MBIE-BRANZ Workshop

Airtightness, ventilation and interstitial moisture

Airtightness v Infiltration?

Common langu[redacted]

Not directly co[redacted]

Simple models [redacted]ow right are they?

First, some def[redacted]

Airtightness, definition

- Airtightness – an indirect measurement of the collective size of gaps and holes in the building fabric that have a path to outside (blower door test)
- Assumes the flow through these holes follows a power law (reasonable at test pressures)
- Can't identify looping paths (more on that later – in risks)
- Is NOT linear with pressure difference

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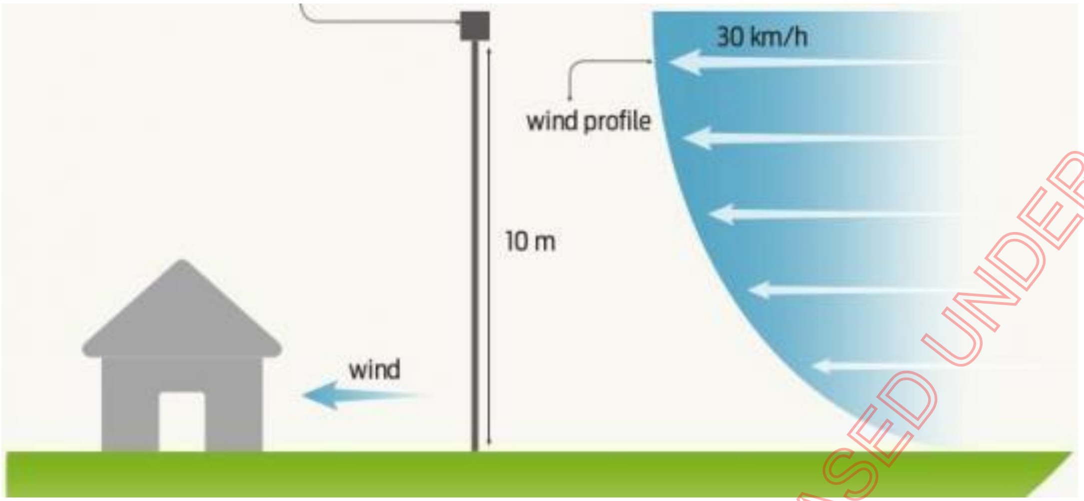
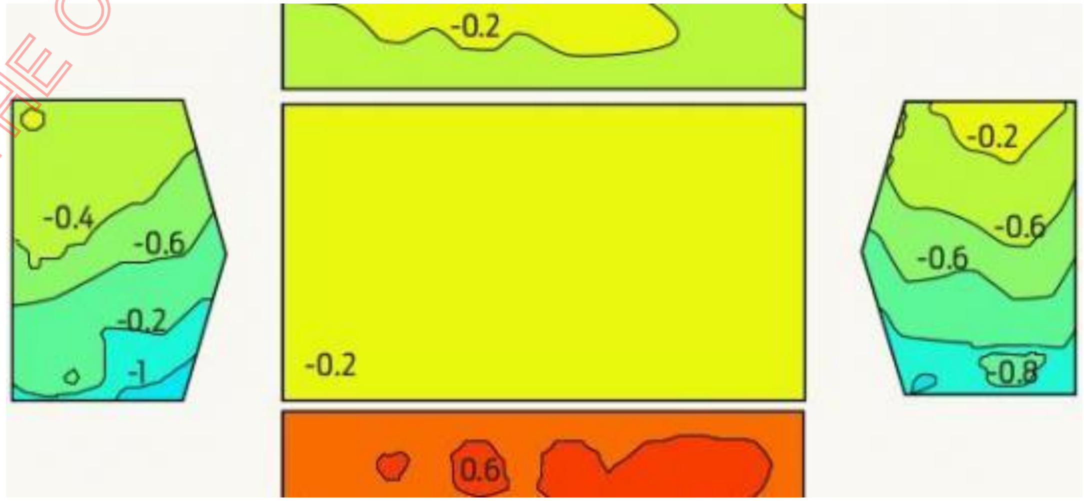
Infiltration

- Actual air leakage through the shell in service
- Driven by wind and stack effect
- Only approximates a power law if leakage openings are evenly distributed
- Not always the case when we build more airtight



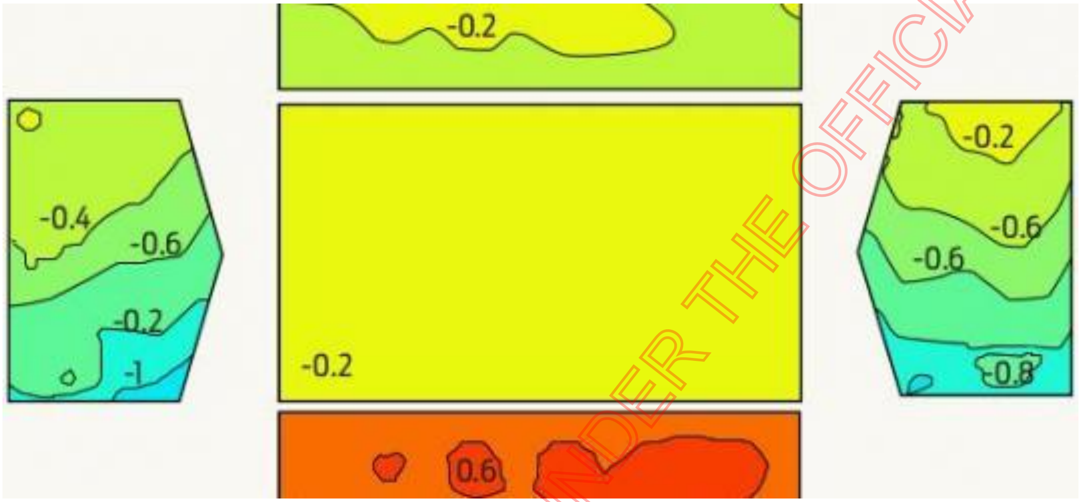


Approximating infiltration from airtightness?

- /20 ‘rule of thumb’
- EN832 (Phi use this, it is effectively /14.3 with an exposure modification) – removed from EN13790 in 2008, which is why EN832 is referenced now
- LBNL model, AIM model

Other methods?

