Multipor external thermal insulation composite systems (ETICS)
External thermal insulation composite systems (ETICS) are used to improve the energy efficiency of buildings. The insulating material is bonded directly to the exterior wall, mechanically fastened with anchors and then plastered with a base coat and finishing render. Together the individual components form a fully compatible, tested and technically approved system which includes all the necessary accessories and supplementary products and is easy to install. The Multipor ETICS has been issued with several European national technical approvals including one in Germany (abZ) and a European technical assessment.

For over 50 years ETICS have been used to insulate external walls – mainly for refurbishments initially, but nowadays for new buildings too as rising energy prices make a well-insulated building envelope increasingly attractive. In contrast, about one third of heat energy is lost through poorly insulated external walls.

By upgrading insulation to current standards now, you not only reduce future energy consumption, you can also benefit from numerous subsidies (e.g. from the German government-owned development bank KfW, www.kfw.de).

**Ecological? Of course!**
High energy consumption is not only a burden on household budgets, it is environmentally irresponsible to waste fossil fuels in this way. We believe that every tonne of CO₂ is one tonne too many.

**Mission 2020**
As we become increasingly aware of the need for intelligent construction, there is growing demand and support for sustainable practices. EU Member States have to comply with the EPBD (Energy Performance of Buildings Directive) and the Energy Efficiency Directive, the EU’s main legislation covering the reduction of energy consumption of buildings. Transposition to national legislation and definition of nearly zero-energy buildings varies from one member state to another. For example, the requirements of the German Energy Saving Ordinance (EnEV 2014) become more rigorous with each revision as the German government strives to meet its climate targets: A 40% reduction in total emissions of harmful greenhouse gases by 2020. On 1 January 2016 the EnEV tightened requirements by reducing the permitted annual primary energy demand for residential buildings by 25% compared with the current reference building.

**Which is the right path?**
Insulation measures have been a primary focus for several years. Environmentally harmful petroleum-based polystyrene insulation products are still widely used, especially in modern, energy-efficient homes. However, the use of diffusion-proof plastic envelopes to increase the energy efficiency of older facades instead of healthy, ecological materials that are more in keeping with the spirit of our times is highly debatable in terms of building physics.
One example of good practice is the Feldberger Hof Family Hotel in the Black Forest, which is described in more detail in Chapter 3.6. The hotel’s guiding principle is to think about the end at the beginning! With future generations in mind, the Multipor insulation system – with proven sustainability – was used in this project.

Cost-effective and energy-efficient
People investing in property want to be sure that their money is well spent. A high quality Multipor ETICS is a worthwhile investment which not only reduces energy costs, but also increases the value of the property, thereby helping to reduce vacancy rates.

The revised EnEV 2014 came into force on 1 May 2014, heralding the following changes to the energy performance certificate: Building owners must provide prospective purchasers or new tenants with an energy performance certificate without being asked in a bid to make the building’s energy efficiency more transparent and help them estimate future costs. Builders must issue a preliminary energy performance certificate for new buildings, which is replaced by a valid energy performance certificate on completion of the building.

Unique benefits of the ecological, mineral-based Multipor ETICS
Not all insulation is the same. Intelligent Multipor ETICS offer superior insulation properties as well as other building-physical characteristics of relevance to new buildings and refurbishments.

Multipor ETICS with approved finishing render is a non-combustible Class A building material from the plinth right up to the roof. This system does not produce droplets of burning material, nor generate toxic smoke. So it’s not surprising that Multipor ETICS have already been installed successfully in many nurseries, schools, hospitals and other public buildings. The system is also an ideal choice for multistorey residential buildings, since it fully complies with all thermal insulation and fire protection requirements without the need for special measures (e.g. fire barriers).

Surface moisture causes microbiological attack. But with the Multipor ETICS and mineral-based finishing render, this moisture does not arise in the first place: Rapid re-drying and a high thermal storage capacity compared with other insulating materials prevent the problem occurring in a natural way, since mineral systems have optimal diffusion properties. Rather than ‘sealing’ walls, the system absorbs moisture and re-releases it, resulting in a stable temperature and moisture balance. So unlike many conventional plastic-bonded insulation materials, Multipor ETICS does not need toxic biocides to be incorporated into the final coat.

Whether on the facade of a school subject to high mechanical loads or in a detached house in need of refurbishment: Pressure-resistant Multipor ETICS mineral insulation boards perform to their strengths in any situation and provide a complete system that satisfies all existing requirements. With a comparatively high bulk density of approx. 110 kg/m³, they create a monolithic system structure which sounds like a solid wall when tapped. This prevents woodpecker damage and also protects against rodents.
Intelligent insulation
Lime, sand, cement and water – made from natural, mineral-based raw materials, Multipor mineral insulation boards are completely safe, fully recyclable and have optimum diffusion properties. Multipor ETICS largely eliminate thermal bridging and ensure a pleasant indoor climate all year round. Ease of installation is further confirmation that Multipor is an intelligent system solution. Multipor ETICS mineral insulation boards can be effortlessly cut to any shape and ensure a high degree of cost-effectiveness and efficiency. The system’s ecological properties make it ideal for use in construction projects requiring sustainability certificates (e.g. DGNB, BREEAM or LEED).

The specific product characteristic values are available to download on the online DGNB navigator at http://www.dgnb-navigator.de/

Ecology/sustainability
Multipor ETICS mineral insulation boards are a safe, ecological alternative to conventional insulating materials – the ideal solution for environmentally aware and health-conscious customers and builders. Waste material and offcuts can be recycled simply and affordably (e.g. by using Multipor Big bags) or disposed of in landfill as sorted building rubble [European Waste Catalogue code 17 01 01].

The natureplus environmental seal, IBU declaration and eco-INSTITUT A+ rating confirm these environmental credentials.

