


# Eco-campus, in a rural environment, for agronomy students

by Leslie Gonçalves / 2023-03-13 00:00:00 / France / 1494 / FR

New Construction



Primary energy need :

## 11.1 kWhep/m<sup>2</sup>.an

(Calculation method : RT 2012 )

**ENERGY CONSUMPTION**

*Economical building* *Building*

< 50	A	A
51 à 90	B	
91 à 150	C	
151 à 230	D	
231 à 330	E	
331 à 450	F	
> 450	G	

*Energy-intensive building*

**Building Type** : Student residence  
**Construction Year** : 2021  
**Delivery year** : 2022  
**Address 1 - street** : D6113 11400 LASBORDES, France  
**Climate zone** : [CsC] Interior Mediterranean - Mild & dry summer.

**Net Floor Area** : 1 983 m<sup>2</sup>  
**Construction/refurbishment cost** : 4 090 000 €  
**Number of Dwelling** : 80 Dwelling  
**Cost/m<sup>2</sup>** : 2062.53 €/m<sup>2</sup>

**Certifications :**



## General information

Develop and revitalize rural areas:

- Reflecting a sustainable eco-built architecture of level E3C2 (efficient envelope, orientations, compactness, solar contributions, summer comfort, renewable energies).
- Building housing differently for students whose professional objectives are oriented towards the sectors of the environment, agri-food, biotechnologies, water resources and the animation of a territory.
- Promoting landscaping and gentle pathways.
- Respecting the environment and preserving biodiversity with an ecologist.
- Managing rainwater on the plot (specialized design office).
- Using local, durable and aesthetic materials (local wood, tiles with local factories, biosourced insulation).

- A strong reusing approach (flat tiles on the facade, interior furniture, Benjes hedges).
- Co-designing the project with the users and making the project a testing ground to raise student awareness (6 participatory workshops, school site, welcome booklet).
- A cleaning site approach with follow-up and mobilization with the actors.

## Building users opinion

Lau Re: "It's good that the school made these accommodations even if at the time the boarding school was nice for the first years, we had to find another one afterwards and it was more of a hassle. Great initiative La Raque!"

Source: [https://www.facebook.com/ecolessuperieurelaraque/videos/523541433098937/?locale=fr\\_FR](https://www.facebook.com/ecolessuperieurelaraque/videos/523541433098937/?locale=fr_FR)

## If you had to do it again?

We had planned a water heater called "Twido solar", a hybrid solution essentially powered by direct injection by photovoltaic panels, which had obtained TITLE V approval; but during the bidding this product and the company went bankrupt. We therefore replaced this innovative solution with the production of domestic hot water from a thermodynamic system. The AUER brand EDEL AIR system is based on air/water type thermodynamic production which has a 1.2 kW electrical backup.

## See more details about this project

<https://www.seuil-architecture.com/2021/04/13/constuction-logements-etudiants/>

<http://www.laraque.com/vie-etudiante/eco-campus/>

[https://www.facebook.com/ecolessuperieurelaraque/videos/523541433098937/?locale=fr\\_FR](https://www.facebook.com/ecolessuperieurelaraque/videos/523541433098937/?locale=fr_FR)

<https://www.una-ingenierie.com/2023/02/10/ateliers-participatifs-co-construisons-leco-campus-de-lasbordes/>

<https://www.alogea.fr/actualites/inauguration-de-leco-campus-de-la-raque-le-20-janvier-2023/>

## Photo credit

Stéphane Brugidou  
Origin Creative Agency  
Seuil architecture

## Stakeholders

### Contractor

**Name** : Bailleur social Alogéa  
**Contact** : Nathalie PENTEL - nathalie.pentel[a]alogea.fr  
<https://www.alogea.fr/>

### Construction Manager

**Name** : Seuil architecture  
**Contact** : Leslie et Philippe GONCALVES - 74 rue Saint Jean Balma - 05 34 40 29 19  
<https://www.seuil-architecture.com/>

### Stakeholders

**Function** : Thermal consultancy agency  
Ecovitalis

Guillaume BARBE - g.barbe[a]ecovitalis.com

<https://www.ecovitalis.fr/>  
Fluid MOE and environment

**Function** :

Tassera

BET VRD and structure

**Function** : Others

Sarah MEYER

Au village, 32600, MONBRUN, France - meyersarahm[a]gmail.com

<https://ecologue.fr/>

Ecologue

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Function : Structures calculist

Emacoustic

Agence de Toulouse, 6 rue des Tonneliers, 31700, Blagnac - 09 82 34 62 50 - contact[a]emacoustic.fr

