JJI-JOIST TECHNICAL BULLETIN

SUBJECT: **Ground Floor Design & Restraint**	Bulletin Number:	Date Issued:
Sheet 1 of 11	**9 Revision B**	**06.04.2004**

Introduction

When designing the ground floor of a residential dwelling using I-Joists, there are various factors taken in to account which are considerably different than when designing a first or subsequent upper floor. The protection required to resist moisture from the ground penetrating the upper surface and the absence of any restraint on the underside of the I-Joists are the two main considerations.

This bulletin outlines the requirements for preparation of the ground beneath the ground floor for England, Wales and Scotland, the ventilation requirements for ground floor design, the various insulation options available and gives references to all relevant regulations.

Ground Floor Resistance to Moisture

The Building Regulations and the NHBC require the ground beneath the floor to be covered to restrict the passage of moisture to the inside of the dwelling and to prevent plant growth. Specific requirements vary but the ground cover may be either:

FOR ENGLAND & WALES

1. Concrete at least 50mm thick laid on polythene sheet at least 300 microns thick (1200 gauge); or 250 microns thick (1000 gauge) polythene if assessed in accordance with the appropriate BBA certificate or to the PIFA standard

or

2. Minimum 100mm thick of concrete laid on a hardcore bed of clean broken brick

or

3. Concrete at least 50mm thick laid on a polyethylene membrane laid on 50mm sand blinding

or the alternative approach

4. By following the relevant recommendations of Clause 11 of the Code of Practice 102:1973 *Protection of Buildings against water from the ground*

A damp proof course must separate any timber from any material that can carry moisture from the ground. Also, to prevent water collecting on the ground covering where the external ground level is higher than internal, the ground covering should be laid to fall to an appropriate drainage outlet.

Ground Floor Resistance to Moisture contd.

It should be noted that in certain parts of the country, special precautions may be necessary to reduce the entry of radon gas, Areas in England and Wales where special precautions are necessary are detailed in BRE Report 211: "Radon – guidance on protective measures for new dwellings" and report No 212 – "Construction of new buildings on gas contaminated land". No guidance is currently available for protection for suspended timber ground floors in new dwellings. Where precautions are necessary, the building designer should ensure that they are acceptable to NHBC or other approving bodies.

FOR SCOTLAND

A hardcore bed 100mm thick of clean broken brick or similar inert material consolidated to form a level, crack free surface.

With **either:**

1. A damp proof membrane in accordance with section 3 of the Code of Practice 102:1973

or

2. Concrete 50mm thick laid on 0.25mm (1000 gauge) polythene sheet

or

3. Concrete 100mm thick

The areas affected by Radon Gas emissions, that require special precautions, are listed in the BRE document 'Radon guidance on protection measures for new dwellings in Scotland'.

Figure 1 shows a typical timber ground floor construction.

