LOFTZONE™

Loft insulation isn't working in 80% of UK houses:

What can we do about it?

One hour CIAT-accredited CPD Seminar
for architecture and construction professionals

Order of content of seminar

- Loft Insulation Regulations and Standards, Installation Method and Market Penetration
- ‘In-Use Factors’ which diminish insulation performance, including Carbon Trust survey on loft usage
- The effect of loft insulation compression on U-values
- Safety requirements in lofts, including RoSPA loft accident statistics
- Traditional insulation and building methods, which are no longer appropriate
- Alternative techniques to maximise insulation performance
- Specific design considerations and U-value calculator
- Summary
- Test Questions

Loft insulation: why it's needed

- On average, 25% of a building's heat loss through its insulated external envelope is through the roof
  (source: Energy Savings Trust)

Loft insulation: Buildings Regulations and Technical Standards

Type of application	Required U-value for the loft ceiling (W/m²K)	Required thickness of thermal conductivity insulation if laid at the ceiling of the loft
New build	U = 0.13 (EW&NI BRAD L1A) U = 0.11 (Scotland STS 6.2)	340mm 400mm
Retrofit	U = 0.16 (EW&NI BRAD L1B) U = 0.13 (Scotland STS 6.2)	270mm 340 mm

- This assumes that mineral fibre insulation is used with a thermal conductivity k value of 0.044 W/mK (as found in the most common products)
- It is possible to reduce insulation thicknesses by using other materials
- It is also possible to insulate above, between and/or below the pitched roof rafters; this creates a ‘warm loft’. Warm lofts are not the subject of this presentation.

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Note: Don’t Forget Overheating

- Mineral fibre or plastic thermal conductivity insulation keeps heat in during winter. but
  - Does not readily let heat out in the summer
  - Does not prevent radiant solar heat from entering the property in the summer either
  - In both cases, leading to potential overheating, affecting 20% of housing *(source: Zero Carbon Homes)*
- Consider loft insulation with the additional property of high decrement delay/ thermal mass, including:
  - Cellulose fibre flake (recycled newspaper)
    - easy installation around any framing
  - Cork granules (easy installation) or boards
  - Wood fibre batts or boards
  - Other plant fibre insulation materials in various formats
- This is the subject of a separate CPD seminar by Green Building Encyclopaedia. Contact: for CPD

Thick loft insulation: installation method

Step 1: lay insulation between the joists
(usually 75 or 100mm tall)

Step 2: roll another layer at 90 degrees to the first layer, to give the total required thickness

Loft insulation: market penetration

- Of the 23 million domestic lofts in the UK:
  - 15 million have >100mm of insulation
    (*Source: DECC, 2016)*
- The vast majority have been insulated using mineral fibre rolls, usually selected for cheapness and ease of installation
- Many other materials are available, whether natural, non-natural, virgin or recycled/re-used.
- Others formats include: loose, blown or sprayed insulation, rigid board insulation and multi-foils
- An simple comparison can be found at Superhomes and more detailed comparisons are available upon request from LoftZone.

Is loft insulation "fit and forget"?

- Unfortunately no, the performance is spoiled by:
  - Significant 'In-Use Factors', which means that loft insulation does not work as well as it was designed to
- Assuming that the insulation has been fitted correctly, according to PAS 2030 guidelines:
  - Without gaps and
  - Permitting cross-ventilation at eaves
- Then the 'In-Use Factors' on the following slide come into play

Some Common In-Use Factors:

- Compression of the loft insulation down to joist height
  - Storage of belongings directly on top of the insulation
  - Placing loft boards on to the joists
- Safe access decks installed in the loft, bearing on the ceiling joists
  - Usually well below the required thickness of insulation
  - Compressing the insulation above and between the joists
- Thermal bridging through the ceiling joists, especially if the joists have been built up, through the use of cross-battening
- Householder or maintenance contractor action
  - e.g. moving the insulation away to create safe access pathways and then not being able to replace it properly, or at all
- After becoming moist from condensation build up in the loft:
  - Insulation deterioration
  - Performance drop off

