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Dow - Building Solutions

Insulating single-ply roofs with STYROFOAM

Insulating single-ply roofs

The use of single-ply waterproofing membranes in combination with metal deck systems enables the construction of lightweight, long-span roofs at pitches of 10° and below. Siting rigid insulation above the decking brings the whole roof structure, with the exception of the waterproofing membrane, within the insulating envelope, which:

- maintains the structure at an even temperature.
- reduces the risk of harmful condensation.
- minimises thermal movement within the structure.

Single-ply metal deck roofs offer a cost effective way of covering large spans. Installation of the roof covering can begin as soon as the structural steelwork is in place, allowing the construction of the roof to take place independently of many other parts of the project.

General considerations

Lightweight single-ply roofs usually consist of profiled steel decking fixed to steel purlins and overlaid with a vapour control layer. Rigid insulation board is fixed through the crowns of the decking and then overlaid with a light coloured, single-ply, polymeric waterproofing membrane which is usually mechanically fixed through the decking (see figure 59).

The STYROFOAM™ Solution for insulating single-ply roofs is ROOFMATE™ RL-X.

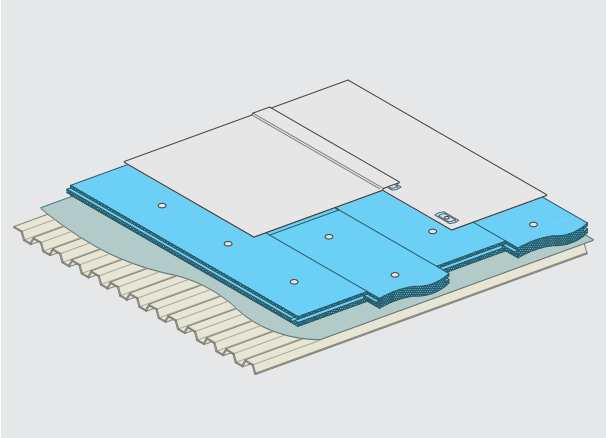

Figure 59 >> Mechanically fixed single-ply membrane

ROOFMATE RL-X is designed to give the maximum benefit in single-ply roof construction:

- high compressive strength helps reduces the risk of mechanical fixings working loose after installation.
- enhanced dimensional stability minimises the number of fixings required and reduces board movement in service.
- supports pedestrian traffic during installation.
- minimal water pick-up enables insulation to be laid in any weather.
- easy to install.
- ROOFMATE RL-X is suitable for use under all single-ply polymeric waterproofing membranes.

Consult Page 08 for the full physical and performance data of ROOFMATE RL-X.

Choice of membrane

ROOFMATE RL-X insulation is designed for use under light coloured (grey through white) single-ply polymeric membranes. *ROOFMATE RL-X insulation is not suitable for use under dark coloured waterproof coverings such as bituminous felt or black EPDM.* To prevent plasticiser migration PVC membranes should be isolated from ROOFMATE RL-X boards by a suitable separating layer.

Loading

The roof structure must be strong enough to withstand the maximum predicted loads with a suitable factor of safety.

ROOFMATE RL-X boards are suitable for occasional pedestrian maintenance traffic but if more frequent traffic is expected, additional protection of the membrane and boards is required, eg. walkway layers or concrete paving slabs on spacers.

U value	0.16	0.18	0.20	0.25	0.35
ROOFMATE RL-X	200	180	160	120	80

Table 17 ROOFMATE RL-X thickness (mm) to achieve U-values (W/m².K)

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Securement

Fixings for the roof covering and insulation must able to withstand predicted wind-uplift forces; refer to the membrane supplier's and fixing manufacturer's data for loading limits and calculation methods.

Each ROOFMATE RL-X board should be secured to the deck with three fixings, each having a washer of at least 20cm^2 area: these are in addition to any used to secure the waterproof membrane to the deck. Half boards or less may be secured with two fixings.

Drainage

Good drainage is vital to the long term performance of a flat roof. To ensure the minimum finished falls of 1:80 recommended in BS 6229 falls should be designed at 1:40.

Falls can be constructed by

- designing the roof structure to falls.
- applying a screed to falls or
- adding tapered insulation.*

When assessing the requirements of gutters and outlets designers should refer to BS EN 12056-3.

