BUILDING PERFORMANCE

Consultation document
Building Code update
Insulation requirements in housing and other buildings

Amending Acceptable Solutions H1/AS1 and H1/AS2 and Verification Methods H1/VM1 and H1/VM2

5 December 2024

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

Ministry of Business, Innovation and Employment (MBIE)

Hīkina Whakatutuki – Lifting to make successful

MBIE develops and delivers policy, services, advice and regulation to support economic growth and the prosperity and wellbeing of New Zealanders.

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Preface

The Building Code forms a key part of our building regulatory system in New Zealand. It sets the minimum performance requirements for the design of buildings.

The Ministry of Business, Innovation and Employment (MBIE) is responsible for updating the Building Code and its documents so we can keep pace with innovation, current construction methods and the needs of contemporary New Zealand.

At MBIE, we aim for a balance between setting minimum performance requirements where necessary to ensure buildings are safe, healthy and durable. MBIE encourage higher standards of performance where this will impact positively on health and resilience outcomes for the country.

The New Zealand Building Code is contained in regulation made under the Building Act 2004. The Building Code is performance-based, meaning that it prescribes only the level of performance that building work is required to achieve. The Building Code does not prescribe technical detail or standards to determine how the required level of performance must be achieved.

There are different ways to show that a building complies with the Building Code. One way people may choose to comply is through the use of acceptable solutions or verification methods. These documents contain technical details, standards, calculation methods, and/or testing methods that are deemed to comply with the Building Code. Using these documents is one of the easiest ways to ensure a building meets the performance requirements set out in the Building Code.

If designers or builders want to comply with the Building Code performance requirements directly, they may also choose to use an alternative solution. An alternative solution is a flexible option that promotes innovation.

An alternative solution can include a material, component or construction method that differs completely or partially from those given in the acceptable solutions and verification methods. They will usually require specific design and input from suitably qualified people, such as architects or engineers.

Alternative solutions are not deemed to comply with the Building Code and must be assessed by Building Consent Authorities (BCAs) on their individual technical merits.

This consultation document has been prepared in response to emerging issues in the implementation of new insulation requirements in housing. It follows on from previous consultations from 2021 and 2022 on this topic.

Please take the time to let us know your thoughts. MBIE will carefully consider and weigh all submissions before making any decisions. You can provide feedback by following the instructions on MBIE's Have Your Say webpage.

Final decisions on the changes will be made and communicated in mid-2025.

Seeking feedback

Use the consultation document to learn about the proposed changes to insulation and energy efficiency requirements and send your feedback on them.

Think about the objective for energy efficiency in the Building Code and the key outcomes that MBIE has identified in meeting this objective.

The document includes questions for feedback. When you send your feedback, it helps if you can include evidence to support your views, for example references to independent research, facts and figures, or other relevant examples.

How to provide feedback

MBIE needs your feedback on the proposed changes to Building Code acceptable solutions and verification methods for insulation and energy efficiency requirements by 5:00 pm on Friday, 28 February 2025

Your submission can be sent using either:

- the online submission form
- a Word version of the submission form, which you can download and fill in, or print out and complete by hand
- your own short letter or document.

Where possible, provide relevant facts, figures, data, examples and documents to support your views.

Emailing or posting your submission

- Email your submission to: building@mbie.govt.nz with a subject title “H1 Consultation Dec 2024”
- Post your submission to:

  Building System Performance
  Ministry of Business, Innovation and Employment
  PO Box 1473
  Wellington 6140

Where possible, we appreciate receiving submissions electronically. If emailing an attachment, we prefer a Word or text-searchable PDF format.

Your feedback will contribute to further development of the Building Code acceptable solutions and verification methods.

Release of information

Release of information on MBIE website

MBIE may publish copies or excerpts of submissions. MBIE will consider you have consented to this when you submitted your feedback unless you clearly specify otherwise in your submission.

If your submission contains any confidential information or information we should not publish, please:

- state this at the start of your submission, with any confidential information clearly marked within the feedback text
- provide a separate version, with your confidential information removed, for publication on the MBIE website.

Release of information under the Official Information Act

Once submitted, your feedback becomes official information, and can be requested under the Official Information Act 1982 (OIA).

An OIA request asks for information to be made available unless there are sufficient grounds for withholding it. If some or all of your submission falls within the scope of any request for information received by MBIE, they cannot guarantee that your feedback will not be made public. Any decision to withhold information requested under the OIA is reviewable by the Ombudsman.

Get help from the ombudsman – Ombudsman New Zealand

If you do not want your submission feedback released as part of an OIA request, please say so in your submission feedback together with the reasons why. MBIE will take your objections into account when responding to their OIA request.

Personal information

The Privacy Act 2020 contains principles on how various agencies, including MBIE, collect, use and disclose information provided by individuals.

Any personal information you supply to MBIE in the course of providing your submission feedback is only:

- used for the purpose of assisting in the development of advice in relation to this consultation, or
- for contacting you about your submission.

MBIE may also use your personal information for other reasons permitted under the Privacy Act 2020 (for example, with your consent, for a directly related purpose, or where the law permits or requires it).

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MBIE will only keep your personal information for as long as it is needed for the purposes for which the information may lawfully be used.

Where any information provided (which may include personal information) constitutes public records, it will be kept to the extent required by the Public Records Act 2005.

MBIE may also be required to disclose information under the Official Information Act 1982, to a Parliamentary Select Committee or Parliament in response to a Parliamentary Question.

You have rights of access to, and correction of, your personal information. For more information, go to the MBIE website www.mbie.govt.nz.

1. Introduction

1.1. The Building Code regulates minimum insulation requirements through clause H1 Energy Efficiency

1.1.1. Insulation helps keep buildings cool in the summer and warm in the winter

Building Code clause H1 Energy Efficiency contains mandatory requirements to provide adequate thermal resistance (insulation) to buildings to help keep them energy efficient. Buildings need to have adequate insulation in roofs, windows, walls and floors to keep people warm, dry and healthy and to make sure that energy is being used efficiently. Insulation can make it easier to cool a building in the summer and heat a building in the winter helping to reduce the amount of energy used in all parts of the country.

1.1.2. In 2021, MBIE published changes to energy efficiency and insulation requirements

In 2021, MBIE published updates to the acceptable solutions and verification methods for H1 Energy Efficiency to make new buildings healthier and more energy efficient.

This update was made following a consultation that received more than 700 submissions. In that consultation, we heard changes for insulation requirements were long overdue as New Zealand lagged behind other countries.

In the 2021 consultation 98% of respondents supported the proposal to increase minimum insulation requirements in the acceptable solution and verification method documents used to comply with H1. The feedback was summarised as telling us to “go as far and fast as possible, without breaking anything”.

The final changes were the best balance of upfront cost and long-term energy efficiency at the time. The level of increase to insulation was based on the findings from research studies commissioned by MBIE. The final changes were separated by the type of building (housing, and small buildings versus other larger buildings[1]).

1.1.3. In 2022, MBIE extended the deadlines to transition to the new requirements

In 2022, MBIE heard that there were concerns with the timeframes to implement the new requirements. The unprecedented levels of building activity, product shortages and cost increases within the sector meant there were additional pressures and stresses on our construction workforce.

As such, MBIE consulted on extending the deadlines for transitioning to higher insulation settings. This consultation received 840 submissions. Based on the barriers and issues identified at the time, MBIE decided to extend the transition period for some of the requirements for housing into 2023. This extension allowed the building and construction sector more time to be able to deliver on the changes.

The transition period ended in November 2023 and the changes have now been fully in-place for over one year.

1.1.4. There have been concerns raised following the insulation changes from 2021

In early 2024, concerns were raised about the insulation changes from 2021. These concerns focused on the:

- financial impacts of the changes and the impacts on the cost of construction.
- use of insulation in the warmest parts of the country and whether insulation settings were appropriate or were making houses too hot.

This led to questions whether the changes are still appropriate and whether the benefits exceeded the costs.

[1] These terms are defined within the acceptable solutions and verification methods for H1 Energy efficiency. Housing of any size (including multi-unit apartment buildings) has the same requirements.

As part of MBIE's role as the building regulator, we continue to actively monitor the implementation of new requirements. It is important that the minimum requirements strike the right balance between the outcomes they can help achieve, such as lower power bills, and the upfront costs they impose onto households and businesses. It is also important to check whether these settings cause unintended consequences, for example if the increased insulation causes dampness issues and overheating.

1.2. MBIE has taken another look at the changes made in 2021

1.2.1. MBIE has identified outcomes that we would like to achieve

The mandatory requirements for H1 in the Building Code regulations require that buildings be provided with adequate levels of insulation to facilitate the efficient use of energy.

For this review, we have identified the following additional outcomes we want to achieve while maintaining adequate energy efficiency in buildings:

- Balancing upfront building costs, and longer-term benefits.
- Removing barriers for designers to optimise insulation for energy efficiency in a building.
- Improving the consistency and certainty of compliance and consenting of buildings in regards to insulation requirements and energy efficiency.

1.2.2. MBIE has engaged with the sector and commissioned further research and cost estimates for providing insulation in new houses

Throughout 2024, MBIE has been reviewing the changes to insulation requirements. In order to do this, we have recently:

- engaged with the sector to better understand their practical experience with the insulation settings since 2021.
- commissioned quantity surveyors to provide updated cost estimates for different levels of insulation in housing, which included the previous insulation settings first published in 2008.
- commissioned the Building Research Association of New Zealand (BRANZ) to undertake a full cost benefit analysis using updated computer modelling of the temperatures and energy use in new housing.
- assessed the risks of overheating, internal moisture and condensation as result of the changes made to insulation in 2021.

1.2.3. What MBIE have heard from key building and construction sector stakeholders

In recent meetings, key building and construction sector stakeholders told us that they generally supported the current H1 settings and expressed the following views:

- Using the calculation or modelling compliance methods usually results in better outcomes compared to the schedule method (see subsection 2.1.12.1.1 below for explanations of the different compliance methods).
- Any changes should be based on evidence. Assessment of costs and benefits should consider both upfront costs and long-term benefits. This includes energy efficiency improvements, and the health and wellbeing benefits of warmer and drier buildings.
- Industry has made significant investments to meet the current H1 settings. Reversing them is unlikely to reduce upfront costs due to the sunk costs of these investments.
- Insulation does not cause overheating. Overheating is caused by poor design. It would be advantageous for the sector to collectively put more effort into providing education for designers to avoid overheating and internal moisture issues.
- MBIE should also consider updating the Building Code to help to address overheating and internal moisture risks.

1.2.4. Cost-benefit analysis indicates that meeting the current insulation requirements can be cost-effective and beneficial overall

Building Research Association of New Zealand (BRANZ) cost-benefit analysis suggests that meeting the current H1 insulation requirements for housing and small buildings can be cost-effective and beneficial overall. The long-term energy efficiency benefits outweigh the additional upfront costs.

However, the balance between costs and benefits depends on the compliance method that is used. BRANZ's analysis shows that using the calculation or modelling methods achieves the highest benefit to cost ratio overall. This is because the calculation and modelling methods enable people to adjust the insulation levels of different building elements to optimise a buildings' overall energy performance in the most cost-effective way.

BRANZ also assessed whether the current H1 insulation requirements are creating overheating and internal moisture risks in housing. The research confirmed that housing overheating is not simply caused by insulation, rather it is a combination of design factors such as sun heat gains during the day, window shading, heat absorption properties of building materials, as well as ventilation and building orientation.

BRANZ's analysis also shows that the current H1 settings are not increasing internal moisture risks in buildings.

See section 2.17 below for more details on BRANZ's findings on the effects of insulation on overheating and internal moisture risks in housing.

1.2.5. MBIE have developed for proposals for change for housing and small buildings, and for large buildings

We have developed several proposals that aim to achieve the identified outcomes. These proposals are primarily focused on the settings for housing and small buildings in the Acceptable Solution H1/AS1 and Verification Method H1/VM1 – refer Section 2.

However, some of these proposals relate to similar provisions for the insulation settings in large buildings (other than housing). Stakeholders also identified other areas that may cause design complexity leading to unnecessary costs for large building typologies.

To maintain consistency between the documents and approaches, we have included additional proposals to amend Acceptable Solution H1/AS2 and Verification Method H1/VM2. These proposals are specifically for large buildings and are presented separately – refer Section 3.

1.2.6. MBIE wants to hear your feedback and opinions on insulation and energy efficiency

The following sections seek your feedback on specific proposals to change the insulation settings and the ways to demonstrate compliance with H1 through the use of acceptable solutions and verification methods. MBIE welcomes your feedback on these proposals.

2. Insulation in housing and small buildings

This section covers energy efficiency for all housing, and small buildings up to 300 m^2. The proposals relate to ways to amend the Acceptable Solution H1/AS1 and Verification Method H1/VM1 to:

- Optimise insulation to better balance upfront building costs and longer-term benefits
- Improve the consistency and certainty of compliance and consenting of buildings regarding insulation requirements and energy efficiency.

2.1. Background on energy efficiency for housing and small buildings

2.1.1. There are currently three main ways to comply

There are three compliance pathways for H1 energy efficiency insulation provisions for housing and small building:

- the **schedule method** which prescribes tabulated minimum construction R-values for the roof, walls, windows, doors, skylights and floors of a building based on its location in the country.
- the **calculation method** which is based on simple equations and allows a designer to customise the insulation levels between different building elements to give the same relative heat loss as a building that complies with the schedule method.
- the **modelling method** which uses computer modelling to demonstrate that the proposed building does not require more heating and cooling energy than a reference building that complies with the schedule method. It provides the greatest flexibility to customise insulation levels.