Some Less-Common In-Use Factors:

- Wind scour or wind washing at the eaves and along the top of the insulation, drawing heat out of the insulation surface
- Vermin attack
- Wildlife inhabitation displacing or tunnelling through insulation
- Accumulation of dust and debris, especially after roofing work
- Water ingress through old or leaky roof coverings

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The biggest 'In-Use Factor' is loft insulation compression

- Tests undertaken by the National Physical Laboratory showed that compressing mineral fibre loft insulation:
  - affects the U value
  - is very significant
  - Is much worse than previously thought
- Compressing 270mm to 75mm/100mm (typical joist heights):

Thickness	270mm	100mm	75mm
Thermal resistance m2K/W	6.11	3.09	2.42
U-Value W/m2K	0.164	0.324	0.413
Increase in heat lost	-	98%	152%

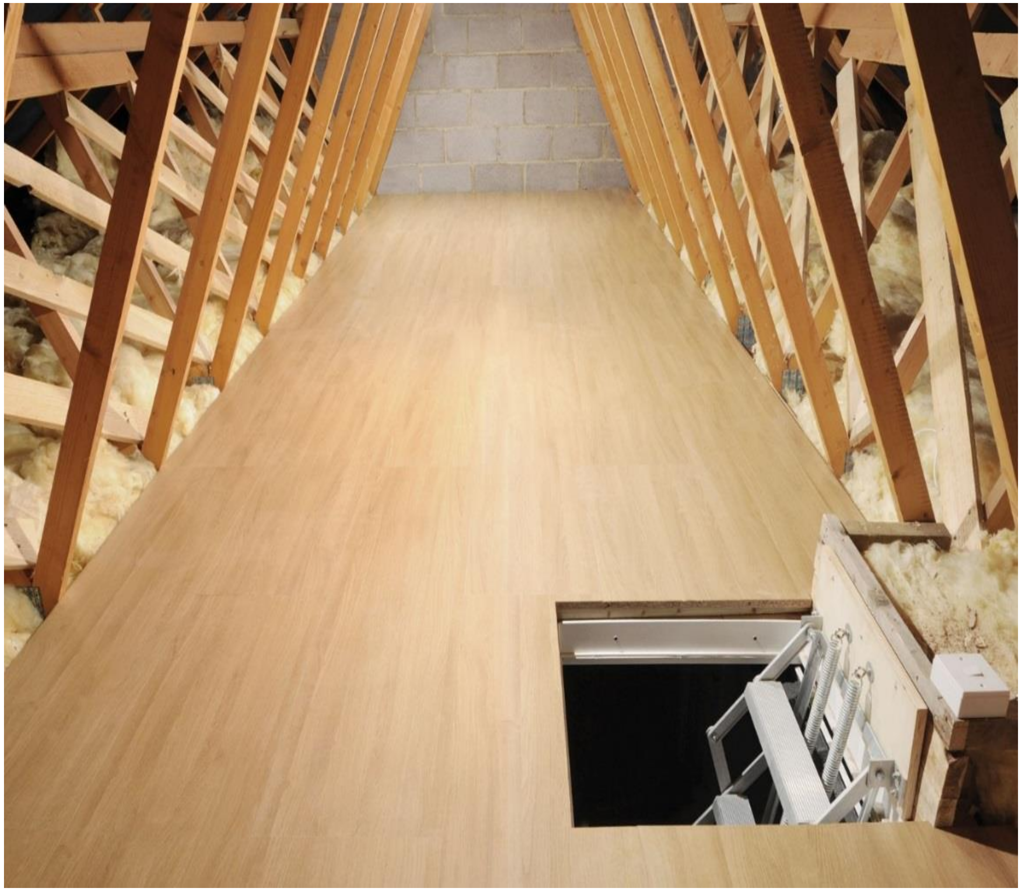
NPL National Physical Laboratory

Obvious examples of In-Use Compression

- Storage of belongings: directly on to the insulation, or on decking resting on the joists – in both cases squashing the insulation

