Construction Level 2 – Roof Construction: Flat Roofs – Part 2

1 of 17 – Welcome

A house loses 35% of its heat through the walls. Another 25% is lost through the roof, while in older style flat roofs the problem is even worse. However, today the insulation materials have to perform to comply with the Part L building regulations.

In this session we cover the following topics:

* Flat roof main elements
* Strength and stability
* Typical construction
* Problems with flat roofs

2 of 17 – Overview

In a flat roof, the waterproofing is always supported by a structural roof deck. This is usually a timber boarding of some type, which in turn is supported on joists. The ceiling, if any, is usually fixed directly to the underside of the joists.

Garages may be un-insulated, but most roofs above the habitable part of the house are insulated to comply with Building Regulations.

In houses, the insulation is sometimes placed immediately above the ceiling (and below the roof deck), or above the roof deck (beneath the waterproof covering).

These two design options provide the basis for warm and cold roofs.

3 of 17 – Warm and cold roof design

There are two main ways for insulating a flat roof effectively. These are cold flat roof and warm flat roof designs.

Whilst cold flat roofs have historically been the most commonly used method of insulation, modern day changes in people’s lifestyles have necessitated other options.

With increased family time spent inside houses, higher amounts of clothes and personal washing, drying clothes and cooking, have all contributed to higher levels of water vapour being created.

**Cold roof design:**

Many residential flat roofs have the waterproofing laid directly onto the deck, with the insulation placed above the ceiling between the joists. This arrangement allows the waterproof layer and deck beneath it to become **cold**.

In cold weather, these roofs are prone to condensation, which can cause some materials to decay and distort. This negative aspect can be reduced by through-ventilation, which needs to be provided to each and every space above the insulation, between the joists.

The parts of a cold roof construction are:

* Roof covering
* Insulation
* Joists and timber subdeck
* Ceiling

**Warm roof design:**

A warm roof construction has the insulation above the roof deck, therefore keeping the deck warm. This popular construction is ideal for modern day lifestyle requirements, as it reduces the amount of condensation that could form in cold weather, and therefore the need for ventilation of the roof structure.

In this construction the waterproof layer is attached on top of the insulation.

The parts of a warm roof construction are:

* Roof covering
* Timber deck (optional)
* Insulation
* Vapour control layer
* Joists and timber subdeck
* Ceiling

4 of 17 – Vapour control layer

All flat roofs that use the warm roof design need to have a vapour control layer (VCL) fitted between the deck and the insulation. This can be one or two layers of bitumen membrane and metal foil-cored felts, loose laid or polyethylene.

**What does a VCL do?**

A ‘breathable’ vapour control layer reduces any moisture (condensation) from permeating through to the roof deck, which will cause damage or decay, but allows enough to provide adequate ventilation.

5 of 17 – Insulation and building regulations

In the UK, since 2006, flat roof insulation has had to comply with **Part L** building regulation documents; Conservation of Fuel & Power. This states that a new-build flat roof meets set standards and complies with rigorous U-value targets. Any upgrades to existing flat roofs (based on any refurbishment of more than 50%) must also comply.

U-value is described as the amount of energy lost in watts per square metre of material for a given temperature difference of 1°C or 1°K from one side of the material to the other. **The lower the U-value, the better it is as an insulating material.**

**Cold roof condensation risk**

The dew point is between the timber decks and the ceiling, between the joists and insulation.

When warm vapour meets the cold dew point, this can cause condensation problems and therefore a cold roof should be cross-ventilated.

6 of 17 – Flat roof insulation materials

There are many types of insulation available for flat roofs and warm roof designs. The most common materials are:

**Composite boards**

Insulation typical U-values – 0.22 (300mm thick)

Some products are available, which combine the advantages of two materials in a single board (e.g. cork/polyurethane (PUR)).

**Mineral wool (or rock wool)**

Insulation typical U-values – 0.17 (200mm thick)

A heat and fire resistant material, available in a range of thicknesses.

**Polyisocyanurate (PIR)**

Insulation typical U-values – 0.18 (150mm thick)

A very efficient insulator, PIR is the most commonly used, it is light-weight and available in various sheet sizes and thicknesses.

