Multipor roof insulation systems
6.0 Multipor roof insulation systems

6.1 General introduction and planning

- Maximum stability and compressive strength (300 kPa/350 kPa)
- Deformation-free
- Non-combustible, A1-rated material in compliance with DIN EN 13501-1
- Technically approved as per Z-23.11-1501/ETA-05/0093
- Vapor-permeable
- Purely mineral-based, free from fibers
- Age-resistant, dimensionally and volumetrically stable
- Easy-to-use
- Ecologically certified by natureplus, IBU and eco-INSTITUT

Multipor mineral insulation board is suitable for insulating pitched and flat roofs in cold or warm roof constructions. Chapter 6.8 deals with Multipor roof insulation board for pitched roofs, including all planning and design details. Chapter 6.2 below describes the use of Multipor roof insulation board for flat roofs.

Function of roof constructions

Roofs are mainly designed to protect the building, its occupants and contents from the effects of the outside world. Flat roof insulation in particular is exposed to enormous temperature variations – approx. 80° C to approx. -20° C – and must therefore satisfy special requirements. Mechanical stress, moisture, wind suction load and increasingly, fire protection, all play an important role. If the insulating material ignites in the roof area during insulation and sealing work, for example, smoldering fires can have far-reaching consequences. The roof construction is thus a complex element of the building project which requires proper, professional planning.

Roof utilization

A distinction is made between the following types of flat roof:

- Unutilized roof areas (extensive green and/or gravelled roofs exposed to weather), accessed only occasionally, e.g. for maintenance purposes
- Utilized roof areas (intensive green roofs as well as balconies, terraces and rooftop parking).

Multipor roof insulation boards are ideally suited to both types of roof.

Flat roof shapes

The term ‘flat roof’ does not define – as frequently assumed – the shape of a roof construction, but rather the arrangement of the roof layers: Flat roofs are generally constructed with a flat, homogenous, membrane-like waterproofing system which is continuously supported by a seamless supporting structure (e.g. insulation). In the roofing industry it is widely recognized that flat roofs can have any shape or pitch.

Roof pitch

- The pitch of the roof should be taken into account during the planning phase, since standing water significantly impairs the life expectancy of the waterproofing system. DIN 18531-1 thus classifies flat roof constructions in two categories, depending on their intended use:
Multipor roof insulation systems 6.0
General introduction and planning 6.1

Category K2 (high-quality roof constructions): This defines structures with a longer service life and lower maintenance requirements. In this category, the minimum standard fall in the waterproofing layer is at least 2% and in the valleys, at least 1%. Only high-quality waterproofing products defined as such in DIN 18531-1 may be used. Substrate unevenness and design tolerances must also be taken into account at the design stage.

Category K1 (standard roof constructions): This category represents the minimum requirements for a roof construction. K1 roof waterproof roofing membranes may be used here. However, if the pitch falls below the level specified for category K2, higher quality K2 waterproof membranes must be used, even if the end result is still a K1 roof. Multipor cut-to-fall boards enable the construction of perfectly functioning pitched roofs with virtually any fall to suit the architect’s whim.

The U-value of the pitched insulation is calculated in accordance with DIN EN ISO 6946. The old method of calculating the U-value for an average thickness of insulation is no longer valid.

<table>
<thead>
<tr>
<th>Designation Unit Description</th>
<th>Design value of thermal conductivity (( \lambda )) W/(mK)</th>
<th>Compressive strength kPa</th>
<th>Tensile strength kPa</th>
<th>Deformation ≤ 1 mm for 1000 N point load</th>
<th>E modulus N/mm²</th>
<th>Bulk density kg/m³</th>
<th>Water vapor diffusion resistance factor (( m_{v} ))</th>
<th>Specific heat capacity (c) J/(kgK)</th>
<th>Thermal expansion coefficient (( \alpha_{t} )) 1/K</th>
<th>Water absorption (short-term) as per DIN EN 1609 kg/m³</th>
<th>What absorption (long-term) as per DIN EN 12087 kg/m³</th>
<th>Board size (L x W) mm</th>
<th>Fire protection/material class as per DIN EN 13501-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAA*</td>
<td>0.045</td>
<td>300</td>
<td>≥ 80</td>
<td>200</td>
<td>approx. 115</td>
<td>3</td>
<td>850</td>
<td>1*10⁻³</td>
<td>≤ 2</td>
<td>≤ 3</td>
<td>600 x 390</td>
<td>A1, non-combustible</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Characteristic values for Multipor roof insulation board

<table>
<thead>
<tr>
<th>Product</th>
<th>Application</th>
<th>Compressive stress</th>
<th>Material class (fire rating)</th>
<th>Areas of use</th>
<th>Deformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipor 300 kPa ( \lambda = 0.045 ) W/(mK)</td>
<td>DAA* dh (high load)</td>
<td>A1</td>
<td>Utilized roofs, terraces</td>
<td>Deformation-free</td>
<td></td>
</tr>
<tr>
<td>Multipor 350 kPa ( \lambda = 0.047 ) W/(mK)</td>
<td>DAA* ds (very high load)</td>
<td>A1</td>
<td>Rooftop parking, industrial floors etc.</td>
<td>Deformation-free</td>
<td></td>
</tr>
</tbody>
</table>

* DAA = roof insulation below waterproof membrane, covering as per DIN 4108-10
** DAD = roof insulation below roof, covering as per DIN 4108-10
6.0 Multipor roof insulation systems

6.1 General introduction and planning

As a service, we can calculate the thickness of insulation required and draw up the complex roof plans.