Less obvious, but equally bad

- From a thermal conductivity insulation perspective, this loft is poor (at least in the central area)
- Assuming there is insulation under the boards, then it is only as deep as the joists, and it may well have been squashed from the Building Standards thickness down to joist height – which at least <u>*doubles* the heat lost</u>



Myth 1: Modern truss-rafter roofs are not designed for storage in the loft

- Both Building Regulations Approved Document A Table 4 (see below) and BS 5268:Part 3 for modern trussed rafter roofs require the loft ceiling to support:
  - 0.25 kN/m2 distributed imposed load (for storage)
    - (1/8th of the loading for a domestic floor)
  - 0.90 kN concentrated point load (for a person accessing loft, assumed to be the load through one person's leg)
- Light storage is therefore permissible, even though many builders tell the occupants otherwise
- Note that many traditional in-situ cut timber roofs are often much stronger than trussed rafter roofs

Table 4 **Imposed loads**

Element	Loading
Roof	Distributed loads 1.00kN/m² for spans not exceeding 12m 1.5kN/m² for spans not exceeding 6m
Floors	Distributed load: 2.00kN/m²
Ceilings	Distributed load: 0.25kN/m² together with concentrated load: 0.9kN

Myth 2: People can be persuaded not to use their loft for storage

- Actually, the opposite is overwhelmingly true:
  - 78% of UK householders say loft storage is “very important” or “essential”
  - 82% use their lofts for storage
    - Of those, 78% say theirs is more than half full
  - Only 26% know that squashing insulation is bad for it

  (Source: Carbon Trust survey, Biggest ever survey of UK loft users (6,000 responses), 2012)
- 69% of people in fully occupied homes do not have enough space for storage

  (Source: CABE, HATC, Ipsos Mori, quoted in RIBA “Case for Space” report, 2011)

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Safety in lofts is also an important issue:

- Estimated 1,500 hospital visits each year in the UK owing to:
  - falls from lofts
  - falls through loft ceilings

  (Source: RoSPA, based on latest available survey figures for A&E departments. Data excludes fatalities)

- Architects and builders have a **requirement** to design-in safe maintenance under CDM 2015
- Landlords have a 'Duty of Care' to their maintenance staff

Safe loft access is required to services:

- Cold water storage tank, ball valve, water supply and delivery pipes, insulation and overflow pipe
- Boiler top-up tank, ball valve, water supply and delivery pipes, insulation and overflow pipe
- Boiler fuel and power supply, flues, pipes and insulation
- Communal or District heating flow and return pipes and insulation if fitted
- Hot water cylinder or solar cylinder, ball valve, water supply, overflow and delivery pipes, and insulation
- Solar thermal panel expansion tank, pipes and insulation
- Solar PV inverter and cables
- Power Shower Pumps
- Extractor fans and ducts
- MVHR Mechanical Ventilation with Heat Recovery ducting
- Power and data cables and conduit
- Pipe work and insulation
- TV aerial, satellite dish, cable box and cables
- Domestic sprinkler system pipework and insulation
- Smoke detectors and cables
- Warden Call systems
- Ceiling mounted down lighters
- Ceiling mounted fans
- Ceiling mounted air conditioning units