<https://www.emacoustic.fr/>

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Function : Others

Socotec

Marc TEISSEIRE et Laurent HUSS - Agence de Carcassonne - marc.teisseire[a]socotec.com - laurent.huss[a]socotec.com

<https://www.socotec.fr/>

Control office

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Function : Others

Una ingénierie

Leslie et Philippe GONCALVES - 74 rue Saint Jean Balma - 05.34.40.29.19

<https://www.una-ingenierie.com/>

Usage control assistant and reuse guide

## Type of market

Other

## Other type of market

Assimilated public market, MOP law

## Allocation of works contracts

Separate batches

# Energy

## Energy consumption

Primary energy need : 11,10 kWhEP/m<sup>2</sup>.an

Calculation method : RT 2012

Breakdown for energy consumption :

Breakdown of the primary energy need (excluding ENR production):

- Heating: 11.1 kWhEF/m<sup>2</sup>.year - 17%
- DHW: 44.4 kWhEF/m<sup>2</sup>.year - 67%
- Lighting: 4.1 kWhEF/m<sup>2</sup>.year - 6%
- Auxiliary ventilation: 4.8 kWhEF/m<sup>2</sup>.year - 7%
- Distribution auxiliaries: 1.6 kWhEF/m<sup>2</sup>.year - 2%

## Envelope performance

Envelope U-Value : 0,64 W.m<sup>-2</sup>.K<sup>-1</sup>

More information :

Summer comfort was also a point of vigilance, given the massive wooden construction. The paving (low-carbon concrete) on the ground floor and the thick screed of the floor contribute to the inertia of the building, reinforced by the solar protection devices (roller shutters, wooden pergolas) and the high-performance envelope.

Facade complex:

- 20mm flat tile cladding / 30mm horizontal wooden cleat / 30mm vertical wooden cleat / 22mm OSB panel / 160mm wood wool insulated MOB / Vapor barrier / 40mm wood wool insulation / 2 BA13

Or

- 20mm light colored lime plaster / 40mm cork ETI insulation / 22mm OSB panel / 160mm wood wool insulated MOB / 22mm OSB panel / 40mm wood wool insulation / 2 BA13

Composition of the ground floor paving:

Flexible floor finish / Compounding + anti-humidity barrier / 240mm low carbon concrete slab / 180mm insulation + additions on stringers / Abundant earth

Composition of the G+1 floor:

Flexible floor finish / 60mm screed / 22mm OSB panel / 200mm joists / 100mm wood wool insulation / 2 BA13

Roof complex:

Roof tiles 30% inclination / Traditional framework - 440mm insulation in cellulose wadding / 2 BA13 CF1/2h

Summer solar factor: Sw E = 0.44 / 0.31 / 0.29 / 0.30 depending on orientation cf. thermal notice

Winter solar factor: Sw C = 0.44 / 0.31 / 0.29 / 0.30 depending on orientation cf. thermal notice

Indicator : I4

Air Tightness Value : 0,80

## Renewables & systems

### Systems

Heating system :

- Geothermal heat pump
- Fan coil

Hot water system :

- Heat pump

Cooling system :

- Geothermal heat pump
- Fan coil

Ventilation system :

- Humidity sensitive Air Handling Unit (Hygro B)

Renewable systems :

- Solar photovoltaic
- Heat Pump on geothermal probes

Renewable energy production : 88,00 %

Other information on HVAC :

The production of heating for the dwellings is ensured by heat pumps (heat pump) water/water on vertical geothermal probes. Each island is made up of a 21 kW heat pump connected to 3 geothermal boreholes of 125 ml each. The Coefficient of Performance is 4.51, which means that for 1 kWh of electrical energy supplied, the heat pump produces 4.51 kWh of heating, i.e. 78% free energy. The heat pump, via its thermodynamic cycle, will produce hot heating water which will be stored in a 400-litre buffer tank providing an energy reserve. Regulation of the flow temperature is programmed according to a water law (10 probes 150 ml deep) with regulation on water law: there is 1 heat pump per island of 21.2 kW & COP = 4.7. l.

The emission of heating in the dwelling is carried out by a fan coil of the duct type (Rate 40/35°C for optimization of the SCOP). The team turned to fan coil type transmitters for several reasons:

- They make it possible to free the student room / living room from any footprint and therefore optimize the interior layout;
- They have the ability to be reactive and to adapt quickly to the level of occupancy;
- They have a high transmission power which is beneficial for geocooling;
- They have been sized for a low flow so as not to create any acoustic discomfort.

