BASAJAUN

Biobased components for curtain wall façade

Preliminary insight of Basajaun project

Sustainable Places 2023 ◦ 14th-16th of June 2023

Laura Vandi, Innovation project manager

FOCCHI SPA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 862942

basajaun-horizon.eu

SUSTAINABLE PLACES 2023

Overview

- Introduction
- Methodology
  - Basajaun facade specifications
  - Development of facade system design
  - Tests and results
- Conclusion

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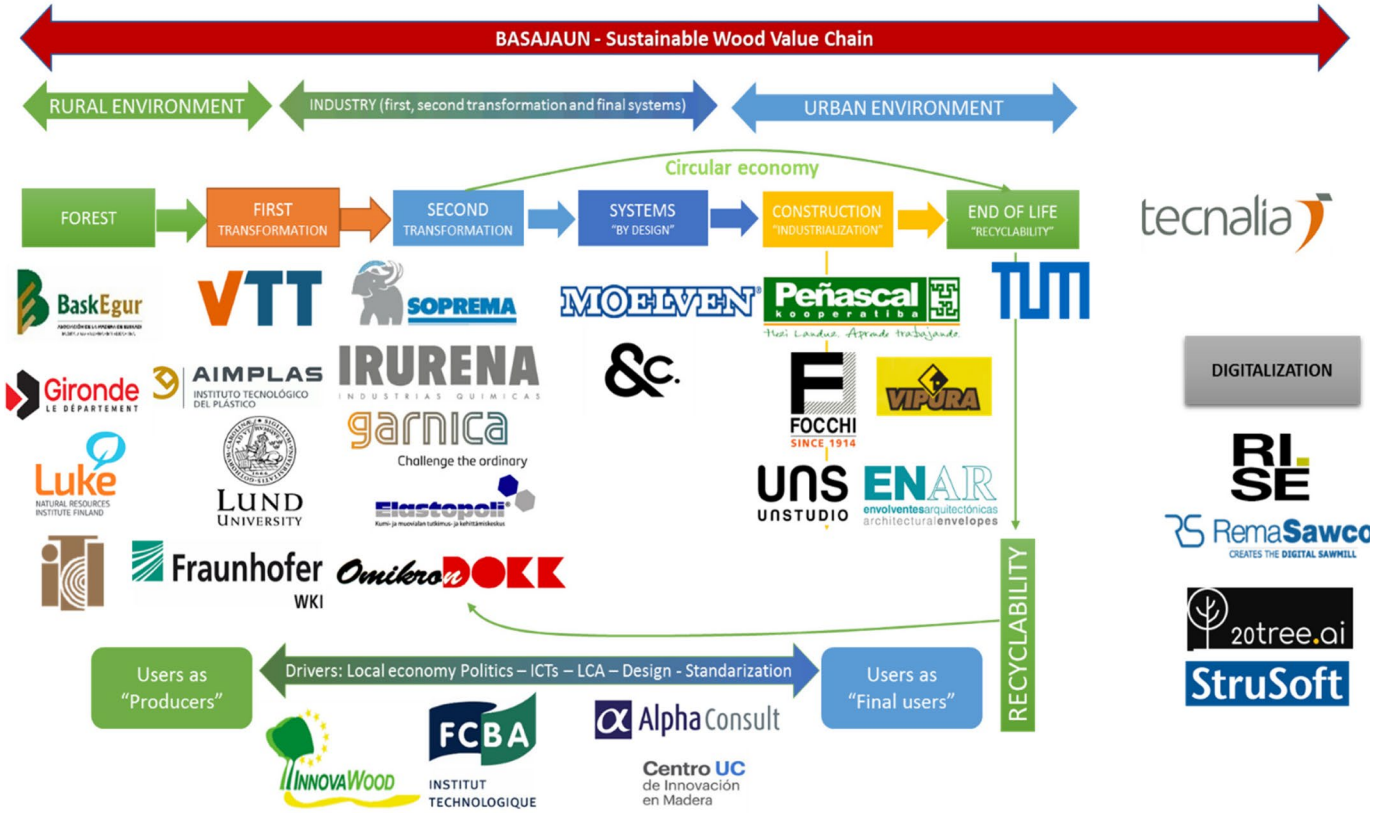
Introduction

Basajaun overview

- Project timeline
  01/10/2019 → 31/03/24
- Call
  H2020 – IA grant n° 862942
  LC-RUR-11 Part B
- Partners
  29 partners from 12 countries
  Coordinator – TECNALIA RESEARCH and INNOVATION
  Javier.GarciaJaca@tecnalia.com
- Focchi
  Responsable for the designing and manufacturing a prefabbricated curtain wall building envelope which integrates bio-based materials

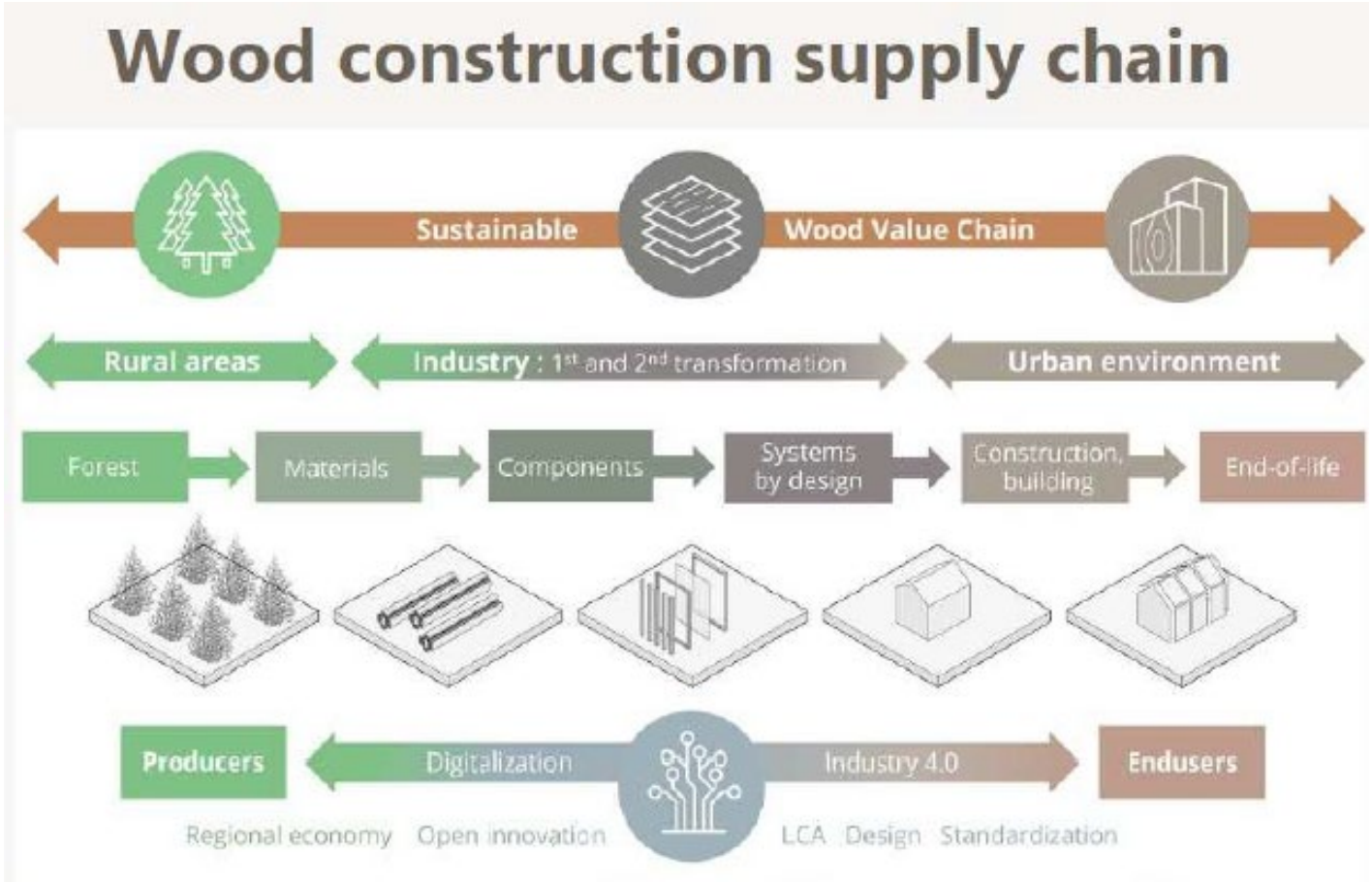


Basajaun context and objective

Forestry and wood industries provide employment and income in Europe's rural regions

Wood stores CO2 in solid products for decades and can be recycled both biologically and technically.

The digital transformation is leading to disruptive changes also in forestry and wood industries.