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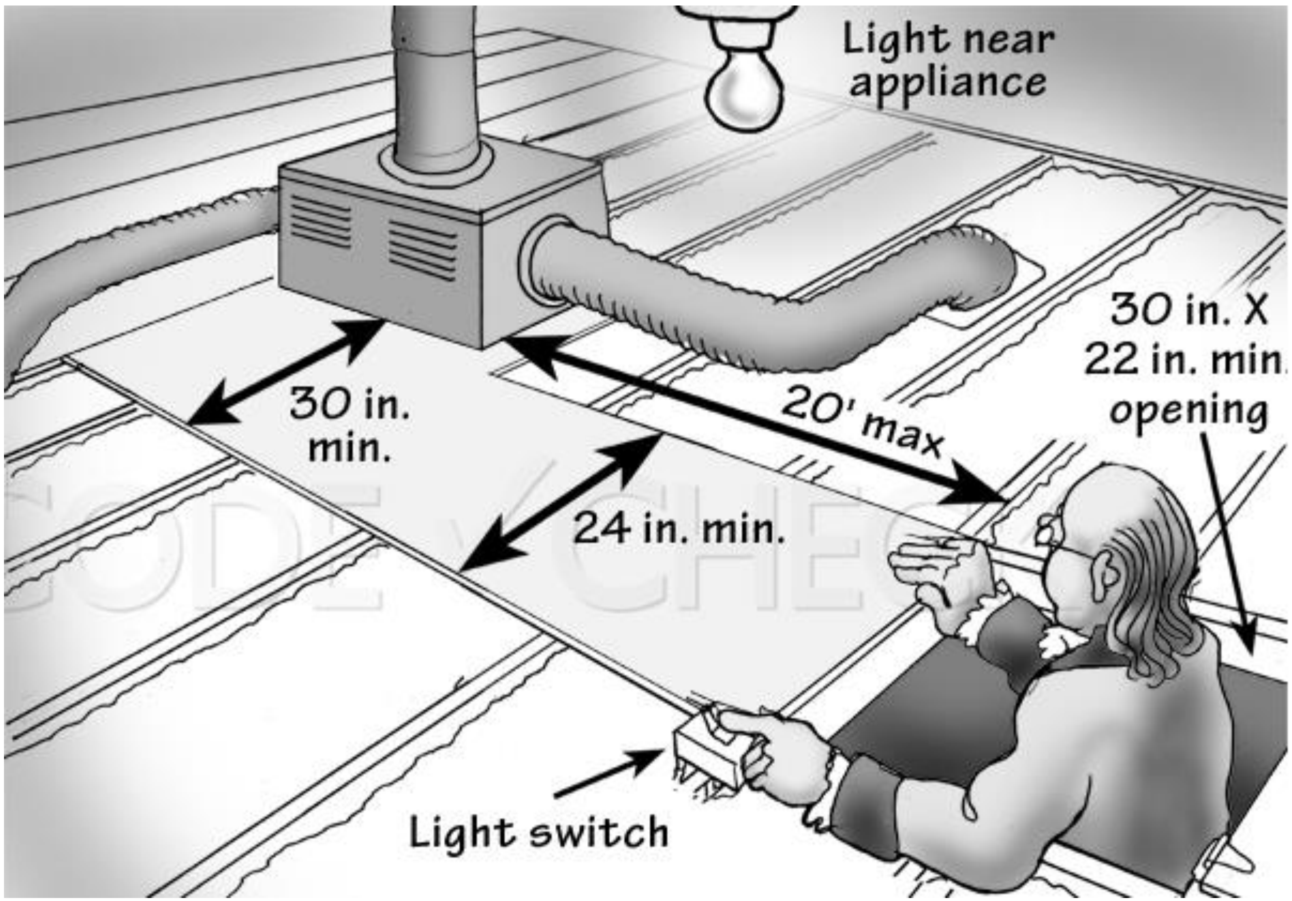
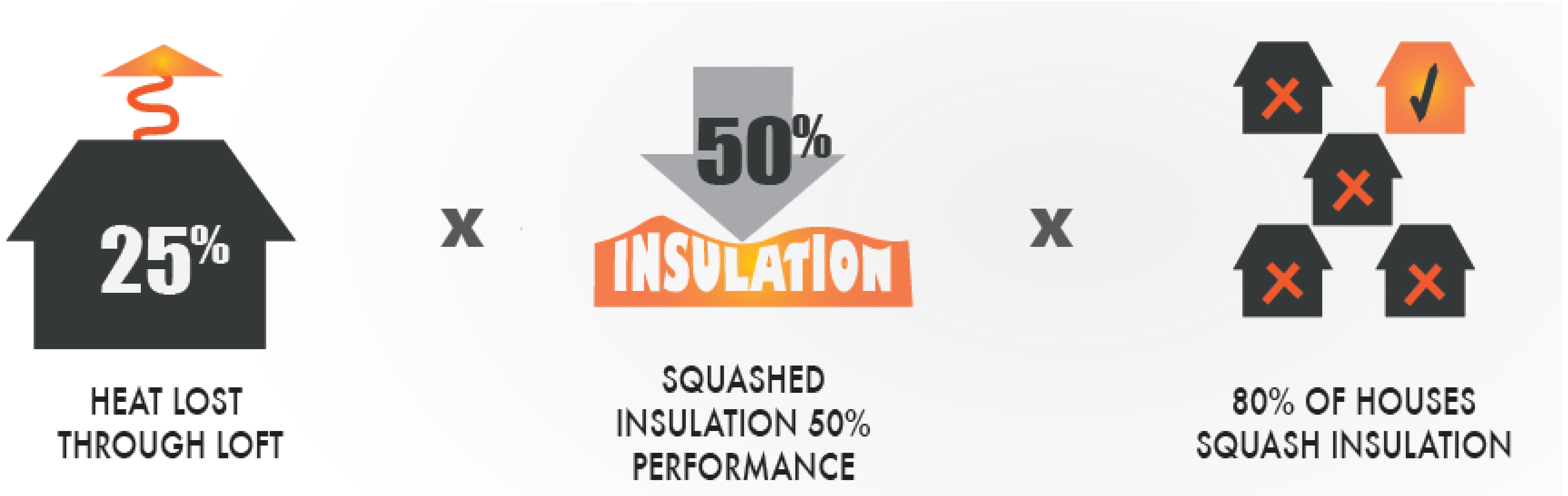
Safe access platforms can be the cause of top-up insulation removal or compression