Passive air conditioning is produced by the same geothermal water/water heat pumps. In summer or mid-season, the geothermal installation will carry out "geocooling". The principle is based on a direct exchange between the water from the boreholes and the water circulating in the emitters. Thus, the cost of cooling will be reduced to the simple circulation of water in the networks! This will provide pleasant hygrothermal comfort regardless of the outside temperatures. The emission of cooling in the dwelling is done in the same way as heating.

Geothermal heat pump on dry vertical probes because centralized production had the best performance. The choice of low-temperature production led to dissociating the production of domestic hot water so as to maintain a high coefficient of performance on geothermal production.

This installation also has the virtue of being able to carry out passive cooling in the premises through geocooling, the principle of which is to carry out a direct exchange between the water from the boreholes and the secondary networks.

### Smart Building

BMS :

Counting by room to carry out challenges (small competitions) between students for their energy sobriety: determine the room that consumes the least!

## Environment

## Biodiversity approach

Thanks to the involvement of the ecologist within our group, the eco-campus plays a major role in the creation of functional habitats for local fauna. The enrichment of the plant palette and the preservation of the existing flora promote the biodiversity in place.

The project provided for varied landscapes, plant sequences and recreational spaces. Benjes hedges (reuse) have been created to break the winds, promote biodiversity and create shelters and nesting places for local wildlife. This technique consists of piling up branches of dead wood horizontally between stakes, up to about one meter in height. In order to complete the nesting/hibernation, resting and feeding places for the local fauna, other types of shelters have also been installed on the Eco-campus.

- **Birdhouses:** Several passerines have been observed on the site, including the House Sparrow (*Passer domesticus*), the European Goldfinch (*Carduelis carduelis*) and the Greenfinch (*Chloris chloris*). To remedy the scarcity of natural nesting sites, shelters for sparrow colonies have been directly integrated into the facades of two buildings of the eco-campus. Three general nesting boxes for passerines were also positioned.
- **Bat houses:** The wooded area of the school is a favorable place for the hibernation of tree bats. Located in a mainly agricultural landscape, the eco-campus has integrated the installation of three bat houses on trees bordering the basin. They thus complete the natural shelters provided by the old trees in the forest.
- **Melliferous flower meadow** to attract pollinating insects.
- **Largely fruit and berry-bearing tall stem trees and shrubs**, a food source for some species of birds.
- **Perennial climbing plants**, suitable for the nesting of certain species of birds.
- **Country hedges and dry hedges**, habitats for a whole host of species (insects, spiders, micromammals, birds, etc.).

These habitats thus promote the feeding, reproduction and circulation of local biodiversity. To create these habitats, the eco-campus has turned to local and hardy plant species, adapted to the environment and the fauna observed on the site.

### Mitigation actions on soil and biodiversity :

The altimetric layouts of the buildings have been studied to match the topography as much as possible in order to limit earthworks to what is strictly necessary. Topsoil has been reused and reclaimed on site. Vegetated structures such as valleys, ditches and the retention basin fulfill complementary functions related to the management of rainwater, the creation of new habitats favorable to biodiversity and the structuring of the landscape. Their effectiveness is directly related to the capacity of soils and plants.

## Risks

### Hazards to which the building is exposed :

- Heatwave

### Risks measures put in place :

Summer comfort was a point of vigilance, given the massive wooden construction. The paving (low-carbon concrete) on the ground floor and the thick screed of the floor contribute to the inertia of the building, reinforced by the solar protection devices (roller shutters, wooden pergolas). In addition, all through housing.

In addition to these passive elements, we have implemented geocooling via geothermal heat pump probes.

For summer and winter comfort, the envelope of the buildings is efficient.

## Urban environment

- Department: Aude (11)
- Altitude: 30m
- Climate zone: H3
- Base outdoor temperature: Winter: -5°C / Summer: 32°C

The project is located in the heart of a rural natural environment with high potential and remarkable assets. From the departmental 6113, the project constitutes, by its location, its scale and its spatial organization, an integrated built sequence, echoing the town of Lasbordes. The project is respectful of the environment and fits into the wider landscape without cutting off the heritage dimension views of the territory: the project offers perspectives on the agricultural fields preserved and protected by the municipality's PLU.

The taking into account of the site's history is reinforced by a contemporary writing, with clean lines, which associates local and vegetal materiality. The project also constitutes the entry sequence to the École Supérieure de La Raque and enhances the site and its activities on a regional scale, giving it a clear and strong identity. This highlighting contributes to energizing the local rural territory.

