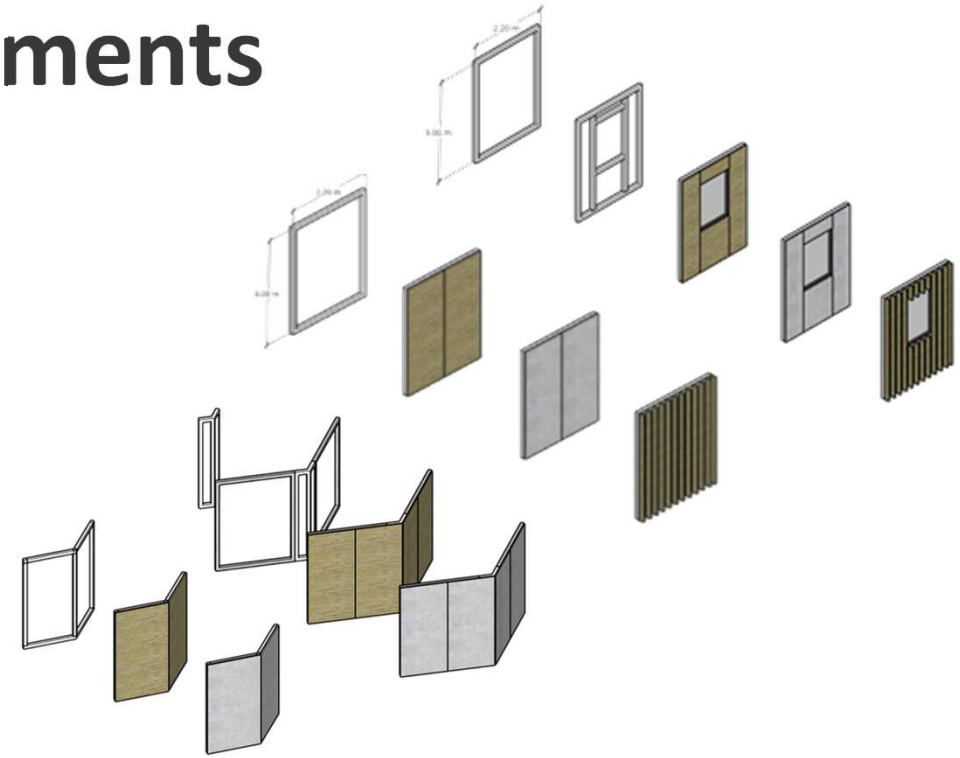
Basajaun façade requirements

Market Requirements:

- Industrialization
- Architectural Customization:

  external cladding customization

  set of typologies



To meet these market requirements the most effective technological solution is the **Unitized Curtain Wall system** for both facade systems (vision and opaque facade systems).

Basajaun façade performance targets

BASIC REQUIREMENT		FINLAND BUILDING CODE	FRANCE BUILDING CODE	BASAJAUN FACADE SYSTEM DESIGN
Safety in case of fire	Reaction to fire	D-s2, d2 - B-s1, d0 Cladding system: D-s2, d2 - A2-s1, d0	IT249 - NF EN 1995-1-2+ national annexe	B1-s1,d0
	Fire resistance	EI30 - EI120	R 15 to 90 depending on the category of family. limitations are depending on building types	EI30 internal layer Fire resistance test to be conducted
Protection against noise	Airborne sound insulation	Sound insulation R'w ≥ 30 dB. SFS-EN ISO 717-1.	Acoustic reduction index RA=31	RA=31 Acoustic test to be conducted
Energy economy and heat retention	Thermal transmittance	U Value of wall/facade ≤ 0,17 W/m²K U value of window ≤ 1,0 W/m²K	U Value of opaque = 0,20 W/m²K U Value window ≤1,3 W/m²K U Value door ≤ 0,80 W/m²K	Simulation with EN ISO 10077-2:2019
		Air permeability rate (q50) of a building envelope may be a maximum of 4.0 m3/(h m2).	Air permeability < 0.4 m3(h/.m2)	Air permeability < 0.4 m3(h/.m2) Test under 13830 to be conducted

Basajaun façade system design

First Solution

The first Basajaun facade system design is a preliminary solution which includes the main characteristics and requirements expected by the facade system design.
Considerations and needs faced:

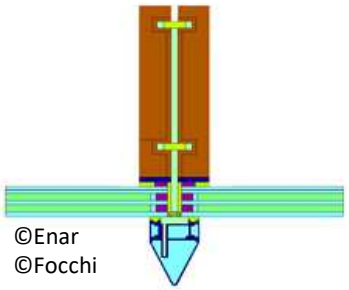
- **biocomposite profiles for unitized curtain wall facade systems** - A set of profiles are designed with the new mechanical characteristics defined by biocomposite material development.
- **wood based products** - Internal layer for fire resistance and insulation material for thermal performance.
- **external cladding** - A fixing mechanism for the external cladding is designed to allow a finishing interchangeable and customizable.