Loft insulation compression is a limiting factor in meeting the UK's carbon targets

- The energy used by domestic buildings in the UK accounts for approximately 25% of the UK's total emissions *(Source: Carbon Trust)*
- And yet we now see that loft insulation performs badly in so many buildings



Ofgem and independent research quantification of the In-Use Factors

- Ofgem assumes that IUFs reduce the effectiveness of loft insulation by 35%. For example, this is mandated in legislation for the ECO scheme *(Source: ECO Measures Table)*

- Subsequent research collated by LoftZone shows this to be an underestimate, since 27.5% is for loft insulation compression alone *(Source: White Paper on Loft Insulation IUFs)*

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So what are the solutions?

- Raising timber panel decking above existing joists with softwood framing or joists?

- Decking on top of rigid foamed-plastic boards?

- Proprietary supports and decking systems?

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Cross-Battening used to be common

But raising timber panel decking on softwood framing/joists is no longer good practice

- The extra timber is:
  - Heavy and awkward to get in and fit in a confined space
  - It may use up a significant proportion of the load bearing capacity of the loft floor
  - Unable to cope with uneven joist heights – the resulting deck will be uneven
  - Unable to cope with services (e.g. pipes) laid on top of the joists – these get in the way of the new timber
- Installers must remember to put back in place any existing top-up thermal conductivity insulation before decking over
  - Taking care to fit gap-free insulation around framing or joists
  - Often hard to inspect for quality of work once the boards have been screwed on top

Watch out for Part L1A of the 2013 Buildings Regulations!

- The extra timber acts as a thermal bridge through the insulation
  - Linear (if on top of joists) or Point (if laid at right angles to existing joists)
- Part L1A of the 2013 Building Regulations in England and Wales mandate that Psi values for these thermal bridges have to be allowed for in the U-value calculation for the roof
- This will require an increase in thermal conductivity insulation thickness to compensate
  - If there is no room in the loft location, it will be needed elsewhere

Decking on to rigid foamed plastic insulation?

Risks associated with using rigid foamed plastics insulation (1)

- Foamed plastics insulation are not normally moisture permeable so vapour barriers are essential - but difficult to add to existing ceilings
- The lack of a vapour barrier can cause interstitial or surface condensation, as moist air passing through the ceiling insulation will cool and may condense on the underside of the deck board
- For conventional pitched roof cross-ventilation it is recommended that there is at least an adequate air gap between the top of the insulation and the underside of the decking board *(source: BRE)*
  - This means that additional timber must be used to raise the decking above the rigid insulation. But this has the same problem as cross-battening.

