Strategies for green architecture: case studies in Portugal

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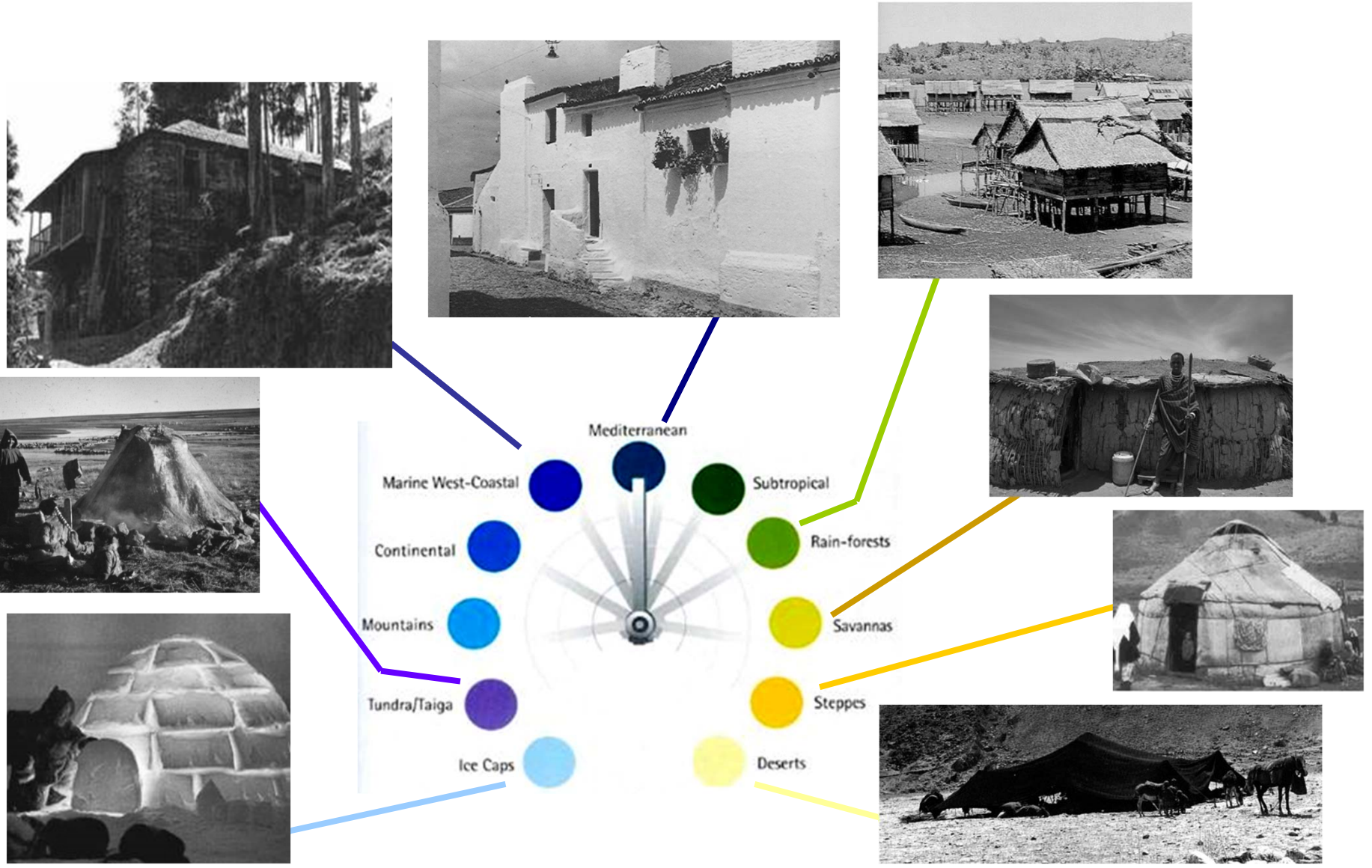
Introduction



Contemporary Systems

The contemporary construction presents several problems of eco-efficiency:

- Reduced possibilities for reuse or even recycling materials (permanently adhered components);
- Non-local materials (centrally produced);
- Industrialized materials (high embodied carbon).

Traditional Systems

Traditional construction on the other hand is generally much more eco-efficient:

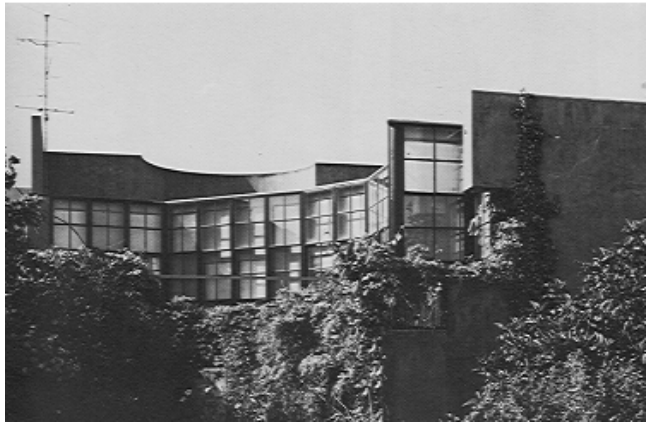
- Increased possibilities for reuse and recycling materials (due to the use of dry" joints);
- Local materials (heavyweight from site);
- Natural materials (low embodied carbon).

Strategies

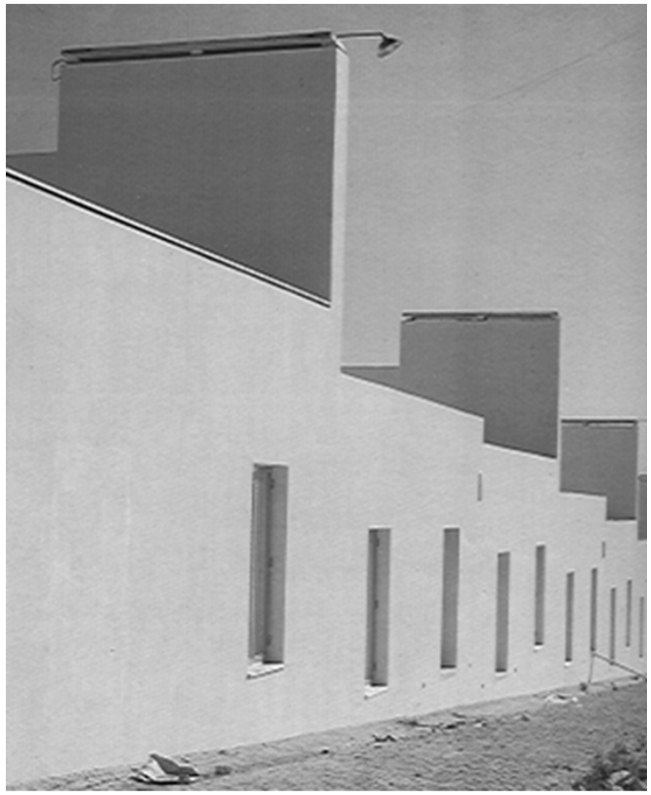
More local	Less material	More reuse	Less transport	More natural

Clara Vieira, Aveiro site

Nieta Rocha, Angra do Heroísmo site, Azores



Casa Beires (Póvoa de Varzim) – Siza Vieira



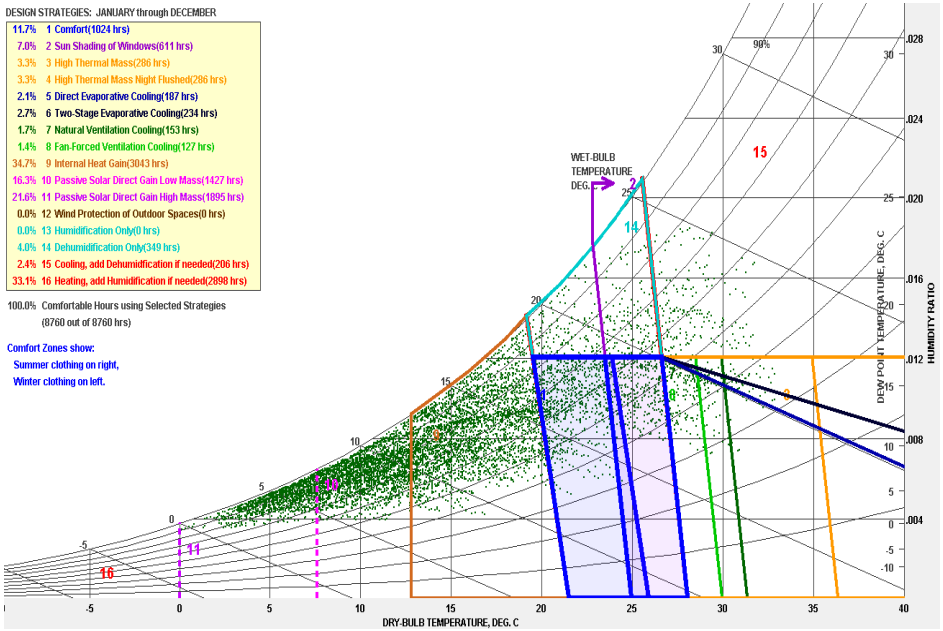
Bairro da Malagueira (Évora) – Siza Vieira

