



# N-II House insulation guide



Version 2.2



Providing the services of:

**Chartered Professional Engineers**

## Document History - Redco Project No. 8954

Version No.	Prepared By:	Description	Date
Version 1.0	Hamish Pearse-Danker	Draft Issue	23/11/2009
Version 2.0	Graham Rundle	Revised issue	06/04/2011
Version 2.1	Graham Rundle	Revised issue	05/09/2011
Version 2.2	Graham Rundle	Revised issue	30/4/2012

### **Version 2.0**

This version was revised to bring it into line with the interpretation of Clause 5.3.2 Ventilated air gaps in NZS 4214:2006 that BRANZ used in the latest version of the BRANZ Home Insulation Guide.

BRANZ have followed the procedure set out in the worked Example F4 in the Appendix to NZS 4214. This procedure varies from the wording of Clause 5.3.2 which was used in the earlier version of this guide.

This interpretation of Clause 5.3.2 reduces the wall framing insulation required for some cavity wall cases.





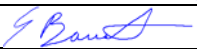
### **Version 2.1**

Amendments have also been added to allow the use of high R-value claddings as a thermal break and to elaborate on the requirements for roof construction.

### **Version 2.2**

Following discussions with BRANZ the use of high value R-value claddings as a thermal break has been removed when these claddings are fitted over a cavity.

## Document Acceptance

Action	Name	Signed	Date
Prepared By:	Graham Rundle		30/4/2012
Reviewed By:	Hamish Pearse-Danker		30/4/2012
Approved By:	Graham Rundle		30/4/2012
<b>On behalf of:</b>	<b>Redco NZ Ltd</b>		
Reviewed By:	Chris Kay		08/05/2012
Approved By:	Gordon Barratt		08/05/2012
<b>On behalf of:</b>	<b>NASH NZ</b>		

### **Disclaimer**

The information contained in this document is current as at April 2012 and is based on data available to the National Association of Steel-Framed Housing Incorporated (NASH) at the time of going to print.

This document replaces all previous versions of the NASH N11 House Insulation Guide. NASH reserves the right to change the information contained in this document without prior notice. It is important that you call 0800 333 225 to confirm that you have the most up to date information available and/or refer to the PUBLICATIONS page at [www.nashnz.org.nz](http://www.nashnz.org.nz).

NASH welcomes suggestions for improvements and encourages readers to notify them immediately of any inaccuracies or ambiguities by emailing [gm@nashnz.org.nz](mailto:gm@nashnz.org.nz)

NASH has used its reasonable endeavours to ensure the accuracy and reliability of the information contained in this document and, to the extent permitted by law, will not be liable for any inaccuracies, omissions or errors in this information nor for any actions taken in reliance on this information.

## Contents

Title Page .....	i
Contents .....	iii
1 Introduction .....	1
1.2 The New Zealand Building Code (NZBC) .....	1
1.3 Compliance Documents.....	2
2 Insulation.....	3
2.1 Thermal breaks .....	3
2.2 Condensation.....	3
2.3 Thermal break recommendations.....	4
2.3.1 Minimum – Code Compliant.....	4
2.3.2 Better .....	4
2.3.3 Best .....	4
3 Construction recommendations .....	5
3.3 Wall Construction Recommendations .....	5
3.3.1 Direct-fixed Cladding.....	5
3.3.2 High R-value Claddings as the Thermal Break .....	6
3.3.3 Cladding Fixed Over a Cavity .....	6
3.3.4 Cavity fitted outside of Thermal Break .....	7
3.4 Roof Construction.....	8
3.4.1 Trussed roof .....	8
3.4.2 Skillion roof.....	9
3.4.3 Gable Ends.....	10
3.4.4 High walls at Mono pitch roofs .....	10
4.0 How to use this Guide .....	11
4.1 Wall Construction R-Values .....	11
4.1.1 General Wall Claddings.....	11
4.1.2 Specific Wall Claddings.....	11
4.2 Roof Construction R-Values .....	12
Section A Wall construction R-Values.....	A1
Section B Roof construction R-Values .....	B1



## I Introduction

This NASH *House Insulation Guide* is intended for designers, builders, Building Consent Authorities (BCAs) and manufacturers as a guide to assess the expected thermal performance of various forms of light steel framing construction.

R-Value Graphs for steel framed wall and roof construction are provided in Sections A & B of this Guide. These graphs allow designers, builders and BCAs to readily determine whether specific light steel framed constructions will satisfy New Zealand Building Code provisions.

The data used to create these graphs has been calculated using methods based on NZS 4214 *Methods of determining the total thermal resistance of parts of buildings* and the findings of report NASH N-10 *Thermal breaks and cavity construction*.

### 1.2 The New Zealand Building Code (NZBC)

The NZBC contains two Clauses, E3 Internal Moisture and H1 Energy Efficiency, which influence the use of insulation in buildings. The NZBC performance requirements are mandatory and those performances may differ according to the type of occupancy ('classified use') of the building. The relevant extracts for light steel framing are:

E3

#### “PERFORMANCE

**E3.3.1 An adequate combination of thermal resistance, ventilation and space temperature must be provided to all habitable spaces, bathrooms, laundries, and other spaces where moisture may be generated or may accumulate.**

**Performance E3.3.1 does not apply to communal non-residential, commercial, industrial, outbuildings or ancillary buildings.”**

H1

#### “PERFORMANCE

**H1.3.1 The building envelope enclosing spaces where the temperature or humidity (or both) are modified must be constructed to-**

- (a) provide adequate thermal resistance; and**
- (b) limit uncontrolled airflow.**

**H1.3.2A Buildings must be constructed to ensure that,-**

- (a) if they are buildings in climate zone 3, their building performance index does not exceed 1.55; and**
- (b) if they are buildings in climate zone 1 or in climate zone 2 and are in a warm location, their old measure building performance index does not exceed 0.13; and**
- (c) if they are buildings in climate zone 1, or climate zone 2 and are in a cool location, their old measure building performance index does not exceed 0.12**

**Performance H1.3.2A applies only to Housing.**

**H1.3.2B For the purposes of performance H1.3.2.A, a building partly in climate zone 3 and partly in climate zone 2 must be treated as if it were a building in climate zone 2.**

- H1.3.2C Buildings must be constructed to ensure that,—**
- (a) if they are buildings in climate zone 2 or climate zone 3, their building performance index does not exceed 1.55; and**
  - (b) if they are buildings in climate zone 1 and are in a warm location, their old measure building performance index does not exceed 0.13; and**
  - (c) if they are buildings in climate zone 1 and are in a cool location, their old measure building performance index does not exceed 0.12.**

**Performance H1.3.2C applies only to Housing.**

**H1.3.2D For the purpose of performance H1.3.2.C, a building partly in climate zone 2 and partly in climate zone 1 must be treated as if it were a building in climate zone 1.**

**H1.3.2E Buildings must be constructed to ensure that their building performance index does not exceed 1.55.**

**Performance H1.3.2E applies only to Housing.**

Acceptable solutions to meet these requirements are then outlined in E3/AS1:

### **1.3 Compliance Documents**

To meet the performance requirements of the NZBC Acceptable Solutions and Verification methods are provided.

For internal moisture, the relevant Clauses for light steel framing from the Acceptable Solution to E3 (E3/AS1) are:

*“1.1 Thermal resistance*

*1.1.1 R-values for walls, roof and ceilings shall be no less than:*

*a) For light timber frame wall or other framed wall construction with cavities, 1.5.”*

*...*

*d) For roofs or ceilings of any construction, 1.5*

*“1.1.4 For the construction to be acceptable:*

*...*

*d) Where steel studs are used, a thermal break shall be provided for each steel member. Wood fibre insulating board or expanded polystyrene (EPS) strips, 12mm minimum thick and fixed directly behind the external cladding provide an effective thermal break.”*

This Clause is expected to be changed when E3 is next reviewed.

A minimum R-value of 0.25 is expected to be stipulated in line with the minimum adopted in the BRANZ Home Insulation Guide - 4<sup>th</sup> Edition. Direct fixed claddings providing an R-value greater than 0.25 should be able to be treated as a thermal break in their own right.

For energy efficiency, the Acceptable Solution H1/AS1 refers to NZS 4218 *Energy efficiency – housing and small building envelopes* as the minimum insulation levels for compliance in housing and small buildings.

The R-Value graphs for various wall and roof constructions given in Sections A & B allow designers, builders and BCAs to readily determine whether specific light steel framed constructions will satisfy NZBC provisions.

## 2 Insulation

The thermal performance (R-value) of a specific light steel framed construction depends on the framing, the insulation material placed between the framing and the thermal break used. Steel has a high thermal conductivity, so thermal bridging is a significant issue and can reduce the efficiency of insulation placed between the framing by up to 50%.

### 2.1 Thermal breaks

Thermal breaks reduce the effects of thermal bridging. Thermal bridging occurs where there is a high heat conductance path. In light steel wall framing this occurs anywhere steel members penetrate through the insulation such as at studs, nogs, bottom plates, and top plates. These members can allow heat to move from the warmer interior to the colder exterior through the steel, by-passing any insulation placed between them. This leads to localised cold areas over the framing on the interior face. If the surface temperature were to fall below the internal dew point, condensation could form on these cold bridges. As well as the possibility of condensation, thermal bridges will also significantly reduce wall R-values.

Thermal breaks can be created by fixing insulation to the outside face of the steel framing. Insulation used as a thermal break reduces the thermal bridging and as such is more effective in increasing the overall wall R-value than the same amount of insulation placed within the framing. To meet the requirements of E3 and maximise the efficiency of insulation placed between the framing the thermal breaks detailed in the following Section 3 are recommended based on a 'minimum', 'better' and 'best' rating:

### 2.2 Condensation

Acceptable Solution E3/AS1 requires that the control of fungal growth is achieved by minimising the risk of internal condensation through maintaining the correct balance between interior temperature and ventilation. There are no minimum heating requirements for most buildings in New Zealand, but insulation will help to maintain a suitable interior temperature. A minimum R-value of R1.5 is specified for framed wall construction, as well as the requirement for a thermal break on steel studs. The thermal breaks nominated as providing an effective break are 12mm of wood fibre insulating board (no longer recommended due to durability) or 12mm of EPS.

These thermal breaks are not necessary to meet the overall R1.5 value. This can be achieved without the use of a thermal break, if the right cladding, wall insulation and stud depth are provided. Instead the thermal breaks are there to reduce cold bridging, which can lead to condensation on the framing and or inside face of the wall, which in turn can lead to fungal growth.

It should be noted that the thermal bridge is as wide as the steel stud flange. It is assumed in the calculation model that there is no frame insulation within the flanges of the studs. Insulation batts have generally been manufactured to fit between solid members and so generally the frame insulation is not installed with insulation within the stud. Finite element modelling has also demonstrated that any insulation within the stud section has little effect on the overall insulation value or the flow of heat. This insulation "gap" will also not affect the potential for condensation.

However, some manufacturers are now making wider format batts to fully fill the space between steel stud webs and the use of these wide format batts is recommended.

## 2.3 Thermal break recommendations

From the research carried out into the thermal performance of light steel framed walls NASH recommends the following thermal breaks based on a 'minimum', 'better' and best' rating.

### 2.3.1 Minimum – Code Compliant

This is the lowest performance thermal break that will satisfy the present Building Code requirements of E3, Internal Moisture. The risk of condensation is minimised, but thermal bridging still significantly reduces the thermal performance of insulation placed between studs and makes meeting HI targets difficult. The build up of dust on colder surfaces, could also be a significant issue depending on climate zone and cladding. The "Minimum" thermal break is therefore not recommended for walls shaded for over 50% of the day in winter.

"Minimum" thermal break:

All Climate Zones R0.25 strips (e.g. 10mm EPS), with a width equal to width of the section (plus 30mm if outside underlay), placed over all wall framing (studs, plates and nogs)

### 2.3.2 Better

"Better" thermal breaks effectively eliminate the risk of condensation and minimise the risk of dust build up. They also ensure there is a good overlap between the wall insulation and thermal break to stop bridging at the edges of the flange and minimises the effects of poor installation.

'Better' thermal break:

Climate Zones 1 & 2 R0.35 strips (e.g. 10mm XPS or 15mm EPS) with a width equal to the width of the section (plus 30mm if outside underlay)  
Climate Zone 3 R0.40 sheath (e.g. 15mm EPS sheets)

### 2.3.3 Best

As well as the advantages of the "Better" thermal break recommendations, "Best" thermal breaks reduce the temperature difference across the face of the wall to the point where they are negligible. They also significantly boost the walls thermal performance, to increase the thermal efficiency of the building or allow a reduction in insulation placed between the framing.

'Best' thermal break:

Climate Zone 1 & 2 R0.40 sheath (e.g. 15mm EPS sheets)  
Climate Zone 3 R0.50 sheath (e.g. 15mm XPS or 20mm EPS sheets)



### 3 Construction recommendations

Thermal breaks are both specified in E3/AS1, and recommend for meet HI requirements. The application of thermal breaks also effects E2 *External Moisture* requirements, so to satisfy all these requirements the following construction methods are recommend.

#### 3.3 Wall Construction Recommendations

Thermal breaks should be applied to studs, bottom and top plates, and noggs.

##### 3.3.1 Direct-fixed Cladding

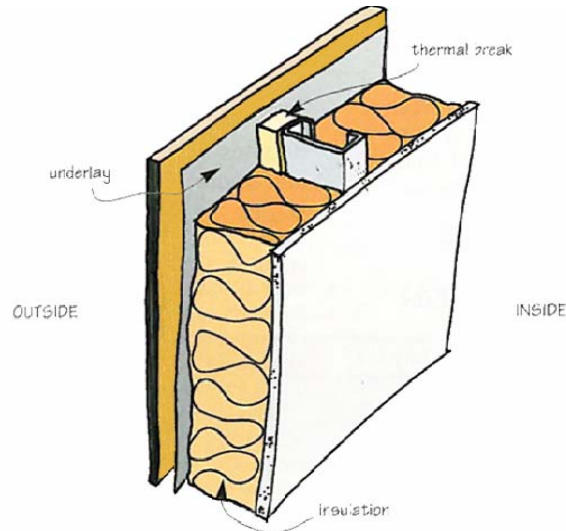


Fig. 1 Thermal break strips inside underlay

Wall underlay fixed to the outside of the thermal break ensures that any possible condensation is kept away from the framing, gaps in thermal break are not critical and there is a greater depth for insulation.

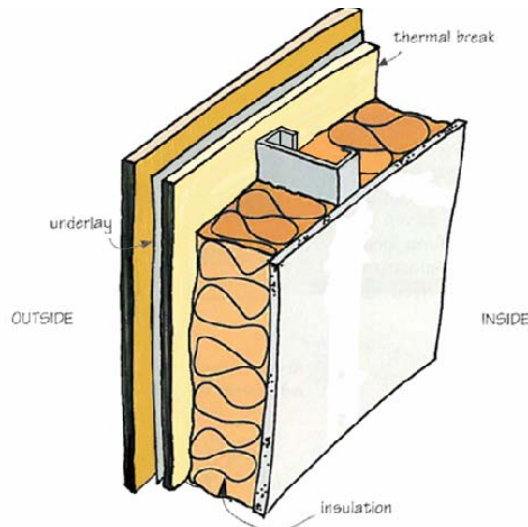


Fig. 2 Thermal break sheath inside underlay

Wall underlay fixed to the outside of sheet insulation maximises thermal performance.

### 3.3.2 High R-value Claddings as the Thermal Break

Direct fixed cladding systems with an R-value greater than 0.25 can be treated as the thermal break in their own right, and considered as a thermal break sheath.

Claddings that can be treated this way include direct fixed AAC, EIFS, and twin walled vinyl weatherboards.

Claddings fitted over a cavity can not be treated as a thermal break sheath, as ventilation in the cavity can expose the steel framing to external temperatures particularly at the bottom plate.

Overall wall R-values can be derived from the General Wall Cladding graphs.

Note: Thermal breaks are required to all steel wall framing members including at eaves, above where cladding may end. i.e. above the soffit of the eaves overhang.

### 3.3.3 Cladding Fixed Over a Cavity

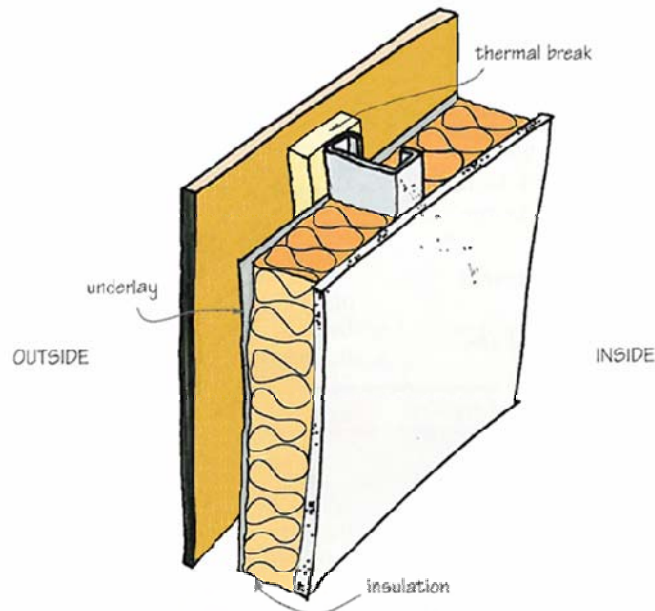


Fig. 3 Thermal break strips outside underlay

Thermal break strips fitted outside the underlay are acceptable with a cavity. The thermal break needs to be fitted with no gaps and needs to lap the insulation either side of the section for at least 15mm.

The thermal breaks fixed to the nogs, bottom and top plates must be thinner than those used on the studs so that the cavity can drain and ventilate. If 20mm battens were used on the studs, 10mm EPS strips could be used on the nogs and plates. The reduced depth of the horizontal thermal breaks would provide an opening of approximately 5600mm<sup>2</sup> per stud spacing, which is greater than the minimum E2 requirements for both the cavity spacers, 2000mm<sup>2</sup> (E2 9.1.8.2) and the cavity base closure, 1000mm<sup>2</sup>/m (E2 9.1.8.3) The reduced depth will therefore allow adequate air movement through the cavity.

### 3.3.4 Cavity fitted outside of Thermal Break

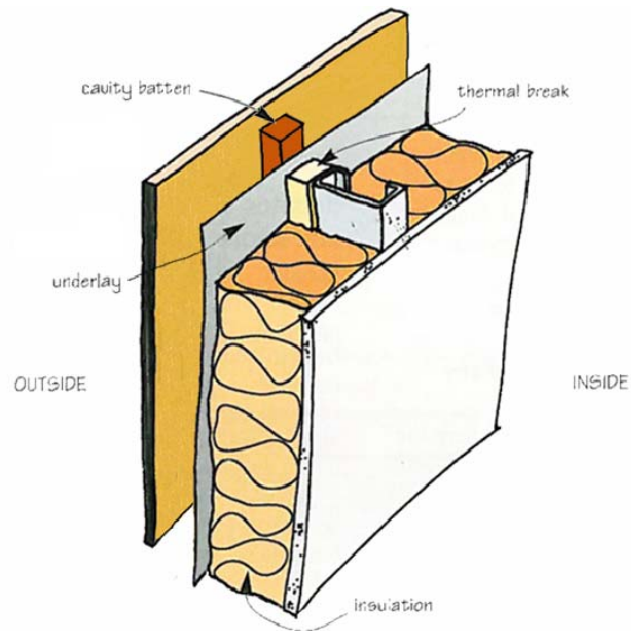


Fig. 4 Thermal break strips inside underlay

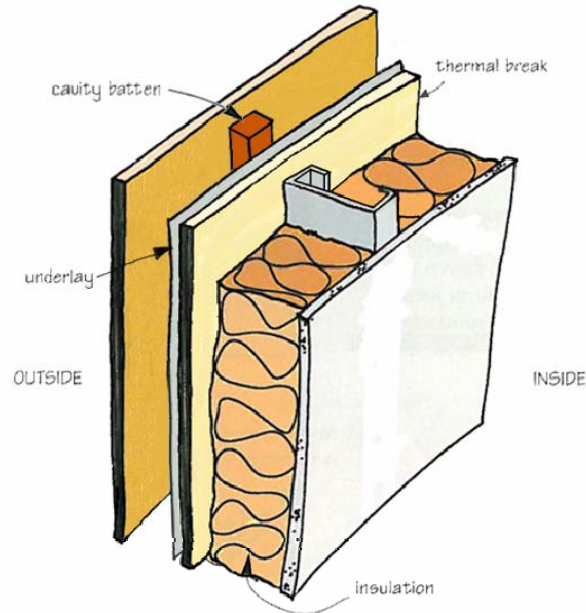


Fig. 5 Thermal break sheath inside underlay

An E2 cavity can be created outside of the thermal break and the building wrap in the manner prescribed in E2/NZBC, as shown in Fig. 4 & 5 above.