Risks associated with using rigid foamed plastics insulation (2)

- Rigid foamed plastics insulation must not be allowed to touch plastic conduit or plastic sheathing of electrical cables
  - Polymer migration may modify the performance of both plastics
    - Plastics can dissolve away
  - At particular risk are expanded or extruded polystyrene rigid foamed plastic or rigid board insulation, and polyurethane spray foam
  - There is more information in a technical paper on "The migration of plasticisers from PVC cable sheathing into expanded polystyrene insulation".
- Finally, on a practical point, large sections of rigid insulation/decking are also hard to get through the loft hatch and fit within a confined loft space, without gaps

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BBA Approval Inspection Testing Certification — Certificate 15/5269

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Example of fire caused by polymer migration

- Over a period of years there was a reaction between the plasticiser in the PVC cabling and the polystyrene insulation, whereby the plasticiser migrated out of the PVC, softening the styrene which adhered to the PVC, leaving a brittle cable that cracked and split, exposing live conductors which caused a fire involving the timbers within the loft space.

(Source: East Sussex Fire and Rescue Service)

New raised loft decking systems

- There are a number of new products and systems on the market
- Only one system has been approved by BBA for use in construction:
  - It is strong enough to withstand the required loading
  - It is tall enough to meet most modern insulation thicknesses
  - It avoids creating a significant thermal bridge through the insulation
  - It has a ventilation gap to avoid surface or interstitial condensation

- That system is LoftZone StoreFloor (www.loftzone.co.uk)

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LoftZone StoreFloor: plastic supports and metal beams to raise timber panel decking

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LoftZone StoreFloor installations (1)

LoftZone StoreFloor installations (2)

- In new build truss-roof residential properties

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LoftZone StoreFloor installations (3)

- Also used for safe access walkways in non-domestic buildings

Design Consideration 1: Does the LoftZone system cause a significant thermal bridge through its supports?

- No it does not. The Buildings Research Establishment calculated that the thermal conductivity through the plastic supports was negligible, because of their material choice and because of the small contact areas
- They need not be considered in U-value calculations
- See next slide for screenshot from the report

Thermal bridge through supports?

4 Hygrothermal assessment of LoftZone floor

This reduced surface temperature is to be compared to the dewpoint temperature as calculated from the interstitial condensation calculations for the behaviour of the roof construction and LoftZone floor as a whole.

The U-values determined from the modelled roof construction with and without the influence of the thermal bridging of the nylon supports are 0.1226 and 0.1220 W/m²K respectively. The effect of the thermal bridging of the nylon supports is therefore not significant and so can be ignored when calculating the U-value of roof constructions that incorporate the LoftZone floor. Note that the thermal bridging of the timber joist is still included when calculating the U-value of the roof construction that incorporates the LoftZone floor.

Design Consideration 2: Size of Ventilation Gap

- The ventilation gap needed to reduce the risk of interstitial condensation is dependent on the humidity of the air and the ventilation levels in the loft
- 50 mm between the top of the insulation and the underside of the decking boards is default practice and recommended by BBA
- BRE calculated that a 29 mm ventilation gap would be sufficient, so long as there was adequate ventilation in the loft (e.g. from the eaves)
- The LoftZone supports are 279mm tall and are placed on to the existing joists (which are usually 75mm or 100mm tall). This gives up to 350mm depth for insulation plus a 29mm air-gap. Should the insulation levels be deeper, then the LoftZone supports would be raised up with small sections of timber directly underneath the support (no need to cross-batten however).

bre

Client Report:

Hygrothermal assessment of LoftZone floor

Client report number 275586

Prepared for:
Pier Cave
LoftZone Ltd

28 November 2011

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26 May 2015
Our Ref: HCT008-1000