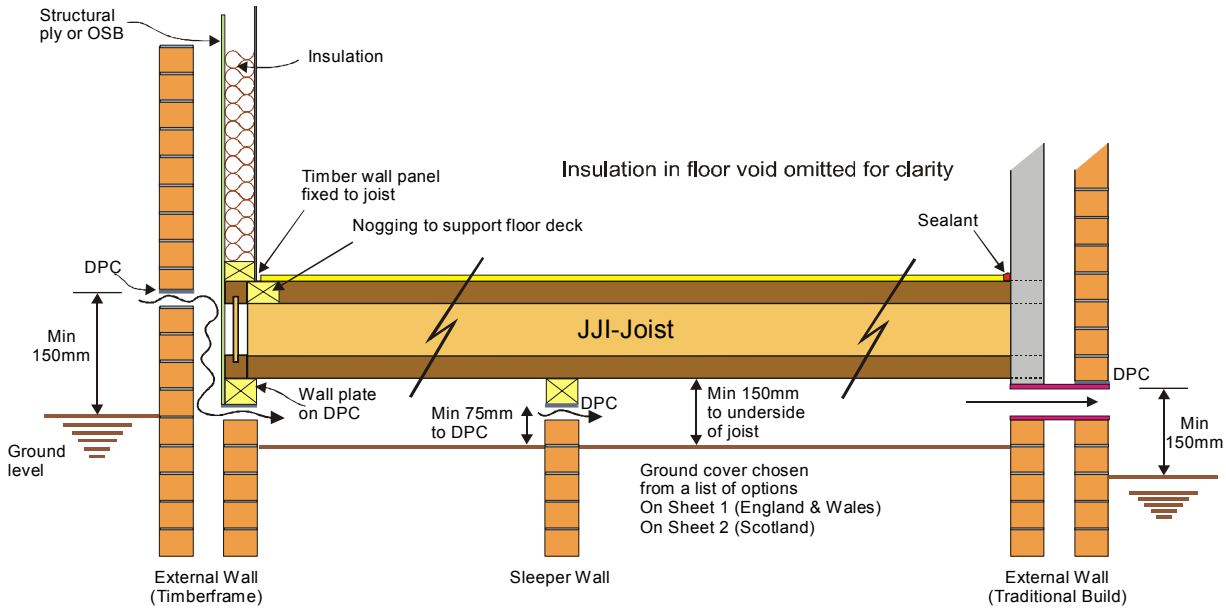

Figure 1. Typical ground floor construction for timber frame and traditional construction

Ventilation

All parts of the void underneath the suspended floor require at least two parts of ventilation on opposite sides of the buildings external walls to the outside, and to all other parts of the building. The openings should be at least 1500mm^2 for each metre run of wall (alternatively, in Scotland, an open area of 500mm^2 for at least every 1m^2 of floor area may be used for ventilation purposes).

Where the above ventilation is not possible, sufficient ventilation from both sides should be provided by a combination of pipes and ducts, and any pipes used should have a minimum diameter of 100mm.

Insulation

Thermal insulation is required in all ground floors and each different house type must be assessed individually to identify the specific U values* and thus the corresponding thickness of insulation to be used. Different insulation arrangements may be used on the ground floor; one of the following three options should be used:

1. Quilt insulation supported on plastic netting or breather membrane
2. Quilt insulation supported on a board fixed to the top side of the bottom flange of the JJI-Joist
3. Solid insulation supported on the bottom flange of the JJI-Joist.

**the U value is the 'thermal transmittance', a measure of how much heat will pass through a structure when the air temperature differs by 1°C*

Figure 2 illustrates the different methods of providing insulation.

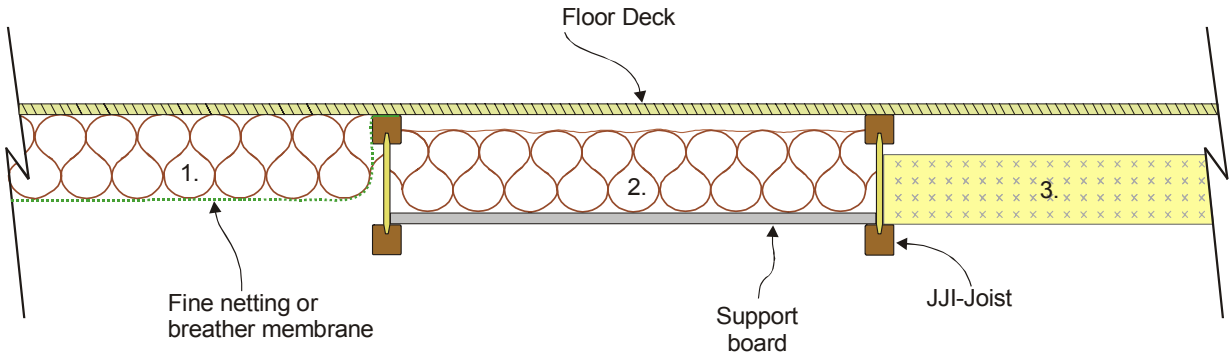

Figure 2. Insulation Options

Insulation continued

The insulation should be particularly well fixed at the junction between the external wall and the floor. This helps to maintain insulation continuity and prevent condensation forming at the point of thermal bridging. It is therefore advisable to leave a 50mm gap between the first joist and the inner leaf of the external wall and fill this space with mineral wool insulation as shown in Figure 3. A good fix of insulation against the JJI-Joists is vital as any gaps or any reduction of thickness of insulation will allow cold air to enter from the subfloor and circulate throughout the structure. This rule does not apply when boarding is used to support the insulation, as it is itself an airtight layer.