- Hourly tools like Contam – which need pressure coefficient maps among other data
- Direct measurement – tracer gas techniques



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Some real world examples

- Co-heating work
  - Stable internal temperatures maintained for ~2weeks+ (30 degrees, with some solar gain during the day)
  - Infiltration measured throughout
  - Airtightness tested as well
  - Power use measured – direct measurement of whole of building heat loss coefficient

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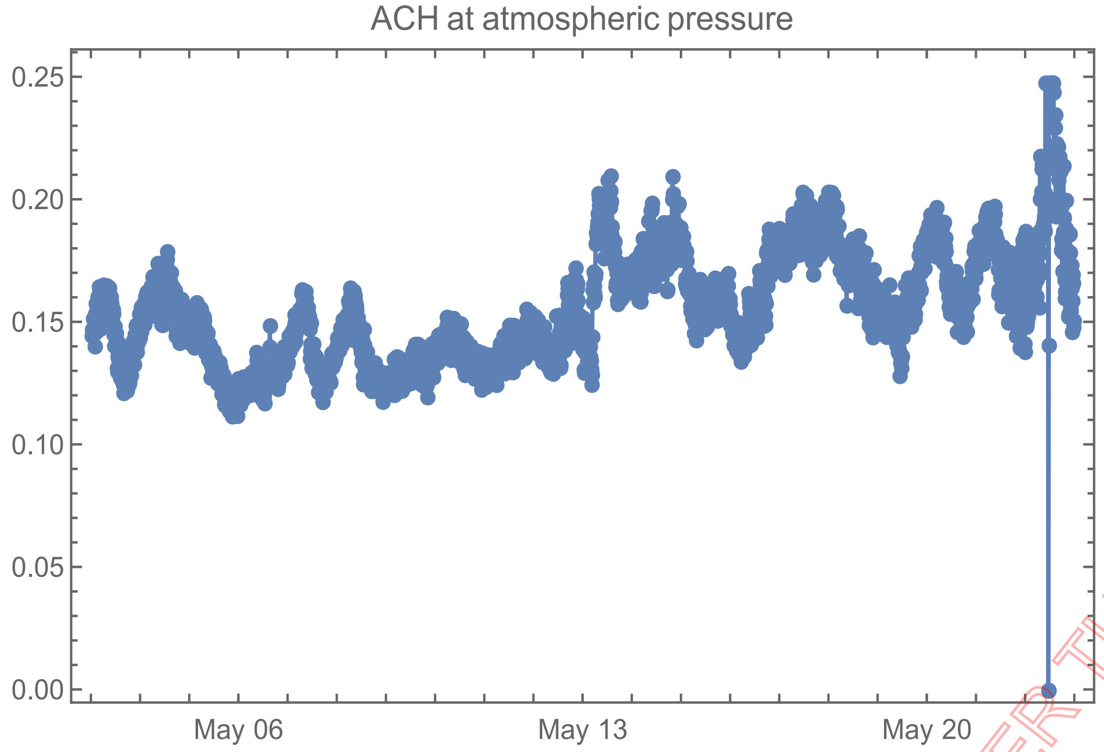
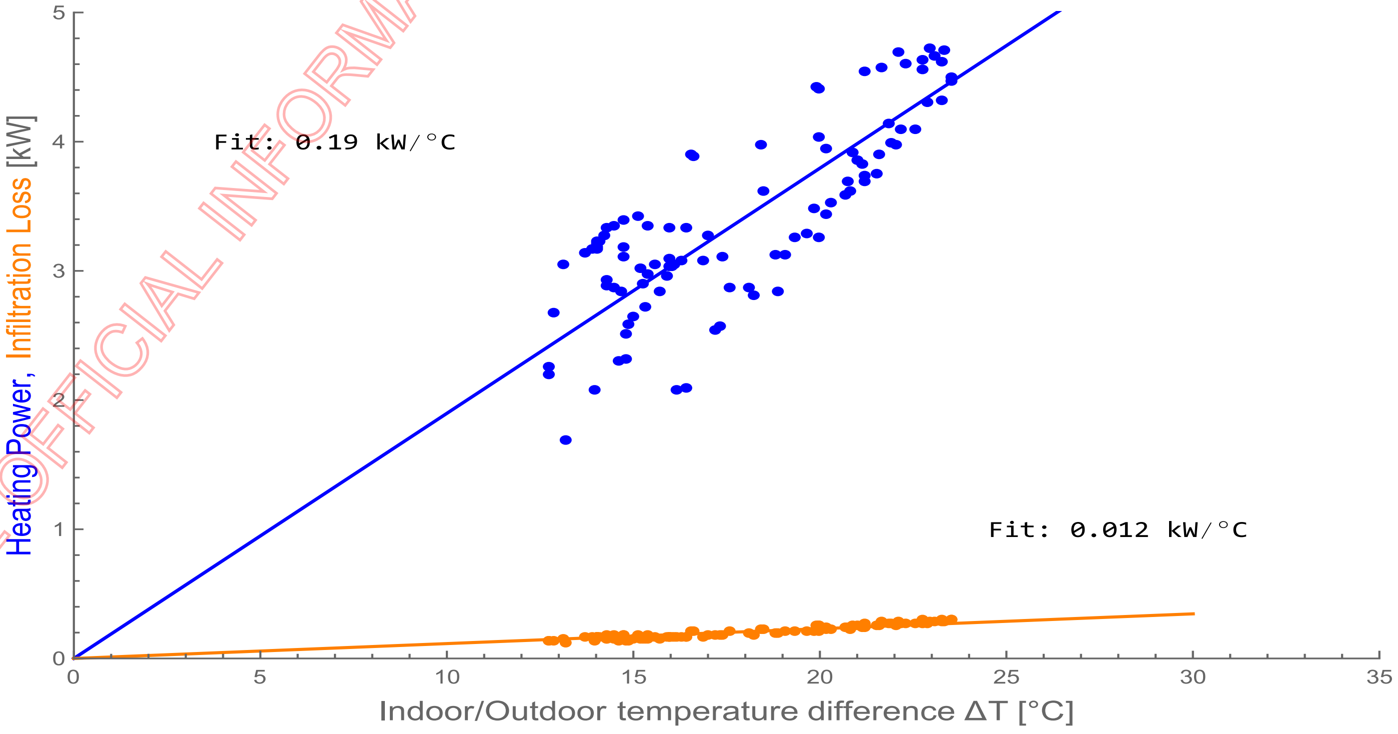
House 1: Single level standalone





Airtightness	12.1 ACH@50Pa
Infiltration via /20	0.61 ACH
Infiltration via EN832	0.85 ACH
Measured via tracer gas	0.18 ACH