Multipor external thermal insulation composite systems (ETICS)
### General introduction and planning

#### Solid Multipor ETICS mineral insulation boards

With a high bulk density compared with conventional insulating materials, Multipor ETICS mineral insulation boards (bonded and anchored) form a virtually monolithic system structure. This means that when the facade is tapped, it sounds more like a solid wall than a conventional external thermal insulation composite system. A mineral-based Multipor ETICS thus forms a superior quality, solid, sustainable structure – especially in combination with Ytong AAC and Silka calcium-silicate blocks based on identical raw materials.

#### EnEV requirements for the external walls of new buildings

The Multipor ETICS easily meets the requirements of the German Energy Saving Ordinance (EnEV) for new buildings – and even exceeds them. More detailed information on the latest EnEV can be found in Chapter 7.1.6. A combination of Multipor ETICS and Ytong masonry offers optimum solutions for highly insulated external walls built to KfW Efficiency House or passive house standards. When combined with Silka calcium-silicate blocks, in addition to enhancing the energy performance, it also satisfies more stringent requirements for the

### Table 1: Characteristic values of Multipor ETICS – main system components

<table>
<thead>
<tr>
<th></th>
<th>Multipor ETICS mineral insulation board</th>
<th>Multipor lightweight mortar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations</td>
<td>German national technical approval Z-23.11-1501, European technical assessment ETA-05/0093 (see other national assessments on country-specific websites)</td>
<td>Lightweight rendering and plastering mortar LW as per EN 998-1</td>
</tr>
<tr>
<td>Dry bulk density</td>
<td>100 – 115 kg/m³</td>
<td>approx 770 kg/m³</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>≥ 30 kPa</td>
<td>CS II; 1.50 – 5.0 N/mm²</td>
</tr>
<tr>
<td>Transverse tensile strength/tensile bond strength</td>
<td>≥ 80 kPa</td>
<td>≥ 250 kPa</td>
</tr>
<tr>
<td>Shear strength</td>
<td>≥ 30 kPa</td>
<td>–</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>$\lambda = 0.043 \text{ W/(mK)}$ – declared value $\lambda_{10, \text{ ay}} = 0.042 \text{ W/(mK)}$ – limit value</td>
<td>$\lambda_{10, \text{ ay}} = 0.18 \text{ W/(mK)}$</td>
</tr>
<tr>
<td>Water vapor diffusion resistance factor</td>
<td>$\mu = 3$</td>
<td>$\mu \leq 10$</td>
</tr>
<tr>
<td>E modulus</td>
<td>approx. 200 – 300 N/mm²</td>
<td>approx. 2000 N/mm²</td>
</tr>
<tr>
<td>Water absorption</td>
<td>– Short-term (24 h) as per DIN EN 1609</td>
<td>$W_p \leq 2.0 \text{ kg/m}^2$</td>
</tr>
<tr>
<td></td>
<td>– Long-term (28 d) as per DIN EN 12087</td>
<td>$W_p \leq 3.0 \text{ kg/m}^2$</td>
</tr>
<tr>
<td>Water absorption</td>
<td>– Water absorption coefficient due to capillary action as per DIN EN 1015-18</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$W_2, c \leq 0.2 \text{ kg/(m}^2 \text{ min}^{0.5})$</td>
</tr>
<tr>
<td>Dimensions /delivery quantity</td>
<td>600 x 390 mm</td>
<td>20 kg/bag</td>
</tr>
<tr>
<td></td>
<td>$d = 60 – 300 \text{ mm (in increments of 20)*}$</td>
<td>approx. 30 l/20 kg; sufficient for approx. 6 m² reinforcement with a 5-mm layer thickness</td>
</tr>
<tr>
<td></td>
<td>$d = 50 – 300 \text{ mm (in increments of 25)**}$</td>
<td></td>
</tr>
<tr>
<td>Material requirement</td>
<td>4.3 boards/m²</td>
<td></td>
</tr>
</tbody>
</table>

* from the Stulln and Cologne/Portz factories

** from the Dobrich factory
### General introduction and planning

#### 3.0 Multipor external thermal insulation composite systems (ETICS)

#### 3.1 General introduction and planning

Table 2 summarizes the U-values that can be obtained.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Ytong AAC</th>
<th>Silka calcium-silicate block</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PP 4-0.50 / $\lambda = 0.12$ W/(mK)</td>
<td>PP 2-0.35 / $\lambda = 0.09$ W/(mK)</td>
</tr>
<tr>
<td>Wall thickness $B_1$ in cm</td>
<td>XL Basic 20-1.8 / $\lambda = 0.99$ W/(mK)</td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td>20.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Multipor insulation thickness $B_2$ in cm</td>
<td>U-values [W/(m²K)]</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.35</td>
<td>0.31</td>
</tr>
<tr>
<td>8</td>
<td>0.30</td>
<td>0.27</td>
</tr>
<tr>
<td>10</td>
<td>0.27</td>
<td>0.24</td>
</tr>
<tr>
<td>12</td>
<td>0.24</td>
<td>0.22</td>
</tr>
<tr>
<td>14</td>
<td>0.22</td>
<td>0.20</td>
</tr>
<tr>
<td>16</td>
<td>0.20</td>
<td>0.18</td>
</tr>
<tr>
<td>18</td>
<td>0.18</td>
<td>0.17</td>
</tr>
<tr>
<td>20</td>
<td>0.17</td>
<td>0.16</td>
</tr>
<tr>
<td>22</td>
<td>0.16</td>
<td>0.15</td>
</tr>
<tr>
<td>24</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td>26</td>
<td>0.14</td>
<td>0.13</td>
</tr>
<tr>
<td>28</td>
<td>0.13</td>
<td>0.12</td>
</tr>
<tr>
<td>30</td>
<td>0.12</td>
<td>0.12</td>
</tr>
</tbody>
</table>