### 3.4 Roof Construction

#### 3.4.1 Trussed roof

With trussed roof construction the insulation is fitted to the ceiling. It is important that this insulation is run over and fully covers the bottom chord of the roof trusses. This can also be achieved by butting batts to either side of the trusses and overlapping the truss chord.

The insulation is to be fitted closely around the truss web members and be packed into the channel section of these members. The insulation blanket is to extend out to the edges of the roof space and cover the wall top plate.

To prevent thermal bridging through the heel of the truss into the top plate of the wall, a thermal break should be provided between the heel of each truss and the top plate. This thermal break shall have a minimum R-value of 0.25 and can be achieved by the use of HD EPS or custom made plastic packers. These packers are commonly of the order of 25mm thick to match the depth of ceiling battens. The packers should be at least as wide as the bottom chord of the truss.

At the eaves overhang the thermal breaks on all the steel wall framing members are to extend up past the eaves soffit and include the top plate.

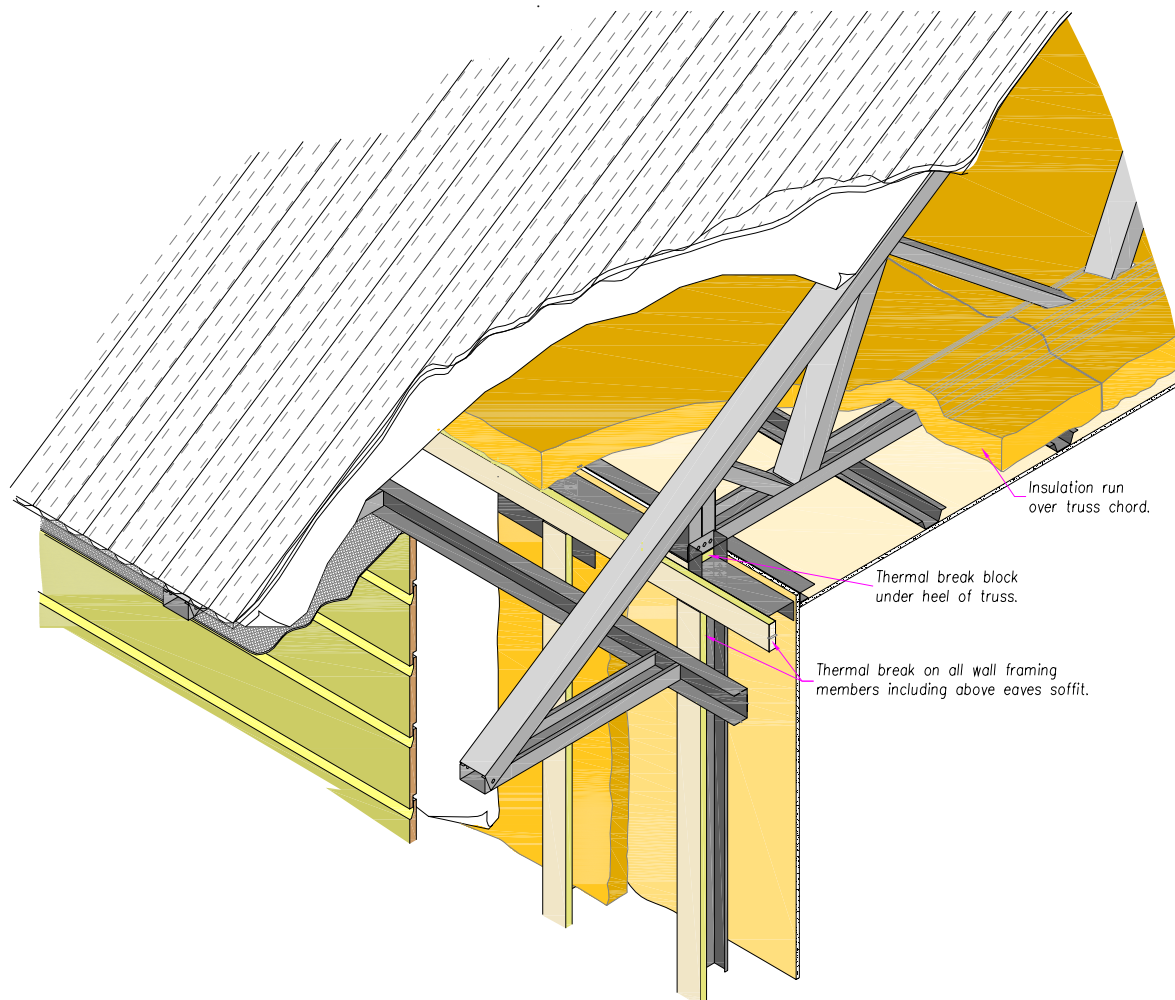


Fig. 6 Thermal breaks and insulation at trussed roof

### 3.4.2 Skillion roof

Skillion roofs can be constructed in a similar manner to framed walls with a thermal break strip fitted to the outside face of the rafters. These strips should be 15mm wider each side of rafter flange when fitted outside of the roofing underlay, and should also cover the end of the rafter.

At an eaves overhang of a skillion roof the thermal break strips are to be fitted to the top and bottom of the rafters.

A thermal break is not required between the top plate and the underside of the rafters.

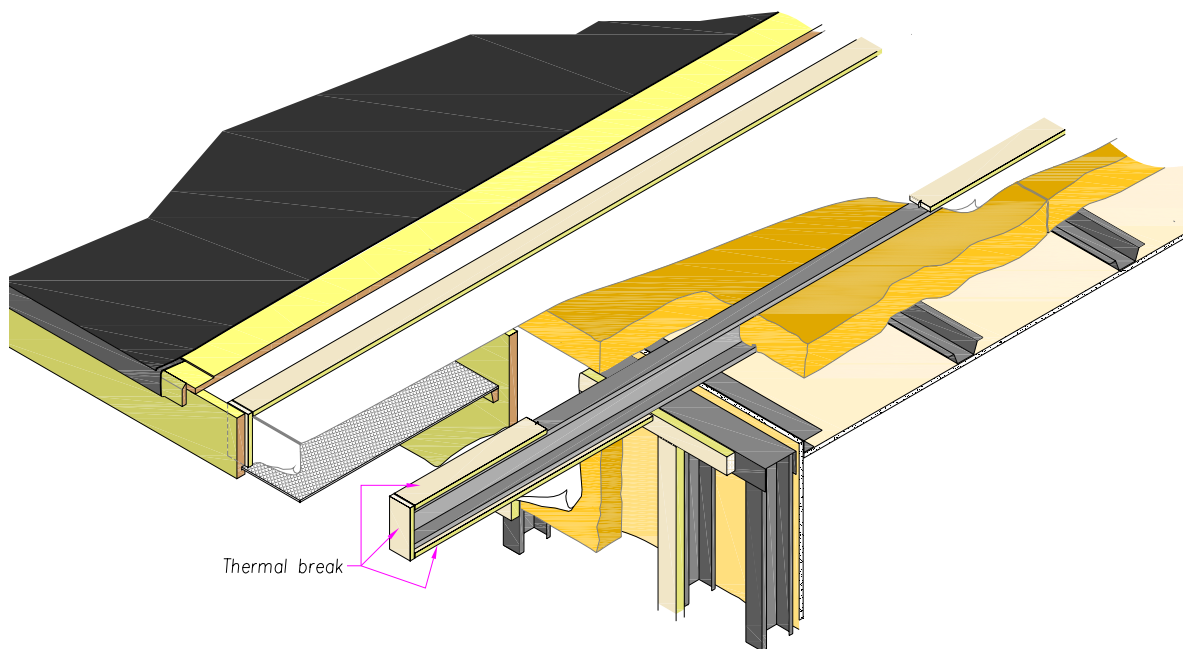


Fig. 7 Thermal breaks and insulation at skillion roof

### 3.4.3 Gable Ends

Gable ends should be framed with a gable end truss. The wall framing should have a top plate at ceiling level and be separated from the gable end truss by thermal break packers. This arrangement provides for continuity of the insulation envelope with a thermal break between the wall framing and the roof framing as provided on the other walls.

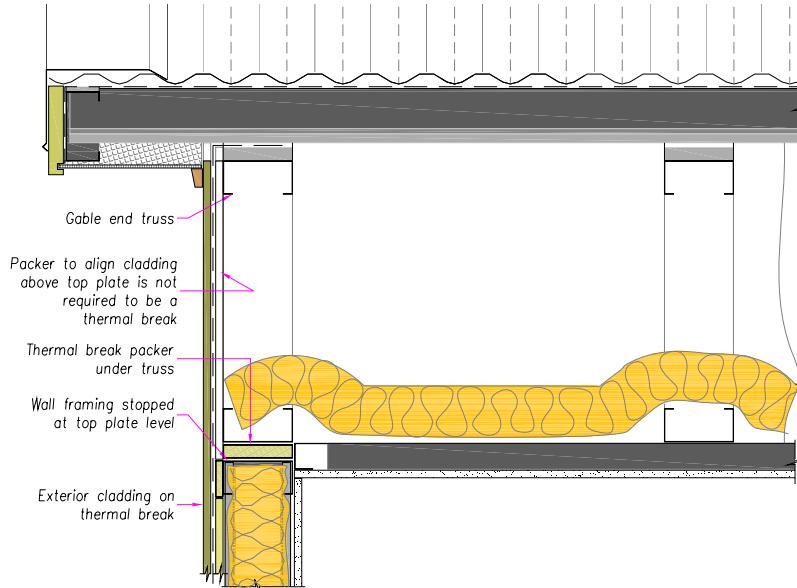


Fig. 8 Thermal breaks and insulation at gable end

### 3.4.4 High walls at Mono pitch roofs

Wall framing under mono pitch roof trusses should finish with a top plate at ceiling level and be separated from the trusses by thermal break packers.

This arrangement provides for continuity of the insulation envelope with a thermal break between the wall framing and the roof framing as provided on the other walls.

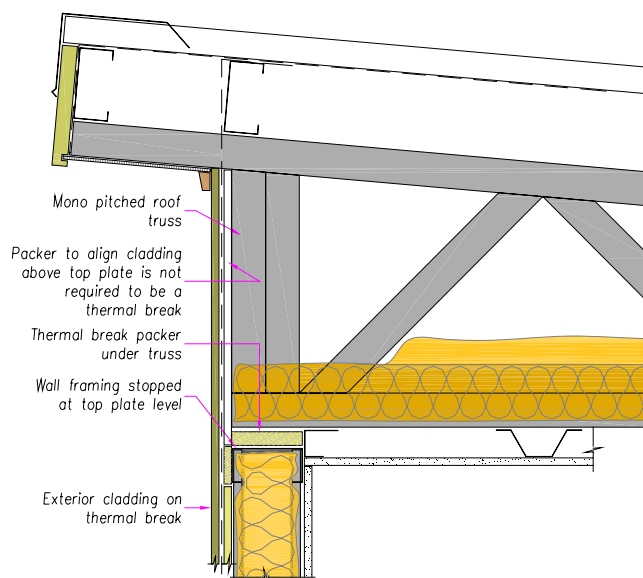


Fig. 9 Thermal breaks and insulation at mono pitch roof



## 4.0 How to use this Guide

This guide contains a number of graphs that relate framing insulation R-value, thermal break R-value and generic construction to the R-value achieved for each construction type.

### 4.1 Wall Construction R-Values

R-Value graphs are provided firstly for general wall construction where the R-value of the cladding is known or derived from the accompanying tables. These are followed by R-Value graphs which are provided for wall constructions with specific wall claddings.

The graphs have the framing insulation product's R-value on the horizontal axis and resulting construction R-value on the vertical axis. Thermal break R-values are represented by lines on the graph.

#### 4.1.1 General Wall Claddings

The first two wall construction graphs on Pages A3 and A5 allow a user that knows the R-value of the specific cladding to find the total construction R-value.

These graphs consider claddings for 90mm wall framing with studs @600ctrs and 90mm framing with studs @ 400ctrs. The specific instructions for using these graphs are provided on the page preceding each set of graphs.

#### 4.1.2 Specific Wall Claddings

The R-Value graphs from page A6 onwards cover various wall constructions with specific wall claddings

The graphs have the framing insulation product's R-value on the horizontal axis and resulting construction R-value on the vertical axis. Thermal break R-values are represented by lines on the graph. There are two ways to use these graphs:

- 1 *Where you know the R-value of the insulation and thermal break and need to estimate the total construction R-value.* For instance page A17 shows a 90mm framing @ 600 centres with masonry veneer over a cavity and 10mm plasterboard internal lining. If the wall under consideration had R2.20 framing insulation with thermal breaks strips of 20mm EPS, you would take a line up from R2.20 on the horizontal axis to the point of intersection with the dark blue line (thermal break R0.50). This then gives you the resulting construction on the vertical axis, R2.10.
- 2 *Where you want to achieve a given R-value from the construction.* Using the graph in the previous example you would like to achieve a resulting construction R-value of 1.90. Run a horizontal line from R1.90 on the vertical axis. Each time it intersects with a thermal break the horizontal axis shows the R-value of the framing insulation that with that thermal break would result in an overall R-value of R1.9. For example
  - Thermal break sheath R0.50 with framing insulation R1.8
  - Thermal break strip R0.35 with framing insulation R 1.98 minimum
  - Thermal break strip R0.25 with framing insulation R2.2

Overlaid on each graph are vertical dashed lines representing common framing insulation R-values. The exact R-value of different products should be checked with the manufacturer.

Drawings are indicative only to illustrate general construction – they are not detailed working drawings. All dimensions in millimetres.

Always check with the latest NZBC Acceptable Solutions and New Zealand Standards to determine current levels of performance.

## 4.2 Roof Construction R-Values

R-Value graphs are provided for both trussed roof construction and skillion roof construction.

The trussed roof construction R-Values have been adjusted to allow for expected losses through the truss web members that penetrate the ceiling insulation. The R-Values derived are not dependant on the type of roof cladding carried by the trusses.

Reference should be made to the section on trussed roof construction on Page 6 of this Guide.

The skillion roof construction R-Values have not included any contribution from the roof claddings.

Reference should be made to the section on skillion roof construction on Page 7 of this Guide.



## Section A

### Wall Construction R-Values

#### General Wall Claddings

##### Any wall cladding

Direct-fixed or cavity, 90mm framing, TCT  $\leq$  0.75, studs @ 600, 10mm plasterboard A2

Direct-fixed or cavity, 90mm framing, TCT  $\leq$  0.75, studs @ 400, 10mm plasterboard A4

#### Specific Wall Claddings

##### Bevel-back weatherboards

Direct-fixed, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A6

Cavity, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A8

##### Rusticated weatherboards

Direct-fixed, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A10

Cavity, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A12

##### Sheet cladding

Direct-fixed, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A14

##### Masonry Veneer

Cavity, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A16

##### Fibre-cement - weatherboard (7.5mm)

Direct-fixed, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A18

Cavity, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A20

##### Metal profile

Direct-fixed or cavity, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A22

##### EIFS (External Insulation and Finish Systems)

Cavity, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A24

##### AAC (Autoclaved Aerated Concrete)

Cavity, 90mm framing, TCT  $\leq$  0.75, 10mm plasterboard A26

### Any cladding with studs @ 600

Steel frame - cavity or direct fixed - 90mm framing, TCT ≤ 0.75, 10mm plasterboard

#### Where you know the construction and wish to estimate the total construction R-value:

For instance brick veneer with R2.20 framing insulation and 10mm EPS sheath, you would take a line up from R2.20 on the horizontal axis to the point of intersection with the dark green line (thermal break R0.30). This then gives you the resulting Adjusted R-value of 1.79 on the vertical axis. Add on the Brick veneer R-value from Table 1.0 below - 0.06 + 0.16 for the cavity to give a total construction of  $(1.79 + 0.06 + 0.16) = R 2.01$

#### To find the insulation possibilities to achieve a given total construction R-value:

Decide on the required R-value. (e.g. R = 1.9)

Determine the cladding R-value from Table 1.0 below and subtract this value from the R-value required.

Where there is a cavity also subtract 0.16 to get the "Adjusted R-value"

(e.g. Adjusted R-value =  $1.9 - 0.06 - 0.16 = 1.68$  (Brick veneer with cavity))

Decide which type of thermal break to use, sheath or strips. (e.g. sheath)

Use the adjusted R-value in the appropriate graph for the thermal break type to find the thermal break / framing insulation options that would give that value. From the Adjusted R-value look across and each time you cross a thermal break R-value line drop down to find the frame insulation R-value required to achieve the adjusted R-value with that thermal break.

(e.g. Possible options for brick veneer example above would be: thermal break R0.4 with insulation R1.8, thermal break R 0.3 with insulation R2.2, thermal break R0.2 with insulation R2.6. For claddings with an R-value >0.25, do not adjust R-value, but use cladding R-value as thermal break R-value.