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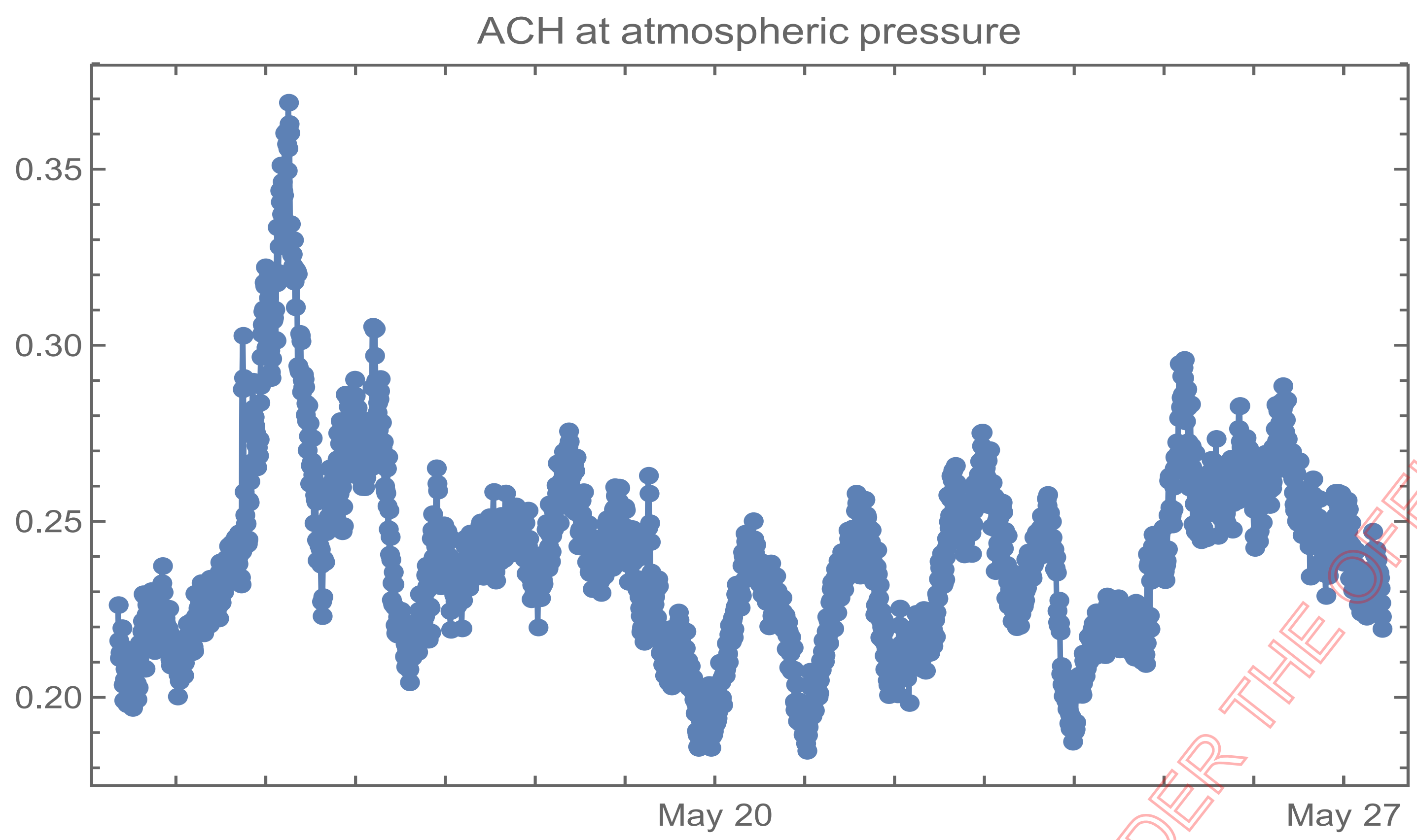
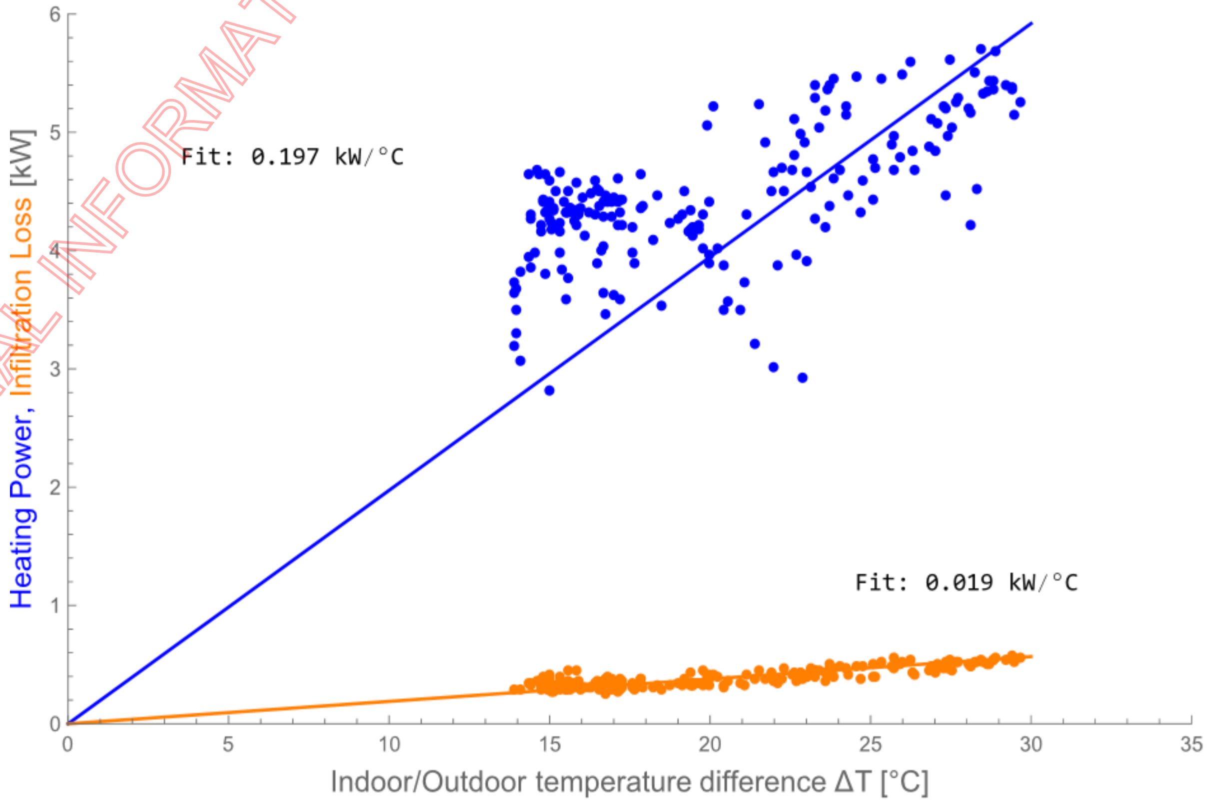
House 2: 2 Level duplex