- $\leq$ Reference value [0.28 W/m²K]
- Recommendation for EnEV standard houses
- Recommendation for energy-efficient houses

**Wall construction**

2.0 cm interior plaster, $\lambda = 0.51$ W/(mK)

$B_1$ cm Ytong AAC or Silka calcium-silicate block

$B_2$ cm Multipor ETICS mineral insulation board

1.4 cm exterior plaster, $\lambda_{ext} = 0.18$ W/(mK)

(Multipor lightweightmortar)

$R_{int} + R_{ext} = 0.17$ m²K/W

- **EnEV requirements for the external walls of refurbished buildings**
  
  Germany has an above average number of older dwellings which are badly or inadequately insulated, resulting in high energy costs and uncomfortable living conditions in summer and winter alike. The solution is a highly thermally insulating, ecological Multipor ETICS which can be applied easily and economically to mineral substrates such as masonry or concrete. After all, the revised EnEV 2014 places stricter requirements on the thermal insulation of refurbishments and re-rendering projects than for new buildings.
Table 3: U-values of functional walls with Multipor ETICS mineral insulation board – refurbishments

<table>
<thead>
<tr>
<th>Designation</th>
<th>Solid brick</th>
<th>AAC</th>
<th>Lightweight concrete hollow blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\rho = 1.6 \text{ kg/dm}^3$, $\lambda = 0.68 \text{ W/(mK)}$</td>
<td>$\rho = 0.5 \text{ kg/dm}^3$, $\lambda = 0.14 \text{ W/(mK)}$</td>
<td>$\rho = 0.9 \text{ kg/dm}^3$, $\lambda = 0.44 \text{ W/(mK)}$</td>
</tr>
<tr>
<td>Wall thickness B1 in cm</td>
<td>24.0 30.0 36.5 50.0</td>
<td>20.0 24.0 24.0 36.5 50.0</td>
<td></td>
</tr>
<tr>
<td>Multipor insulation thickness B2 in cm</td>
<td>U-value [W/(m²K)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.50 0.48 0.46 0.42</td>
<td>0.33 0.30 0.46 0.41 0.36</td>
<td>0.46 0.41 0.36 0.31</td>
</tr>
<tr>
<td>8</td>
<td>0.41 0.40 0.38 0.36</td>
<td>0.29 0.26 0.29 0.34 0.31</td>
<td>0.38 0.34 0.30 0.27</td>
</tr>
<tr>
<td>10</td>
<td>0.35 0.34 0.33 0.31</td>
<td>0.25 0.24 0.29 0.30 0.27</td>
<td>0.33 0.30 0.27</td>
</tr>
<tr>
<td>12</td>
<td>0.30 0.29 0.29 0.27</td>
<td>0.23 0.21 0.28 0.26 0.24</td>
<td>0.28 0.26 0.22</td>
</tr>
<tr>
<td>14</td>
<td>0.27 0.26 0.25 0.24</td>
<td>0.21 0.20 0.25 0.24 0.22</td>
<td>0.25 0.24 0.22</td>
</tr>
<tr>
<td>16</td>
<td>0.24 0.23 0.23 0.22</td>
<td>0.19 0.18 0.23 0.21 0.20</td>
<td>0.23 0.21 0.20</td>
</tr>
<tr>
<td>18</td>
<td>0.22 0.21 0.21 0.20</td>
<td>0.17 0.17 0.21 0.20 0.18</td>
<td>0.21 0.20 0.18</td>
</tr>
<tr>
<td>20</td>
<td>0.20 0.19 0.19 0.18</td>
<td>0.16 0.15 0.19 0.18 0.17</td>
<td>0.19 0.18 0.17</td>
</tr>
<tr>
<td>22</td>
<td>0.18 0.18 0.17 0.17</td>
<td>0.15 0.14 0.18 0.17 0.16</td>
<td>0.17 0.16 0.15</td>
</tr>
<tr>
<td>24</td>
<td>0.17 0.16 0.16 0.16</td>
<td>0.14 0.14 0.16 0.15 0.15</td>
<td>0.17 0.16 0.15</td>
</tr>
<tr>
<td>26</td>
<td>0.16 0.15 0.15 0.15</td>
<td>0.13 0.13 0.15 0.14 0.14</td>
<td>0.14 0.14 0.14</td>
</tr>
<tr>
<td>28</td>
<td>0.15 0.14 0.14 0.14</td>
<td>0.13 0.12 0.14 0.14 0.13</td>
<td>0.14 0.14 0.13</td>
</tr>
<tr>
<td>30</td>
<td>0.14 0.14 0.13 0.13</td>
<td>0.12 0.12 0.13 0.12 0.12</td>
<td>0.13 0.13 0.12</td>
</tr>
</tbody>
</table>

Table 3 summarizes the U-values that can be obtained.

Table 4 shows the thermal resistance of different thicknesses of Multipor ETICS mineral insulation board for detailed verification of thermal insulation properties.

Table 4: Multipor ETICS mineral insulation boards — dimensions and thermal resistance R [m²K/W]

<table>
<thead>
<tr>
<th>Thermal conductivity (declared value)</th>
<th>Board thickness [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 80 100 120 140 160 180 200 220 240 260 280 300</td>
</tr>
<tr>
<td>$\lambda = 0.042 \text{ W/(mK)}$</td>
<td>1.163 1.744 2.326 2.907 3.489 4.069 4.651 5.814 6.977</td>
</tr>
</tbody>
</table>

Multipor ETICS
Multipor ETICS mineral insulation boards used in combination with Multipor lightweight mortar create a non-combustible masonry system with an A2 fire resistance rating which thus satisfies all fire protection requirements.