Basajaun façade system design

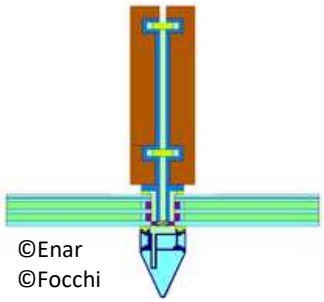
Optimization phase: from 1st to 2nd solution

Different configurations have been considered and the scenarios with different profile materials have been simulated to investigate the thermal behaviour of the façade system:

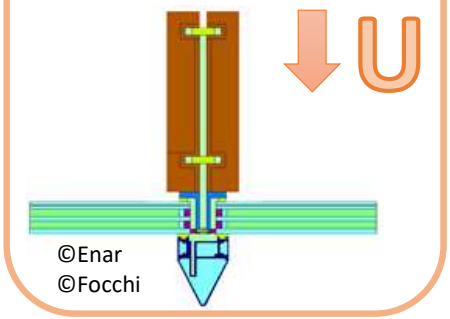
Wooden profile



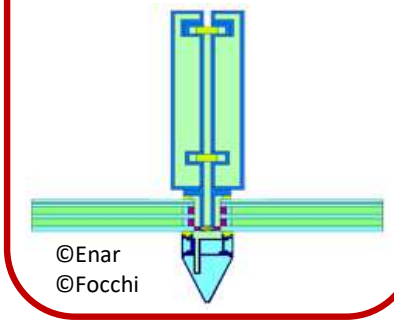
Wooden and pultruded profile



Wooden profile with pultruded



Pultruded profile



Thanks to

The lowest value of transmittance is the solution of the wooden profile with the pultruded. To reduce the number of components and optimizing the façade system it has been chosen the solution with only a pultruded profile whose transmittance value is slightly higher

Basajaun façade system design

Second solution

The second solution implements the first solution. The second solution is the result of the following considerations and needs:

General characteristic - The second solution identifies different materials which follow the demo regulations. In particular, the facade system kept in consideration the profile connections, the breathability of the facade and the wood-based material products.

Profile - Two activities have been conducted:

- *profile/mould reduction*
- *thicker profile*

Components fixing system - it was decided to use a structural sealant rather than a mechanical restraint system as a fixing system for the external layer (aesthetic).

Basajaun façade system design

Second solution

External cladding -the cladding system remains interchangeable.

Membranes - External and internal membranes allow fire reaction, resistances and breathability performances requested.

Plywood - application of plywood in the facade is evaluated for internal and external layers.

- *Internal layer* – protection of the wood fiber insulation panel (fire resistance).
- *External layer* - it has been evaluated, but not resistant to weather conditions.

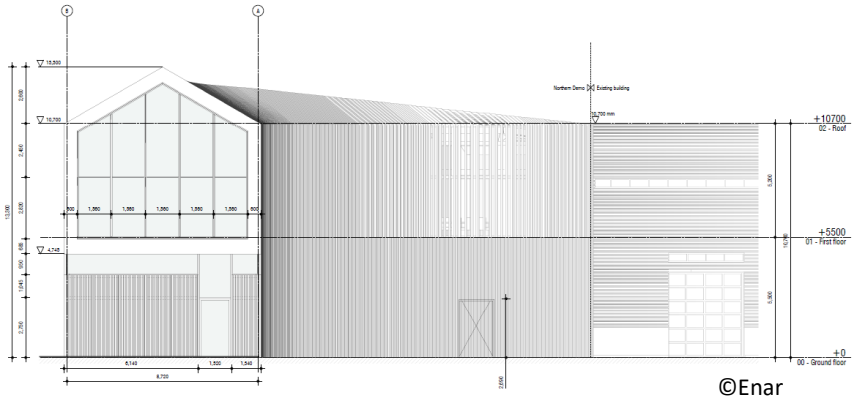
External Fin - aesthetic element.

Basajaun façade system design

Optimization phase: from 2nd solution to final system design

The façade system development had to keep in consideration not only the technical and engineering characteristics but also the Demo building requirements and the Basajaun objective.

The aim of the project was to **improve the manufacturing process** of the unit façade by developing a reduced number of unit typologies.



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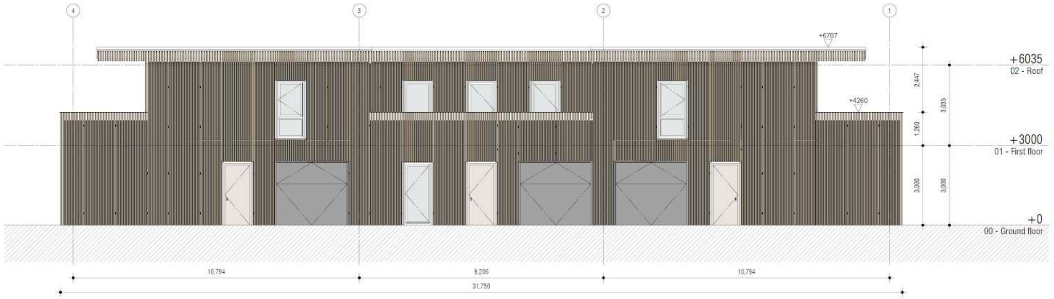

Elevation A - Northern elevation
1 : 100

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Basajaun façade system design

Final design

Result of the previous evolutions, requirements, and considerations.

The main developments in this final design are:

- **General characteristic -** In the final design has been reduced the facade thickness: the wood fiber insulated panel has been **reduced by 52 mm** since it was not required by the French Demo regulations.
- **Biocomposite profile -** four different profiles
  - Mullions - Female transom - Male transom
  - Male profile
  - Internal key
  - External frame (for windows and doors)
- **External cladding -** is maintained interchangeable
- **Plywood** - used to withstand up to 30 minutes for the fire resistance.
- **Shading** - French demo design requires it in the window facade system (external roller shutter).

