LOFTZONE™

Loft insulation isn’t working in 80% of UK houses What can we do about it?

One hour CPD Seminar for architecture and construction professionals

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Order of content of seminar

- EST Energy Saving Trust guidance
- 'In-Use Factors' which diminish insulation performance
- Building Regulations, Technical Standards and voluntary schemes
- ZCH Zero Carbon Hub statistics on overheating
- DECC statistics on roof insulation
- NPL National Physics Laboratory research on insulation performance
- Carbon Trust surveys on loft usage
- RoSPA loft/ceiling accident statistics
- Alternative techniques to maximise insulation performance
- GBE Calculator U Values & Thermal Bridge modification factors
- Test Questions and Answers

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Loft insulation: why it's needed

On average, 25% of a building's heat loss through its insulated external envelop is through the roof

(source: Energy Savings Trust)

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Loft insulation:
Buildings Regulations & Technical Standards

Type of application	Required U-value for the loft ceiling (W/m2.K	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 thermal conductivity insulation is used
  - with a thermal conductivity k value of 0.044 W/m.K
  - as found in some of the common products
- It is possible to have reduced 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 loft’ is not the subject of this presentation.

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Loft insulation: Other Voluntary Standards

Type of application	Required U-value for the loft ceiling (W/m2.K)	Required thickness of thermal conductivity insulation if laid at the ceiling of the loft (k value: 0.044 W/m.K)
New build Passivhaus	U = 0.15	280 mm
New build AECB CarbonLite Steps: 1, 2 & 3 = Silver, Bronze & Gold	U = 0.15	280 mm
EnerPHit Passivhaus Retrofit Cool-temperate climate	U = 0.15	280 mm
AECB CarbonLite Retrofit (CLR)	U = 0.10	425mm

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.

Food for thought (1)

It should also be noted that:

- Mineral fibre and plastic thermal conductivity insulation
  - Keep heat in during winter
  - Do not readily let it out in summer (adding to overheating potential)
- And they do not keep radiant solar heat out in summer
  - Leading to potential overheating (affecting 20% of housing (ZCH))
- Consider loft thermal conductivity insulation with the additional property of high decrement delay, 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

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Food for thought (2)

- mineral fibre and plastics are good for stopping winter heat loss
- mineral fibre and plastics do not stop solar heat gain through opaque building fabric
- UK Building Regulations do not address summer solar heat gain
  - despite 20% of homes overheating in summer (ZCH)
- The subject of a separate CPD seminar by GBE

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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

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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
- Other materials are available:
  - Cellulose fibre, wood fibre, cork, cotton, recycled denim,
  - Foamed plastics, fibre plastics,
- Others formats include:
  - Loose, blown or sprayed insulation
  - Rigid board insulation
  - Multifoils

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So, once a loft is properly insulated, is everything okay?

- Unfortunately no, the performance is spoiled by:
  - Significant ‘In-Use Factors’
  - This means that loft thermal conductivity insulation does not work as well as it was meant to
- Assuming that the insulation has been fitted correctly:
  - Without gaps and
  - Permitting cross-ventilation at eaves
- Then ‘In-Use Factors’ come into play…

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Some common In-Use Factors:

- Compression of the loft insulation
  - e.g. by storage of belongings directly on insulation or on deck boarding
- Safe access deck boarding 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
- 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
- Thermal bridging through the ceiling joists

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Some less-common In-Use Factors:

- Vermin attack
- Wildlife inhabitation displacing or tunnelling through insulation
- Wind scour or wind washing at the eaves and along the top of the insulation, drawing heat out of the insulation surface
- 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:
  - Compressing mineral fibre loft insulation:
  - Affects the U value
  - It is very significant
  - Much greater than previously thought
- Compressing from 270mm to 100mm (4" ceiling joist height)
  - U-value and heat loss increases by <200%
- Compression from 270mm to 75mm (3" ceiling joist height)
  - U-value and heat loss increases by <240%