Basajaun outcomes

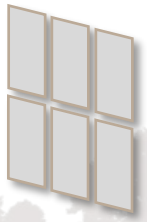
Innovations

Novel bio-based materials, products and building system

Demo buildings

Full-scale demonstration projects realized with multiple partners

Curtain wall facade



Digital twin F2DBF

Industry 4.0 platform to ensure traceability and transparency of engineering process

Studies and Reports

Building with wood addressing a holistic value chain and rural development

Co-creation platform

Upscaling of results together with more regional companier and stakeholders

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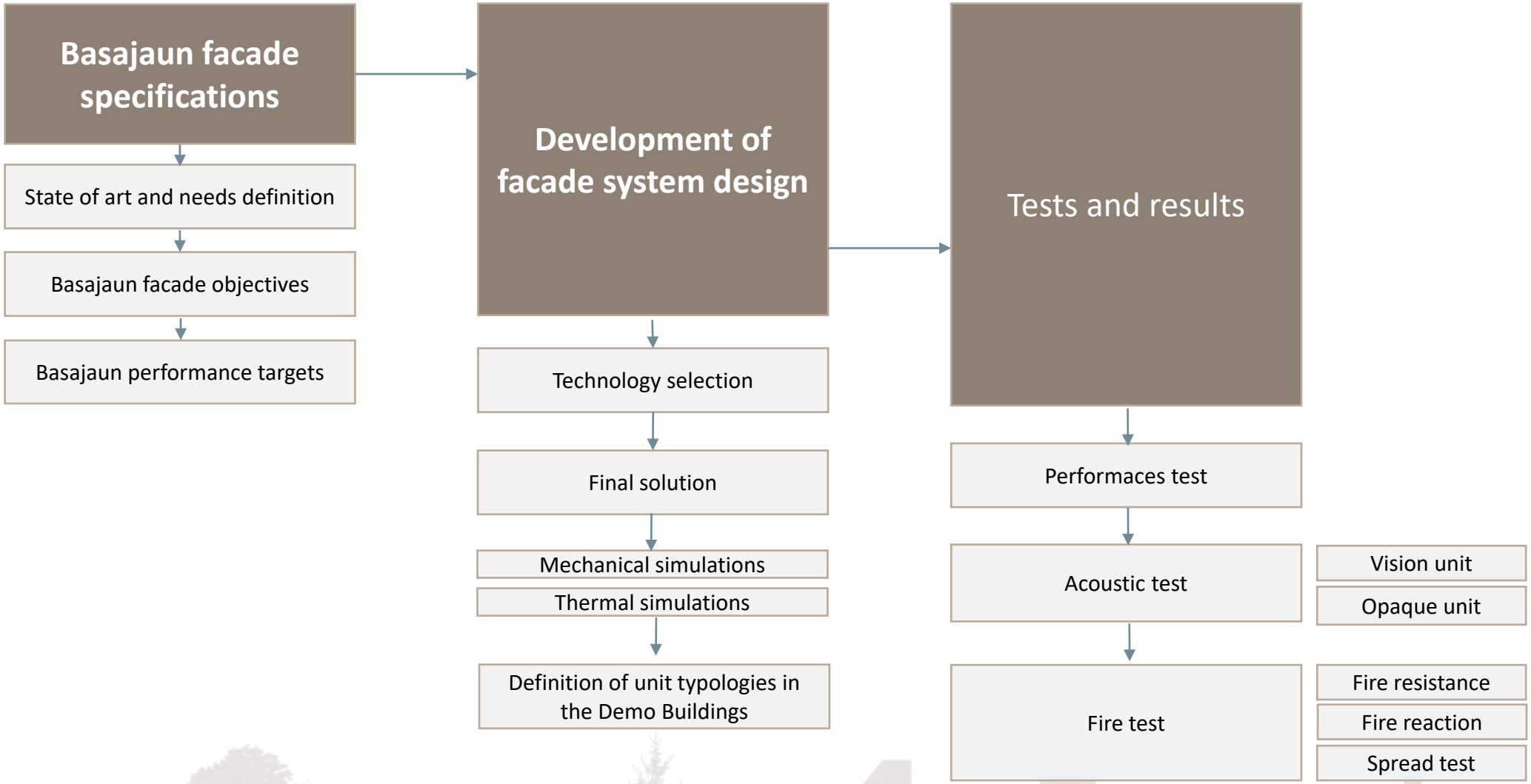
Methodology

Methodology



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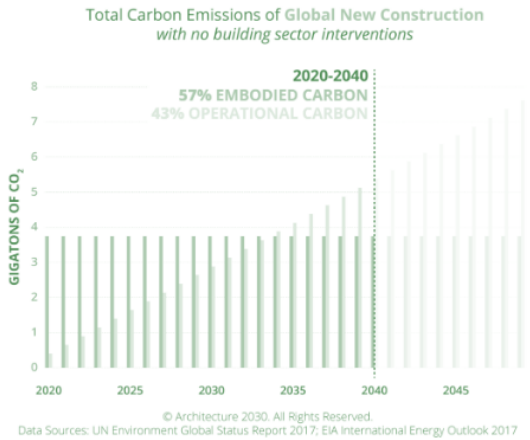
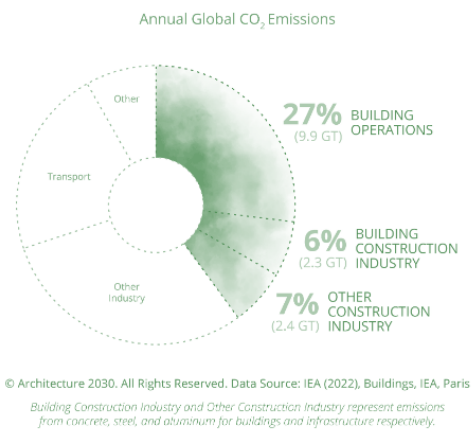
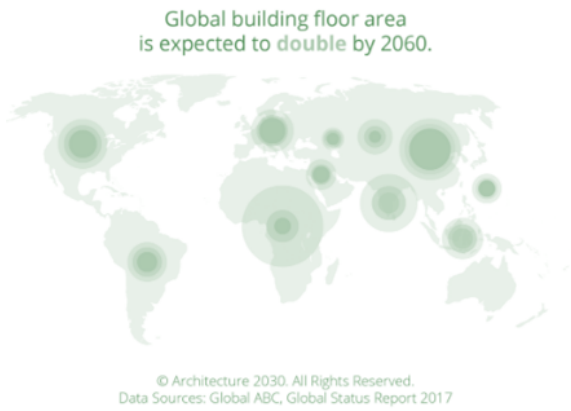
Basajaun facade specifications

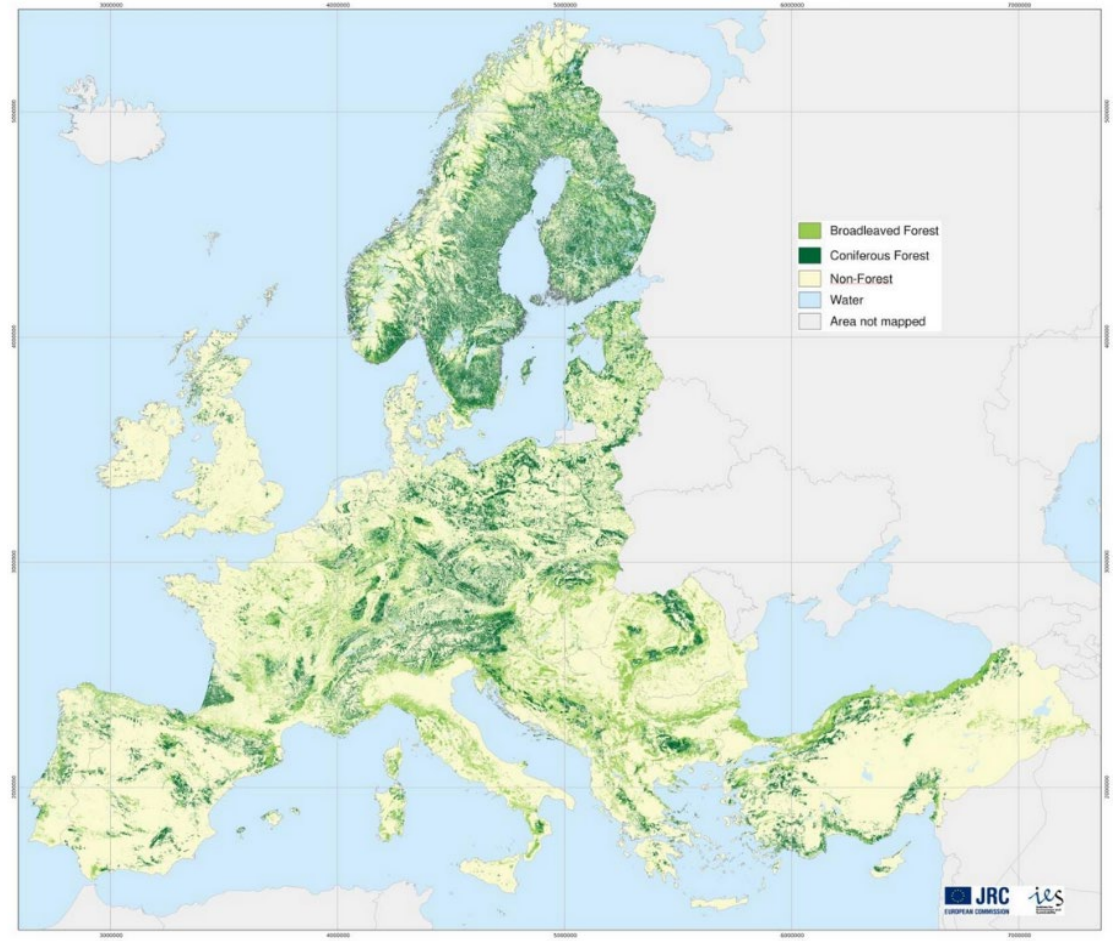
Horizon 2020 no. 862942
basajaun-horizon.eu