Airtightness	8.7 ACH@50Pa
Infiltration via /20	0.435 ACH
Infiltration via EN832	0.609 ACH
Measured via tracer gas	~0.24 ACH

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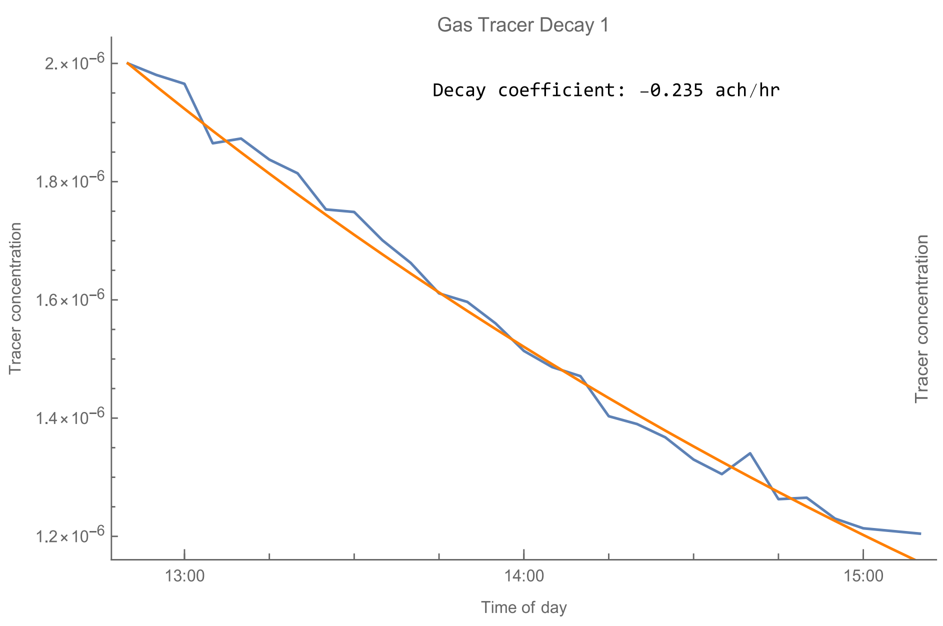
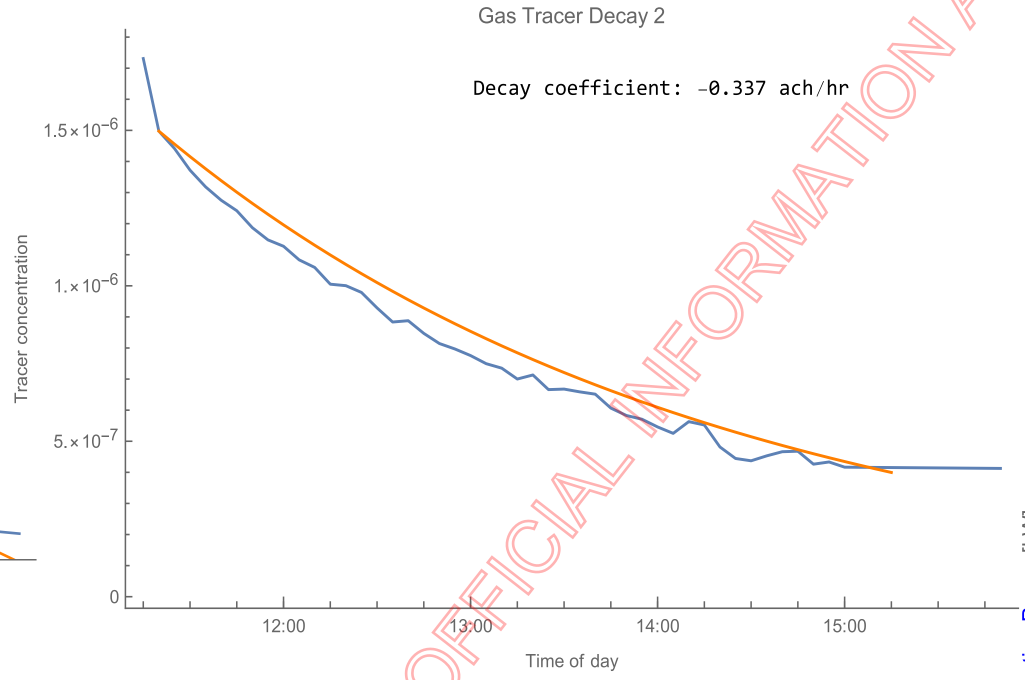
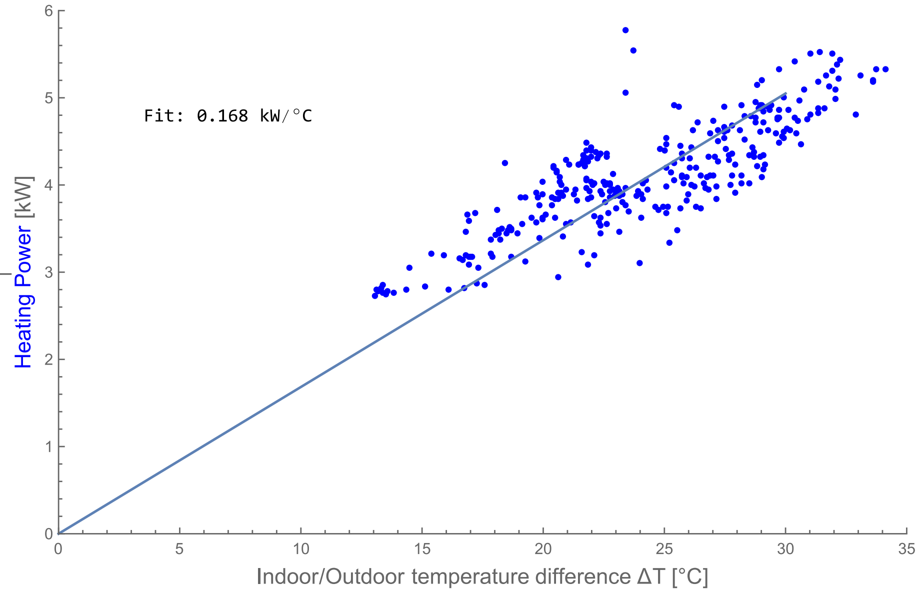
House 3: Single level standalone







