Ministry of Housing,
Communities &
Local Government

Research into resistance to moisture in buildings

Identification of common types of construction

July 2019
PRP Architects LLP
Ministry of Housing, Communities and Local Government

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1. Background

It is a requirement of Part C of the Building Regulations that buildings, and people who use these buildings, are adequately protected from harmful effects of moisture. Approved Document C provides guidance on how to meet this requirement. However, much of this guidance was made before the energy performance requirements for buildings were improved in recent years and it is not certain that these recommendations are still appropriate. In addition, Approved Document C refers to a number of British Standards and other publications, but the usefulness and applicability of these documents, particularly in relation to retrofit works, required reviewing. It should be noted that this project focused specifically on moisture from precipitation, surface and interstitial condensation.

The Ministry of Housing, Communities and Local Government (MHCLG) commissioned PRP to carry out this research study, entitled *Research into resistance to moisture in buildings.*

The project was delivered in three main stages:

- **Stage One: Background research**
  Stage One covered all the background research activities required to inform the refinement of the analysis methodology and the parameters used for the analysis.

- **Stage Two: Detailed analysis of identified construction typologies**
  Stage Two involved the detailed analysis of the various construction types identified in Stage One for both new build and retrofit, including key thermal bridge junctions. In this stage, a number of software analysis packages and methodologies will be used to carry out a sensitivity analysis on each of the identified construction typologies:

  - Simplified Modelling based on *BS EN ISO 13788 (2012)* - the 'Glaser Method'
  - Standardised Modelling based on *BS EN 15026 (2007)* - with the use of a software package, WUFI (Wärme und Feuchte Instationär)
  - Multi-dimensional Thermal Modelling to *BS EN ISO 10211 (2007)* - with the use of THERM (for construction junctions only)

- **Stage Three: Simplified rules and recommendations**
  Stage Three involved the formulation of simplified rules and recommendations using the conclusions from the Stage Two work.

The outputs of this research are a series of eight reports, entitled:

- Research into resistance to moisture in buildings: Research Summary
- **Research into resistance to moisture in buildings: Identification of common types of construction**
- Research into resistance to moisture in buildings: Using calculation methods to assess surface and interstitial condensation

- Research into resistance to moisture in buildings: Using numerical simulation to assess moisture risk in new constructions
- Research into resistance to moisture in buildings: Using numerical simulation to assess moisture risk in retrofit constructions. Part 1
- Research into resistance to moisture in buildings: Using numerical simulation to assess moisture risk in retrofit constructions. Part 2
- Research into resistance to moisture in buildings: Assessment of current moisture guidance
- Research into resistance to moisture in buildings: Simplified rules for reducing the risk of moisture

2. Our Approach

This report is **Identification of common types of construction** of the Research into resistance to moisture in buildings project.

The key objective of this report is to identify the most common and representative construction types in England, for both new build and existing construction.

This forms part of the background research, the first stage of the 3-stage research methodology.

Using the Consultants team's in-house expertise and drawing on literature and data sources available (e.g. Approved Document C, English Housing Survey, and Standard Assessment Procedure (SAP)), an initial desktop research exercise has been carried out to generate a list of construction types for both new build and existing construction.

Government statistics (including English Housing Survey data) were also used in order to understand the frequency of these construction types for both residential and non-residential buildings. Most commonly used retrofit measures were considered when determining the types of construction for detailed analysis.

The list of construction types was shortlisted to form two lists of the most common types of construction, one for New Build and another for Retrofit. The shortlist will inform the Stage 2 detailed analysis phase.

An initial gap analysis identifies thermal bridge junctions that have no Accredited Construction Details (ACDs) available and cannot be used to simply comply with Approved Document C. Those thermal bridge junctions with the highest heat loss have therefore been shortlisted for detailed analysis.

Approved Document L (L1A, L1B, L2A and L2B) have also been cross-referenced to provide a comparison backstop U-values.

Good practice U-values have been taken from SAP Appendix R - Reference values as representing forward trends towards zero carbon.