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Loft insulation compression

Squashed thickness: 100 mm

Thermal resistance: 3.09 m2.K/W

U value: 0.324 W/m2.K

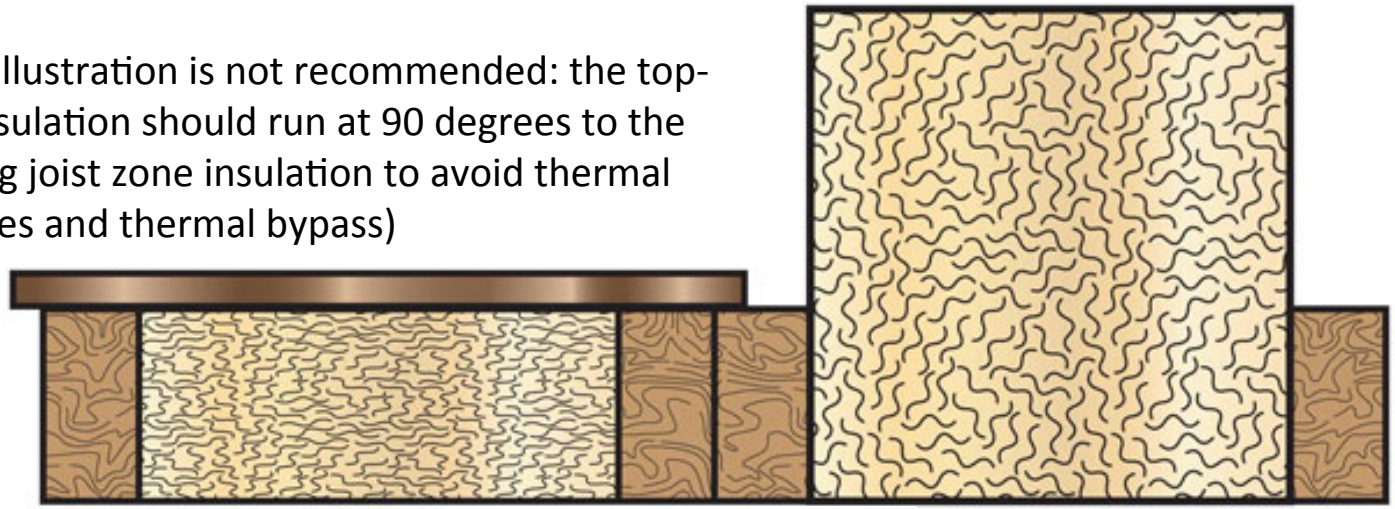
Difference in U values: 198%

Recommended thickness: 270 mm

Thermal resistance: 6.11 m2.K/W

U value: 0.164 W/m2.K

(NB. Illustration is not recommended: the top-up insulation should run at 90 degrees to the ceiling joist zone insulation to avoid thermal bridges and thermal bypass)



NPL
National Physical Laboratory

This loft may look tidy,

- But from a thermal conductivity insulation perspective, it is very poor (at least in the central area)
- The insulation is either only 100 mm (up to joist height)
- Or the insulation has been squashed down to 100 mm

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Causes of thermal conductivity insulation compression

- Storage of belongings:
  - directly on the insulation
  - or on decking on the insulation

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Loft ceiling light storage loadings

- Building Regulations Approved Document A Table 4 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)
- Traditional insitu cut timber roofs are often much stronger than trussed rafter roofs
- Many building owners and occupiers want to use their loft for storage

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Loft storage is important

- 6000 survey respondents:
- 78% say loft storage is 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 UK survey of loft users

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Safety in lofts is an issue:

200 hospital visits each year in the UK owing to:

- falls from lofts
- falls through loft ceilings

(source: RoSPA)

Architects and builders have a requirement to design-in safe maintenance under CDM 2015