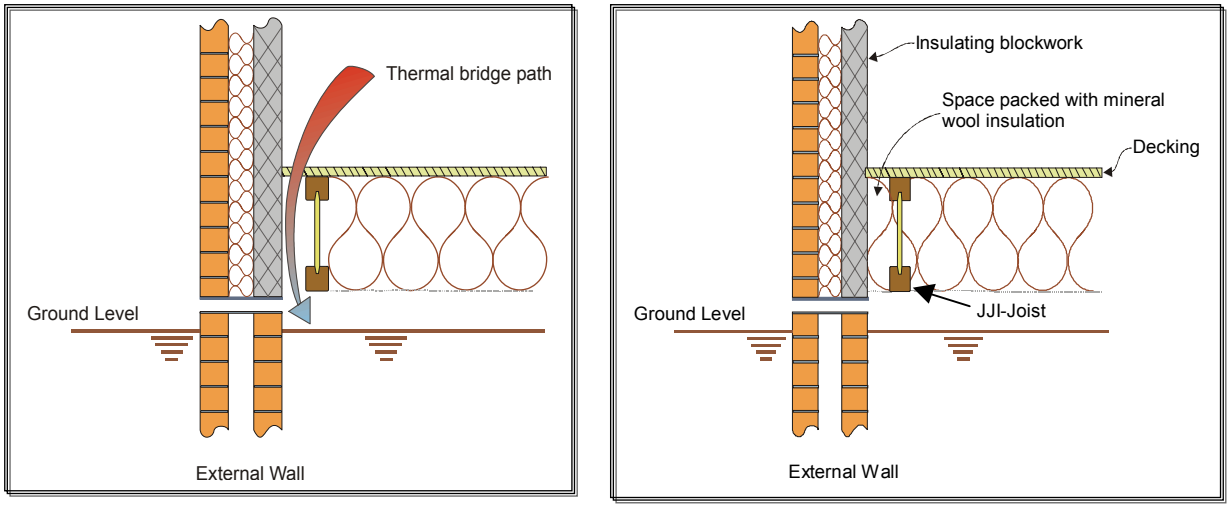

Figure 3. Insulation Continuity

Design

It is recommended that the option of using stiffer joists to increase the serviceability index and reduce deflection to a value comparable with an in-situ or pre-cast concrete ground floor should be discussed with the Building Designer. This recommendation will give a better 'feeling' floor, as household appliances used on the ground floor, such as washing machines can cause vibrations throughout the ground floor. A ground floor with increased stiffness (reduced deflection) should help dampen this effect.

A ground floor has no plasterboard on the underside of the joists that would normally provide lateral restraint. As a result of this, it may be necessary to install longitudinal binders to the bottom flange of the JJI-Joists or full depth JJI-Joist blocking pieces between joists, usually where a joist is continuous and supported on an internal load-bearing wall at the point where the forces in the bottom flange change from tensile to compressive. The specific requirements of the bracing required depend on the geometry of the floor and so each job must be assessed individually.

The position of lateral restraint can be established by using either JoistMaster (version 3) or FloorMaster (version 3). Both of these software programs will indicate the position of the blocking/binders requirement on the calculation sheet. The position should be identified on the joist layout plan.

Design (continued)

Because of the increased air humidity and associated increase in moisture content below the ground floor, suspended timber ground floors are in a service class 2 environment. The design properties of the JJI-Joists given in the Technical Manual are based on service class 1 conditions. This means these properties need to be reduced by factors as outlined in the BBA Certificate to take account of the reduced strength and stiffness of JJI-Joists. When using JoistMaster or FloorMaster the ground floor design option should be selected as this automatically reduces the JJI-Joist properties. Table 1 below indicates the JJI-Joist properties down-rated for service class 2 conditions.