Basajaun façade system design

Unit typologies for French Demo building

Opaques Modules

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Windows Modules

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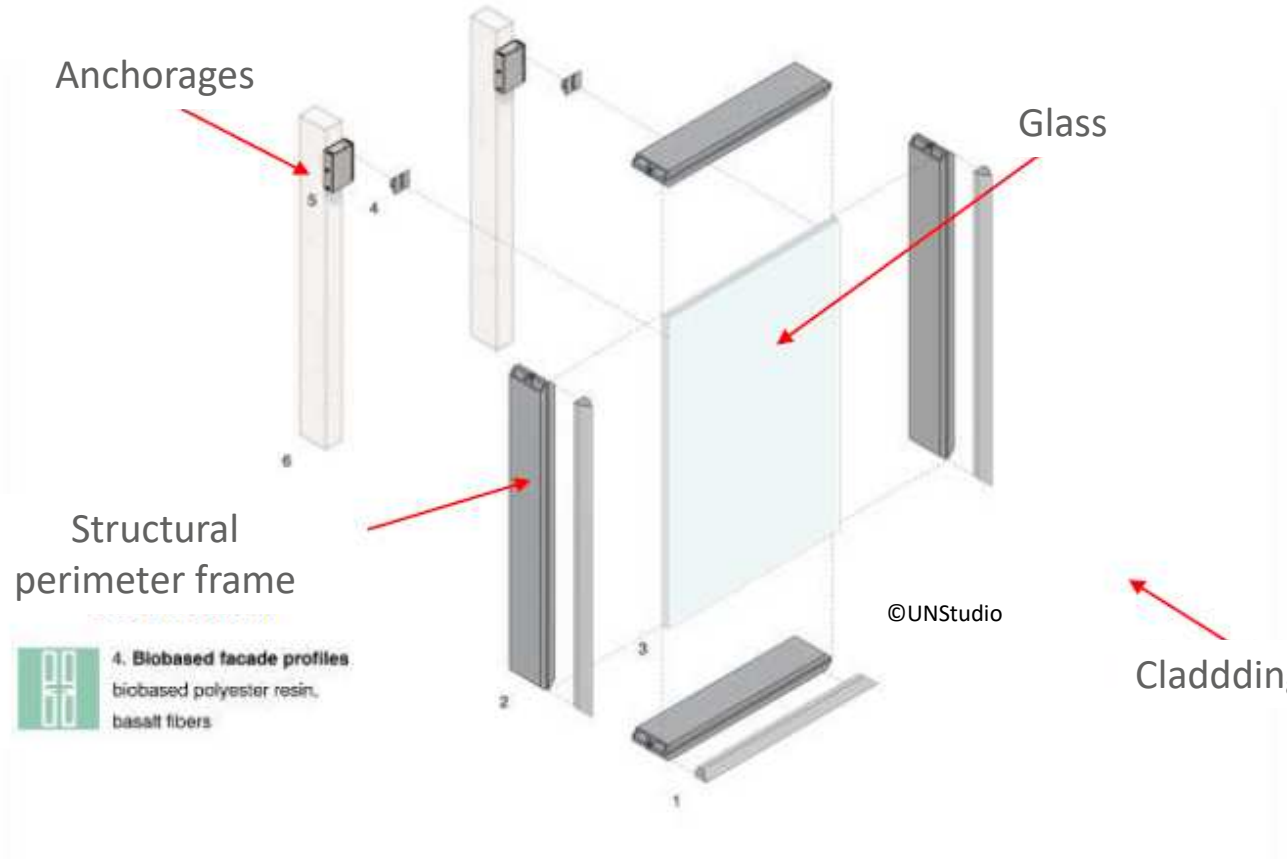