**Uplift protection**

Measures must be taken to prevent flat roofs of all types lifting due to wind suction. DIN EN 1991-1-4 has governed the requirements for determining the wind suction forces acting on buildings since July 2012; this method includes the location of the building (wind zone), the terrain category, the building height and the internal pressure ratios in the calculation. The resulting wind suction forces are then taken into account in the design of the roof construction package.

There are various ways of providing wind uplift protection for flat roof constructions:
- Adequately dimensioned applied load (ballast) for loose-laid roof systems (e.g. gravel, vegetation, paving)
- Frictional bonding of all roof layers
- Mechanical fastening of waterproofing to the supporting structure.

Regardless of the method of fixing however, the waterproof membrane should always be fastened at the edges as stipulated in the relevant standards governing flat roofs. This ensures that any horizontal forces (e.g. from wind suction, shrinkage of the waterproof membrane, vibrations from the supporting structure etc.) are absorbed and so prevents damage in the connection areas.

As part of our scope of supply, we offer wind load calculations for both ballasted and bonded roof constructions. For mechanically fastened systems, however, please contact the manufacturer of the waterproof membrane because additional factors apply here, e.g. sheeting width and/or product-specific types of fastener (seam, block or line fasteners). More information about our services can be found on the download section of our website at www.multipor.com.

**Cost-effectiveness**

Roofs generally have a life expectancy of several decades. However, hastily chosen construction products and processing errors can cause structural damage, leading to substantial losses. High quality roof constructions with a high-quality combination of insulation and waterproofing – such as Multipor mineral insulation board with proven waterproofing systems – thus constitute a worthwhile investment and ensure durability and reliability. Multipor roof insulation boards are one of the most economical insulating materials on the market for flat roofs due to their optimal properties in terms of
- fire protection
- compressive strength
- non-compressibility
- ecology
- thermal insulation.
Fire protection
Buildings and roofs with high fire protection requirements must have non-combustible insulation. As a high-performance insulating material with an A1 fire rating, Multipor roof insulation board is a completely safe option in this respect. Unlike conventional insulating materials, roofs insulated with Multipor satisfy strict requirements for non-combustibility, compressive strength and non-compressibility. All in one material.

Compressive strength/non-compressibility
Multipor roof insulation boards can confidently be used for numerous different roof structures – from unloaded, unutilized roofs to heavily loaded roofs with rooftop parking or roof terraces. Material approvals and technical proofs of suitability have been issued on the basis of these outstanding properties. Corresponding certificates are available on the download section of our website at www.multipor.com.

Ecology/sustainability
Multipor roof insulation boards are an environmentally friendly alternative to conventional plastic, mineral fiber or foam glass insulation. Made from natural raw materials, during processing and subsequent use they remain completely safe and ecofriendly.

The IBU declaration certifies that Multipor insulation is manufactured in a resource and environmentally friendly way and that its constituents are of mineral origin. Roof insulation made from long-lasting Multipor roof insulation board is ideal for environmentally aware and health-conscious customers and builders. Offcuts can be sorted and collected in Multipor Big Bags on site and returned to our plants for recycling, or alternatively they can be safely disposed of in landfill.
Reference building

GHOTEL HOTEL & LIVING, WÜRZBURG

- Complex, challenging pitched roof construction
- Individual calculation of gradients
- Lens-shaped roof geometry demanded adaptable insulating material
- Quick, straightforward adaptation of insulating material
- Particularly stringent wind load and fire protection requirements

**Project data**

<table>
<thead>
<tr>
<th>Building type</th>
<th>Hotel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Würzburg</td>
</tr>
<tr>
<td>Application</td>
<td>Roof insulation</td>
</tr>
<tr>
<td>Products used</td>
<td>Multipor roof insulation board as customized pitched roof with 2% pitch</td>
</tr>
<tr>
<td></td>
<td>Multipor lightweight mortar</td>
</tr>
</tbody>
</table>
Reference building

Kö-Bogen, Düsseldorf

- Complex adaptation to amorphous office building geometry
- Customized pitched roof construction
- Green roof construction on reinforced concrete slab
- Stringent compressive strength and fire protection requirements
- LEED-certified building

<table>
<thead>
<tr>
<th>Project data</th>
<th>Shopping center and offices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building type</td>
<td>Düsseldorf</td>
</tr>
<tr>
<td>Location</td>
<td>Roof insulation</td>
</tr>
<tr>
<td>Application</td>
<td>Multipor roof insulation board as customized pitched roof with 2% pitch</td>
</tr>
<tr>
<td>Products used</td>
<td>Multipor lightweight mortar</td>
</tr>
</tbody>
</table>

Photo: Kö Bogen

Photo: Kö Bogen/Friedhelm Krischer
6.2 Detail drawings for flat roof insulation

Detail drawings for flat roof insulation

Parapet, green roof

Parapet connection, gravel ballast

Railing detail

Drainage with roof gutter

Download these and other detail drawings at www.multipor.com/detaildrawings.php
Detail drawings for flat roof insulation