Aveiro

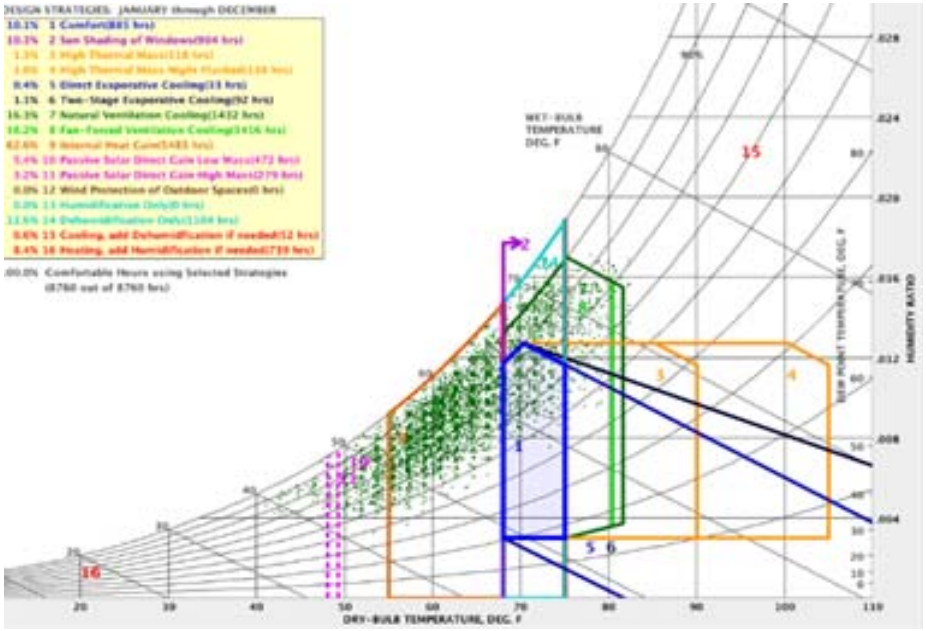

Casa Tipo 1

Angra do Heroísmo

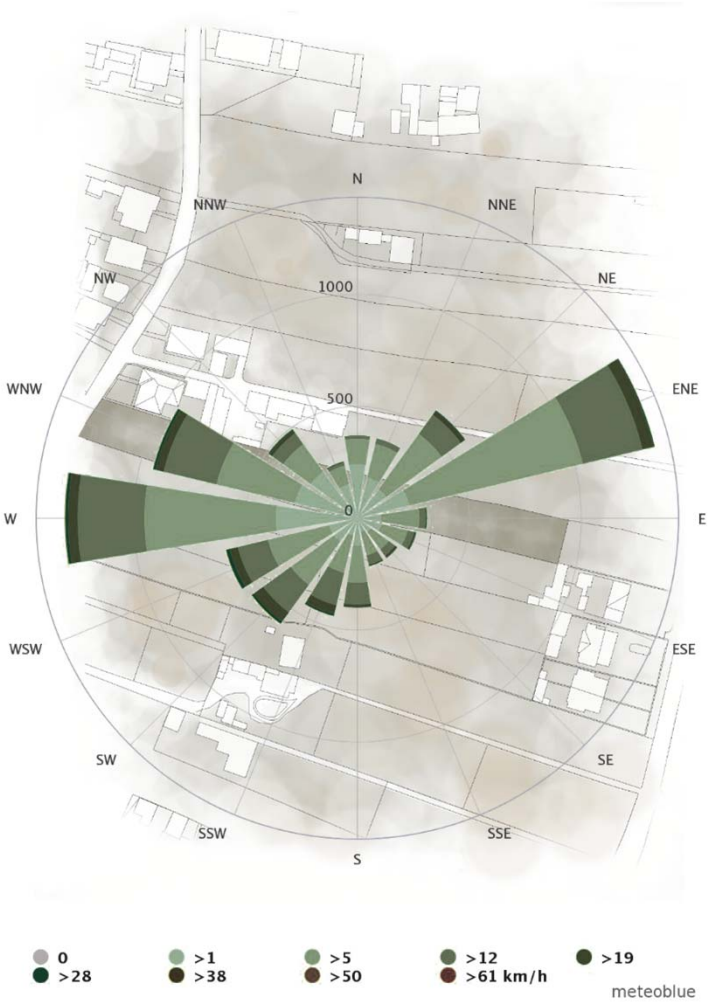
Aveiro



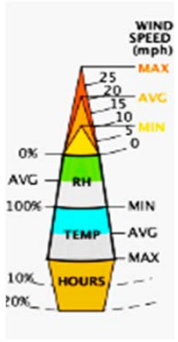
Angra do Heroísmo



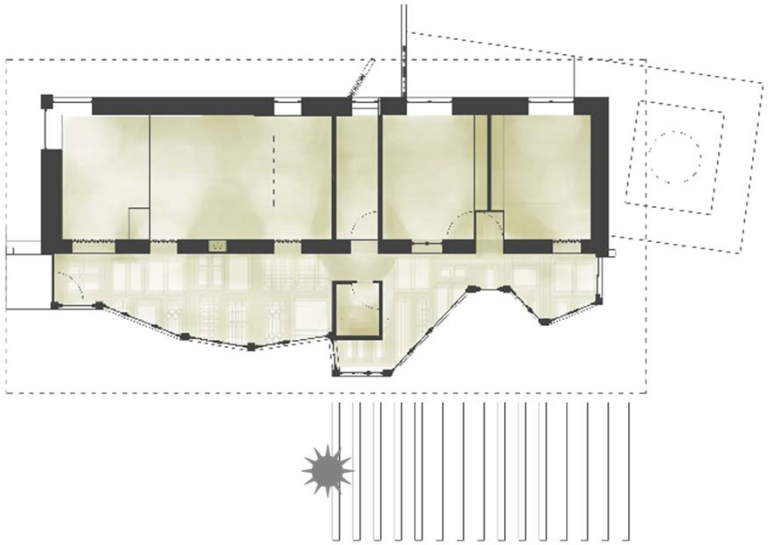
Aveiro

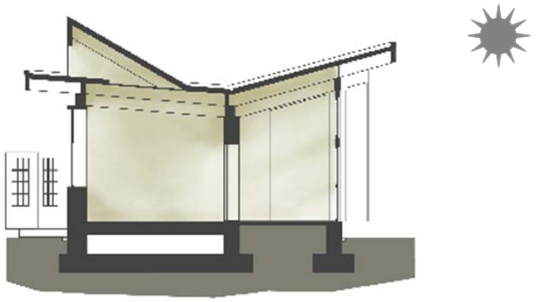


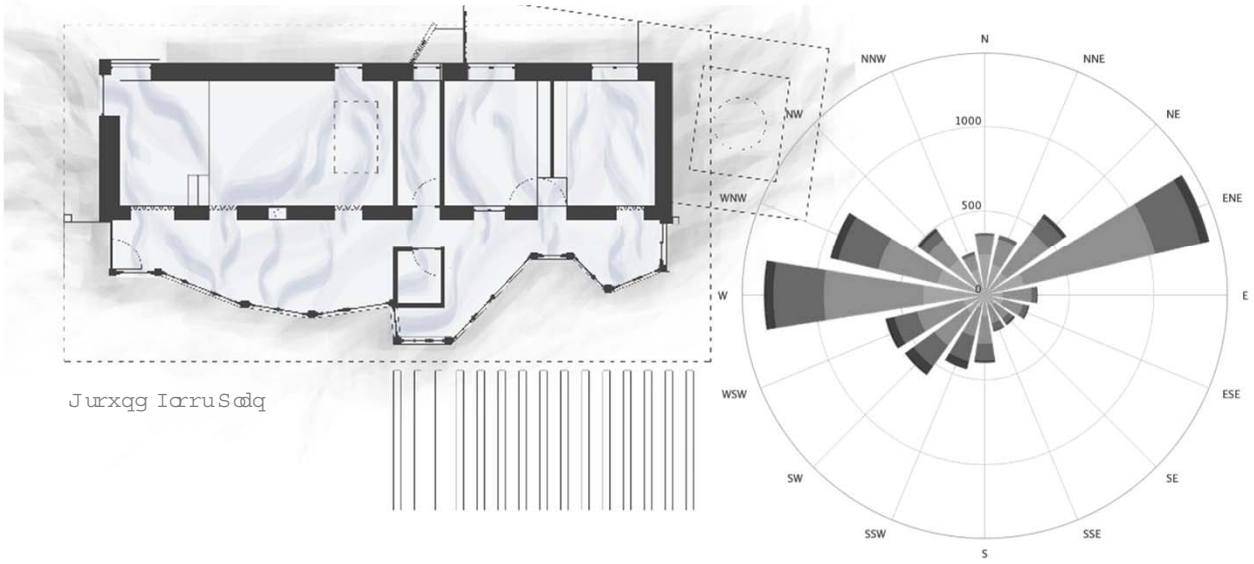
Angra do Heroísmo

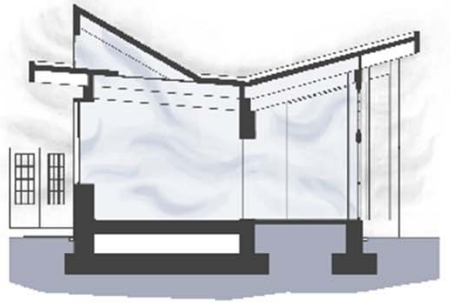


Design with climate: Sun and Wind - Aveiro

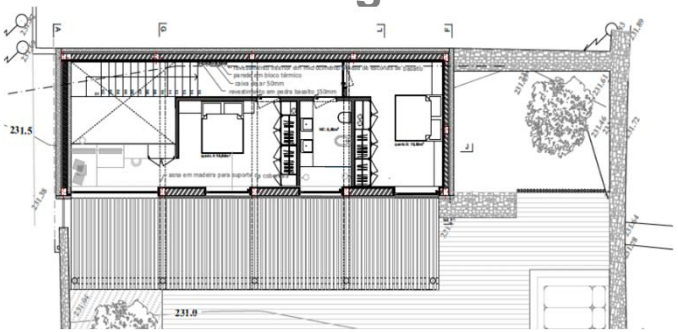




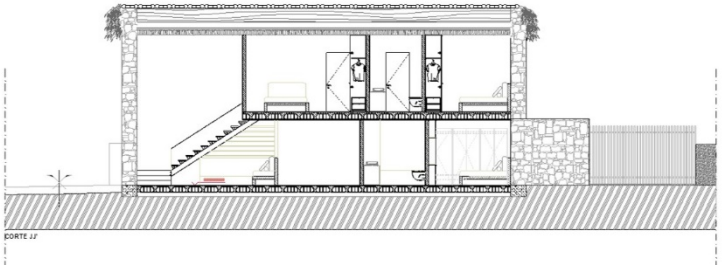


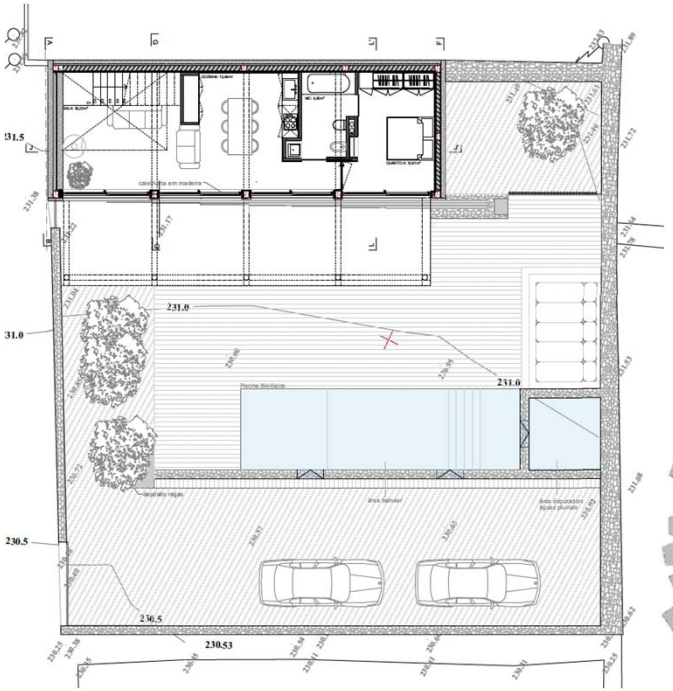


Design with climate: Sun and Wind – Angra do Heroismo

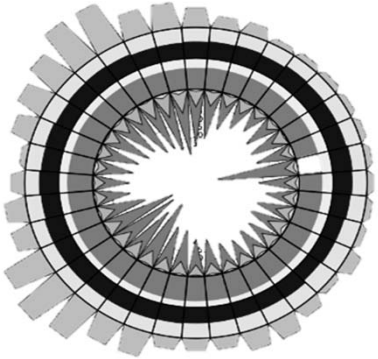


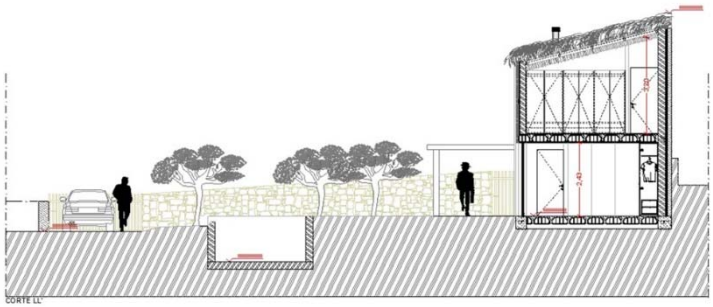
Iluw Iarru Sdq





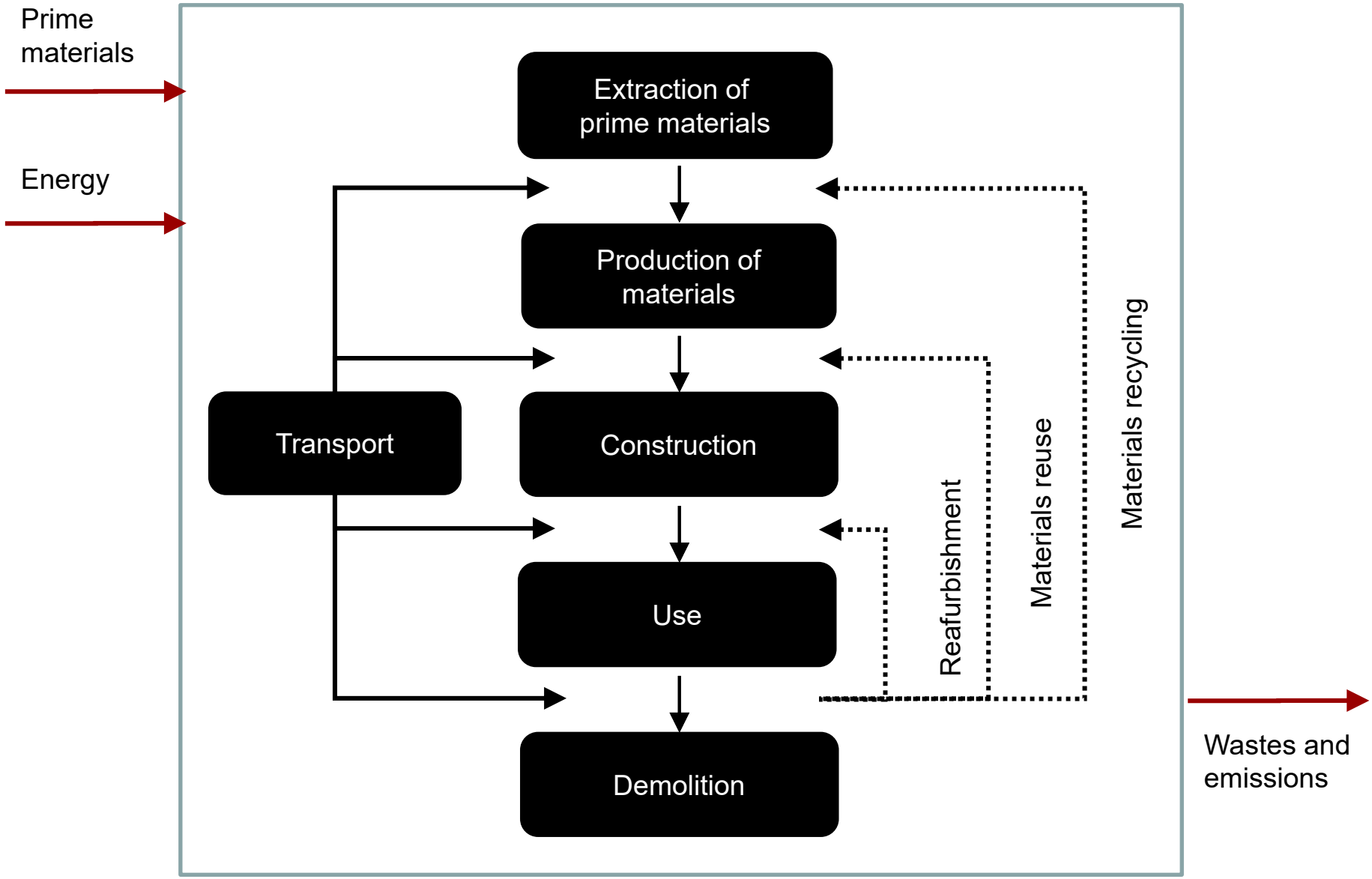
Jurqg Iarru Sdq



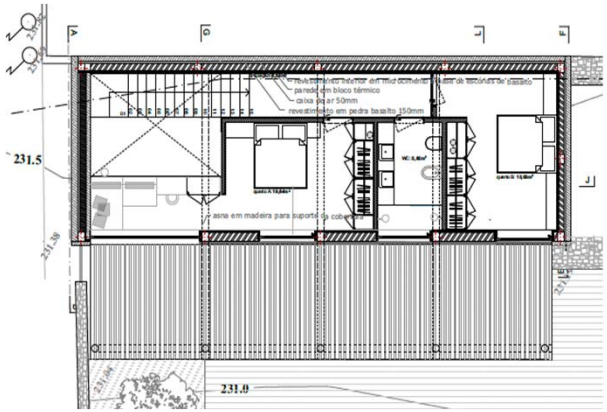


Vhfwrqv

Construction phase - LCA



Minimum Areas, Maximum use



IluvwIcrruSodq 0D}ruhv

Jurxqg IcrruSodq 0Dyhlur

	número de compartimentos por fogo							
	2 T0	3 T1	4 T2	5 T3	6 T4	7 T5	8 T6	Mais de 8 Tx>6
	áreas em metros quadrados							
Quarto casal	—	10,5	10,5	10,5	10,5	10,5	10,5	10,5
Quarto duplo	—	—	9	9	9	9	9	
Quarto duplo	—	—	—	9	9	9	9	
Quarto duplo	—	—	—	—	—	9	9	restantes quartos 9m2
Quarto simples	—	—	—	—	6,5	6,5	6,5	6,5
Quarto simples	—	—	—	—	—	—	6,5	6,5
Sala	10	10	12	12	12	16	16	16
Cozinha	6	6	6	6	6	6	6	6
Suplemento de área obrigatório	6	4	6	8	8	8	10	(x + 4)m2 (x= n.º de quartos)

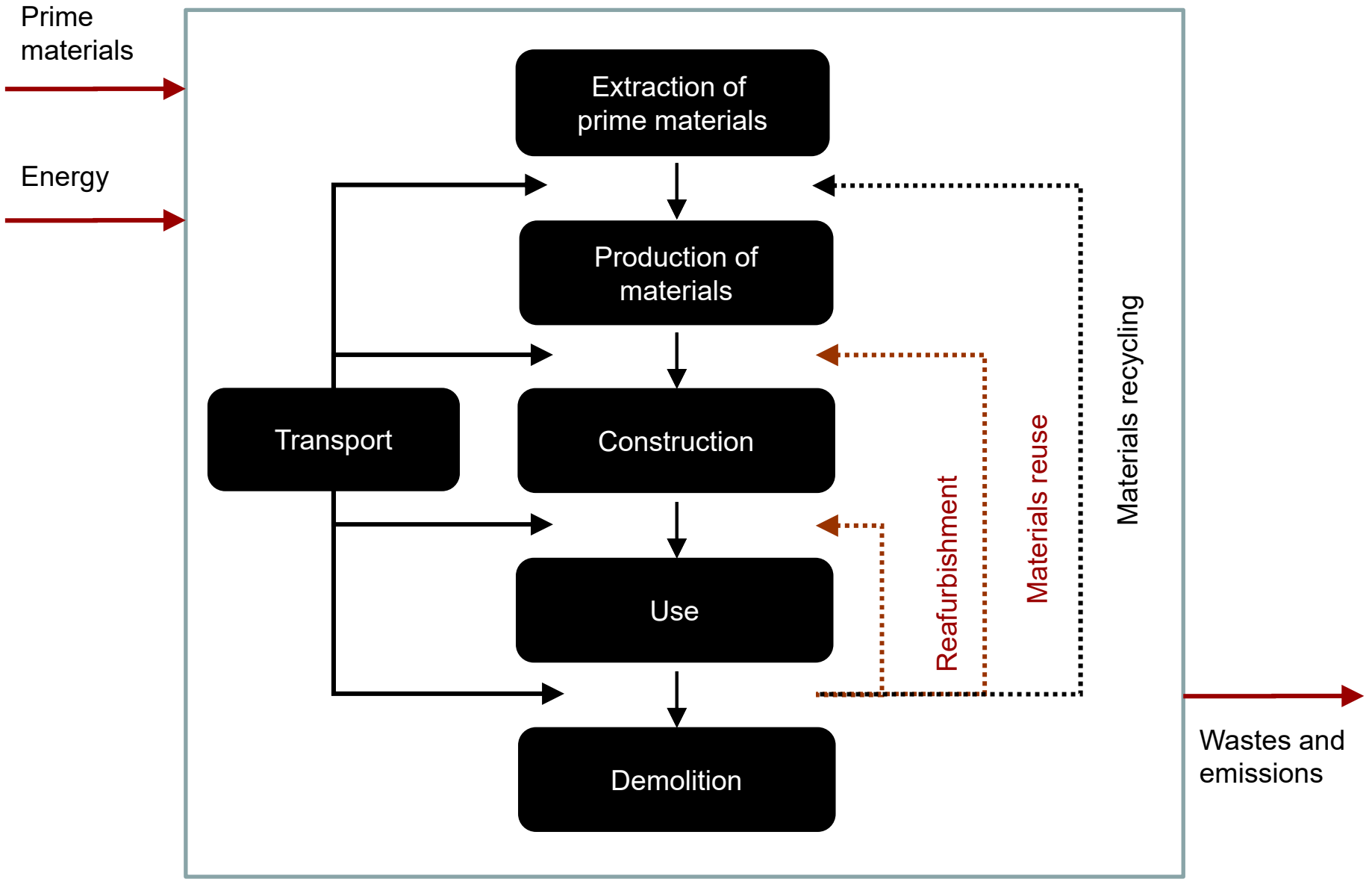
Artigo 67.º