Landlords have a ‘Duty of Care’ to their maintenance staff

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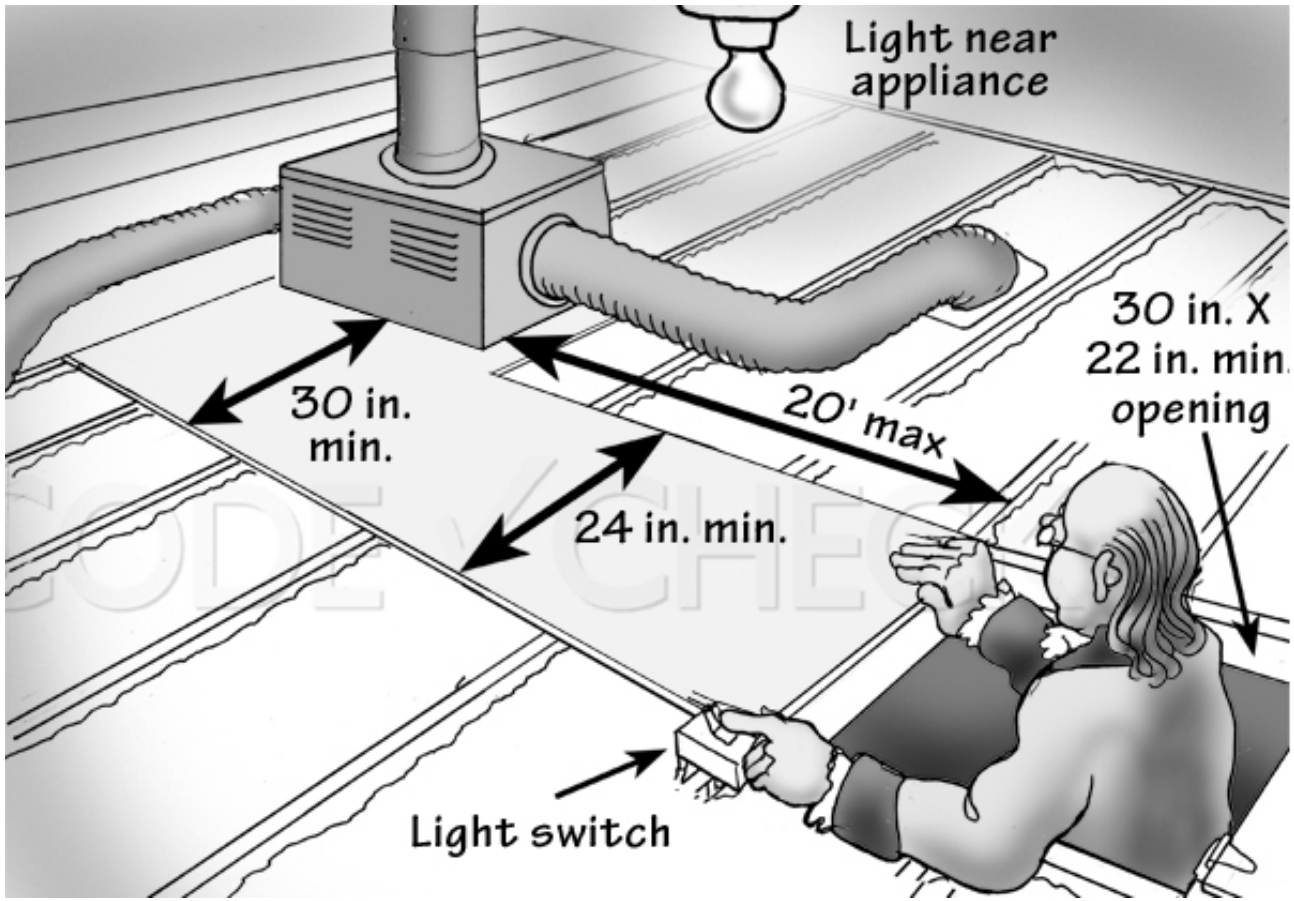
Safe access platforms can be the cause of top-up insulation removal or compression