Wall connection, ballasted roof

Wall connection, terrace

Wall connection/balcony above habitable area

Drainage system with roof flat drain

001 Ytong masonry
005 Ytong exterior render
006 Thermal insulation
007 Reinforced concrete ceiling
009 Waterproof membrane
010 Gravel fill
011 Flashing/cover plate
061 Balcony flooring
064 Drainage channel with grating
084 Ytong curb block
085 Ytong ceiling element
087 Drainage
111 Separation or protective layer
113 Seepage layer
148 Multipor mineral insulation board
190 Vapor barrier
195 Connection profile
197 Roof bolt
253 Multipor flat roof insulation
255 Gravel trap
256 Roll ring
326 Multipor screw-in anchor

Download these and other detail drawings at www.multipor.com/detaildrawings.php
6.3 Loose-laid ballasted flat roof construction

With this type of roof construction, all layers are loose-laid, with the final ballast layer providing uplift protection.

Supporting structure:
- Reinforced concrete
- Autoclaved aerated concrete (AAC)
- Tongue and groove boarding
- Wood composite panels
- Profiled steel sheeting
- In general, any flat, load-bearing substrate without open joints/gaps.

Vapor barrier:
- PE vapor retardants/barriers to suit the waterproofing system
- Aluminum composite films to DIN 18234 (Industrial Construction Directive)
- Bitumen vapor barriers
- Liquid vapor barriers.

Multipor roof insulation board, loose-laid:
- Minimum thickness 120 mm
- Single-layer up to 240 mm
- Multi-layer, also as cut-to-fall insulation
- Secure insulation to uneven substrates with foam roofing adhesive
- If profiled steel sheeting forms the supporting structure, lay the insulation on a baseboard (e.g. OSB board). The baseboard can be dispensed with if the sheeting has smaller profiles.

Our Multipor technical advisors will happily advise you on this matter.

Waterproof membrane:
- Bitumen and polymer-modified bitumen sheeting
- Plastic and elastomer sheeting
- The separation and protective layers between the insulation board and the waterproof membrane must be arranged in accordance with the sheeting manufacturer’s instructions.

Ballast:
- Gravel
- Vegetation
- Pea gravel for terraces
- The separation, drainage, absorbent and protective layers must be arranged in accordance with the sheeting manufacturer’s instructions and the building regulations governing flat roofs.
- The ballast must be dimensioned as per DIN EN 1991-1-4 and installed in accordance with the wind load calculation.
- For vegetation on green roofs, the imposed load calculation is based on the dry weight of the substrate.
Multipor roof insulation systems

Loose-laid ballasted flat roof construction

1. Reinforced concrete ceiling
2. Vapor barrier, bitumen
3. Multipor roof insulation board
4. Bitumen sheeting, multi-layer
5. Gravel ballast on protective layer

1. Profiled steel sheeting
2. PE vapor barrier
3. Insulation baseboard
4. Multipor roof insulation board
5. Plastic sheeting
6. Gravel ballast on protective layer

1. AAC roof element
2. PE vapor barrier
3. Multipor roof insulation board
4. Plastic sheeting
5. Paving on protective layer

1. AAC roof element
2. Vapor barrier, bitumen
3. Multipor roof insulation board
4. Bitumen sheeting, multi-layer
5. Gravel ballast on protective layer

1. Reinforced concrete ceiling
2. Vapor barrier, bitumen
3. Multipor roof insulation board
4. Bitumen sheeting, multi-layer
5. Paving on protective layer
6.4 Mechanically fastened flat roof construction

With this type of roof construction, the waterproofing layer is secured to the load-bearing supporting structure with suitable fasteners.

Supporting structure:
■ Reinforced concrete
■ Autoclaved aerated concrete (AAC)
■ Tongue and groove boarding
■ Wood composite panels
■ Profiled steel sheeting
■ In general, any flat, load-bearing substrate without open joints/gaps.

Vapor barrier:
■ PE vapor retardants/barriers to suit the waterproofing system
■ Aluminum composite films to DIN 18234 (Industrial Construction Directive)
■ Bitumen vapor barriers
■ Liquid vapor barriers.

Multipor roof insulation board, loose-laid:
■ Minimum thickness 120 mm
■ Single-layer up to 240 mm
■ Multi-layer, also as cut-to-fall insulation
■ Secure insulation to uneven substrates with foam insulation adhesive
■ If the supporting structure is profiled steel sheeting, lay the insulation on a baseboard (e.g. cement-bonded particle board or OSB board). The baseboard can be dispensed with if the sheeting has a low profile.

Our Multipor technical advisors will happily advise you on this matter.

■ Insulation boards which are not secured by the waterproof membrane fasteners must be secured with adhesive or additional fasteners in accordance with building regulations governing flat roofs (in Germany the Flat Roof Directive – *Flachdachrichtlinie*).

Waterproof membrane:
■ Bitumen and polymer-modified bitumen sheeting
■ Plastic and elastomer sheeting.