**Table 1.0**

Cladding	R-Value	
	20 to 50mm Cavity	Direct Fixed
EIFS (50mm)	0.80	1.43
AAC (50mm)	0.26	0.43
Vinyl twin wall weatherboards	0.20	0.33
Timber weatherboards (rusticated)	0.12	0.19
Timber weatherboards (bevel back)	0.11	0.17
Plywood (12mm)	0.08	0.12
Brick veneer (70mm)	0.06	-
Cement weatherboards (7.5mm)	0.05	0.13
Fibre cement sheet (7.5mm)	0.05	0.06
Stucco (20mm)	0.04	0.05
Corrugated Steel	0.03	0.03
General	$0.03 + 0.55 \times \text{R-value of cladding}$	$0.03 + \text{R-value of cladding}$

Direct fixed claddings highlighted in blue can be treated as thermal breaks in their own right

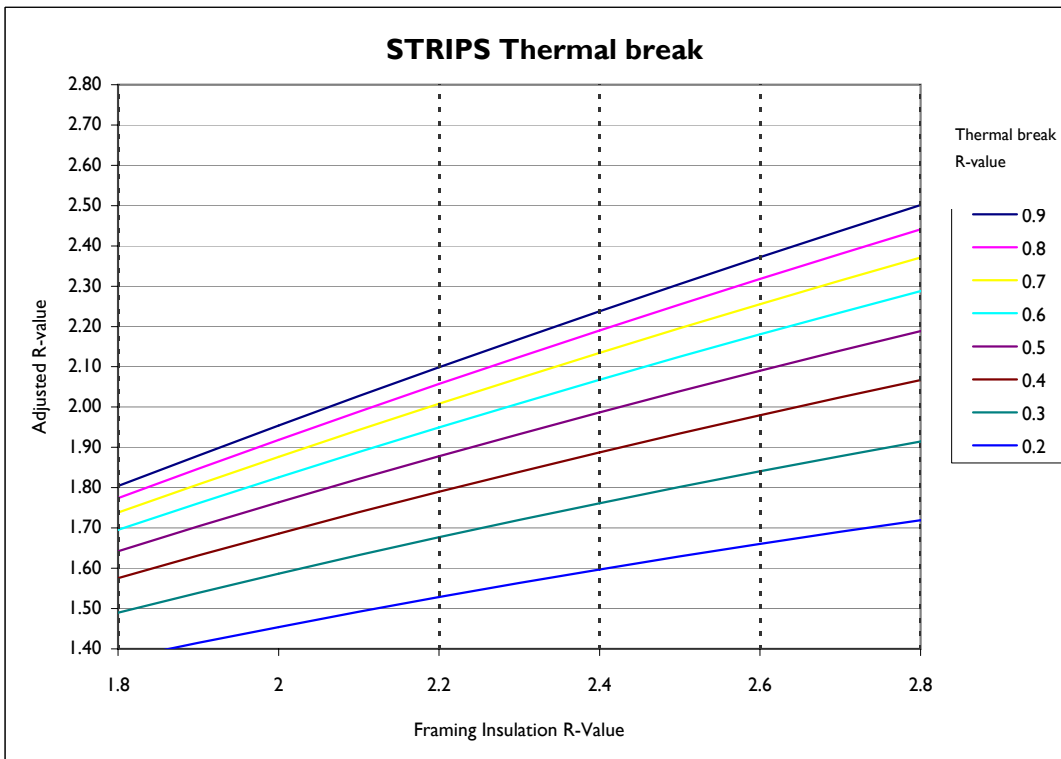
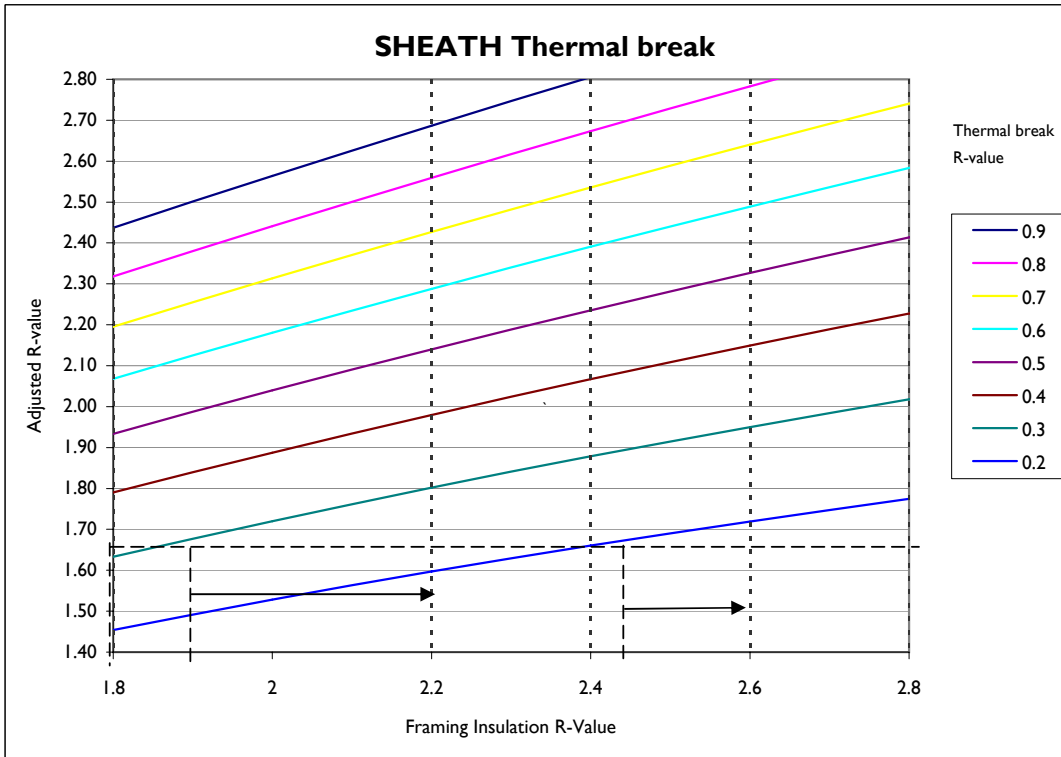
**Table 2.0**

Typical thermal break R-values

Thickness (mm)	R-Value EPS	R-Value XPS
10	0.29	0.37
15	0.42	0.56
20	0.56	0.74
40	1.11	1.48

### Any cladding with studs @ 600

Steel frame - cavity or direct fixed - 90mm framing, TCT ≤ 0.75, 10mm plasterboard



----- Typical framing insulation R-value

### Any cladding with studs @ 400

Steel frame - cavity or direct fixed - 90mm framing, TCT ≤ 0.75, 10mm plasterboard

#### Where you know the construction and wish to estimate the total construction R-value.

For instance brick veneer with R2.20 framing insulation and 10mm EPS sheath, you would take a line up from R2.20 on the horizontal axis to the point of intersection with the dark green line (thermal break R0.30). This then gives you the resulting Adjusted R-value of 1.68 on the vertical axis. Add on the Brick veneer R-value from Table 1.0 below - 0.06 + 0.16 for the cavity to give a total construction of  $(1.68 + 0.06 + 0.16) = R 1.90$

#### To find the insulation possibilities to achieve a given total construction R-value:

Decide on the required R-value. (e.g. R = 1.9)

Determine the cladding R-value from Table 1.0 below and subtract this value from the R-value required.

Where there is a cavity also subtract 0.16 to get the "Adjusted R-value"

(e.g. Adjusted R-value =  $1.9 - 0.06 - 0.16 = 1.68$  (Brick veneer with cavity))

Decide which type of thermal break to use, sheath or strips. (e.g. sheath)

Use the adjusted R-value in the appropriate graph for the thermal break type to find the thermal break / framing insulation options that would give that value. From the Adjusted R-value look across and each time you cross a thermal break R-value line drop down to find the frame insulation R-value required to achieve the adjusted R-value with that thermal break.

(e.g. Possible options for brick veneer example above would be: thermal break R0.4 with insulation R1.8, thermal break R0.3 with insulation R2.2, For direct fixed claddings with an R-value >0.25, do not adjust R-value, but use cladding R-value as thermal break R-value.

**Table 1.0**

Cladding	R-Value	
	20 to 50mm Cavity	Direct Fixed
EIFS (50mm)	0.80	1.43
AAC (50mm)	0.26	0.43
Vinyl twin wall weatherboards	0.20	0.33
Timber weatherboards (rusticated)	0.12	0.19
Timber weatherboards (bevel back)	0.11	0.17
Plywood (12mm)	0.08	0.12
Brick veneer (70mm)	0.06	-
Cement weatherboards (7.5mm)	0.05	0.13
Fibre cement sheet (7.5mm)	0.05	0.06
Stucco (20mm)	0.04	0.05
Corrugated Steel	0.03	0.03
General	$0.03 + 0.55 \times \text{R-value of cladding}$	$0.03 + \text{R-value of cladding}$

Direct fixed claddings highlighted in blue can be treated as thermal breaks in their own right

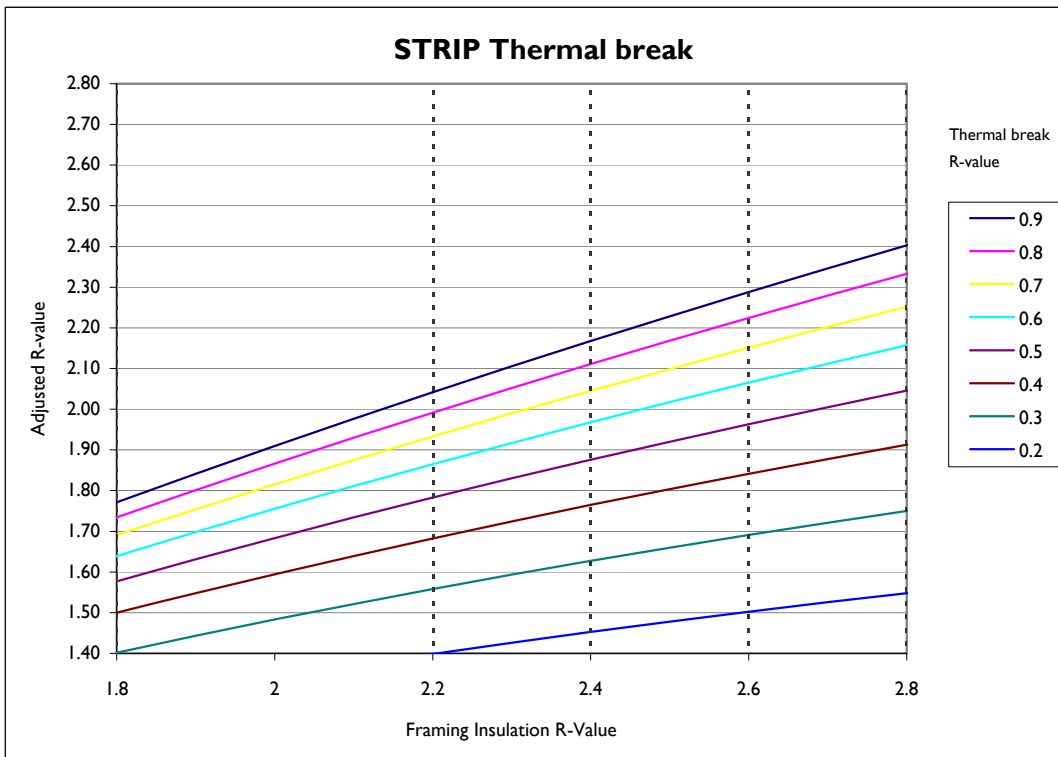
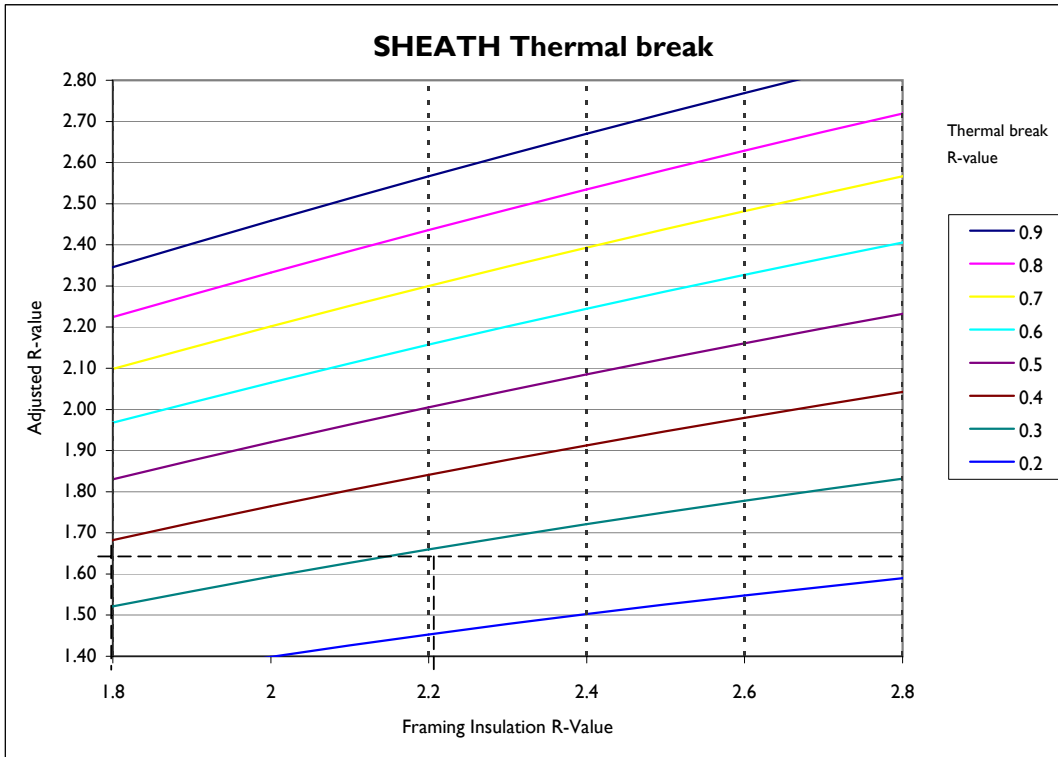
**Table 2.0**

Typical thermal break R-values

Thickness (mm)	R-Value EPS	R-Value XPS
10	0.29	0.37
15	0.42	0.56
20	0.56	0.74
40	1.11	1.48

### Any cladding with studs @ 400

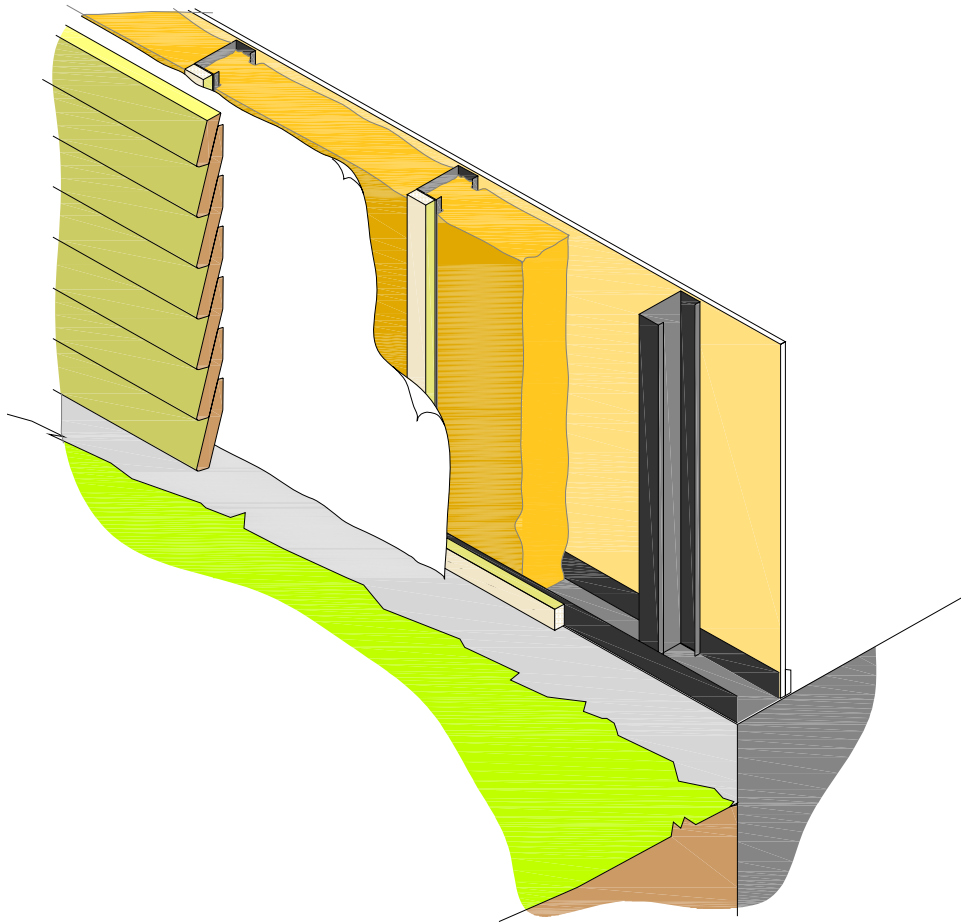
Steel frame - cavity or direct fixed - 90mm framing, TCT ≤ 0.75, 10mm plasterboard



----- Typical framing insulation R-value

## Bevel-back timber weatherboards - Direct-fixed

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard

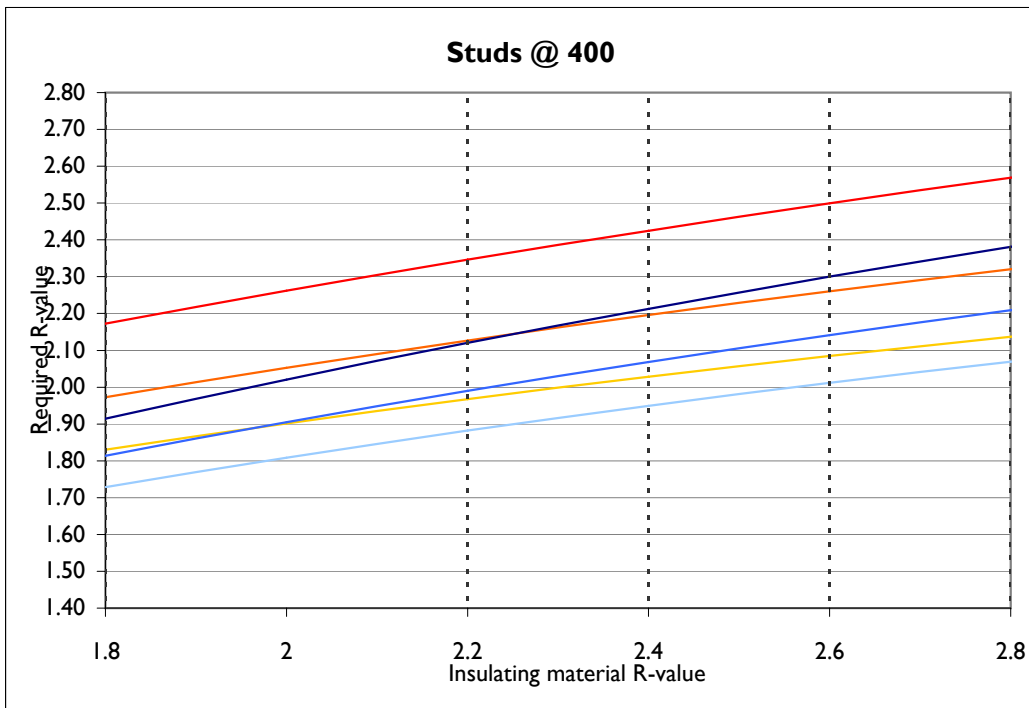
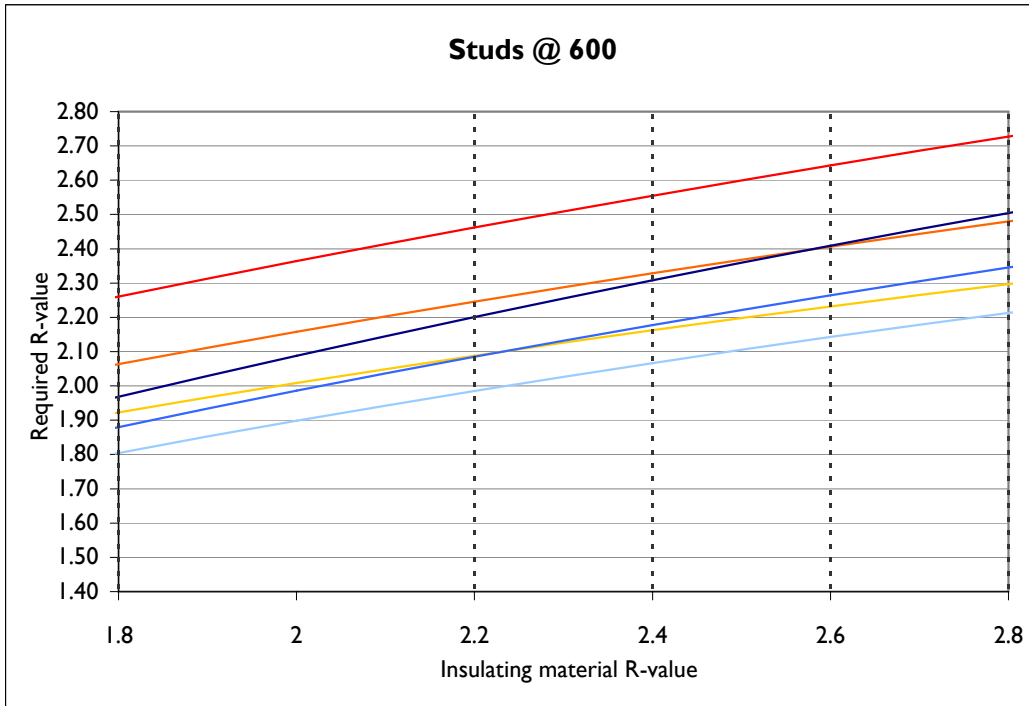