State of art and needs definition









Basajaun facade objectives

biocomposites materials, wooden fibers, plywood

to industrialize the manufacture process in factories

to make the transport and installation activities easy and safe

to design a non-structural and lightweight envelope

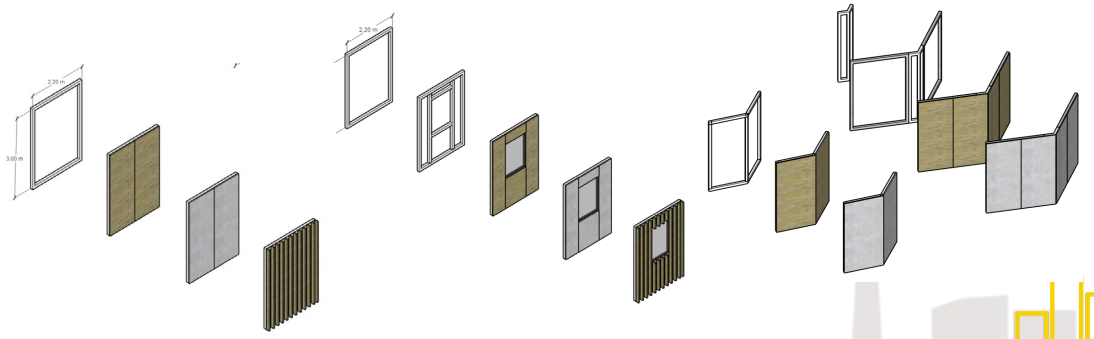
Architectural customization

to implement multiple typologies (vision and opaque building) of façade systems with different targets

to use biocomposites-based product from forest materials

Unitized Curtain Wall system

Material cladding and Facade typology



Basajaun performances target

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

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Facade system design

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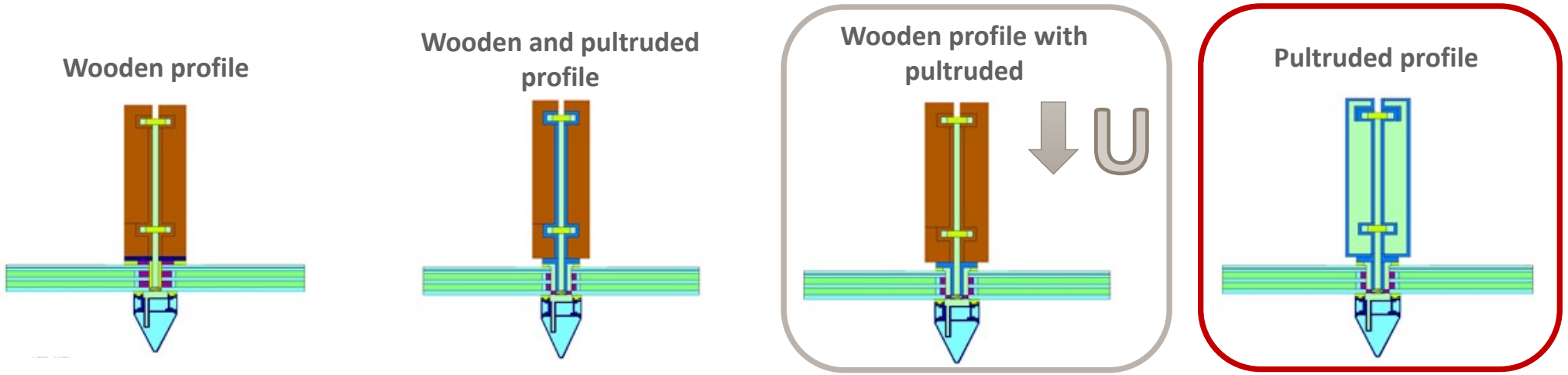
Facade system design: technology selection



1. The lowest value of transmittance is the solution of the wooden profile with the pultruded.
2. 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