Table 1. JJI-Joist Properties Service Class 2 Conditions

Joist Series JJI-	Moment Capacity Load Sharing (kN m)	Flexural Rigidity EI ($Nmm^2 \times 10^9$)	Shear Rigidity GA ($N \times 10^9$)	Shear Capacity Load Sharing (kN)	End Supports				Intermediate Supports	
					45mm bearing		89mm bearing		89mm bearing	
					No web stiffener	Web Stiffener	No web stiffener	Web Stiffener	No web Stiffener	Web Stiffener
145A	1.57	103	0.52	2.22	2.02	-	2.48	-	4.26	-
195A	2.31	225	0.84	2.81	2.55	5.01	3.01	5.01	5.38	7.56
195B	2.91	301	0.84	2.81	2.55	5.01	3.01	5.01	5.38	7.56
195C	3.36	361	0.84	2.81	2.55	5.01	3.01	5.01	5.38	7.56
195D	4.25	488	0.84	2.81	2.55	5.01	3.01	5.01	5.38	7.56
220A	2.67	304	1.00	3.09	2.81	5.01	3.28	5.01	5.95	7.56
220B	3.36	407	1.00	3.09	2.81	5.01	3.28	5.01	5.95	7.56
220C	3.89	489	1.00	3.09	2.81	5.01	3.28	5.01	5.95	7.56
220D	4.92	660	1.00	3.09	2.81	5.01	3.28	5.01	5.95	7.56
235A	2.87	357	1.10	3.26	2.97	5.01	3.44	5.01	6.28	7.56
235B	3.62	477	1.10	3.26	2.97	5.01	3.44	5.01	6.28	7.56
235C	4.18	575	1.10	3.26	2.97	5.01	3.44	5.01	6.28	7.56
235D	5.30	775	1.10	3.26	2.97	5.01	3.44	5.01	6.28	7.56
245A	3.02	396	1.16	3.38	3.09	5.01	3.54	5.01	6.51	7.56
245B	3.81	530	1.16	3.38	3.09	5.01	3.54	5.01	6.51	7.56
245C	4.41	636	1.16	3.38	3.09	5.01	3.54	5.01	6.51	7.56
245D	5.58	859	1.16	3.38	3.09	5.01	3.54	5.01	6.51	7.56
300A	3.78	645	1.51	4.02	2.98	5.01	3.67	5.01	5.87	7.56
300B	4.77	860	1.51	4.02	2.98	5.01	3.67	5.01	5.87	7.56
300C	5.52	1033	1.51	4.02	2.98	5.01	3.67	5.01	5.87	7.56
300D	7.00	1392	1.51	4.02	2.98	5.01	3.67	5.01	5.87	7.56
350C	6.51	1480	1.83	4.61	2.67	5.01	3.22	5.01	5.15	7.56
350D	8.25	1992	1.83	4.61	2.67	5.01	3.22	5.01	5.15	7.56
400C	7.47	2012	2.15	5.19	2.44	5.01	2.88	5.01	4.60	7.56
400D	9.47	2704	2.15	5.19	2.44	5.01	2.88	5.01	4.60	7.56
450D	10.66	3530	2.47	5.77	2.25	5.01	2.63	5.01	4.19	7.56

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Notes for Table 1.

1. The design properties are applicable to long term load duration.
2. Design properties are applicable to load sharing and non load-sharing situations except that non load-sharing properties for moment capacity and shear capacity should be multiplying the tabulated values by 0.96.
3. The support values are based on the bearing lengths shown.
4. Refer to BBA Certificate 99/3633 for further information.