Airtightness	9.4 ACH@50Pa
Infiltration via /20	0.47 ACH
Infiltration via EN832	0.66 ACH
Measured via tracer gas	~0.3 ACH

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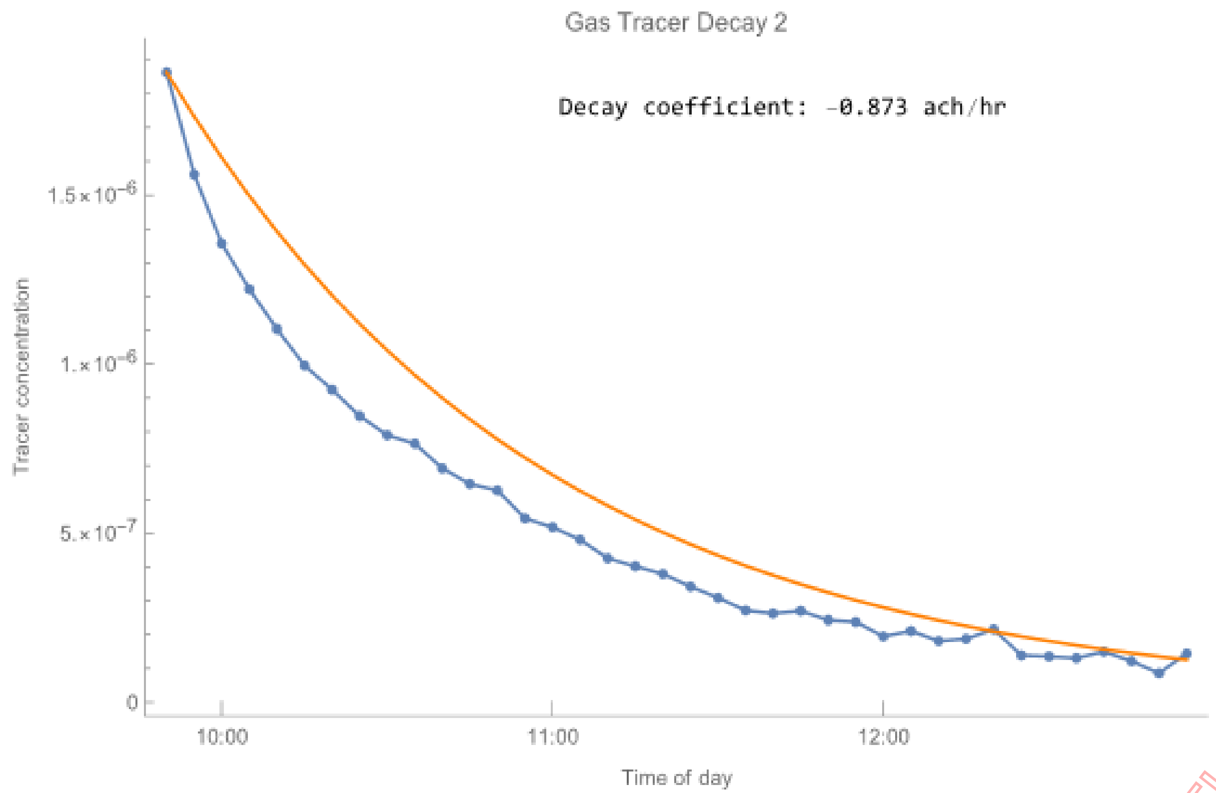
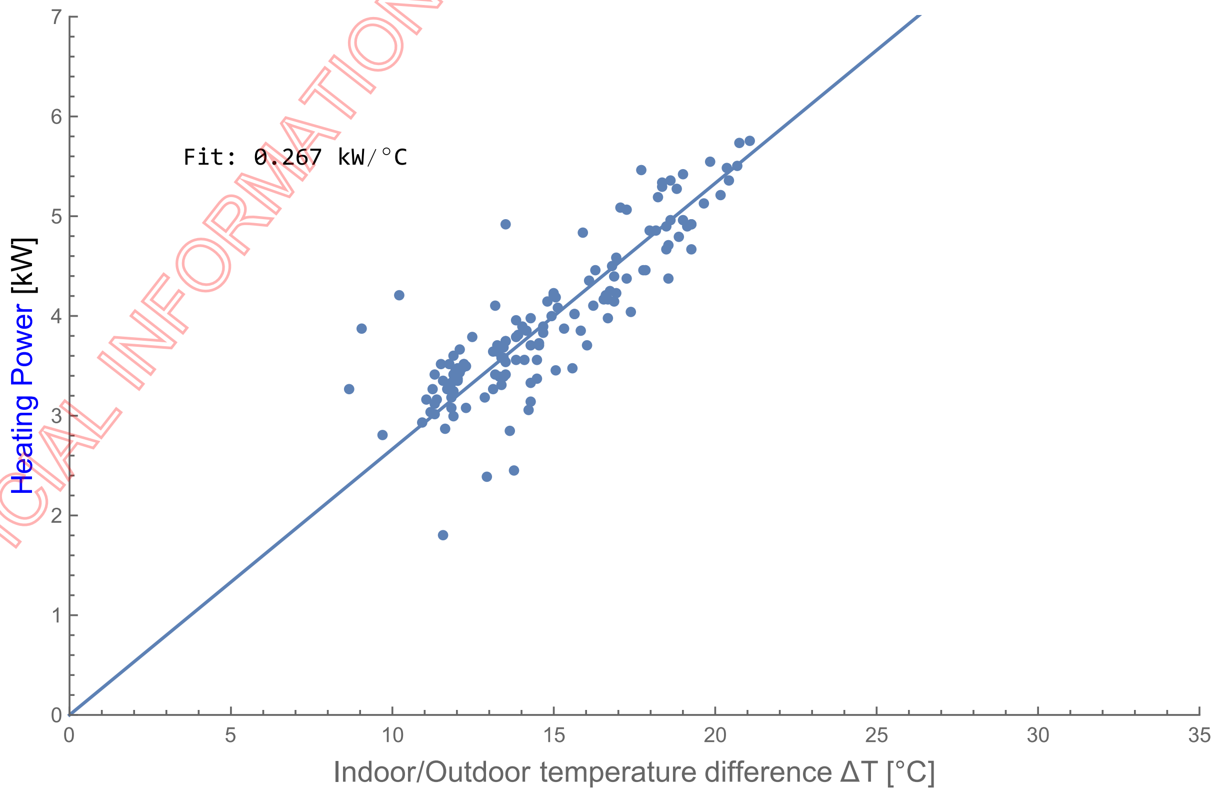
House 4: Single level duplex





