

ENERGY EFFICIENT HOMES

The Role of Thermal Modelling in Home Design

House 2.0 | Episode 3

Featuring Julie Villard, Architect and Eco Design Advisor, Christchurch City Council

Energy Efficient Homes

ABOUT THIS EPISODE

Test your home *before* you build

How will your home perform in winter, in summer, and in the months between? Thermal modelling can tell you before you build.

Planning a new home often starts with layout and views. This episode asks a different question: how will your designer test the house for comfort, running costs, and moisture before anything is built?

These show notes cover Episode 3 of our House 2.0 series. We talked with Julie Villard, an architect and the Eco Design Advisor at Christchurch City Council. She does some thermal modelling herself, and she reviewed the thermal modelling report for her own home in Lyttelton. The points in this guide are drawn from the interview.



WATCH THE FULL INTERVIEW

The Role of Thermal Modelling in Home Design

House 2.0, Episode 3

youtu.be/V_QfJNVV364

MORE FROM JULIE

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ASK YOURSELF

Does your home stay warm in winter and cool in summer?

THE BIG IDEA

A test run for your home

HOW IT WORKS

An architect designs a new build on a computer. That 3D model can then be used to predict how the building will perform in its location, with local weather, over a period of time. The designer can change the design, rerun the model, and keep refining until the results are right. That version is what gets built.

WHAT IT DOES

Lets a designer see how a home will perform before anyone picks up a hammer.

WHERE IT SITS IN THE BUILDING CODE

Energy efficiency is covered by clause H1 of the Building Code, which sets minimum requirements by climate zone and by building type. There are five climate zones in New Zealand. Christchurch is in zone 5, so insulation requirements are a bit higher than they are in Auckland, for example.

QUICK FACT

5

climate zones across New Zealand. Christchurch is in zone 5.

QUICK FACT

3

ways a designer can currently show a home complies with H1.

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ASK YOURSELF

What climate zone do you live in? Do you know how it affects your building requirements?

THE BUILDING CODE

Three ways to show a home complies

Designers currently have three options to show a home meets H1.

	METHOD	HOW IT WORKS
1	**Schedule method**	Works from set assumptions, not your actual design. Being removed on 27 November 2026 because it is not accurate enough.
2	**Calculation method**	A simple equation that also works from assumptions about the building.
3	**Modelling method**	Compares your real 3D model with the same model built to the Building Code requirements. The most accurate option to date.

WHY ASSUMPTIONS FALL SHORT

The older methods might assume that 30% of a building is windows. Your design may have less or more. The modelling method uses what you are actually building.

QUICK FACT

5%

of designers used the schedule method in 2024.

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ASK YOUR DESIGNER

Which method will you use to show my home meets the Building Code?

WHAT IT CAN TELL YOU

What a model can tell you

HEATING, COOLING, AND COMFORT

The most common use of modelling is working out how much heating or cooling a building needs to stay at a steady temperature, say 20°, all year. Used early, it can also tailor a design to the performance you want: an even temperature all year, or a little warmer in winter and a little cooler in summer. It can predict airflow too, which helps if you want to rely on natural ventilation.

INSULATION AND MOISTURE

Fibre insulation and rigid insulation behave very differently in winter and summer, and a model can show which one suits a design. It can also show where condensation will form inside a wall. Change the thickness, the type of insulation, or the wall layers, and a designer can aim for a wall that stays warm and dry all year.

THE STEEL BEAM TEST

Steel outside the thermal envelope, or passing through it, can cause serious condensation problems. A designer can model wrapping the beam in rigid insulation and check the result: no condensation, compliance with E3 (internal moisture), and no moisture problems. Tick.

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ASK YOURSELF

Where in your walls could moisture collect? Has anyone checked?

TRY IT ON SCREEN

Change one thing, rerun the model

A designer can change one parameter at a time and see what it does to the whole building.

	IF THE DESIGNER CHANGES…	THE MODEL SHOWS…
1	**Insulation type or thickness**	What each option - such as 90 mm, 140 mm, or external insulation - actually delivers.
2	**The glazing area**	Whether less glass keeps the temperature steadier than more insulation everywhere.
3	**The rotation of the building**	Whether a 10° turn gives you more sun in the morning or the afternoon.
4	**A comfort target**	What it takes to feel 2° warmer in the shoulder seasons.
5	**A room with a special job**	A room, such as one for a book and antique collection, held at a constant temperature all year.

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ASK YOURSELF

What tweaks could you make in your design to improve comfort or warmth?