2.1.2. Insulation requirements vary between six climate zones

New Zealand has diverse climates – from subtropic in Northland to sub-Antarctic in Invercargill. The insulation requirements specified in the acceptable solutions and verification methods for clause H1 Energy Efficiency vary between six climate zones across the country. Southern and alpine regions that experience colder winters have higher insulation requirements than northern regions with milder climates.

2.2. Optimising insulation to better balance upfront building costs and longer-term benefits

2.2.1. Topics identified

The upfront cost of insulation in buildings is offset by ongoing benefits including reduced heating and cooling bills, and improved occupant comfort. There are differences to the degree to which the three compliance methods enable designers to optimise insulation levels for a particular building and strike the right balance between upfront building costs and long-term benefits.

Recent sector engagement and BRANZ analysis identified that:

- **Topic 1:** The schedule method may lead to higher upfront costs and less cost-effective construction than the more flexible calculation and modelling methods.

- **Topic 2:** The calculation method contains restrictions to the flexibility of roof, wall and floor R-values that can lead to unnecessarily costly and complex construction in some buildings.
- **Topic 3:** Where underfloor heating is only used in bathrooms, the minimum R-values for heated floors may cause unreasonable upfront costs.

2.3. Topic 1: The schedule method may lead to higher upfront costs and less cost-effective construction than the more flexible calculation and modelling methods

2.3.1. Reasons for the change

Because of its simplicity, the schedule method has historically proven the most popular. Using this compliance method, designers do not need to consider what insulation levels (R-values) are most appropriate and cost-effective for the various elements of a particular building.

Designers can simply specify constructions that achieve the prescribed minimum R-values. Building Consent Authorities can easily check if a building complies by comparing the specified construction R-values against the schedule method R-values. This provides a high degree of certainty whether a proposed building design complies.

Whilst the simplicity and certainty provide a strong incentive for designers to use the schedule method, this generally comes at the expense of higher building costs ultimately faced by households and businesses, with potential negative impacts on the affordability of new housing.

Recent BRANZ analysis[2] commissioned by MBIE found that there is a strong economic case for using the calculation or modelling methods instead of the schedule method. These methods provide flexibility that enables the use of different, often lower insulation levels (R-values) than the schedule method. This helps reduce upfront building costs and improves the overall cost-effectiveness of the insulation in a building.

2.3.2. Proposed change: Remove the schedule method

The proposed change includes removing the schedule method, leaving the calculation and modelling methods as compliance pathways. This proposed change involves amendments to Acceptable Solution H1/AS1 *Energy Efficiency for all housing, and buildings up to 300m^2*. For more details of the proposed wording in H1/AS1, please refer to Appendix A.

2.3.3. Analysis of the proposed change

The primary objective of this proposal is to reduce upfront building costs and improve the cost-effectiveness of the insulation required for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

MBIE considers that removing the schedule method will best achieve this objective by better encouraging building designers to optimise insulation levels for each building they are designing. Removing the schedule method will increase the use of the remaining calculation and modelling methods.

Compared to the schedule method, the calculation and modelling methods enable significant reductions in upfront building costs from optimised insulation levels tailored to the individual building, whilst still achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

[2] Sullivan, J., Curtis, M., McNeil, S., Burgess, J. & MacGregor, C. (2024). Technical analysis of New Zealand Building Code energy efficiency clause H1 settings for residential buildings. BRANZ Ltd.

Designers can already choose to use the calculation and modelling methods instead of the schedule method. However, designers do not directly benefit from the reductions in building costs achievable with the other compliance methods. The familiarity, simplicity and certainty offered by the schedule method acts as a disincentive for designers to use other compliance methods.

User-friendly online tools[3] have made the calculation method more accessible, easy to use, and only require a negligible amount of additional technical capability and work by the designer compared to the schedule method. Recent sector feedback indicates that designers have already started adopting the calculation method more, instead of the schedule method.

The modelling method has to date been the least commonly used method as it requires specialist computer modelling skills, access to relevant building modelling tools or software and takes more time than the other two methods.

MBIE expects that the impacts of removing the schedule method include:

- **Lower upfront building costs**
    - Removing the schedule method will encourage designers to optimise their insulation solution for each building, reducing upfront costs while maintaining compliance.
    - For a sample single or double storey house, BRANZ's analysis identified upfront cost savings of $3,712 to $9,565 when using the calculation method, and $2,318 to $15,071 when using the modelling method. This could have positive impacts on the affordability of new housing and small buildings.
- **Higher energy usage (running costs and carbon emissions)**
    - Higher energy usage for heating and cooling in new housing and small buildings. This is because the calculation and modelling methods oftentimes enable compliance with less insulation than the schedule method[4].
    - However, the estimated costs from additional energy use by using the calculation or modelling methods instead of the schedule method are relatively modest in comparison to the savings in build costs. For a sample single or double storey house, BRANZ's analysis estimates additional annual household energy costs of $53 to $236 when using the calculation method, and $27 to $351 when using the modelling method.
- **More work for designers and Building Consent Authorities when establishing compliance**
    - The removal of the schedule method will require designers to calculate or model the insulation required.
    - However, where designers use the calculation method via one of the available user-friendly online tools and enclose a copy of the output with their building consent application, the additional work required compared to the schedule method is negligible.
- **Upskilling required by the industry**
    - Removing the schedule method may feel like a big step for some designers and MBIE would work with the industry to support this transition and help designers become competent with the use of the calculation method, including the use of existing free online tools[5].
- **More innovation**
    - Removing the schedule method could encourage innovation within the industry as practitioners explore new ways of achieving compliance. This could lead to increased development and uptake of innovative products, technologies or design methods that improve building performance.

On balance, MBIE considers that the benefits of removing the schedule method outweigh the costs.

[3] Free tools that have implemented the calculation method include the New Zealand Green Building Council's H1 Calculator and BRANZ's H1 Calculation method tool.
[4] At least where a proposed building's glazing area is less than 30% of its total wall area. BRANZ' analysis of building consent data of a sample of new detached homes found that only around 10% had glazing areas greater than this.
[5] Free tools that have implemented the calculation method include the New Zealand Green Building Council's H1 Calculator and BRANZ's H1 Calculation method tool.

2.3.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed option was considered to address the issue more effectively.

These discounted options included:

- **Reverting the R-value settings back to the previous fourth editions of H1/AS1 and VM1** that were in effect between 2008 and 2022:

  A recent cost-benefit analysis commissioned by MBIE found that reverting insulation requirements back to the previous settings is uneconomic.[6]

- **Reducing the minimum R-values of the schedule method:**

  This option would not achieve our objective because recent BRANZ analysis[7] found that there is no single simple answer on what R-value settings provide the best balance between upfront building costs and long-term benefits. This is because it depends on a building's design, and there are also significant variations in material costs depending on suppliers and other factors.

  Only adjusting the schedule method R-values could also lead to unintended inconsistencies in required performance between the compliance methods. This is because the schedule method minimum R-values are used as the benchmark in the calculation and modelling methods.

  Whilst R-value reductions could be made consistently for all three compliance methods, this could enable unintended reductions in insulation levels of new homes and buildings. For some buildings the current modelling method already enables reducing insulation to less than what was commonly used under the previous fourth editions of H1/AS1 and VM1.

- **Providing multiple combinations of R-values** for the roof, walls, windows and floor in the schedule method that designers could choose from:

  Currently the schedule method only provides one combination for each climate zone. MBIE considers this option less practicable and effective than the proposed removal of the schedule method. This is because the most cost-effective combination of insulation for achieving compliance depends on many factors, including the material supply and labour costs applicable to a particular building, a building's shape and size of glazing areas.

  Using the calculation or modelling methods was identified as being more effective for providing the flexibility to optimise insulation, at no significant additional effort for designers and Building Consent Authorities when existing user-friendly tools for the calculation method are used.

- **Increasing awareness and providing education for building designers about other compliance methods**:

  Given that the calculation and modelling methods have been available for over twenty years MBIE does not consider a lack of awareness of the other compliance methods to be a current barrier. Whilst additional education would help some designers switch away from the schedule method, the proposed option is considered to be more effective.

MBIE have determined that the proposed approach of amending Acceptable Solution H1/AS1 to remove the schedule method is the most reasonable and effective option for achieving the objective of reducing upfront

[6] Sullivan, J., Curtis, M., McNeil, S., Burgess, J. & MacGregor, C. (2024). Technical analysis of New Zealand Building Code energy efficiency clause H1 settings for residential buildings. BRANZ Ltd.
[7] ibid

building costs and improving the cost-effectiveness of the insulation required for achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

2.3.5. Questions for the consultation Topic 1

1-1. Do you support amending Acceptable Solution H1/AS1 as proposed to remove the schedule method?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

1-2. Please explain your views.

2.4. Topic 2: The calculation method contains restrictions to the flexibility of roof, wall and floor R-values that can lead to unnecessarily costly and complex construction in some buildings

2.4.1. Reasons for the change

The calculation method uses simple equations and allows a designer to customise the insulation levels between different building elements.

A proposed building must not exceed the calculated heat loss of a theoretical reference building that is insulated with R-values that match those of the current schedule method.

The calculation method offers a lot of flexibility but does not allow the R-values of the roof, wall and floor of a proposed building to be reduced below 50% of the corresponding R-values in the reference building.

Industry feedback and recent BRANZ analysis suggest that the current minimum possible R-values for roof, walls and floors in the calculation method are too restrictive, resulting in unnecessarily costly and complex construction in some buildings. These concerns are primarily about the minimum R-values for roofs and slab-on-ground floors.

For roofs, insulation products required to achieve the current minimum possible R-value of R3.3[8] can be too thick to find adequate space in some low pitch roofs or skillion roofs. Creating adequate space may require costly and complex solutions such as raised heel roof trusses. Apart from the additional construction costs, the additional height required by a raised heel truss may make it more difficult to stay within the recession plane where a building is close to a boundary.

For slab-on-ground floors, achieving the required minimum possible R-value (ranging from R0.75 to R0.85[9] depending on the climate zone) can be difficult and costly where the area of heated and cooled space directly above the floor is very small.[10] An example would be a multi-storey house where the only space that may be heated or cooled on the ground floor are the bottom of a stairwell and a small bathroom next to a large garage.

Whilst designers can choose to use the modelling method in such situations (which does not have these minimum R-value requirements), this is more time-consuming and requires access to modelling tools and specialist technical skills that not all designers have.

2.4.2. Proposed change: Adjust the minimum possible R-values in the calculation method

The proposed change includes adjusting the minimum possible R-values for the roof, walls and floor of the calculation method as shown in Table 2-1. To improve clarity, MBIE proposes to specify the new, adjusted minimum R-values directly instead of a percentage of reference building R-values.

This proposed change involves amendments to Acceptable Solution H1/AS1 *Energy Efficiency for all housing, and buildings up to 300m²*. For more details of the proposed wording in H1/AS1, please refer to Appendix A.

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[8] Which is 50% of the R6.6 roof R-value in the reference building heat loss equation.
[9] Which is 50% of the slab-on-ground floor R-values in the reference building heat loss equations.
[10] This is because the achieved R-value depends on the ratio between the area of the slab-on-ground floor, and its perimeter. For this, only the parts of the floor under spaces that can be heated or cooled are considered. The lower the area-to-perimeter ratio, the lower the achieved R-value of a slab-on-ground floor of a particular construction and insulation.

Table 2-1: Calculation method – Minimum possible R-values (status quo and proposed)

		Climate zone					
		1	2	3	4	5	6
Roof	Status quo[1]	R3.3					
	Proposed	R2.6					
Walls	Status quo[2]	R1.0					
	Proposed	R1.0					
Floors							
- **Slab-on-ground floors**	Status quo[3]	R0.75				R0.8	R0.85
	Proposed	No minimum R-value					
- **Other floors**	Status quo[4]	R1.25			R1.4	R1.5	
	Proposed	R1.3					

Notes:

(1) Based on 50% of R6.6, which is the roof R-value in the reference building equations for all climate zones.
(2) Based on 50% of R2.0, which is the wall R-value in the reference building equations for all climate zones.
(3) Based on 50% of R1.5, R1.6 and R1.7, which are the slab-on-ground floor R-values in the reference building equations for the respective climate zones.
(4) Based on 50% of R2.5, R2.8 and R3.0, which are the R-values for other floors in the reference building equations for the respective climate zones.

2.4.3. Analysis of the proposed change

The primary objective of this proposal is to reduce upfront building costs and improve the cost-effectiveness of the insulation required for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

MBIE considers that adjusting the minimum possible R-values in the calculation method will best achieve this objective. The proposed change will enable building designers avoid complex and costly constructions in the situations described in subsection 2.4.1 above, without having to use the more time-consuming and complex modelling method.

Compared to the status quo, MBIE considers that adjusting the minimum possible R-values as proposed will reduce upfront costs for some buildings, whilst still achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

MBIE expects that the impacts of adjusting the minimum possible R-values in the calculation method as proposed include:

- **Lower upfront building costs**

  Building designers using the calculation method will be able to avoid complex and costly constructions in buildings with low-pitch roofs, skillion roofs and small slab-on-ground floors.

- **Less work for designers and Building Consent Authorities when establishing compliance.**
  Designers wanting to avoid complex and costly insulation solutions for low-pitch roofs, skillion roofs and small slab-on-ground floors will be able to use the calculation method, rather than the more time-consuming and complex modelling method.

- **Less thermal comfort for building occupants**

  Where people are in proximity to building elements with less insulation, they may experience some thermal discomfort during hot or cold weather. However, MBIE considers the proposed adjustments of the minimum possible R-values to have a minimal impact on thermal comfort.

- **No significant change to a building's energy usage (running costs and carbon emissions)**

  Whilst the proposed change will increase the flexibility of the calculation method, it will not change the required overall thermal performance of the building.