The insulation boards do not generate toxic fumes in the event of fire, which is why they are widely used in public buildings such as nurseries, schools and hospitals. Their non-combustibility also makes them suitable for use in multistorey buildings up to 100 m tall. From a height of 22 m above ground level, only Class A insulation material may be used in ETICS in compliance with the fire protection standard DIN 4102. Furthermore, due to the non-combustibility of Multipor ETICS mineral insulation boards, there is no need to install fire barriers above windows and door openings which are required with combustible insulating materials over 100 mm thick.
Awkward, error-prone changes of material within the system are thus avoided, leading to further cost savings.

**Practical tip:** To be designated an A2 building material, the system must be mineral-based. As an adhesive and reinforcement mortar, mineral-based Multipor lightweight mortar should always be used in combination with a correspondingly approved finishing render, since adhesive mortars and finishing renders with a relatively high organic content (e.g. synthetic resin plasters) can reduce the fire resistance rating.

### Sound insulation

The sound insulation standard DIN 4109 governs acoustic requirements to protect against external noise. These requirements are determined by the purpose of the building and the relevant exterior noise levels. External thermal insulation composite systems invariably have an impact on the sound insulation of external walls and are therefore taken into account when demonstrating compliance with sound insulation requirements. Multipor ETICS mineral insulation boards have no adverse effect on sound insulation – on the contrary.

### ETICS as a sound insulation model

An external wall insulated with an external thermal insulation composite system can be regarded as a ‘mass-spring-mass system’ (Fig. 1). The ‘hard’ finishing and reinforcement render on one side and wall material on the other constitute the mass elements. These are connected by the insulation, which acts acoustically and dynamically like a spring in response to sound. The system comprising solid wall – insulation – exterior render is induced to vibrate particularly well at its resonant frequency. Sound transmission works better in this frequency range. Or to put it another way: Sound insulation is worse in this frequency range.

The mass of the insulating material and its dynamic stiffness have a direct influence on sound insulation and in particular, on resonant frequency. Resonant frequencies in the audible range can result in the acoustic properties of a wall being worse after insulation has been applied than in the uninsulated state.

The level of resonant frequency is thus a key factor in assessing the acoustic effects of an ETICS. The Multipor ETICS performs particularly well here, since it has a higher dynamic stiffness than insulation systems made from mineral fiber or EPS (expanded polystyrene) and thus achieves a higher resonant frequency. As a result, there is no negative impact on sound insulation in the low frequency range – the very range where high traffic noise pollution occurs, especially in inner-cities.
Furthermore, acoustic measurements conducted by several recognized institutes have shown that a Multipor ETICS has no adverse effect on the sound reduction index of an external wall required to demonstrate compliance with sound insulation requirements (Table 7). Depending on the external wall construction, it can even improve the index by up to 2 dB, which places it among the top-performing insulating systems, especially in the low frequency range (traffic noise). Furthermore, several studies have been carried out, none of which have found any diminution of the weighted sound reduction index.

Sound insulation in compliance with the technical approval
In accordance with national technical approval Z-33.43-596, which applies to the Multipor ETICS, the following equation is used to demonstrate that the sound insulation complies with the weighted sound reduction index $R'_{w,R}$ of the wall structure:

$$R'_{w,R} = R'_{w,R,0} + \Delta R'_{w,R}$$

where

- $R'_{w,R,0}$ Calculated value of the weighted sound reduction index of the solid wall without ETICS
- $\Delta R'_{w,R}$ Corrected value as follows:
  - $\Delta R'_{w,R} = 0$ dB for load-bearing walls with a mass per unit area of $\geq 300$ kg/m², an insulation thickness of 60 mm and a rendering system with a mass per unit area of $\leq 10$ kg/m²
  - $\Delta R'_{w,R} = -2$ dB for all other construction variants

In accordance with national technical approval Z-33.43-596, the corrected values include a blanket safety margin of $-2$ dB specified by the DiBT, which has been applied to the test values. However, in reality a Multipor ETICS does not diminish the sound reduction index, as confirmed by the aforementioned tests.

Spectrum adaptation terms
Sound perception is a complex process which depends on many factors. The most important variables for identifying sound signals are audible frequencies between 20 and 20,000 Hz and sound pressure. The acoustic performance of external thermal insulation composite systems to mitigate external noise must therefore be verified, with traffic noise almost invariably constituting the primary noise fraction. The essential difference between traffic noise and internal noise pollution is due to the different, frequency-dependent sound reduction indices arising from the combination of load-bearing masonry and thermal insulation. These two different actions are responsible for the occupant’s subjective impression of experiencing poor acoustic performance, despite compliance with statutory sound insulation requirements.
DIN EN ISO 717-1 introduced ‘spectrum adaptation terms’ in 1997 as a realistic means of recording human sound perception. The adaptation term C represents outside background noise (pink noise) while C_tr refers to road traffic noise. The weighted sound reduction indices can be used to calculate the spectrum adaptation terms, without the need for additional separate tests. The corrected values are calculated on the basis of the existing measured values.

The corrected value $\Delta(R_w + C_tr)$ is more suitable for assessing the sound insulation of an external wall structure than the $R_w$-value alone. This value describes the change in acoustic performance of an ETICS-insulated wall compared with an uninsulated wall. It represents the sum of the differences in sound insulation values of a wall in the insulated and uninsulated state.

$$\Delta (R_w + C_tr) = R_{w, ETICS} - R_{w, wall}$$

Based on road traffic noise, this value may indicate a better or worse acoustic performance and is weighted to reflect the sensitivity of the human ear in accordance with DIN EN ISO 717-1.

This again highlights Multipor’s positive product characteristics, alongside the other benefits. According to measurements conducted in 2012, a Multipor ETICS does not bring about any changes in normative terms based on the weighted sound reduction index $R_w$. The average value of all sound insulation tests on walls with Multipor ETICS resulted in an average improvement of approx. 1.2 dBs (Table 8).