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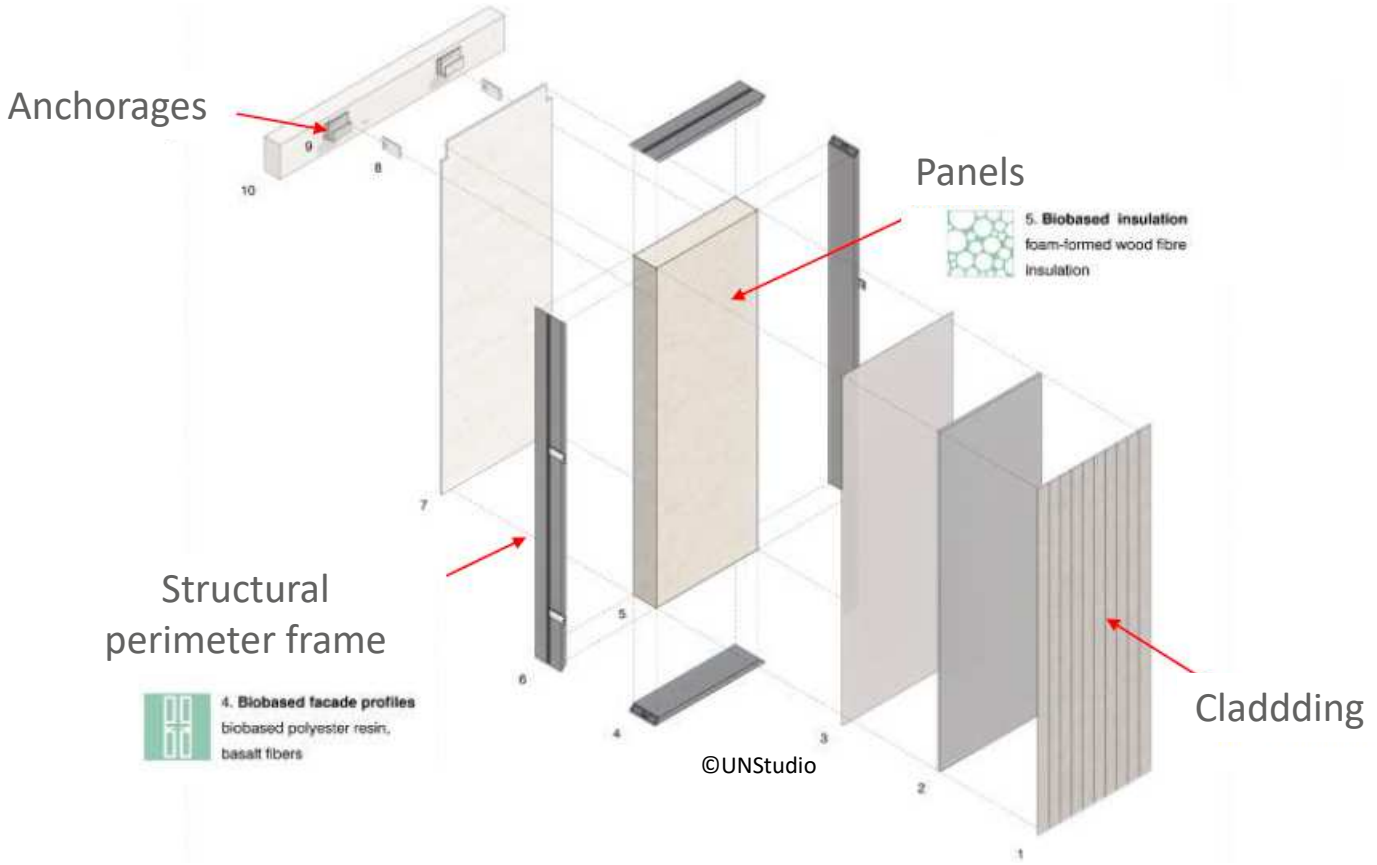
Basajaun façade system design

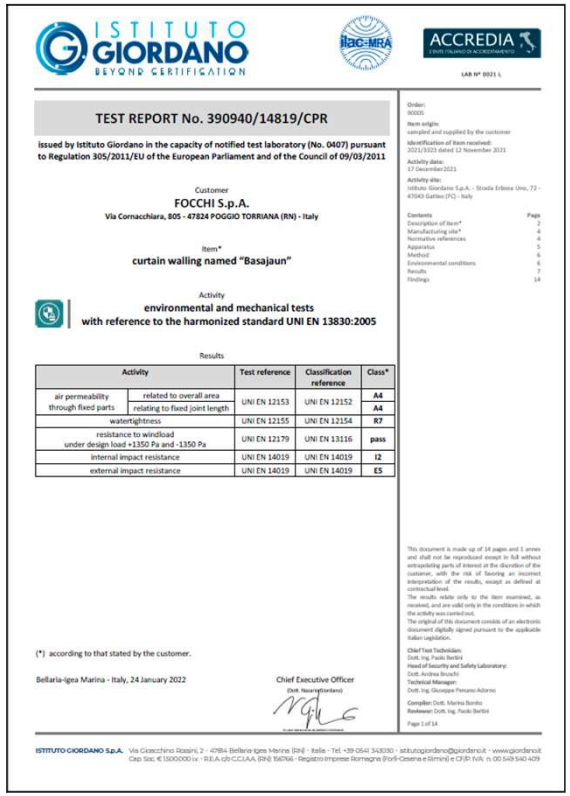


Thanks to UNSTUDIO

Laboratory tests results of the prototypes

- Environmental test sequence:
  - Air permeability.
  - Water tightness.
  - Resistance to wind load.
  - Air permeability.
  - Water tightness.
  - Resistance to wind load.
- Safe impact/break resistance.
- Reaction to fire
- Fire resistance
- Resistance to own weight
- Acoustic attenuation
- Mechanical simulations
- Hydrothermal behaviour
- Biocomposite material characterization

Environmental and mechanical tests



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BEYOND CERTIFICATION

ACCREDIA

LAB N° 0021 L

TEST REPORT No. 390940/14819/CPR

issued by Istituto Giordano in the capacity of notified test laboratory (No. 0407) pursuant to Regulation 305/2011/EU of the European Parliament and of the Council of 09/03/2011

Customer
FOCCHI S.p.A.
Via Cornacchiara, 805 - 47824 POGGIO TORRIANA (RN) - Italy

Item*
curtain walling named "Basajaun"

Activity
environmental and mechanical tests with reference to the harmonized standard UNI EN 13830:2005

Results

Activity		Test reference	Classification reference	Class*
air permeability through fixed parts	related to overall area	UNI EN 12153	UNI EN 12152	A4
	relating to fixed joint length			A4
watertightness		UNI EN 12155	UNI EN 12154	R7
resistance to windload under design load +1350 Pa and -1350 Pa		UNI EN 12179	UNI EN 13116	pass
internal impact resistance		UNI EN 14019	UNI EN 14019	I2
external impact resistance		UNI EN 14019	UNI EN 14019	E5

(*) according to that stated by the customer.