  The maximum permitted calculated heat loss of a proposed building will remain unchanged and continue to be based on the calculated heat loss of a theoretical reference building. This means where a designer makes use of the lower minimum R-values, this will need to be compensated for in other parts of a building's thermal envelope.

- **No change to internal moisture risks**

  Buildings classified as housing and communal residential buildings will still be required to satisfy the Building Code performance requirement E3.3.1 for internal moisture. For this, Acceptable solution E3/AS1 *Internal Moisture* specifies minimum R-values for walls, roofs and ceilings which are not affected by this proposed change.

  For light timber frame wall or other framed wall constructions with cavities, the E3/AS1 minimum R-value of R1.5 requires more insulation than the minimum R-value of the H1/AS1 calculation method.

On balance, MBIE considers that the benefits of adjusting the minimum possible R-values in the calculation method as proposed outweigh the costs.

2.4.4. Other option MBIE considered

As part of the analysis, we also considered the option of removing the minimum R-values in the calculation method. However, this option was not further pursued on the basis that the proposed option was considered to address the issue more effectively. Removing the minimum R-values altogether would not likely provide significant additional upfront cost savings over the proposed option but could undermine achieving the 'adequate thermal resistance' required by Building Code clause H1.3.1(a).

Whilst the modelling method does not have minimum R-values, it uses advanced computer tools to comprehensively assess a building's thermal performance. In contrast, the calculation method's simple equations are less accurate and minimum R-values for the roof, walls and floor are a necessary component of ensuring 'adequate thermal resistance'.

We determined that the proposed approach of amending Acceptable Solution H1/AS1 to adjust the minimum R-values in the calculation method is the most reasonable and effective option for achieving the objective.

2.4.5. Questions for the consultation Topic 2

2-1. Do you support amending Acceptable Solution H1/AS1 to adjust the minimum possible R-values in the calculation method as proposed?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

2-2. Please explain your views.

2.5. Topic 3: Where underfloor heating is only used in bathrooms, the minimum R-values for heated floors may cause unreasonable upfront costs

2.5.1. Reasons for the change

Building elements that are part of the thermal envelope and have embedded heating systems, such as floors with inbuilt underfloor heating, must meet certain minimum R-values. These R-values are higher than the schedule method minimum R-values, and also higher than the minimum R-values of the calculation method discussed in subsection 2.4 above.

The minimum R-values for building elements with embedded heating apply irrespective of the chosen compliance pathway. They cannot be reduced by using the calculation or modelling methods. These higher minimum R-values aim to ensure that heated building elements have adequate thermal resistance to prevent excessive heat loss, enable efficient and effective operation of the embedded heating system and limit heating energy use and costs.

Achieving the minimum R-values for heated building elements typically requires more insulation and upfront building costs. Where the embedded heating is used for general space heating across large parts of a building, these additional costs are generally outweighed by the ongoing energy cost savings from the additional insulation.

However, it is common for new homes to have underfloor or undertile heating solely in bathrooms. Where underfloor or undertile heating covers only a very small part of a building's floor, the additional costs from achieving the minimum R-values for heated building elements may not be justified.

In particular, common insulation solutions for slab-on-ground floors, such as underslab and slab-edge insulation, cannot be isolated to just the part of the floor that is heated. Instead, to be effective such insulation needs to be applied to the entire floor.

2.5.2. Proposed change: Exempt embedded heating solely used in bathrooms from additional insulation

The proposed change includes exempting buildings from the higher minimum R-values for heated building elements where embedded heating systems are solely used in bathrooms. This proposed change involves amendments to Acceptable Solution H1/AS1 and Verification Method H1/VM1. For more details of the proposed wording, please refer to Appendix A for H1/AS1 and Appendix B for H1/VM1.

Similar amendments are proposed for Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m^2.*

For clarity, when using the calculation method, the minimum R-values discussed in subsection 2.4 above would still apply to all roofs, walls and floors and are not affected by this proposal.

Equally, if MBIE was not to proceed with the proposed removal of the schedule method discussed in subsection 2.3 above, the exempt bathroom heated building elements would still need to achieve the schedule method R-values.

2.5.3. Analysis of the proposed change

The primary objective of this proposal is to reduce upfront building costs and improve the cost-effectiveness of the insulation required for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

For this issue, MBIE considers that the proposed exemption for embedded heating solely used in bathrooms will best achieve this objective. Compared to the status quo, MBIE considers that the proposed exemption will reduce upfront costs for some buildings, whilst still achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

MBIE expects that the impacts of this proposal include:

- **Lower upfront building costs.** The proposed change will enable building designers avoid disproportionately complex insulation solutions that create costs that may not be justified.
- **Higher energy usage (running costs and carbon emissions).** Reducing thermal insulation under embedded heating reduces energy efficiency by increasing heat loss. However, as bathrooms are typically small this impact will be modest.

On balance, MBIE considers that the benefits of the proposed exemption outweigh the costs.

2.5.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed option was considered to address the issue more effectively.

These discounted options included:

- **Removing the higher minimum R-values for building elements with embedded heating.** MBIE considers that this option would not achieve 'adequate thermal resistance' as required by Building Code clause H1.3.1(a). It would result in excessive heat loss, energy use and heating costs, particularly where embedded heating covers large areas.

- **Reducing the minimum R-values for building elements with embedded heating.** MBIE does not consider this option reasonable because the status quo minimum R-values are generally appropriate, except where embedded heating only covers a small area.

- **Extending the proposed exemption to other areas, such as kitchens.** MBIE does not propose this option because spaces other than bathrooms would typically have larger embedded heating systems where the additional insulation to meet the minimum R-values for building elements with embedded heating is generally justified.

We determined that the proposed approach of amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 to exempt heated building elements where embedded heating systems are solely used in bathrooms is the most reasonable and effective option for achieving the objective.

2.5.5. Questions for the consultation Topic 3

3-1. Do you support amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 as proposed to reduce upfront costs and improve the cost-effectiveness of insulation by exempting building elements with embedded heating from higher minimum R-values where embedded heating systems are solely used in bathrooms?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

3-2. Please explain your views.

2.5.6. Additional questions for topics 1 to 3

SQ1. What impacts from the proposals for topics 1 to 3 do you expect?
These may be economic/financial, environmental, health and wellbeing, or other areas.

SQ2. Is there any support that you or your business would need to implement the proposed changes if introduced?

SQ3. If there are other issues MBIE should consider to better balance upfront building costs and longer-term benefits of insulation in housing and small buildings, please tell us.

2.6. Consistency and certainty of compliance and consenting

2.6.1. Topics identified

Clear and up-to-date requirements in acceptable solutions and verification methods support consistency of how the requirements are applied and help provide certainty for designers, Building Consent Authorities and building users that buildings comply with the Building Code. This also helps avoid unnecessary delays in the consenting process.

For Acceptable Solution H1/AS1 and Verification Method H1/VM1, sector feedback and BRANZ analysis helped us identify the following topics:

- **Topic 4:** The modelling method includes requirements that are unclear or outdated.
- **Topic 5:** Thermal bridging from framing in walls is not adequately considered.
- **Topic 6:** How the areas of roofs, walls and floors should be measured is unclear.
- **Topic 7:** NZS 4214 includes ambiguous instructions for determining the R-values of walls, roofs and some floors.
- **Topic 8:** For some mixed-use buildings it is unclear whether H1/AS1 and H1/VM1 can be used, or H1/AS2 and H1/VM2.
- **Topic 9:** The look-up tables with R-values for slab-on-ground floors do not cater for some common situations.
- **Topic 10**: The look-up table with R-values for vertical windows and doors in housing misses some common glazing types.
- **Topic 11**: Acceptable Solution H1/AS1 and Verification Method H1/VM1 include obsolete provisions and definitions, and outdated references to documents and tools.

2.7. Topic 4: The modelling method includes requirements that are unclear or outdated

2.7.1. Reasons for the change

The modelling method is based on computer simulation of the thermal and energy performance of the proposed building, and of a theoretical reference building which acts as a compliance benchmark. The simulations rely on several modelling inputs and assumptions that influence the modelling results and compliance outcomes. Verification Method H1/VM1 specifies modelling requirements and default assumptions that aim to achieve consistency in how buildings are simulated, and certainty that a building has enough insulation to comply.

Feedback from sector technical experts have helped MBIE identify some areas in the modelling method where current requirements and assumptions are unclear or outdated. This includes:

- **Uncertainty about what climate data best represents the climate at a building site.**

  All building modelling software requires climate information for the location of the proposed building, usually in the form of weather files.

  There is a wide range of weather files from various sources that either come with relevant modelling software or can be downloaded online. However, not all weather files are robust and up to date. This can affect the accuracy of the modelling and how much insulation is required for a building to comply.

- **Uncertainty about what solar heat gain coefficient should be modelled for glazing in the reference building.**
  The solar heat gain coefficient is a measure for how easily heat from solar radiation can pass through glazing into the building. It can vary widely for different glazing products and can have a big impact on

the thermal and energy performance of a building. Currently H1/VM1 does not specify the solar heat gain coefficient that modellers should assume for the theoretical reference building. This results in inconsistent compliance outcomes.

- **The current natural ventilation setpoint for housing does not adequately assess a building's ability to cool itself via open windows.**

  The natural ventilation setpoint is the indoor temperature at which the modelling software assumes that windows in the simulated building get opened to passively cool down the building.

  In H1/VM1, it is currently set at 24°C for housing, just one degree below the 25°C active cooling setpoint at which windows are simulated to close. This does not allow enough 'room' for natural ventilation to have much cooling effect. It contributes to cooling energy use results in the modelling method that may be unrealistically high and that distort compliance outcomes.

- **The current default modelling assumptions for internal heat gains from electrical plug loads and occupants are out of date and too high.**

  These are assumptions for how much heat is released inside a building from electrical appliances and the body heat from people.

  The current assumptions are out of date. They do not reflect the improved energy efficiency of modern appliances, and that new homes tend to be larger with fewer occupants than was historically the case. This affects the accuracy of modelling results and can distort compliance outcomes.

- **Deviations from default modelling assumptions are not always explained in building consent applications.**

  Deviation makes it more difficult for Building Consent Authorities to check if the modelling method was used correctly, and if a building complies.

2.7.2. Proposed changes

The proposed changes involve amendments to Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²*. They include:

- **Prescribing the use of the most recent NIWA weather files.**

  NIWA have recently produced updated weather files for use with building energy modelling software. These files include information about the present climate of the different parts of Aotearoa New Zealand and can be freely downloaded from MBIE's Building Performance website.

  MBIE proposes to prescribe the use of the new NIWA weather files for the present climate when using the modelling method, either directly or as climate data that have been converted from these weather files into the format required by the modelling software.

- **Specifying the solar heat gain coefficient to be modelled for glazing in the theoretical reference building.**

  MBIE proposes to add a new requirement that glazing in the reference building needs to be modelled with a solar heat gain coefficient of no less than 0.55 and no more than 0.6. These values correspond to the most used double-glazing products in new housing, with a Low E coating and a U_g-value of 1.1.

  This proposed change would better define the glazing properties in the theoretical reference building model but would not prescribe the type of glazing that can be used in the actual proposed building.

- **Reducing the natural ventilation setpoint for passive cooling from 24°C to 22°C for housing** to better assess a building's ability to cool itself via open windows.

- **Adjusting default modelling assumptions for internal heat gains from electrical plug loads and occupants.**

  For buildings classified as housing, MBIE proposes to reduce the default power density for internal gains from plug loads from currently 24.5 W/m^2 to 13.5 W/m^2.

  In combination with the existing H1/VM1 default percentages of maximum plug load for different times of day, the proposed new value better represents current typical electricity use and associated heat release from electrical appliances in Aotearoa New Zealand households. It is based on analysis of data from EECA's Energy End Use Database and comparisons to international building modelling standards.

  MBIE also proposes to simplify and reduce the default power density for internal gains from occupants (heat release from people's bodies). The current default assumption is 150 W for the first 50 m^2 floor area, plus 3 W/m^2 beyond that.

  The proposed new default assumption is 2.5 W/m^2, which equates to about one occupant for each 30 m^2 floor area. MBIE also proposes to make adjustments to account for the reduced amount of body heat that people release while sleeping at night.

- **Adding a new requirement for modellers to document and justify any deviations from default assumptions.** This is to improve transparency and make it easier for Building Consent Authorities to assess building consent applications that are based on the modelling method.

For more details of the proposed wording in H1/VM1, please refer to Appendix B.

2.7.3. Analysis of the proposed changes

The primary objective of the proposed changes is to support consistency of how the modelling method is applied and provide certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

For this issue, MBIE considers that the proposed changes to the modelling method will best achieve this objective.

MBIE expects that the impacts of this proposal include:

- **Improved accuracy of modelling results** that better reflect how buildings perform from updated modelling inputs and assumptions.
- **Better consistency and certainty of compliance** from clearer requirements.
- **Fewer delays in the building consenting process** from more transparent building consent documentation.
- **Upskilling required by building modellers** to adopt the proposed changes in their modelling practices.
- **Costs to some software providers** to incorporate the proposed changes in their building modelling software. Whilst most modelling software is generic, some tools have been specifically built to incorporate the H1/VM1 modelling method and would require updating.

On balance, MBIE considers that the benefits of the proposed exemption outweigh the costs.

2.7.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed changes were considered to address the issue more effectively.

These discounted options included:

- **Allowing the use of weather files with future-projected climate data in the modelling method.**

  Whilst MBIE has confidence in the robustness of the future-projected climate versions of NIWA's weather files[11], there has not been enough time since completion of these files to assess the potential impacts of their use in the modelling method.

  There is also great uncertainty about which climate change scenario may be most appropriate to use. MBIE may consider this option for a future update of H1/VM1.