1- As áreas brutas dos fogos terão os seguintes valores mínimos:

	Tipo de fogo							
	T0	T1	T2	T3	T4	T5	T6	Tx>6
área bruta em metros quadrados	35	52	72	91	105	122	134	1,6 x Ah

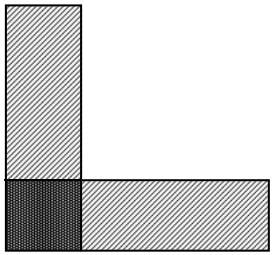
	espaço	área (m2)
1	sala comum	22.15
2	cozinha	6.05
3	instalação sanitária	4.35
4	quarto de casal	10.60
5	quarto duplo	10.10
	área útil total	53.25
	área bruta total	74.00

	espaço	área (m2)
3	instalação sanitária de serviço	1.90
6	espaço ambíguo	30.10
	área útil total	32.00
	área bruta total	36.25

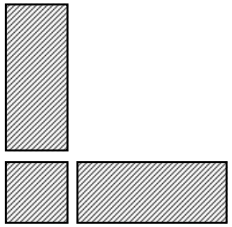
Construction phase - LCA



Design for Deconstruction



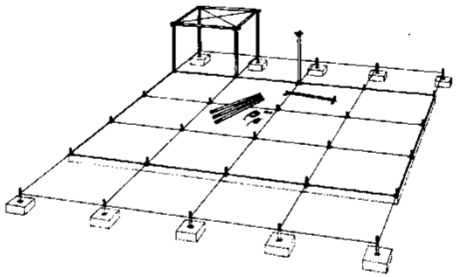
Better quality structure and permanent connection - contemporary construction

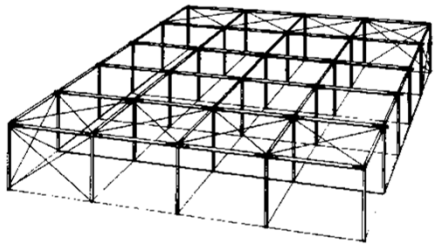


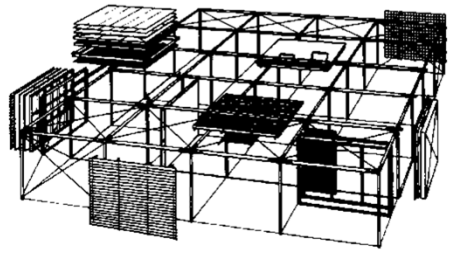
Similar or different quality but easy separation - building 100 years ago

Certain factors may allow building components to be more easily recovered, including:

- Use dry joint systems;
- Possibility of separating the components in each system - modularity;
- Use standardized and homogeneous materials;
- Lightweight building systems.

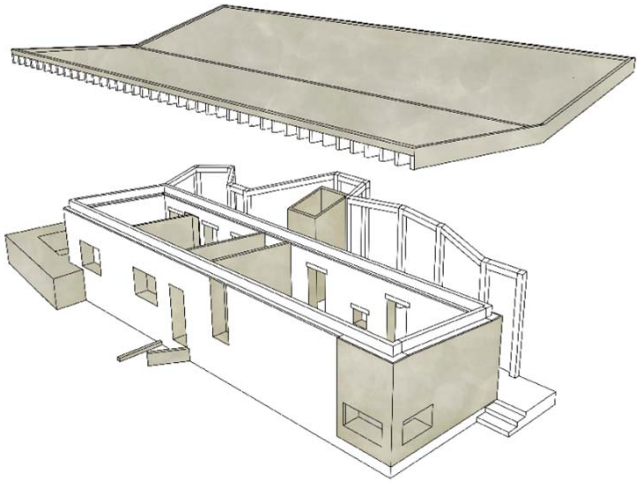






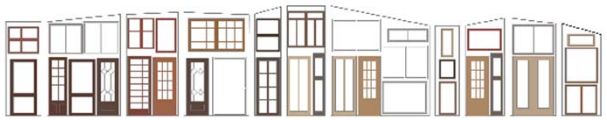
"Yacht House" (Horden 1995)

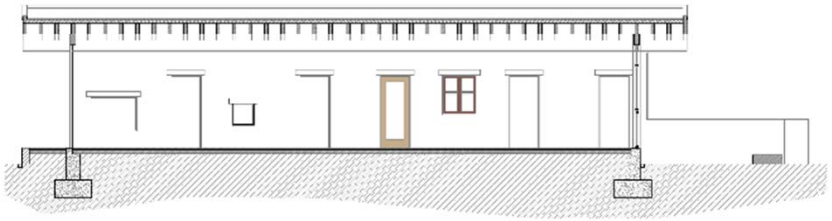
Coatings - Aveiro



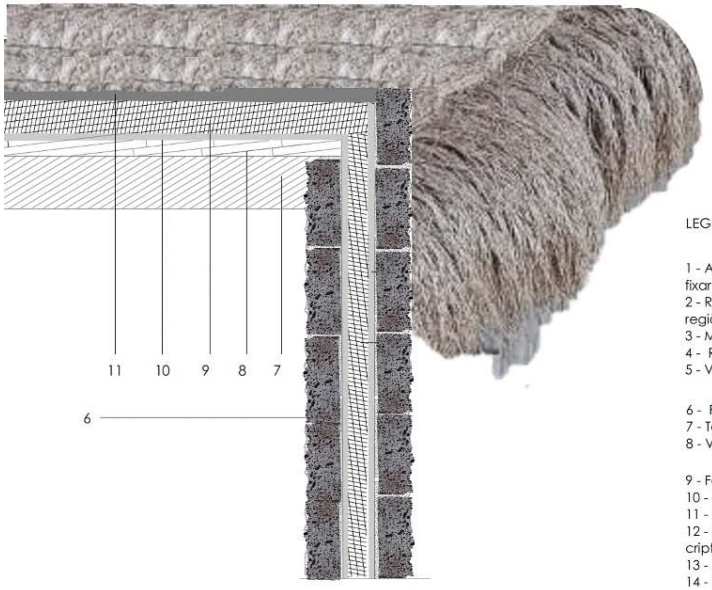
UHXVHG FRDWLQJV

Windows - Aveiro





Reused Straw and Canes – Angra do Heroísmo

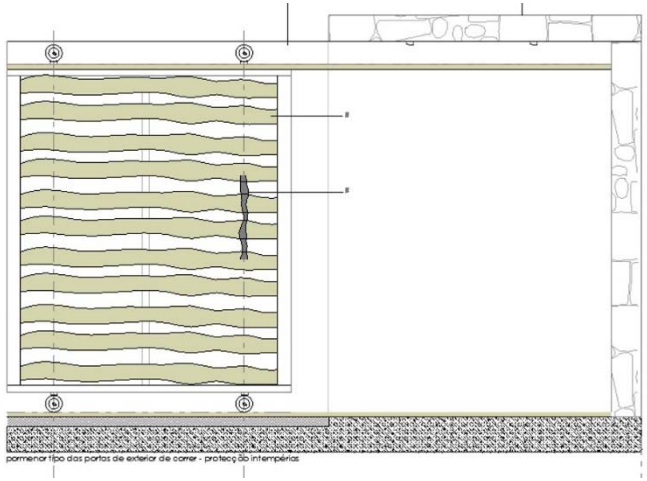


LEGENDA:

1 - Aplicação de rede galinheiro granpeada pontualmente para ajudar a fixar a festuca seca
2 - Revestimento em microcimento com escórias vulcânicas de basalto da região, acabamento meio brilho
3 - Madeira de criptómeria
4 - Revestimeto de pedra basalto e cal com alvenaria argamassada
5 - Viga em madeira criptómeria

6 - Forro em cana com 3cm com acabamento em óleo de linhaça
7 - Tabuas de criptoméria autoclavado
8 - Viga em em criptoméria 14x8cm

9 - Forro em casquinha 2cm
10 - Manta/mebrana anti-poeiras feita a partir da polpa celulósica da festuca 0,5cm
11 - Isolamento à base de fibras estraídas da festuca
12 - Sub-telha, placa ondulada constituída por base betuminosa e fibras celulósicas à base de criptómeria
13 - Cobertura Vegetal em Festuca seca dos Açores 15/20/30 cm
14 - Canas da Ilha com espigão para fixação da festuca seca



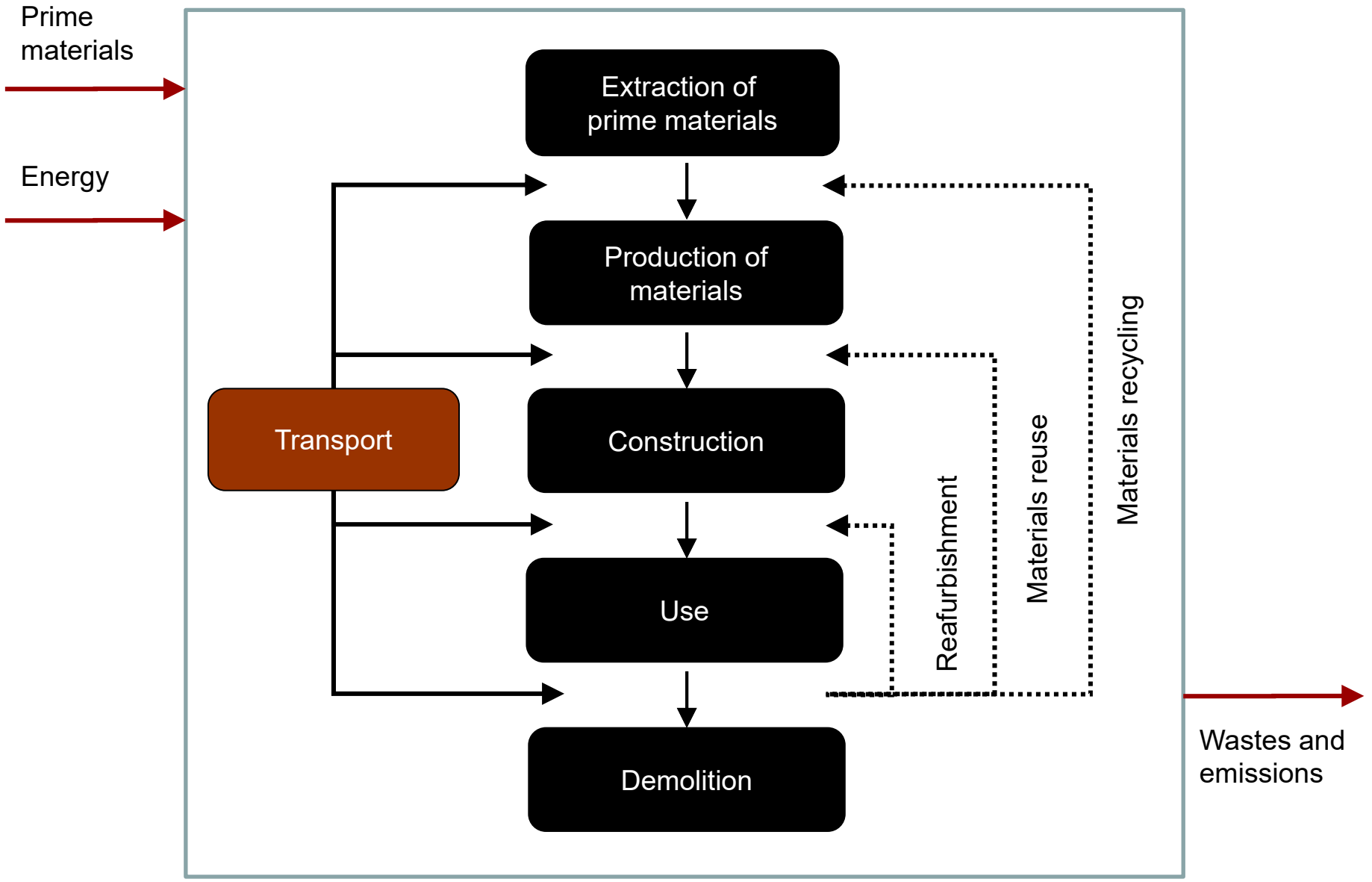
Arts and Crafts – Angra do Heroísmo






Nieta Atelier

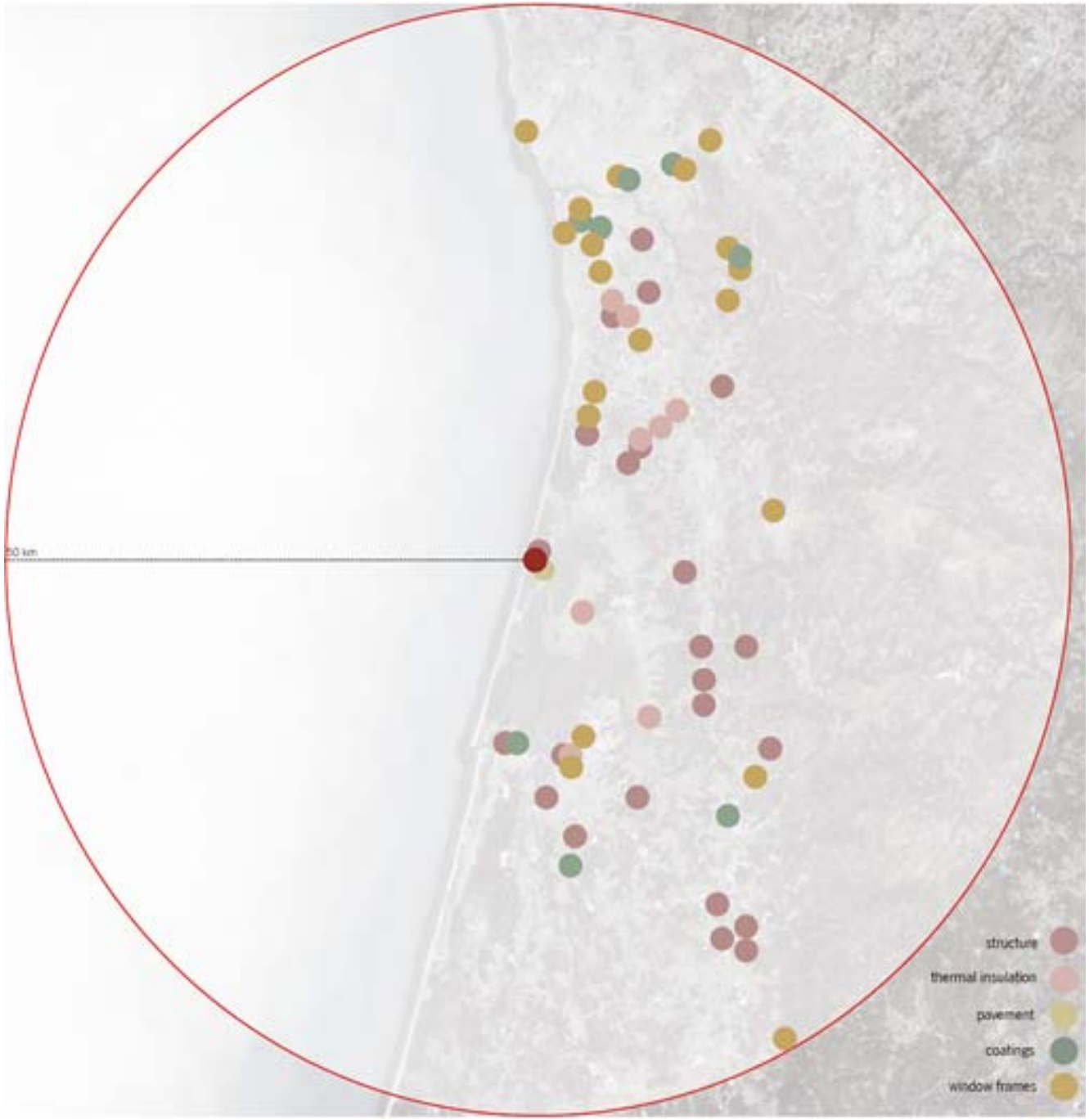
Construction phase - LCA



0,1kW/h

100kW/h


Kodak
FILM • CAMERAS
Airtel


50 km
structure
thermal insulation
pavement
coatings
window frames

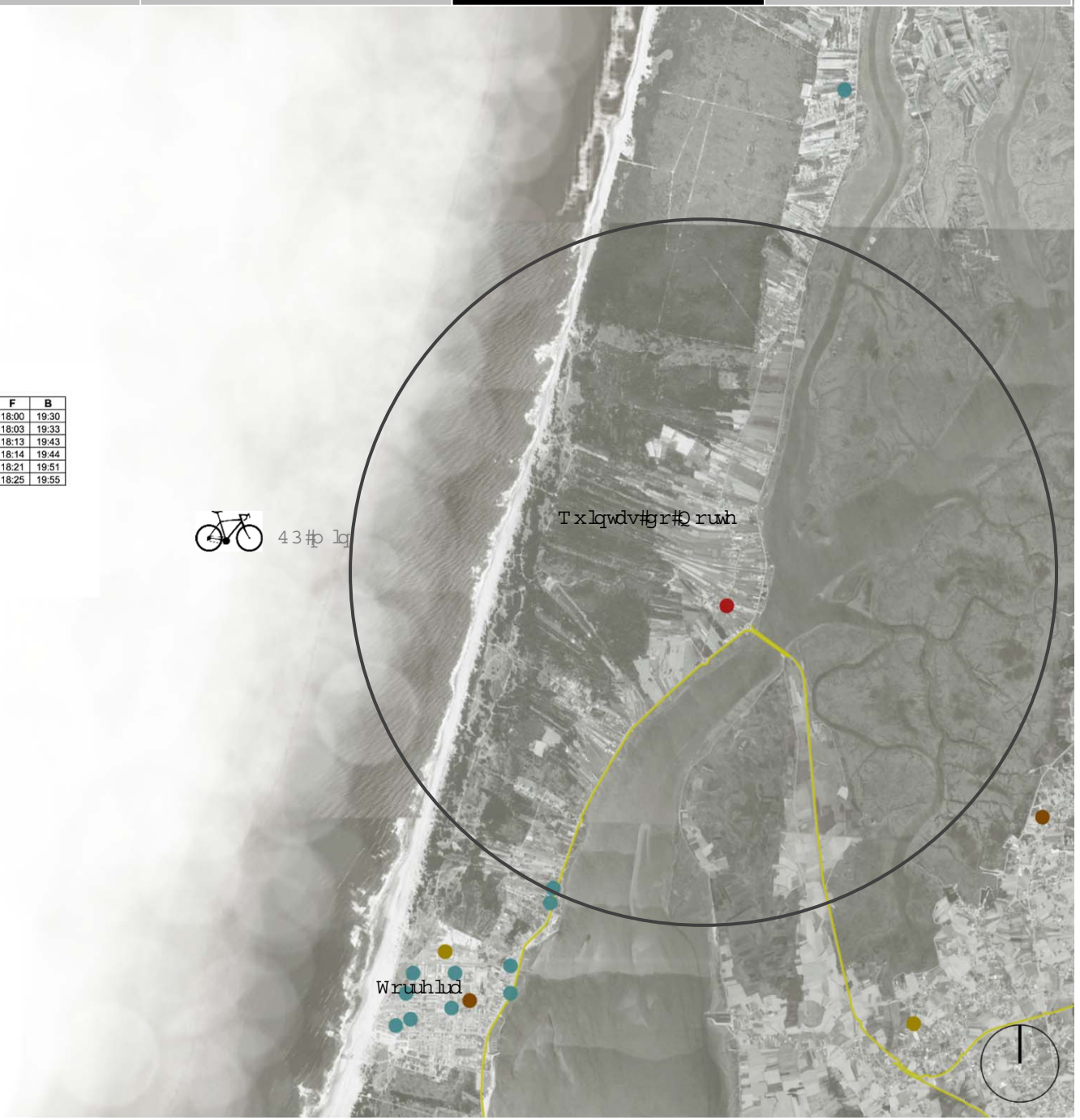
- Site
- Groceries
- Schools
- Pharmacies
- Cycle lane
- Bus service