Dear Dave

Hygrothermal performance of LoftZone Floor with 29 mm ventilated airspace

I have reviewed the hygrothermal performance of the LoftZone floor with the 35 mm air space between the loft insulation and the underside of the LoftZone OSB boarding and, in the case of the depth of this air gap reducing to 29 mm, the hygrothermal performance as calculated is unchanged. However, as indicated in our earlier report to you (BRE Report No. 275586 – "Hygrothermal assessment of LoftZone floor", this performance depends on their being adequate cross-ventilation of this fairly narrow air space. Reducing the depth of this air space is likely to make any cross ventilation slightly more difficult. That said, if it is the case that a 35 mm deep air space with cross-ventilation is sufficient to avoid interstitial condensation on the underside of the LoftZone OSB boarding, then a small reduction in the depth of air-space to around 30 mm is unlikely to result in interstitial condensation. However, as indicated in our earlier report to you, it may be advisable to consider proving, either *in-situ* over a winter or in a suitable laboratory mock-up, that the level of ventilation is indeed adequate to prevent the risk of interstitial condensation. As before, adequate ventilation of the cold loft space as a whole is also still required.

Yours sincerely

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Tool for Designers: GBE Calculator

- There is a free tool for designers to select required materials choices and calculate U-values when loft decking is needed
- GBE Calculator LoftZoneStoreFloorUValue A05BRM100117 XLSX *(link opens Excel document)*

GBE Calculator Thermal Bridge LoftZoneStoreFloor

GBE

Edit 8 cells below by choosing from drop down menus V

Choose this worksheet before closing the file and continuing in Show

Notes:
BBA compliance meets EU Construction Products Directive
BBA compliance meets Building Regulation 7 'Proper Material'
BCO may insist on BBA as evidence of a 'Proper Material'
BBA compliance ensures a competent system
Professionals may need BBA compliance to protect PII
BIY or Self-build may need BBA compliance for BCO approval
DIY installations do not need BBA compliance and BCO approval
BBA = British Board of Agrement Certified Product/System
BCO = Building Control Officer
DIY = Do It Yourself
BIY = Build It Yourself (Self-Build)

Existing ceiling Joist depth (75, 100 only working options)	100	mm	Good	BBA: Minimum 100 mm; Mnimum 0.25 kN/m2
Existing ceiling Joist width (32, 35, 38, 50, etc.)	32	mm	Fails BBA requirement	BBA: Minimum 35 mm
Existing ceiling Joist spacing (300, 400, 450, 600)	600	mm	Good	Imperial sizes could be added
Top-up insulation thickness (100, 150, 170, 200, 230, 250, 270)	270	mm	Fails BBA requirement	BBA: Maximum 230 mm
Top-up insulation k value: (0.037 in BBA, 0.038 batt or 0.042 quilt in ISO 6924, 0.044 in CPD)	0.044	W/m.K	Check schedule below if it meets U Value	BBA: refers to 0.037 W/m.K as a complient option
Top-up insulation roll width (570, 600)	600	mm	Good	Implemented in assembly 8 only
Deck board coordinating size (325, 610)	610	mm	Fails: Gappy insulation?	Implemented in assemblies 5, 6, 7 & 8
Ventilation zone below deck (50 mm recommended by BRE and BBA)	29	mm	Fails BBA requirement	BBA: Minimum 50 mm: BRE letter permits >29 mm