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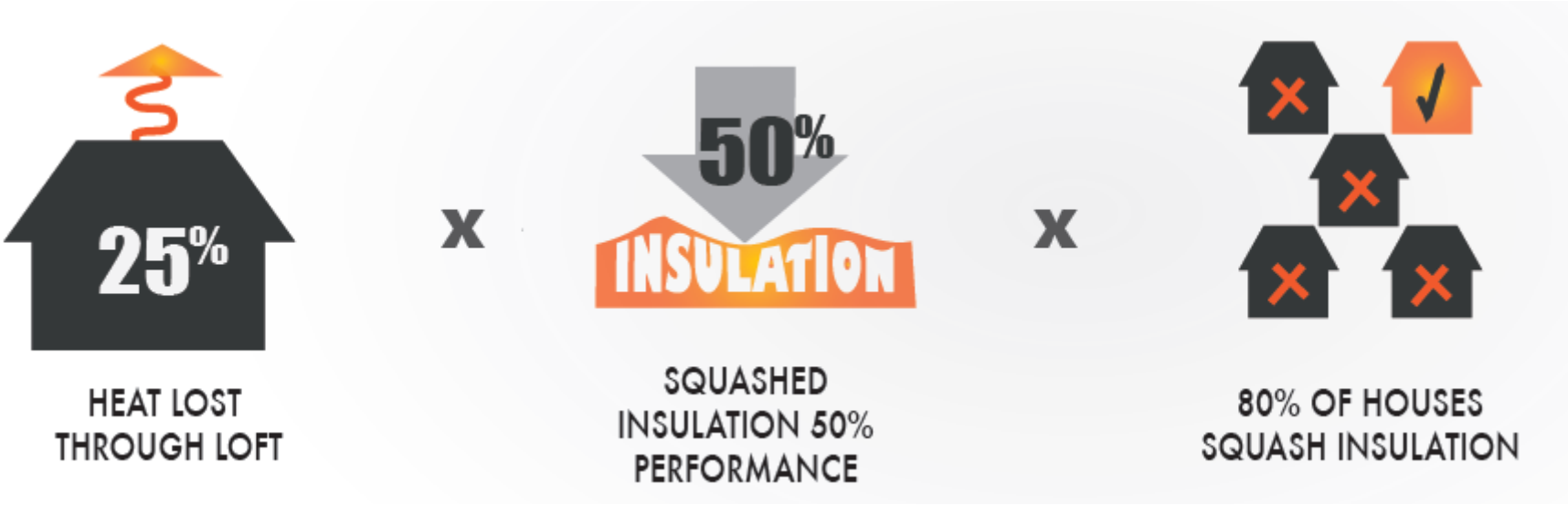
It all adds up…. 25-30% (2005) of UK energy demands are from domestic property



Ofgem estimates that In-Use Factors reduce the effectiveness of UK-wide loft insulation by 29% (2013)

Ofgem Energy Company Obligation measures

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So what are the alternatives?

- 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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Raising decking above existing joists with softwood joists and timber panel decking?

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Raising timber panel decking on new softwood framing or joists is no longer good practice

- This used to be common practice when thermal conductivity insulation thickness requirements were low
- But the extra timber is:
  - heavy and awkward to get in and fit in a confined space
  - Also acts as a thermal bridge through the insulation
    - Linear (if on top of joists) or Point (if laid at right angles to existing joists)
    - Psi values for the thermal bridges have to be allowed for in the U-value calculation for the roof under Building Regulations or Technical Standards
- 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
- Not forgetting 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

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Decking on to rigid foamed plastic insulation?

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Risk associated with decking on top of rigid foamed-plastics insulation

- 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 it 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 a 50 mm air gap at the eaves
- This cross ventilation gap should be continued between the top of the insulation and the underside of the decking board *(source: BRE)*
- Plastic insulation must not be allowed to touch plastic conduit or plastic sheathing to electrical cables
  - Polymer migration may modify the performance of both plastics
    - Plastics can dissolve away
  - Polystyrene rigid foamed-plastic
  - Polyurethane spray foam insulation
- Large sections of rigid insulation/decking are also hard to get through the loft hatch and fit within a confined loft space

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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 modern insulation thicknesses
  - Without creating a significant thermal bridge through the insulation
  - It has a ventilation gap to avoid surface or interstitial condensation.
- That system is LoftZone StoreFloor

LOFTZONE™ STOREFLOOR

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

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Reduced Ventilation Gap

- 50 mm pitched roof cross ventilation is default practice to reduce risk of interstitial condensation, BR, BRE and BBA recommend it
- BBA were asked ask to carry out hygro-thermal moisture movement and thermal bridge analysis of LoftZone Storefloor details
- They concluded 29 mm ventilation gap would was unlikely to cause interstitial condensation

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RAISED LOFT FL

STORE

This Agrément Certificate Product Sheet[1] relates to StoreFloor[2], for use as a raised loft flooring system to provide space for insulation materials.

(1) Hereinafter referred to as 'Certificate'.
(2) StoreFloor is a registered trademark.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Structural performance — loft floors incorporating the syst dead and imposed floor loads (see section 6).