Common thermal bridge junctions that are likely to be affected by retrofit insulation measure have also been identified.

3. Types of Construction

The tables below summarises the typical types of construction used in both new build and existing buildings. The types are divided into 3 sub-sections, namely floors, walls and roofs.

The 'New Build' column includes the typical types of construction that are likely to be found in buildings yet to be built.

The 'Existing Construction' column includes the typical types of construction that are likely to be found in existing buildings. These also include the retrofit measures that are installed to these buildings to date.

It is understood that within each construction types, there will be a number of minor variations of material and insulation, and different levels of porousness will apply. A working set of the most common construction types will be generated from this list and a generic construction build-up will be used as representation of each type.

3.1. Floors

		Found in	
Element Type	**Construction Type**	**New Build**	**Existing Construction**
Ground floors	Suspended timber floor - un-insulated	X	√
	Suspended timber floor - insulated	√	√
	Ground bearing concrete - un-insulated	X	√
	Ground bearing concrete - insulated above with screed finish	√	√
	Ground bearing concrete - insulated above with floating timber finish	√	√
	Ground bearing concrete - insulated below with screed finish	√	√
	Ground bearing concrete - insulated below with floating timber finish	√	√
	Beam and block floor - un-insulated	X	√
	Beam and block floor - insulated above with screed finish	√	√
	Beam and block floor - insulated above with floating timber finish	√	√

		Found in	
Element Type	**Construction Type**	**New Build**	**Existing Construction**
Upper floors (including all unheated spaces, e.g. car parks, bin stores)	Timber joist with boards - un-insulated	X	√
	Timber joist with boards - insulated	√	√
	Concrete - un-insulated	X	√
	Concrete - insulated above with screed finish	√	√
	Concrete - insulated above with floating timber finish	√	√
	Concrete - insulated below with screed finish	√	√
	Concrete - insulated below with floating timber finish	√	√
	Beam and block floor - un-insulated	X	√
	Beam and block floor - insulated above with screed finish	√	√
	Beam and block floor - insulated above with floating timber finish	√	√
	Beam and block floor - insulated below with screed finish	√	√
	Beam and block floor - insulated below with floating timber finish	√	√
	Profiled metal deck with concrete slab	√	√
	Light gauge steel joists	√	√

3.2. Walls

3.2.1. Low Rise Buildings

		Found in	
Archetypes	**Construction Variations**	**New Build**	**Existing Construction**
Solid (including Insulated Concrete Formwork (ICF))	Un-insulated with semi-porous finish e.g. facing brickwork	X	√
	Un-insulated with non-porous finish e.g. rainscreen / render	X	√
	Internal Insulated with semi-porous finish e.g. facing brickwork	X	√
	Internal Insulated with non-porous finish e.g. rainscreen / render	X	√
	External insulation with semi-porous finish e.g. facing brickwork	√	√
	External insulation with non-porous finish e.g. rainscreen / render	√	√
	External and internal insulation with non-porous finish e.g. rainscreen / render	√	√
Cavity	Un-insulated with semi-porous finish e.g. facing brickwork	X	√
	Un-insulated with non-porous finish e.g. rainscreen / render	X	√
	Partial-fill with semi-porous finish e.g. facing brickwork	√	√
	Partial-fill with non-porous finish e.g. rainscreen / render	√	√
	Full-fill with semi-porous finish e.g. facing brickwork	√	√
	Full-fill with non-porous finish e.g. rainscreen / render	√	√
Timber frame	With air gap and semi-porous finish e.g. facing brickwork	√	√
	With air gap and non-porous finish e.g. rainscreen / render	√	√
	No air gap and non-porous finish e.g. rainscreen / render	√	√
Structural Insulated Panel System (SIPS)	With air gap and semi-porous finish e.g. facing brickwork	√	√
	With air gap and non-porous finish e.g. rainscreen / render	√	√
	No air gap and non-porous finish e.g. rainscreen / render	√	√