OVERHEATING

Sun, eaves, and glass

EAVES AND SUN ANGLE

The sun sits at a different angle in winter and summer, so a home can be designed for both. Eaves, the part of the roof that extends past the wall, shade the windows depending on the sun angle. Julie describes them as the hat of a house with eyebrows.

In summer the sun is high, so the eaves block it. In winter it is lower, so the sun still reaches the room when you want the heat.

THE FISH TANK EFFECT

Julie calls homes with far too much glass facing north 'fish tanks', where overheating is guaranteed.

QUICK FACT

1 kW

a rule of thumb from the episode: heat gain per square metre of north facing glass while the sun is shining.

QUICK FACT

20 heaters

Picture 20 column heaters on your floor, all switched on while the sun shines. That's Julie's way of describing the effect of 20 square metres of north-facing glass.

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ASK YOURSELF

How much glass faces north in your design? What will stop it overheating in summer?

OVERHEATING

Shape, seasons, and overheating

SHAPE, GLASS, AND INSULATION

People may assume more insulation always means better performance. Julie says a model can show that reducing the glazing area does more to keep the temperature steady, and can save money. Shape matters too. A compact home is more efficient than one with a million corners. That is the surface-to-volume ratio we covered in **Episode 2**.

WATCH THE SHOULDER SEASONS

Eaves designed for winter and summer may not perform in between. Julie has seen designs that overheat in spring and autumn, but not in summer. In a two- or three-storey home, heat also rises, so the top floor can overheat from warm air moving up, not only from the sun.

IF THE MODEL SHOWS OVERHEATING

Overheating is happening more and more often, and people want to be sure their house is not going to be a hotbox. If a model shows a problem, you have options: change the size of the openings, use less fixed glass and more windows that open to flush the building, add a skylight, or add landscaping and a pergola. Some are cost-effective and some are not, or you can simply cool with a heat pump.

THE POINT

Finding a problem on screen opens up options. Finding it after you move in does not.

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ASK YOURSELF

Has anyone checked how your home performs in spring and autumn, not just winter and summer?

BEYOND R VALUES

Why one number is not enough

More insulation does not automatically mean a better performing building.

New Zealand design leans heavily on R-value. The modelling method can use a different measure, which tells you more about the whole building.

	MEASURE	WHAT IT TELLS YOU
1	**R-value**	The resistance to heat loss of a single product. A higher number is better, but it is one figure for one product.
2	**kWh per square metre**	How much energy a building loses through its fabric. It can be related to the heat pump or cooling system you need, so the system can be sized to the home.

IN JULIE'S WORDS

'People may assume that if you put more insulation, your building is going to be more performant, right? And that's not necessarily the case.'

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ASK YOURSELF

When someone tells you a home is well insulated, what else would you want to know?

A REAL EXAMPLE

Julie's own home

THE STORY

When Julie designed **her own house in Lyttelton**, she asked the professional sizing her heating to send her the thermal modelling report. She noticed the heat demand looked higher than she expected. The model had left out the home's ventilation system with heat recovery. Once the data was corrected, the house needed a 4.3 kW heat pump to heat the whole house to 20°. The thermal engineer suggested specifying 5 kW, just in case.

THE LESSON

A model is only as good as its inputs. Julie once found a design losing far more heat than expected. Two walls were not connected, and the model read the gap as an open window. Even the spacing of the studs matters, because it sets the proportion of timber in a wall. Accurate information at the start means accurate answers at the end.

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ASK YOURSELF

How would you know the model behind your heating system included everything in your home?

WHAT IT MEANS FOR YOU

Why it matters for your home

PERFORMANCE IS PART OF THE BRIEF

It's like buying a car. If the maker says it goes from 0 to 100 in six seconds, you might want to check. A house is the same. Without modelling, you are relying on the designer's experience, and there may be surprises.

UPFRONT COST AND RUNNING COST

Performance and budget are linked. A more performant home can cost more to design and build, but the power bills are lower for the life of the building. Power prices are expected to keep rising, so it's a conversation to have with your designer early.

COMFORT AND HEALTH

A performant home gives you a controlled indoor environment, and Julie says you are less likely to be sick at home. Her own experience: in a 1905 villa she saw the doctor four times in her first winter. Since moving into her new build in Lyttelton, she says she is barely sick.

AIRTIGHT HOMES NEED VENTILATION

The episode also touched on ventilation. A home that becomes very airtight without a ventilation system traps moisture and CO2.

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ASK YOURSELF

How would you weigh a higher upfront cost against lower power bills for the life of the building?

ASK YOUR DESIGNER

Questions worth asking

When you talk to a designer or a design and build company, these questions are a good place to start.