HORÁRIO

PARDELHAS ⟶ TORREIRA

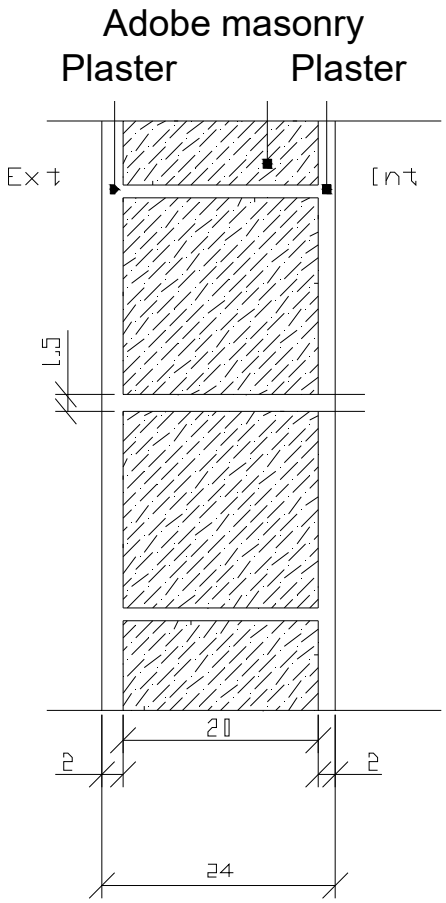
Localidades	A		A	B	C	B	D	E	F	B
Pardelhas	06:30	09:10	11:45	13:00	14:10	14:30	17:00	17:40	18:00	19:30
Esteiro	06:33	09:13	11:48	13:03	14:13	14:33	17:03	17:43	18:03	19:33
Feiteira	06:43	09:23	11:58	13:13	14:23	14:43	17:13	17:53	18:13	19:43
Quintas Norte	06:44	09:24	11:59	13:14	14:24	14:44	17:14	17:54	18:14	19:44
Quintas Sul	06:51	09:31	12:06	13:21	14:31	14:51	17:21	18:01	18:21	19:51
Torreira	06:55	09:35	12:10	13:25	14:35	14:55	17:25	18:05	18:25	19:55

(A) De 2ª a sábado
(B) De 1 / 7 a 15 / 9.
(C) De 16 / 9 a 30 / 6.
(D) De 16 / 9 a 30 /.Só sábados,domingos e Feriados.
(E) De 2ª a 6ª.
(F) Só sábados domingos e Feriados, de 1 / 7 a15 / 9.



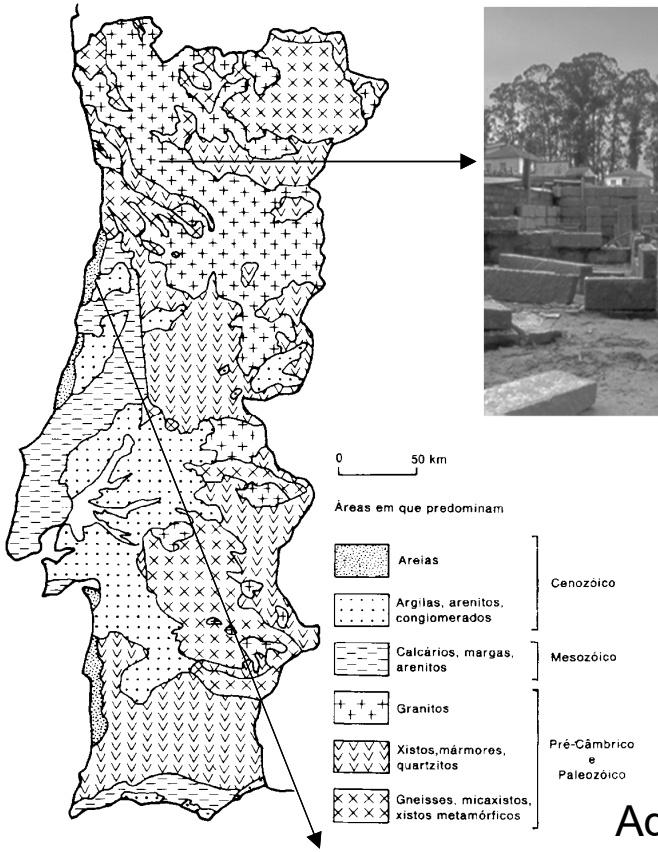
1,5kW/h

150kW/h

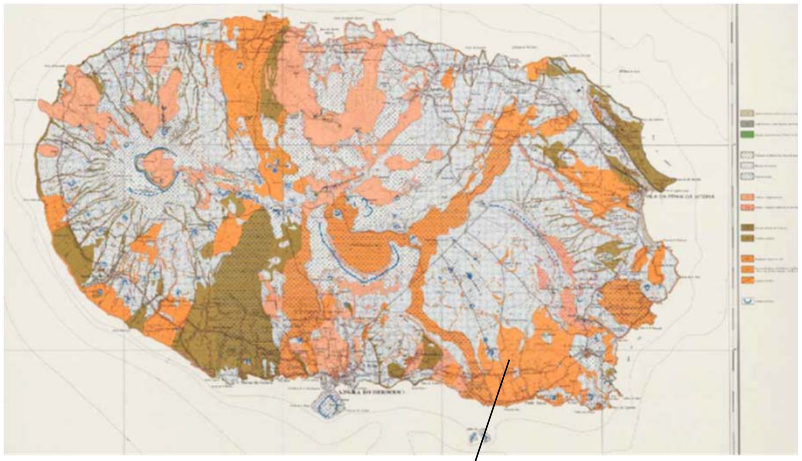


Single wall in adobe blocks

Adobe (workshop in UMinho)

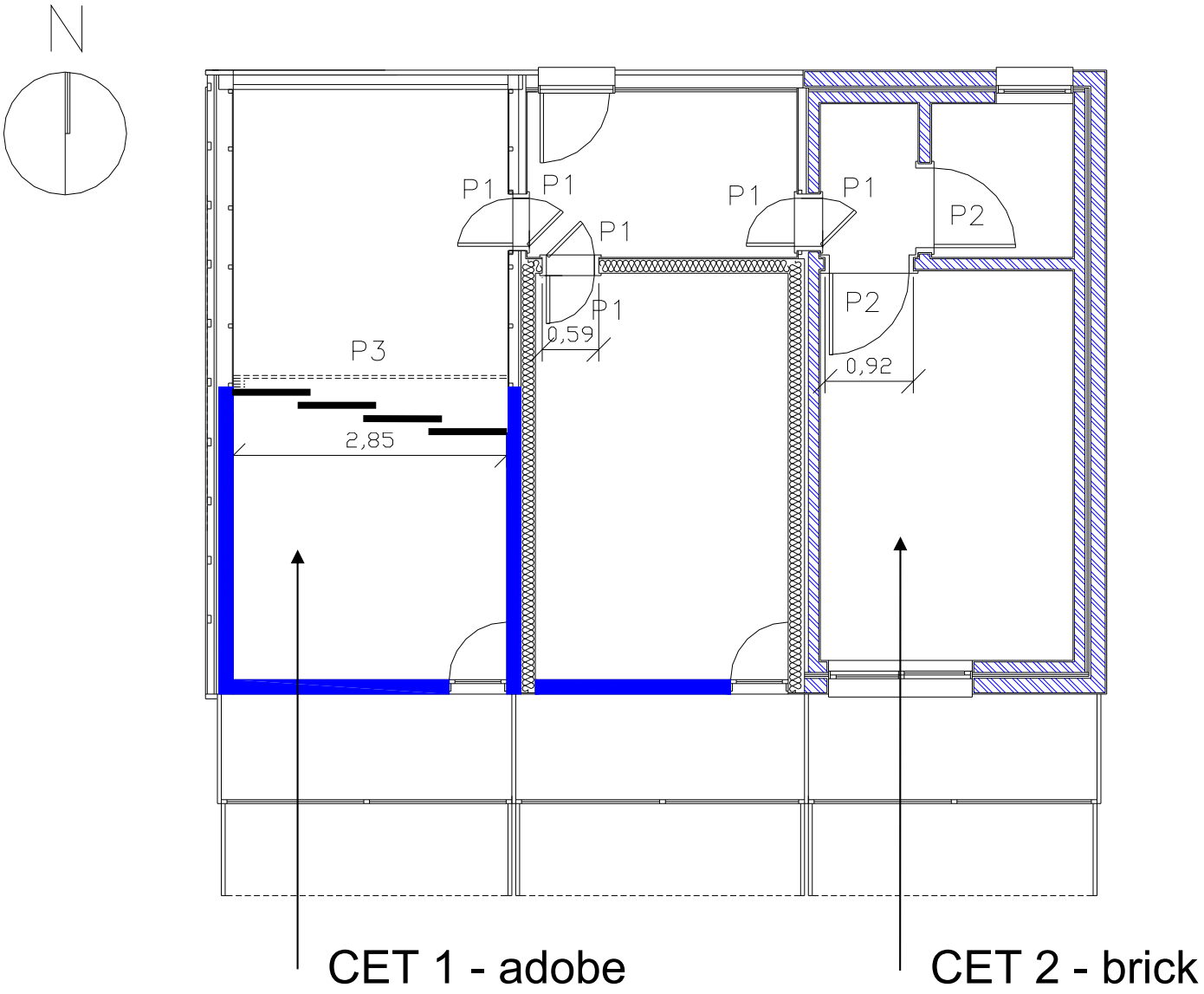


Granite



Basalt - Azores

Adobe - Aveiro

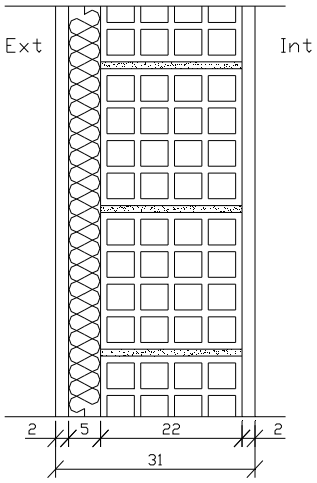

N
P1
P1
P1
P1
P1
P1
P2
P2
P3
0,59
0,92
2,85
CET 1 - adobe
CET 2 - brick

Selected Wall types to comparative study considered in the conventional typology

	B22 Hollow brick	A20 Adobe		S20 Stone	
Weight (kg/m²u.p.a.*)	3034,0	3682,1		3332,1	
EE (kWh/m²u.p.a.*)	2187,6	1391,9	(-36%)	1474,1	(-33%)
GWP** (g/m²u.p.a.*)	392408,4	276147,4	(-30%)	278947,4	(-29%)
AP*** (g/m²u.p.a.*)	4603,0	3299,2	(-28%)	3299,2	(-28%)
COD**** (g/m² u.p.a.*)	13364,0	2281,7	(-83%)	2281,7	(-83%)

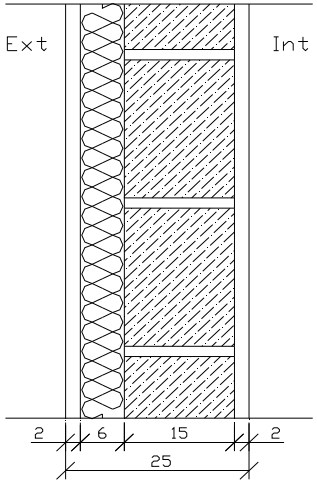
* u.p.a.: useful pavement area; ** GWP - Global Warming Potential in grams of equivalent CO_2; *** AP - Acid potential in grams of SO_2; **** COD - Chemical Oxygen Depletion in grams of NO_x

