

VOXELL

PASSIVE DESIGN PRINCIPLES

How a house heats, cools, and ventilates itself.



What passive design is

Passive design is the building doing the work. Orientation, layout, glazing, insulation, thermal mass, shading, and ventilation, designed as one system, so the house holds a comfortable temperature with as little machinery and purchased energy as possible. None of it is exotic. It's mostly decisions that cost nothing at concept stage and can't be retrofitted later.

The payoff is real:

BRANZ modelling found an average house can need two to three times the heating energy of a similarly priced house designed with passive solar principles.

SAME BUDGET, VERY DIFFERENT POWER BILL.

The principles

Orient to the north. In New Zealand the sun tracks through the north, so living areas and most of the glazing should face north or close to it; there's a reasonable swing either side of true north before performance falls away. A shallow floor plan running east-west maximises the north face. This is the single highest-value decision on the project, and it's made on day one.

Use thermal mass, and don't smother it. Dense materials, typically an exposed concrete floor, absorb the day's solar gain and release it in the evening. Mass only works if the sun can reach it and it isn't covered. Carpet over the slab in a sun-facing room quietly switches the system off.

Insulate past the minimum, and mind the envelope. The Building Code sets floors, not targets. Insulation beyond code, attention to thermal bridging through framing, and well-specified windows are what let the collected heat stay in the building. The envelope is also where quality of construction matters most: performance on paper is lost through gaps on site.

Size the glazing by direction. North glazing collects winter sun, and the right amount depends on the thermal mass available to store what it collects; oversized glass brings summer overheating and night-time heat loss, so bigger is not better. South glazing should be the minimum needed for daylight and outlook, because it only ever loses heat. East and especially west glazing stay modest, because low morning and afternoon sun is hard to shade and drives summer overheating.

Shade for summer, admit the winter. The sun is high in summer and low in winter, which means a correctly sized eave does both jobs at once: it blocks the high summer sun and lets the low winter sun deep into the room. The right overhang depth depends on latitude and window height, so it's calculated per project, not guessed.

Build tight, ventilate right. Modern homes are far more airtight than older stock, which is good for warmth and terrible for moisture unless ventilation is deliberate. BRANZ's guidance is exactly that phrase: build tight, ventilate right. Moisture gets extracted at the source, kitchens and bathrooms, and the home gets a designed supply of fresh air, not whatever leaks in.

Ventilation is not optional

1 in 5

NEW ZEALANDERS IN A HOME THAT WAS
SOMETIMES OR ALWAYS DAMP (STATS NZ,
2023)

1 in 6

LIVING WITH VISIBLE MOULD LARGER
THAN AN A4 SHEET

This is the principle New Zealand has historically got wrong, and the country's housing statistics show it. Damp homes are unhealthy homes, and airtight construction without designed ventilation makes dampness worse, not better.

There are three families of mechanical ventilation used here: positive-pressure roof-cavity systems, continuous extract systems, and balanced heat-recovery systems that transfer warmth from outgoing stale air to incoming fresh air. They are not interchangeable, and they don't all play well together: the right strategy depends on the house, its airtightness, its heating, and its budget. We design the ventilation strategy with the architecture, not as an afterthought, because a mismatched system can undo the rest of the design.

Passive design or Passive House?

The words are close; the things are different. Passive design is a set of principles every home should apply in some degree. Passive House is a specific certified international standard with hard numbers behind it, set by the international Passive House Institute and supported in New Zealand by PHINZ, including a heating demand limit of 15 kWh per square metre per year and verified airtightness tested with a blower door. It's rigorous, it works, and certification is a deliberate project decision with cost attached.

Most of our clients don't need the certificate to get the outcome. A well-executed passively designed home, or a high Homestar rating, delivers most of the same day-to-day experience. What matters is that the principles are applied early and verified with modelling, not bolted on late.

How Voxell approaches it

Sustainability isn't a bolt-on for us. Orientation, envelope, glazing, and ventilation are in the design from the first sketch, and we test the big moves with in-house energy modelling early, when decisions are still free. On our multi-unit work the same thinking scales: terraces staggered so winter sun reaches yards and living rooms, block layouts driven by daylight and cross-ventilation, and ventilation strategies matched to how each home will actually be built and heated.

**DESIGNED IN FROM THE FIRST
SKETCH**

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Sources: BRANZ and Level, level.org.nz passive design guidance; MBIE, Smarter Homes design guides (passive heating); BRANZ, Build tight, ventilate right; Stats NZ and the Environmental Health Intelligence programme (EHINZ), damp and mouldy dwellings indicators; Passive House Institute building criteria, via PHINZ (passivehouse.nz).

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