Bevel-back  
Steel framed – Direct fixed with thermal break

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Bevel-back weatherboard construction can be direct fixed up to a risk factor of 12 (E2/AS1)
- 4 Check manufacturers specifications for suitability of wall wrap

### Bevel-back timber weatherboards - Direct-fixed

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



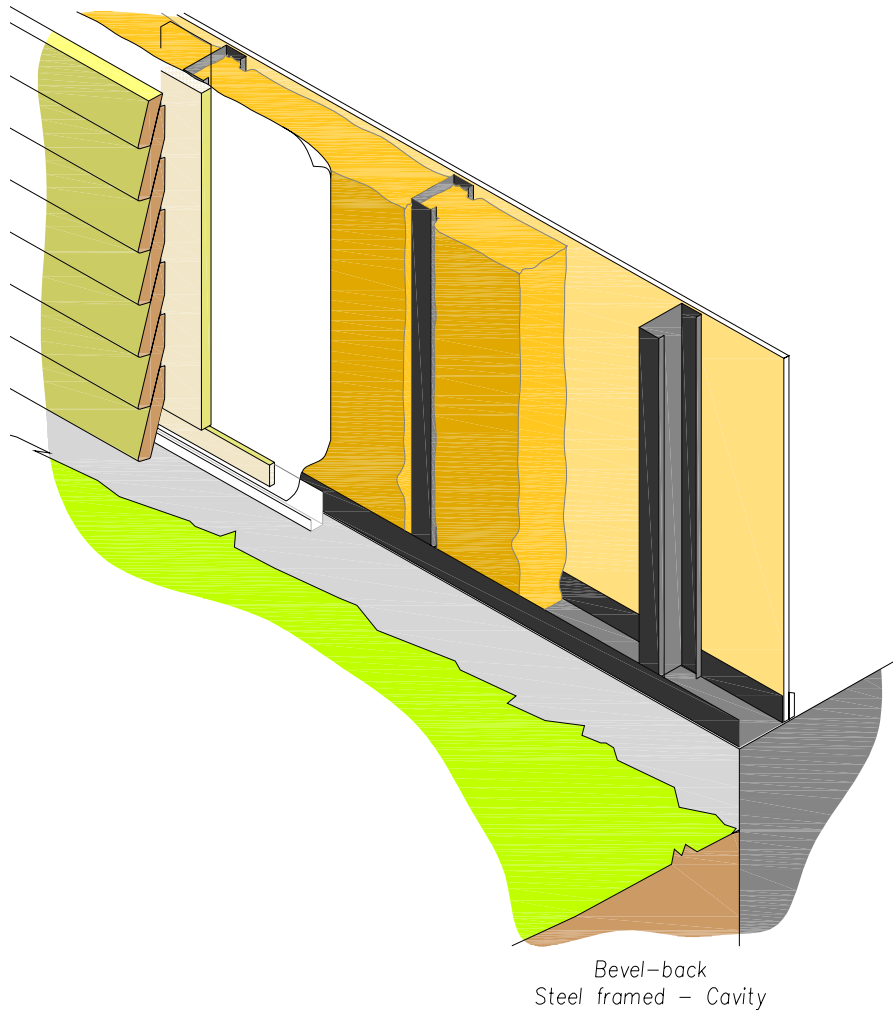
----- Typical framing insulation R-value

**Thermal break**

	R0.50 strips (15mm XPS, 20mm EPS)		R0.50 sheath (15mm XPS, 20mm EPS)
	R0.35 strips (10mm XPS, 15mm EPS)		R0.35 sheath (10mm XPS, 15mm EPS)
	R0.25 strips (10mm EPS)		R0.25 sheath (10mm EPS)

### Bevel-back timber weatherboards - Cavity

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard

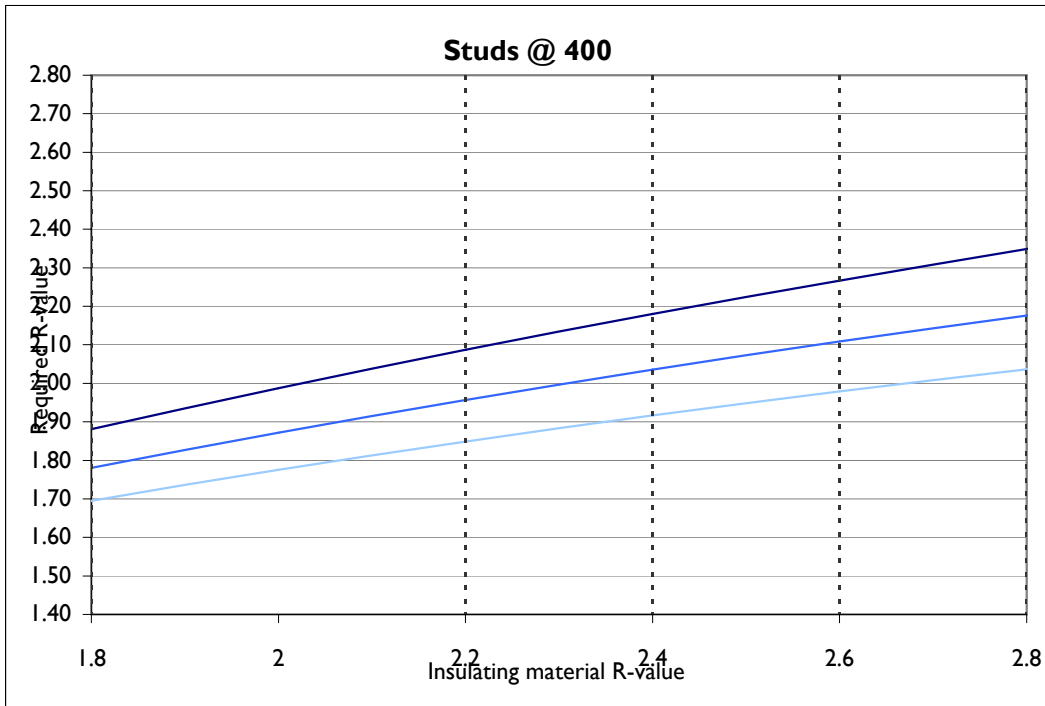
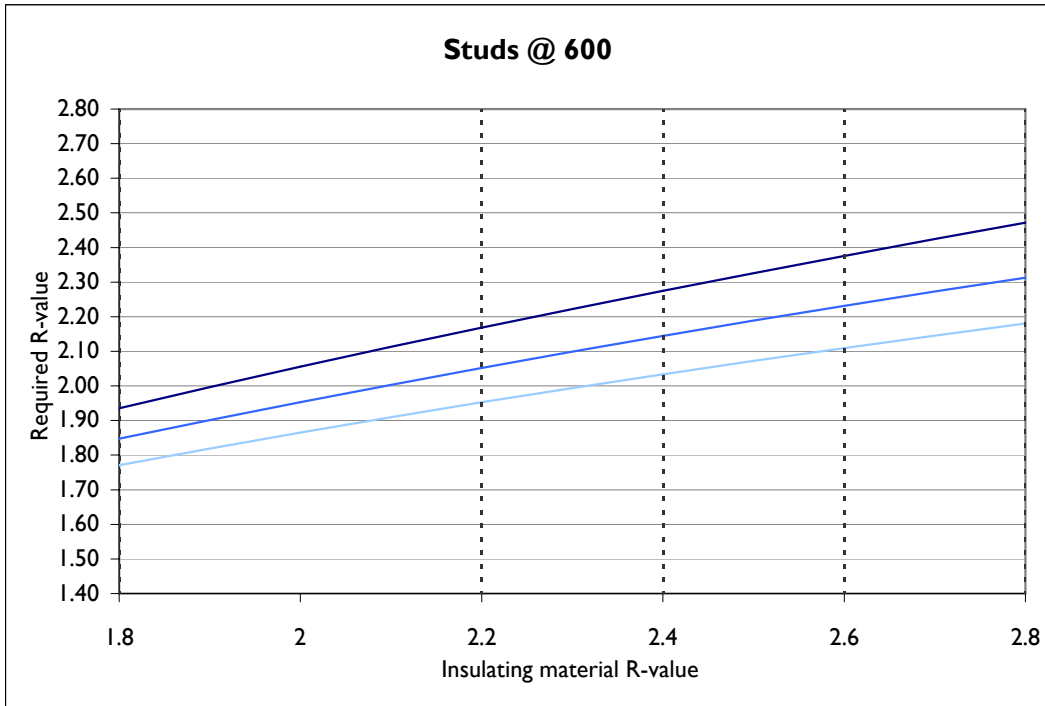


- 1 All insulants should be placed against wall wrap or sheathing*
- 2 When absorbant claddings are used, follow suppliers recommendations on painting*
- 3 Check manufacturers specifications for suitability of wall wrap*



### Bevel-back timber weatherboards - Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



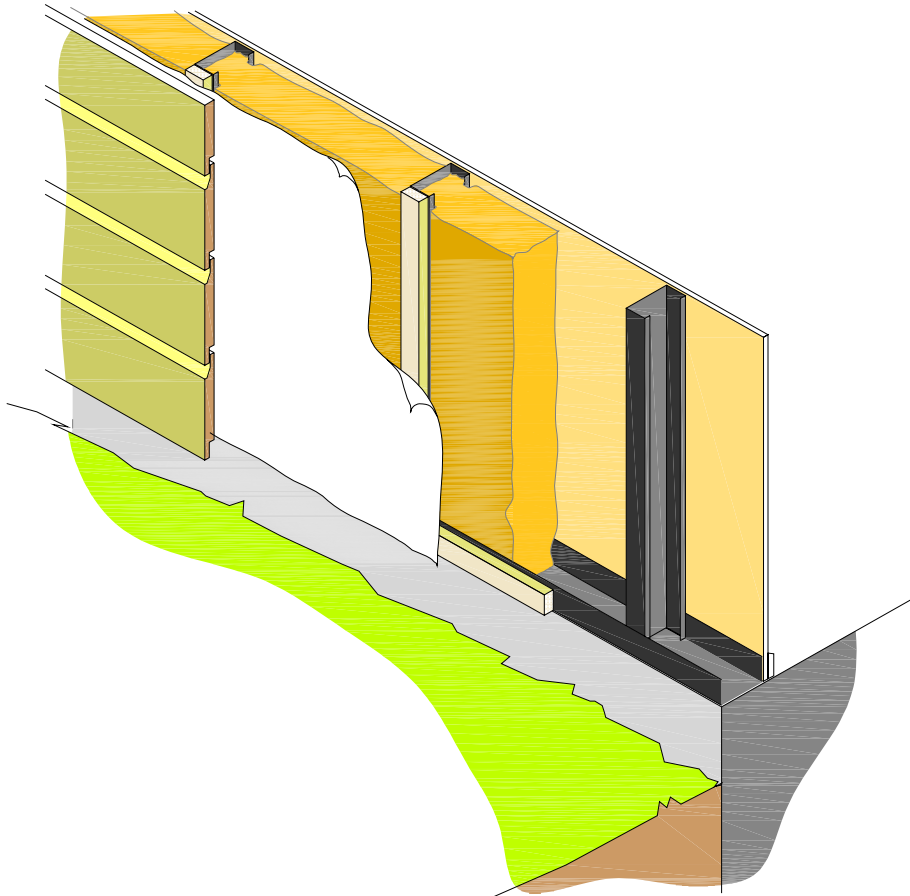
----- Typical framing insulation R-value

#### Thermal break

- R0.50 strips (15mm XPS, 20mm EPS)
- R0.35 strips (10mm XPS, 15mm EPS)
- R0.25 strips (10mm EPS)

### Rusticated timber weatherboards - Direct-fixed

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard

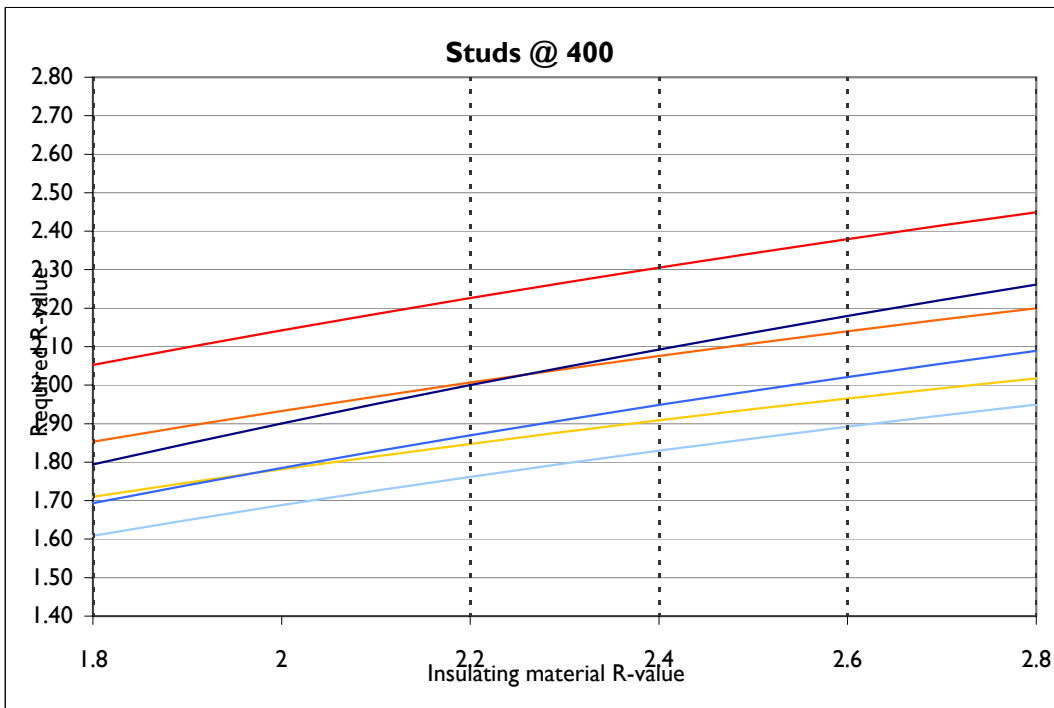
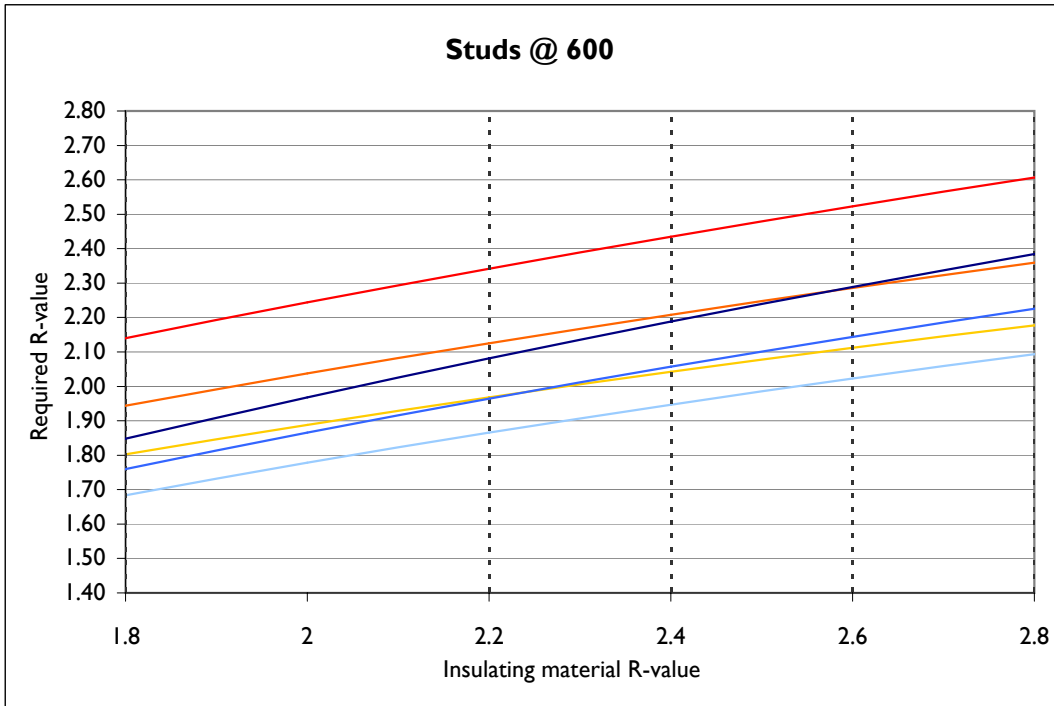


Rusticated  
Steel framed – Direct fixed with thermal break

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Bevel-back weatherboard construction can be direct fixed up to a risk factor of 6 (E2/AS1)
- 4 Check manufacturers specifications for suitability of wall wrap

### Rusticated timber weatherboards - Direct-fixed

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



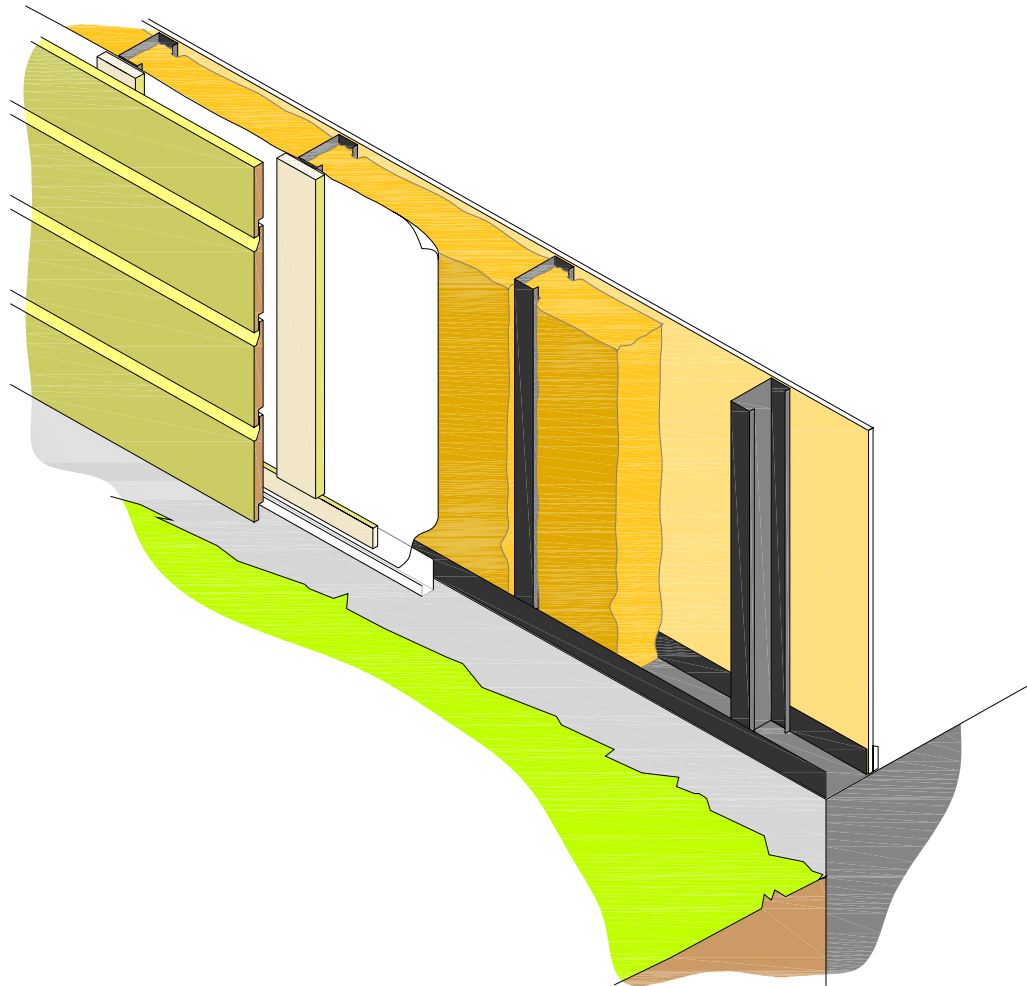
----- Typical framing insulation R-value