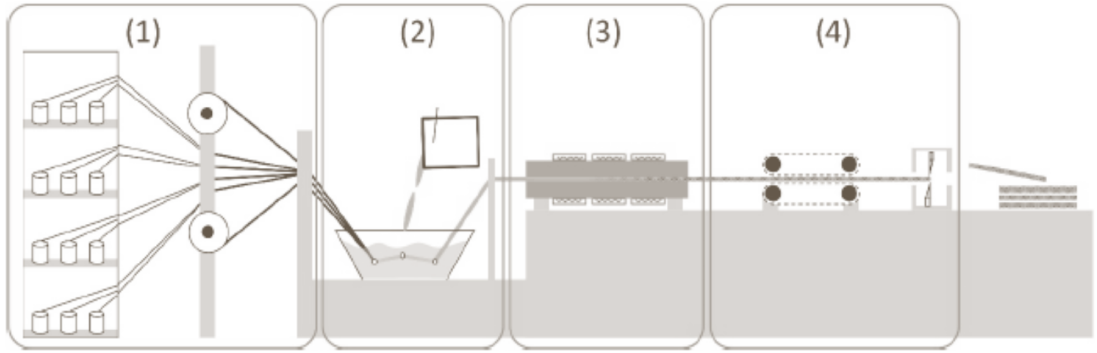
Basajaun biocomposite profile

- Wooden fiber
- Basalt fiber

→ 60%

- Resin

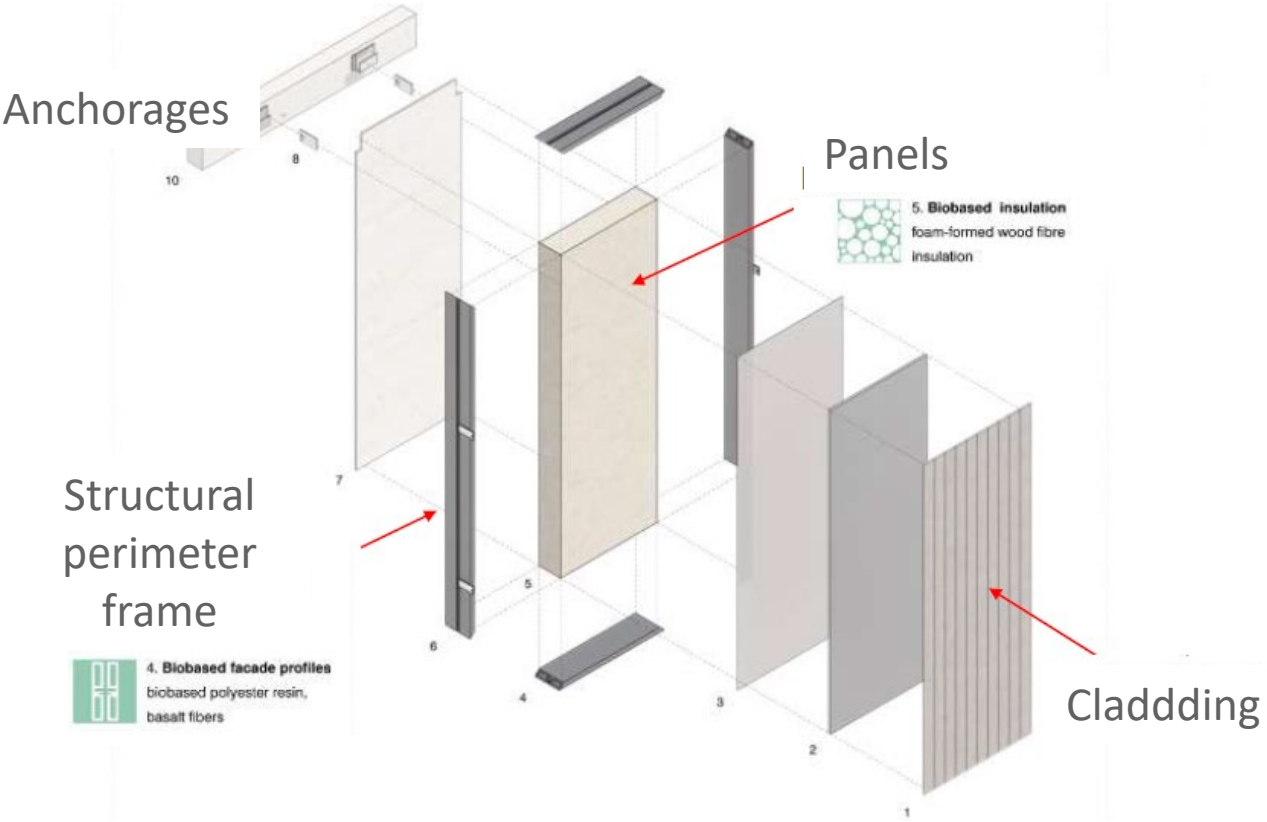
→ 40%



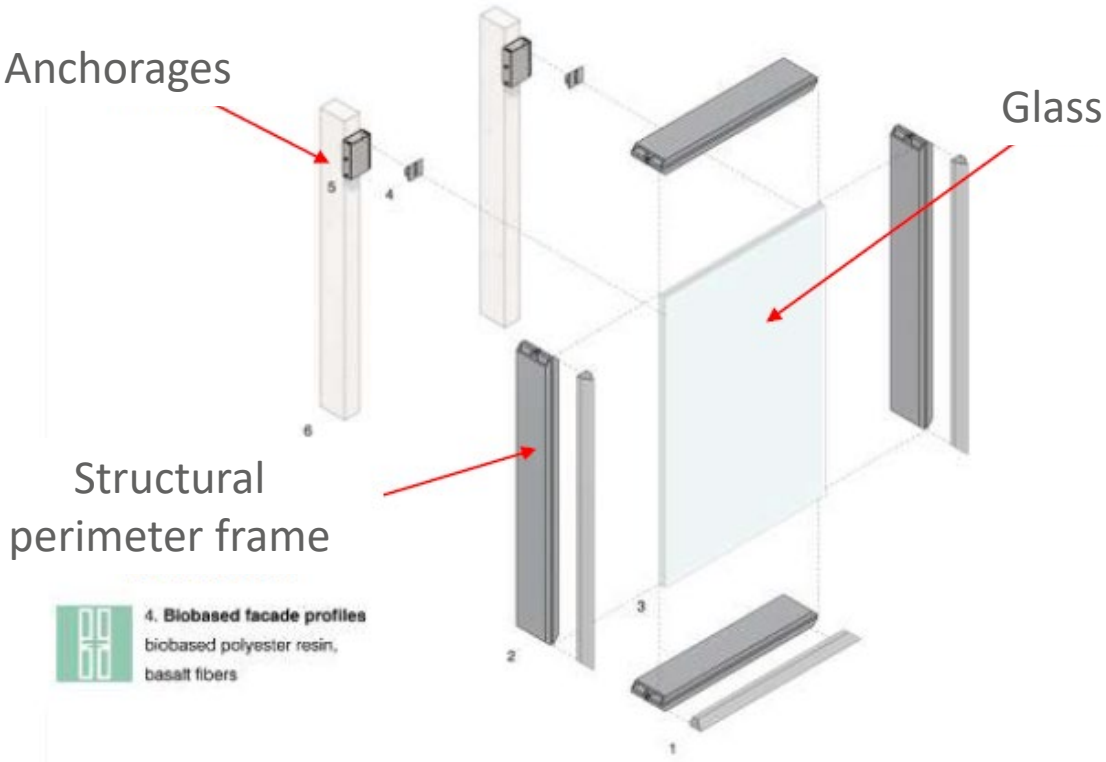
Pultrusion process

Biocomposite profile

Facade system design - components

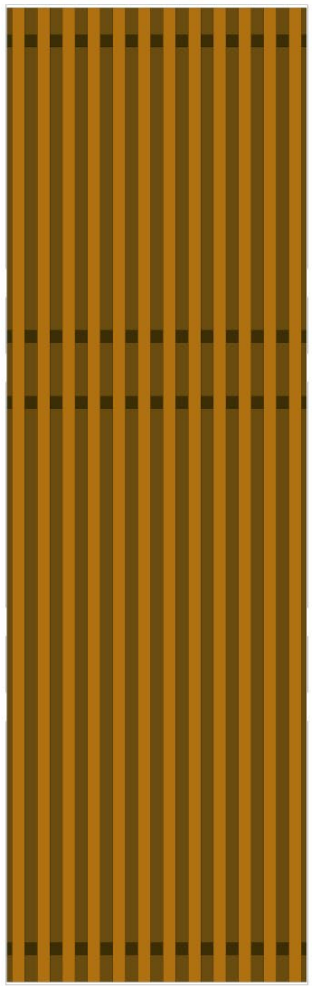


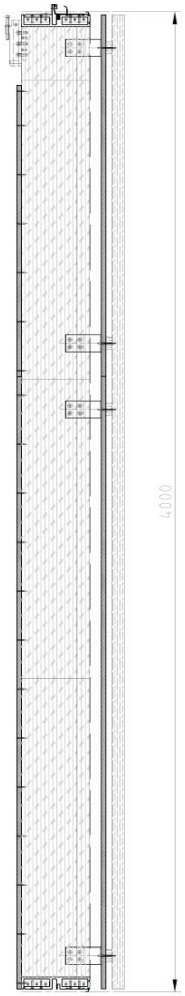
Opaque unit

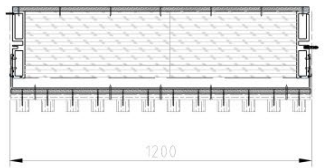


Vision unit

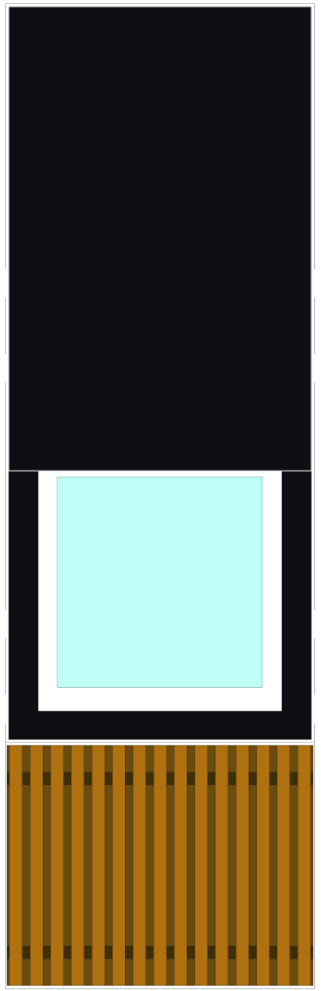
Opaque unit

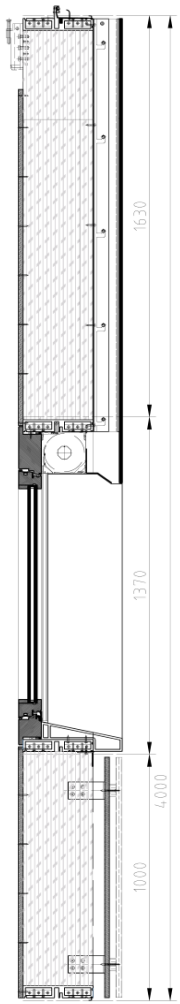


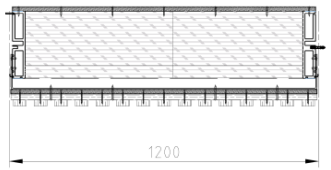




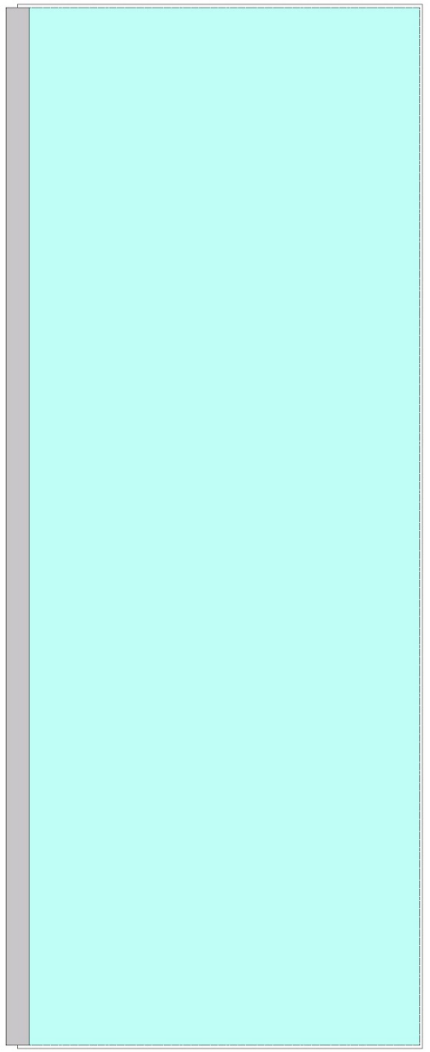
Window unit

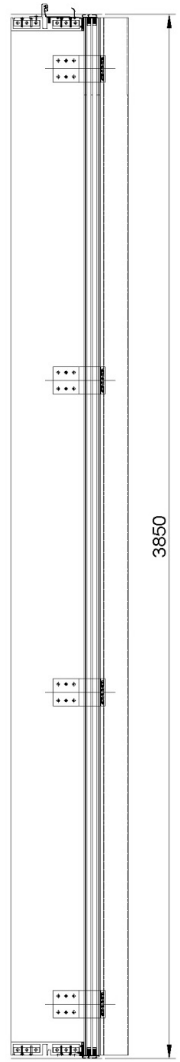


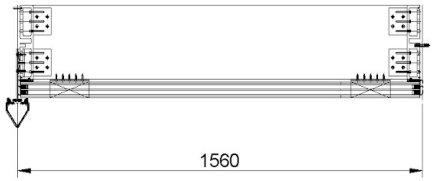




Vision unit



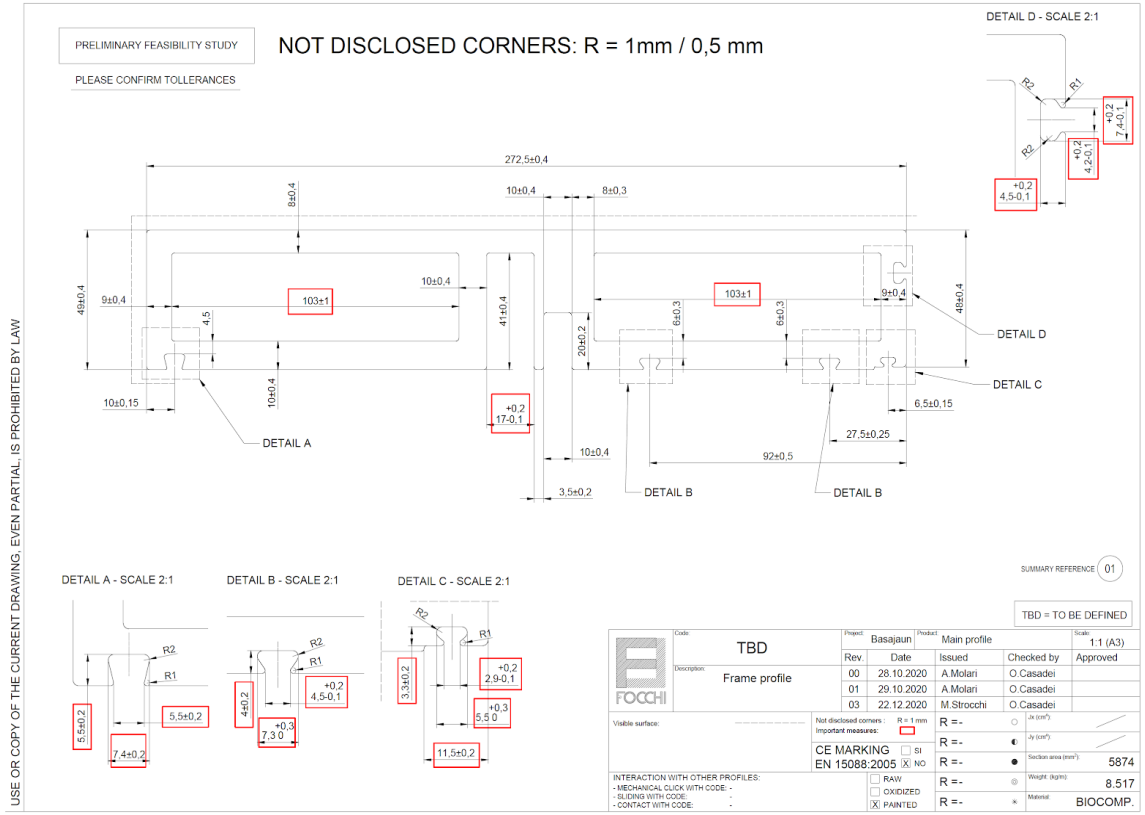




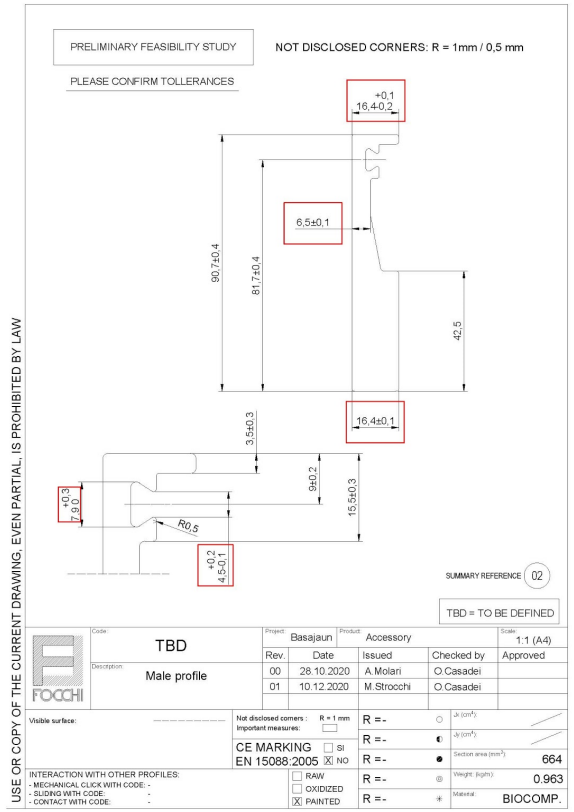

Opaque unit
Window unit
Vision unit
VALLICELLI
FORLI

Biocomposite profile