Land plot area : 25 814,00 m<sup>2</sup>

Built-up area : 35,00 %

Green space : 5 016,00

## Products

### Product

Flat tile

Terreal

<https://www.terreal.com/fr>

Product category : Finishing work / paints, mural, wallcoverings

The project implements a flat tile of second choice, downgraded, in facade cladding.



## Costs

### Construction and exploitation costs

Renewable energy systems cost : 274 714,00 €

Cost of studies : 1 180 000 €

Total cost of the building : 5 270 081 €

Subsidies : 1 040 510 €

Additional information on costs :

Regional subsidies within the framework of the No Watt scheme and Ademe heat funds

## Circular Economy

### Circular economy strategy

Phase in which reuse has been integrated : Sketch study

Type of circular economy strategy implemented :

- Targeting a few diversified products for testing
- Maximization of quantities on targeted products
- Maximization of the carbon gain

Type of circular economy strategy implemented :

Territorial and business survey

Quantified targets for reuse? :

Goals :

- 100% downgraded flat tiles
- 100% furniture
- 100% Benjes hedge filling

Results :

- 50% downgraded flat tiles
- 100% furniture
- 100% Benjes hedge filling

Integration of reuse into the written contract documents : Reuse in non mandatory variant

Validation protocol for reused materials : Yes

Validation protocol for reused materials :

Existing technical sheets (dormant stocks + downgraded).

For the hurdles of Benjès, no technical subjects.

Deposit validation form : No

### Reuse : same function or different function

Batches concerned by reuse :

- Facades
- Indoor joineries
- Landscaping

For each batch : Reused Materials / Products / Equipments :

### Actors

- **Design & management of the reuse of facades and furniture:** Seuil architecture and Una Ingénierie
- **Design of the Benjes hedges:** Sarah Meyer ecologist
- **Supplier of facade tiles:** Terreal
- **Company implementing facades:** Sud Charpente

- **Furniture supply and implementation company:** Tiquet
- **Implementation of Benjes hedges:** piquets: Aude TP company, branches: students, Sarah Meyer and Una engineering.

## Details of quantities

**Facades** = 1038 m<sup>2</sup> of which 519m<sup>2</sup> are reused (50%) - origin: downgraded tiles from Terreal

**Furniture** = 5079m<sup>2</sup> of reused panels, i.e. 100% of cupboards, benches, tables/desks, kitchen tops and kitchen fronts - origin: dormant stock from Tiquet (interior joinery company):

- 81 cabinets / 1.5 plates / cabinet = 81 x 1.5 plates knowing that 1 plate of 2800x2070 mm is 81 x (5.81 x 1.5) = 704 m<sup>2</sup>
- 72 benches - box / 0.5 plate / bench = 72 x 0.5 plates knowing that 1 plate of 2800x2070 mm is 72 x (5.81 x 0.5) = 210 m<sup>2</sup>
- 81 tables / desks / 6 plates / table = 81 x 6 plates knowing that 1 plate of 2800x2070 mm is 81 x (5.81 x 6) = 2823 m<sup>2</sup>
- 72 kitchens / 3 plates / kitchens = 72 x 3 plates knowing that 1 plate of 2800x2070 mm is 72 x (5.81 x 3) = 1255m<sup>2</sup>
- 81 worktops = 1.80x06 x 81 = 1.08x81 = 87m<sup>2</sup>

**Hedges of Benjès** = 5m3 / hedge - origin: plant recovered on site

Reused materials rate :

**Several constraints/opportunities arose throughout the operation.**

## Regarding downgraded tiles

Two types of Old Country flat tiles from Terreal were concerned: Manor and Old Earth. We asked the company to mix up the façade by taking the tiles alternately from each of the pallets. The company then mounted a few conclusive facades up to the composition of a zebra facade. The graphic and aesthetic result was inconclusive, but the reuse process went against dismantling. We therefore decided to keep the facade and to determine that for the other buildings we would separate the facades according to the two references, which turned out to be conclusive.

> The final result and the benefit of the 8.2 kgeqCO<sub>2</sub>/m<sup>2</sup>SDP avoided make us say that the reuse process was worth it!

## About the furniture

The interior joinery company had developed, a few years earlier, a kitchen sector with massive purchases, in particular of wood-aluminium handles. The handles had not passed and were stored dormant in one of the crowded warehouses. If we had not considered this resource initially, we seized this opportunity, without loss for the company.

## Regarding the multitude of panels, and colored edges or with decoration

We made many round trips with the company, to agree on the remaining materials, those sold in the meantime, those that were finally scratched or the references not found. The balance sheet for the company which emptied its stocks is however mixed with regard to the time spent. Not to mention the very important time for the architecture firm in supporting the process.