U (W/m².ºC) = 0,44
R_w (dB) = 53



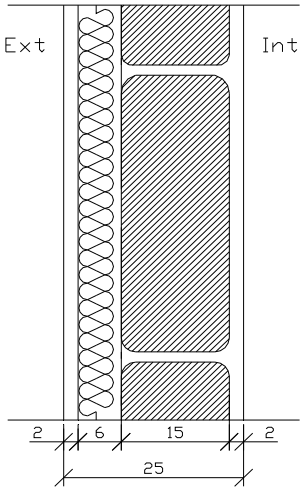
B22 - Hollow brick

U (W/m².ºC) = 0,44
R_w (dB) = 49

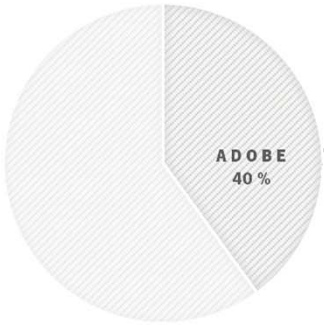


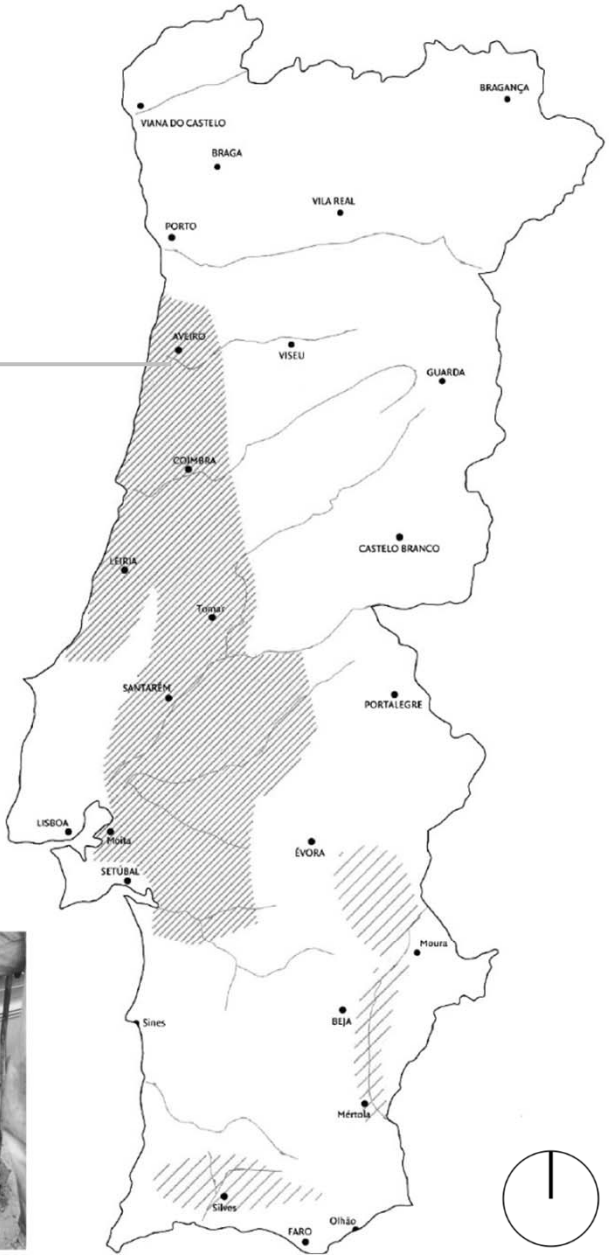
A20 - Adobe

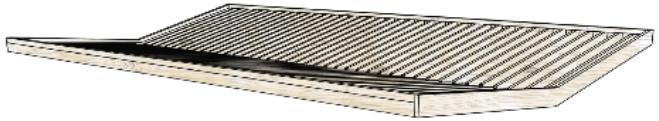
U (W/m².ºC) = 0,46
R_w (dB) = 55

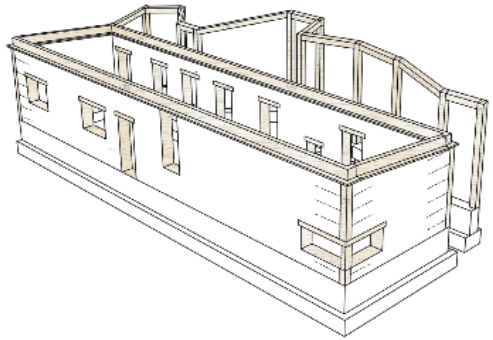


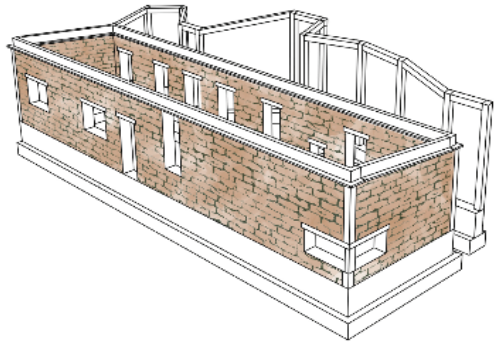
S20 - Stone

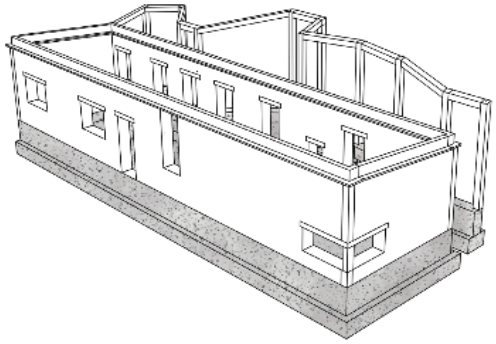

ADOBE
40 %


BRAGANÇA
VIANA DO CASTELO
BRAGA
VILA REAL
PORTO
AVEIRO
VISEU
GUARDA
COIMBRA
CASTELO BRANCO
LEIRIA
Tomar
SANTARÉM
PORTALEGRE
LISBOA
Mora
ÉVORA
SETÚBAL
Moura
Sines
BEJA
Mértola
Silves
Olhão
FARO







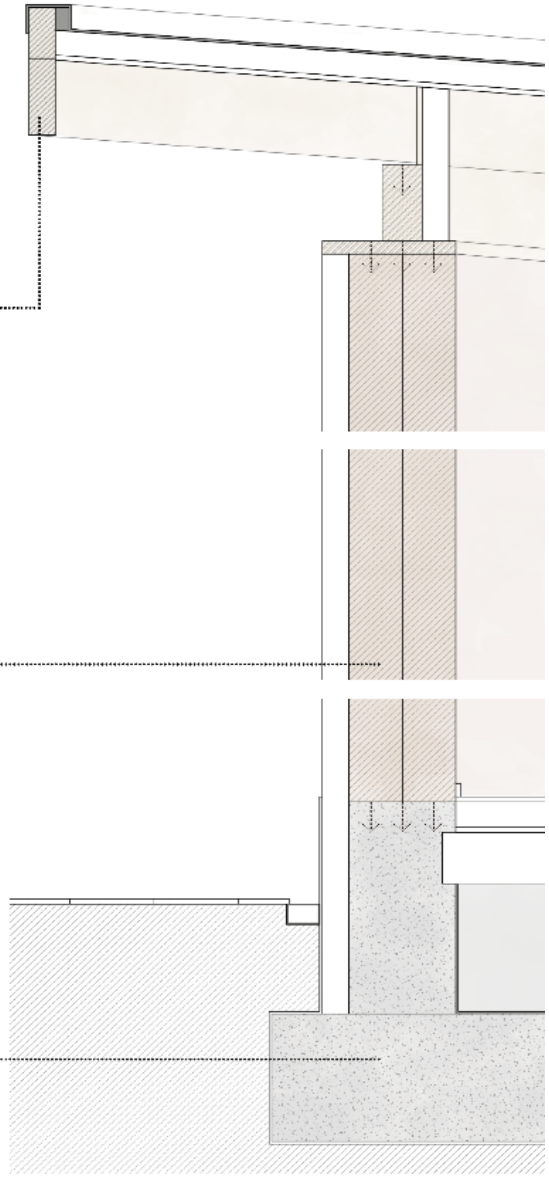


isometric view

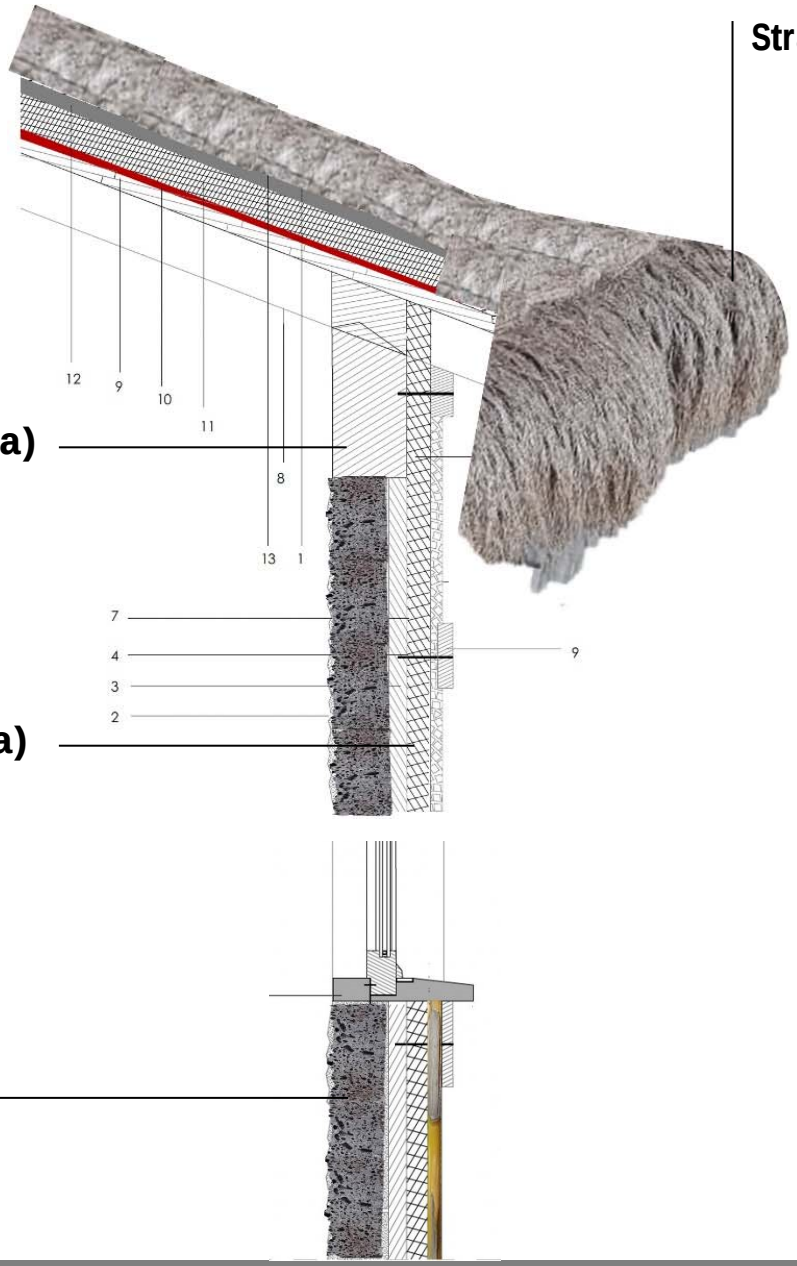
timber

adobe

concrete



vertical section



LEGENDA:

1 - Aplicação de rede galinheiro granpeada pontualmente para ajudar a fixar a festuca seca
2 - Revestimento em microcimento com escórias vulcânicas de basalto da região, acabamento meio brilho
3 - Madeira de criptómeria
4 - Revestimeto de pedra basalto e cal com alvenaria argamassada
5 - Viga em madeira criptómeria

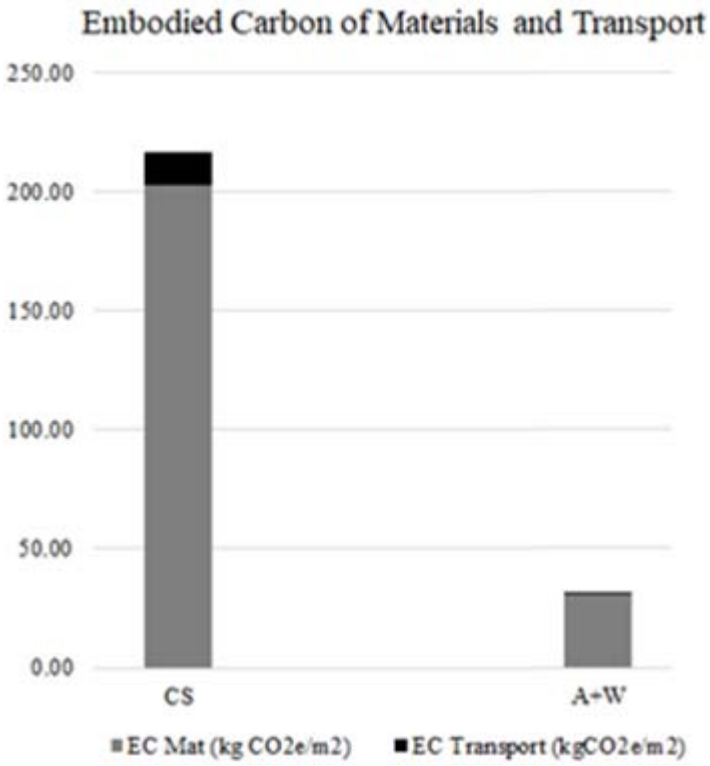
6 - Forro em cana com 3cm com acabamento em óleo de linhaça
7 - Tabuas de criptoméria autoclavado
8 - Viga em em criptoméria 14x8cm