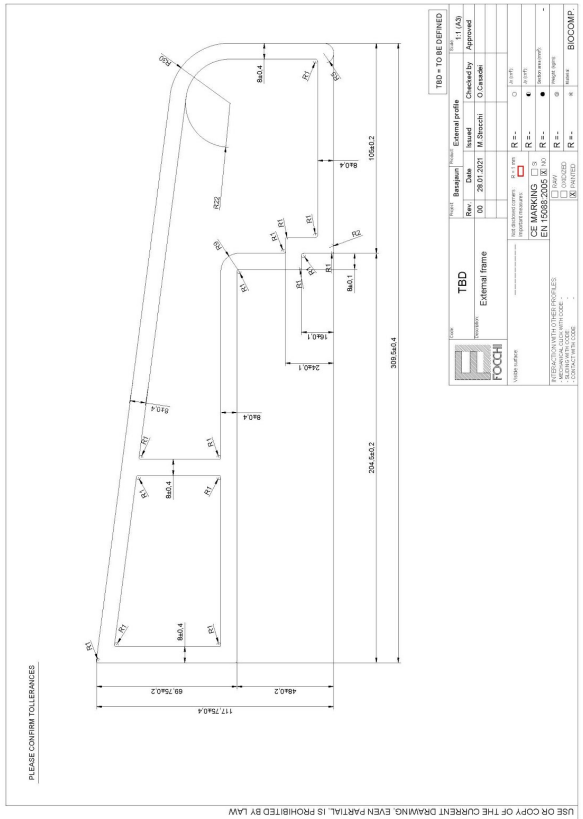
Main profile – mullion and transom



Male accessory for male transom



Window frame



Facade system design – mechanical simulation

Simulation of Module 1 with maximum load: Maximum wind load= 3.5KN/m2

Perimeter Structure Stress Analysis:

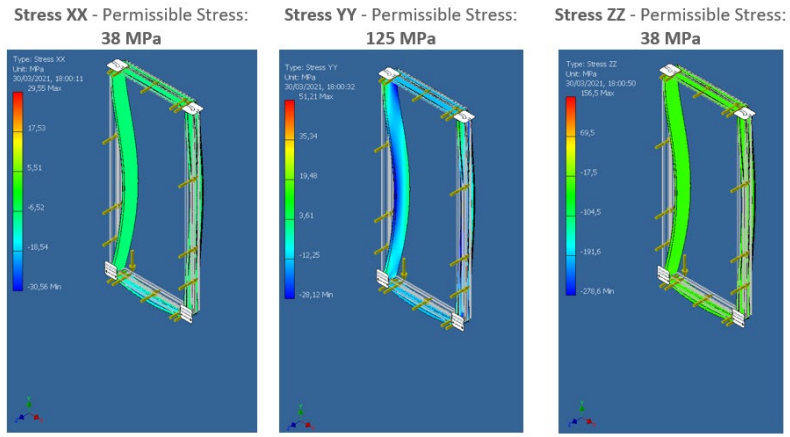


Figure 48 Perimeter structure stress analysis

Stress ZZ - Permissible Stress: **38 MPa**

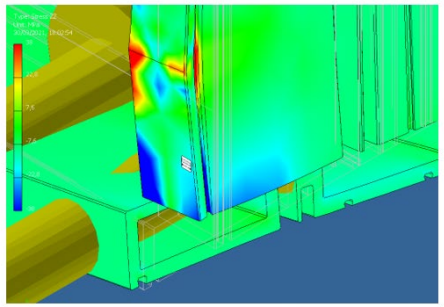


Figure 49 The maximum stress is exceeded in a small area, so the profile is considered adequate.

Simulation of Module 1 with typical load: Maximum wind load= 1.5KN/m2

Perimeter Structure Stress Analysis

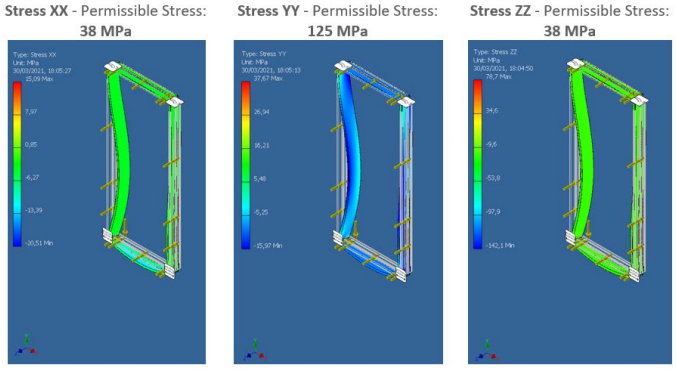


Figure 53 Perimeter Structure Stress Analysis

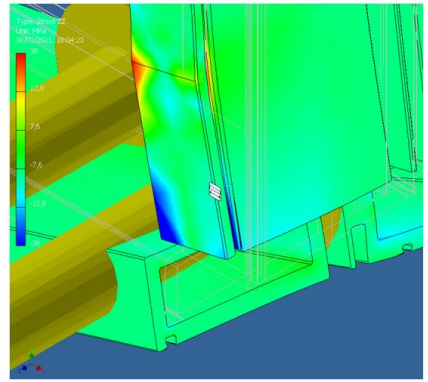


Figure 54 The maximum stress is exceeded in a really small area, so the profile is considered adequate.