> The final result of the 80 interior fittings with multiple and coordinated aesthetic renderings (constituting distinct and identifiable dwellings) as well as the benefit of the 22.2 kgeqCO<sub>2</sub>/m<sup>2</sup>SDP avoided make us say that it was worth it!

## Logistics

Rehabilitation and reconditioning operations (if project concerned by a cleaning/demolition stage) : No

Storage of materials for reuse in situ (if project concerned by a cleaning/demolition stage) :

- On site, on a dedicated area not covered

Storage of materials from external supply :

- No problem of storage, supply correlated to the progress of the works

## Insurance

Consultation of the technical controller : Yes

Specific mission given to the technical controller :

No specific mission for the Socotec control office, because no characterization.

Additional premium :

Non

## Environmental assessment

Impacts avoided : water, waste, CO<sub>2</sub> :

**Reused flat tiles** : 519m<sup>2</sup> (50% of facades):

- CO<sub>2</sub> avoided: 8217.84kg
- Water consumption avoided: 43.20 m<sup>3</sup>
- Waste avoided: 4534 kg

**Furniture** :

Box entry for the 81 cupboards, the 72 bench units on wheels:

- CO2 avoided: 1226 kg
- Water consumption avoided: 1.64 m3
- Waste avoided: 1085 kg

Input for the 81 worktops and 81 desks/tables (plans)

- CO2 avoided: 2800 kg
- Water consumption avoided: 3.79 m3
- Waste avoided: 2477 kg

Entry for 6-unit kitchen doors, but taken as if 3 units (because small sizes) x 81 = 243 U

- CO2 avoided: 15736 kg
- Avoided water consumption: 190 m3
- Waste avoided: 8195 kg

**Summary per batch:**

Categories	CO2 avoided (kg)	Water consumption avoided (m3)	Waste avoided (kg)
Outdoor Facilities	0	0	0
Landscaping / Locksmithing - Metalwork	0	0	0
framework	0	0	0
Partitions	0	0	0
Blanket	0	0	0
Roofing / Outdoor facilities	0	0	0
Lightings	0	0	0
Security lights	0	0	0
HVAC equipment	0	0	0
Electrical equipment	0	0	0
facades	0	0	0
False ceilings	0	0	0
Raised floors	0	0	0
False ceilings	0	0	0
Big work	0	0	0
Sanitation facilities	0	0	0
Insulation	0	0	0
Exterior carpentry	0	0	0
Interior joinery	15736.21487	190.393148	8195.610857
Furniture	4026.626618	5.406050685	3562.541871
Paint	0	0	0
Plumbing	0	0	0
floor coverings	0	0	0
Floor or wall coverings	0	0	0
Wall coverings	0	0	0
building security	0	0	0
Locksmithing - metalwork	0	0	0
VRD	0	0	0
	<b>CO2 avoided (kg)</b>	<b>Water consumption avoided (m3)</b>	
<b>TOTAL</b>	19762.84148	195.7991987	11758,15273

**In total, the reuse operation saved the equivalent of:**

- **158,103 kilometers traveled by a small car, i.e. 180 Paris-Nice journeys,**
- **1305 rectangular bathtubs filled with water,**
- **24 years of household waste from a Frenchman.**

**More details on the avoided impacts :**

We can consider that when a material is reused, the project avoids the emission of CO2 during certain phases of the life cycle of the material. In particular, we can consider that it should not have been produced specifically for this project and subtract the carbon impact of production (phases A1 to A3).

Considering a collective FDES file for wood for **interior fittings** from the INIES database, we consider an impact on global warming of 14.9 kgeqCO2/m2 of wood, including 8.8 kgeqCO2/m2 for the production phase. **This is therefore 43,930 kgeqCO2 avoided over the total life cycle of the building, i.e. 22.2**



## kgeqCO2/m2SDP.

For the **50% of flat terracotta tiles on the facades**, we can base ourselves on a collective FDES sheet for terracotta cladding from the INIES database, we consider an impact on global warming of 44.4 kgeqCO2/m2 of terracotta including 35.6 kgeqCO2/m2 for the production phase. **This is therefore 6,280 kgeqCO2 avoided over the total life cycle of the building, i.e. 8.2 kgeqCO2/m2SDP.**

## Economic assessment

Total cost of reuse : 245 600 €

Reuse quantified in the companies' offers? : Yes

Purchasing process for reused materials :

- Purchase by the company from a reuse platform
- Others

Purchasing process for reused materials :

During the competition and the studies we wanted to carry out a very low carbon project, but the Lasbordres PLU imposed two materials on the facade: terracotta or coating. For the sustainability of the project, we have applied lime rendering on ETI cork on the facades protected from the winds and driving rains and we have prescribed terracotta on the facade.