Archetypes	Construction Variations	Found in	
		New Build	Existing Construction
Light Gauge Steel Frame (LGSF)	With air gap and semi-porous finish e.g. facing brickwork	√	√
	With air gap and non-porous finish e.g. rainscreen / render	√	√
	No air gap and non-porous finish e.g. rainscreen / render	√	√

3.2.2. Medium / High Rise / Commercial Buildings

Archetypes	Construction Variations (including Construction Variations in table 4.2.1)	Found in	
		New Build	Existing Construction
Steel frame	Blockwork with semi-porous finish	√	√
	Blockwork with non-porous finish	√	√
	Structural Insulated Panel System (SIPS) with semi-porous finish	√	√
	Structural Insulated Panel System (SIPS) with non-porous finish	√	√
	Light Gauge Steel Frame (LGSF)	√	√
	Curtain walling	√	√
Concrete frame and pre-cast concrete	Blockwork with semi-porous finish	√	√
	Blockwork with non-porous finish	√	√
	Structural Insulated Panel System (SIPS) with semi-porous finish	√	√
	Structural Insulated Panel System (SIPS) with non-porous finish	√	√
	Light Gauge Steel Frame (LGSF)	√	√
	Curtain walling	√	√

3.3. Roofs

		Found in	
Roof Type	**Construction Type**	**New Build**	**Existing**
Pitched	Cold (slates/concrete/clay tiles) - un-insulated	X	√
	Cold (slates/concrete/clay tiles) - insulated	√	√
	Warm (slates/concrete/clay tiles)	√	√
	Metal - un-insulated	X	√
	Metal - insulated built up / composite panel	√	√
Flat	Warm - steel	√	√
	Warm - concrete	√	√
	Warm - timber	√	√
	Cold - timber	√	√
	Inverted - concrete	√	√
	Un-insulated	X	√

3.4. Assessment of Backstop U-values against the Current Regulations and Good Practice

An assessment has also been carried out to understand the back-stop U-values currently stated in the different Building Regulations and good practice, including:

- Approved Document C - Site preparation and resistance to contaminants and moisture (AD C) 2013 edition
- Approved Document L1A - Conservation of fuel and power in new dwellings (AD L1A) 2013 edition
- Approved Document L1B - Conservation of fuel and power in existing dwellings (AD L1B) 2010 edition with 2010, 2011 and 2013 amendments
- Approved Document L2A - Conservation of fuel and power in new buildings other than dwellings (AD L2A) 2013 edition
- Approved Document L2B - Conservation of fuel and power in existing building other than dwellings (AD L2B) 2010 edition with 2010, 2011 and 2013 amendments
- Standard Assessment Procedure (SAP) 2012 version

It is noted that the backstop U values in AD C are to prevent surface condensation, whereas those in AD L are to conserve fuel and power.

This assessment not only identifies inconsistencies in Part C, but allows us to target U-value increments when testing against surface and interstitial condensation risks.

Element	Element Variation	AD C Backstop Value	AD L1A Backstop Value	AD L1B Backstop Value (New elements)	AD L2A Backstop Value	AD L2B Backstop Value (New elements)	SAP TER Value
Walls	Cavity Insulation	**0.70**	0.30	0.28	**0.35**	0.28	**0.18**
Walls	Internal / External Insulation	**0.70**	0.30	0.28	**0.35**	0.28	**0.18**
Floors		**0.70**	**0.25**	0.22	**0.25**	0.22	**0.13**
Roofs	Pitched insulation at ceiling	**0.35**	0.20	0.16	**0.25**	0.16	**0.13**
Roofs	Pitched Insulation at rafter	**0.35**	0.20	0.18	**0.25**	0.18	**0.13**
Roofs	Flat	**0.35**	0.20	0.18	**0.25**	0.18	**0.13**
Party Wall		-	0.20	-	-	-	**0.00**
Windows		-	2.00	1.60	**2.20**	1.80	**1.40**
Swimming Pool basin		-	0.25	0.25	0.25	0.25	-
Vehicle access doors		-	-	-	1.50	1.50	-
High usage entrance doors		-	-	-	3.50	3.50	-
Roof ventilators (including smoke vents)		-	-	-	3.50	3.50	-