The separation and fire protection layers must be arranged in accordance with the sheeting manufacturer’s instructions. With regard to wind load calculations for mechanically fastened systems, please contact the manufacturer of the waterproof membrane because additional factors have to be taken into account, e.g. sheeting widths and/or product-specific types of fastener (seam, block or line fasteners).
Multipor roof insulation systems

Mechanically fastened flat roof construction

1. Profiled steel sheeting
2. Vapor barrier, aluminum composite foil
3. Multipor roof insulation board
4. Plastic sheeting, mechanically fastened

1. Profiled steel sheeting
2. Vapor barrier, aluminum composite foil
3. Insulation baseboard
4. Multipor roof insulation board
5. Plastic sheeting, mechanically fastened

1. Timber supporting structure
2. Vapor barrier, aluminum composite foil
3. Multipor roof insulation board
4. Plastic sheeting, mechanically fastened

1. AAC roof element
2. PE vapor barrier
3. Multipor roof insulation board
4. Plastic sheeting, mechanically fastened

1. Supporting structure
2. Vapor barrier, bitumen
3. Multipor roof insulation board
4. Bitumen sheeting, multi-layer, mechanically fastened

1. Reinforced concrete ceiling
2. PE vapor barrier
3. Multipor roof insulation board
4. Plastic sheeting, mechanically fastened
6.5 Flat roof construction with rooftop parking

Flat roof constructions with rooftop parking – a parking deck – are especially challenging due to the static loading: The structural layers must be capable of withstanding extremely high vertical loads. The roof structure must also be able to safely discharge horizontal loads (braking and acceleration forces).

For this reason, reinforced concrete is the only suitable supporting structure.

Vapor barrier:
- Bitumen vapor barriers – suitable for the substrate and for bonded systems, including substrate preparation (e.g. bituminous primer)
- Liquid vapor barriers (suitable for bonded systems).

Multipor roof insulation board, bonded:
- Minimum thickness 120 mm
- Single-layer up to 240 mm
- Multi-layer, also as cut-to-fill insulation.

Bonding the first layer:
- Hot bitumen
- Liquid vapor barrier

Bonding subsequent layers (for multi-layer installation):
- Hot bitumen
- Multipor lightweight mortar.

Waterproof membrane:
- Bitumen and polymer-modified bitumen sheeting
- Plastic and elastomer sheeting.

Wear layer/road surface:
- Concrete load distribution plate as per structural calculation
- To prevent stress cracking, load distribution plates must be subdivided and separated by gaps.
- Interlocking paving on bed of grit or sand, as per structural calculation
- At least 10 cm thick interlocking concrete paving
- With regard to separation, antifrictional and protective layers, please refer to the sheeting manufacturer’s instructions.

Tables 2 and 3 give typical values for the structural design of the wear layer/road surface. The structural engineers involved in the construction project are responsible for producing the final structural design.

| Table 1: Parameters for dimensioning the load distribution plate WLG 047 |
|---------------------------------|---------------------|
| Compressive strength | 350 kPa |
| E modulus | 200 N/mm² |
| Bedding class C₀ (3 mm bitumen adhesive + 10 cm Multipor + 12 mm bitumen sheeting) | 270 MN/m³ |
| Load distribution plate | 2.5 x 2.5 m |
Table 2: Typical design values for load distribution plate

<table>
<thead>
<tr>
<th>Wheel pressure [KN]</th>
<th>Required thickness of load distribution plate [cm]</th>
<th>Reinforcement (refers to German Norms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>12</td>
<td>Q188 in field center</td>
</tr>
<tr>
<td>7.5</td>
<td>12</td>
<td>Q188 in field center</td>
</tr>
<tr>
<td>10.0</td>
<td>12</td>
<td>Q188 in field center</td>
</tr>
<tr>
<td>15.0</td>
<td>18</td>
<td>Q257 A top and bottom</td>
</tr>
<tr>
<td>20.0</td>
<td>24</td>
<td>Q335 A top and bottom</td>
</tr>
</tbody>
</table>

Concrete class for load distribution plate: C35/45 XC4 XD 3 XF4 XM1
Reinforcing steel class: BSt 500 (A)

Table 3: Typical design values for depth of paving bed (sand, grit etc.)

<table>
<thead>
<tr>
<th>Bridge class</th>
<th>Pour height without vibration coefficient [cm]</th>
<th>Pour height with vibration coefficient [cm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/30</td>
<td>40</td>
<td>48</td>
</tr>
<tr>
<td>30/30</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>16/16</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>12/12</td>
<td>25</td>
<td>31</td>
</tr>
<tr>
<td>9/9</td>
<td>22</td>
<td>26</td>
</tr>
<tr>
<td>6/6</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>3/3</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

Detail drawing of interlocking paving on bed of grit

* primer coat
6.6 Installing Multipor flat roof insulation

High quality Multipor flat roof insulation satisfies all modern construction requirements. Product quality is ensured by continuous internal and external quality control, as well as careful handling during processing and follow-up work.

**Product characteristics:**
- High level of fire protection with A1 fire rating to DIN EN 13501-1
- Pressure resistant to 300 kPa or 350 kPa
- Monolithic, mineral-based, free from fibers and binders
- Deformation-free
- Resistant to aging, dimensionally and volumetrically stable
- Positive acoustic properties
- Resistant to insects and rodents
- Technically approved as per Z-23.11-1501 and ETA-05/0093
- Ecologically certified by natureplus, IBU and eco-INSTITUT.

**Benefits:**
- Easy installation
- Low board weight, easy handling
- Suitable for all conventional installation methods
- Fiber-free, so no skin irritation
- Easy to cut with a handsaw
- Easy to sand down any differences in height
- Highly adaptable to building geometry.