- **Specifying a single value for the solar heat gain coefficient for glazing in the theoretical reference building.**

  MBIE considers that providing a narrow range of permitted values as proposed is more reasonable. This is because the solar heat gain coefficients of the most used double-glazing products in new housing vary slightly between suppliers.

  Whilst the proposed change only affects the theoretical reference building, the narrow range of permitted values will enable more modellers to use identical solar heat gain coefficients in both the proposed and reference building models. This saves time and costs in setting up these models, whilst still adequately achieving the objective of consistency.

We determined that the proposed approach of amending Verification Method H1/VM1 to clarify and update modelling method requirements is the most reasonable and effective option for achieving the objective.

2.7.5. Questions for the consultation Topic 4

4-1. Do you support amending Verification Method H1/VM1 as proposed to clarify and update requirements for the modelling method?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

4-2. Please explain your views.

[11] Also available on MBIE's Building Performance website.

2.8. Topic 5: Thermal bridging from framing in walls is not adequately considered

2.8.1. Reasons for the change

Many buildings in Aotearoa New Zealand have walls where thermal insulation is installed between timber or steel framing. The framing members act as thermal bridges. This is because heat can pass more easily through the framing materials than through the insulation. The more framing a wall has, the greater the thermal bridging effect that worsens the thermal resistance (R-value) of the wall.

With all compliance pathways for the H1 energy efficiency insulation provisions, designers need to determine the thermal resistance (R-value) of the proposed building elements that form part of a building's thermal envelope. Designers can either calculate the R-value or use tools with pre-calculated values such as the BRANZ House Insulation Guide.

For determining the R-value of framed walls, current requirements in Acceptable Solution H1/AS1 and Verification Method H1/VM1 require consideration of the effects of certain framing members but allow ignoring the effects of additional framing members at corners, junctions and around window and door openings. This significantly overestimates the R-value of framed walls.

In addition, designers will generally not know how much framing a building's walls require to meet structural and buildability requirements. This is because the required amount of framing in walls is generally determined by pre-nailed frame and truss manufacturers during the construction-stage of a building, which is after building consent. This means, with the current requirements there is great uncertainty about the amount of framing that should be assumed.

Research by Beacon Pathway from 2018[12] and 2021[13] suggests that industry commonly assume that framing accounts for 14 to 18% of a wall's area, whereas the actual timber framing fraction observed in a sample of 47 new detached houses ranged from 24 to 57%, with an average of 34%. It found that the observed amount of framing is generally necessary to meet structural and weathertightness requirements, and not excessive.

More recent data from PlaceMakers Manufacturing for a much larger random sample of 452 new residential and commercial buildings had an average framing percentage of 38% of the net wall area, ranging from 23 to 64%. Whilst framing percentages in this sample vary between individual buildings, there was no significant difference in average framing percentages for different building types, or for different spacings of regular studs and dwangs. MBIE considers this the most robust information on wall framing fractions currently available in Aotearoa New Zealand.

The big difference in commonly assumed and observed actual wall framing percentages means that wall R-values determined for demonstrating compliance with the H1 energy efficiency insulation provisions greatly overestimate actual wall R-values. For example, a timber-framed wall insulated to achieve a wall R-value of R2.0 using an assumed 18% framing percentage only achieves R1.6 if a more realistic framing percentage of 38% is considered.

2.8.2. Proposed changes

The proposed changes involve amendments to Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²*. Similar amendments are proposed for Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²*. They include:

[12] Ryan, V., Penny, G., Cuming, J., Baker, G and Mayes, I. (2019). Measuring the Extent of Thermal Bridging in External Timber-Framed Walls in New Zealand. Final Report – Building Levy Project LR11092. Report Wall/3 from Beacon Pathway Inc.

[13] Ryan, V., Penny, G., Cuming, J., Riley, M. (2021). Thermal Bridging in External Walls: Stage Two. Report by Beacon Pathway.

- Requiring a framing fraction of no less than 38% to be assumed when determining the construction R-value of framed walls, unless a designer can demonstrate that a lower framing fraction is justified. This would replace the current provision which requires consideration of the effects of certain framing members but not others.

- Reducing the wall R-value in the theoretical reference building of the calculation and modelling methods from R2.0 to R1.6. Equally, if MBIE was not to proceed with the proposed removal of the schedule method discussed in subsection 2.3 above, the minimum R-value for walls would be reduced from R2.0 to R1.6 in the schedule method.

For more details of the proposed wording, please refer to Appendix A for H1/AS1 and Appendix B for H1/VM1.

2.8.3. Analysis of the proposed changes

For this issue, the primary objective of the proposed changes is to support better consistency of accuracy between R-values of framed and non-framed walls and provide certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

A secondary objective is to avoid additional costs.

MBIE considers that the proposed changes to requirements for determining framed wall R-values will best achieve these objectives. MBIE expects that the impacts of this proposal include:

- **Better consistency and certainty of compliance from clearer requirements.**

- **Improved accuracy of calculation and modelling results used for establishing compliance** that better reflect how buildings perform. This is because of more accurate wall R-value inputs.

- **A more level playing field between buildings with framed and non-framed walls**. The currently permitted practice of overestimating R-values for framed walls puts buildings with non-framed walls, such as those made of structural insulated panels or with external insulation, at a disadvantage.

- **No additional work or costs for designers and Building Consent Authorities.**

  MBIE expects that designers will adopt the proposed default framing fraction of 38% in most situations and simply use this instead of their current lower framing fraction assumptions.

  Alternatively, where designers wish to use a lower value, they could request framing fraction information for their proposed building from a frame and truss manufacturer and provide it as justification with the building consent application.

  MBIE is aware of one frame and truss manufacturer offering this service already pre-consent and expects that other manufacturers would follow if the proposed changes were implemented.

- **No additional building costs.** The proposed adjustment of reference building wall R-values from R2.0 to R1.6 would ensure that the change in framing fraction would not result in required changes to the construction of buildings, or different specifications of required insulation products to achieve compliance.

On balance, MBIE considers that the benefits of the proposed changes outweigh the costs.

2.8.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed changes were considered to address the issue more effectively.

These discounted options included:

- **Requiring designers to use the actual framing fraction when determining the construction R-value of framed walls.**

  Whilst this option would be most accurate, MBIE does not consider it reasonably practicable. It could result in considerable additional work, delays and costs if frame and truss manufacturers had to provide information on actual framing fractions to designers pre-consent for every building with framed walls.

- **Not reducing the wall R-value in the theoretical reference building of the calculation and modelling methods to compensate for the proposed higher framing fraction assumption.**

  This option would require additional insulation and construction changes and not meet MBIE's objective of avoiding additional costs.

We determined that the proposed approach of amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 to better consider thermal bridging in framed walls is the most reasonable and effective option for achieving the objectives.

2.8.5. Questions for the consultation Topic 5

5-1. Do you support amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 as proposed to better consider thermal bridging in framed walls?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

5-2. Please explain your views.

2.9. Topic 6: How the areas of roofs, walls and floors should be measured is unclear

2.9.1. Reasons for the change

With all compliance pathways for the H1 energy efficiency insulation provisions, designers need to determine the areas of building elements. These areas are used to establish which compliance methods can be used for a proposed building, and as inputs for the calculation and modelling methods.

For the areas of roofs, walls, and floors there can be big differences depending on whether they are measured on the inside or on the outside of a building. This is because external measurements include the thickness of external building elements, whereas internal measurements do not.

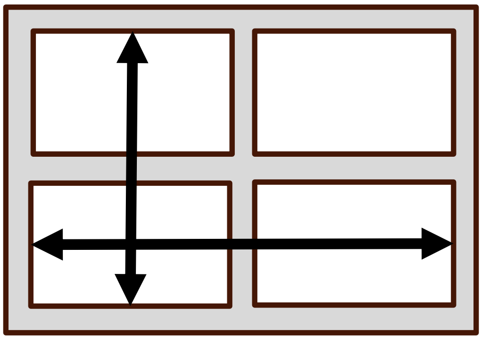
Acceptable Solution H1/AS1 and Verification Method H1/VM1 currently do not specify how the areas of roofs, walls and floors should be measured. This creates inconsistency and uncertainty of compliance.

2.9.2. Proposed change: Roofs, walls and floors to be measured using overall internal dimensions

The proposed change involves amendments to Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²* to require the areas of roofs, walls and floors to be measured using overall internal dimensions. Similar amendments are proposed for Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²*.

As shown in Figure 2-1 below, overall internal dimensions are measured between the internal surfaces of a building's envelope and include the thickness of any interior walls and floors.

Figure 2-1: Overall internal dimensions



For more details of the proposed wording, please refer to Appendix A for H1/AS1 and Appendix B for H1/VM1.

2.9.3. Analysis of the proposed change

For this issue, the primary objective of the proposed changes is to support better consistency and certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

For this issue, MBIE considers that the proposed changes will best achieve this objective by providing a clear requirement on how the areas of roofs, walls and floors are to be measured. MBIE does not expect this proposed change to result in any additional work or costs.

2.9.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed changes were considered to address the issue more effectively.

These discounted options included:

- **Requiring the use of external dimensions.**

  Whilst external dimensions are used in some industry building certification schemes like Passivhaus, MBIE does not considers the use of external dimensions appropriate for the H1 compliance methods. This is because the schedule and calculation methods have limits for the glazing area that are expressed as glazing area to wall area percentages.

  The assumed glazing area in the theoretical reference building of the calculation and modelling methods also depends on the wall area of a proposed building. The use of external dimensions would result in inconsistent compliance outcomes depending on the thickness of the roof, walls and floor of a building.

- **Requiring the use of internal dimensions that exclude the thickness of interior walls and floors.**

  Compared to the proposed option, this would require more work for designers to establish the areas of roofs, walls and floors, and would be less accurate given that interior walls and floors are part of a building's overall heated or cooled space.

We determined that the proposed approach of amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 to require roofs, walls and floors to be measured using overall internal dimensions is the most reasonable and effective option for achieving the objective.

2.9.5. Questions for the consultation Topic 6

6-1. Do you support amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 as proposed to improve certainty and consistency of compliance by requiring the areas of roofs, walls and floors to be measured using overall internal dimensions?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

6-2. Please explain your views.

2.10. Topic 7: NZS 4214 includes ambiguous instructions for determining the R-values of roofs, walls and some floors

2.10.1. Reason for the change

With all compliance pathways for the H1 energy efficiency insulation provisions, designers need to determine the thermal resistance (R-value) of the proposed building elements that form part of a building's thermal envelope. Designers can either calculate the R-value or use tools with pre-calculated values such as the BRANZ House Insulation Guide.

For roofs, walls and floors, Acceptable Solution H1/AS1 and Verification Method H1/VM1 currently require R-values to be determined using the methods described in New Zealand standard NZS 4214[14].

From discussions with technical experts MBIE identified that clause 5.7.1 (a) in NZS 4214 does not clearly define the boundaries of the bridged portion of a building element for the purpose of calculating its R-value. This can lead to incorrect results and creates uncertainty and inconsistency of compliance with the H1 energy efficiency insulation provisions.

2.10.2. Proposed change: Provide clear requirements on how to apply NZS 4214

The proposed change involves amendments to Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²* to provide clearer requirements for defining the boundaries of the bridged portion of a building element when calculating its R-value to NZS 4214. Similar amendments are proposed for Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²*.

MBIE proposes to add a modification to the current citation of NZS 4214 to H1/AS1 and H1/VM1, with replacement wording for clause 5.7.1 (a) in NZS 4214. See Table 2-2 below for a comparison of the status quo and the proposed modified wording.

Table 2-2: Modified citation for clause 5.7.1 (a) in NZS 4214 (status quo and proposed)

Status quo wording in NZS 4214	Proposed wording
(a) Select two planes to the plane of the wall, which enclose the portion of structure within which thermal bridging occurs	(a) The bridged portion of the structure encloses the layers within which thermal bridging occurs. Where multiple bridged layers are immediately adjacent, they shall all be included in the bridged portion. Where multiple bridged layers are separated by homogenous layer(s), they shall be treated as separate bridged portions. On each side, the bridged portion is defined to end at the nearest face of the next homogenous layer (parallel to the plane of the building envelope component), except where: i) that next homogenous layer is an insulation material or air cavity, in which case the insulation material or air cavity is to be included in the bridged portion ii) that next homogenous layer is in between two bridged layers, in which case half of the intermediary homogenous layer is included in each of the adjacent bridged portions

For more details of the proposed wording, please refer to Appendix A for H1/AS1 and Appendix B for H1/VM1.

[14] NZS 4214:2006 Methods of determining the total thermal resistance of parts of buildings

2.10.3. Analysis of the proposed change

For this issue, the primary objective of the proposed change is to support better consistency and certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

MBIE considers that the proposed changes will best achieve this objective by providing clearer requirements for defining the boundaries of the bridged portion of a building element when calculating its R-value using NZS 4214.

MBIE does not expect this proposed change to result in any additional work or costs. BRANZ have confirmed that the pre-calculated R-values in the House Insulation Guide already conform to the proposed new requirements.

2.10.4. Other options MBIE considered

For this issue, apart from retaining the status quo MBIE did not identify any other options.

2.10.5. Questions for the consultation Topic 7

7-1. Do you support amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 as proposed to improve certainty and consistency of compliance by providing clearer requirements for defining the boundaries of the bridged portion of a building element when calculating its R-value using NZS 4214?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don’t support it.
☐ Not sure/no preference.

7-2. Please explain your views.

2.11. Topic 8: For some mixed-use buildings it is unclear whether H1/AS1 and H1/VM1 can be used, or H1/AS2 and H1/VM2

2.11.1. Reason for the change

For the purposes of the Building Code buildings are categorised into different classified uses. The H1 energy efficiency insulation provisions only apply to buildings with classified uses of housing, communal residential, communal non-residential (assembly care) and commercial. They do not apply to buildings, or parts of buildings classified as industrial or communal non-residential (assembly service).