Fire

Building Regulation B4 requires roofs to resist the spread of fire over the roof and from one building to another. Roof covering classified according to BS 476: Part 3: 1958 as AA, AB or AC may be used without restrictions (see Approved Document B, Technical Standard D in Scotland). Experience suggests a roof construction which has a protective layer of 50mm of gravel above the waterproofing layer will achieve an AA rating. Non-ballasted, mechanically fixed, plasticised PVC roofing membranes will normally achieve an AB rating.

BRE document 'Thermal insulation: avoiding risks' indicates cellular plastic insulants laid directly on a metal deck may melt when there is a fire source within the building. Improved fire protection may be provided by the use of:

- sprinkler systems.
- fire rated suspended ceilings.
- fire barriers which form a break in the insulation layer, giving effective fire separation.

Consult a fire Safety Engineer where any doubt exists on the need for fire protection.

Thermal performance

Table 17 shows the amount of ROOFMATE RL-X required to meet a range of U-values.

Condensation

Condensation can cause rot, decay and the corrosion of metal components, leading to roofing failure. Whilst the risk of condensation is low for a metal deck roof featuring ROOFMATE RL-X insulation under normal environmental conditions, condensation risk analysis should still be performed, using the method given in BS EN 150 13788.

If the calculation predicts harmful levels the design should be reassessed. Consider:

- reducing the humidity level within the building.
- increasing the thickness of thermal insulation.

Specification

Use the following NBS clause to specify ROOFMATE RL-X insulation in a single-ply roof:

J42 Single layer polymeric roof covering

452 Warm deck insulation

- Insulation: extruded polystyrene board to BS EN 13164
- **Manufacturer and reference:**

Dow Chemical Co. Ltd,
Building Solutions,
2 Heathrow Boulevard,
284 Bath Road, West Drayton, Middlesex, UB7 0DQ.
Tel: 020 8917 5050 - Fax: 020 8917 5413

ROOFMATE RL-X
Thickness: 50/60/80/120 mm
Board size: 2500mm x 600mm
Edge profile: tongue and groove
Compressive strength: 300 kN/m^2
Design loading: 110 kN/m^2
Fire classification: EUROCLASS E

* A tapered insulation system based on STYROFOAM is available from the A. Proctor Group who offer a full design and installation service for cut-to-falls insulation.

References

Agrément certificates

- 87/1836 Pitched roofs - warm roof concept
- 88/2105 Cavity walls
- 92/2782 Floors
- 97/3431 Inverted roofs

Building Regulations

- Approved Documents to the Building Regulations
  - A Structure
  - B Fire safety
  - C Site preparation and resistance to moisture
  - E Resistance to the passage of sound
  - L1A Conservation of fuel and power in new dwellings
  - L1B Conservation of fuel and power in existing dwellings
  - L2A Conservation of fuel and power in new buildings other than dwellings
  - L2B Conservation of fuel and power in existing buildings other than dwellings
- Technical Handbooks to Building Standards Scotland Regulations

BRE publications

- Thermal insulation: avoiding risks BR 262:2002.
- Conventions for U-value calculations
  - B. Anderson BR443: 2006
- Building Elements: 'Floors and Flooring' – PW Pye and HW Harris BR 332: 1997
- Foundations, basements and external walls BR 440: 2002.
- BRE Digest 311. Wind scour of gravel ballast on roofs.
- BRE IP 17/01. Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings.

British Standards

- BS 743: 1970: Specification for materials for damp proof courses.
- BS 476: Fire tests on building materials and structures.
  Part 2: 1987. Methods for determination of the fire resistance of loadbearing elements of construction.
  Part 3: 1958: External fire exposure roof test
- BS 743:1970: Specification for Materials for Damp proof courses.
- BS 1202: Specification for nails.
  Part 1: 2002: Steel nails.
- BS 5250: 2002: Code of practice for control of condensation in buildings.
- BS 5427: Code of practice for the use of profiled sheet for roof and wall cladding on buildings.
  Part 1: 1996: Design.
- BS 5950: Structural use of steelwork in building.
  Part 4: 1994 Code of practice for design of composite slabs with profiled steel sheeting.
- BS 5268: Structural use of timber.
  Part 4: Fire resistance of timber structures.
  – Section 4.2: 1990: Recommendations for calculating fire resistance of timber stud walls and joisted floor constructions.
  Part 7: Recommendations for the calculation basis for span tables.
  – Section 7.1: 1989: Domestic floor joists.
- BS 5502: Buildings and structures for agriculture.
  Part 23: 1990: Code of practice for fire precautions.
  Part 42: 1990: Code of practice for design and construction of pig buildings.
  Part 71: 1992: Code of practice for design and construction of ventilated stores for potatoes and onions.
- BS 5534: 2003: Code of practice for slating and tiling.
- BS 5628: Code of practice for use of masonry.
  Part 3: 1985: Materials and components, design and workmanship.
- BS 6203: 1991 (1996) Guide to fire characteristics and fire performance of expanded polystyrene materials used in building applications.
- BS 6229: 2003: Code of practice for flat roofs with continuously supported coverings.
- BS 6398: 1983: Specification for bitumen damp proof courses for masonry.
- BS 6399: Loading for Buildings
  Part 1: 1996: Code of practice for dead and imposed loads.
  Part 2: 1997: Code of practice for wind loads.
  Part 3: 1988: Code of practice for imposed roof loads.