	QUESTION	WHY IT MATTERS
1	**How are you modelling the performance of this house?**	Tests whether performance claims stand up on your actual design.
2	**How confident are you designing a building without using the modelling method?**	Without modelling, you rely on the designer's experience.
3	**Have you modelled spring and autumn, not just winter and summer?**	Overheating can show up in the shoulder seasons.
4	**What size heating and cooling system does the model say the home needs?**	Modelling lets the system be sized to the home.
5	**How do the budget and the running costs trade off?**	Performance and budget are linked, so raise it early.

THE HOUSE AS A SYSTEM

Julie likes that modelling treats a house as one system, not separate silos of insulation, ventilation, and windows. In her words: *'I want underfloor heating, and then you realise through the model that this is not necessarily the best device to heat your house according to what you have.'*

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START WITH THIS

How are you modelling the performance of this house?

WHERE IT IS HEADING

More designers are modelling

MORE DESIGNERS ARE CHOOSING TO MODEL

Julie says more and more residential homes are using the modelling method, and not only because they have to. If a design has more than 40% windows, it is the only method that can be used. Many designs below that threshold still use it, because designers want reassurance that a home will perform as expected.

A small number use it to find the bare minimum they can get away with, such as cutting insulation or windows back to the minimum. As the host says in the episode, the Building Code minimum is not high enough for general human comfort.

SPECIALISTS ARE COMING

As modelling gets more complex, Julie expects thermal engineers and other specialists to do more of it, as they already do overseas and in Australia. In her view, architects and designers are generalists who bring in experts when they need them.

QUICK FACT

40%

windows: above this, Julie says the modelling method is the only one that can be used.

JULIE'S WISH LIST FOR THE BUILDING CODE

Julie expects the modelling method to become the main priority for compliance, and possibly the only one at some point. Her own wish list for the Code: a climate change and carbon clause, airtightness addressed (probably in G4), and thermal bridging addressed too. These are her personal views.

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ASK YOURSELF

If your designer models your home, is it to confirm it will perform, or to meet Code?

WINDOWS

Windows set back into the wall

WHAT IT IS

A recessed window sits in line with the insulation, in the middle of the wall, rather than out at the cladding.

WHAT IT DOES

Avoids a thermal bridge at the window, where heat can escape faster.

HOW IT WORKS

A window at the cladding line creates a thermal bridge, and a model shows it as cooler surface temperatures around the window. The windows might be very performant, but the connection between the window and the wall is not.

WHERE IT IS HEADING

Julie says 30% of new builds now have recessed windows. Ten years ago, she says, no one did it. She expects it to become standard very soon.

QUICK FACT

30%

of new builds have recessed windows.

QUICK FACT

10% to 15%

of a home's efficiency can be lost with windows at the cladding line.

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ASK YOURSELF

Are the windows in your design set into the insulation, or out at the cladding?

EPISODE REFERENCE

Key terms from this episode

A quick reference for the terms used in the conversation.

TERM	WHAT IT MEANS
Thermal modelling	A computer simulation of a building, using its 3D design and local weather, to predict how it will perform before it is built.
H1	The part of the Building Code that covers energy efficiency.
Modelling method	The most accurate way to show H1 compliance, comparing your real model with the same building built to the Code's requirements.
R value	A measure of resistance to heat loss. A higher number is better.
kWh per square metre	A measure of how much energy a building loses through its fabric, used to size heating and cooling.
Thermal bridge	A path where heat escapes faster than it would through insulation, such as steel through a wall or a window at the cladding line.
Dew point	The point in a wall where warm, moist air has cooled enough for water to condense.
Shoulder seasons	Spring and autumn, when a home designed for winter and summer can still overheat.
Recessed window	A window set back in line with the insulation, not out at the cladding.
Surface area to volume ratio	The relationship between a shape's outer surface and its inner volume. Compact shapes lose less heat than complicated ones.

NEXT STEPS

Why build an Energy Efficient Home

A home should keep a family comfortable, healthy, and protected from rising running costs, and you should know how it will perform before you build it.

TALK TO US EARLY

You do not have to be ready to build. Talk to us while you are finding land and working out what kind of home you want.

PERFORMANCE, NOT JUST LAYOUT

Lower energy costs, better health, and comfortable rooms all winter are part of what a home should deliver.

BUILT ON BUILDING SCIENCE

Our approach uses the same principles as Passive House: better insulation, better windows and doors, deliberate airtightness, ventilation with heat recovery, and reduced thermal bridging.

WORKING TOWARDS MODELLING

We are working towards thermally modelling our own builds, so we can show you how a design will perform before it is built.

Schedule a call

Watch the interview

Thinking about your next build? Let's talk about your section, your plans, and how your home could perform.