To demonstrate compliance with the Building Code's H1 energy efficiency insulation provisions, Acceptable Solution H1/AS1 and Verification Method H1/VM1 can be used for buildings classified as housing of any size, and for buildings up to 300 m^2 that are classified as communal residential, communal non-residential (assembly care) or commercial. Buildings greater than 300 m^2 that are classified as communal residential, communal non-residential (assembly care) or commercial fall within the scope of Acceptable Solution H1/AS2 and Verification Method H1/VM2.

With the current H1 acceptable solutions and verification methods it can be unclear which of these documents can be used for some mixed-use buildings.

When deciding which H1 acceptable solution or verification method applies to the parts of a building that are not housing, it is unclear whether the floor area of building parts classified as housing, industrial or communal non-residential (assembly service) should be considered. This creates uncertainty and inconsistency of compliance.

2.11.2. Proposed change

The proposed change involves amendments to Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²* to provide clearer requirements for establishing which of the H1 acceptable solutions and verification methods apply for mixed-use buildings. Similar amendments are proposed for Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²*.

MBIE proposes that for mixed-use buildings, any parts classified as housing, industrial or communal non-residential (assembly service) are not considered when determining whether the area of the building is greater than 300 m^2.

For more details of the proposed wording, please refer to Appendix A for H1/AS1 and Appendix B for H1/VM1.

2.11.3. Questions for the consultation Topic 8

8-1. Do you support amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 as proposed to improve certainty and consistency of compliance by providing clearer requirements for determining which compliance pathways can be used for a mixed-use building?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

8-2. Please explain your views.

2.12. Topic 9: The look-up tables with R-values for slab-on-ground floors do not cater for some common situations

2.12.1. Reasons for the change

With all compliance pathways for the H1 energy efficiency insulation provisions, designers need to determine the thermal resistance (R-value) of the proposed building elements that form part of a building's thermal envelope. For slab-on-ground floors, an easy way for designers is to look up the R-value of common types of slab construction from tables provided in Appendix F of Acceptable Solution H1/AS1. Calculating the R-value of a slab-on-ground floor requires specialist technical skills and software that most designers do not have.

Industry feedback and recent BRANZ analysis suggest that the current tables do not cover some common situations. This includes small slab-on-ground floors, and floors with slab edge insulation that does not go around the entire floor perimeter. For example, because of an attached garage.

This can make it difficult for designers and Building Consent Authorities to establish whether a building complies with the H1 energy efficiency insulation provisions.

2.12.2. Proposed changes

The proposed changes involve amendments to Acceptable Solution H1/AS1 *Energy Efficiency for all housing, and buildings up to 300m²* to enable the use of the look-up tables for slab-on-ground floor R-values for more situations. Similar changes are proposed for Acceptable Solution H1/AS2 *Energy Efficiency for buildings greater than 300m²*.

They include:

- **Adding rows to the existing slab-on-ground floor R-value look-up tables** in Appendix F of H1/AS1 for floors with area-to-perimeter ratios down to 0.6. Currently these tables only cover floors with area-to-perimeter ratios down to 1.6.
- **Adding instruction for interpolating between different tables** to enable determining the R-value of floors with slab edge insulation that does not go around the entire floor perimeter.

For more details of the proposed wording in H1/AS1, please refer to Appendix A.

2.12.3. Questions for the consultation Topic 9

9-1. Do you support amending Acceptable Solution H1/AS1 as proposed to make it easier for designers and Building Consent Authorities to establish whether a building complies with the H1 energy efficiency insulation provisions by enabling the use of the look-up tables for slab-on-ground floor R-values for more situations?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

9-2. Please explain your views.

2.13. Topic 10: The look-up table with R-values for vertical windows and doors in housing misses some common glazing types

2.13.1. Reason for the change

With all compliance pathways for the H1 energy efficiency insulation provisions, designers need to determine the thermal resistance (R-value) of the proposed building elements that form part of a building's thermal envelope. For vertical windows and doors in housing, an easy way for designers is to look up the R-value of common types of glazing from a Table E.1.1.1 in Appendix E of Acceptable Solution H1/AS1.

Industry feedback and recent BRANZ analysis suggest that the current table do not cover some common types of glazing with certain thermal performance characteristics. This can make it difficult for designers and Building Consent Authorities to establish whether a building complies with the H1 energy efficiency insulation provisions.

2.13.2. Proposed changes

The proposed changes involve amendments to Acceptable Solution H1/AS1 *Energy Efficiency for all housing, and buildings up to 300m²* to enable the use of the look-up table for vertical windows and doors in housing for more common types of glazing.

They include:

- **Adding rows to Table E.1.1.1** in Appendix E of H1/AS1 for windows and doors that have double glazing units with U_g-values of 2.9, 1.2 and 1.0 W/(m² K), and triple-glazing units with a U_g-value of 2.1 W/(m² K)
- **Removing rows for uncommon double-glazing units** with a U_g-value of 0.9 W/(m² K), and triple glazing units with a U_g-value of 1.89 W/(m² K).

For more details of the proposed wording in H1/AS1, please refer to Appendix A.

2.13.3. Questions for the consultation Topic 10

10-1. Do you support amending Acceptable Solution H1/AS1 as proposed to make it easier for designers and Building Consent Authorities to establish whether a building complies with the H1 energy efficiency insulation provisions by enabling the use of the look-up table for vertical windows and doors in housing for more common types of glazing?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

10-2. Please explain your views.

2.14. Topic 11: Acceptable Solution H1/AS1 and Verification Method H1/VM1 include obsolete provisions and definitions, and outdated references to documents and tools

2.14.1. Reason for the change

MBIE has identified obsolete and outdated provisions, definitions and references to documents and tools in Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²*.

2.14.2. Proposed changes

The proposed changes involve amendments to Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²* to make these documents more user-friendly and reduce the risk of misinterpretations that can create uncertainty and inconsistency of compliance.

The proposed changes include:

- Removing obsolete provisions that enabled an extended transition for increased insulation requirements for housing from changes made in 2021 and 2022
- Removing references to the Annual Loss Factor (ALF) tool which has been withdrawn by BRANZ, and removing definitions associated with calculating the Building Performance Index (BPI) that were reliant on the ALF tool
- Updating references to the latest editions of the BRANZ House Insulation Guide, AS/NZS4859.1[15], and the Passive House Planning Package (PHPP) tool
- Making other minor editorial changes to improve clarity and readability.

For more details of the proposed wording, please refer to Appendix A for H1/AS1 and Appendix B for H1/VM1.

2.14.3. Questions for the consultation Topic 11

11-1. Do you support amending Acceptable Solution H1/AS1 and Verification Method H1/VM1 as proposed to make these documents more user-friendly and reduce the risk of misinterpretations that can create uncertainty and inconsistency of compliance?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

11-2. Please explain your views.

2.14.4. Additional questions for Topics 4 to 11

SQ4. What impacts from the proposals for topics 4 to11 do you expect?
These may be economic/financial, environmental, health and wellbeing, or other areas.

[15] AS/NZS 4859.1:2018 Thermal insulation materials for buildings - Part 1: General criteria and technical provisions

SQ5. Is there any support that you or your business would need to implement the proposed changes for topics 4 to 11 if introduced?

SQ6. If there are other issues MBIE should consider to better support consistency and certainty of compliance and consenting for insulation in housing and small buildings, please tell us.

2.15. Summary of the proposals for housing and small buildings

TABLE 1-3: Summary of proposals to change Acceptable Solution H1/AS1 and Verification Method H1/VM1

Outcome	Potential changes

Optimising insulation to better balance upfront building costs and longer-term benefits	• Remove the schedule method from Acceptable Solution H1/AS1, leaving the calculation method and modelling method as compliance pathways.
	• Amend the minimum R-values in the calculation method to increase flexibility by:
	  ◦ Reducing the minimum possible R-value for roofs in the calculation method from R3.3 to R2.6
	  ◦ Removing the minimum possible R-value for slab-on-ground floors
	  ◦ Harmonising the minimum R-value for other floors to R1.3 across all climate zones.
	• Exempt buildings from the higher minimum R-values for heated building elements where embedded heating systems are solely used in bathrooms.

Consistency and certainty of compliance and consenting	• Clarify and update requirements for the modelling method by:
	  ◦ Prescribing the use of the most recent weather files from NIWA
	  ◦ Specifying the solar heat gain coefficient to be modelled for glazing in the reference building (proposed permitted range is no less than 0.55 and no more than 0.6)
	  ◦ Reducing the natural ventilation setpoint for passive cooling from 24°C to 22°C for housing
	  ◦ Adjusting default modelling assumptions for internal gains from electrical plug loads and occupants
	  ◦ Adding a new requirement for modellers to document and justify any deviations from default assumptions.
	• Require a framing fraction of no less than 38% to be assumed when determining the construction R-value of framed walls, unless a designer can demonstrate that a lower framing fraction is justified. Reduce the wall R-value in the reference building of the calculation and modelling methods from R2.0 to R1.6.
	• Require the areas of roofs, walls and floors to be measured using overall internal dimensions.
	• Modify the citation of NZS 4214 to calculate R-values.
	• Clarify requirements for establishing which of the H1 acceptable solutions and verification methods apply for mixed-use buildings and exclude the area of building parts that are classified as housing, industrial or communal-residential when determining the area of the building.
	• Amend H1/AS1 Table E.1.1.1 with construction R-values of selected windows and doors.
	• Expand the slab-on-ground floor performance tables in H1/AS1 Appendix F to cover more situations.
	• Remove references to the Annual Loss Factor (ALF) tool which has been withdrawn by BRANZ, and remove definitions associated with calculating the Building Performance Index (BPI) that were reliant on the ALF tool.
	• Update references to the latest editions of the BRANZ House Insulation Guide, AS/NZS4859.1, and the Passive House Planning Package (PHPP).
	• Make other minor editorial changes to improve clarity and readability.

For more details of the proposed wording, please refer to Appendix A for H1/AS1 and Appendix B for H1/VM1.

2.16. Transition period for housing and small buildings

Effective date: Subject to consultation outcome

Transitional arrangements: 12 months

It is proposed that the existing Acceptable Solutions and Verification Method will remain in force, as if not amended, for a period of 12 months from the date of publication (the proposed cessation date) as described in TABLE 2-4.

TABLE 2-4: Proposed transitional arrangements for Acceptable Solution H1/AS1 and Verification Method H1/VM1

Document	Before 'Publication' date	From 'Publication' date (effective date) To 12 months after 'Publication' date (cessation date)
Existing Acceptable Solution H1/AS1 and Verification Method H1/VM1	If used, will be treated as complying with the Building Code	If used, will be treated as complying with the Building Code
Amended Acceptable Solution H1/AS1 and Verification Method H1/VM1	Does not apply to Building Consents issued before this date	If used, will be treated as complying with the Building Code

2.16.1.1 Transition period for residential and small buildings H1/AS1 & H1/VM1

SQ7. Do you agree with the proposed transition time of 12 months for the proposed changes to take effect?

☐ Yes, it is about right.
☐ No, it should be longer (24 months or more).
☐ No, it should be shorter (less than 12 months).
☐ Not sure/no preference.

2.17. Effects of the H1 insulation requirements on overheating and dampness risks in new housing

2.17.1. MBIE commissioned research in response to concerns

In early 2024, concerns were raised about the insulation changes from 2021. This included concerns that the increased insulation causes dampness issues and overheating in new housing.

In response to these concerns, and to inform this review of the H1 settings, MBIE commissioned BRANZ to undertake a comprehensive technical analysis. This included assessing the risks of overheating, internal moisture and mould as result of the changes made to insulation in 2021.

2.17.2. Overheating risk findings

Overheating risk is generally greatest during daytime. BRANZ's analysis shows that the increased H1 insulation requirements from the 2021 changes help to reduce daytime overheating risks compared to the previous H1 settings. Increased insulation in the roof, wall, and windows typically reduce the risk of overheating during the daytime by reducing solar gain. However, the increased insulation also slows the cooling down of a building overnight.

Many factors can contribute to overheating in buildings. This includes ventilation, building orientation and shading, window size and glazing. A poorly ventilated building with large windows may overheat where the design does not effectively allow for managing heating loads and cooling demands.

The Building Code sets the minimum performance a building must achieve; however it currently does not have a performance requirement to manage overheating in buildings, allowing some building designs to be at risk of overheating, irrespective of insulation levels. Potentially guidance, new H1 solutions, regulation, or some other approach could support designers with this potential risk.

2.17.3. Internal moisture risk findings

BRANZ's analysis also found that the increased H1 insulation requirements are not increasing internal moisture risks in buildings. While higher insulation levels can influence the dynamic of internal moisture, key factors affecting internal moisture were found to be wall cladding colour, roof colour, the amount of moisture released inside a building and a building's orientation.

Currently the Building Code sets minimum performance requirements for internal moisture under Clause E3.

2.17.4. Managing overheating and internal moisture in homes

SQ8. If you think MBIE should support building designers with designing homes that safeguard building occupants from high indoor temperatures in summer (overheating) and other potential moisture risks, what approach should MBIE take?

3. Insulation in large buildings

This section covers energy efficiency for large buildings greater than 300m^2 other than housing. The proposals relate to ways to amend the Acceptable Solution H1/AS2 and Verification Method H1/VM2 to:

- Optimise insulation to better balance upfront building costs and longer-term benefits
- Improve the consistency and certainty of compliance and consenting of buildings regarding insulation requirements and energy efficiency.