The target U-value increments chosen for the detailed analysis will be (as highlighted in bold in the above table):

- The AD C backstop value
- The highest from the range of the AD L backstop values
- The SAP TER value as they represent current good practice towards zero carbon

4. A Working Set of the Construction Typologies

4.1. New Build

For new build, a working set of the most common construction typologies is proposed, as detailed in the table below. These construction typologies will be considered for use in the Stage 2 detailed analysis phrase, and potential explicit inclusion in Approved Document C (AD C).

These construction typologies have been cross-referenced with AD C to determine whether they are currently included in the document.

A traffic light system has been employed to reflect:

- Explicitly referenced
- Implicitly referenced
- Not referenced

	Construction Type	**Ref in AD C**
Floors (Ground Floors)		
1	Suspended timber floor - insulated	
2	Ground bearing concrete - insulated above	
3	Ground bearing concrete - insulated below	
4	Beam and block floor - insulated above	
Floors (Upper Floors)		
5	Timber joist with boards - insulated	
6	Concrete - insulated above	
7	Concrete - insulated below	
Walls (Low Rise Buildings)		
8	Solid - Internal Insulated with a semi-porous finish	
9	Solid - External insulation with a non-porous finish	
10	Solid - External and internal insulation with a non-porous finish	
11	Cavity - Partial-fill with a semi-porous finish e.g. facing brickwork	
12	Cavity - Full-fill with a semi-porous finish e.g. facing brickwork	
13	Timber frame with air gap and a semi-porous finish e.g. facing brickwork	
14	Timber frame with no air gap and a non-porous finish e.g. render	
15	Light Gauge Steel Frame (LGSF) with air gap and a semi-porous finish e.g. facing brickwork	
Walls (Medium / High Rise / Commercial Buildings)		
16	Curtain walling	

	Construction Type	Ref in AD C
Roofs (Pitched)		
17	Cold roof (slates/concrete/clay tiles) - insulated	
18	Warm roof (slates/concrete/clay tiles)	
Roofs (Flat)		
19	Warm roof - timber	
20	Cold roof - timber	
21	Warm roof - concrete	
22	Inverted roof - concrete	

4.2. Existing Buildings after Common Retrofit Measures have been Applied

For retrofit measures within existing buildings, a working set has been proposed for the construction typologies with the most common retrofit measures currently being used, as detailed in the table below. The numbers of the construction type are related to the new build numbers above in 4.1.

These construction typologies will be considered for use in the Stage 2 detailed analysis phrase, and potential explicit inclusion in Approved Document C (AD C).

	Construction Type	Retrofit Measures Applied
Floors		
1.1	Suspended timber ground floors	Insulation within joists
1.2	Suspended timber ground floors	Insulation added above
2	In situ ground bearing concrete floors	Insulation added above
4	Beam and block ground floors	Insulation added
5.1	Exposed upper floors - timber joist with boards	Insulation between joists
5.2	Exposed upper floors - timber joist with boards	Insulation added below
6	Exposed upper floors - concrete	Insulation added above
7	Exposed upper floors - concrete	Insulation added below
Walls		
8	Solid masonry	Internal Wall Insulation (IWI)
9	Solid masonry	External Wall Insulation (EWI)
11.1	Cavity masonry with no insulation	Internal Wall Insulation (IWI)
11.2	Partial-fill cavity masonry	IWI
12.1	Cavity masonry with no insulation	External Wall Insulation (EWI) and Cavity Wall Insulation (CWI)
12.2	Full-fill cavity masonry	IWI
14.1	Framed building	EWI
14.2	Framed building	IWI

	Construction Type	Retrofit Measures Applied
Roofs		
17	Cold (pitched) roof	Loft insulation
18	Warm (pitched) roof	Sloping ceiling insulation
20	Cold flat roof	Insulation
19	Warm flat timber roof	Insulation below
22	Inverted flat concrete roof	Insulation above
21	Warm Flat concrete roof	Insulation above
23	Metal roof sheet	Insulation

Exceptions

	Construction Type	Retrofit Measures Applied
E1	Cavity masonry with no insulation	EWI with no cavity filled
E2	Partial-fill cavity masonry	EWI

The 2 types listed above are not recommended measures for retrofit works. It is proposed that these measures will not be modelled in the detailed analysis phase, but they will be dealt with through a recommended commentary in AD C.