Bellaria-Igea Marina - Italy, 24 January 2022

Chief Executive Officer

Activity		Test reference	Classification reference	Class*
air permeability through fixed parts	related to overall area	UNI EN 12153	UNI EN 12152	A4
	relating to fixed joint length			A4
watertightness		UNI EN 12155	UNI EN 12154	R7
resistance to windload under design load +1350 Pa and -1350 Pa		UNI EN 12179	UNI EN 13116	pass
internal impact resistance		UNI EN 14019	UNI EN 14019	I2
external impact resistance		UNI EN 14019	UNI EN 14019	E5

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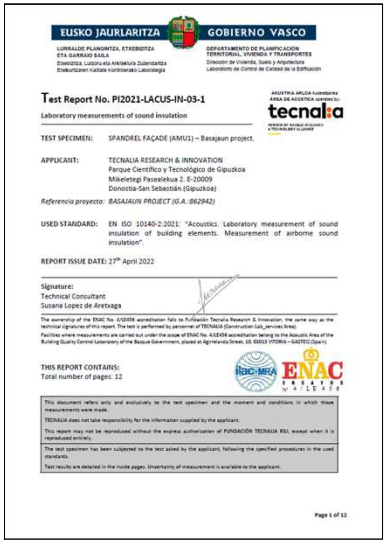
Acoustic tests



EUSKO JAURLARITZA GOBIERNO VASCO

Test Report No. PI2021-LACUS-IN-03-1

Laboratory measurements of sound insulation

TEST SPECIMEN: SPANDREL FAÇADE (AMU1) – Basajaun project.

APPLICANT: TECNALIA RESEARCH & INNOVATION
Parque Científico y Tecnológico de Gipuzkoa
Mikeletegi Pasealekua 2. E-20009
Donostia-San Sebastián (Gipuzkoa)

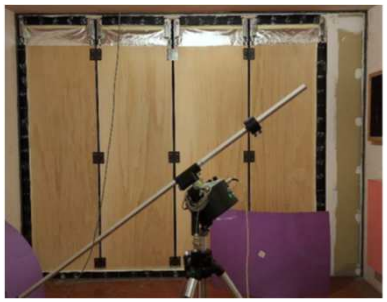
Referencia proyecto: BASAJAUN PROJECT (G.A.:862942).

USED STANDARD: EN ISO 10140-2:2021: "Acoustics. Laboratory measurement of sound insulation of building elements. Measurement of airborne sound insulation".

REPORT ISSUE DATE: 27th April 2022

Signature:
Technical Consultant
Susana Lopez de Aretxaga

THIS REPORT CONTAINS:
Total number of pages: 12



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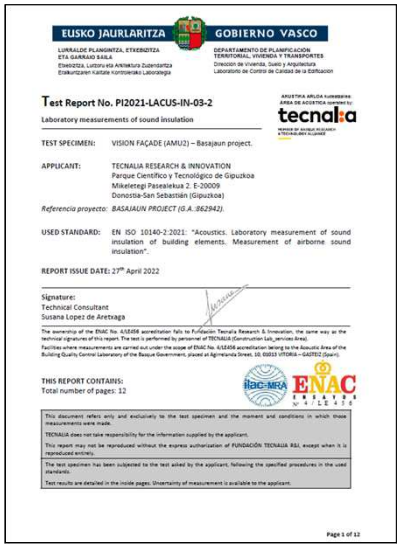

EUSKO JAURLARITZA GOBIERNO VASCO

Test Report No. PI2021-LACUS-IN-03-2

Laboratory measurements of sound insulation

TEST SPECIMEN: VISION FAÇADE (AMU2) – Basajaun project.

APPLICANT: TECNALIA RESEARCH & INNOVATION
Parque Científico y Tecnológico de Gipuzkoa
Mikeletegi Pasealekua 2. E-20009
Donostia-San Sebastián (Gipuzkoa)

Referencia proyecto: BASAJAUN PROJECT (G.A.:862942).

USED STANDARD: EN ISO 10140-2:2021: "Acoustics. Laboratory measurement of sound insulation of building elements. Measurement of airborne sound insulation".

REPORT ISSUE DATE: 27th April 2022

Signature:
Technical Consultant
Susana Lopez de Aretxaga

THIS REPORT CONTAINS:
Total number of pages: 12

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Opaque module

Rating according to EN ISO 717-1:2020:

$R_w(C;C_{tr})$: 44 (-2; -7) dB; $C_{100-5000}$: -1 dB; $C_{tr,100-5000}$: -7 dB

$R_A = R_w + C_{100-5000}$: 43 dB

$R_{A,tr} = R_w + C_{tr,100-5000}$: 37 dB

Evaluation based on laboratory measurement results obtained by an engineering method.

Vision module

Rating according to EN ISO 717-1:2020:

$R_w(C;C_{tr})$: 42 (-2; -6) dB; $C_{100-5000}$: -1 dB; $C_{tr,100-5000}$: -6 dB

$R_A = R_w + C_{100-5000}$: 41 dB

$R_{A,tr} = R_w + C_{tr,100-5000}$: 36 dB

Evaluation based on laboratory measurement results obtained by an engineering method.