**Expanded polystyrene**

Insulation typical U-values – 0.19 (150mm thick)

This is also an efficient insulator but it is very heat-sensitive and will require a protective overlay

(e.g. wool-fibre).

**Polyurethane foam (PUR)**

Insulation typical U-values – 0.18 (130mm thick)

Polyurethane foam is sprayed or injected, it expands to fill the voids.

7 of 17 – Question 1

What was the earliest type of flat roof design?

1. Lean-to
2. Cold roof
3. Warm roof
4. Pitched roof

The correct answer is B, cold roof.

8 of 17 – Question 2

Which of the following lifestyle elements can cause additional condensation in cold weather to the house?

Choose all that apply:

1. Cooking
2. Washing
3. Drying clothes
4. Leaving doors open
5. Heating
6. House lighting

The correct answers are A, B and C, cooking, washing and drying clothes.

9 of 17 – Question 3

If the insulation material is placed above the roof deck, but below the waterproof layer, what sort of roof design is it?

1. Lean-to
2. Cold roof
3. Warm roof
4. Pitched roof

The correct answer is C, warm roof.

10 of 17 – Question 4

The list below shows the components of a warm roof construction, but not in the correct order. What should the correct order be?

1. Ceiling
2. Insulation
3. Joists and timber subdeck
4. Roof covering
5. Timber deck (optional)
6. Vapour control layer

The correct order should be 4, 5, 2, 6, 3 and 1, as shown below:

1. Roof covering
2. Timber deck (optional)
3. Insulation
4. Vapour control layer
5. Joists and timber subdeck
6. Ceiling

11 of 17 – Question 5

The list below shows the components of a cold roof construction, but not in the correct order. What should the correct order be?

1. Ceiling
2. Insulation
3. Joists and timber subdeck
4. Roof covering

The correct order should be 4, 2, 3 and 1, as shown below:

1. Roof covering
2. Insulation
3. Joists and timber subdeck
4. Ceiling

12 of 17 – Question 6

What does the vapour control layer do?

1. Stops rainwater getting through the roof deck
2. Reduces moisture from getting through
3. Increases humidity in the room below
4. Insulates the roof deck preventing heat loss

The correct answer is B, reduces moisture from getting through.

13 of 17 – Question 7

In what year did Part L building regulations for conservation of fuel and power come into effect?

1. 1996
2. 2000
3. 2006
4. 2016

The correct answer is C, 2006.

14 of 17 – Question 8

Read the following statement and decide whether it is true or false.

The lower the U-value the lower the performance of the insulation material

True

False

The correct answer is: False

15 of 17 – Question 9

Using the following choice of words; **U-value**, **R-values**, **measures**, **energy**, **watts**, **metre**, **1°C**, **2°C**, **material**, **lower**, **insulating** and **thermal**, fill in the blanks in the paragraph below on U-values (not all words will be used):

**Blank** is described as the amount of **blank** lost in **blank** per square **blank** of material for a given temperature difference of **blank** or 1°K from one side of the **blank** to the other. The **blank** the U-value, the better it is as an **blank** material.

The correct paragraph should read:

**U-value** is described as the amount of **energy** lost in **watts** per square **metre** of material for a given temperature difference of **1°C** or 1°K from one side of the **material** to the other. The **lower** the U-value, the better it is as an **insulating** material.

16 of 17 – Question 10

Which of the following insulation materials is the most efficient for its thickness?

1. Polyisocyanurate (PIR) - 0.18 @ 150 mm thick
2. Mineral wool - 0.17 @ 200 mm thick
3. Expanded polystyrene - 0.19 @ 150 mm thick
4. Composite boards - 0.22 @ 300 mm thick

The correct answer is A, Polyisocyanurate (PIR) - 0.18 @ 150 mm thick.

17 of 17 – End

You have now completed this session for thermal flat roof design and insulation.

In this session you found out about:

* Flat roof main elements
* Strength and stability
* Typical construction
* Problems with flat roofs

If you are unsure or have any questions about any of these topics, speak to your tutor for more help.