Facade system design – thermal simulation

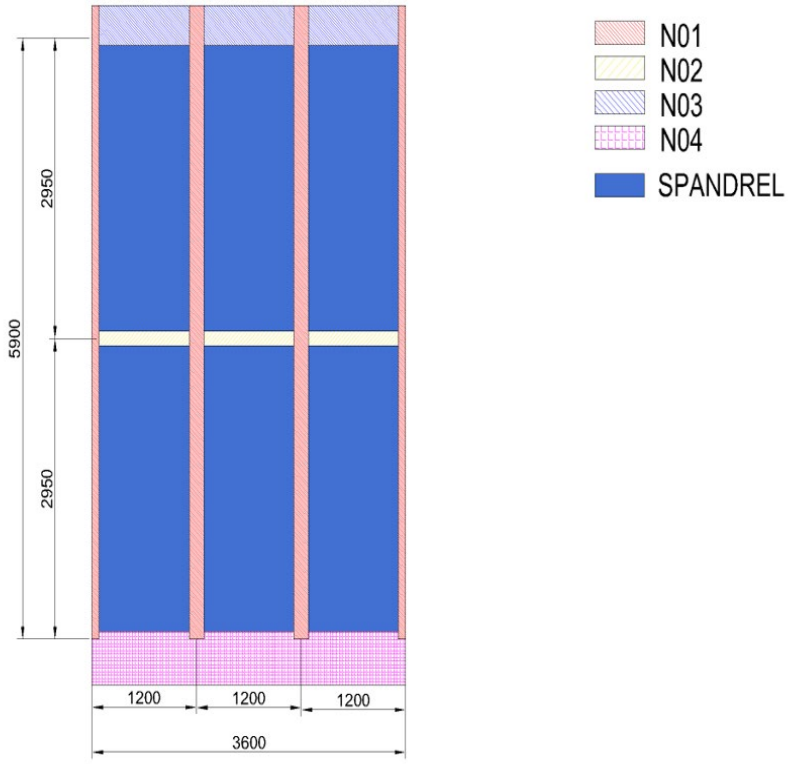
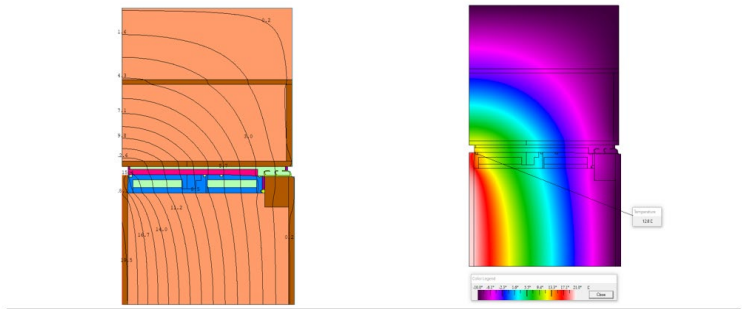
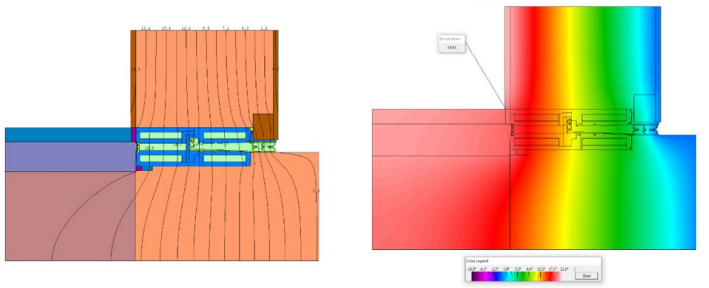


Figure 74 Typical elevation for nodes identification



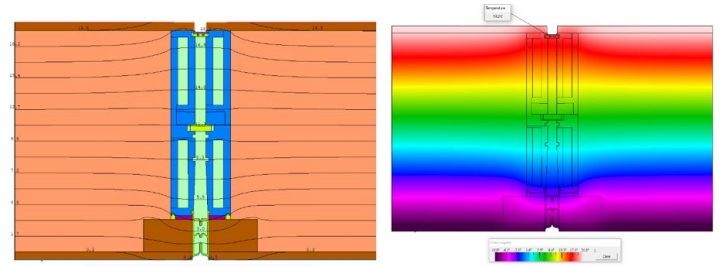
NOD03 Opaque façade system- Node transom- upper part

U TJ = 0.146 W/m²K Tsimin= 12.8 ≥ 10.2 [°C] – VERIFIED



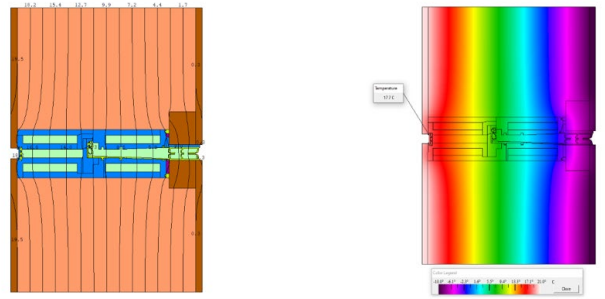
NOD04 Opaque façade system- Node transom- lower part

U TJ = 0.212 W/m²K Tsimin= 18.6 ≥ 10.2 [°C] – VERIFIED



NOD01 Opaque façade system- Node Mullion-Mullion

U TJ = 0.414 W/m²K Tsimin= 18.2 ≥ 10.2 [°C] – VERIFIED



NOD02 Opaque façade system- Node transom female- transom male

U TJ = 0.452 W/m²K Tsimin= 17.7 ≥ 10.2 [°C] – VERIFIED –

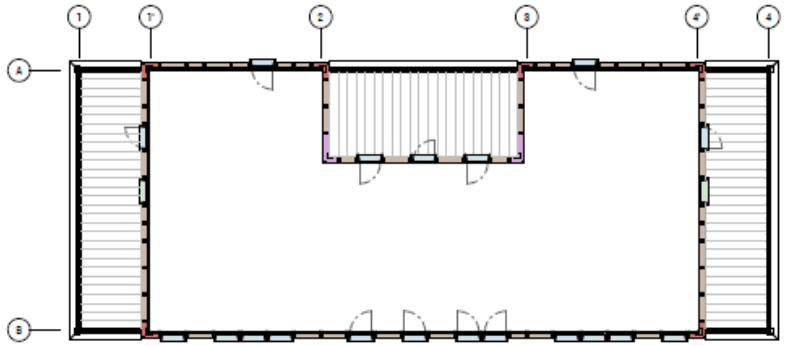
UCW = 0.19 W/m2K ≤ 0.20 W/m2K (French Demo)
VERIFIED

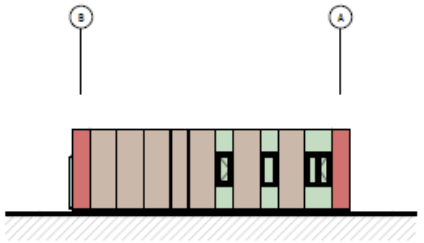
Integration of the system in the demo buildings

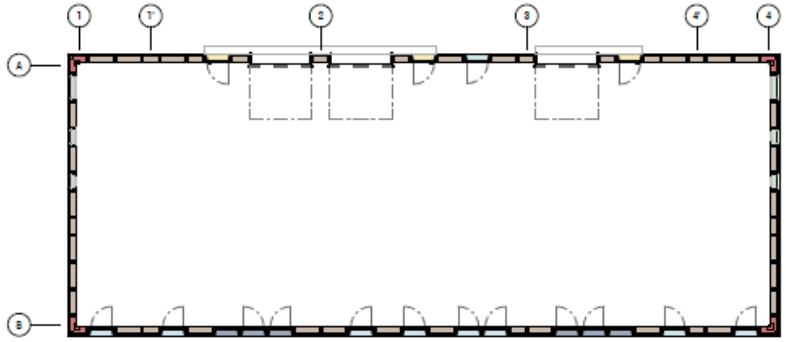
Finnish demo

French demo

Building typologies – French Demo







FS = Façade System

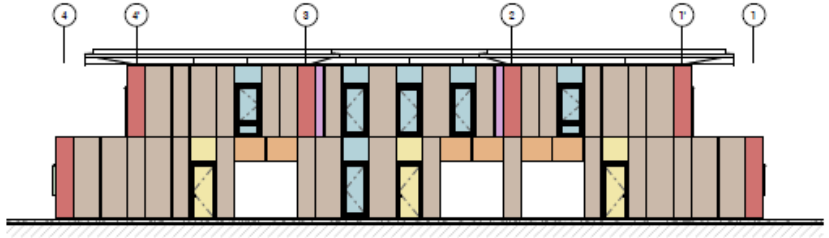
2nd code refers to the Height (module & anchorages)
- A = Ground floor modules (3,658m)
- B = First floor modules (3,174m)
- C = Garage modules (1,046m)

3rd code refers to the Width of modules or the window type/hand.

Opening (from interior)	RH = Right hand LH = Left hand

ComponentLID	SystemID	Type	Count	Height	Width
Opaque Vertical Module					
FS.01	A-01	FS_Opaque Panel	11	3.592 mm	778 mm
FS.01	A-02	FS_Opaque Panel Terrace	3	3.592 mm	778 mm
FS.01	A-03	FS_Opaque Panel	9	3.592 mm	1.178 mm
FS.01	A-04	FS_Opaque Panel Terrace	20	3.592 mm	1.178 mm
FS.01	B-01	FS_Opaque Panel	17	3.174 mm	778 mm
FS.01	B-02	FS_Opaque Panel	27	3.174 mm	1.178 mm
Opaque Corner Module					
FS.02	A-01	FS_Opaque Corner Panel	4	3.592 mm	778 mm
FS.02	B-01	FS_Opaque Corner Panel	6	3.174 mm	778 mm
Opaque Nook Module					
FS.03	B-01	FS_Opaque Nook Panel	1	3.174 mm	1.314 mm
FS.03	B-02	FS_Opaque Nook Panel	1	3.174 mm	1.314 mm
Opaque Horizontal Module					
FS.04	C-01	Horizontal	6	1.036 mm	1.378 mm
Middle Window Module					
FS.05	A-01	Casement Terrace_RH	2	3.592 mm	778 mm
FS.05	A-02	Fixed Window Terrace	2	3.592 mm	778 mm
FS.05	A-03	2Vent_Vertical Terrace_LH	1	3.592 mm	1.178 mm
FS.05	A-04	2Vent_Vertical Terrace_RH	1	3.592 mm	1.178 mm
FS.05	B-01	Casement (P1)_RH	2	3.174 mm	1.178 mm
Inferior Window Module					
FS.06	A-01	Casement (P0)_LH	6	3.592 mm	1.178 mm
FS.06	A-02	Casement (P0)_RH	3	3.592 mm	1.178 mm
FS.06	B-01	2p.Hz Window (P1)_LH	2	3.174 mm	1.178 mm
FS.06	B-02	2p.Hz Window (P1)_RH	4	3.174 mm	1.178 mm
FS.06	B-03	Casement (P1)_LH	2	3.174 mm	1.178 mm
FS.06	B-04	Casement Exterior_RH P1	3	3.174 mm	1.178 mm
FS.06	B-05	Fixed Window (P1)	8	3.174 mm	1.178 mm
Complete Window Module					
FS.07	A-01	Casement_LH	2	3.592 mm	1.178 mm
FS.07	A-02	Casement_RH P0	2	3.592 mm	1.178 mm
FS.07	A-03	Fixed Window	2	3.592 mm	1.178 mm
Opaque Door Module					
FS.08	A-01	P0_LH_RH	3	3.609 mm	1.178 mm