Airtightness	22.3 ACH@50Pa
Infiltration via /20	1.12 ACH
Infiltration via EN832	1.56 ACH
Measured via tracer gas	~0.9 ACH

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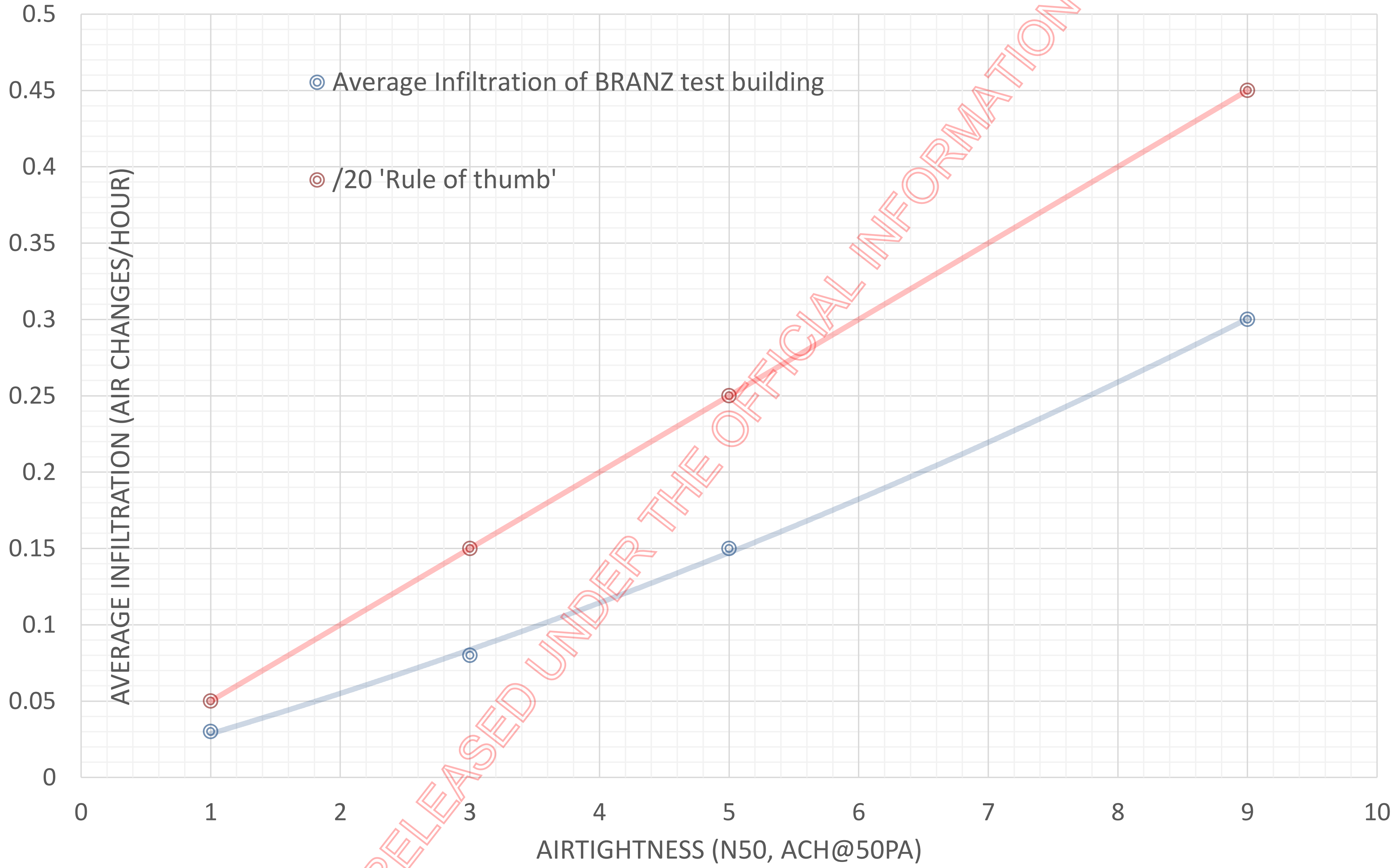
The trend with this building