Fire resistance tests

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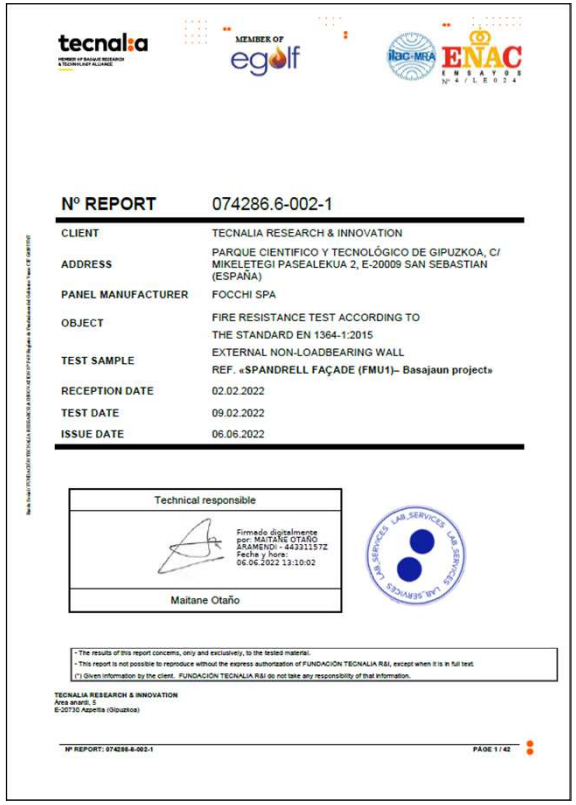

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Nº REPORT	074286.6-002-1
CLIENT	TECNALIA RESEARCH & INNOVATION
ADDRESS	PARQUE CIENTIFICO Y TECNOLÓGICO DE GIPUZKOA, C/ MIKELETEGI PASEALEKUA 2, E-20009 SAN SEBASTIAN (ESPAÑA)
PANEL MANUFACTURER	FOCCHI SPA
OBJECT	FIRE RESISTANCE TEST ACCORDING TO THE STANDARD EN 1364-1:2015
TEST SAMPLE	EXTERNAL NON-LOADBEARING WALL REF. «SPANDRELL FAÇADE (FMU1)– Basajaun project»
RECEPTION DATE	02.02.2022
TEST DATE	09.02.2022
ISSUE DATE	06.06.2022

Technical responsible

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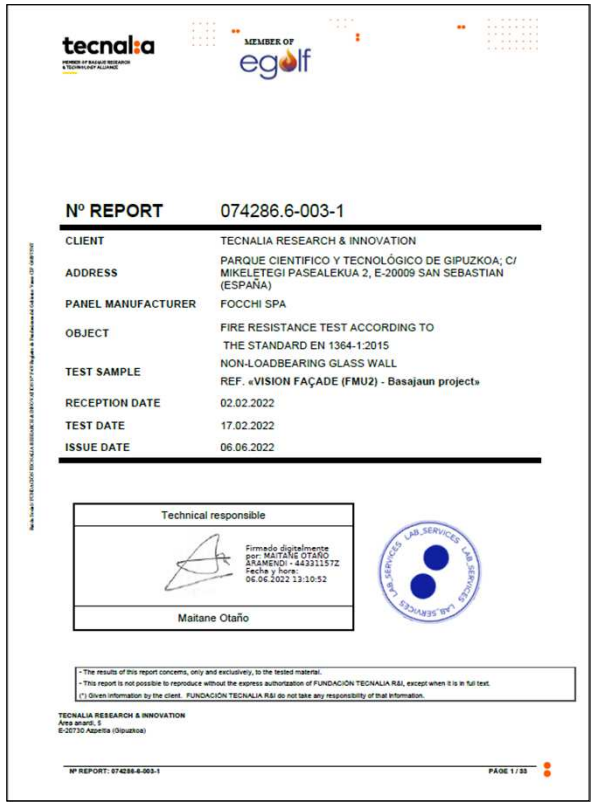

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PANEL MANUFACTURER	FOCCHI SPA
OBJECT	FIRE RESISTANCE TEST ACCORDING TO THE STANDARD EN 1364-1:2015
TEST SAMPLE	NON-LOADBEARING GLASS WALL REF. «VISION FAÇADE (FMU2) - Basajaun project»
RECEPTION DATE	02.02.2022
TEST DATE	17.02.2022
ISSUE DATE	06.06.2022

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Spandrell module

Fire resistance classification: EI 60 (i→o)

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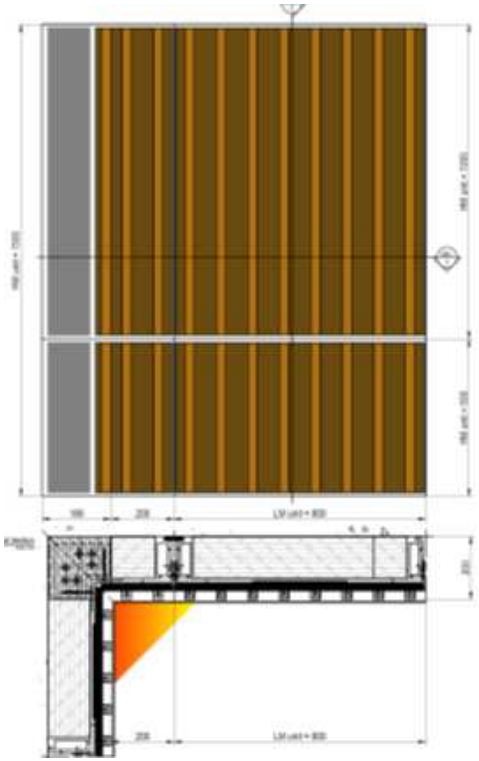
Reaction to fire