Opaque Vertical Modules
Opaque Horizontal Modules
Opaque Corner Modules (exterior)
Opaque Corner Modules (hook)
Inferior window module
Middle window module
Complete window module
Module with entrance door



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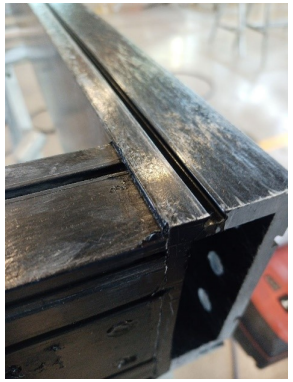
Tests and results

Mock-up manufacturing – opaque unit

Biocomposite preparation – drilling, screwing, sealing before the assembling

Mullion with metal profile for connection – all the holes have been sealed



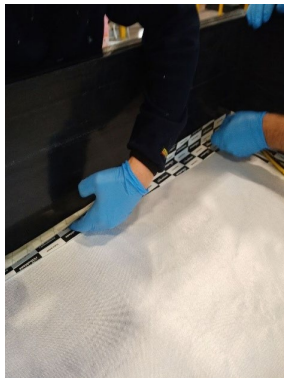
Mullion and Transom connection

Double tape positioning for the internal membrane fixing to the bio composite profile

Internal membrane - position to the module facade

External tape for water tightness

Wooden panel positiong



After reversing the module, it is positioned the second double tape for watertightness

Wooden fiber insulation panel

External membrane position and metal profile for cladding system fixing

Cladding positioning to the facade module

Opaque facade module – Acoustic and Fire mock-ups

Mock-up manufacturing

Opaque unit

Vision unit

Performance mock-up

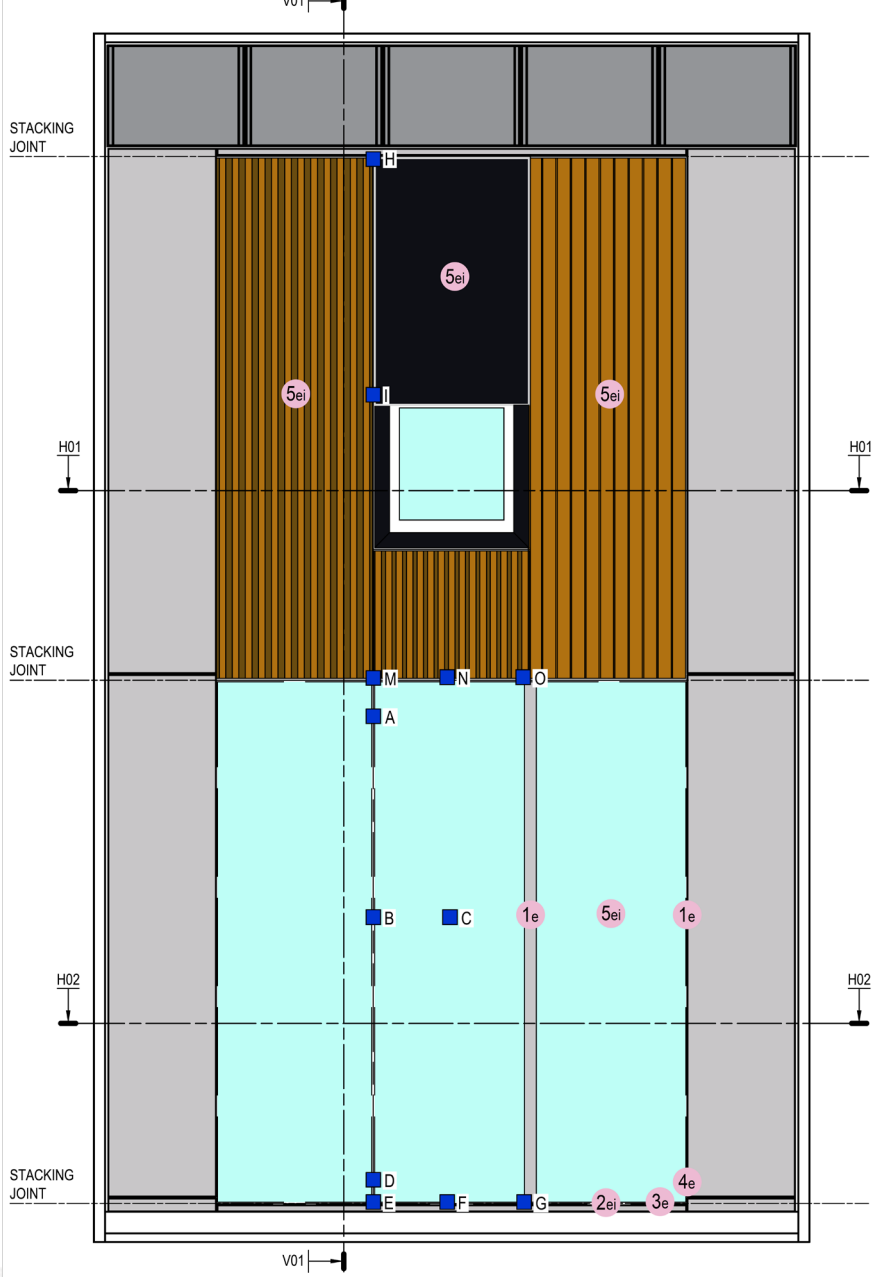
Preparation phase

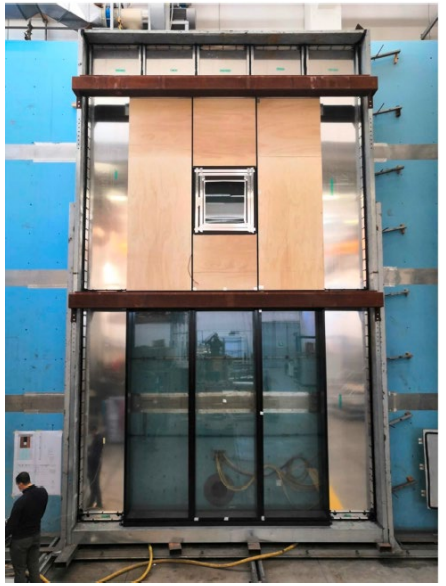
- Test Chamber in accredited entity premises – ISTITUTO GIORDANO
- Test conducted by accredited entity - ISTITUTO GIORDANO

Design

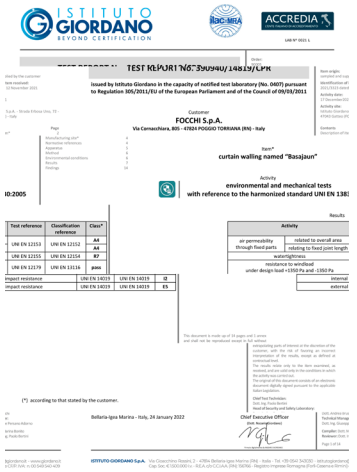
The test is composed by 6 units:

- Ground floor: 3 vision units (Finnish demo);
- First floor:
  - 2 opaque units with different external finishing (French and Finnish demo);
  - 1 window unit (French demo)





Performance mock-up



Result

- Report by accredited entity
- Results achieved

Conclusion

- Innovative ventilated façade tested with EN ISO 13830:2005
- Safety façade demonstrated with different materials (interchangeable)

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**

Acoustic mock-up

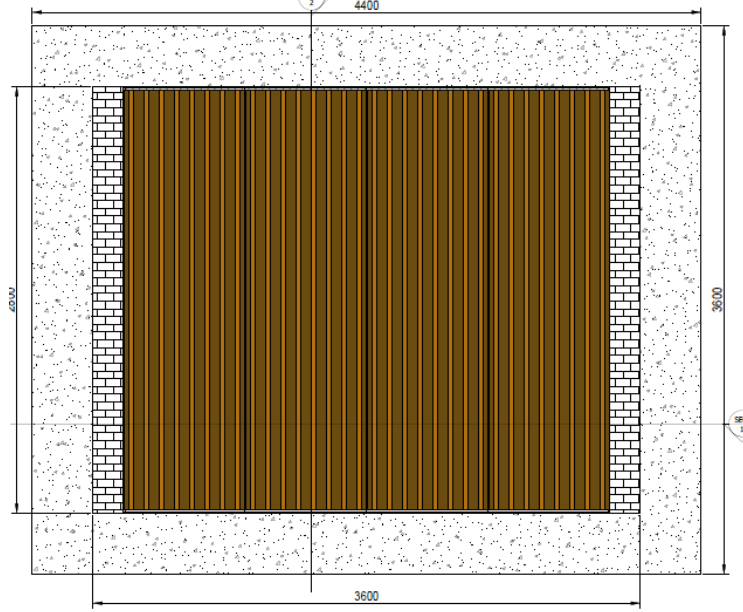
Preparation phase

- Test Chamber in accredited entity premises – TECNALIA
- Test conducted by accredited entity – TECNALIA