3.1. Background on energy efficiency for large buildings

3.1.1. There are currently three main ways to comply

Like for housing and small buildings, there are three compliance pathways for the H1 energy efficiency insulation provisions for large buildings:

- the **schedule method** which prescribes tabulated minimum construction R-values for the roof, walls, windows, doors, skylights and floors of a building based on its location in the country.
- the **calculation method** which is based on simple equations and allows a designer to customise the insulation levels between different building elements to give the same relative heat loss as a building that complies with the schedule method.
- the **modelling method** which uses computer modelling to demonstrate that the proposed building does not require more heating and cooling energy than a reference building that complies with the schedule method. It provides the greatest flexibility to customise insulation levels.

3.1.2. Insulation requirements vary between six climate zones

The insulation requirements specified in Acceptable Solution H1/AS2 and Verification Method H1/VM2 for large buildings vary between the same six climate zones that are also used for housing and small buildings.

3.2. Optimising insulation to better balance upfront building costs and longer-term benefits

3.2.1. Topics identified

The upfront cost of insulation in buildings is offset by ongoing benefits including reduced heating and cooling bills, and improved occupant comfort. There are differences to the degree to which the three compliance methods enable designers to optimise insulation levels for a particular building and strike the right balance between upfront building costs and long-term benefits.

Recent sector engagement identified that:

- **Topic 12:** The schedule method may lead to less cost-effective construction than the more flexible calculation and modelling methods.
- **Topic 13:** The calculation method for large buildings does not provide flexibility for roof, skylight and floor R-values, limiting opportunities for optimising insulation.
- **Topic 14:** Where underfloor heating is only used in bathrooms, the minimum R-values for heated floors may cause unreasonable upfront costs.

3.3. Topic 12: The schedule method may lead to less cost-effective construction than the more flexible calculation and modelling methods

3.3.1. Reason for the change

When using the schedule method, designers do not need to consider what insulation levels (R-values) are most appropriate and cost-effective for the various elements of a particular building.

Designers can simply specify constructions that achieve the prescribed minimum R-values. Building Consent Authorities can easily check if a building complies by comparing the specified construction R-values against the schedule method R-values. This provides a high degree of certainty whether a proposed building design complies.

Whilst the simplicity and certainty provide an incentive for designers to use the schedule method, this can come at the expense of higher building costs ultimately faced by building owners and businesses.

The calculation and modelling methods provide more flexibility that enables the use of different insulation levels (R-values) than the schedule method. This can help reduce upfront building costs and improve the overall cost-effectiveness of the insulation in a building.

Industry feedback indicates that for large buildings it is already more common for designers to use the calculation and modelling methods to demonstrate compliance with the H1 insulation provisions. Large buildings other than housing are more varied in design and less likely to fit within the scope of the schedule method.

3.3.2. Proposed change: Remove the schedule method

The proposed change includes removing the schedule method, leaving the calculation and modelling methods as compliance pathways. This proposed change involves amendments to Acceptable Solution H1/AS2 *Energy Efficiency for buildings greater than 300m²*. For more details of the proposed wording in H1/AS2, please refer to Appendix C.

3.3.3. Analysis of removing the schedule method

The primary objective of this proposal is to reduce upfront building costs and improve the cost-effectiveness of the insulation required for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

MBIE considers that removing the schedule method will best achieve this objective by better encouraging building designers to optimise insulation levels for each building they are designing.

Removing the schedule method will increase the use of the remaining calculation and modelling methods. Compared to the schedule method, the calculation and modelling methods enable reductions in upfront building costs from optimised insulation levels tailored to the individual building, whilst still achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

MBIE expects that the impacts of removing the schedule method include:

- **Lower upfront building costs.**
  Removing the schedule method will encourage designers to optimise their insulation solution for each building, reducing upfront costs while maintaining compliance.

- **Higher energy usage (running costs and carbon emissions)** for heating and cooling in new large buildings.
  This is because the calculation and modelling methods can enable compliance with less insulation than the schedule method. However, MBIE expects that the estimated costs from additional energy use by using the calculation or modelling methods instead of the schedule method are relatively modest in comparison to the savings in build costs.

- **More work for designers and Building Consent Authorities when establishing compliance.**
  The removal of the schedule method will require designers to calculate or model the insulation required.

  Alternatively, designers may choose to hire specialists or invest in software tools capable of performing complex energy modelling, which could increase costs.

  Increased use of the calculation and modelling methods may also require more detailed in-depth checks by Building Consent Authorities. This could add a small amount of time to the processing of consents. MBIE expects that these costs will be less than the potential savings in upfront costs from optimised insulation.

- **Upskilling required by the industry.**
  Removing the schedule method may feel like a big step for some designers and MBIE would work with the industry to support this transition and help designers become competent with the use of the calculation method, including supporting the creation and use of user-friendly online tools that implement the calculation method for large buildings.

- **More innovation.**
  Removing the schedule method could encourage innovation within the industry as practitioners explore new ways of achieving compliance. This could lead to increased development and uptake of innovative products, technologies or design methods that improve building performance.

On balance, MBIE considers that the benefits of removing the schedule method outweigh the costs.

3.3.4. Other options considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed option was considered to address the issue more effectively.

These discounted options included:

- **Providing multiple combinations of R-values** for the roof, walls, windows and floor in the schedule method that designers could choose from:

  Currently the schedule method only provides one combination for each climate zone. MBIE considers this option less practicable and effective than the proposed removal of the schedule method.

  The most cost-effective combination of insulation for achieving compliance depends on many factors, including the material supply and labour costs applicable to a particular building, a building's shape and size of glazing areas.

  Using the calculation or modelling methods was identified as being more effective for providing the flexibility to optimise insulation.

- **Increasing awareness and providing education for building designers about other compliance methods**:
  Given that the calculation and modelling methods have been available for over twenty years MBIE does not consider a lack of awareness of the other compliance methods to be a current barrier. Whilst additional education would help some designers switch away from the schedule method, the proposed option is considered to be more effective.

MBIE determined that the proposed approach of amending Acceptable Solution H1/AS2 to remove the schedule method is the most reasonable and effective option for achieving the objective of reducing upfront building costs and improving the cost-effectiveness of the insulation required for achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

3.3.5. Questions for the consultation Topic 12

12-1. Do you support amending Acceptable Solution H1/AS2 as proposed to remove the schedule method?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

12-2. Please explain your views.

3.4. Topic 13: The calculation method does not provide flexibility for roof, skylight and floor R-values, limiting opportunities for optimising insulation

3.4.1. Reason for the change

The calculation method uses simple equations and allows a designer to customise the insulation levels between different building elements.

A proposed building must not exceed the calculated heat loss of a theoretical reference building that is insulated with R-values that match those of the current schedule method.

The calculation method offers more flexibility but currently allows designers to vary the R-values of the walls, doors and windows only. For the roof, skylights and floor, the calculation method for large buildings has fixed minimum R-values.

Industry feedback suggests that the current inflexibility for roofs, skylights and floors results in unnecessarily costly and complex construction in some buildings.

A common example is a large commercial warehouse where the only heated and cooled space is a small office area. Here, achieving the minimum R-values for the office floor can be difficult and costly because its area is so small.[16]

Whilst designers can choose to use the modelling method in such situations (which provides full flexibility for the R-values of all building elements), this is more time-consuming and requires access to modelling tools and specialist technical skills that not all designers have.

3.4.2. Proposed change: Allow flexibility for the R-values of all building elements in the calculation method

The proposed change includes adjusting the heat loss equations for the proposed and theoretical reference buildings in the calculation method to allow flexibility for the R-values of all building elements that form part of a building's thermal envelope. This proposed change involves amendments to Acceptable Solution H1/AS2 *Energy Efficiency for buildings greater than 300m²*. For more details of the proposed wording in H1/AS2, please refer to Appendix C.

3.4.3. Analysis of the proposed change

The primary objective of this proposal is to reduce upfront building costs and improve the cost-effectiveness of the insulation required for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

MBIE considers that allowing flexibility for the R-values of all building elements in the calculation method will best achieve this objective. The proposed change will enable building designers avoid complex and costly constructions in the situation described in subsection3.4.1 above, without having to use the more time-consuming and complex modelling method.

Compared to the status quo, MBIE considers that this proposal will reduce upfront costs for some buildings, whilst still achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

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[16] This is because the achieved R-value depends on the ratio between the area of the slab-on-ground floor, and its perimeter. For this, only the parts of the floor under spaces that can be heated or cooled are considered. The lower the area-to-perimeter ratio, the lower the achieved R-value of a slab-on-ground floor of a particular construction and insulation.

MBIE expects that the impacts of allowing flexibility for the R-values of all building elements in the calculation method as proposed include:

- **Lower upfront building costs.**

  Building designers using the calculation method will be better able to optimise insulation for each individual building and avoid complex and costly constructions, for example in large buildings with small heated or cooled spaces.

- **Less work for designers and Building Consent Authorities** when establishing compliance.

  Designers wanting to avoid complex and costly insulation solutions will be able to use the calculation method, rather than the more time-consuming and complex modelling method.

- **No significant change to a building's energy usage (running costs and carbon emissions).**

  Whilst the proposed change will increase the flexibility of the calculation method, it will not change the required overall thermal performance of the building.

  The maximum permitted calculated heat loss of a proposed building will remain unchanged and continue to be based on the calculated heat loss of a theoretical reference building.

  Where a designer reduces roof, skylight or floor R-values as a result of the proposed added flexibility, this will need to be compensated for in other parts of a building's thermal envelope.

- **More innovation.**

  Increased flexibility of the calculation method could encourage innovation within the industry as practitioners explore new ways of achieving compliance. This could lead to increased development and uptake of innovative products, technologies or design methods that improve building performance.

On balance, MBIE considers that the benefits of adjusting the minimum possible R-values in the calculation method as proposed outweigh the costs.

3.4.4. Other options MBIE considered

Apart from the retaining the status quo MBIE did not consider any other options.

3.4.5. Questions for the consulation Topic 13

13-1. Do you support amending Acceptable Solution H1/AS2 to allow flexibility for the R-values of all building elements in the calculation method as proposed?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

13-2. Please explain your views.

3.5. Topic 14: Where underfloor heating is only used in bathrooms, the minimum R-values for heated floors may cause unreasonable upfront costs

3.5.1. Reason for the change

Building elements that are part of the thermal envelope and have embedded heating systems, such as floors with inbuilt underfloor heating, must meet certain minimum R-values. These R-values are higher than the schedule method minimum R-values.

The minimum R-values for building elements with embedded heating apply irrespective of the chosen compliance pathway. They cannot be reduced by using the calculation or modelling methods. These higher minimum R-values aim to ensure that heated building elements have adequate thermal resistance to prevent excessive heat loss, enable efficient and effective operation of the embedded heating system and limit heating energy use and costs.

Achieving the minimum R-values for heated building elements typically requires more insulation and upfront building costs. Where the embedded heating is used for general space heating across large parts of a building, these additional costs are generally outweighed by the ongoing energy cost savings from the additional insulation.

However, it is common for new buildings to have underfloor or undertile heating solely in bathrooms. Where underfloor or undertile heating covers only a very small part of a building's floor, the additional costs from achieving the minimum R-values for heated building elements may not be justified.

In particular, common insulation solutions for slab-on-ground floors, such as underslab and slab-edge insulation, cannot be isolated to just the part of the floor that is heated. Instead, to be effective such insulation needs to be applied to the entire floor.

3.5.2. Proposed change: Exempt embedded heating solely used in bathrooms from additional insulation

The proposed change includes exempting buildings from the higher minimum R-values for heated building elements where embedded heating systems are solely used in bathrooms. This proposed change involves amendments to Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²*. For more details of the proposed wording, please refer to Appendix C for H1/AS2 and Appendix D for H1/VM2.

Similar amendments are proposed for Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m².*

For clarity, if MBIE was not to proceed with the proposed removal of the schedule method discussed in subsection 3.3 above, the exempt bathroom heated building elements would still need to achieve the schedule method R-values.

3.5.3. Analysis of the proposed change

The primary objective of this proposal is to reduce upfront building costs and improve the cost-effectiveness of the insulation required for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

For this issue, MBIE considers that the proposed exemption for embedded heating solely used in bathrooms will best achieve this objective. Compared to the status quo, MBIE considers that the proposed exemption will reduce upfront costs for some buildings, whilst still achieving 'adequate thermal resistance' as required by Building Code clause H1.3.1(a).

MBIE expects that the impacts of this proposal include:

- **Lower upfront building costs.** The proposed change will enable building designers avoid disproportionately complex insulation solutions that create costs that may not be justified.
- **Higher energy usage (running costs and carbon emissions).** Reducing thermal insulation under embedded heating reduces energy efficiency by increasing heat loss. However, as bathrooms are typically small this impact will be modest.

On balance, MBIE considers that the benefits of the proposed exemption outweigh the costs.

3.5.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed option was considered to address the issue more effectively.

These discounted options included:

- **Removing the higher minimum R-values for building elements with embedded heating:**

  MBIE considers that this option would not achieve 'adequate thermal resistance' as required by Building Code clause H1.3.1(a). It would result in excessive heat loss, energy use and heating costs, particularly where embedded heating covers large areas.

- **Reducing the minimum R-values for building elements with embedded heating.**

  MBIE does not consider this option reasonable because the status quo minimum R-values are generally appropriate, except where embedded heating only covers a small area.

- **Extending the proposed exemption to other areas, such as kitchens.**

  MBIE does not propose this option because spaces other than bathrooms would typically have larger embedded heating systems where the additional insulation to meet the minimum R-values for building elements with embedded heating is generally justified.

We determined that the proposed approach of amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 to exempt heated building elements where embedded heating systems are solely used in bathrooms is the most reasonable and effective option for achieving the objective.