**Thermal break**

	R0.50 strips (15mm XPS, 20mm EPS)		R0.50 sheath (15mm XPS, 20mm EPS)
	R0.35 strips (10mm XPS, 15mm EPS)		R0.35 sheath (10mm XPS, 15mm EPS)
	R0.25 strips (10mm EPS)		R0.25 sheath (10mm EPS)

### Rusticated timber weatherboards - Cavity

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard

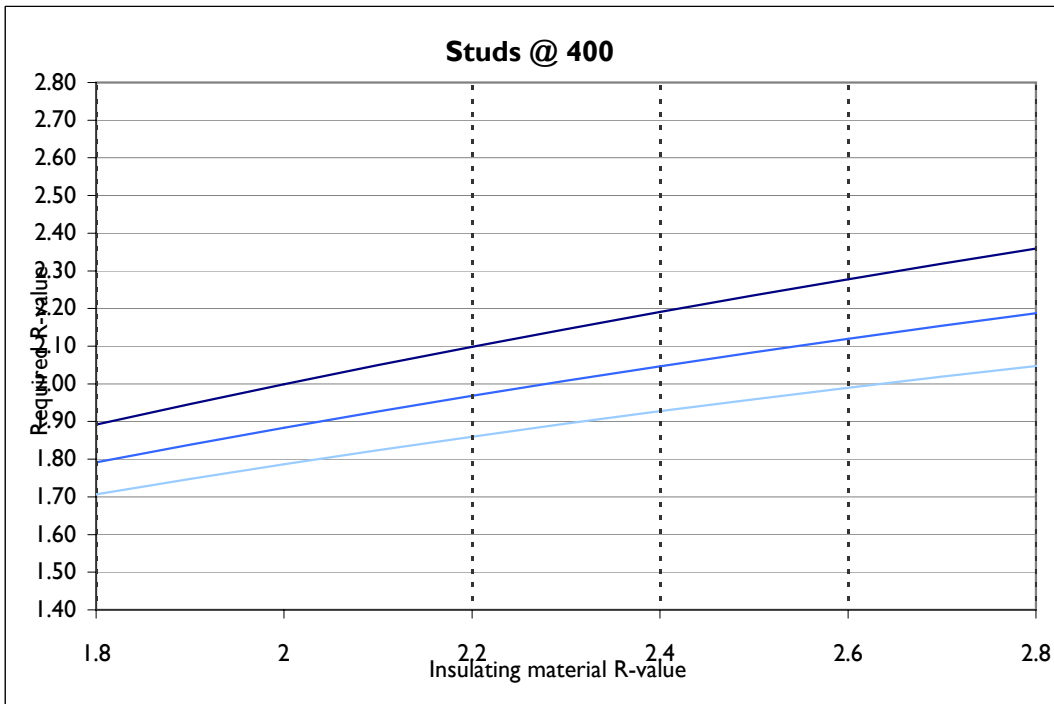
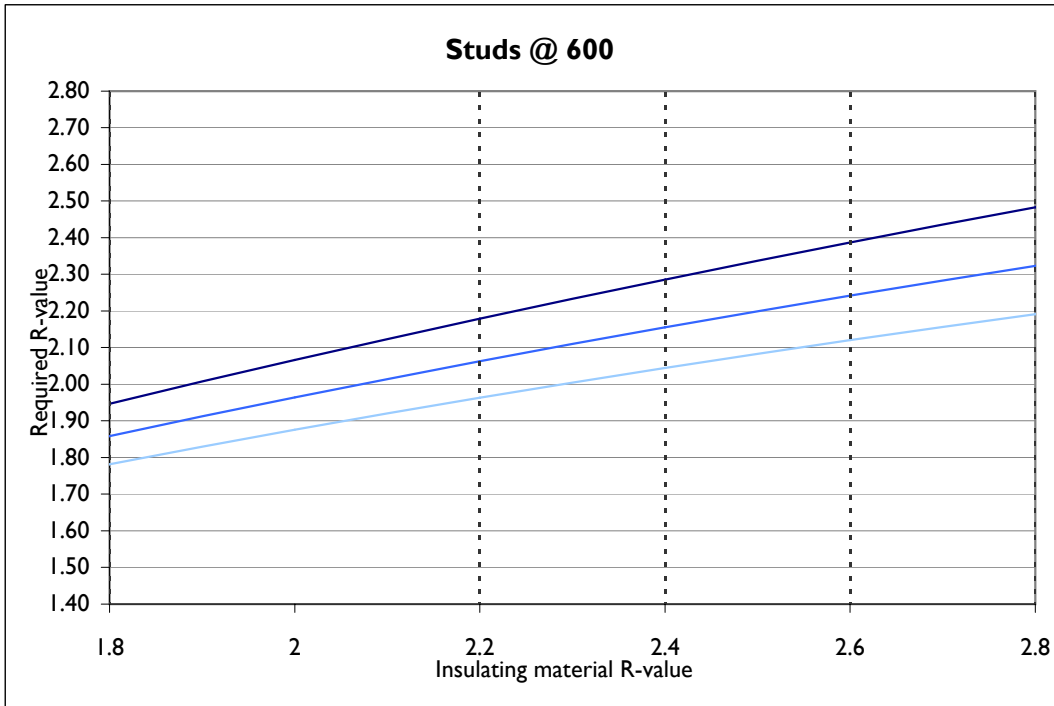


Rusticated  
Steel framed - Cavity

- 1 All insulants should be placed against wall wrap or sheathing*
- 2 When absorbant claddings are used, follow suppliers recommendations on painting*
- 3 Check manufacturers specifications for suitability of wall wrap*

### Rusticated timber weatherboards - Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



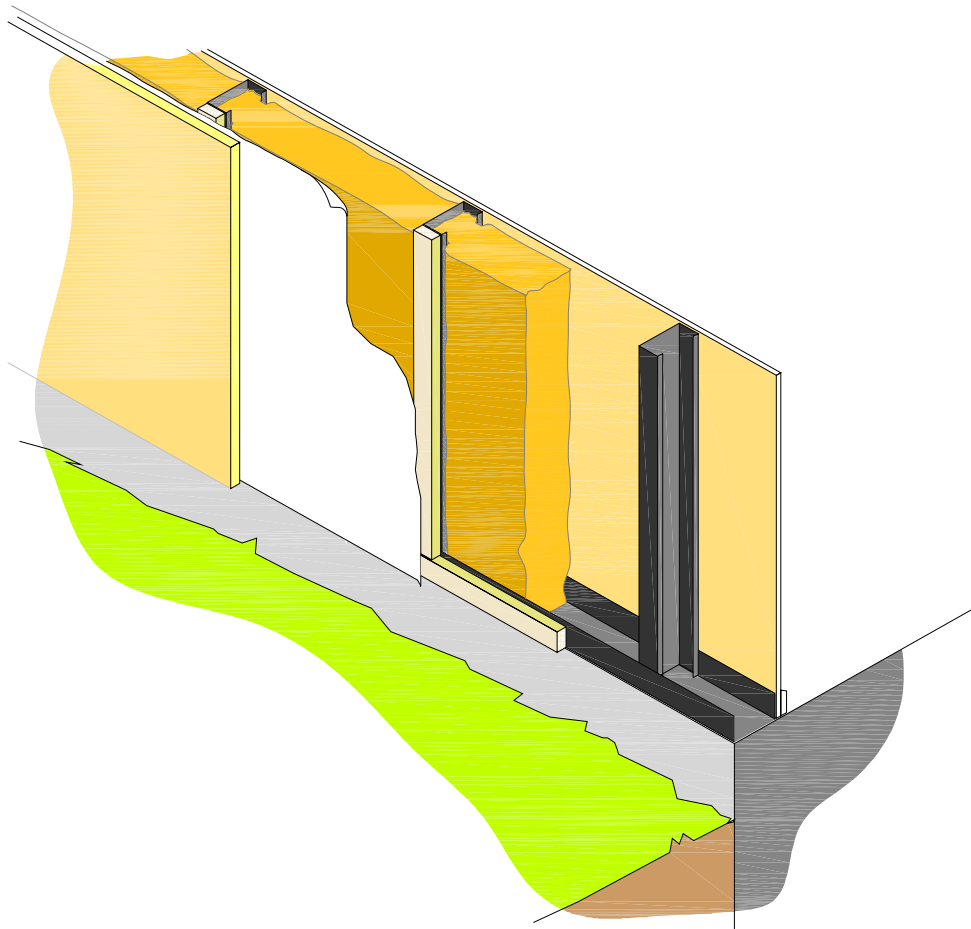
----- Typical framing insulation R-value

**Thermal break**

- R0.50 strips (15mm XPS, 20mm EPS)
- R0.35 strips (10mm XPS, 15mm EPS)
- R0.25 strips (10mm EPS)

### Sheet cladding - Direct-fixed

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard

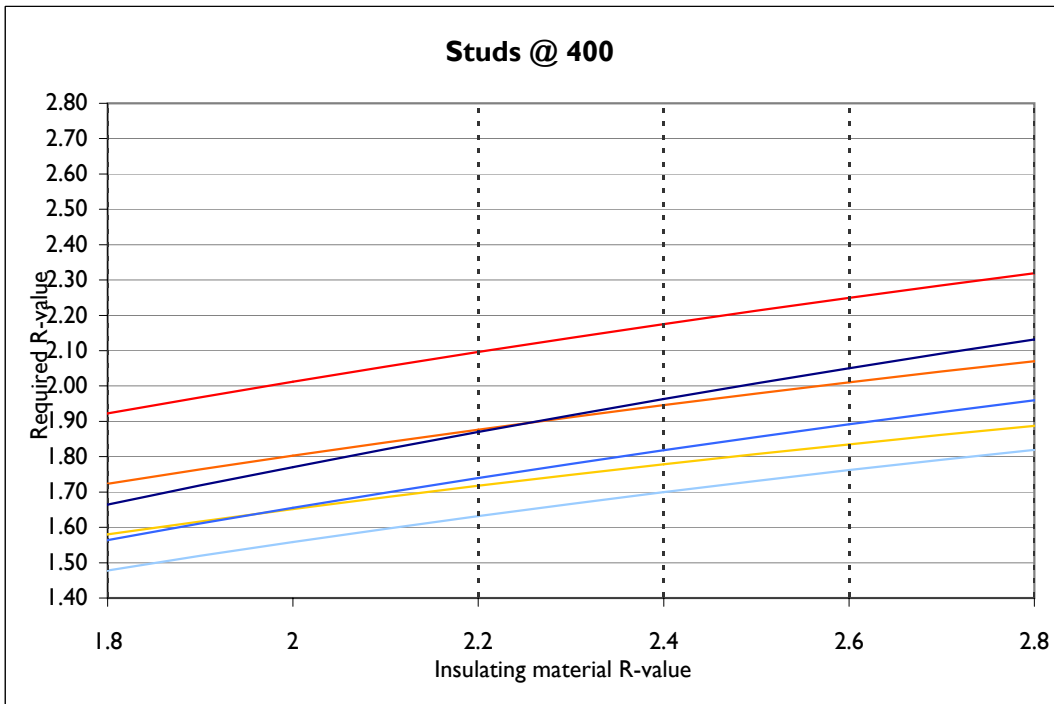
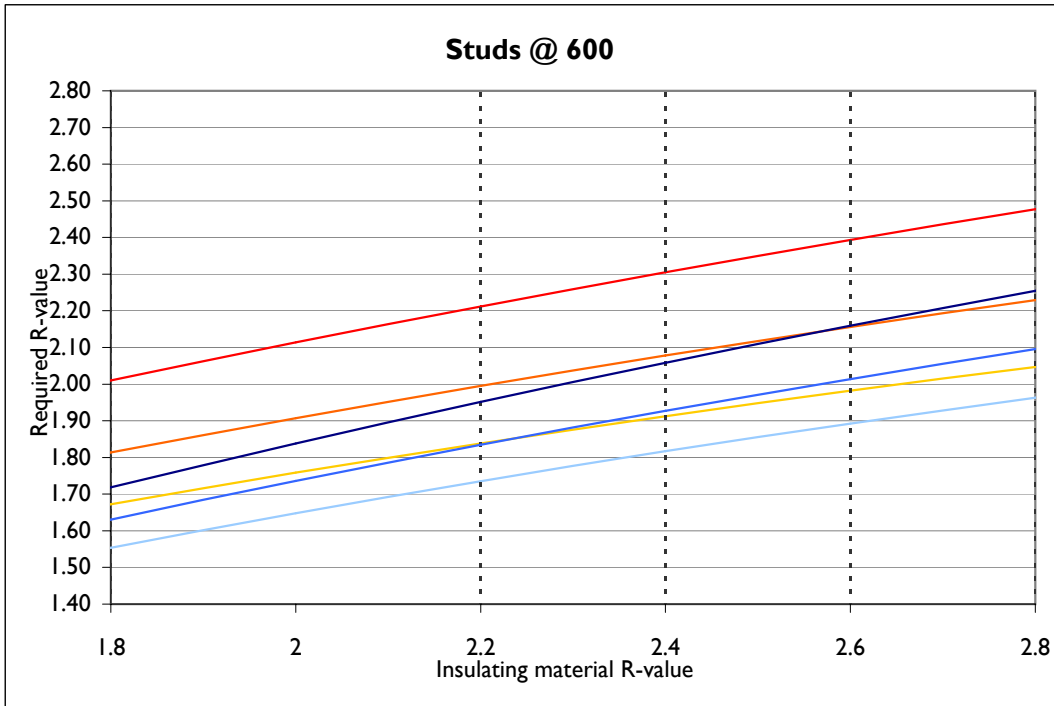


Sheet cladding  
Steel framed – Direct fixed with thermal break

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Flat sheat cladding can be direct fixed up to a risk factor of 6 (E2/AS1)
- 4 Check manufacturers specifications for suitability of wall wrap

### Sheet cladding - Direct-fixed

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



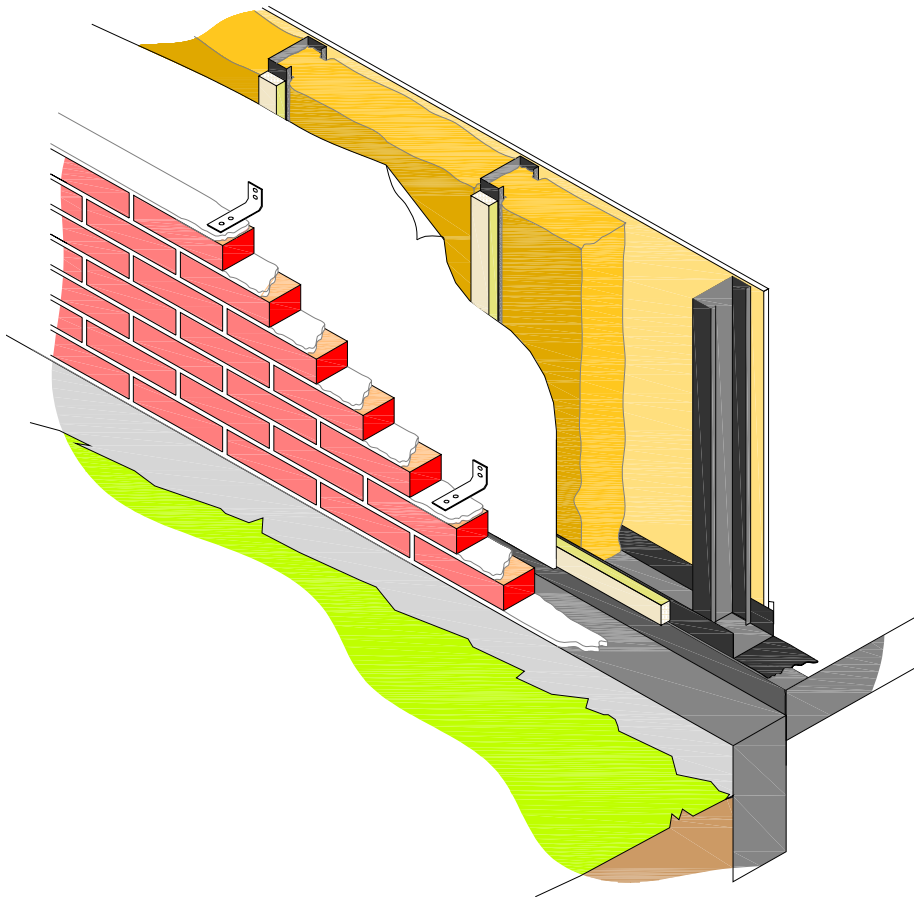
----- Typical framing insulation R-value

**Thermal break**

	R0.50 strips (15mm XPS, 20mm EPS)		R0.50 sheath (15mm XPS, 20mm EPS)
	R0.35 strips (10mm XPS, 15mm EPS)		R0.35 sheath (10mm XPS, 15mm EPS)
	R0.25 strips (10mm EPS)		R0.25 sheath (10mm EPS)