**Flat roof insulation**
Multipor roof insulation is available as flat or cut-to-fall boards. Both have identical product characteristics in terms of thermal and fire protection, compressive strength and environmental compatibility as per general technical approval Z-23.11-1501 and European ETA-05/0093.

**Flat boards**
Flat Multipor roof insulation boards are used when the load-bearing roof structure already has a fall.

Roofs can generally be constructed with one thickness or multiple thicknesses of insulation.

We supply flat insulation board thicknesses of 120 to 240 mm (in 20-mm increments) for single-layer installation. Boards up to 300 mm thick are also available on request. Please speak to our Multipor technical advisers for insulation thicknesses < 120 mm. For multi-layer installation, each layer must be at least 120 mm thick.

**Cut-to-fall boards**
We also supply Multipor roof insulation board cut-to-fall in the factory, which avoids the costly and time-consuming construction of sloping screeds or pitched supporting structures [1].
To achieve the required thermal insulation, cut-to-fall boards generally consist of at least one flat board as a base (at least 120 mm), followed by a layer of pitched boards. Table 1 shows the overall composition for different thicknesses of insulation:

<table>
<thead>
<tr>
<th>Insulation thickness [mm]</th>
<th>Product</th>
<th>Cut-to-fall roof system</th>
</tr>
</thead>
<tbody>
<tr>
<td>70–250</td>
<td>Not required</td>
<td>70–250</td>
</tr>
<tr>
<td>250–430</td>
<td>180</td>
<td>70–250</td>
</tr>
<tr>
<td>430–610</td>
<td>2 x 180</td>
<td>70–250</td>
</tr>
</tbody>
</table>

Cut-to-fall boards are manufactured in various standard falls: 1.0%, 1.7%, 2.0%, 2.5%, 3.0% and 5.0%. Other falls can also be manufactured to suit the building. The building codes governing flat roofs allow for a minimum fall of 2.0%. If the roof is designed with a smaller fall, additional measures must be put in place in accordance with current regulations for flat roofs.

**Multipor wedged profile**

When fitting multiple layers of bitumen sheeting, wedge-shaped profiles must be inserted alongside rising building elements to give a kink-free finish.

Lay Multipor wedged profiles alongside the rising structure (wall, parapet etc.) and bond to the previously laid flat or cut-to-fall boards with Multipor lightweight mortar, PU insulation adhesive or hot bitumen.

**Priming**

With bonded roof constructions, a bitumen primer is required in accordance with DIN 18195 and DIN 18531 to achieve a non-positive

Wedged profiles are neither necessary nor desirable with plastic or elastomer sheeting. System accessories (interior and exterior corners, connecting collars, parapet gullies etc.) are available in local product ranges.
connection between the bituminous membrane and the substrate. A bitumen primer is not needed for loose-laid ballasted or mechanically fastened roof constructions.

**Applying the vapor barrier**

All vapor barriers/inhibitors must be installed in accordance with building regulations governing flat roofs (in Germany, the Flat Roof Guidelines published by the ZVDH – the German Roofing Contractors’ Association) and the manufacturers’ instructions and product data sheets. For a bonded roof construction, grade V60 S4 + AL or G200 S4 + AL bitumen sheeting with aluminum insert serves as the vapor barrier, which is fully fused (welded) to give a non-positive connection [3]. Alternatively, type PYE V60 S4 + AL or PYE G200 S4 + AL polymer-modified vapor barriers and vapor barriers laid in hot-poured bitumen (e.g. 100/25) can be used [4]. Vapor barriers for loose-laid ballasted or mechanically fastened constructions do not need to be fully fused – they can simply be loosely laid or fastened intermittently.

Cheaper vapor barriers made from polyethylene [5] and aluminum composite films, which can similarly be loosely laid, are also suitable for this type of application. With these two alternatives, however, it is essential to seal seams correctly and ensure a vapor-tight connection to rising structural elements.

Any height differences can be evened out using engineered granules or quartz sand.

Liquid-applied vapor barriers based on polyurethane resin serve three functions: Primer, vapor barrier and adhesive for Multipor roof insulation board. Mix the two-component material in accordance with the manufacturer’s instructions and then spread over the entire surface of the substrate at a rate of at least 2 kg/m² (depending on the substrate) using a rubber squeegee [6].

**Installing insulation boards**

Lay Multipor roof insulation boards with tightly butted staggered joints. Do not fill longitudinal and transverse joints. Rub down any unevenness in the board joints with the Multipor sanding board [7], taking care to brush off the sanding dust.