Unintended Consequence of Retrofit Measures

There are additional elements such as Party Walls where insulation may occur and have an effect on condensation (surface or interstitial).

There are also potential issues of condensation in elements being treated, e.g. sloping ceilings adjacent to a wall being insulated.

Special cases e.g. chimneys are also complex and require further investigation.

These cases presently fall outside of the project scope but they are important to note and should potentially be modelled with the intention to provide guidance in resolving the issues.

5. Types of Junction

The table below shows thermal bridge junctions identified by SAP, and represents a complete list of thermal bridge junctions that can be found in both new-build and retrofit dwellings. The table also cross-references Accredited Construction Details (ACDs) where they are suitable for various construction techniques. This forms the initial part of a gap analysis for thermal bridging insofar as those construction types where no ACDs are available and those junction types where no ACDs have yet been produced are identified.

Some construction types e.g. SIPS are unlikely to have generic ACDs produced independently, however, system manufacturers should be encouraged to produce sets for these systems.

SAP Ref	**Thermal Bridge Description**	**Default ψ** value (W/m·K)	**ACD ψ** value (W/m·K)	**TFEE ψ** value (W/m·K)	**Trad cavity detail ACD reference(s)**	**Timber framed ref**	**Steel Frame ref**	**Wall EWI ref**	**Wall IWI ref**
Junctions with an external wall									
E1	Steel lintel with perforated steel base plate	1.00	0.5	0.05	MCI-WD-01			MEI-WD-01	MII-WD-01
E2	Other lintels (including other steel lintels)	1.00	0.3	0.05	MCI-WD-02 MCI-WD-03	TFW-WD-01	SFW-WD-01	MEI-WD-02	MII-WD-02 MII-WD-03
E3	Sill	0.08	0.04	0.05	MCI-WD-04	TFW-WD-02	SFW-WD-02	MEI-WD-03	MII-WD-04
E4	Jamb	0.10	0.05	0.05	MCI-WD-05 MCI-WD-06	TFW-WD-03 TFW-WD-04	SFW-WD-03 SFW-WD-04	MEI-WD-04	MII-WD-05 MII-WD-06
E5	Ground floor (normal)	0.32	0.16	0.16	MCI-GF-01 MCI-GF-02 MCI-GF-03	TFW-GF-01 TFW-GF-02 TFW-GF-03	SFW-GF-01 SFW-GF-02	MEI-GF-01 MEI-GF-02 MEI-GF-03	MII-GF-01 MII-GF-02 MII-GF-03
E19	Ground floor (inverted)	0.07		0.07					
E20	Exposed floor (normal)	0.32		0.32					
E21	Exposed floor (inverted)	0.32		0.32					
E22	Basement floor	0.07		0.07					
E6	Intermediate floor within a dwelling	0.14	0.07	0	MCI-IF-01 MCI-IF-02	TFW-IF-01	SFW-IF-01	MEI-IF-01	MII-IF-01 MII-IF-02
E7	Party floor between dwellings (in blocks of flats)	0.14	0.07	0.07	MCI-IF-01			MEI-IF-01	MII-IF-01
E8	Balcony within a dwelling, wall insulation continuous	0.00	0	0					
E9	Balcony between dwellings, wall insulation continuous	0.04	0.02	0.02					
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	1.00		0.02					
E10	Eaves (insulation at ceiling level)	0.12	0.06	0.06	MCI-RE-01 MCI-RE-02 MCI-RE-03 MCI-RE-05	TFW-RE-01 TFW-RE-02 TFW-RE-03 TFW-RE-05	SFW-RE-01 SFW-RE-02 SFW-RE-03 SFW-RE-05	MEI-RE-01 MEI-RE-02 MEI-RE-03 MEI-RE-05	MII-RE-01 MII-RE-02 MII-RE-03 MII-RE-05
E24	Eaves (insulation at ceiling level - inverted)	0.24		0.24					
E11	Eaves (insulation at rafter level)	0.08	0.04	0.04	MCI-RE-04 MCI-RE-06 MCI-RE-07 MCI-RE-08	TFW-RE-04 TFW-RE-06 TFW-RE-07 TFW-RE-08	SFW-RE-04 SFW-RE-06 SFW-RE-07 SFW-RE-08	MEI-RE-04 MEI-RE-06 MEI-RE-07 MEI-RE-08	MII-RE-04 MII-RE-06 MII-RE-07 MII-RE-08
E12	Gable (insulation at ceiling level)	0.48	0.24	0.06	MCI-RG-01	TFW-RG-01	SFW-RG-01	MEI-RG-01	MII-RG-01

