

Sustainable materials that bring construction to life

We explore the key sustainable materials in Passivhaus construction: certified timber, natural insulation, recycled materials and the benefits of natural building.

What we specify and why: materials tested on site

Talking about sustainable materials from a desk is easy. Talking about them after more than 120 homes built, with real performance data and years of experience with specific suppliers, is another matter. At PAPIK Group, every material we specify has passed through the filter of the building site: what works on paper does not always work under the rain of the Montseny or the heat of a summer in the Maresme.

Here we explain the materials we have chosen, why we chose them, and what we have learned along the way. It is not a theoretical catalogue: it is what we actually put into our Passivhaus homes.

Why we chose the light timber frame

The building system that defines our work is the light timber frame (platform frame). It is not an aesthetic decision; it is a technical, environmental and economic decision that we have refined over more than fifteen years.

Fir (*Picea abies*) is our reference species for the structure. It offers an excellent strength-to-weight ratio, is easy to machine, and its hygrothermal behaviour adapts well to the Mediterranean climate. Each cubic metre of fir stores approximately 500 kg of CO₂ captured during the tree's growth, according to the sector's EPD (Environmental Product Declaration) data.

When we open a pack of FSC-certified fir studs, we know exactly where each piece comes from. This traceability is not bureaucracy; it is the guarantee that the forest it comes from regenerates.

FSC (Forest Stewardship Council) certification is not optional in our projects. At K-Alzina, for example, all the structural timber carries the FSC seal, which guarantees that it comes from responsibly managed forests. The cost difference compared with non-certified timber is minimal (between 3% and 5%), but the impact on the forest chain of custody is enormous.

Why a light frame and not CLT (cross-laminated timber)? We have assessed it across several projects. CLT is an extraordinary material for large spans and tall buildings, but for single-family homes in our region, the light frame offers more design flexibility, better integration of the insulation within the wall thickness, and a lower cost per square metre. On the K-Valld'Or project (280 m²), the frame system allowed us to reach a wall U-value of 0.15 W/m²K with a total wall thickness of 32 cm, including finishes.

Cork: our local insulation

If there is one material that identifies us as Catalan builders, it is cork. The cork oak (*Quercus suber*) grows in the north-east of Catalonia, in the comarques of Alt Empordà and La Selva, and its bark is harvested without felling the tree, in nine-year cycles that allow full regeneration.

We use expanded cork (ICB, Insulation Cork Board) as façade insulation in ETICS systems and as roof insulation. Its properties are hard to beat in our climatic context: a thermal conductivity of 0.040 W/mK, a density of 110-120 kg/m³ that gives it notable thermal inertia (ideal for dampening summer heat peaks), resistance to moisture, fire and insects, and a practically unlimited service life.

The proximity advantage is real and quantifiable. The cork we specify travels less than 200 km from the cork grove to the site. Compare it with an expanded polystyrene made in Germany or a rock wool produced in Denmark: the reduction in transport-related emissions is drastic. In addition, cork has a favourable carbon balance throughout its life cycle; the cork expansion process uses only the water vapour generated by the resin's own fats, with no added adhesives.

We have learned, however, that cork is not suitable for everything. In narrow cavities or irregular geometries, we prefer blown cellulose, which adapts better to the gaps and guarantees the continuity of the insulation. The combination of cork (exterior) plus cellulose (interior cavities) is the solution we have adopted on projects such as K-Codines, where we obtained a roof U-value of 0.12 W/m²K.

Blown cellulose: performance and economy

Recycled cellulose is a material we particularly like for its honesty: it is shredded newspaper treated with boron salts (flame retardants and antifungals), nothing more. It has a thermal conductivity of 0.038-0.040 W/mK, excellent acoustic behaviour and a hygroscopic capacity that helps to regulate the indoor humidity.

The blowing process lets us completely fill the cavities of the frame, eliminating the thermal bridges that appear with badly placed rigid panels. In terms of cost, blown cellulose is between 20% and 30% cheaper than expanded cork, which makes it ideal for the large thicknesses that the Passivhaus standard requires.

The complete envelope: membranes and airtightness

A material that often goes unnoticed but is absolutely critical in a Passivhaus home is the air-tightness barrier. We use high-quality polyethylene or polypropylene membranes, with specific adhesive tapes for each joint and junction, and acrylic sealants for the service penetrations.

The difference between a house with a Blower Door of 0.3 ACH and one of 0.8 ACH (which would not pass certification) is often not a question of design, but of execution. The membranes have to be continuous, the tapes have to adhere to clean, dry surfaces, and every hole for a cable or a pipe has to be sealed individually. At K-Llavaneres, our first Passivhaus project (198 m²), we achieved a result of 0.4 ACH that confirmed our airtightness protocol was working.

Airtightness is not solved with a single miracle product. It is solved with a team that understands why each tape and each seal matter, and that executes it with the same care on the first linear metre as on the hundredth.

Interior finishes: health and coherence

The choice of materials does not stop at the structure. Inside our homes, we specify standard plasterboard or moisture-resistant plasterboard for wet areas, always with low-VOC paints (volatile organic compounds). In areas where the client wants exposed timber, we use laminated fir or larch with natural protective oils.

Floors are another point where material coherence matters. We offer options of certified solid timber, porcelain stoneware made on the peninsula (with fewer transport kilometres than Asian imports), or microcement for clients seeking a seamless finish. In every case, the adhesives and grouts we specify meet the EC1 classification of very low emissions.

What we have learned: successes and mistakes

Fifteen years of experience and 120 homes yield many lessons. Some of the most relevant:

Larch timber for a ventilated façade ages with a very attractive silver-grey patina, but it requires installation with open joints and a well-ventilated air cavity. On the early projects, we underestimated the importance of designing the detail at the base of the façade, where water accumulates. That detail is now one of our team's mandatory check points.

Sprayed cellulose (wet) has not worked as well for us as blown cellulose (dry) in our climate. The ambient humidity during application can slow the drying and cause temporary condensation problems. We have abandoned the wet system and work exclusively with dry blowing.

Cork, on the other hand, has positively surprised us with its durability. In reviews of projects more than ten years old, the cork insulation keeps its thermal properties intact, with no measurable degradation. It is a material that lasts as long as the building.

Sustainable construction does not consist of choosing the greenest materials in the catalogue. It consists of understanding how they interact with each other, how they behave over time, and how they must be executed to deliver the performance they promise. That is the difference between a specification sheet and a home that works.