- Installing in a bonded roof construction: There are various ways of achieving a non-positive connection (friction fit) between the Multipor roof insulation boards and the substrate, as shown in Table 2.
- Installing on loose-laid ballasted roofs and mechanically fastened roofs: Loose-lay the Multipor roof insulation boards on loose-laid ballasted roofs. For mechanically fastened roof constructions, loose insulation boards which are not secured by the fasteners for the waterproof membrane must be secured with adhesive or additional fasteners. We recommend using a PU cartridge adhesive to even out any unevenness in the substrate.
### Table 2: Different methods of installing Multipor roof insulation boards

<table>
<thead>
<tr>
<th>Installation method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot bitumen</td>
<td>Lay the Multipor roof insulation boards in a full bed of hot-poured bitumen (e.g. grade 100/25) to ensure full-surface adhesion to the vapor barrier. Apply the hot-poured bitumen at a rate of approximately 3 kg/m².</td>
</tr>
<tr>
<td>Vapor barrier with thermally active upper surface</td>
<td>Use a torch to heat the thermally active adhesive strips on the upper surface of the vapor barrier. Then lay the Multipor roof insulation boards immediately in these liquefied bituminous strips.</td>
</tr>
<tr>
<td>Liquid vapor barrier</td>
<td>Apply the liquid vapor barrier, then lay the Multipor roof insulation boards as described for hot-poured bitumen above. Pay careful attention to the pot life of the liquid vapor barrier and follow the manufacturer’s instructions.</td>
</tr>
<tr>
<td>PU foam insulation adhesive</td>
<td>Apply the PU foam insulation adhesive to the vapor barrier in accordance with the manufacturer’s instructions, taking into account the wind suction load. Refer to the manufacturer’s instructions for coverage. Then lay the Multipor roof insulation boards on top. We recommend a PU cartridge adhesive.</td>
</tr>
</tbody>
</table>
Several options are also available for installing the insulation boards in two layers or in conjunction with cut-to-fall boards (see Table 3). Always ensure that joints in subsequent layers are staggered.

If the geometry of the profiled steel sheeting calls for the use of a baseboard, this must be laid directly on top of the sheeting and suitably fastened in accordance with the wind load calculation. The vapor barrier is then fused to the insulation baseboard.

**Table 3: Bonding the second layer of insulation**

<table>
<thead>
<tr>
<th>Installation method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipor lightweight mortar</td>
<td>Apply a full bed of Multipor lightweight mortar to the upper surface of the first layer of boards using a 12-millimetre notched trowel [13]. Gently float the boards for the second layer into the bed of adhesive and butt up the unmortared longitudinal and transverse joints tightly (without adhesive). [14]. Apply further layers of insulation in the same way as the second layer. When applied with a 12-mm notched trowel, the lightweight mortar will cover approximately 3.5 kg/m².</td>
</tr>
<tr>
<td>PU foam insulation adhesive</td>
<td>Apply the PU foam insulation adhesive in accordance with the manufacturer’s instructions, taking into account the wind suction load. Then lay the second layer of mineral insulation boards in the fresh adhesive. Butt the unmortared longitudinal and transverse joints up tightly (without adhesive). Apply further layers of insulation in the same way as the second layer and refer to the manufacturer’s instructions for information about coverage [15].</td>
</tr>
<tr>
<td>Hot bitumen</td>
<td>Lay the Multipor roof insulation boards in a full bed of hot-poured bitumen (e.g. grade 100/25) to ensure full-surface adhesion to the first layer [16]. Butt the unmortared longitudinal and transverse joints up tightly (without adhesive). Apply further layers of insulation in the same way as the second layer. Apply the hot-poured bitumen at a rate of approximately 2.5 kg/m² [17].</td>
</tr>
</tbody>
</table>
Waterproof membrane
Waterproof membranes must always be laid in accordance with the manufacturer’s instructions and the building regulations governing flat roofs. Various design options are shown in the following tables. Note that all the layers of a bonded roof construction must be bonded together by means of a non-positive connection. The waterproof membranes of loose-laid ballasted and mechanically fastened roof constructions are normally loose-laid.

<table>
<thead>
<tr>
<th>Waterproof membrane</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>First layer comprising cold self-adhesive bitumen membrane, thermally activated on the underside</td>
<td>Gradually roll out the waterproof sheeting, removing the protective film on the underside. Thermally activate the exposed adhesive bitumen with a torch, then bond the membrane fully to the Multipor roof insulation boards (18).</td>
</tr>
<tr>
<td>First layer comprising roofing membrane, bonded in hot bitumen</td>
<td>Apply the roofing membrane (PYE-PV 200 DD) using the pour-and-roll method by spreading a full bed of hot bitumen (e.g. 100/25 grade) over the Multipor roof insulation boards at a rate of approximately 3 kg/m², making sure there are no voids (19).</td>
</tr>
<tr>
<td>Second layer comprising polymer-modified bitumen membrane as per DIN EN 13707</td>
<td>The second layer consists of a polymer-modified bitumen membrane as per DIN EN 13707 which is compatible with the first layer. Lay this second layer parallel to the first layer with staggered joints, making sure it fuses fully with the first layer (20).</td>
</tr>
</tbody>
</table>

Table 4: Bituminous waterproof membranes

- **First layer: Thermally activated cold self-adhesive bitumen membrane**
- **Applying hot bitumen**
- **Second waterproof membrane**
- **Loose-laid and ballasted plastic membrane**
- **Bonded plastic membrane**
- **Mechanically fastened plastic membrane**
Further roof construction / Further loads
Bonded and mechanically fastened roof constructions need no further ballast and are exposed to the weather. Loose-laid roof constructions, on the other hand, require a layer of ballast suitably designed for the wind suction load. Depending on the planned usage, this may take the following form:

- 16-32 mm gravel for unutilized roof surfaces [24]
- Paving laid in 8-16 mm pea gravel for terraces and balconies
- Vegetation for green roofs, including all functional layers [25]
- Concrete block paving on grit substrate, or reinforced concrete slabs for walkable and drivable surfaces [26]

Arrange any separation and protective layers in accordance with the relevant manufacturer’s specifications. Green roofs can be additionally equipped with absorbent and drainage layers.