This means, on average, an approximate 4-dB difference between Multipor ETICS and other systems. For a sound level of 20 dB, this equates to a virtual halving of the traffic noise level actually perceived by the human ear. A sound level of 20 dB corresponds to a clearly audible noise (computer fan, rustling leaves etc.). A doubling of sound perception could conceivably have an impact on sleep behavior. When a Multipor ETICS is used, even significant road traffic noise, such as stationary buses with their engines running or heavy lorry traffic, is perceived as less disturbing – compared with other systems. This significantly improves quality of life for users of the building. At a sound level of 20 dB, a 5-dB level change is perceived as a doubling or halving of noise perception.

### Planning documents

The applicability of ETICS is described in the general technical approval. The DIBt (German Institute for Building Technology) has granted national technical approval no. Z-33.43-596 to Multipor ETICS as a bonded and anchored system and lists the main system components and their purpose as follows:

- Multipor lightweight mortar as system adhesive
- Multipor ETICS mineral insulation board
- Multipor screw-in anchor with general technical approval
- Multipor lightweight mortar as reinforcement render
- Multipor reinforcement mesh
- Approved finishing render or Multipor lightweight mortar as finishing render.

When using non-combustible Multipor plinth insulation, the following additional components are required:

- Multipor plinth insulation board
- Multipor waterproofing slurry.

The mineral insulating material enables solid, mineral-based substrates such as masonry and concrete – with or without rendering – to be insulated in an environmentally friendly way.

<table>
<thead>
<tr>
<th>Table 8: Comparison of spectrum adaptation terms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All tests</strong></td>
</tr>
<tr>
<td>Multipor ETICS (dB)</td>
</tr>
<tr>
<td>$\Delta (R_w + C_tr)$</td>
</tr>
</tbody>
</table>

Source for other insulation systems: Technische Systeminfo 7 – Schallschutz – Fachverband Wärmedämm Verbundsysteme e. V., p. 35 (Technical System Information 7 – Sound Insulation, published by Germany’s ETICS trade association).
Optimal results can be obtained in new buildings by combining Silka calcium-silicate blocks or Ytong AAC with Multipor. Multipor ETICS are also ideal for upgrading the uninsulated, mineral-based substrates of old buildings to the latest energy efficiency standards. However, they are not suitable for substrates made from wood, steel or sheet metal substructures. Plinth insulation boards must be fitted to the plinth area in accordance with our directions. Care must be taken to ensure that a vertical damp-proof membrane is applied to the external wall in accordance with DIN 18195 prior to fitting the plinth insulation.

External walls are naturally exposed to large temperature variations and different weather effects.

ETICS requirements are based on regional climate, driving rain load and building type in accordance with DIN 4108-3. A Multipor ETICS provides reliable, long-term protection to the fabric of the building – Multipor ETICS mineral insulation boards are water-repellent and can safely be used with a compatible rendering system to protect against moisture, rainfall and periods of bad weather.

### Table 9: Minimum number of anchors/insulation board, depending on wind load as per DIN EN 1991-1-4

<table>
<thead>
<tr>
<th>Anchor load class [kN/anchor]</th>
<th>Wind pressure ( w ) [kN/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \leq 0.56 )</td>
</tr>
<tr>
<td>( \geq 0.20 )</td>
<td>1</td>
</tr>
</tbody>
</table>

Mechanical fasteners/anchors

Multipor ETICS mineral insulation boards are additionally secured with technically approved Multipor screw-in anchor. When installed correctly, this creates a superior quality, functional ETICS with a service life at least on a par with a normal rendered facade.

Different wind loads apply depending on the region, position and height of the building, in accordance with the requirements of DIN EN 1991-1-4. Wind forces exert tensile stress on both the Multipor ETICS mineral insulation board and the adhesive bond. The forces arising are safely discharged into the load-bearing substrate via the approved Multipor screw-in anchor. In accordance with national technical approval Z-33.43-596, at least one technically approved screw-in anchor is required for each insulation board (see Table 9).
Detailed planning documents for Multipor ETICS
The current versions of the following standards apply:
- National technical approval Z-23.11-1501 "Multipor mineral insulation board" and
- Z-33.43-596 "Multipor external thermal insulation composite system (ETICS)"
- Safety data sheets for the system components
- DIN 4108-2: Thermal protection and energy economy in buildings – Part 2: Minimal requirements to thermal insulation
- DIN 4108-3: Thermal protection and energy economy in buildings – Part 3: Protection against moisture subject to climate conditions: requirements and directions for design and construction
- DIN 4108-4: Thermal protection and energy economy in buildings – Part 4: Hygrothermal design values
- DIN 4108-10: Thermal protection and energy economy in buildings – Part 10: Application-related requirements for thermal insulation materials – factory-made products
- DIN 18195 – Waterproofing of buildings
- DIN EN ISO 6946: Building components and building elements – Thermal resistance and thermal transmittance – Calculation method
- DIN EN 15026: Hygrothermal performance of building components and building elements – Assessment of moisture transfer by numerical simulation
- DIN 55699: Application of external thermal insulation composite systems
- ATV DIN 18345: German construction contract procedures (VOB) – Part C: General technical specifications in construction contracts (ATV) – Thermal insulation composite systems
- DIN 18202: Tolerances in building construction – Buildings
- The current version of the German Energy Saving Ordinance (EnEV 2014 dated 01.05.2014)
- Fachverband der Stuckateure für Ausbau und Fassade (Germany’s trade association of plasterers for internal finishes and facades) – Guidelines: Connections to windows and roller shutters for rendering/plastering, external thermal insulation composite systems and dry lining
- Bundesausschuss Farbe und Sachwertschutz (Federal committee for paints and the protection of property) – Datasheet No. 21: Technical guidelines for the planning and application of external thermal insulation composite systems
3.2 Detail drawings for ETICS