As part of our low-carbon approach, we have therefore limited our impacts by carrying out a territorial survey to identify deposits of terracotta resulting from reuse. The company Terreal, a local industrialist with one of its factories in the same town as the project or nearby, offered us downgraded tiles whose purpose is either resale to individuals or recycling as part of its process. industrial. On 100% of the facades as an objective to be achieved, we were able to source 50% of tiles from reuse.

Regarding the interior furniture, we wanted to let the exterior carpenter use a solution adapted to his know-how and his own resources. With the specific mention: "for this operation, the contracting authority has shown a strong desire to apply a sustainable development approach. The project is part of this approach by seeking to reuse and revalorize building materials, second choice or re-use in a circular economy reflection. Reused wood will be favored to respond to the problems of resource depletion, waste management and reduction of the environmental impact of construction". The furniture was described in the broadest sense: "Production, supply and installation of a box in panels or laminated slats, in reused wood. Once the analyzes of the offers had been made, a company survey was carried out on the basis of its dormant stocks in its warehouses to confirm the choice of panels, edges and handles retained for the implementation of the furniture".

Finally, Benjès hedges were created with dead wood from a few cuts of wild thickets on the site of the project and branches collected by students in nearby planted fringes at the Ecole de la Raque.

More details on the economic balance :

For the social landlord Alogéa, the economic results are positive:

- Obtaining regional subsidies (No Watt scheme), where reuse was highly appreciated and encouraged;
- Interior fittings in color at the price of white.

## Communication

Communication on the process : Yes

If so, please specify :

Many visits have taken place on the eco-campus:

- Visit of Envirobat Occitanie and Fibois Occitanie;
- Visit of the entire team of the Seuil Group (Seuil architecture, Una engineering and Lhab achievements);
- Visit of INSA students;
- Visits to the demonstrator site by students from La Raque (x4);
- Visit organized by the contracting authority Alogéa;
- Inauguration with religious sacrament of wooden buildings.

Numerous posts on social networks have made it possible to present the approaches of the eco-campus and more particularly the circular economy approach.

Project visit : Yes

## Circular design

Responsible consumption :

No car park was built as part of the eco-campus operation, the school car park was deemed sufficient. The open ground surface, representing 65% of the plot, has been preserved in permeable, planted and recreational spaces.

Functionality economy :

A great economy of space has been studied, particularly in the participatory process:

- Promote common terraces and passageways rather than private balconies;
- Pooling of spaces: common laundry, bike rooms, parking, terraces;
- Accommodations requested by the participatory workshops to make them adapted to real needs (all accommodations were modified after the competition);
- All outdoor spaces have been studied with regard to real needs: vegetable garden space initially planned in the eco-campus, brought back into the school; relocation of the petanque area close to the school access; removal of barbecues and confirmation of all other contest hypotheses.

### Industrial and territorial economy :

The first of the relations is between the eco-campus and the Ecole Supérieure de la Raque, through the relations of the flow of children but also of the ecological continuities treated between the landscaped areas and the park of the Ecole de la Raque.

The second is between the eco-campus of the surrounding green and blue frameworks: preservation of the stream, corridors of species and species, landscaped valleys vis-à-vis agricultural fields.

The third is between the campus (the eco-campus + the Ecole Supérieure de la Raque) and the municipality of Lasbordes, with two-wheeled and motorized flows.

The clean worksite and the use of dry channels have made it possible to guarantee traceability of hazardous waste (very low) and of the various worksite flows.

### Eco-design :

All the buildings were made in the dry process with a strong desire:

- Promote the rehabilitation of buildings: their adaptability to standard housing is possible by combining student rooms.
- To anticipate the end of life of buildings: the selective deconstruction of end-of-life materials, favoring mechanical fixings.

### Sustainable supply :

The building envelope is very effective in limiting the heating and cooling of housing. The use of renewable energies (geothermal) has proven itself with low maintenance requirements. The implementation of self-consumption photovoltaics is also more appreciated given that recycling channels are beginning to be deployed in the south of France.

The management of water on the plot with the retention basin and the study of the law on water makes it possible to limit networks that are too large, especially in a rural setting.

Biosourced insulation: wood fiber (MOB and half-still), cellulose wadding (roofing), cork (facades with lime plaster) make it possible to consider natural degradation.

