

A sustainable home on the slopes of the Montseny

K-Alzina, 180 m² on the slopes of the Montseny: FSC timber structure, bioclimatic design and 23.90 tonnes of CO₂ saved. This is how it was built.

K-Alzina: building in the Montseny without leaving a trace

Building inside the Montseny Natural Park is not like building anywhere else. The planning restrictions are strict, logistical access is limited, the terrain has steep slopes, and the climate swings between cold winters with frequent frosts and hot, humid summers. All of this means that every project decision carries implications that do not exist on a conventional urban plot.

K-Alzina is a 180 m² single-family home that we built on the slopes of the Montseny. The brief started from a clear premise on the client's part: a house that was coherent with the natural setting where it stood, with the least possible environmental impact, and that met the Passivhaus standard of comfort and efficiency.

The challenge: permits, access and climate

The first obstacle was administrative. Building within the perimeter of the Natural Park requires specific environmental reports, height and massing limits, colour restrictions for the exterior finishes, and a construction waste management plan approved by the park. The permit process was considerably longer than on an urban project.

Access to the plot posed a second logistical challenge. The entrance track, narrow and with tight bends, limited the size of the transport vehicles. This shaped the planning of the build: the prefabricated frame elements had to have dimensions compatible with medium-sized lorries, and material storage had to be done in phases to avoid occupying natural ground outside the authorised work zone.

The Montseny climate was the third decisive factor. Winter temperatures regularly drop below 0 degrees, with lows of -5 or -7 degrees in cold spells. In summer, the combination of heat and high humidity demands an envelope that manages water vapour well. The bioclimatic design had to work at both extremes.

The design: orientation and form serving the climate

The architectural design, by the firm Arquítir, is based on an L-shaped plan that embraces the terrain and creates a south-facing courtyard. This layout responds to specific thermal criteria: it maximises passive solar gain in winter (the low sun reaches deep into the main rooms), while the wings of the building shelter the courtyard from the prevailing northerly winds.

The openings were calculated with the PHPP (Passive House Planning Package) to balance solar gains against overheating risks. On the south façade, the large-format windows incorporate external solar shading (sliding larch shutters) that block the summer sun without giving up the views. On the east and west façades, the openings are more restrained to minimise unwanted solar gains on summer afternoons.

In the Montseny, the challenge is not only keeping the house warm in winter. The combination of heat and humidity in summer demands a design that breathes without losing airtightness. Every construction detail is conceived for both extremes.

Structure and materials: FSC timber from top to bottom

The skeleton of K-Alzina is entirely FSC-certified timber, with a light timber-frame system in fir that combines structural strength and thermal efficiency. FSC certification was a non-negotiable requirement of the project, consistent with the location in a natural park: every piece of timber comes from responsibly managed forests, with full chain-of-custody traceability.

The thermal envelope combines expanded cork insulation on the exterior (an 8 cm ETICS system) with blown cellulose in the cavities of the frame (16 cm). This combination allowed us to reach the following U-values:

External walls: 0.15 W/m²K. Roof: 0.12 W/m²K. Ground slab: 0.18 W/m²K. Windows (timber-aluminium with triple glazing): 0.85 W/m²K on average.

The ventilated façade combines larch timber battens in the day zones with a white ETICS finish in the night zones, creating a contrast that dialogued with the park's colour guidelines. Inside, the painted plasterboard surfaces sit alongside walls of exposed laminated timber, a device that adds warmth and reinforces the connection with the material at the heart of the project.

Energy performance: the data

K-Alzina's energy performance has been validated by the measurements and the certification. The Blower Door test gave a result of 0.35 ACH at 50 Pa, well below the Passivhaus limit of 0.6 ACH. This figure reflects careful execution of the airtightness barrier, with particular attention to service penetrations and the joints between frame panels.

The heating demand calculated with PHPP stands at 14 kWh/m²/year, and the cooling demand at 11 kWh/m²/year. Both figures meet the Passivhaus limit of 15 kWh/m²/year for each use. The controlled mechanical ventilation, with a Zehnder ComfoAir Q350 unit, recovers more than 90% of the energy from the extract air, which proves decisive in the cold months of the Montseny.

The home uses no gas. Climate control is handled by an aerothermal heat pump that covers heating, cooling and domestic hot water. The photovoltaic installation, with lead-battery storage, makes it possible to cover a significant share of the annual electricity consumption.

Carbon balance: what the figures say

One of the aspects that makes K-Alzina distinctive is its favourable carbon balance. According to the life cycle assessment (LCA) calculation, compared with an equivalent conventional build of concrete and masonry, the project has saved 23.90 tonnes of CO₂ in construction emissions. In addition, the structural timber used has absorbed and stores 41.82 tonnes of atmospheric CO₂. These figures follow the methodology of the environmental product declarations (EPD) of the timber sector.

The net balance is therefore clearly favourable: instead of emitting tens of tonnes of carbon as a conventional build would, K-Alzina acts as a carbon sink. The building retains more CO₂ than the process of building it generated.

Connecting interior and exterior

One of the guiding principles of K-Alzina is the gradual dissolution of the boundary between the living space and the landscape. The large openings of the south façade frame the views towards the Montseny and flood the main rooms with natural light. The covered porch, at the intersection of the two wings of the L, works as an outdoor living room for much of the year.

The treatment of the immediate ground reinforces the integration: gardens of native, low-water-maintenance plants replace the conventional lawn, and a rainwater collection system feeds the drip irrigation. The aim was that, over time, the garden would blend into the surrounding woodland.

What makes K-Alzina different from other PAPIK Group projects

Every PAPIK Group project has its singularities, but K-Alzina differs from the previous ones in several respects. Compared with K-Llavaneres (198 m², our first Passivhaus) or K-Codines (212.75 m²), K-Alzina was the first project where we had to work with the restrictions of a natural park, with everything that implies in terms of logistics, materials seen from the outside and waste management.

It was also the project where we refined our passive solar shading system with sliding shutters, a solution we have kept in later projects such as K-Valld'Or (280 m²). And it was the confirmation that our building system works in severe climatic conditions: if the light frame and the Passivhaus envelope work in the Montseny, they work anywhere in Catalonia.

K-Alzina was the proof that building in a protected setting does not mean giving anything up. It means doing it better, with more attention to detail and more respect for the place.

For the owners, the result is a home where the indoor temperature stays stable all year round without constant intervention, where the air is clean and renewed thanks to the MVHR, and where the energy bills are a fraction of what they would pay in a conventional house of the same size. K-Alzina shows that building responsibly in the Montseny is not a utopia. It is a matter of knowing how to do it.

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