3.5.5. Questions for consultation Topic 14

14-1. Do you support amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 as proposed to reduce upfront costs and improve the cost-effectiveness of insulation by exempting building elements with embedded heating from higher minimum R-values where embedded heating systems are solely used in bathrooms?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

14-2. Please explain your views.

3.5.6. Additional questions for topics 12 to 14

SQ9. What impacts from the proposals for topic 12 to 14 do you expect? These may be economical/financial, environmental, health and wellbeing, or other areas.

SQ10. Is there any support that you or your business would need to implement the proposed changes for topics 12 to 14 if introduced?

SQ11. If there are other issues MBIE should consider to better balance upfront building costs and longer-term benefits of insulation in large buildings other than housing, please tell us.

3.6. Consistency and certainty of compliance and consenting

3.6.1. Topics identified

Clear and up-to-date requirements in acceptable solutions and verification methods support consistency of how the requirements are applied and help provide certainty for designers, Building Consent Authorities and building users that buildings comply with the Building Code. This also helps avoid unnecessary delays in the consenting process.

For Acceptable Solution H1/AS2 and Verification Method H1/VM2, sector feedback helped us identify the following issues:

- **Topic 15:** The modelling method includes requirements that are unclear or outdated.
- **Topic 16:** The schedule method does not adequately limit heat losses and gains from skylights in large buildings.
- **Topic 17:** Thermal bridging from framing in walls is not adequately considered.
- **Topic 18:** How the areas of roofs, walls and floors should be measured is unclear.
- **Topic 19:** NZS 4214 includes ambiguous instructions for determining the R-values of walls, roofs and some floors.
- **Topic 20:** For some mixed-use buildings it is unclear whether H1/AS1 and H1/VM1 can be used, or H1/AS2 and H1/VM2.
- **Topic 21:** The look-up tables with R-values for slab-on-ground floors do not cater for some common situations.
- **Topic 22**: Acceptable Solution H1/AS2 and Verification Method H1/VM2 include obsolete provisions and definitions, and outdated references to documents and tools.

3.7. Topic 15: The modelling method includes requirements that are unclear or outdated

3.7.1. Reasons for the change

The modelling method is based on computer simulation of the thermal and energy performance of the proposed building, and of a theoretical reference building which acts as a compliance benchmark.

The simulations rely on several modelling inputs and assumptions that influence the modelling results and compliance outcomes. Verification Method H1/VM2 specifies modelling requirements and default assumptions that aim to achieve consistency in how buildings are simulated, and certainty that a building has enough insulation to comply.

Feedback from sector technical experts has helped MBIE identify some areas in the modelling method where current requirements and assumptions are unclear or unnecessary. This includes:

- **Uncertainty about what climate data best represents the climate at a building site.**

  All building modelling software requires climate information for the location of the proposed building, usually in the form of weather files.

  There is a wide range of weather files from various sources that either come with relevant modelling software or can be downloaded online. However, not all weather files are robust and up to date. This can affect the accuracy of the modelling and how much insulation is required for a building to comply.

- **An unnecessary requirement to model HVAC systems.**

  For commercial buildings, the H1/VM2 modelling method currently requires heating, ventilation and air-conditioning (HVAC) systems to be simulated, even though this part of the modelling has no impact on whether a building complies with the H1 energy efficiency insulation provisions. Whilst Building Code clause H1.3.6 has energy efficiency requirements for HVAC systems in commercial buildings, H1/VM2 is not a compliance pathway for those requirements[17].

- **Deviations from default modelling assumptions are not always explained in building consent applications.**

  This makes it more difficult for Building Consent Authorities to check if the modelling method was used correctly, and if a building complies.

3.7.2. Proposed changes

The proposed changes involve amendments to Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²*. They include:

- **Prescribing the use of the most recent NIWA weather files.**

  NIWA have recently produced updated weather files for use with building energy modelling software. These files include information about the present climate of the different parts of Aotearoa New Zealand and can be freely downloaded from MBIE's Building Performance website.

  MBIE proposes to prescribe the use of the new NIWA weather files for the present climate when using the modelling method, either directly or as climate data that have been converted from these weather files into the format required by the modelling software.

[17] Instead, designers can use Verification Method H1/VM3 *Energy Efficiency of HVAC systems in commercial buildings* to demonstrate compliance with Building Code clause H1.3.6.

- **Removing the requirement to model HVAC systems.**

  Verification Method H1/VM3 *Energy Efficiency of HVAC systems in commercial buildings* provides a compliance pathway to demonstrate compliance with Building Code clause H1.3.6 (Energy efficiency of HVAC systems).

- **Adding a new requirement for modellers to document and justify any deviations from default assumptions.**

  This is to improve transparency and make it easier for Building Consent Authorities to assess building consent applications that are based on the modelling method.

For more details of the proposed wording in H1/VM2, please refer to Appendix D.

3.7.3. Analysis of the proposed changes

The primary objective of the proposed changes is to support consistency of how the modelling method is applied and provide certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

For this issue, MBIE considers that the proposed changes to the modelling method will best achieve this objective.

MBIE expects that the impacts of this proposal include:

- **Improved accuracy of modelling results** that better reflect how buildings perform from updated climate data as modelling inputs.
- **Better consistency and certainty of compliance** from clearer requirements.
- **Fewer delays in the building consenting process** from more transparent building consent documentation.
- **Less work for building modellers** from the removal of the requirement to model HVAC systems.

On balance, MBIE considers that the benefits of the proposed exemption outweigh the costs.

3.7.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed changes were considered to address the issue more effectively.

These discounted options included:

- **Allowing the use of weather files with future-projected climate data in the modelling method.**

  Whilst MBIE has confidence in the robustness of the future-projected climate versions of NIWA's weather files[18], there has not been enough time since completion of these files to assess the potential impacts of their use in the modelling method.

  There is also great uncertainty about which climate change scenario may be most appropriate to use. MBIE may consider this option for a future update of H1/VM2.

- **Making the H1/VM2 modelling method an additional compliance pathway for the H1 Energy Efficiency requirements for HVAC systems in commercial buildings.**

[18] Also available on MBIE's Building Performance website.

Whilst MBIE considers that computer modelling of HVAC systems could form the basis of a compliance pathway for HVAC system energy efficiency in the future[19].

The current H1/VM2 modelling method is currently not set up for the computer modelling of HVAC systems.

Significant analysis would be required to help develop a computer-modelling based compliance pathway for demonstrating compliance with Building Code clause H1.3.6.

MBIE have determined that the proposed approach of amending Verification Method H1/VM2 to clarify and simplify modelling method requirements is the most reasonable and effective option for achieving the objective.

3.7.5. Questions for the consultation Topic 15

15-1. Do you support amending Verification Method H1/VM2 as proposed to clarify and simplify requirements for the modelling method?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

15-2. Please explain your views.

[19] In addition to the current Verification Method H1/VM3 *Energy Efficiency of HVAC systems in commercial buildings*.

3.8. Topic 16: The schedule method does not adequately limit heat losses and gains from skylights in large buildings

3.8.1. Reasons for the change

Skylights are one of the weakest parts of a building's thermal envelope. On a per square metre basis, heat losses and gains through skylights are significantly greater than through other parts of the roof.

Currently the schedule method does not limit the area of skylights in large buildings, allowing buildings to have large areas of their roof covered with skylights that can contribute to significant heat losses and gains, poor energy efficiency and thermal discomfort for occupants.

The proposal to remove the schedule method from Acceptable Solution H1/AS2 discussed in subsection 3.3 above would resolve this issue. However, depending on the feedback on this consultation, MBIE could decide not to proceed with that proposal.

3.8.2. Proposed change

The proposed change involves amendments to Acceptable Solution H1/AS2 *Energy Efficiency for buildings greater than 300m^2* to limit the permitted area of skylights in the schedule method to 1.5% of the roof area. This proposal is only relevant if MBIE's other proposal to remove the schedule method discussed in subsection 3.3 above does not proceed.

3.8.3. Analysis of the proposed change

The primary objective of the proposed change is to support consistency and provide certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

For this issue, MBIE considers that the proposed changes will best achieve this objective in case the proposal to remove the schedule method does not proceed.

MBIE expects that the impacts of this proposal include:

- **Lower energy usage (running costs and carbon emissions) from improved energy efficiency**
- **Better consistency of compliance**
- **More work for designers and Building Consent Authorities when establishing compliance.** For buildings with skylight areas above the proposed limit, designers would need to use the calculation or modelling method instead.

On balance, MBIE considers that the benefits of the proposed change outweigh the costs.

3.8.4. Questions for consultation Topic 16

16-1. Do you support amending Acceptable Solution H1/AS2 to introduce a limit on the skylight area in the schedule method in H1/AS2 (in case MBIE does not proceed with the proposed removal of the schedule method from H1/AS2)?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

16-2. Please explain your views.

3.9. Topic 17: Thermal bridging from framing in walls is not adequately considered

3.9.1. Reason for change

As discussed for housing and small buildings in subsection 2.8 above, current requirements for determining the R-value of framed walls in the H1 acceptable solutions and verification methods significantly overestimate R-values for framed walls. There is also great uncertainty about the amount of framing that should be assumed when determining framed wall R-values. The same issues exist for large buildings within the scope of H1/AS2 and H1/VM2.

3.9.2. Proposed changes

The proposed changes involve amendments to Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²*. Similar amendments are proposed for Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²*. They include:

- Requiring a framing fraction of no less than 38% to be assumed when determining the construction R-value of framed walls, unless a designer can demonstrate that a lower framing fraction is justified. This would replace the current provision which requires consideration of the effects of certain framing members but not others.

- Reducing the wall R-values across the six climate zones for the theoretical reference building of the calculation and modelling methods to compensate so that the introduction of the default 38% framing fraction would not result in additional costs. Equally, if MBIE was not to proceed with the proposed removal of the schedule method discussed in subsection 2.3 above, the minimum R-values for walls would be reduced in the schedule method.

For more details of the proposed wording, please refer to Appendix C for H1/AS2 and Appendix D for H1/VM2.

3.9.3. Analysis of the proposed changes

For this issue, the primary objective of the proposed changes is to support better consistency of accuracy between R-values of framed and non-framed walls and provide certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

A secondary objective is to avoid additional costs.

MBIE considers that the proposed changes to requirements for determining framed wall R-values will best achieve these objectives. MBIE expects that the impacts of this proposal include:

- **Better consistency and certainty of compliance from clearer requirements.**
- **Improved accuracy of calculation and modelling results used for establishing compliance** that better reflect how buildings perform. This is because of more accurate wall R-value inputs.
- **A more level playing field between buildings with framed and non-framed walls**.
  The currently permitted practice of overestimating R-values for framed walls puts buildings with non-framed walls, such as those made of structural insulated panels or with external insulation, at a disadvantage.

- **No additional work or costs for designers and Building Consent Authorities.**

  MBIE expects that designers will adopt the proposed default framing fraction of 38% in most situations and simply use this instead of their current lower framing fraction assumptions.

  Alternatively, where designers wish to use a lower value, they could request framing fraction information for their proposed building from a frame and truss manufacturer and provide it as justification with the building consent application.

  MBIE is aware of one frame and truss manufacturer offering this service already pre-consent and expects that other manufacturers would follow if the proposed changes were implemented.

- **No additional building costs.**

  The proposed adjustment of reference building wall R-values would ensure that the change in framing fraction would not result in required changes to the construction of buildings, or different specifications of required insulation products to achieve compliance.

On balance, MBIE considers that the benefits of the proposed changes outweigh the costs.

3.9.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed changes were considered to address the issue more effectively.

These discounted options included:

- **Requiring designers to use the actual framing fraction when determining the construction R-value of framed walls.**

  Whilst this option would be most accurate, MBIE does not consider it reasonably practicable. It could result in considerable additional work, delays and costs if frame and truss manufacturers had to provide information on actual framing fractions to designers pre-consent for every building with framed walls.

- **Not reducing the wall R-values in the theoretical reference building of the calculation and modelling methods to compensate for the proposed higher framing fraction assumption.**

  This option would require additional insulation and construction changes and not meet MBIE's objective of avoiding additional costs.

We determined that the proposed approach of amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 to better consider thermal bridging in framed walls is the most reasonable and effective option for achieving the objectives.

3.9.5. Questions for the consultation Topic 17

17-1. Do you support amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 as proposed to better consider thermal bridging in framed walls?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

17-2. Please explain your views.

3.10. Topic 18: How the areas of roofs, walls and floors should be measured is unclear

3.10.1. Reasons for the change

As discussed for housing and small buildings in subsection 2.9 above, with all compliance pathways for the H1 energy efficiency insulation provisions, designers need to determine the areas of building elements. These areas are used to establish which compliance methods can be used for a proposed building, and as inputs for the calculation and modelling methods.

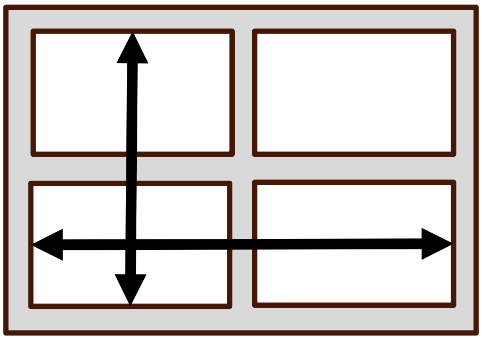
The H1 acceptable solutions and verification methods currently do not specify how the areas of roofs, walls and floors should be measured. This creates inconsistency and uncertainty of compliance, including for large buildings within the scope of Acceptable Solution H1/AS2 and Verification Method H1/VM2.

3.10.2. Proposed change: Roofs, walls and floors to be measured using overall internal dimensions

The proposed change involves amendments to Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m^2* to require the areas of roofs, walls and floors to be measured using overall internal dimensions. Similar amendments are proposed for Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m^2*.