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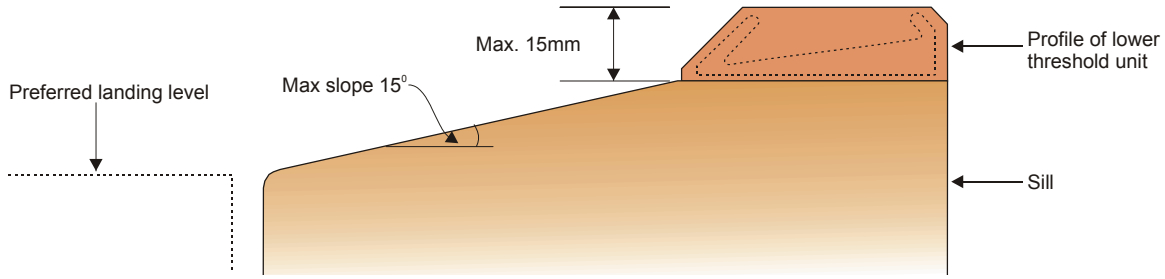
Disabled Access

From October 25th 1999, it is a requirement for all new domestic dwellings that they must follow the amendments made to the UK Building Regulations (Part M – 1999, Access and Facilities for Disabled People, Building Regulations 1991 for England & Wales and Part Q – Access and facilities for Dwellings, Building Standards (Scotland) Regulations 1990) to improve access and facilities for the elderly and disabled in residential dwellings. The significance of this on the design of ground floors is that at least one entrance to a dwelling must have a level threshold, thus enabling wheelchair users and ambulant disabled safe and easy access to and from the building. The amended Building Regulations described here must be followed in addition to the requirements of the rest of this Technical Bulletin for ground floor design.

The details presented here apply only at the entrance to the dwelling where it is assumed that either, a level approach to the main entrance is provided or a sloped access ramp up to the threshold is constructed. The following details firstly show the general requirements for level thresholds in England and Wales, and Scotland, followed by a construction detail (Figure 8) suitable to meet the requirements.

For England and Wales



Note: Any proprietary lower threshold unit that fits within the profile shown will be acceptable

Figure 4. Sill and Threshold constraints

It should be noted that

- The previous section on “Ground Floor Resistance to Moisture in England and Wales” should be followed
- No internal transition unit is required where the finished floor level is no greater than 15mm below the top of the lower threshold unit (10mm if the finished floor level is an uncompressed soft pile carpet).
- **The junction between the timber threshold and the external landing should not be sealed as this may cause long term deterioration of the sill.**
- The surface of a landing which is not sufficiently exposed to require drainage should be between 5 and 10mm below the sill. The leading edge of the sill should be rounded or chamfered to provide a smoother transition for wheelchair users.
- The top of the sill should be rounded or angled to discourage water ingress. The slope should be no greater than 15^{o} to the horizontal (but preferably lower) to minimise the barrier for wheelchair users.
- Vertical changes in level of more than 5mm should always be chamfered.
- Transition units should have a maximum gradient of 15^{o} and a slip resistant surface. They should start no less than 5mm and no more than 15mm from the top of the lower threshold unit and finish no more than 5mm above the level of the expected floor covering.

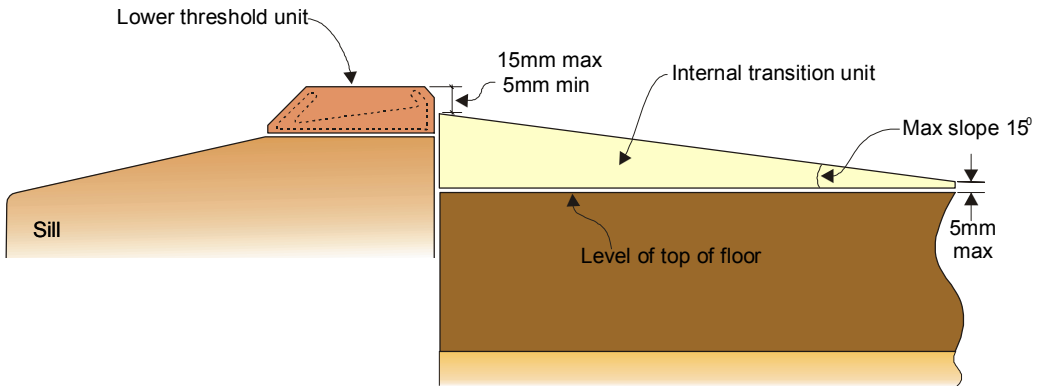


Figure 5. Internal Transition Unit

For Scotland:

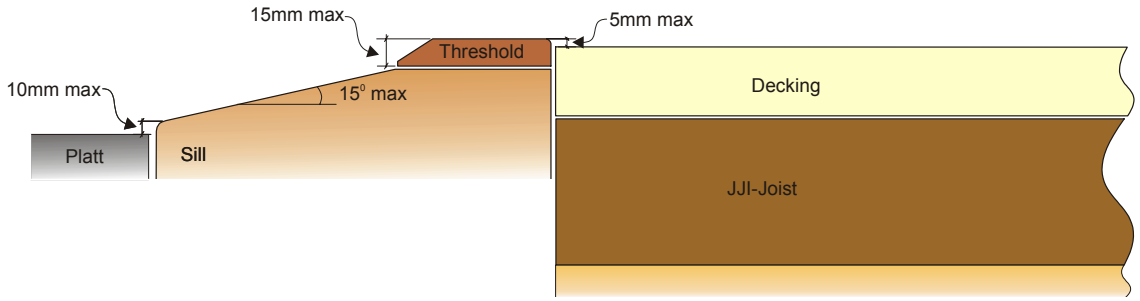


Figure 6. Sill and Threshold constraints

It should be noted that

- The previous section on "Ground Floor Resistance to Moisture in Scotland" should be followed
- The surface of the platt (a Scottish term for a hard level surface) should be no more than 10mm below the leading edge of the sill, as shown in the diagram above.
- No single vertical increment associated with the sill or the threshold should be more than 15mm, and any sloping element should have a slope not more than 15 degrees to the horizontal. Any vertical increment of more than 5mm should be rounded or chamfered.
- Where the floor covering is designed to be more than 15mm below the top of the threshold an internal transition unit should be provided as shown in Figure 7.
- The transition unit should have a gradient not more than 15 degrees to the horizontal, a slip resistant surface, and should start not less than 5mm and not more than 10mm from the top of the threshold and finish not more than 5mm above the floor covering.

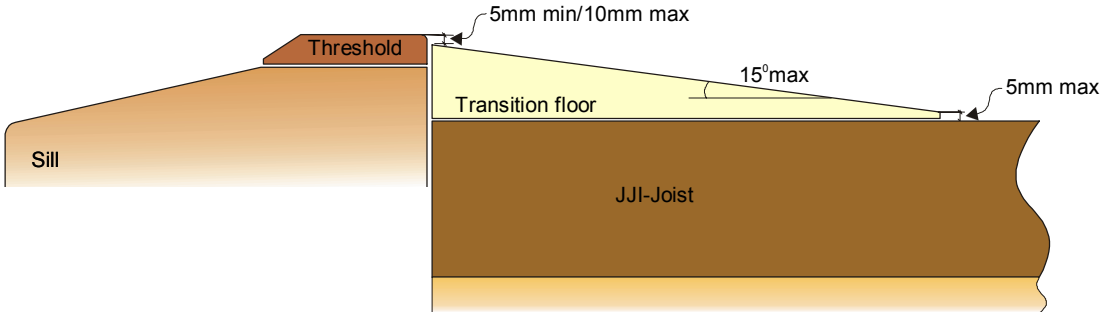


Figure 7. Internal Transition Unit

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Figure 8 shows an example of a threshold detail applicable to timber frame construction. It is intended to be a generic illustration suitable to meet the requirements for England, Wales and Scotland. and not a working drawing. It is the responsibility of the builder to detail the construction.