SAP Ref	Thermal Bridge Description	Default ψ value (W/m·K)	ACD ψ value (W/m·K)	TFEE ψ value (W/m·K)	Trad cavity detail ACD reference(s)	Timber framed ref	Steel Frame ref	Wall EWI ref	Wall IWI ref
E13	Gable (insulation at rafter level)	0.08	0.04	0.08	MCI-RG-02 MCI-RG-03 MCI-RG-04	TFW-RG-02 TFW-RG-03 TFW-RG-04	SFW-RG-02 SFW-RG-03 SFW-RG-04	MEI-RG-02 MEI-RG-03 MEI-RG-04	MII-RG-02 MII-RG-03 MII-RG-04
E14	Flat roof	0.08	0.4	0.08	MCI-RF-01		SFW-RF-01	MEI-RF-01	MII-RF-01
E15	Flat roof with parapet	0.56	0.28	0.56	MCI-RF-02	TFW-RF-01	SFW-RF-02	MEI-RF-02	MII-RF-02
E16	Corner (normal)	0.18	0.09	0.09	Can be assumed if insulation is continuous	TFW-EW-01	Can be assumed if insulation is continuous	Can be assumed if insulation is continuous	Can be assumed if insulation is continuous
E17	Corner (inverted – internal area greater than external area)	0.00	-0.09	-0.09	Can be assumed if insulation is continuous	Can be assumed if insulation is continuous	Can be assumed if insulation is continuous	Can be assumed if insulation is continuous	Can be assumed if insulation is continuous
E18	Party wall between dwellings	0.12	0.06	0.06	MCI-IW-01	TFW-IW-01	SFW-IW-01	MEI-IW-01	MII-IW-01
E25	Staggered party wall between dwellings	0.12		0.06					
-	Partition Wall				MCI-IW-03 MCI-IW-05 MCI-IW-07	TFW-IW-03	SFW-IW-03	MEI-IW-03 MEI-IW-05 MEI-IW-07	MII-IW-03 MII-IW-05 MII-IW-07
Junctions with a party wall									
P1	Ground floor	0.16		0.08					
P6	Ground floor (inverted)	0.07		0.07					
P2	Intermediate floor within a dwelling	0.00		0					
P3	Intermediate floor between dwellings (in blocks of flats)	0.00		0					
P7	Exposed floor (normal)	0.16		0.16					
P8	Exposed floor (inverted)	0.24		0.24					
P4	Roof (insulation at ceiling level)	0.24		0.12	MCI-IW-02	TFW-IW-02	SFW-IW-02	MEI-IW-02	MII-IW-02
P5	Roof (insulation at rafter level)	0.08		0.08					
Junctions within a roof or with a room-in-roof									
R1	Head of roof window	0.08		0.08					
R2	Sill of roof window	0.06		0.06					
R3	Jamb of roof window	0.08		0.08					
R4	Ridge (vaulted ceiling)	0.08		0.08					
R5	Ridge (inverted)	0.04		0.04					
R6	Flat ceiling	0.06		0.06					
R7	Flat ceiling (inverted)	0.04		0.04					
R8	Roof to wall (rafter)	0.06		0.06					
R9	Roof to wall (flat ceiling)	0.04		0.04					
-	Partition Wall Head				MCI-IW-04 MCI-IW06 MCI-IW-08	TFW-IW-04	SFW-IW-03	MEI-IW-04 MEI-IW-06 MEI-IW-08	MII-IW-04 MII-IW-06 MII-IW-08