As shown in Figure 3-1 below, overall internal dimensions are measured between the internal surfaces of a building's envelope and include the thickness of any interior walls and floors.

Figure 3-1: Overall internal dimensions



For more details of the proposed wording, please refer to Appendix C for H1/AS2 and Appendix D for H1/VM2.

3.10.3. Analysis of the proposed change

For this issue, the primary objective of the proposed changes is to support better consistency and certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

For this issue, MBIE considers that the proposed changes will best achieve this objective by providing a clear requirement on how the areas of roofs, walls and floors are to be measured. MBIE does not expect this proposed change to result in any additional work or costs.

3.10.4. Other options MBIE considered

As part of the analysis, we also considered other options that were not further pursued on the basis that the proposed changes were considered to address the issue more effectively. For more details, see subsection 2.9.4 above.

3.10.5. Questions for the consultation Topic 18

18-1. Do you support amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 as proposed to improve certainty and consistency of compliance by requiring the areas of roofs, walls and floors to be measured using overall internal dimensions?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don’t support it.
☐ Not sure/no preference.

18-2. Please explain your views.

3.11. Topic 19: NZS 4214 includes ambiguous instructions for determining the R-values of roofs, walls and some floors

3.11.1. Reason for the change

As discussed for housing and small buildings in subsection 2.10 above2.9 above, with all compliance pathways for the H1 energy efficiency insulation provisions, designers need to determine the thermal resistance (R-value) of the proposed building elements that form part of a building's thermal envelope.

For roofs, walls and floors, the H1 acceptable solutions and verification methods currently require R-values to be determined using the methods described in New Zealand standard NZS 4214[20].

From discussions with technical experts MBIE identified that clause 5.7.1 (a) in NZS 4214 does not clearly define the boundaries of the bridged portion of a building element for the purpose of calculating its R-value. This can lead to incorrect results and creates uncertainty and inconsistency of compliance with the H1 energy efficiency insulation provisions.

3.11.2. Proposed change: Provide clear requirements on how to apply NZS 4214

The proposed change involves amendments to Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m²* to provide clearer requirements for defining the boundaries of the bridged portion of a building element when calculating its R-value to NZS 4214. Similar amendments are proposed for Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²*.

MBIE proposes to add a modification to the current citation of NZS 4214 to H1/AS2 and H1/VM2, with replacement wording for clause 5.7.1 (a) in NZS 4214. See Table 3-1 below for a comparison of the status quo and the proposed modified wording.

Table 3-1: Modified citation for clause 5.7.1 (a) in NZS 4214 (status quo and proposed)

Status quo wording in NZS 4214	Proposed wording
(a) Select two planes to the plane of the wall, which enclose the portion of structure within which thermal bridging occurs	(a) The bridged portion of the structure encloses the layers within which thermal bridging occurs. Where multiple bridged layers are immediately adjacent, they shall all be included in the bridged portion. Where multiple bridged layers are separated by homogenous layer(s), they shall be treated as separate bridged portions. On each side, the bridged portion is defined to end at the nearest face of the next homogenous layer (parallel to the plane of the building envelope component), except where: i) that next homogenous layer is an insulation material or air cavity, in which case the insulation material or air cavity is to be included in the bridged portion ii) that next homogenous layer is in between two bridged layers, in which case half of the intermediary homogenous layer is included in each of the adjacent bridged portions

For more details of the proposed wording, please refer to Appendix C for H1/AS2 and Appendix D for H1/VM2.

[20] NZS 4214:2006 Methods of determining the total thermal resistance of parts of buildings

3.11.3. Analysis of the proposed change

For this issue, the primary objective of the proposed change is to support better consistency and certainty for designers, Building Consent Authorities and building users that buildings have sufficient insulation for achieving Objective H1.1 of the Building Code, Functional requirement H1.2(a) and Performance H1.3.1 (a).

MBIE considers that the proposed changes will best achieve this objective by providing clearer requirements for defining the boundaries of the bridged portion of a building element when calculating its R-value using NZS 4214.

MBIE does not expect this proposed change to result in any additional work or costs.

3.11.4. Other options MBIE considered

For this issue, apart from retaining the status quo MBIE did not identify any other options.

3.11.5. Questions for the consultation Topic 19

19-1. Do you support amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 as proposed to improve certainty and consistency of compliance by providing clearer requirements for defining the boundaries of the bridged portion of a building element when calculating its R-value using NZS 4214?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

19-2. Please explain your views.

3.12. Topic 20: For some mixed-use buildings it is unclear whether H1/AS1 and H1/VM1 can be used, or H1/AS2 and H1/VM2

3.12.1. Reason for the change

As discussed in subsection 2.11 above, with the current H1 acceptable solutions and verification methods it can be unclear which of these documents can be used for some mixed-use buildings.

When deciding which H1 acceptable solution or verification method applies to the parts of a building that are not housing, it is unclear whether the floor area of building parts classified as housing, industrial or communal non-residential (assembly service) should be considered. This creates uncertainty and inconsistency of compliance.

3.12.2. Proposed change

The proposed change involves amendments to Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m^2* to provide clearer requirements for establishing which of the H1 acceptable solutions and verification methods apply for mixed-use buildings. Similar amendments are proposed for Acceptable Solution H1/AS1 and Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m^2.*

MBIE proposes that for mixed-use buildings, any parts classified as housing, industrial or communal non-residential (assembly service) are not considered when determining whether the area of the building is greater than 300 m^2.

For more details of the proposed wording, please refer to Appendix C for H1/AS2 and Appendix D for H1/VM2.

3.12.3. Questions for the consultation Topic 20

20-1. Do you support amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 as proposed to improve certainty and consistency of compliance by providing clearer requirements for determining which compliance pathways can be used for a mixed-use building?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

20-2. Please explain your views.

3.13. Topic 21: The look-up tables with R-values for slab-on-ground floors do not cater for some common situations

3.13.1. Reasons for the changes

As discussed in subsection 2.12 above, for slab-on-ground floors, an easy way for designers to determine the thermal resistance (R-value) of a proposed slab-on-ground floor is to look up its R-value from tables provided in Appendix F of Acceptable Solution H1/AS2. Calculating the R-value of a slab-on-ground floor requires specialist technical skills and software that most designers do not have.

The current tables do not cover some common situations. This includes small slab-on-ground floors, and floors with slab edge insulation that does not go around the entire floor perimeter. For example, because of an attached garage.

This can make it difficult for designers and Building Consent Authorities to establish whether a building complies with the H1 energy efficiency insulation provisions.

3.13.2. Proposed changes

The proposed changes involve amendments to Acceptable Solution H1/AS2 *Energy Efficiency for buildings greater than 300m^2* to enable the use of the look-up tables for slab-on-ground floor R-values for more situations. Similar changes are proposed for Acceptable Solution H1/AS1 *Energy Efficiency for all housing, and buildings up to 300m^2.*

They include:

- **Adding rows to the existing slab-on-ground floor R-value look-up tables** in Appendix F of H1/AS2 for floors with area-to-perimeter ratios down to 0.6. Currently these tables only cover floors with area-to-perimeter ratios down to 1.6.
- **Adding instruction for interpolating between different tables** to enable determining the R-value of floors with slab edge insulation that does not go around the entire floor perimeter.

For more details of the proposed wording in H1/AS2, please refer to Appendix C.

3.13.3. Questions for the consultation Topic 21

21-1. Do you support amending Acceptable Solution H1/AS2 as proposed to make it easier for designers and Building Consent Authorities to establish whether a building complies with the H1 energy efficiency insulation provisions by enabling the use of the look-up tables for slab-on-ground floor R-values for more situations?

☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

21-2. Please explain your views.

3.14. Topic 22: Acceptable Solution H1/AS2 and Verification Method H1/VM2 include obsolete provisions and definitions, and outdated references to documents and tools

3.14.1. Reason for the change

MBIE has identified obsolete and outdated provisions, definitions and references to documents and tools in Acceptable Solution H1/AS2 and Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m^2.*

3.14.2. Proposed changes

The proposed changes involve amendments to Acceptable Solution H1/AS2 and Verification Method H1/VM2 to make these documents more user-friendly and reduce the risk of misinterpretations that can create uncertainty and inconsistency of compliance.

The proposed changes include:

- Updating references to the latest editions of the BRANZ House Insulation Guide and AS/NZS4859.1[21]
- Deleting obsolete definitions for terms that are not used in the documents
- Making other minor editorial changes to improve clarity and readability.

For more details of the proposed wording changes, please refer to Appendix C for H1/AS2 and Appendix D for H1/VM2.

3.14.3. Questions for the consultation Topic 22

22-1. Do you support amending Acceptable Solution H1/AS2 and Verification Method H1/VM2 as proposed to make these documents more user-friendly and reduce the risk of misinterpretations that can create uncertainty and inconsistency of compliance?
☐ Yes, I support it.
☐ Yes, with changes
☐ No, I don't support it.
☐ Not sure/no preference.

22-2. Please explain your views.

3.14.4. Additional questions for Topics 15 to 22

SQ12. What impacts from the proposals for topic 15 to 22 do you expect? These may be economical/financial, environmental, health and wellbeing, or other areas.

SQ13. Is there any support that you or your business would need to implement the proposed changes for topics 15 to 22 if introduced?

SQ14. If there are other issues MBIE should consider to better support consistency and certainty of compliance for insulation in large buildings other than housing, please tell us.

[21] AS/NZS 4859.1:2018 Thermal insulation materials for buildings - Part 1: General criteria and technical provisions

3.15. Summary of the proposals for large buildings

TABLE 3-2: Summary of proposals to change Acceptable Solution H1/AS2 and Verification Method H1/VM2

Outcome	Potential changes
Optimising insulation to better balance upfront building costs and longer-term benefits	• Remove the schedule method from Acceptable Solution H1/AS2, leaving the calculation method and modelling method as compliance pathways. • Amend the calculation method to allow flexibility for the R-values of all building elements that form part of a building's thermal envelope, not just walls, doors and windows. • Exempt buildings from the higher minimum R-values for heated building elements where embedded heating systems are solely used in bathrooms

Consistency and certainty of compliance and consenting	• Clarify and update requirements for the modelling method by:
	  ◦ Prescribing the use of the most recent weather files from NIWA
	  ◦ Removing the requirement to model HVAC systems
	  ◦ Adding a new requirement for modellers to document and justify any deviations from default assumptions.
	• Limit the permitted area of skylights in the schedule method to 1.5% of the roof area (only relevant if the proposal to remove the schedule method does not proceed).
	• Require a framing fraction of no less than 38% to be assumed when determining the construction R-value of framed walls, unless a designer can demonstrate that a lower framing fraction is justified. Reduce the wall R-values across the six climate zones for the reference building of the calculation and modelling methods to avoid additional costs from the framing fraction change.
	• Require the areas of roofs, walls and floors to be measured using overall internal dimensions.
	• Modify the citation of NZS 4214 to calculate R-values.
	• Clarify requirements for establishing which of the H1 acceptable solutions and verification methods apply for mixed-use buildings and exclude the area of building parts that are classified as housing, industrial or communal-residential when determining the area of the building.
	• Expand the slab-on-ground floor performance tables in H1/AS2 Appendix F to cover more situations.
	• Update references to the latest editions of the BRANZ House Insulation Guide and AS/NZS4859.1.
	• Remove obsolete definitions and make other minor editorial changes to improve clarity and readability.

For more details of the proposed wording, please refer to Appendix C for H1/AS2 and Appendix D for H1/VM2.

3.16. Transition period for large buildings H1/AS2 & H1/VM2

Effective date: Subject to consultation outcome

Transitional arrangements: 12 months

It is proposed that the existing Acceptable Solutions and Verification Method will remain in force, as if not amended, for a period of 12 months from the date of publication (the proposed cessation date) as described in TABLE 3-3.

TABLE 3-3: Proposed transitional arrangements for Acceptable Solution H1/AS2 and Verification Method H1/VM2

Document	Before 'Publishing' date	From 'Publishing' date (effective date) To 12 Months after 'Publishing date' (cessation date)
Existing Acceptable Solution H1/AS2 and Verification Method H1/VM2	If used, will be treated as complying with the Building Code	If used, will be treated as complying with the Building Code
Amended Acceptable Solution H1/AS2 and Verification Method H1/VM2	Does not apply to Building Consents issued before this date	If used, will be treated as complying with the Building Code

3.17. Transition period for large buildings H1/AS2 & H1/VM2

SQ15. Do you agree with the proposed transition time of 12 months for the proposed changes to take effect?

☐ Yes, it is about right.
☐ No, it should be longer (24 months or more).
☐ No, it should be shorter (less than 12 months).
☐ Not sure/no preference.

Appendix A.

Proposed changes to Acceptable Solution H1/AS1 *Energy Efficiency for all housing, and buildings up to 300m²*

https://www.mbie.govt.nz/dmsdocument/29914-appendix-a-proposed-changes-to-acceptable-solution-h1-as1-pdf

Appendix B.

Proposed changes to Verification Method H1/VM1 *Energy Efficiency for all housing, and buildings up to 300m²*

https://www.mbie.govt.nz/dmsdocument/29913-appendix-b-proposed-changes-to-verification-method-h1-vm1-pdf

Appendix C.

Proposed changes to Acceptable Solution H1/AS2 *Energy Efficiency for buildings greater than 300m^2*

https://www.mbie.govt.nz/dmsdocument/29915-appendix-c-proposed-changes-to-acceptable-solution-h1-as2-pdf

Appendix D.

Proposed changes to Verification Method H1/VM2 *Energy Efficiency for buildings greater than 300m^2*

https://www.mbie.govt.nz/dmsdocument/29916-appendix-d-proposed-changes-to-verification-method-h1-vm2-pdf