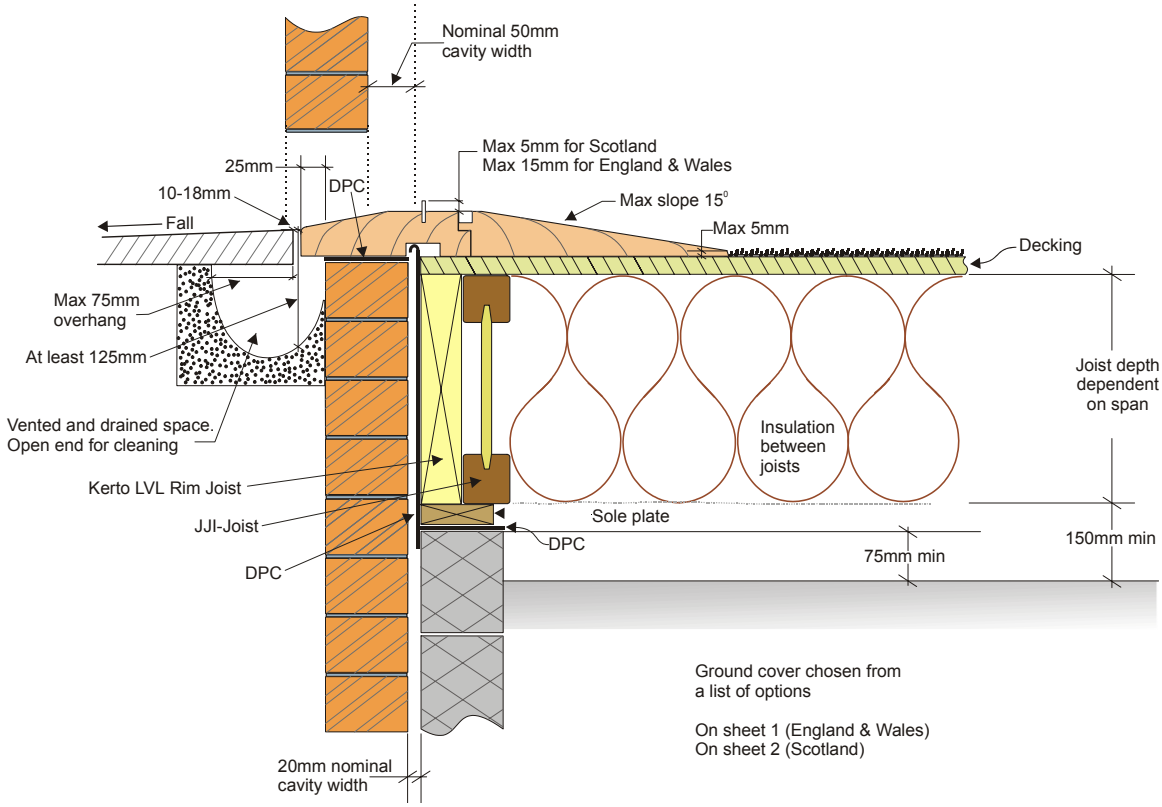

Figure 8. Example of a Threshold Detail

Reference Number: TB 9 (Revision B)	Issued By: - Keith Inglis BEng

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References

- The Building Regulations 1991 Approved Document C: Site Preparation and Resistance to Moisture.
- NHBC Standards: 5.2 Suspended Ground Floors
- Code of Practice 102:1973 Protection of Buildings against water from the ground
- Building Standards (Scotland) Regulations: Part G: Preparation of sites, resistance to moisture and resistance to condensation
- Building Research Establishment Report 2nd Edition. Thermal insulation: avoiding risks
- Building Research Establishment document: Radon: Guidance on Protection Measures for New Dwellings in Scotland
- Building Research Establishment Report 211: Radon: Guidance on Protective Measures for New Dwellings
- Building Research Establishment Report 212: Construction of new buildings on gas contaminated land
- British Board of Agrément Certificate No. 99/3633 JJI-Joists
- Design Protocol for the Evaluation of Permissible Long -Term Structural Properties of JJI-Joists
- Building Regulations 1991: Part M – 1999 Access and Facilities for Disabled People
- Building Standards (Scotland) Regulations 1990: Part Q – Access and facilities for Dwellings
- DETR – Accessible thresholds in new housing; Guidance for house builders and designers

Further reading

- TRADA Technology – Level Thresholds: the timber floor solution
- DETR – Accessible thresholds in new housing; Guidance for house builders and designers