### Masonry veneer - Cavity

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard



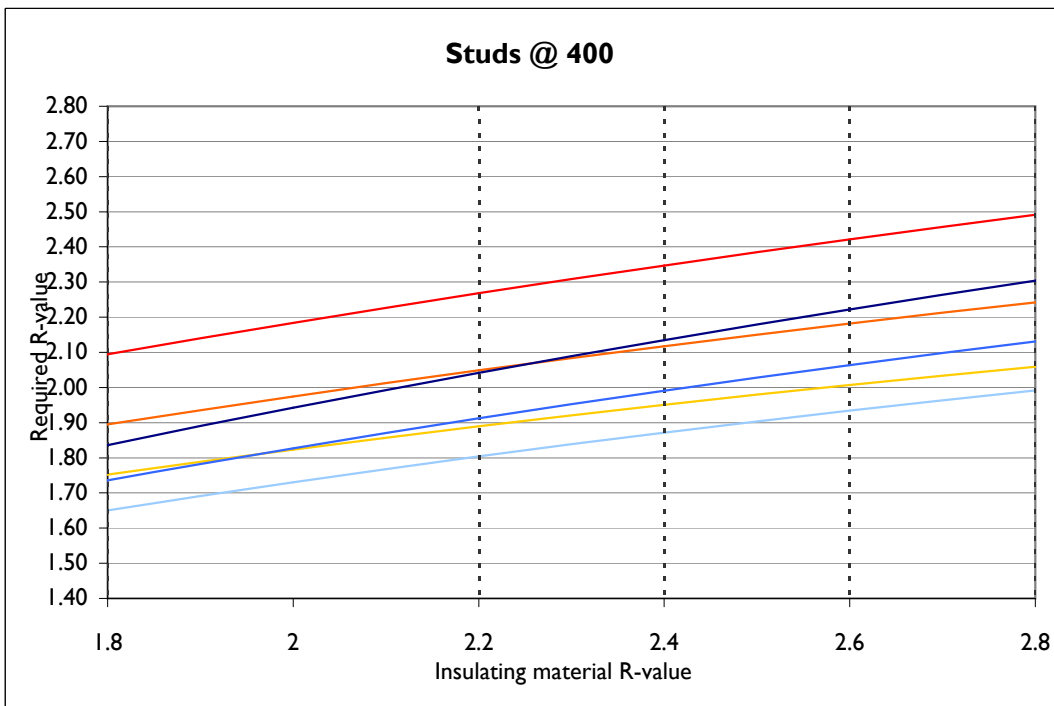
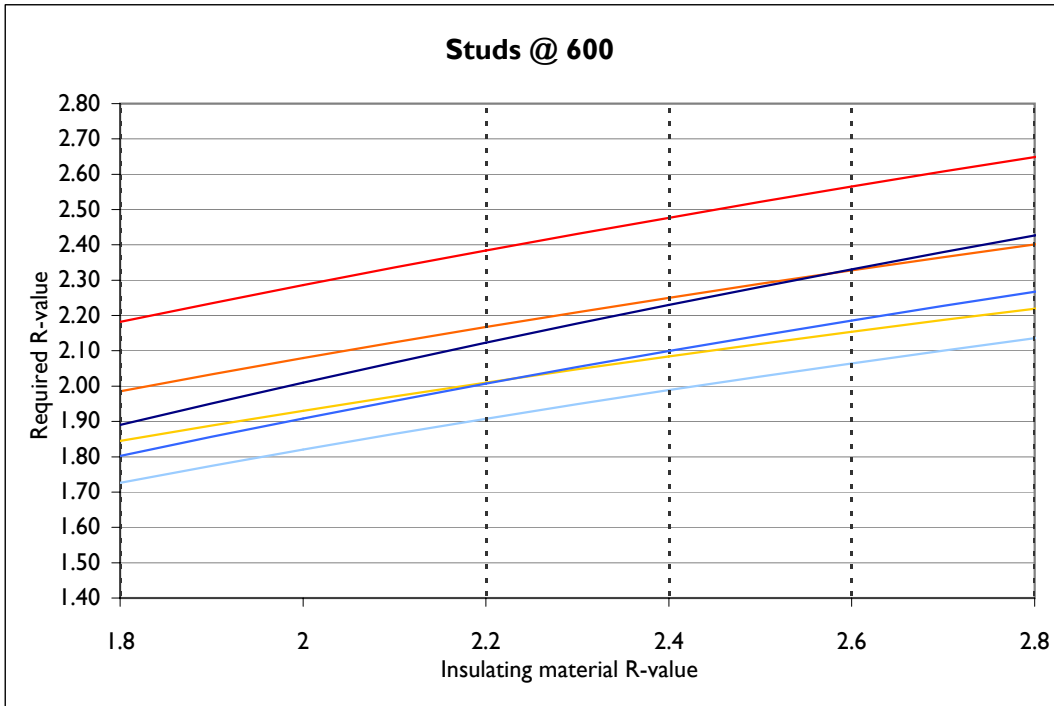
Masonry veneer  
Steel framed - Cavity

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Check manufacturers specifications for suitability of wall wrap



### Masonry veneer - Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



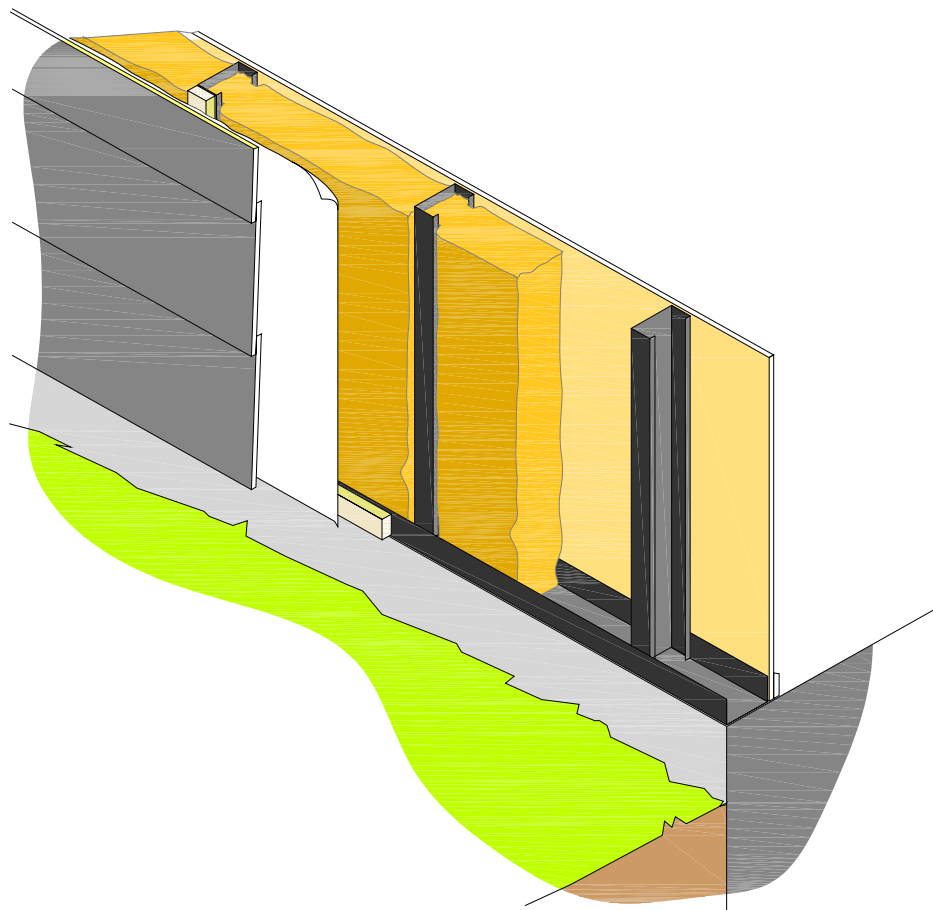
----- Typical framing insulation R-value

**Thermal break**

	R0.50 strips (15mm XPS, 20mm EPS)		R0.50 sheath (15mm XPS, 20mm EPS)
	R0.35 strips (10mm XPS, 15mm EPS)		R0.35 sheath (10mm XPS, 15mm EPS)
	R0.25 strips (10mm EPS)		R0.25 sheath (10mm EPS)

### Fibre-cement weatherboards (7.5mm)- Direct-fixed

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard

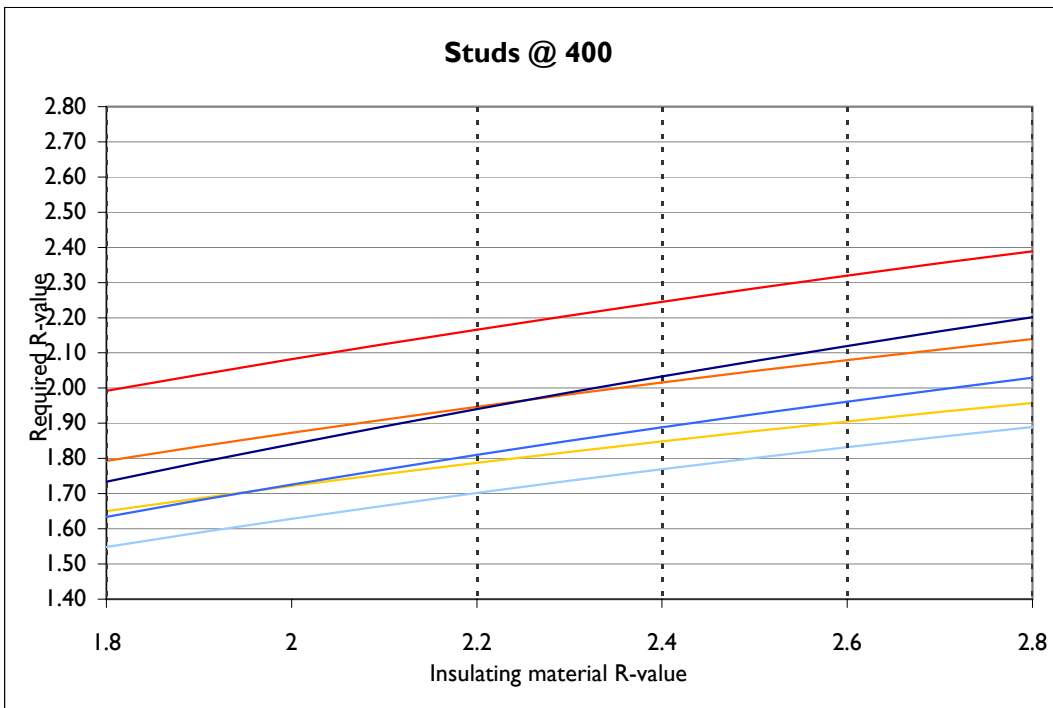
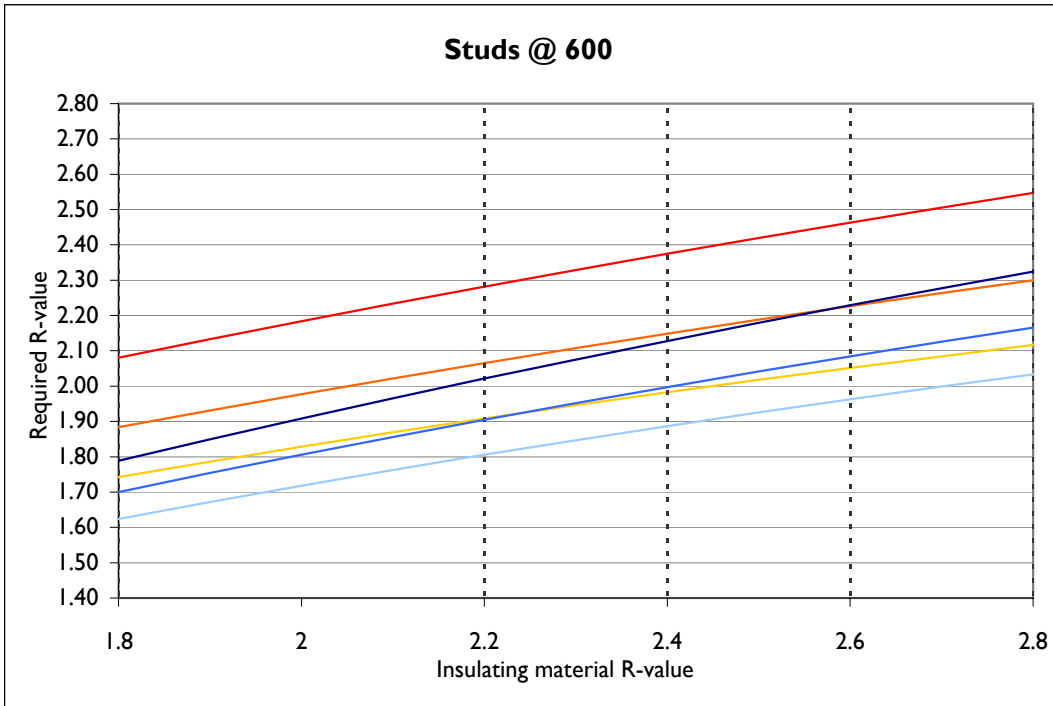


Fibre-cement Weatherboard  
Steel framed - Direct fixed with thermal break

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Fibre-cement weatherboards can be direct fixed up to a risk factor of 6 (E2/AS1)
- 4 Check manufacturers specifications for suitability of wall wrap

### Fibre-cement weatherboards (7.5mm)- Direct-fixed

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



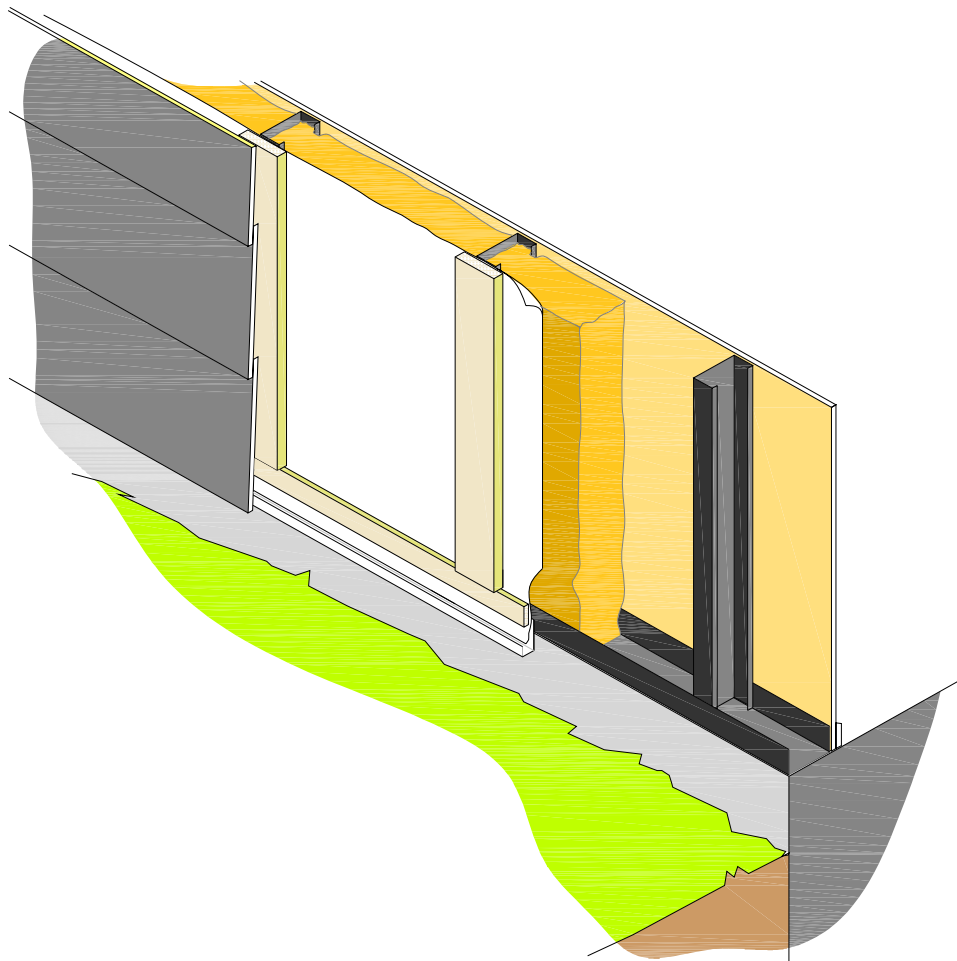
----- Typical framing insulation R-value

**Thermal break**

	R0.50 strips (15mm XPS, 20mm EPS)		R0.50 sheath (15mm XPS, 20mm EPS)
	R0.35 strips (10mm XPS, 15mm EPS)		R0.35 sheath (10mm XPS, 15mm EPS)
	R0.25 strips (10mm EPS)		R0.25 sheath (10mm EPS)

### Fibre-cement weatherboards (7.5mm) - Cavity

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard

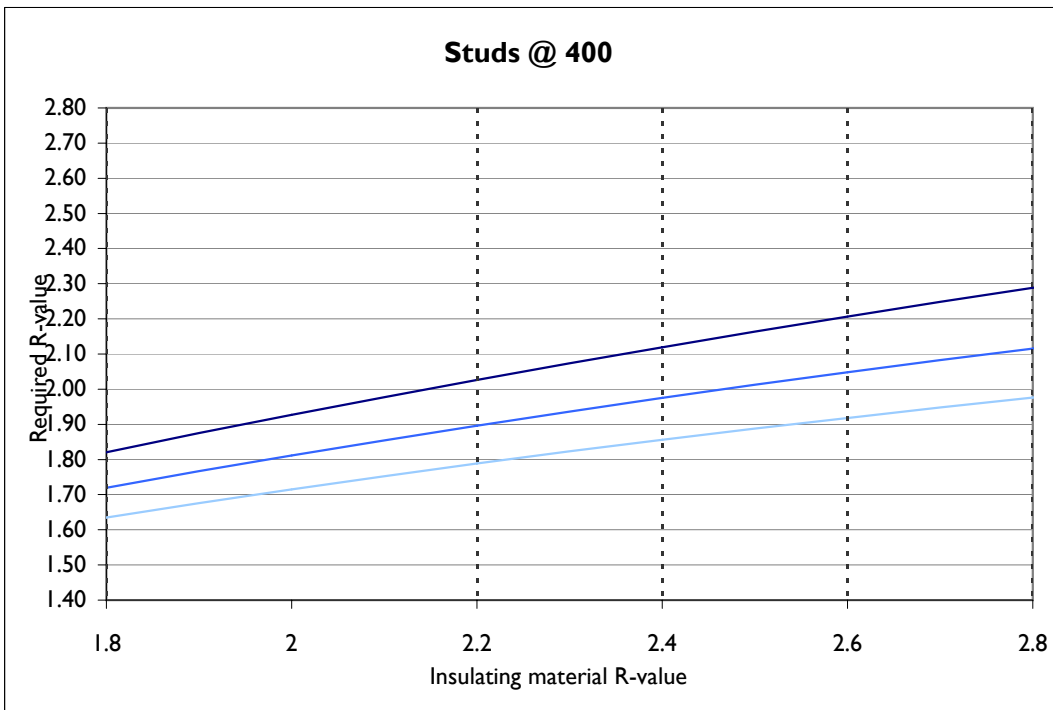
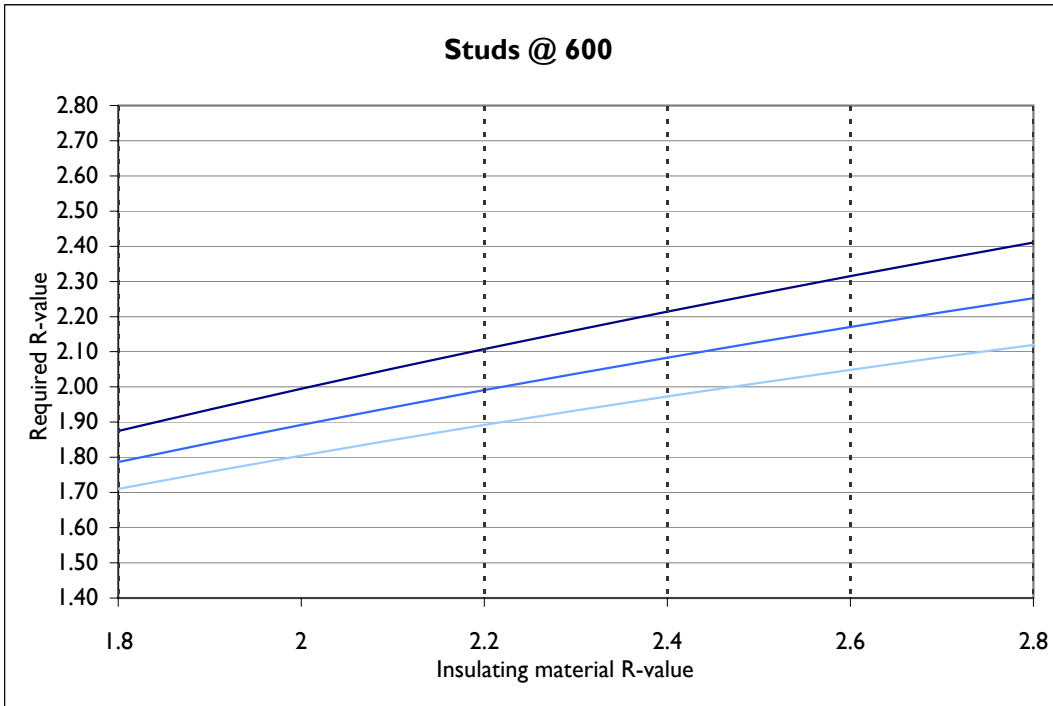


Fibre-cement Weatherboard  
Steel framed - Cavity

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Check manufacturers specifications for suitability of wall wrap