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REPORT No.	074286.6-001-1-a
APPLICANT	TECNALIA
ADDRESS	MIKELETEGI PASEALEKUA 2, E-20009 DONOSTIA – SAN SEBASTIAN (GIPUZKOA)
MANUFACTURER OF PANELS	FOCCHI SPA
ASSEMBLY PERFORMED BY:	TECNALIA
PURPOSE	REACTION TO FIRE TEST REPORT ACCORDING TO EN 13823:2020
TESTED SAMPLE	SPANDREL FAÇADE (FMU1) – Basajaun project REF.« BASAJAUN PROJECT (G.A.:862942) »
RECEPTION DATE	15.11.2021
TEST DATES	22.12.2021
ISSUE DATE	09.06.2022

Pablo Garmendia
Safety Laboratory

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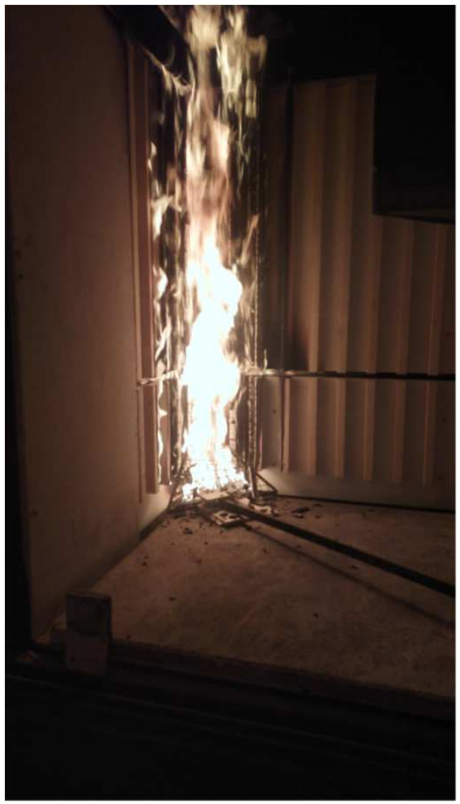
SBI test result: D-s2, D0



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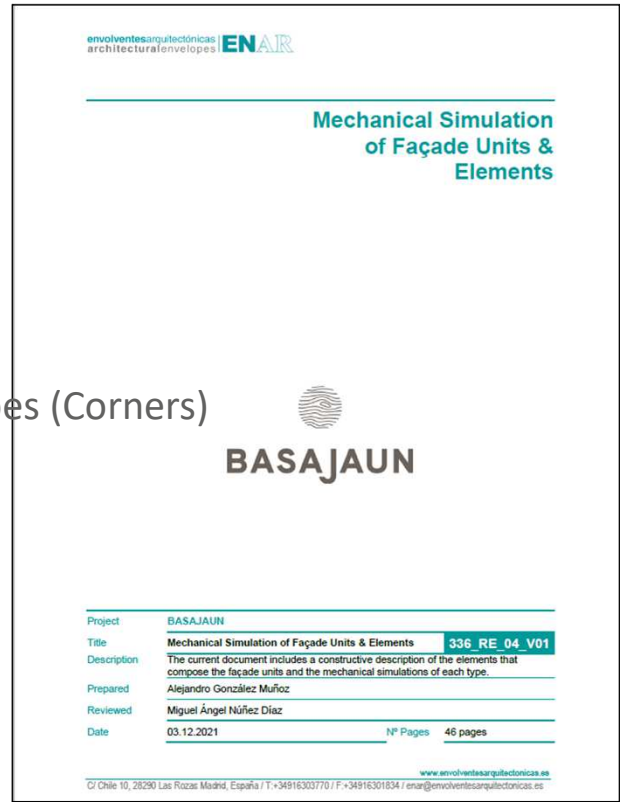
Mechanical simulations

- Mullion and transom of different panels
- Opaque Unit
- Glass Unit
- Window Unit
- Balaustrade Unit
- Corner Unit
- Special reinforcement tubes (Corners)
- Anchorages
- Conection elements
- Screws and fixings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Mechanical Simulation of Façade Units & Elements

BASAJAUN

Project	BASAJAUN
Title	Mechanical Simulation of Façade Units & Elements — 336_RE_04_V01
Description	The current document includes a constructive description of the elements that compose the façade units and the mechanical simulations of each type.
Prepared	Alejandro González Muñoz
Reviewed	Miguel Ángel Núñez Díaz
Date	03.12.2021 — Nº Pages 46 pages