Detail drawings for Multipor ETICS

Plinth insulation, ETICS flush with plinth

Plinth insulation with overhanging ETICS

Plinth insulation with base rail for renovation

Connection to flush or surface-mounted window

Keep the joint free from mortar

001 Ytong masonry
006 Thermal insulation
007 Reinforced concrete ceiling
039 Impact sound insulation
040 Floating screed
068 Plinth render
081 Interior plaster
088 Multipor waterproofing slurry
111 Separation or protective layer
120 Multipor plinth insulation board
149 Pre-compressed sealing tape
168 Existing masonry
173 Multipor lightweight mortar
174 Multipor reinforcement mesh
200 Ytong/Silka masonry
249 Multipor ETICS mineral insulation board
251 Multipor ceiling insulation
261 Existing render
264 Dimpled membrane
283 Plinth rail with drip edge
284 Plinth paintwork
285 System-compatible finishing render
289 Mesh angle bead
326 Multipor screw-in anchor

Note: Airtightness and mounting of window to comply with window manufacturer's specifications.

Joint width between the window and ETICS min. 15 mm. Fully insulate cavities with mineral wool.

Download these and other detail drawings at www.multipor.com/detaildrawings.php
Multipor external thermal insulation composite systems (ETICS) 3.0

Detail drawings for ETICS 3.2

Detail drawings for Multipor ETICS
System configuration, bonded double layer up to 300 mm

Return with joint profile

Horizontal section of window

Vertical section of window area

Layer structure must conform to approval.

Keep the joint free from mortar.

Note: Windowsill support bracket

Download these and other detail drawings at www.multipor.com/detaildrawings.php
3.0 Multipor external thermal insulation composite systems (ETICS)

3.2 Detail drawings for ETICS

Detail drawings for Multipor ETICS

Connection to roller shutters with plaster baseboard I

Connection to roller shutters with plaster baseboard II

Connection to overhanging eaves

Parapet wall with small flashing for low building heights

Note: First bond the roof joint board, then insert the pre-compressed PU foam tape.

* Minimum thickness 60 mm

---

Some codes and materials:

- 001 Ytong masonry
- 006 Thermal insulation
- 007 Reinforced concrete ceiling
- 039 Impact sound insulation
- 040 Floating screed
- 050 Blind
- 081 Interior plaster
- 111 Separation or protective layer
- 119 Render edging strip
- 149 Pre-compressed sealing tape
- 168 Existing masonry
- 172 Multipor mortar
- 174 Multipor reinforcement mesh
- 175 PVC corner bead
- 173 Multipor ETICS mineral insulation board
- 249 Multipor ETICS mineral insulation board
- 285 System-compatible finishing render
- 293 Parapet profile
- 326 Multipor screw-in anchor

Download these and other detail drawings at www.multipor.com/detaildrawings.php
Detail drawings for Multipor ETICS

Gable connection

Board arrangement around facade openings incl. anchors

Movement joint with expansion profile

Diagonal reinforcement of facade opening

132 Mineral fiberboard
149 Pre-compressed sealing tape
168 Existing masonry
173 Multipor lightweight mortar
174 Multipor reinforcement mesh
249 Multipor ETICS mineral insulation board
285 System-compatible finishing render
290 Expansion joint profile with sealing tape
326 Multipor screw-in anchor

Download these and other detail drawings at www.multipor.com/detaildrawings.php
3.0 Multipor external thermal insulation composite systems (ETICS)

3.2 Detail drawings for ETICS

Detail drawings for Multipor ETICS

Transition to projecting component

Mounting light loads

Mounting awnings

Mounting downpipes

007 Reinforced concrete ceiling
149 Pre-compressed sealing tape
168 Existing masonry
173 Multipor lightweight mortar
174 Multipor reinforcement mesh

175 Corner protectors
249 Multipor ETICS mineral insulation board
285 System-compatible finishing render

291 Load distribution plate
312 Multipor spiral anchor
326 Multipor screw-in anchor

* Leave 2-3 mm wide joint between wall and ceiling insulation

* Lighting or similar loads

Fix awning as per structural calculations!

Download these and other detail drawings at www.multipor.com/detaildrawings.php
ETICS transitions, connections and edges

The quality and durability of an external thermal insulation composite system depends on the materials used, the quality of workmanship and the careful planning and execution of transitions, connections and edges.

All connections and edges must be designed to ensure that adjacent building components can accommodate hygrothermal deformation without sustaining damage. An ETICS must comply with structural requirements relating to thermal insulation, fire protection, moisture control and airtight/windtight connections (e.g. doors and windows) in the long term.

Connections must be planned and executed with care, especially in the case of the energy-efficient refurbishment of existing buildings. It is important to consider the condition of components that are to be connected, such as rafters, at the planning stage. Any replacements required as part of refurbishment work, including windows, doors and rafters, must be installed before insulation work begins. Any existing movement and expansion joints must be retained and not covered up with insulation.

Multipor has created a series of detail drawings to help planners design the connection details for a specific project. You can find these in the download section of our website at www.multipor.com.

With virtually all building projects, consideration must be given to the following connections:
- Roof
- External wall junctions
- Balcony and/or terrace
- Windows and doors, including windowsills
- Blinds and roller shutter boxes
- See Chapter 3.2 for detail drawings of plinths.

![Note: Widely used ETICS profiles are included in our scope of delivery as system components.]

Brief description of transitions and connections

Edge beading/profiles must be installed to provide a neat finish wherever an ETICS ends. These profiles can also be installed in the facade face or at the corners of the building.

The example of an eaves connection illustrates the importance of good detailed planning before commencing installation work. Connections to eaves must be resistant to driving rain, and at the same time may incorporate roof ventilation. This type of connection can be achieved by combining a suitable roof ventilation profile with a pre-compressed joint sealing tape.