Joist depth	U value	Pass/Fail/ Check Schedule/ Ignore	Thermal bridge modification factor	U value	Pass/Fail/ Check Schedule/ Ignore	Thermal bridge modification factor	
	Look right			100 mm			
	W/m2.K	Pass/Fail	1:x	W/m2.K	Pass/Fail	1:x	Comments:
Existing roof no insulation between ceiling joists	0.000	Ignore	0.00	2.320	Fail	0.37	History: to be avoided
Existing roof insulated between joists	0.000	Ignore	0.00	0.387	Fail	0.75	Should be history: to be avoided
With top-up insulation above joists	0.000	Ignore	0.00	0.115	Check Below	0.91	No access or storage provision: to be avoided
With compressed insulation above and between joists	0.000	Ignore	0.00	0.664	Fail	0.66	Insulation compression: to be avoided
With timber framing, deck, ventilation gap and top-up insulation	0.000	Ignore	0.00	0.111	Check Below	0.75	No longer best practice: permitted, but time to move on
With timber joist, deck, no under deck vent gap and top-up insulation	0.000	Ignore	0.00	0.116	Check Below	0.75	Condensation risk: to be avoided
with LoftZone StoreFloor, deck, under deck vent gap and top-up insulation (GBE)	0.000	Ignore	0.00	0.113	Check Below	0.62	Good Choice
with LoftZone StoreFloor, deck, under deck vent gap and top-up insulation (BRE)	0.000	Ignore	0.00	0.112	Check Below	0.71	Good Choice
with LoftZone StoreFloor, deck, under deck vent gap and gappy top-up insulation	0.000	Ignore	0.00	0.114	Check Below	0.56	Thermal flanking through gappy insulation: to be avoided

Project Target U value: if you wish to state it	0.160	W/m2.K		
Building Regulations L1A New: England Wales Northern Ireland	0.130	W/m2.K	0.130	W/m2.K
Building Regulations L1B Upgrade: England Wales Northern Ireland	0.160	W/m2.K	0.160	W/m2.K
Technical Standards 6.2 New: Scotland	0.110	W/m2.K	0.110	W/m2.K
Technical Standards 6.2 Upgrade: Scotland	0.130	W/m2.K	0.130	W/m2.K
Passivhaus New Build	0.150	W/m2.K	0.150	W/m2.K
AECB CarbonLite Step 1 Silver	0.150	W/m2.K	0.150	W/m2.K
AECB CarbonLite Step 2 Passivhaus UK	0.150	W/m2.K	0.150	W/m2.K
AECB CarbonLite Step 3 Gold	0.150	W/m2.K	0.150	W/m2.K
EnerPHit Passivhaus Retrofit	0.150	W/m2.K	0.150	W/m2.K
AECB CarbonLite Retrofit	0.100	W/m2.K	0.100	W/m2.K

NB:
These design standards do not normally state U values but set maximum building energy demands and their respective software determines U values based on many building and site parameters.
These U values are only give as an example.

Summary

- Loft insulation 'In-Use Factors', in particular compression, are a major issue
- Significant numbers of houses are affected, adding considerably to UK energy and fuel demands and carbon outputs of UK housing
- Storage space is highly important in buildings
- Safe access to the loft for maintenance purposes needs to be designed in by architects and builders
- Most traditional means of solving the need for storage space and safe access walkways are no longer good practice
- The LoftZone StoreFloor is the only product for this purpose that has been approved by BBA for use in construction.

Test Questions:

1. What percentage of households use their loft for storage? (35%, 50%, 82%)
2. If loft insulation is compressed from 270 mm to 100 mm joist height, by how much does the U-value change? (It halves, it doubles, it stays the same)
3. What is the gap recommended by BRE between the top of the insulation and the bottom of the deck, to prevent surface condensation on the underside of the deck boards, assuming adequate ventilation in the loft? (29 mm, 50 mm, 82 mm).
4. What does Ofgem consider the total reduction in the effectiveness of UK loft insulation owing to all In-Use Factors to be? (35%, 50%, 82%)
5. What is the requirement for the loading of the bottom chord of trussed rafter roofs?
   (0.25 kN/m2 distributed imposed load plus 0.90 kN concentrated point load
   0.50 kN/m2 distributed imposed load plus 0.90 kN concentrated point load
   0.82 kN/m2 distributed imposed load plus 0.90 kN concentrated point load)
6. Under which regulations are architects and builders required to design in safe maintenance access? (Part L1A, Working at Height Regulations, CDM 2015)

How to submit your answers:

1. Please email your answers to cpd@loftzone.com
2. Please provide your full name and, if appropriate, your CIAT membership number (optional).
3. If you get 75% of the questions correct, a CPD certificate will be emailed to you.
4. If not, you will be able to resubmit your answers.