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

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

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)

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.

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

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

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
- 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

LOFTZONE

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…

LOFTZONE

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

LOFTZONE

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

LOFTZONE

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%

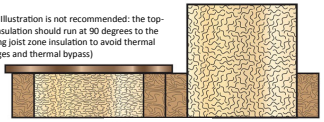
LOFTZONE

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

LOFTZONE

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

LOFTZONE

Causes of thermal conductivity insulation compression

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

LOFTZONE

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

LOFTZONE

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

LOFTZONE

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

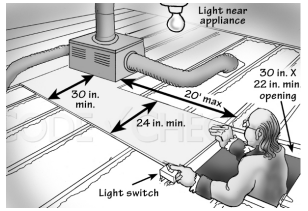
LOFTZONE

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

LOFTZONE

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



LOFTZONE

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

LOFTZONE

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

LOFTZONE

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

LOFTZONE

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

LOFTZONE

Decking on to rigid foamed plastic insulation?

LOFTZONE

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

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

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 15/5269

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

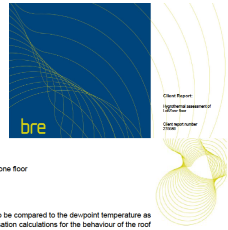
Reduced Ventilation Gap

- 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

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

Thermal bridge through supports?



4 Hygrothermal assessment of LoftZone floor

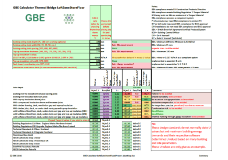
This reduced surface temperature is to be compared to the dewpoint temperature as calculated from the interstitial condensation calculations for the behaviour of the roof construction and LoftZone floor as a whole.

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.

GBE Calculator LoftZone StoreFloor

GBE Calculator Page

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



LoftZone StoreFloor installations

LoftZone StoreFloor installations

- Also used for safe access walkways in schools

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.

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)

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