Thermal insulation — loft floors incorporating the system c material to meet the requirements of the national Building R

Ventilation and condensation risk — ventilated lofts can m

Durability — loft floors fitted with the system will have a life

The BBA has awarded this Certificate to the company na system has been assessed by the BBA as being fit for its maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 17 February 2016

Simon W
Head of

The BBA is a UKAS accredited certification body — Number 113. Thi available in pdf format via the UKAS link

Readers are advised to check the validity and latest issue number of this Agrém

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Dave Raval
LoftZone Ltd
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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

Prepared by: Tim Ward
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Thermal bridge through supports?

- BRE Buildings Research Establishment
- calculated the thermal conductivity through the plastic supports to be negligible
- they need not be considered in U-value calculations

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Thermal bridge through supports?

Client Report:

Hygrothermal assessment of LoftZone floor

Client report number
275586

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.

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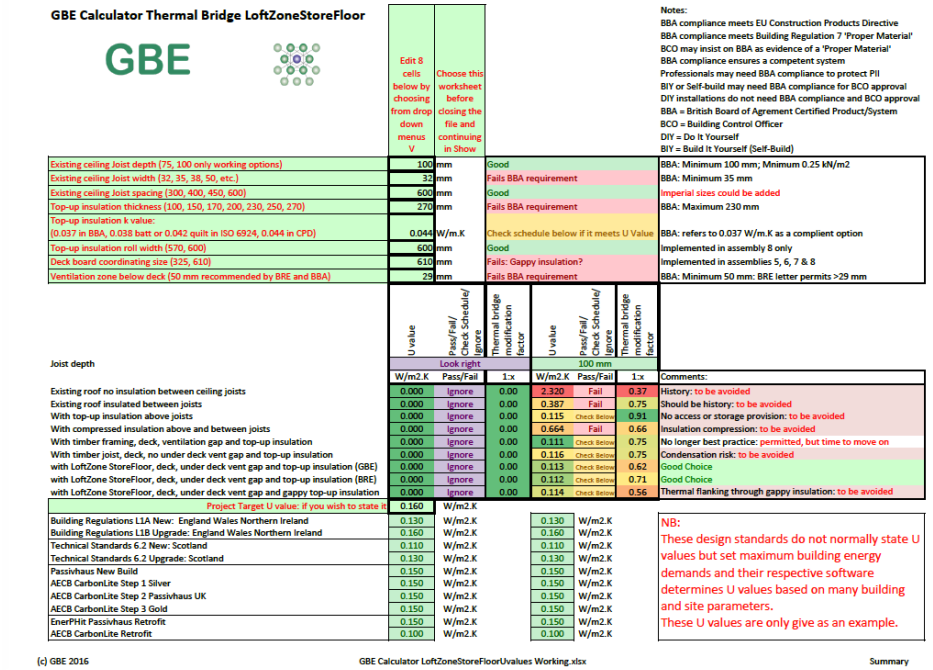
GBE Calculator LoftZone StoreFloor

GBE Calculator Page

- Scroll down to find file
- GBE Calculator LoftZoneStoreFloorUValue A05BRM100117 XLSX



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 compliant 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)	25	mm	Fails BBA requirement	BBA: Minimum 50 mm: BRE letter permits >29 mm

Joist depth	Look right U value W/m2.K	Look right Pass/Fail/Check Schedule/Ignore	Look right Thermal bridge modification factor 1:x	100 mm U value W/m2.K	100 mm Pass/Fail/Check Schedule/Ignore	100 mm Thermal bridge modification factor 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.

(c) GBE 2016 GBE Calculator LoftZoneStoreFloorUvalues Working.xlsx Summary

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LoftZone StoreFloor installations

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LoftZone StoreFloor installations

- Also used for safe access walkways in schools

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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
- Most traditional means of solving the need for storage space, 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.

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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? (35 mm, 50 mm, 82 mm).
4. What does Ofgem consider the total reduction in the effectiveness of UK loft insulation owing to In-Use Factors? (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, STS 6.2, Working at Height Regulations, CDM 2015)

LOFTZONE

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 15/5269

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Test Answers:

1. **82%** of households use their lofts for storage
2. U value **doubles** when insulation compressed 270 to 100 mm
3. **50 mm** cross-ventilation gap is recommended by BRE
4. Ofgem consider 'In-use factors' reduce UK insulation effectiveness by **35%**
5. **0.25 kN/m2** distributed imposed load plus 0.90 kN concentrated point load
6. **CDM 2015** requires safe maintenance access to be designed in