A combination of plinth rail and pre-compressed sealing tape can be used to form the connection to dormer windows or mono-pitched roofs, as well as in the plinth area. In this case the plinth rail can also serve as the side edge profile. Here too, care must be taken to ensure that connections to parapets are also resistant to driving rain.

Connection profiles are sometimes required on wall surfaces where there is a transition to a post-and-beam construction or back-ventilated facade. A rain and splash-proof transition is required at connections to entrances, terraces and balconies.
Applications
Typical examples of Multipor ETICS transitions, connections and edges are shown in the following pages.

Window connection
Connections to window frames can be constructed in the traditional way by inserting Multipor pre-compressed sealing tape in a troweled groove. Multipor plaster finishing profiles [1 – 3] have also proved popular with installers. These have the advantage of forming a watertight seal with the frame (for example by means of integrated pre-compressed sealing tape or an adhesive polyurethane strip). They also come with a welded-on wing of reinforcement mesh so that they can be firmly embedded in the base coat render. The profiles are also supplied with an adhesive strip for attaching a protective film to protect the window from soiling during installation of the ETICS. This creates a decoupled solution between the Multipor ETICS and the window frame which is resistant to driving rain.

For large window and door openings and connections which are required to absorb larger compensating movements, we recommend using finishing profiles which are connected to the frame by an integrated strip of pre-compressed sealing tape (Tab. 1) [2]. Instead of the profiles themselves being bonded to the frames, the sealing layer is formed by the pre-compressed sealing tape. The profiles are fixed to the insulation layer with plastic nails and embedded in the base coat render by means of the attached reinforcement wings.

It is important to achieve a good connection between the insulation and the profile and to ensure that the reinforcement mesh is embedded in the reinforcing layer with a sufficiently large overlap (∆ 10 cm).

To prevent thermal bridging, the reveals of window frames should be insulated with reveal insulation board. With windows that are projecting or flush with the masonry, the Multipor ETICS should run right up to the frame.

An alternative solution is to use pre-compressed sealing tape and create a shadow gap.

Table 1: Window connection profile for windows up to 10 m² and 300 mm insulation thickness

<table>
<thead>
<tr>
<th>Connection profile</th>
<th>Window inset in masonry</th>
<th>Window flush with masonry</th>
<th>Window outside masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td>W32-plus</td>
<td>up to 160 mm</td>
<td>up to 160 mm</td>
<td>–</td>
</tr>
<tr>
<td>W36-plus</td>
<td>up to 300 mm</td>
<td>up to 300 mm</td>
<td>up to 300 mm</td>
</tr>
</tbody>
</table>
**Window sill connection**

As with any other connection, connections to windowsills must be executed with the utmost care. Multipor precompressed joint sealing tape is always used for the bottom and side connection to aluminum window sills [4][5]. A sound-absorbing strip is fitted to the underside of the windowsill for sound insulation. A rubber sealing lip is inserted in the back of the vertical screw plate before the plate is screwed to the lower frame.

Aluminum window sills over 3 m long must be fitted with expansion connectors to accommodate temperature-related changes in length without damaging the window sill.

**Edge profiles** – factory-fitted or applied on site – are used to form neat side connections [5]. These too must be fitted with Multipor precompressed joint sealing tape for connection to the top and side of the Multipor ETICS.

**Natural stone window sills**

Insulation beneath a natural stone window sill must be neatly finished with a mesh angle bead before the windowsill is installed. Joint sealing tape or a flexible seal should also be fitted to the front edge.

Since natural stone window sills do not normally have an edge profile, the joints connecting the insulation to the reveal and window frame must be sealed with a suitable flexible sealant. Suitable profiles, e.g., W32-plus, can be used as an alternative and to avoid maintenance joints.

**Blinds and roller shutter boxes**

Blinds and roller shutter boxes should be integrated into the Multipor ETICS to prevent thermal bridging. Connecting elements must be fitted at the junctions with the boxes and the guide rails [6]. Like windows, boxes may be set back from the external wall surface, flush with the render, or surface-mounted.
3.0 Multipor external thermal insulation composite systems (ETICS)

3.3 ETICS transitions, connections and edges

Recessed or flush-fitted roller shutter boxes must be covered with Multipor ETICS to a minimum thickness of 60 mm. It may be necessary to apply a render baseboard first.

Suitable Multipor finishing profiles can be used for the connection to the guide rails. Surface-mounted roller shutters need a special connection. When fitting reveal insulation, special care must be taken at the transition to the interior to prevent unnecessary heat loss and the risk of condensation and mold formation arising in the first place.

With all types of connection, consideration should be given to the visual appearance as well as the functionality. Galvanized or aluminum plaster rails and corner beads designed for interior applications are not suitable for use in external thermal insulation composite systems.

Plinth insulation
There are various ways of applying insulation to the plinth area. The classic method frequently used for renovating multi-family housing is to install plinth insulation that is not in contact with the ground.

A base rail can be used to form the connection at the base of the plinth [7]. In this case an L-shaped plastic profile with a shorter, vertical upstand is screwed to the existing wall [8]. The profile can be extended with suitable elements if necessary, depending on the thickness of the insulation.

A plug-in profile with integrated drip edge and welded-on mesh is embedded into the base coat render to form the front edge [9].

Alternatively, the plinth connection can be formed using two Multipor mesh angle beads; the front edge is formed by a mesh angle bead with integrated drip edge.

Once the height of the plinth has been determined, the Multipor plinth rails can be fastened to the existing wall at the correct height. Rail connectors prevent possible cracking at the joints. The lower plinth is particularly prone to rainwater splashback. The area in contact with the ground may also be exposed to high mechanical and hygric loads.
The splash zone must extend at least 30 cm above the planned ground level. DIN 18195 requires a vertical damp-proof membrane to be fitted to the wall below ground level. Plinth insulation must extend to 50 cm below the lower edge of the basement ceiling to minimize the effect of thermal bridging.