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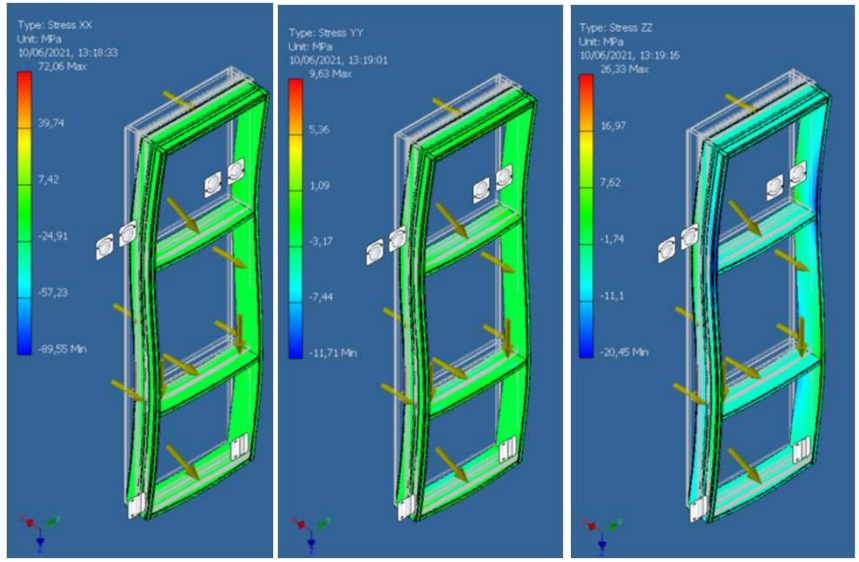

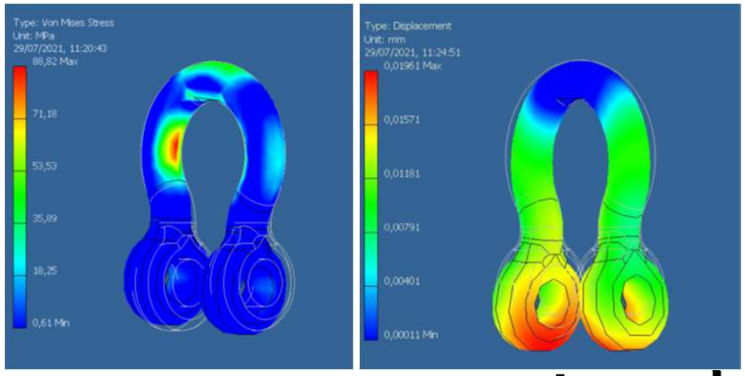

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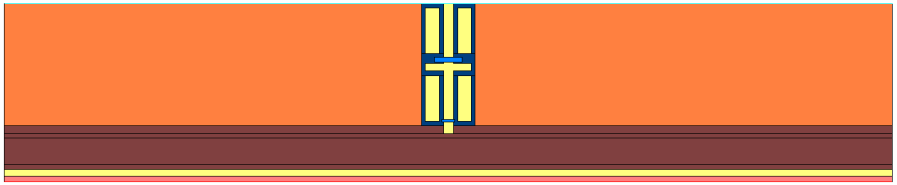
Thermal modelling



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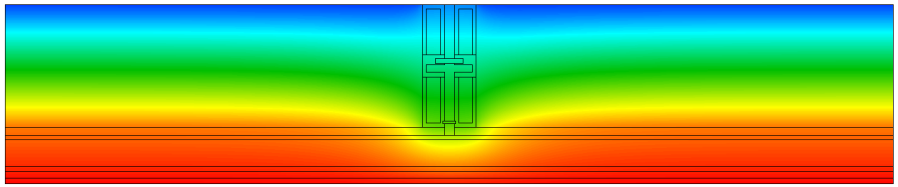
Thermal model for wall



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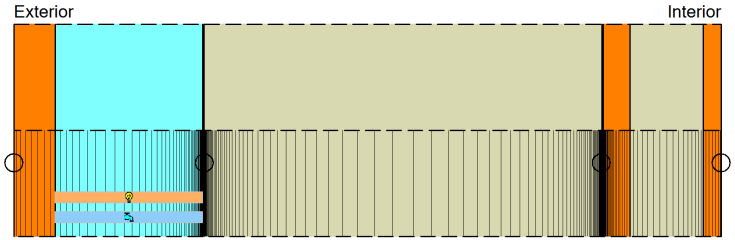
Temperature distribution in thermal model

Equivalent thermal transmittance of wall junctions with profiles:
U = 0.144 W/mK

Hygrothermal simulation



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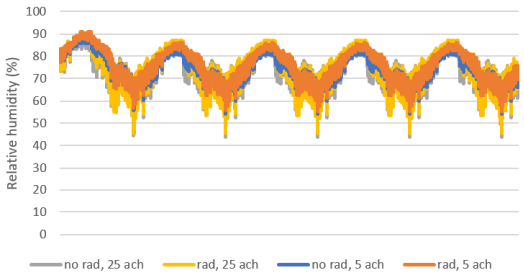
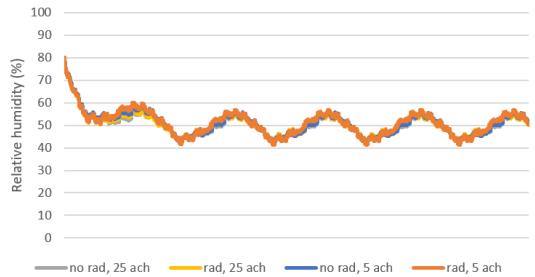
Hygrothermal model of wall



Evolution of relative humidity at outer face of core woodfibre insulation



Evolution of relative humidity at inner face of core woodfibre insulation

Development Process of a Biobased Envelope in the European Project BASAJAUN

Demo building in South Europe

Thanks to

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Development Process of a Biobased Envelope in the European Project BASAJAUN

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THE FUTURE ENVELOPE

TOWARDS ZERO CARBON BUILDINGS

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Thank you!

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