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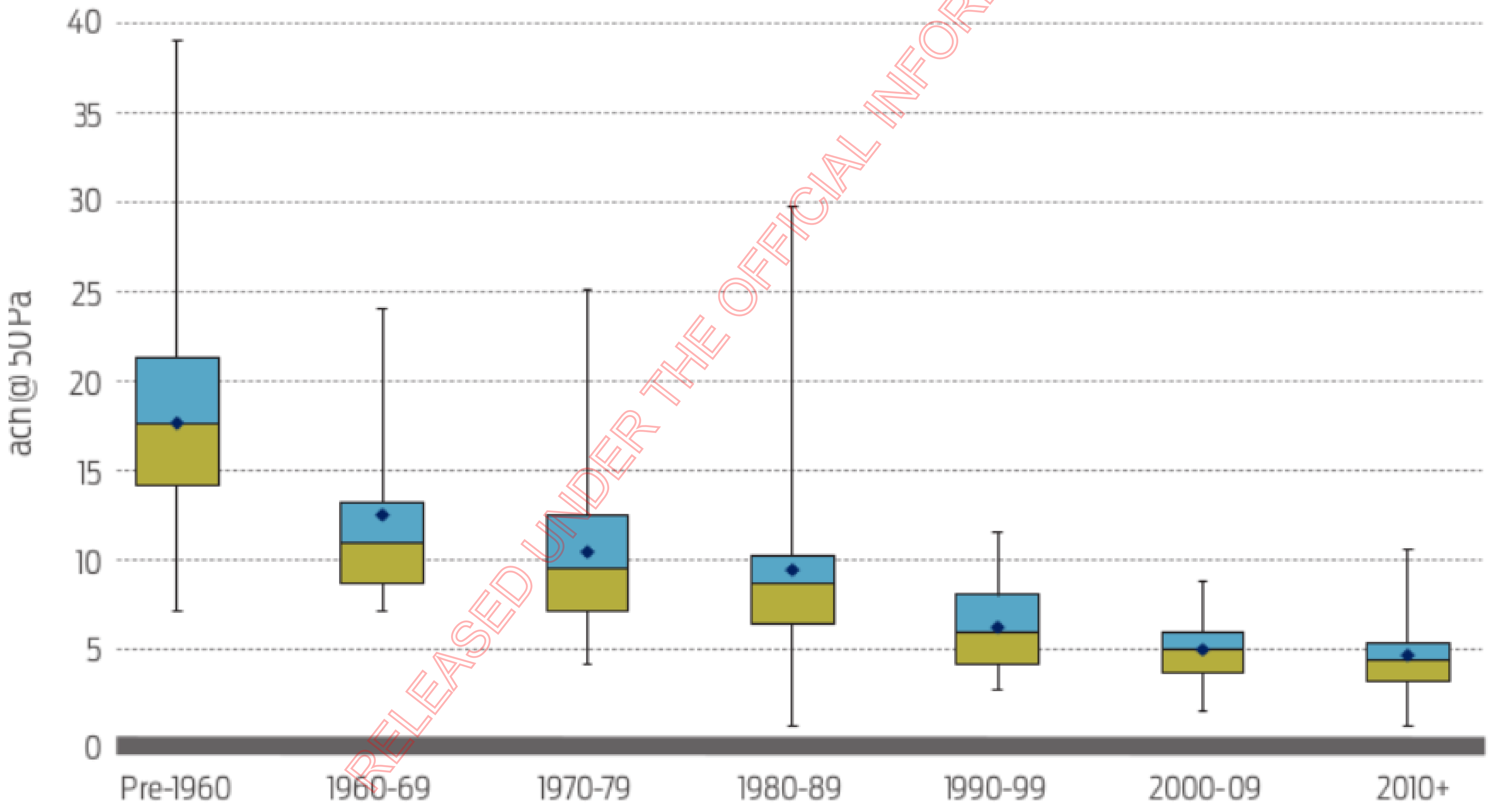
Setting an airtightness target?

- No doubt seen the BRANZ recommendation for 3ach@50Pa, but why?



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s 9(2)(b)(ii)

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Setting an airtightness target – what else?

- Do we take the chance to switch to a permeability metric – m^3/m^2 of envelope? Inline with AU and UK
- It removes ability to 'cheat' the system with larger buildings
- Allows us to take a durability approach, with a reasonably conservative reference pressure (2-4 Pa), and a hygrothermal modelling/measurement campaign
- Airtightness then becomes about interstitial moisture risk

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Ventilation

- We are already in need of mechanical options that are affordable – 1668.2 precludes some viable extract solutions for residential
  - Should make it clear 1668.2 for commercial applications
- MVHR is the 'gold standard' however current cold roof design limits efficiency
- Other losses are far greater than ventilation at the current point in time
- Poor ventilation a major risk factor for interstitial moisture

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Interstitial moisture

- Not simply a question about diffusion only
- Where the predominant layer supporting the airtightness is located compared to the insulation is critical
- Building with ‘enough’ vapour resistance to reduce chance of accumulation, that is also ‘low enough’ to allow drying
- WUFI modelling by proficient operators – education paramount. Many in the market now are not experienced enough.
- Councils lack the expertise to assess as well

Mould growth risk

s 9(2)(b)(ii)

s 9(2)(b)(ii)

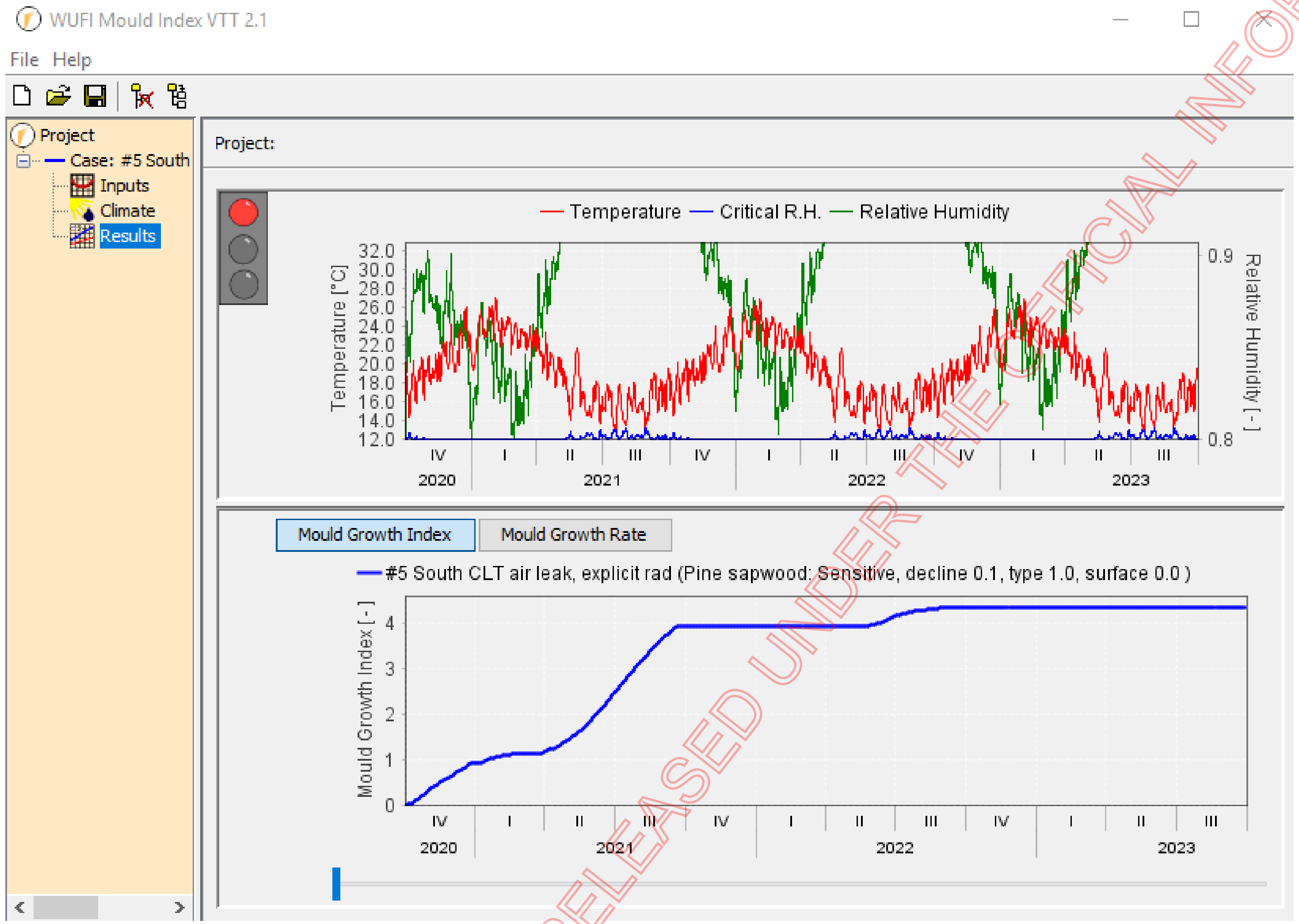
The key performance indicator chosen for this analysis is the VTT mould index at the critical point in each assembly.