The wood for the construction of the walls, floors, frameworks, passageways and pergolas is made of spruce from local forestry operations (Inard and Maugard sawmills) and comes mainly from the Black Forest. The exterior joinery and entrance doors are made of wood/aluminium made of unjointed chestnut square from the Montagne Noire in the Pyrenees.

The facades are made with flat tiles from downgraded production (reuse). All terracotta materials come from Terreal factories located nearby.

### Recycling :

Recycled Grave:

- Backfilling under the road;
- Base and capping layer of fiber concrete slabs (area OM);
- Capping layers of stabilized pathways;
- Foundation layer for the pétanque court.

## Additional information (PDF documents)

## Health and comfort

### Water management

The municipal territory of Castelnaudary includes 27 main rivers and concerns 71 municipalities. The Fresquel watershed extends from Carcassonne (to the East) to the threshold of Naurouze (to the West) and from the limit of the watershed of the Montagne Noire (to the North) to Razès (to the South).

The project includes the implementation of rainwater hydraulic facilities, with a natural retention basin and swales. These landscaping treatments make it possible to guarantee no qualitative and quantitative degradation of the receiving aquatic environment (study of the law on the water of the plot). The 25,814m<sup>2</sup> plot is made up of 65% open ground (very permeable soil) with little or no watering for the plants, which have been chosen accordingly.

At the building level, reducing water consumption has been a priority, with adapted sanitary facilities and an awareness booklet given to students.

### Indoor Air quality

- A+ paint;
- No air quality measurement, but effective ventilation to evacuate pollutants and the housing is through;
- All bathrooms have windows.

## Comfort

### Temperature level :

### Heating and winter comfort

The work on the envelope of the building ensures remarkable thermal comfort for users (efficient insulation and joinery equipped with double glazing).

## Refreshment and summer comfort

All joinery is equipped with blinds to control the management of solar gain. Buildings having double or triple orientations, it is important to have a good management of occultations according to the sun. Some glazing is solar-controlled, depending on the orientation of the facades. Cooling is possible by geocooling via a direct exchange between the capture circuits and the hydraulic networks. In summer, students were advised to take advantage of the cool night air to create natural ventilation capable of cooling the accommodation, thanks to the tilt-and-turn windows and the through design of the accommodation.

### Humidity control :

The accommodations are fitted with B humidity-controlled single-flow mechanical ventilation. The vents in the kitchens and bathrooms provide a minimum permanent extraction flow rate depending on the relative humidity in the room. An additional flow is possible by pulling on the cord to engage the maximum timed flow.

### Acoustic comfort :

This is certainly the point deserving the most attention in timber construction. All the technical complexes have been studied in close collaboration with the design office in order to meet regulatory acoustic requirements.

The project is located near the departmental road 6113 classified in category 2. Depending on the angles of view of the tracks from the facades and the distances between the tracks and the facades, these had to respect the more or less impacting isolations: 34dB for the facades against the D6113 and 30DB for all the others.

### Visual comfort :

#### A bioclimatic design for visual comfort:

- Privileged dual North/South orientation;
- Through housing;
- Perspectives on the great landscape;
- Sunscreens;
- Pergolas and shaded places.

To limit the use of artificial lighting and energy consumption, all the rooms have large openings to take advantage of natural light:

- The living room has a very large window which can be closed with a rolling shutter;
- The bathroom has a window that can be closed with a shutter;
- The kitchen is lit by a glass door which can be closed with an interior blind.

The lamps are low energy consumption (LED lighting) and controlled by switches.

### Ergonomic design :

During the studies, the architects of the operation and the space designer from Seuil architecture designed ergonomic housing, as well as furniture that could be adapted to the various needs:

- The office table is light and its size allows it to pass through the front door to consider meals between students outside;
- The wardrobe and the bed are not fixed to be able to organize your room according to your needs and aspirations of the moment;
- A piece of furniture on wheels allows various uses: bench, bedside table, bookcase. The chair, the bed and the bench also make it possible to create seats around the table/desk in order to eat or work together;
- The furniture is colorful and different depending on the room (circular economy approach).

## Quality of life and services

- A manager makes it possible to guarantee good integration and relations with the students, but also respect for the site and its environmental commitments.
- The welcome booklet produced by the project management (see PDF document) provides historical knowledge of the approach, good practices, sensitive points and challenges).

