

Passivhaus and sustainability: how to minimise the ecological footprint

What defines a sustainable home? We examine the Passivhaus standard, bioclimatic architecture and the real benefits of living in an ecological home.

Meeting the regulations is not enough

In Catalonia, any newly built home must comply with the Technical Building Code (CTE) and its DB-HE section on energy savings. On paper, the CTE sets reasonable minimums: thermal transmittance limits for walls, roofs and windows, and a maximum non-renewable primary energy consumption. In practice, however, the results are mediocre. A home that merely complies with the CTE in climate zone C2 (Barcelona and surroundings) allows walls with transmittances of up to $0.75 \text{ W/m}^2\text{K}$ and can consume between 40 and 60 kWh/m^2 per year for climate control.

The Passivhaus standard operates on a different order of magnitude. Its requirements are not a slightly stricter version of the CTE; they are a complete rethink of what a building should be. Where the CTE sets a wall transmittance of $0.75 \text{ W/m}^2\text{K}$, Passivhaus works with values of 0.10 – $0.15 \text{ W/m}^2\text{K}$. Where the CTE allows an air permeability of 3 air changes/hour at 50 Pa (n_{50}), Passivhaus requires a maximum of 0.6 air changes/hour. And where the CTE sets a climate-control consumption that often exceeds 40 kWh/m^2 , Passivhaus limits it to 15 kWh/m^2 for both heating and cooling.

This difference is not academic. It translates into heating and cooling bills 75–90% lower, into stable indoor temperatures without the need for powerful mechanical systems, and into a comfort that is felt from the first day.

Why at PAPIK Group we chose Passivhaus

When we built K-Llavaneres, our first Passivhaus project of 198 m^2 , we could have opted to comply with the CTE by a generous margin and present it as efficient construction. It would have been easier, faster and cheaper. But the numbers did not add up: a home that complies with the CTE in a Mediterranean climate still needs significant active climate-control systems, still generates substantial operational emissions and still exposes the family to volatile energy bills.

Passivhaus resolves all three issues at once. It is not an add-on or a label: it is a comprehensive design framework that forces you to think of the building as a system where every decision affects all the others. Insulation, airtightness, windows, thermal bridges and ventilation are not five separate elements; they are five facets of a single objective.

After more than fifteen years and more than 120 homes delivered, we have found that the difference between meeting regulations and building well is not a matter of degree: it is a matter of philosophy.

Bioclimatic architecture in a Mediterranean climate

Passivhaus was born in central Europe, where the main challenge is retaining heat in winter. In the Mediterranean, the situation is reversed: long, hot summers are the critical factor. That is why every PAPIK Group project integrates bioclimatic strategies adapted to our climate.

Orienting the main openings to the south makes it possible to capture solar radiation in winter, when the sun is low. In summer, overhangs calculated to the millimetre and solar protections block the direct entry of light when the sun is high. These are not generic formulas: each overhang is sized according to the exact latitude, the orientation of the plot and the shadow profile of the surrounding buildings and vegetation.

The thermal inertia of the materials also plays a decisive role. Concrete ground slabs and solid brick walls store the night-time coolness and release it slowly during the hottest hours, stabilising the indoor temperature naturally. By combining thermal inertia with good continuous insulation and a well-designed cross ventilation, it is possible to maintain comfortable conditions for much of the year without mechanical equipment.

The numbers: Passivhaus vs. CTE in practice

At K-Codines, a home of 212.75 m², we have measured a climate-control consumption below 12 kWh/m² per year. An equivalent home that strictly complied with the CTE would consume between 40 and 60 kWh/m². In absolute terms, this represents a difference of between 6,000 and 10,000 kWh per year, which translates into hundreds of euros of savings each year on heating and cooling bills.

The result of the airtightness test (Blower Door) at K-Codines was 0.4 ACH at 50 Pa, well below the Passivhaus limit of 0.6 ACH and radically lower than the 3 ACH the CTE allows as a maximum. This airtightness not only saves energy: it eliminates draughts, reduces the transmission of outdoor noise and prevents the entry of dust, pollen and uncontrolled moisture.

The additional cost of a Passivhaus home compared with conventional construction sits between 10% and 15%. It is recovered within a few years thanks to the reduced energy bills, and from that point on, every euro saved is net profit over the entire service life of the building.

Real sustainability, not cosmetic

Thermal comfort is a benefit that is noticeable from the first day. Indoor temperatures remain stable throughout the year, with no cold draughts or hot zones near the windows. Controlled mechanical ventilation guarantees clean, filtered indoor air free of pollen, dust and pollutants.

But the sustainability of a Passivhaus goes beyond energy consumption. On our K-Alzina project, in the Montseny, the lightweight FSC-certified timber-frame structure sequesters carbon instead of emitting it. Timber, unlike concrete or steel, is a material that has absorbed CO₂ during its growth and keeps it stored throughout the life of the building.

With such low consumption, the addition of photovoltaic panels makes it possible to cover practically the entire energy demand. At K-Valld'Or, a home of 280 m², operational emissions are zero: there is no gas boiler, no combustion, and the electricity it needs is generated by the building itself. In a context of rising and volatile energy prices, this independence brings a peace of mind that is hard to quantify.