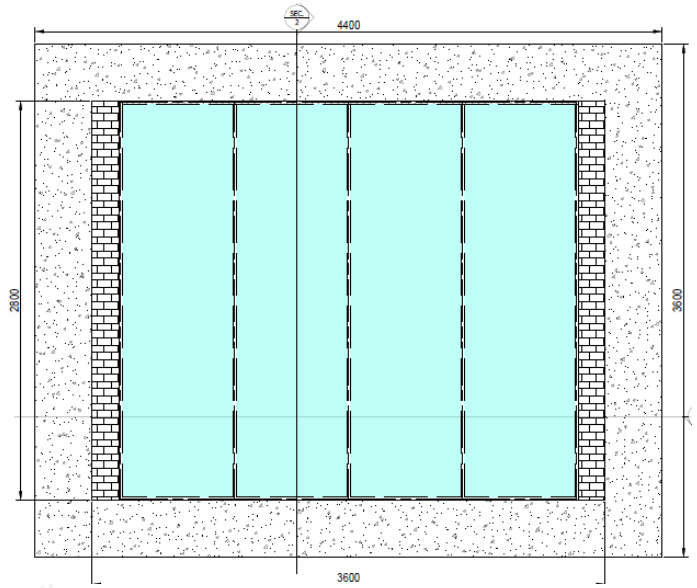
Design

The test is composed by 3 units:

- 3 vision units (Finnish demo);
- 3 opaque units (French demo);



Opaque unit



Vision unit

Acoustic mock-up

Opaque unit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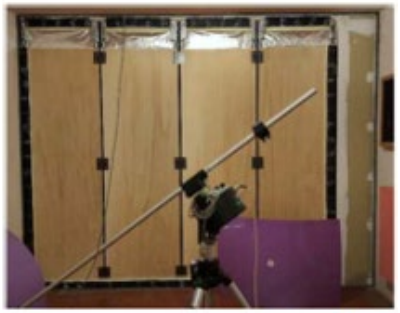

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Rating according to EN ISO 717-1:2020:

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

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

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

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

Vision unit


ELUSKO JAURLARITZA GOBIERNO VASCO

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Rating according to EN ISO 717-1:2020:

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

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

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

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

Fire mock-up: fire resistance

Preparation phase

- Test Chamber in accredited entity premises – TECNALIA
- Test conducted by accredited entity – TECNALIA

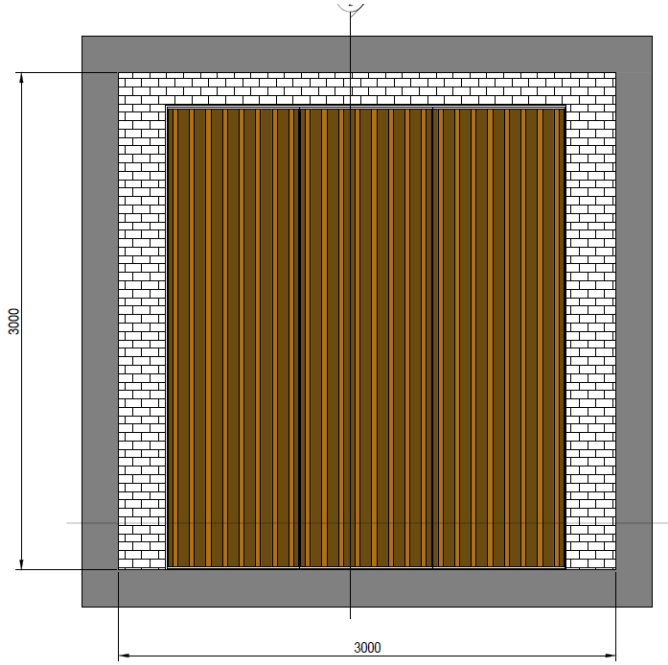
Design

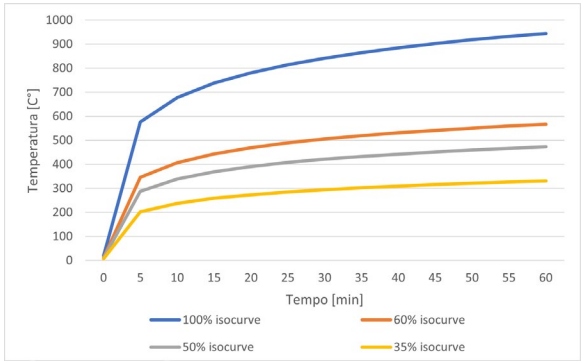
The test is composed by 3 units:

1. Opaque unit
2. Vision unit

Result

Fire resistance classification: EI 60 (i→o)

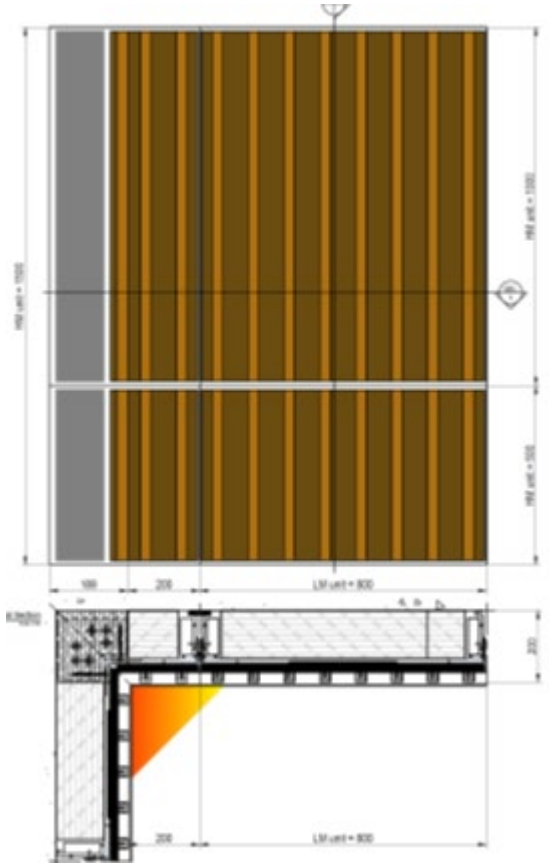




Test conducted at 100% of ISOCURVE for OPAQUE module

Test conducted at 35% of ISOCURVE for VISION module

Fire mock-up: fire reaction



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MEMBER OF egolf

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.«**BASAJAÚN PROJECT (G.A.:862942)** »
RECEPTION DATE	15.11.2021
TEST DATES	22.12.2021
ISSUE DATE	09.06.2022

LAB_SERVICES

Pablo Garmendia
Safety Laboratory

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TECNALIA RESEARCH & INNOVATION
Áreas znardi, 5
E-20730 Azpeitia (Gipuzkoa)

Pablo Garmendia Altuna 44148223 E

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SBI test result: D-s2, D0

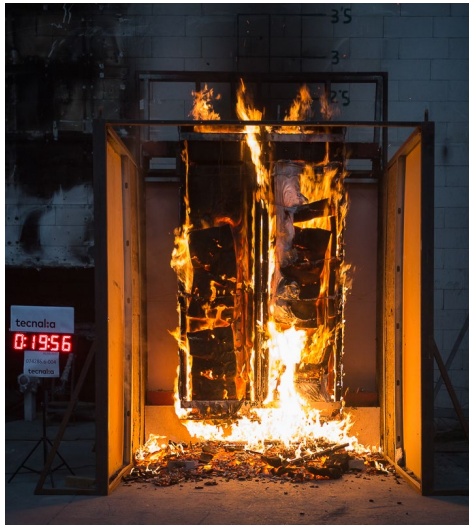
Fire mock-up: spread test

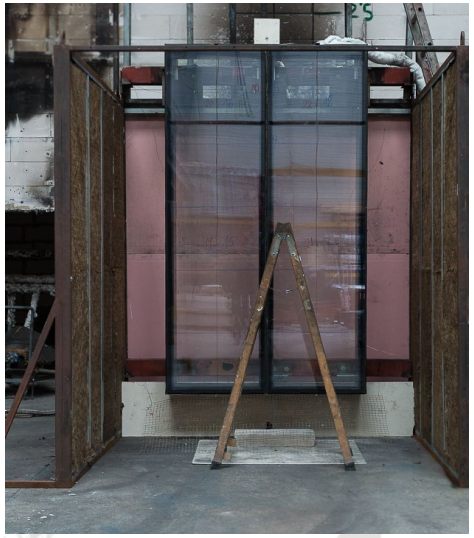
Preparation phase

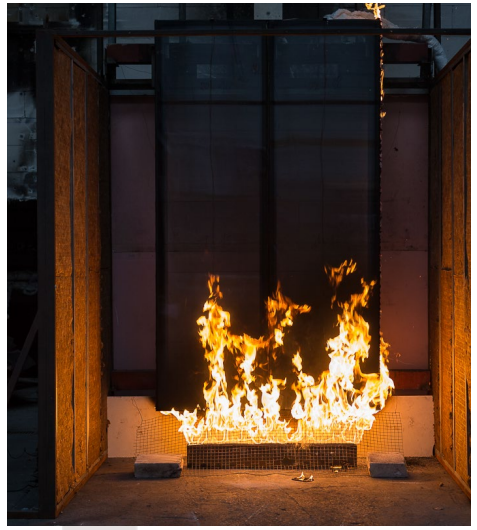
- Test Chamber in accredited entity premises – TECNALIA
- Test conducted by accredited entity – TECNALIA

Design

1. N°3 Opaque units
2. N°3 Vision units







BASAJAUN

Conclusion

Conclusion

Project requirements achievement

- ✓ Industrialization
- ✓ Customization (facade typology and materials for cladding)
- ✓ Applicable to opaque and vision units of the buildings
- ✓ Breathable with high thermal insulation properties
- ✓ Save, easy and fast on-site assembly
- ✓ Mainly made from renewable biobased materials
- ✓ Designed for disassembly for use in closed circular economy material loops

NEXT STEPS

- Reducing cost
- Increasing biobased parts in the profiles
- Reducing weight and thickness
- Production process optimization

Any questions?

Thank you for your kind attention

BASAJAUN

Laura Vandi

Innovation Project Manager

l.vandi@focchi.it

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Thanks to

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