## Carbon

### Initiatives promoting low-carbon mobility

On the scale of the territory (rural environment), the public transport network is poorly developed, which obliges students and staff to regularly use their vehicles to get to the École Supérieure de La Raque. The size of the existing car park, located at the entrance to the site and in the immediate vicinity of the housing created, is a good illustration of this lack of proposals in terms of mobility. The number of parking spaces is sufficient for the site; therefore, no additional places have been provided for under the project. The project prohibits the passage of vehicles in the heart of the housing by the dimensioning of the paths. The project therefore contributes to promoting soft and pedestrian traffic by offering routes in connection with nature.

By offering closed and covered bicycle rooms, distributed in the different groups of buildings, the project encourages the use of alternative transport to the private car. However, the students testified that the bicycle is used very little, because there is no specific adapted arrangement proposed by the municipality. Only an existing country lane that leads to Lasbordes is suitable for cyclists, as it is rarely used by cars.

Unfortunately, the busiest villages where students prefer to go are too far away and not passable by bike. The eco-campus anticipates the future and sees in the long term: these bicycle rooms could find a use if the evolution of the school continues and if it requests the development of cycle paths from the services of the town hall. . In the short term, if the bicycle rooms have no use, they can find other uses: workshop, storage of gardening equipment, etc.

## GHG emissions

GHG in use : 17,80 KgCO<sub>2</sub>/m<sup>2</sup>/an

### Methodology used :

Calculation carried out on the PLEIADES software with the evaluation of the environmental performance according to the carbon energy reference, methodology based on the Life Cycle Analysis and largely on the NF EN 15978 standard. This evaluation is used within the framework of the carbon energy experiment.

GHG before use : 15,36 KgCO<sub>2</sub> /m<sup>2</sup>

Building lifetime : 50,00 année(s)

Energy in use years : 0.86

GHG Cradle to Grave : 905,90 KgCO<sub>2</sub> /m<sup>2</sup>

LCA is a standardized and recognized tool (ISO 14040 series standards). It is the most successful method in terms of global and multi-criteria evaluation, resulting from the interpretation of the quantified balance of incoming and outgoing material and energy flows at each stage of the product's life cycle. The NF EN 15804, NF XP C08-100-1 and NF EN 15978 standards are sectoral versions of the ISO 14040 standard, applied respectively to construction products, equipment and buildings.

The graphic and energy simulation software Pléiades comfie was used to carry out the LCA calculation according to the so-called C- method of the E+C- label.

The INIES database is available in the Pléiades software for the assessment of environmental impacts under the energy-carbon experimentation label. This database contains information on the environmental impacts of products, entered by the manufacturers as well as a set of default data and conventional data made available by the ministry in charge of construction.

## Life Cycle Analysis

LCA diagram and calculation method: calculation carried out on the PLEIADES software with the evaluation of environmental performance according to the energy-carbon benchmark, methodology based on Life Cycle Analysis and largely on the NF EN 15978 standard. This evaluation is used as part of the energy-carbon experiment.

### Material impact on GHG emissions :

Les matériaux de construction et équipement représentent 65 % du bilan carbone.

Material impact on energy consumption : 82,40 kWhEP

### Eco-design material :

- The furniture is in melamine from dormant stocks (reuse);
- The walls, floors, frames, passageways and pergolas are made of spruce from local forestry (Inard and Maugard sawmills);
- The facades are made with flat tiles from the downgraded production of Terreal factories (reuse);
- The exterior joinery and the entrance doors are made of wood/aluminium made of unjointed chestnut square from the Montagne Noire in the Pyrenees;
- The insulation is biosourced: wood fiber (MOB and half-still), cellulose wadding (roof), cork (facades with lime plaster).

## Contest

## Reasons for participating in the competition(s)

Dans un contexte rural, ce projet conduit par le bailleur social Alogéa, maître d'ouvrage de l'opération est reproductible pour sa démarche écologique, participative et régénérative :

- Un éco-campus aux performances environnementales avérées (bioclimatisme, géothermie, photovoltaïque) avec Seuil architecture et le BET environnement Ecovitalis, qui a également suivi la démarche Bâtiment Durable Occitanie.
- Construire avec les entreprises, les industriels et les scieries locales avec des écomatériaux (bois, laine de bois, ouate de cellulose, liège) et une démarche d'économie circulaire (réemploi, chantier propre, recyclage, économie locale) avec Seuil architecture, le BET structure Tassera et l'acousticien Emacoustic.
- Une conception guidée par l'usage dans une démarche participative (enquête et 6 ateliers participatifs) avec Seuil architecture et l'AMU Una ingénierie.
- Création d'habitats fonctionnels pour la faune locale avec l'écologue Sarah Meyer et l'Ecole de La Raque.