<table>
<thead>
<tr>
<th>Installation method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose-laid and ballastedt</td>
<td>Loose-lay the plastic membranes – on a separation layer specified by the manufacturer if necessary. In most cases, longitudinal and transverse seams are sealed with a hot-air welder or welding solvent. Complete the construction in accordance with the manufacturer’s instructions and design the ballast to suit the wind load requirements [21].</td>
</tr>
<tr>
<td>Bonded installation</td>
<td>Use plastic membranes approved for this purpose only. Bond with a system-compatible adhesive supplied by the sheeting manufacturer or apply self-adhesive sheeting to a suitably primed Multipor surface. In most cases, longitudinal and transverse seams are sealed with a hot-air welder or welding solvent. Bonded roof constructions are exposed to the weather [22].</td>
</tr>
<tr>
<td>Mechanical fastening</td>
<td>Loose-lay the plastic membranes – if necessary on a separation or fire-retardant layer specified by the manufacture. Mechanically fasten in a linear or block arrangement at the edges where the sheets overlap. Screws with washers compatible with the load-bearing supporting structure make suitable fasteners. For number of fasteners, refer to membrane manufacturer’s specifications. In most cases, longitudinal and transverse seams are sealed with a hot-air welder or welding solvent. Mechanically fastened roof systems are exposed to the weather [23].</td>
</tr>
</tbody>
</table>
Installing Multipor pitched roof insulation

A solidly constructed pitched roof combined with Multipor pitched roof insulation provides optimum thermal protection in summer and winter. The Ytong combi-roof kit consists of built-to-order Ytong AAC roof elements and Multipor pitched roof insulation [Table 1]. Additional system components include Multipor lightweight mortar and roof bolts for fastening the remaining structure to the roof elements. All timber components (tiling battens and counterbattening) including any fasteners required, as well as the sarking membrane and roof covering, are supplied by the building contractor to complete the combi-roof. The basic version (160 mm Multipor roof insulation) already satisfies the requirements for the EnEV reference building.

A further version of the combi-roof (260 mm Multipor roof insulation) with a U-value of 0.15 W/(m²K) is also available for highly energy-efficient KfW Efficiency House or passive house standards. If you want to use other combinations of roof elements with Multipor roof insulation board in your building project, our Multipor technical advisers will gladly prepare an individual quote.

Several stages are involved in the construction of a solid roof with Multipor roof insulation boards, and several working days must be set aside to allow for the necessary setting times. Ytong AAC roof elements can be fitted to a detached family home in one day to enclose the roof space. During the next few days the ring beam (peripheral tie) is reinforced in compliance with structural calculations and the concrete is poured in situ. Other tasks include fitting the additional timber framework for the roof, the Multipor roof insulation boards and finally the roof covering.

Installing Multipor pitched roof insulation

Multipor roof insulation boards for pitched roofs, Multipor lightweight mortar and the corresponding accessories are delivered to the site punctually on request. Packaged Multipor roof insulation boards and accessories can be temporarily stored on a level substrate.

Multipor pitched roof insulation is supplied shrink-wrapped in recyclable, weatherproof film to protect it from the elements, which should not be removed until just before use. Multipor roof insulation boards are handily packed in small, individually shrink-wrapped packs on euro pallets for easy transportation to the installation site.

Table 1: Characteristic values for Ytong roof elements with Multipor pitched roof insulation

<table>
<thead>
<tr>
<th>Compressive strength/bulk density class</th>
<th>Governed by:</th>
<th>U-value: [W/(m²K)]</th>
<th>Dimensions L x W x H [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAC RF1 4.5-550</td>
<td>EN 12602 1)</td>
<td>Product 0.20</td>
<td>(2250–6000) x 625 x 200 + 160</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.15</td>
<td>(2250–6000) x 625 x 200 + 260</td>
</tr>
</tbody>
</table>

1) Load-bearing part
6.0 Multipor roof insulation systems

6.8 Installing Multipor pitched roof insulation

**Substrate pretreatment**
Make sure the substrate is level, clean and dry before applying the Multipor pitched roof insulation [1]. Remove any concrete casting residues and unevenness in the joint areas. This ensures optimal mortar coverage rates during subsequent bonding of the Multipor roof insulation boards.

**Mixing Multipor lightweight mortar**
Mix the Multipor lightweight mortar with the quantity of water indicated on the mortar bag [2]. Directions for use and safety precautions are clearly indicated on the bag. Do not process the lightweight mortar if the temperature of the component or the ambient temperature is below 5° C. The graduated Multipor bucket [3] makes it easy to mix Multipor lightweight mortar (20 kg/bag) [4].

To obtain a workable consistency, mix the mortar thoroughly using a low-speed mixer with a long, sturdy paddle. Leave to cure for approx. 5 minutes – depending on the weather conditions – then stir the lightweight mortar again before use. Clean paddle mixers thoroughly after use for optimal mixing results.