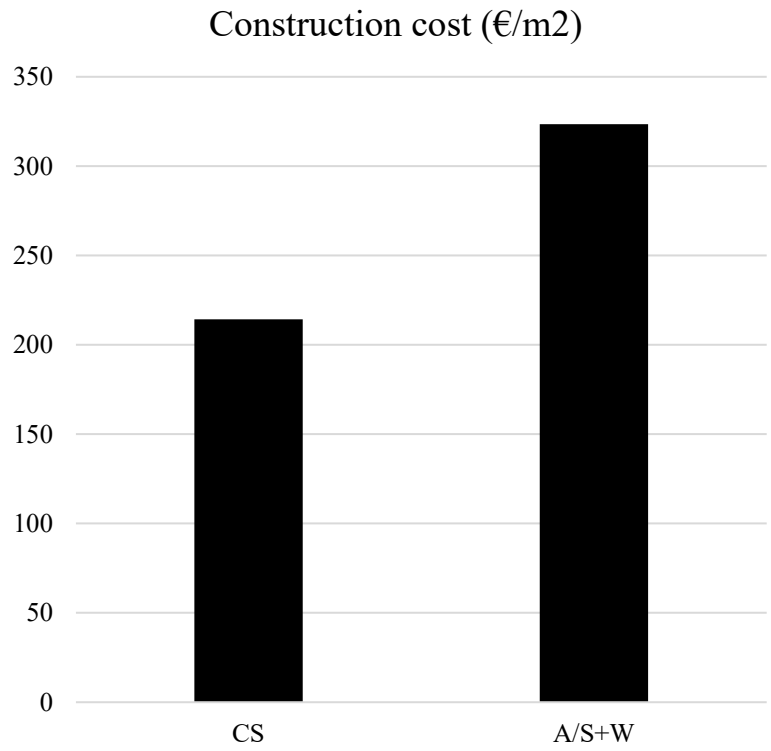
9 - Forro em casquinha 2cm
10 - Manta/mebrana anti-poeiras feita a partir da polpa celulósica da festuca 0,5cm
11 - Isolamento à base de fibras estraídas da festuca
12 - Sub-telha, placa ondulada constituída por base betuminosa e fibras celulósicas à base de criptómeria
13 - Cobertura Vegetal em Festuca seca dos Açores 15/20/30 cm
14 - Canas da Ilha com espigão para fixação da festuca seca

Table 2. Embodied Carbon evaluation of the analyzed solutions.

Total	Materials	Weight (kg)	Weight/m² (kg/m²)	Embodied Carbon (Kg CO_2e/Kg)*	Embodied Carbon (Kg CO_2e)	Embodied Carbon (Kg CO_2e/m²)
CS	Concrete	48033.6		0.13	6244.4	
	Clay Bricks and Blocks	32929.8		0.21	6915.3	
	Steel rods	7002.0		1.71	11973.4	
	Mortar	4579.2		0.20	915.8	
	XPS	945.9		3.29	3112.0	
	Sum	**93490.5**	**649.2**		**29160.9**	**202.5**
A+W	Adobe	66120.0		0.02	1520.8	
	Expanded cork	5820.0		0.19	1105.8	
	Local timber	3685.0		0.49	1816.7	
	Sum	**75625.0**	**525.2**		**4443.3**	**30.9**

*** http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html**





The CS turns out to be the cheapest, however, as it requires more transport, adding the associated costs, it ends up becoming more expensive if overpassed the average distance considered in this study of 200km.

The A/S+W proposal is more expensive than the CS one, but as it uses local soil/stone, is not affected by the transport distance, except for the wood components.

Conclusions

THE TENDENCY

versus

THE OPORTUNITY

Contemporary construction systems

GREAT MAJORITY OF BUILDINGS ARE IN **REINFORCED CONCRETE** AND HOLLOW BRICK

PROBLEMS

- Reduced possibilities for reuse or recycling;
- Non-local materials (centrally produced);
- Industrialized processes (high embodied carbon).

CONCRETE+BRICK STANDS OUT IN 2 PARAMETERS: **LOW COST, WIDSPREAD TECHNOLOGIES**

Traditional construction systems

MIXED WEIGHT CONSTRUCTIVE SYSTEM

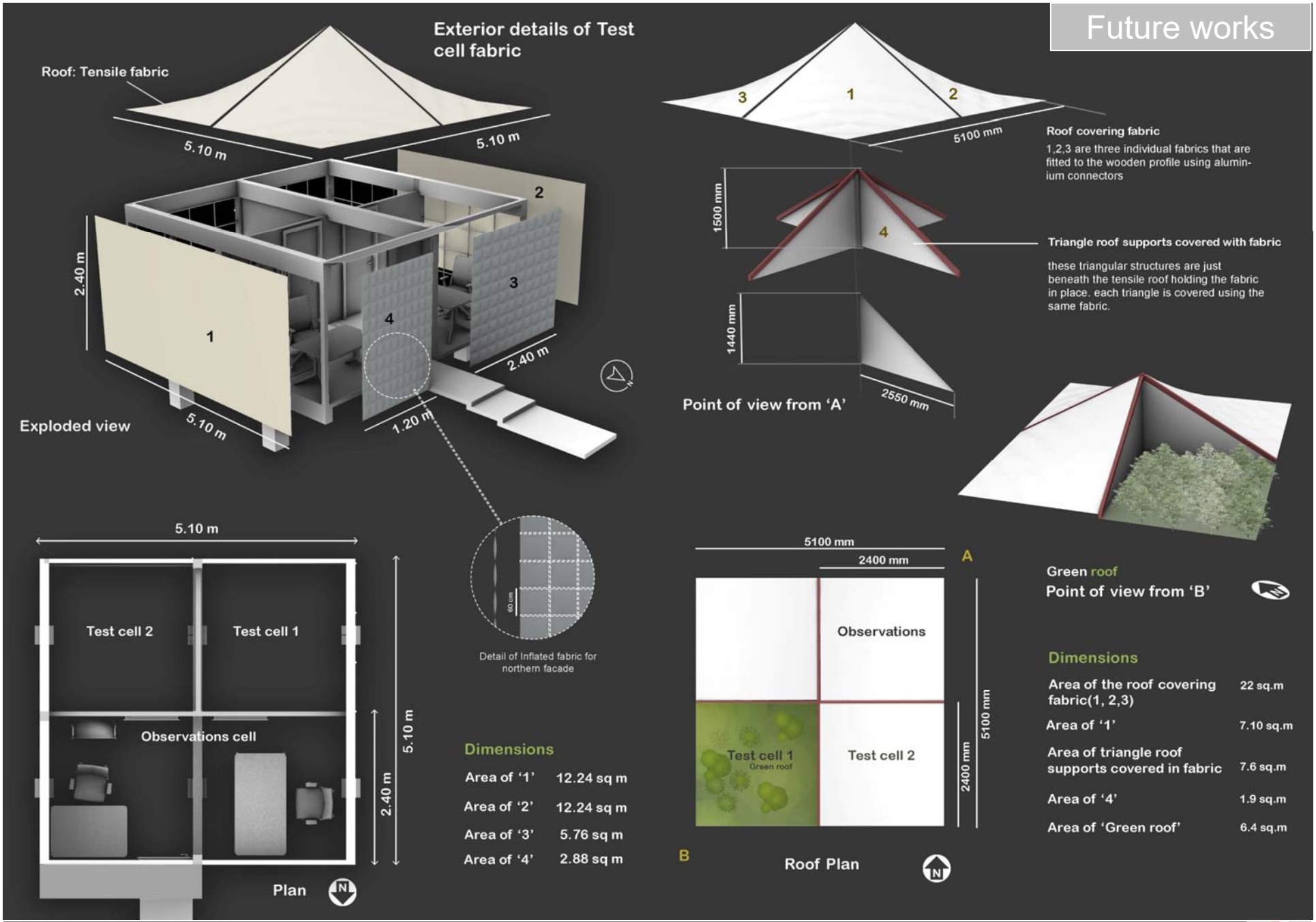
ADOBE + WOOD FRAME
STONE + WOOD FRAME

PROBLEMS

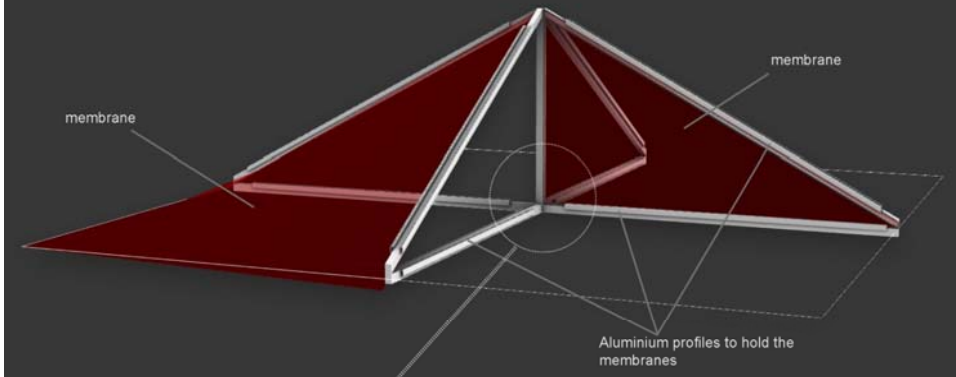
- Higher cost
- Intensive labour;
- Lack of legislation.

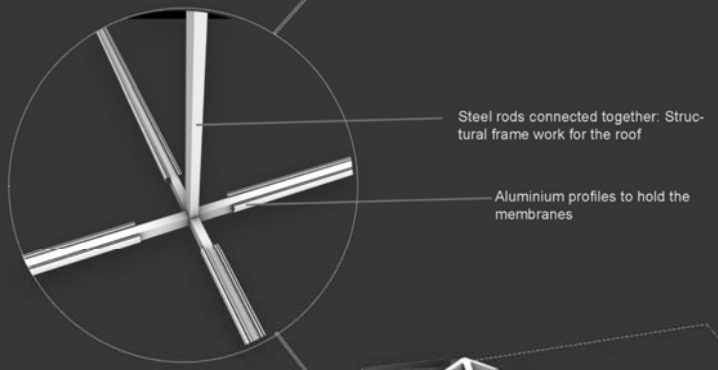
ADOBE/STONE+WOOD STANDS OUT IN 2 PARAMETERS: **LOW EMBODIED CARBON, EASY REUSE**

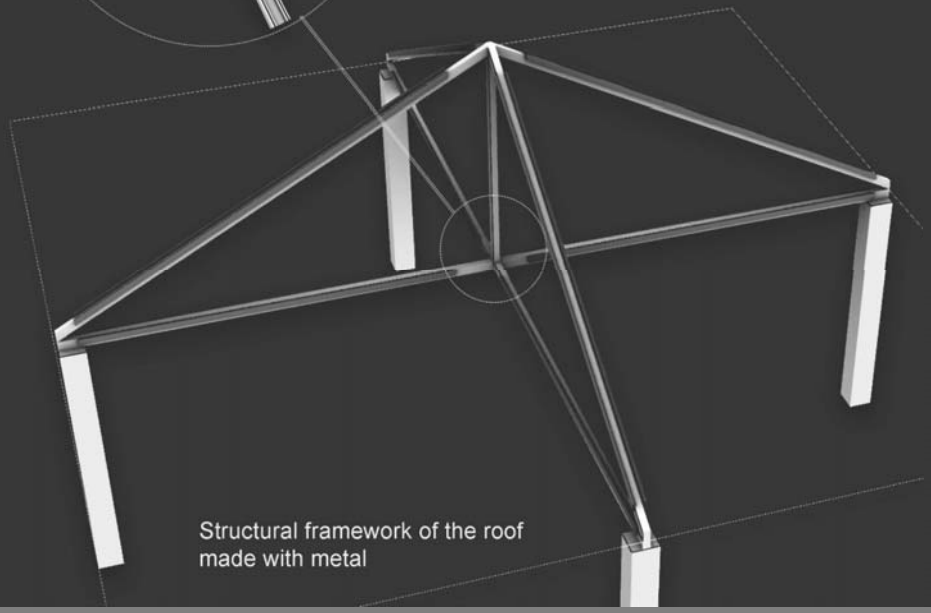
Future works

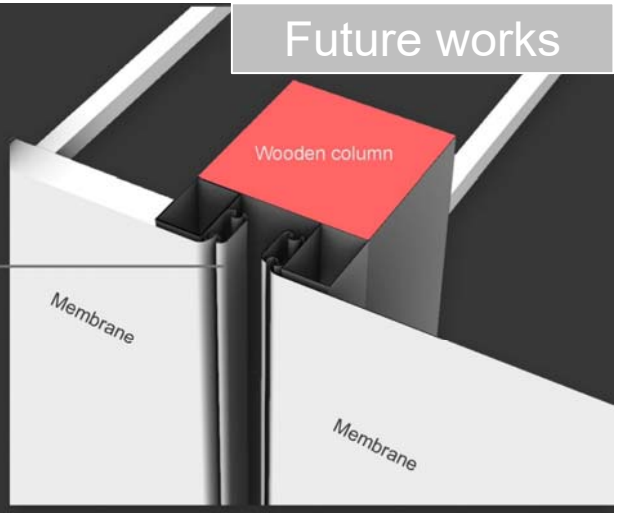


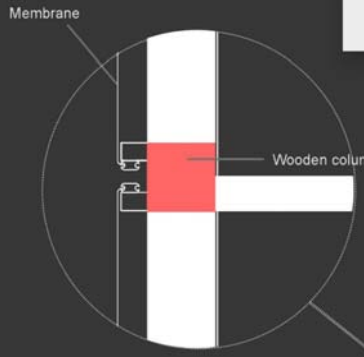
Future works

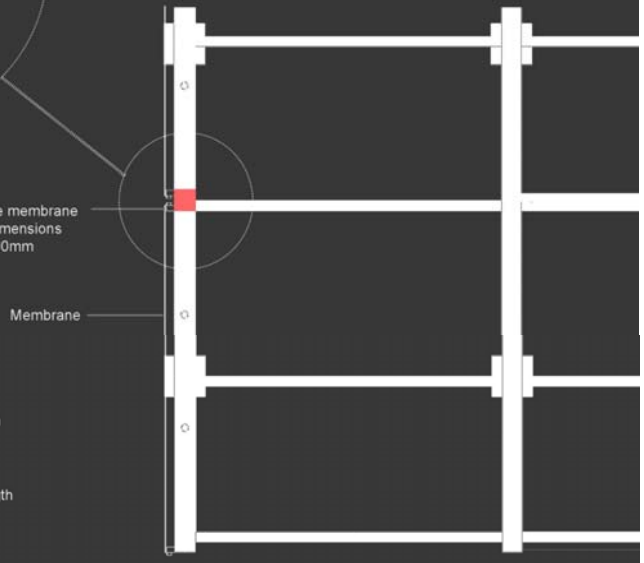












Quantities:

4 Aluminium profile to hold membrane on each side. Total: 8(2.4 mtrs each)

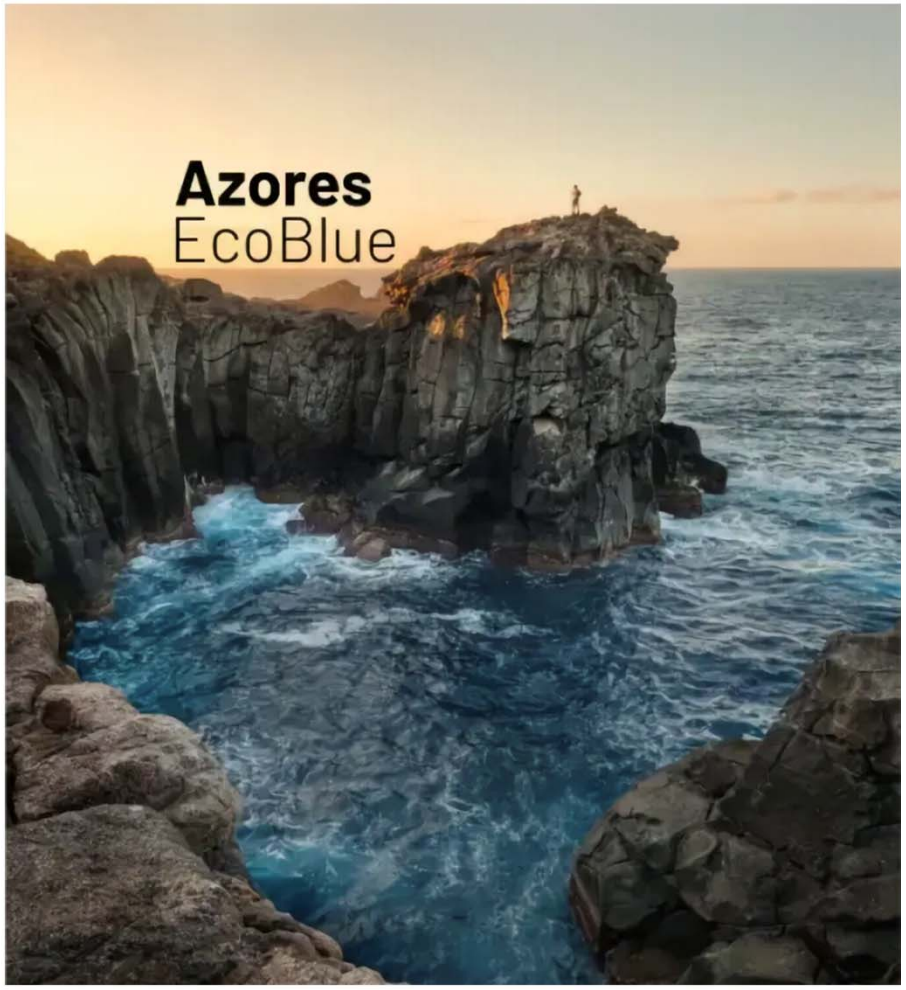
4 rectangular steel rods to hold the membrane profiles. Total: 8(2.4 mtrs length each)

Membrane details for East and West facade

Financed by:

Iceland Liechtenstein Norway grants

know more



Program Operator:

REPÚBLICA PORTUGUESA
ECONOMIA E MAR

Direção-Geral de Política do Mar

Promoter:

CIRCULAR BLUE GROUP

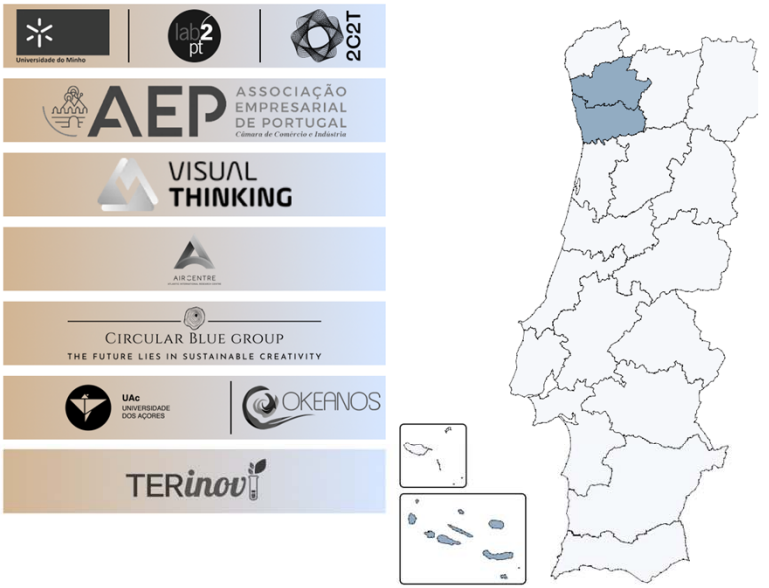
Nieta atelier

Azores
EcoBlue

THE CONSORTIUM

The project consortium presents a model of joint governance with a clear definition of the attributions, contributions and complementarities of each partner. The consortium also intends to include other members at a later stage, through subcontracting, so that they add value and complement their offer, namely companies with competences in the collection, sorting and transport of litter, as well as in the transformation of the yarn and fibre developed from marine litter.

The consortium has technological infrastructures, human resources and the necessary skills to undertake this task, as the group of entities in the consortium will allocate resources and skills with a deep history of scientific and technological development and industrialization projects.

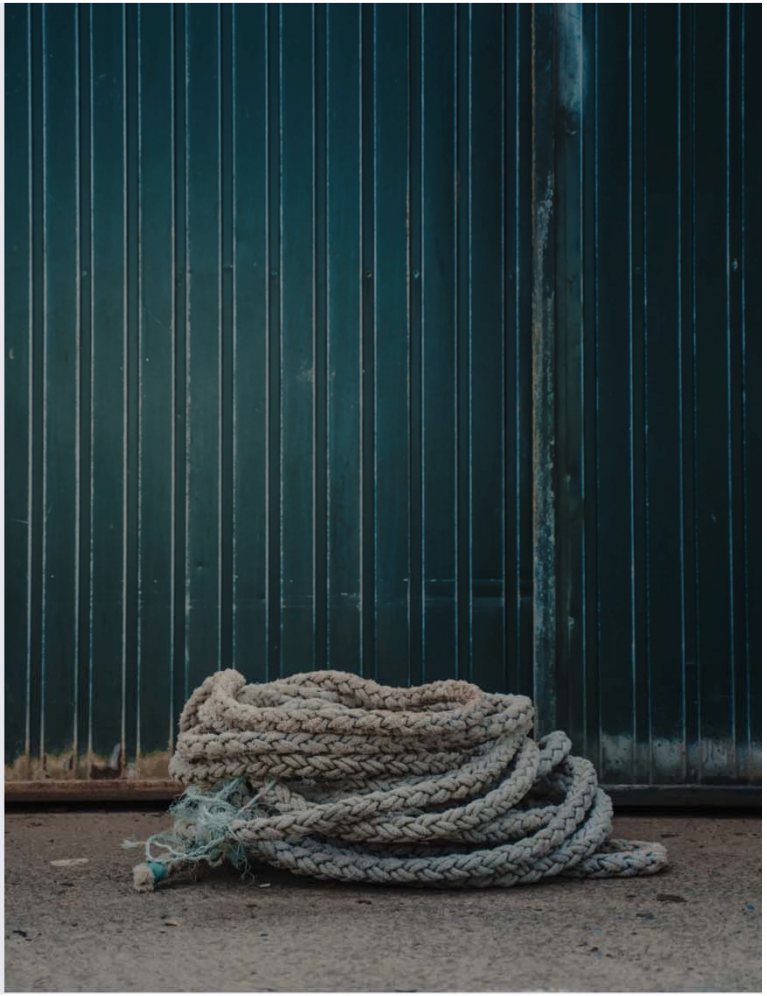


Project financed by Iceland, Liechtenstein and Norway, through the EEA Grants.

Azores
EcoBlue

Marine litter is one of the main enviromental problems with which the oceans are confronted. Continental Portugal and the Autonomous Region of Azores share common challanges, like policy over the sea and the sea in a scenario of waste, given the archipelago of Azores is also not immune to this global problem. There have been studies done to quantify/classify the marine litter in Azores.
Considering the socioeconomical role played by the fishing industry of the Azores, the project is an oportunity to use and develop new and innovative raw materials, transforming marine litter, which is presently little or not at all valued, into a market of excellency, as its "supplier".

To answer these challanges, the project will utilize to their maximum the studies already done and in development by the Universities of Azores and Minho, in their R&D Centres. And, in conjunction with local communities, will collect marine litter and beach residues to develop new threads and fibers for new subproducts. The main activities include the analysis, caracterization, quantification of residues, collection, triage, residue processing, scientific studies about the fibers obtained, development of threads and fibers, and their transformation into fabric and insulating blankets.
Waste will be quantified, analysed, and afterward, presented in a data sharing platform of statistics and scientific studies.



Azores
EcoBlue

As already mentioned, the project intends to transform waste to create threads as raw material for new fabrics and fibers for the development of an insulation blanket. With these and other waste from the sea, a prototype model of an eco-cabin with the new products will be developed. The project will benefit consumers looking for solutions within ecological and recycled eco-design. This eco-cabin pilot prototype can be replicated in other regions that could benefit from its business model, applicable on a global scale. The prototype to be presented constitutes a basis for the development of research work. Simulations and experimental tests of thermal, acoustic and natural lighting tests will be carried out on this prototype.

Scientific studies have already started and are based on the raw materials identified by the R&D centers with the highest percentage of those collected at sea in the Autonomous Region of the Azores. We were able to identify three categories: Silks, cables and algae (weeds). Based on this identification, tests are already being developed in order to create a fiber and thread that will be integrated into the textile, construction and other sectors such as furniture and home accessories. The pilot eco-cabin will be a showroom for the application of construction solutions experimentally validated in the laboratory and in component analysis test cells, as well as a presentation of new craft techniques introduced in construction and home accessories based on marine “trash”.

Azores
EcoBlue

The eco-cabin is based on a constructive system combining heavy local materials as anchorage elements, wood for structure and recycled materials for insulation, panels and shading. The final configuration of the eco-cabin model will be presented in the last semester of the project and it will be unique. With this we intend to develop a base model for sustainable construction, having as analysis/pilot project Terceira Island - Azores and its artisanal culture from marine litter.

In a first phase, analyzing its main environmental problems, such as surpluses from fishing activity, infesting algae and how they can be recreated in a value-added product. Economic studies will be carried out in advance, simulating the structural, thermal, natural lighting and acoustic behavior of the constructive elements and experimental validation of the functional performance in test cells;

Azores
EcoBlue

In view of this analysis and with the scientific knowledge acquired, this base study, in parallel with existing and acquired laboratory equipment for the respective tests, will allow the application of a methodology aimed at the design and construction of eco-cabins that can be flexible enough to be installed in different climatic regions, predominantly coastal. The research and construction model can be based on the analysis and parameterization applied in the Azores EcoBlue pilot eco-cabin. In this way, the parameterization and circular management structure applied in this project can be developed by other creatives, such as architects, engineers and designers.

Azores
EcoBlue

CIRCULAR BLUE GROUP
THE FUTURE LIES IN SUSTAINABLE CREATIVITY

Nieta®
atelier

COMPORTA BLUE
Investimentos Imobiliários Unipessoal Lda.

Thank you!

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