### Fibre-cement weatherboards (7.5mm) - Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



----- Typical framing insulation R-value

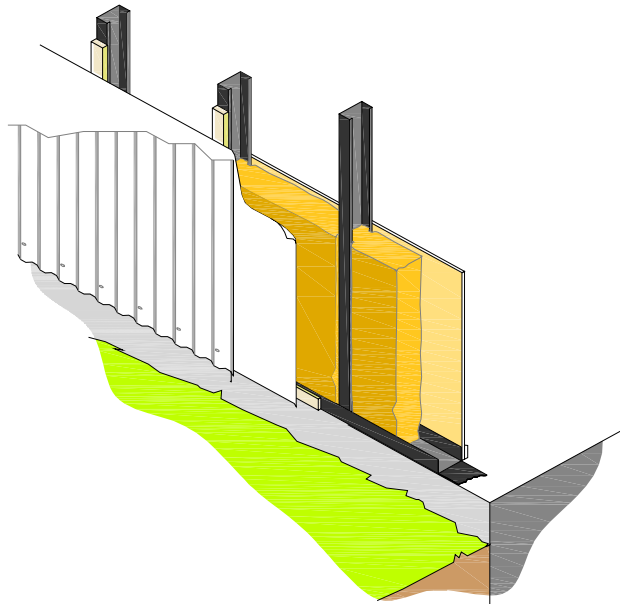
**Thermal break**

- R0.50 strips (15mm XPS, 20mm EPS)
- R0.35 strips (10mm XPS, 15mm EPS)
- R0.25 strips (10mm EPS)

### Metal profile - Direct-fixed and Cavity

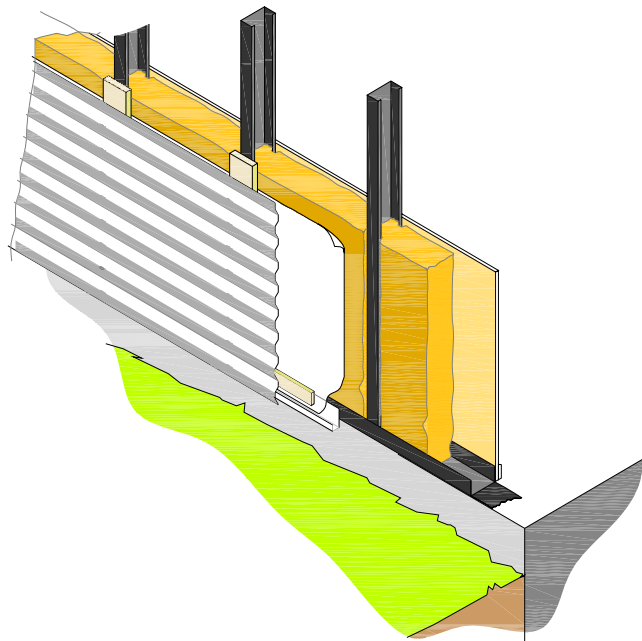
Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard

Direct-fixed



Metal vertical profile  
Steel framed - Direct fixed

Cavity

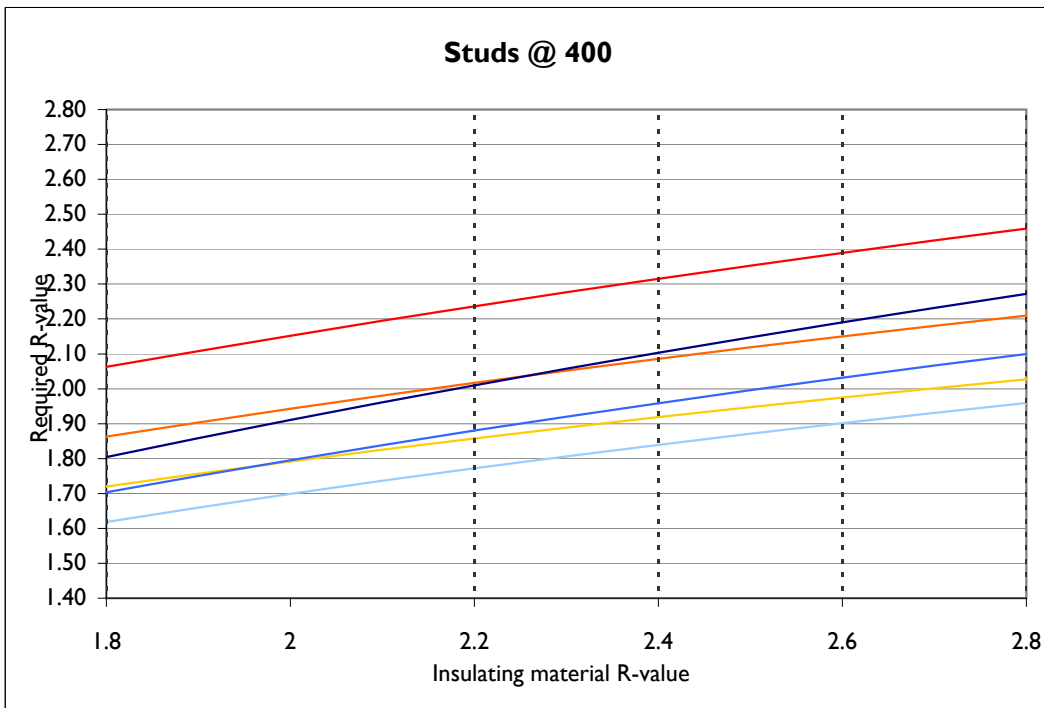
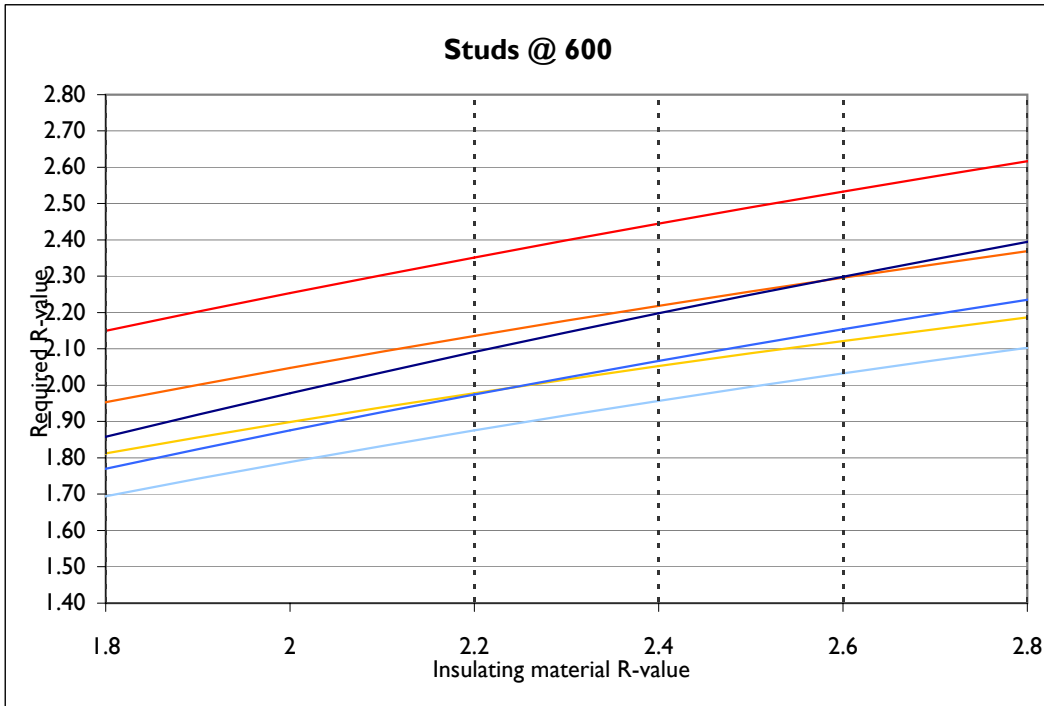


Metal horizontal profile  
Steel framed - Cavity

- 1 All insulants should be placed against wall wrap or sheathing
- 2 Check manufacturers specifications for suitability of wall wrap

### Metal profile - Direct-fixed and Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



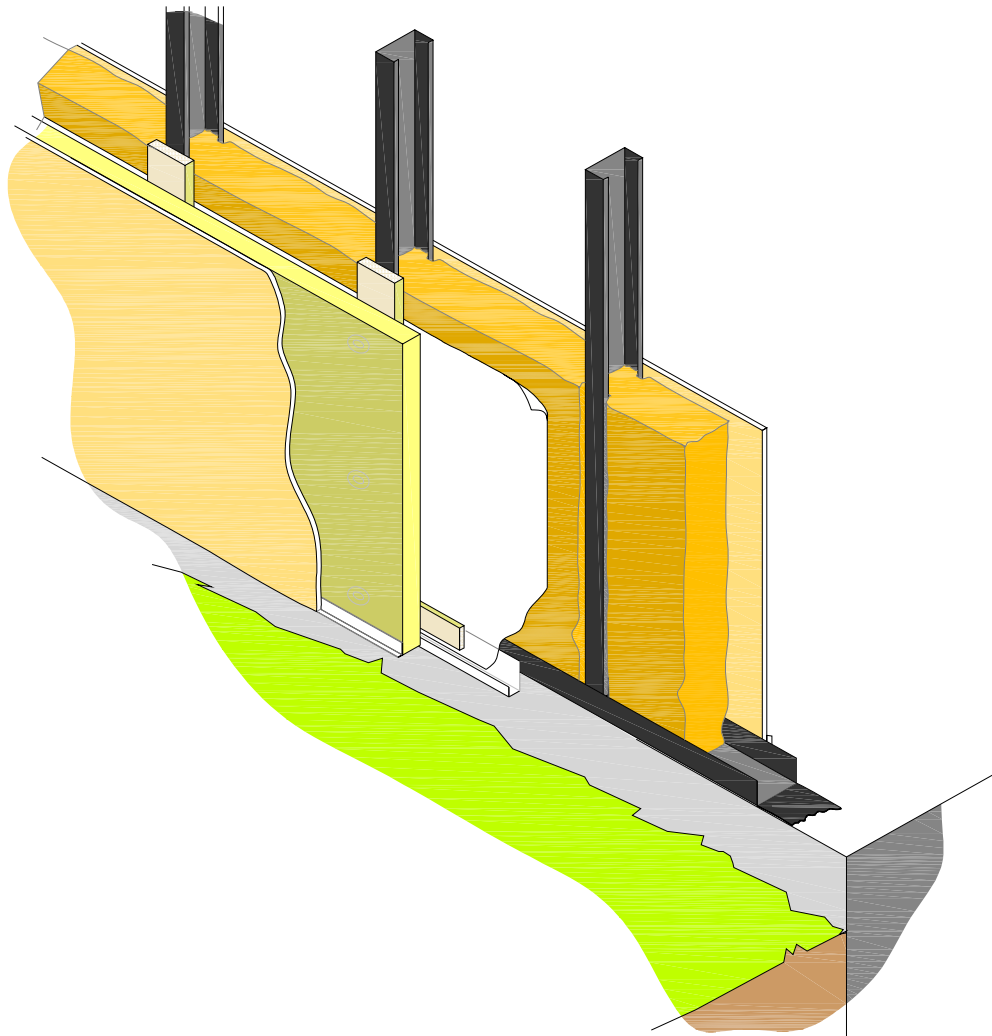
----- Typical framing insulation R-value

**Thermal break**

	R0.50 strips (15mm XPS, 20mm EPS)		R0.50 sheath (15mm XPS, 20mm EPS)
	R0.35 strips (10mm XPS, 15mm EPS)		R0.35 sheath (10mm XPS, 15mm EPS)
	R0.25 strips (10mm EPS)		R0.25 sheath (10mm EPS)

### 50mm EIFS (External Insulation and Finish Systems) - Cavity

Steel frame, 90mm framing, TCT  $\leq 0.75$ , 10mm plasterboard



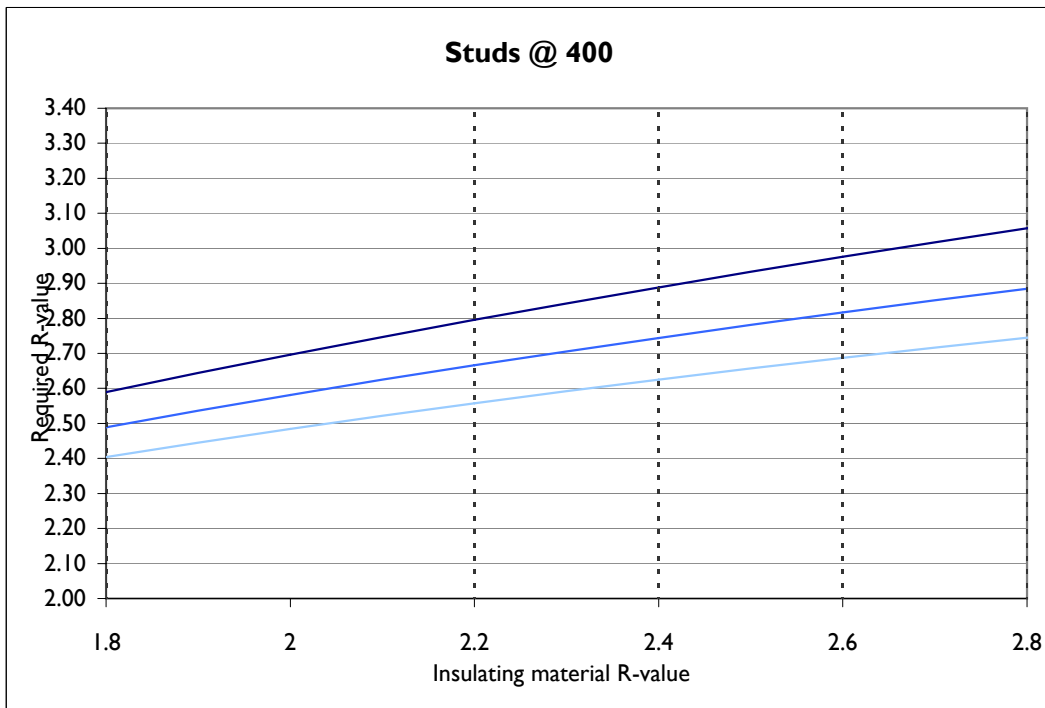
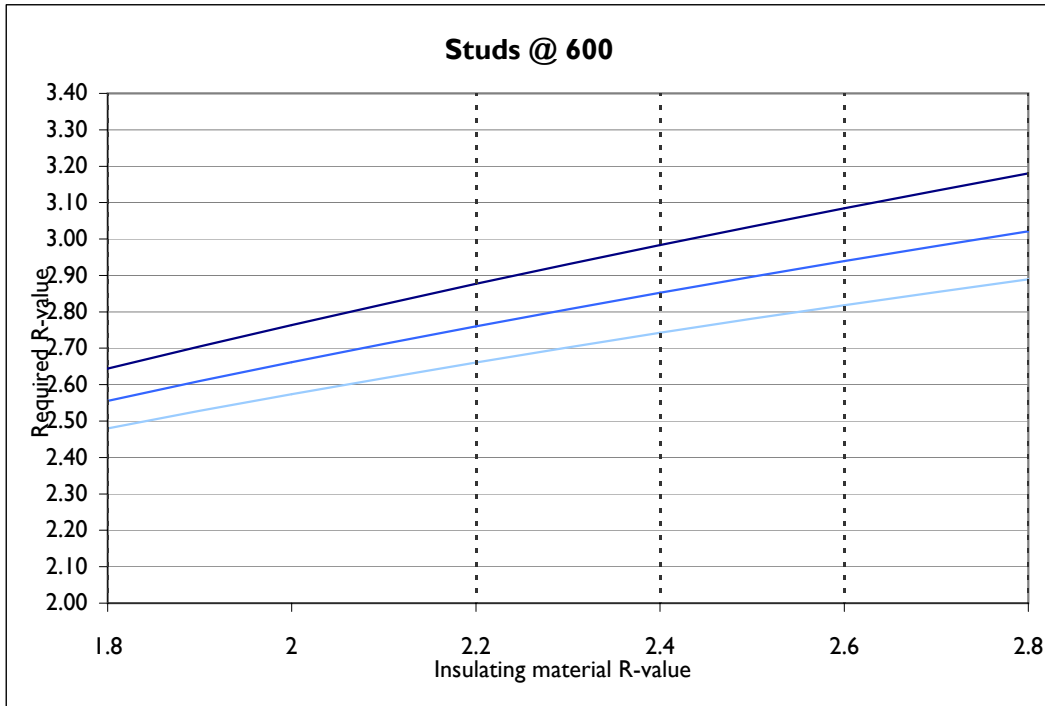
EIFS  
Steel framed – Cavity

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Check manufacturers specifications for suitability of wall wrap



### 50mm EIFS (External Insulation and Finish Systems) - Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



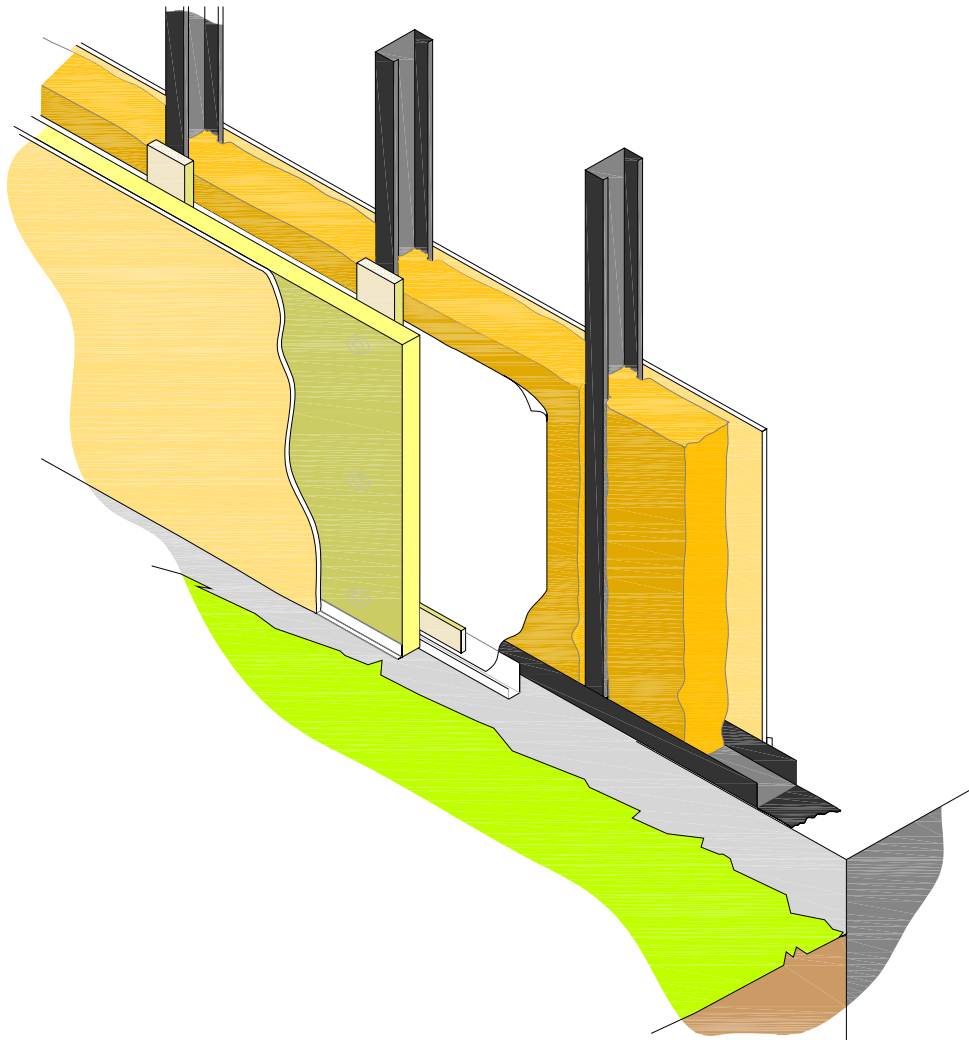
----- Typical framing insulation R-value