8 l of water is required per 20-kg bag. The processing time is approx. 1.5 hours, depending on the weather. Multipor lightweight water has a high coverage rate: One bag yields 30 l of fresh water – enough to bond approx. 6 m² of Multipor roof mineral insulation board. Mix the mortar with a handheld mixer or mixing machine (e.g. G4 plastering machine with agitator, operation: screw auger half-speed, hose length max. 20 m, hose diameter 35 mm). The performance of the adhesive bond cannot be guaranteed if a different adhesive mortar is used.

**Bonding Multipor pitched roof insulation**
For a lasting hold, apply a full bed of Multipor lightweight mortar to the Multipor roof insulation board with a 12-mm notched trowel and comb through [5]. A rate of approx. 3.5 kg/m² will provide sufficient...
mortar to even out slight irregularities on the roof.

Do not fill the head joints. After applying the adhesive mortar, lay the Multipor roof insulation board with the head joints tightly butted up to leave no gap. To avoid open joints (thermal bridging), do not allow any adhesive mortar to get into the head joints.

Lay the boards in a bonded pattern, inserting them perpendicular to the staggered joints. A stripwise installation has proved effective on pitched roofs (starting at the bottom).

Cutting and shaping Multipor roof insulation board
Multipor roof insulation boards can be trimmed to size accurately and effortlessly using a fine-toothed Multipor handsaw. It’s also easy to cut notches in the board [6].

Two-layer installation for thicker insulation
Multipor pitched roof insulation is supplied in thicknesses of 120 to 300 mm in increments of 20 mm and thus satisfies different energy efficiency standards, from EnEV Reference House and KfW Efficiency House to Passive House.

As a deformation-free insulating material, Multipor roof insulation boards can also be installed in two layers, thereby achieving an insulation thickness of up to 600 mm. Simply bond a second layer of Multipor pitched roof insulation to the first layer in an staggered pattern with Multipor lightweight mortar.

Fastening the subsequent timber structure to the Ytong roof elements
The first counter battening is made from grade S10 softwood in accordance with DIN 4074-1 and strength class C24 as per DIN 1052 as a minimum requirement. Fasten the timber batten (minimum dimension 40/60 mm, predrilled if necessary) through the Multipor roof insulation board straight into the Ytong roof element using a Ytong roof bolt or other approved fastener [7] [8] [9]. The number of roof bolt/anchors required depends on the static calculation.
Installing the sarking membrane with counter battens
When the primary counter battens have been installed, fit the sarking membrane ($s_d \leq 0.2$ m) connecting it to penetrations and joint areas in accordance with standard building practice. Then fit the secondary counter battens. This creates two ventilation gaps above and below the sarking membrane, which also improves thermal insulation in summer.

Fastening the tiling battens
Then fasten tiling battens appropriate for the roof covering to the counter battening using suitable fasteners. The roof covering completes the combi-roof. Further battens and fasteners may be required if solar thermal and/or photovoltaic modules are to be additionally installed [10].
Detail drawings for Ytong roof elements with Multipor pitched roof insulation

**Eaves**

![Detail drawing of Eaves](image)

**Eaves without overhang**

![Detail drawing of Eaves without overhang](image)

**Ridge**

![Detail drawing of Ridge](image)

List of components:
- 007 Reinforced concrete ceiling
- 023 Rafters
- 024 Gutter
- 025 Roof tile
- 026 Sarking membrane, vapor-permeable
- 028 Sarking board
- 030 Battens
- 037 Insect protection
- 081 Interior plaster
- 096 Mesh insert
- 100 Ring beam
- 119 Render edging strip
- 139 Battens
- 150 Ytong roof element
- 200 Ytong/Silka masonry
- 218 Galvanized steel angle
- 249 Multipor ETICS mineral insulation board
- 252 Multipor pitched roof insulation
- 309 Ytong roof bolt
- 326 Multipor screw-in anchor

Download these and other detail drawings at [www.multipor.com/detaildrawings.php](http://www.multipor.com/detaildrawings.php)
6.0 Multipor roof insulation systems

6.8 Installing Multipor pitched roof insulation

Detail drawings for Ytong roof elements with Multipor pitched roof insulation

Verge with overhang

Verge with parapet

Verge without overhang

Ridge without overhang

011 Flashing/cover plate
012 Timber board
024 Gutter
025 Roof tile
028 Sarking board
030 Battens
037 Insect protection

081 Interior plaster
096 Mesh insert
100 Ring beam
119 Render edging strip
139 Battens
149 Pre-compressed sealing tape
150 Ytong roof element

026 Sarking membrane, vapor-permeable
028 Sarking board
200 Ytong/Silka masonry
249 Multipor ETICS mineral insulation board
252 Multipor pitched roof insulation
259 Multipor ETICS mineral insulation board
309 Ytong roof bolt
326 Multipor screw-in anchor

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FIRE PROTECTION SOUND INSULATION THERMAL INSULATION MOISTURE CONTROL MOULD-FREE COMFORTABLE ECO-FRIENDLY STRUCTURALLY ENGINEERED SUSTAINABLE ENERGY-EFFICIENT INDOOR CLIMATE ENERGY-SAVING MODERNISATION NEW BUILDING WALL STRUCTURE SOUND INSULATION ECO-FRIENDLY MOISTURE CONTROL SUSTAINABLE ENEV STRUCTURALLY ENGINEERED THERMAL INSULATION ENERGY-EFFICIENT INDOOR CLIMATE ENEV ENERGY-SAVING SOUND INSULATION MODERNISATION NEW BUILDING