- BS 6515: 1984 (1996) Specification for polyethylene damp-proof courses for masonry.
- BS 8000: Workmanship on building sites.
  Part 4: 1989: Code of practice for waterproofing.
- BS 8102: 1990: Code of practice for protection of structures against water from the ground.
- BS 8103 Structural Design of low-rise buildings.
  Part 1: 1995: Code of practice for stability, site investigation, foundations and ground floor slabs for housing.
- BS 8110: Structural use of concrete.
  Part 1: 1997: Code of practice for design and construction.
- BS 8203: 2001 Code of practice for resilient floor coverings.
- BS 8204: Screeds, bases and in-situ floorings.
  Part 1: 1999 Code of practice for concrete bases and cement sand levelling screeds to receive floorings.
  Part 2: 1999: Code of practice for concrete wearing surfaces.
- BS 8215: 1991: Code of practice for design and installation of damp proof courses in masonry construction.
- BS 8218: 1998: Code of practice for mastic asphalt roofing.
- CP 1018: 1971 (1993) Electric floorwarming systems for use with off-peak and similar supplies of electricity.

European standards

- BS EN 1264: Floor heating. Systems and components.
  Part 4: 2001 Installation
- BS EN 12056: Gravity drainage systems inside buildings.
  Part 3: 2000: Roof drainage, layout and calculation.
- BS EN 13164: 2001 Thermal insulation products for buildings - Factory made products of extruded polystyrene (XPS) specification.
- BS EN 13501: Fire classification of construction products and building elements.
  Part 1: Classification using test data from reaction to fire tests
- BS EN 13370: 1998 Thermal performance of buildings – Heat transfer via the ground – Calculation methods
- BS EN 13789: 1999: Thermal performance of buildings - Transmission heat loss coefficient - Calculation method.

International standards

- BS EN ISO 6946: 1997 Building components and building elements – Thermal resistance and thermal transmittance – Caculation method.

Other publications

- CIBSE Guide A (1999)
- DEFRA/DTLR Robust Details – Limiting thermal bridging and air leakage: Robust Construction details for dwellings and similar buildings. 2002
- NBS Domestic Heating Compliance Guide: 2006

Recommendations

The STYROFOAM range of blue extruded foamed polystyrene insulation products includes FLOORMATE, ROOFMATE, WALLMATE and PERIMATE.

STYROFOAM products contain a flame retardant additive to inhibit accidental ignition from a small fire source. STYROFOAM is, however, combustible and if exposed to an intensive fire may burn rapidly.

During shipment, storage, installation and use STYROFOAM products should not be exposed to flames or other ignition sources.

Fire classification is based on small-scale tests, which may not reflect the reaction of the products in its end use state under actual fire conditions.

STYROFOAM products should, when installed, be adequately protected from direct exposure to fire.

Recommendations about the methods, use of materials and construction details are given as a service to designers and contractors. These are based on the experience of Dow with the use of STYROFOAM products. Any drawings are meant only to illustrate various possible applications and should not be taken as a basis for design. Since Dow is a materials supplier and exercises no control over the installation of STYROFOAM products, no responsibility is accepted for such drawings and recommendations.

In particular, no responsibility is accepted by Dow for the systems in which STYROFOAM is used or the method of application by which it is installed. The legal obligations of Dow in respect of any sale of STYROFOAM products shall be determined solely by the terms of the respective sales contract.

Notes

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