6. A Working Set of the Junction Typologies

6.1. New Build

A working set of the most common junction typologies is then proposed, as detailed in the table below. There are nine junctions that at present are not covered by ACDs that have a default Ψ value greater than or equal to 0.1 W/m·K. It is these nine junctions that will be initially tested against BRE IP 1/06 "Assessing the effects of thermal bridging at junctions and around openings" (which supersedes BRE IP 17/01 document currently stated in Approved Document C). These junctions will then be considered for potential explicit inclusion in Approved Document C.

	SAP Ref	**Thermal Bridge Description**	**Default ψ value (W/m·K)**
1	E20	Exposed floor (normal)	0.32
2	E21	Exposed floor (inverted)	0.32
3	E23	Balcony within or between dwellings, balcony support penetrates wall insulation	1.00
4	E24	Eaves (insulation at ceiling level - inverted)	0.24
5	E25	Staggered party wall between dwellings	0.12
6	P1	Ground floor	0.16
7	P7	Exposed floor (normal)	0.16
8	P8	Exposed floor (inverted)	0.24
9	P4	Roof (insulation at ceiling level)	0.24

6.2. Existing Buildings after Retrofit Measures have been Applied

In existing buildings with no or little insulation in each element the thermal bridge junctions are relatively insignificant. As insulation is added to one or both adjoining elements the ψ value will increase and increases condensation risk to that junction.

The purpose of this investigation is to prevent or reduce this risk of condensation to an acceptable level of moisture and create robust rules of thumb.

18 common element junctions have been identified that are likely to be affected by additional insulation in adjoining elements. The 18 junctions are described below and form the working set of retrofit junctions, which will be tested against surface and condensation risk.

	External Walls
1	Window head solid wall - EWI and IWI
2	Sill in solid wall - EWI and IWI
3	Jamb in solid wall - EWI and IWI
4	Ground bearing floor / Solid wall
5	Ground floor suspended / Wall junction
6	Eaves (insulation at flat ceiling level) - EWI
7	Eaves (insulation between / under rafter) - IWI and EWI
8	Gable (insulation at ceiling level) - IWI and EWI
9	Gable (insulation at rafter level) - IWI and EWI
10	Balcony or walkway support penetrates wall
11	Stair string - IWI
12	Below DPC solid wall - EWI
	Floors
13	First floor edge with solid wall / IWI
14	Exposed floors
	Extensions
15	External wall / ground floor junctions
	Roof
16	Cold roof insulation / external wall
17	Loft hatch
	Others
18	External Meter boxes - EWI

It is these junctions that will be initially tested for the effects of introducing insulation measures on thermal bridging and any increase from the base condition in risk of surface condensation.

The junctions will be incrementally tested with common insulation measures in both elements adjacent to the junction type (and with no measure in one of the elements).

7. Next Steps

The types of construction and junctions that have been identified in Section 4 and 6 have been used in the first phase of Stage 2, as detailed in the Background, in order to:

For **New Build**:

- Verify the backstop U-values for the construction types identified in Section 4.1
- Test the approached defined in BRE IP 1/06 "Assessing the effects of thermal bridging at junctions and around openings" (which supersedes BRE IP 17/01 document currently stated in Approved Document C) for the junctions that are identified in Section 6.1

For **Existing Buildings after Retrofit Measures have been Applied (Retrofit)**:

- Analyse the construction types identified in Section 4.2 for condensation risk
- Analyse the typical junctions as identified in Section 6.2 for condensation risk