The critical point is that location in the wall where the mould index is highest i.e. most likely to lead to mould growth.

The VTT mould index model is a 6-point scale indicating the severity of mould growth. Using the VTT mould index, an index of 3 (corresponding to visible mould growth) is usually used as the threshold between a “pass” and a “fail”.

Air leak failure mode

- Standard modelling tests vapour diffusion only.
- Important to test failure modes



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Interstitial moisture – possible pathways forward

- Create a library of low risk build ups and methodologies that give industry some flexibility
- Articulate the critical aspects of these with education campaign
  - Provide a catalogue of 'bad practice' for councils
  - Guideline for how to assess hygrothermal models

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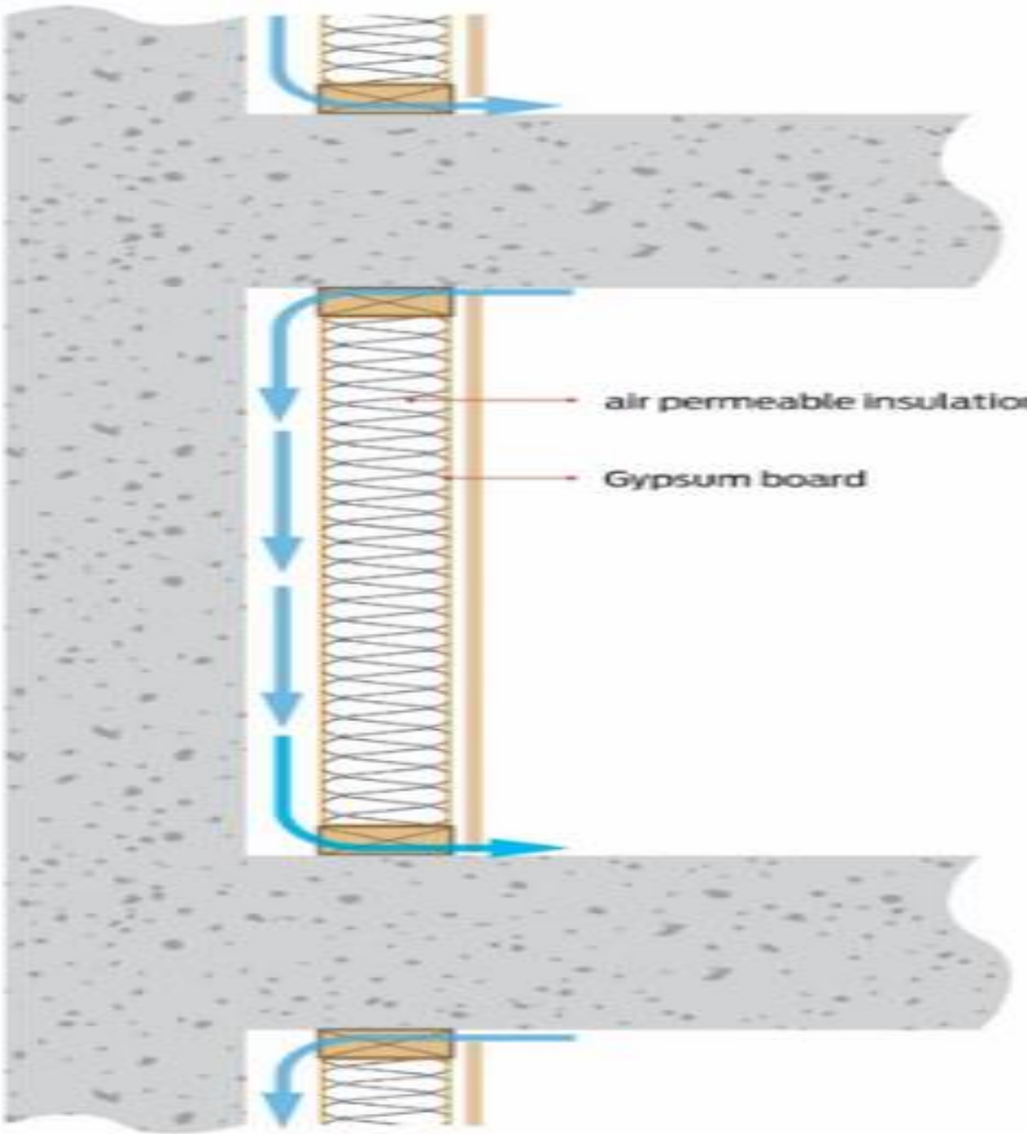
Interstitial moisture – riskfactors

- Looping air leaks to airtightness layer – particularly risky where insulation is inside of this layer
- Can't verify even with a blower door – no exit path
- % split of Rvalue between external and internal a workaround
- This is less of an issue in traditional construction – cladding is relatively loose from the air perspective – hgher drying potential
- Mould in concrete, possible structural issues with CLT etc



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Interstitial moisture – riskfactors

- Inappropriate permeability products – foils or other 'barriers' – unless specific design (ie high moisture load)
- Partial thermal bridges – from outside to part way through wall, or converse from inside. Aggravated thermal bridge
- Current timber % is moderating risk slightly inside the wall, but decreasing internal surface temps (s 9(2)(a) [redacted] Phd)

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Interstitial moisture – riskfactors

- Mixing insulation types – significant change in permeability and/or conductivity at interface
- Plywood as a bracing layer mid wall actually a mitigation strategy – becomes an 'SVR' (analogous to newtons cradle)