**Thermal break**

- R0.50 strips (15mm XPS, 20mm EPS)
- R0.35 strips (10mm XPS, 15mm EPS)
- R0.25 strips (10mm EPS)

### 50mm AAC (Autoclaved Aerated Concrete) - Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard

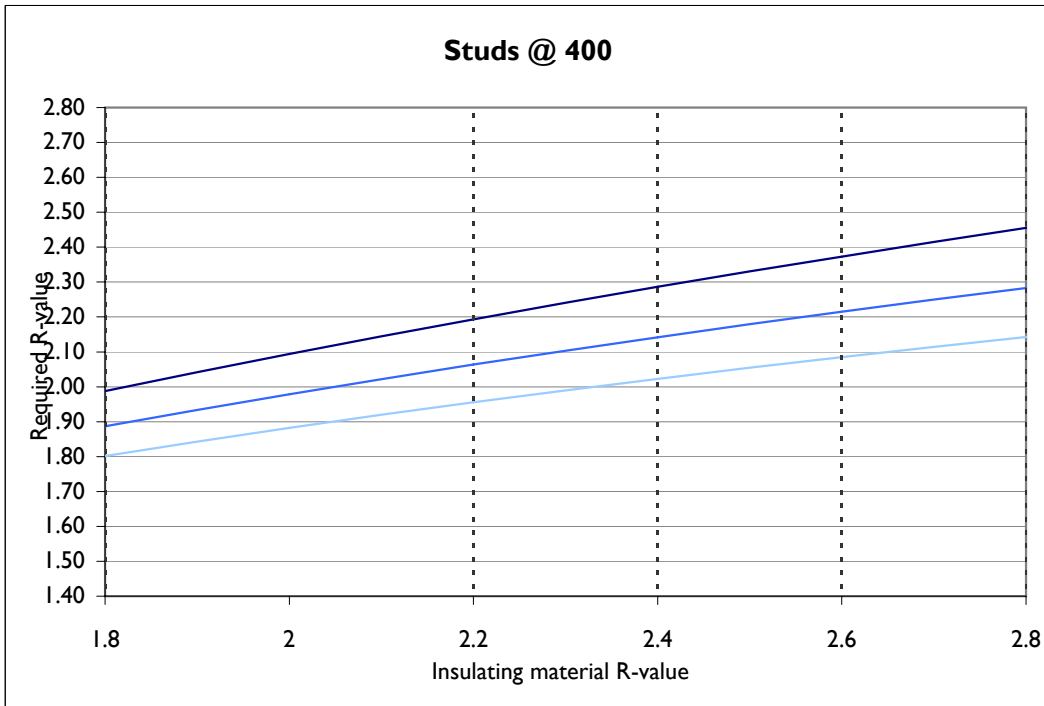
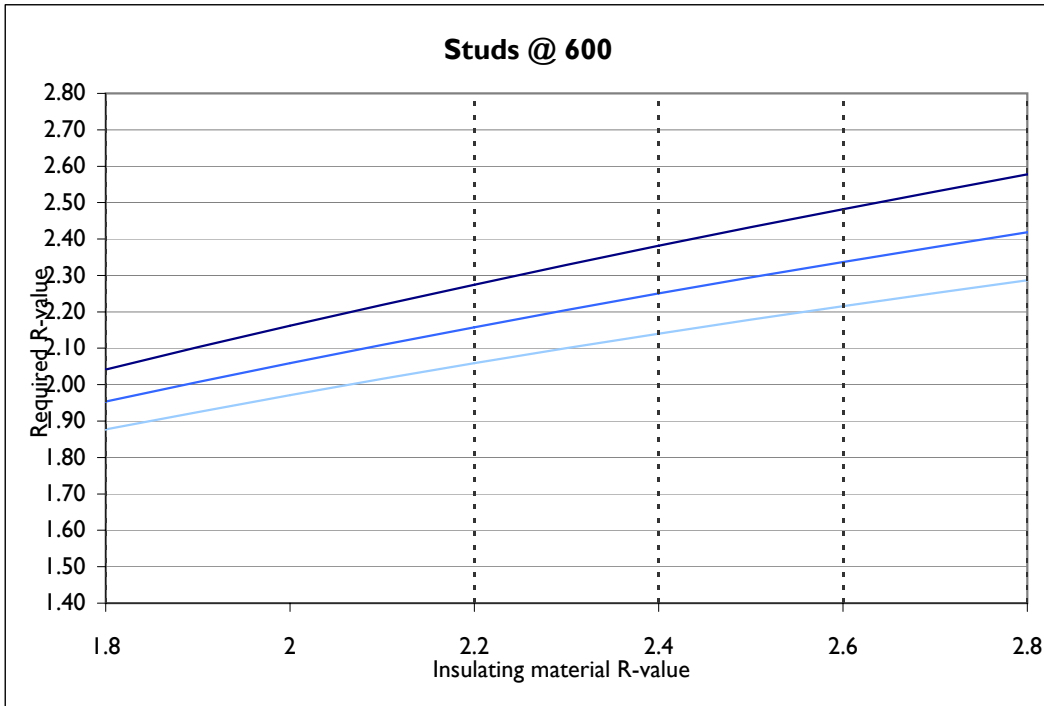


AAC  
Steel framed - Cavity

- 1 All insulants should be placed against wall wrap or sheathing
- 2 When absorbant claddings are used, follow suppliers recommendations on painting
- 3 Check manufacturers specifications for suitability of wall wrap

### 50mm AAC (Autoclaved Aerated Concrete) - Cavity

Steel frame, 90mm framing, TCT ≤ 0.75, 10mm plasterboard



----- Typical framing insulation R-value

**Thermal break**

- R0.50 strips (15mm XPS, 20mm EPS)
- R0.35 strips (10mm XPS, 15mm EPS)
- R0.25 strips (10mm EPS)



## Section B

### Roof Construction R-Values

#### Any roofing material

Pitched steel-framed attic roof, trusses @ 900, 10mm plasterboard ceiling

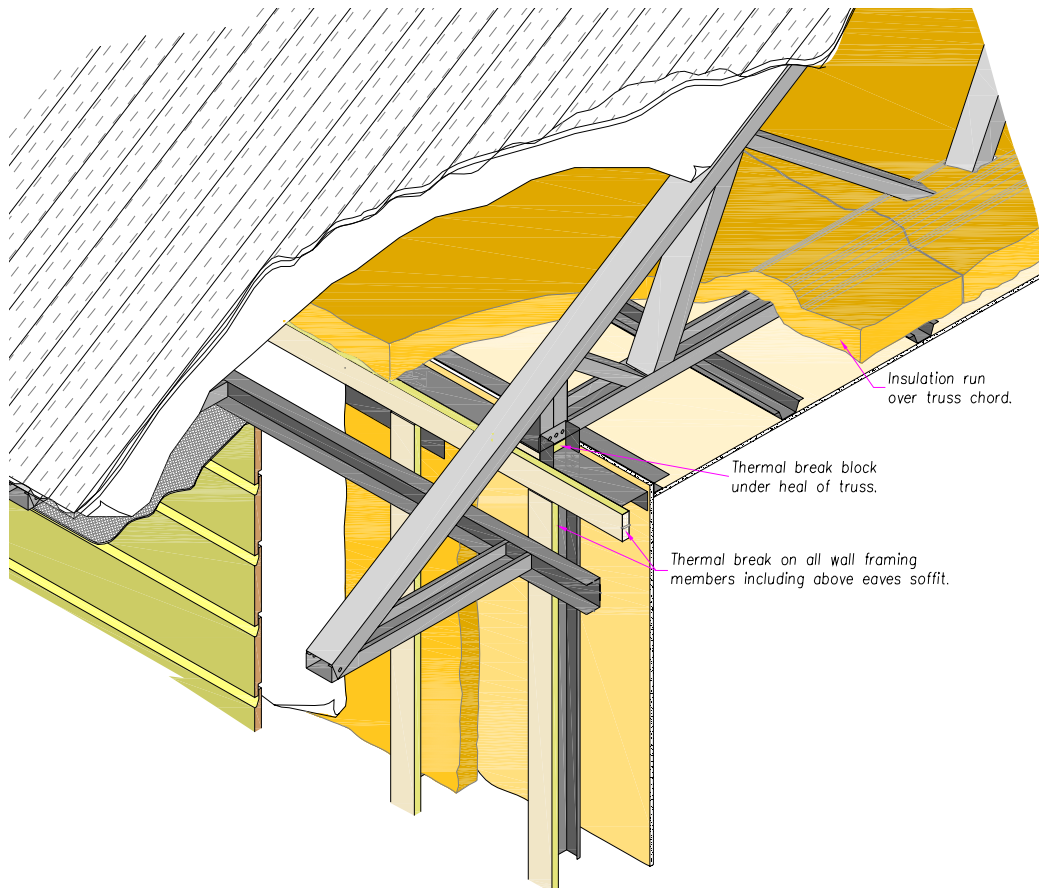
B2

Low slope steel-framed roof, TCT  $\leq$  1.5, 10mm plasterboard ceiling

B4

## Pitched steel-framed attic roof - Any roofing material

Trusses @ 900crs, TCT  $\leq 0.75$ , 10mm plasterboard ceiling

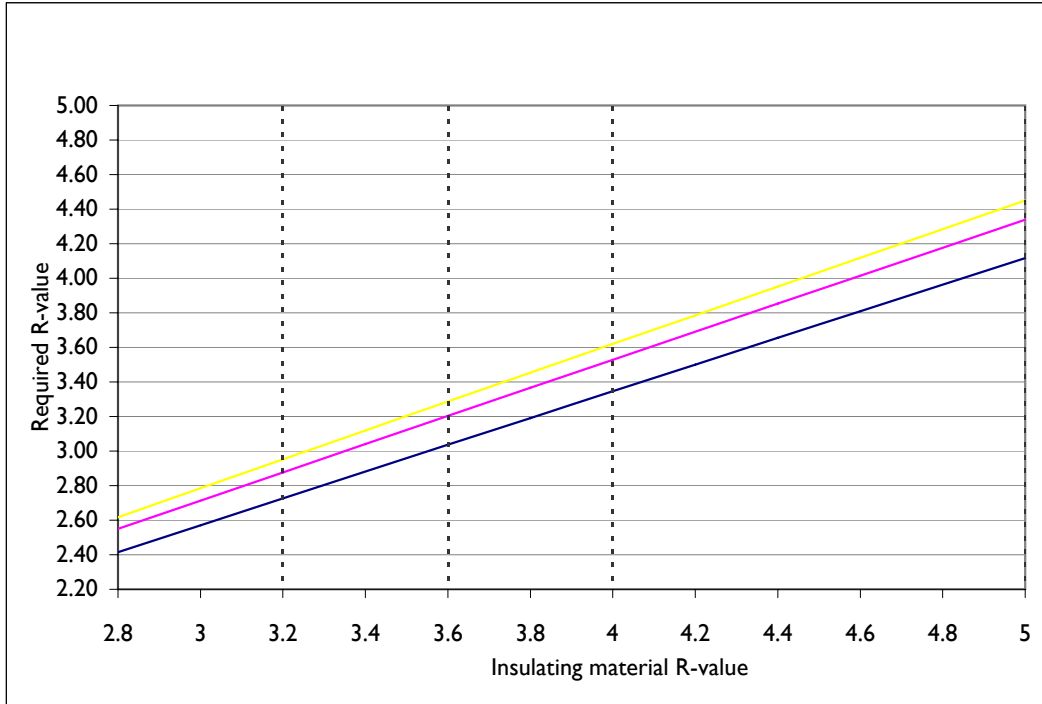


Non-Specific cladding  
Pitched Steel framed - attic roof

- 1 Note that these results require high quality workmanship with batts closely butted together at joints.
- 2 Insulation must be placed in all C sections to avoid air gaps
- 3 Add 0.2 if 12mm softboard is used in lieu of 10mm plasterboard

### Pitched steel-framed attic roof - Any roofing material

Trusses @ 900crs, TCT ≤ 0.75, 10mm plasterboard ceiling



----- Typical framing insulation R-value

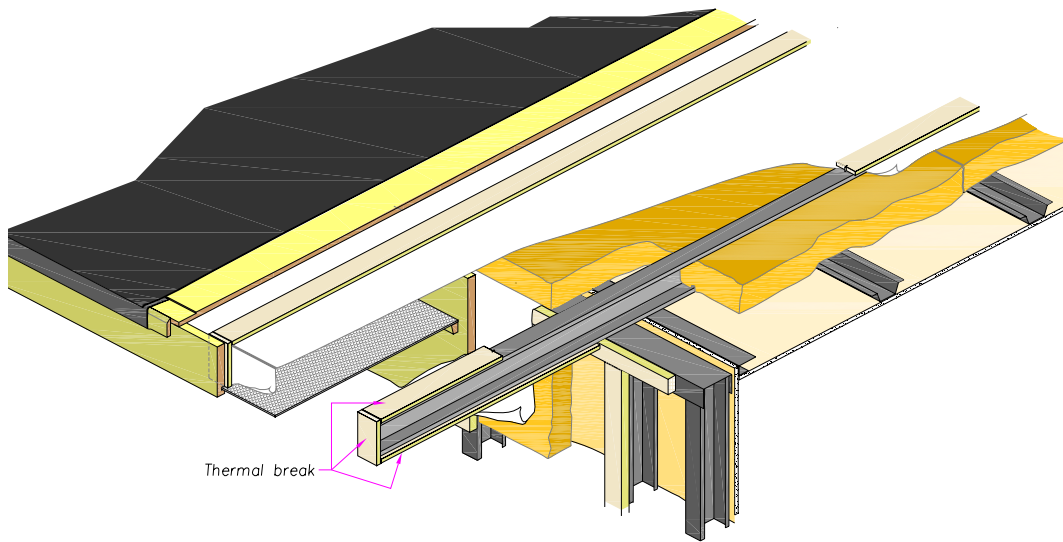
**Key**

Trusses @ 600crs  
 Trusses @ 900crs

Trusses @ 1200crs

### Low slope steel-framed roof - Any roofing material

150mm steel rafters, TCT  $\leq 1.5$ , 10mm plasterboard ceiling

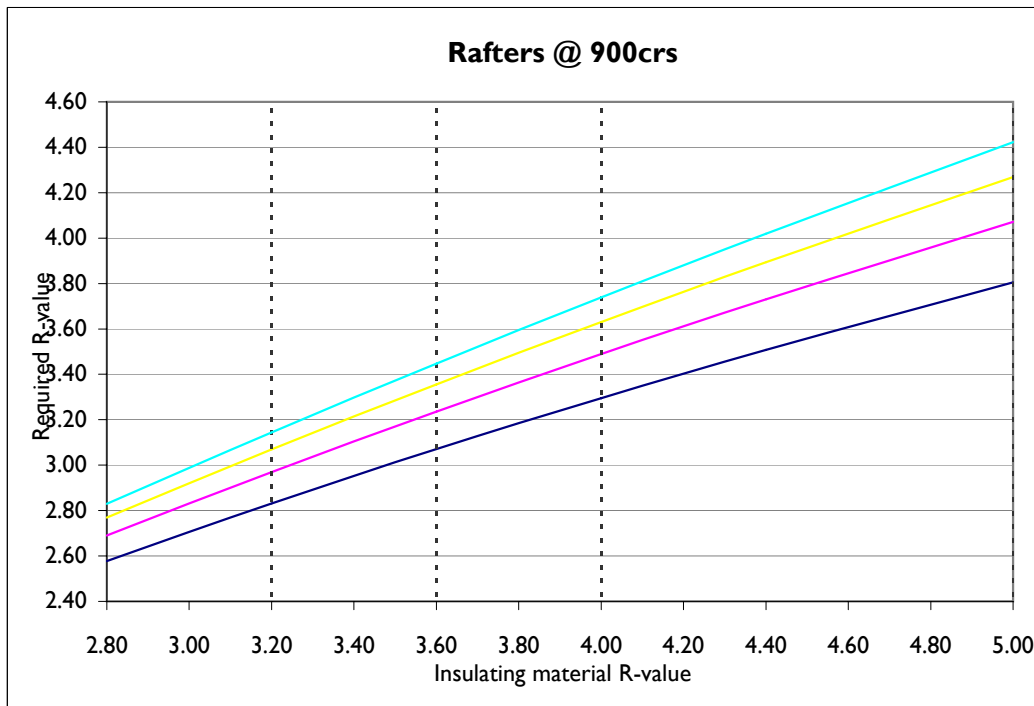
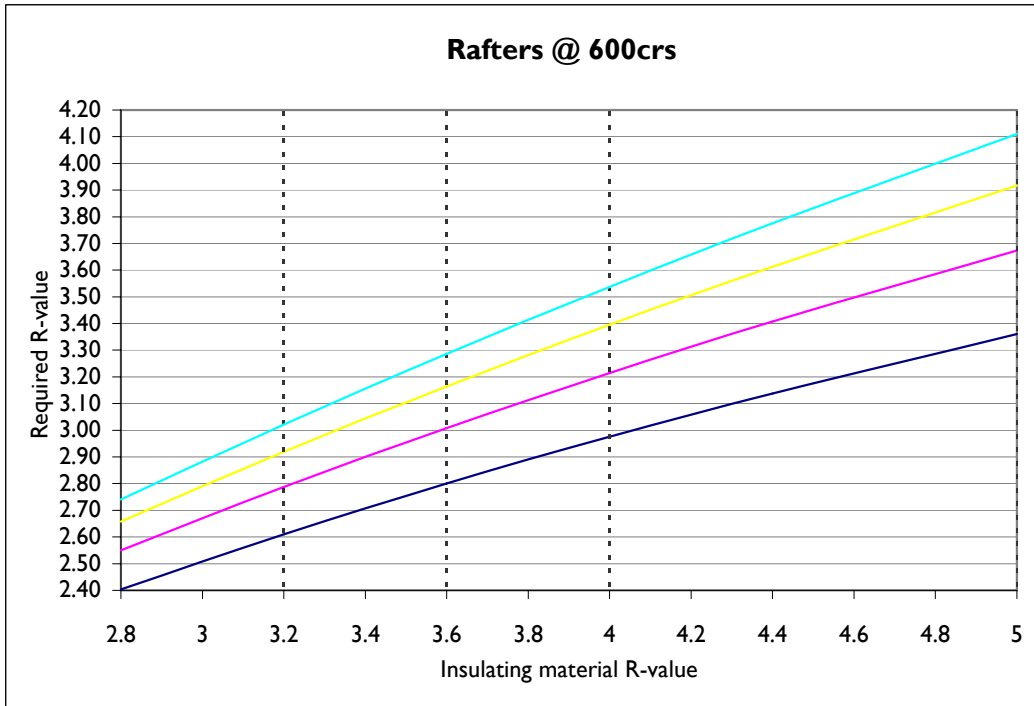


- 1 All rafters require a thermal break with a minimum R-value = 0.25
- 2 Add 0.2 if 12mm softboard is used in lieu of 10mm plasterboard
- 3 Add 0.1 if there is a 20mm air gap between insulation and lining
- 4 Maintain 25mm clearance between top of insulation and roof underlay



### Low slope steel-framed roof - Any roofing material

150mm steel rafters, TCT ≤ 1.5, 10mm plasterboard ceiling



----- Typical framing insulation R-value

**Key**

R0.2 strips  
 R0.4 strips

R0.6 strips  
 R0.8 strips