Alternatively, mineral-based Multipor plinth insulation board, stepped or unstepped, can be installed from where the actual facade insulation starts to approx. 20 cm below ground level [10].

**The corners of buildings and reveals**

Multipor mesh angle beads with welded-on wings have proved an effective means of finishing the corners of buildings and reveals. The mesh wings are embedded in the reinforcement layer of the Multipor ETICS, with sufficient overlap [11].

**Finishing and decorative profiles**

Finishing profiles can be used to create different plaster surfaces or color transitions [12]. These sometimes have welded-on mesh wings and can be embedded in the reinforcement layer with sufficient overlap. This gives the profile the same thickness as the finishing render to create a neat, high quality finish.

**Movement and expansion joints**

Any movement and expansion joints present in the building must be retained in the insulating layer. Under no circumstances should movement and expansion joints be covered with insulation. Otherwise there is a risk of uncontrolled cracking, leading to further damage. Various different profiles are available [13]. The choice of profile is determined by the degree of joint movement, the horizontal or vertical position and the possible type of movements relative to one another – e.g. diagonal or parallel.

To prevent moisture damage, we recommend inserting a suitable joint sealing tape in horizontal joints before fitting the chosen movement joint profile.

**Note:** Widely used ETICS profiles are included in our scope of delivery as system components.
3.0 Multipor external thermal insulation composite systems (ETICS)

3.3 ETICS transitions, connections and edges

Penetrations – as many as necessary, as few as possible
Penetrations should only be made where absolutely unavoidable. Examples include brackets for balustrades, taps, railings, awnings and canopies. Connections to penetrations must be permanent and sealed to protect against driving rain.

Thus all penetrations should be made before fitting the insulation to the facade. The joint between the Multipor ETICS and the penetration is sealed by inserting Multipor joint sealing tape in a troweled groove. Suitable thermally insulating fixing elements are available which can avoid the use of penetrations and thus reduce the number of thermal bridges. Multiple spiral anchors are suitable for light loads (see Chapter 3.8 on fixing loads to Multipor ETICS).

Larger light fittings or brackets for rainwater downpipes can be mounted by inserting a load distribution plate in the insulation layer. Penetrations for scaffolding anchors which are unavoidable for safety reasons can be capped with special scaffolding anchor covers to create an unobtrusive rainproof seal without thermal bridging.

Fire protection details
The connections described above may also be subject to fire protection requirements governed by the building codes of the respective federal states. Since Multipor insulating materials are A1-rated building materials in accordance with DIN 13501 and the system as a whole with approved finishing render has an A2-s1, d0 rating, Multipor is suitable for constructing virtually all fire protection details. Multipor offers significant financial and practical benefits compared with flammable insulating materials because the entire system structure enables the creation of fire protection solutions without the need for fire barriers and changes of material.

Special joint sealing tapes and flexible fire protection sealants are available for movement joints subject to fire protection requirements.

Note: When constructing transitions and fitting connection and edge profiles, please consult the accessory manufacturers’ instructions in addition to our processing guidelines (Chapter 3.7).
Multipor external thermal insulation composite systems (ETICS) 3.0
Mechanical fastening of ETICS 3.4

**Determining wind loads and anchor dimensions**
The Multipor ETICS is a bonded and mechanically fixed system governed by the structural requirements of DIBt approval Z-33.43-596. Multipor ETICS mineral insulation boards applied to the facade are subject to various load types during installation and subsequent use. Both the dead load of the system and the hygrothermal loads are absorbed by the bond strength of the Multipor lightweight mortar. In most cases wind loads constitute the greatest loading in terms of force. It is easy to imagine that wind blowing onto the facade will exert compressive forces on it. All Multipor ETICS system components can easily absorb these forces and transmit them to the facade. At the same time, wind suction loads can occur in the corners of buildings which are greater than wind pressure forces in absolute terms.

Mechanical fixings are used to reliably absorb and distribute these loads. They work by transferring the wind suction load into the load-bearing substrate.

**Wind suction explained**
In technical terms, wind suction is a force exerted on a surface generated by wind flow at the surface. This phenomenon is known as the Bernoulli effect. David Bernoulli discovered the relation between pressure, velocity and flow cross-section. The effect can be seen in the way a river flows around a bridge pier. By reducing the flow cross-section, the flow rate of the water increases. This effect also occurs in buildings when wind circulates around them (Fig.1).

When the wind blows against a building, it backs up and exerts pressure on the windward facade. This is referred to as ram pressure. But the wind does not remain ‘suspended’ on the facade, it is deflected upwards over the roof and around the building. This creates turbulence at the corners of the building. Airborne gas particles entrained in the wind flowing past are carried to the surface, generating a negative pressure, or suction, perpendicular to the areas around which the wind flows.

The higher the wind speed and lesser the turbulence, the greater this negative pressure. The determination of wind loads acting in corners and turbulent areas of buildings is governed by DIN EN 1991-1-4 in Germany.

---

**Fig. 1: Action of wind suction on the building envelope**

[Diagram showing the action of wind suction on a building envelope.]
Wind suction also occurs on the leeward side of the building due to wake turbulence.

In coastal areas especially, wind suction can exert significant forces on flat roofs and facades.

According to DIN EN 1991 1-4, the wind load depends on the building shape, the wind zone (Fig. 2) and local topography.

A tall building on the North Sea coast is exposed to considerably stronger wind loads than a detached house in Frankfurt am Main, for example.

The ETICS absorbs the stresses generated by the wind loads via the lightweight mortar adhesive bond on the wall surface and the anchor fixings inserted into the load-bearing substrate.

Wind suction forces are always greatest at the corners of buildings. To simplify the wind load calculations, these forces are always regarded as static surface loads.

**Anchor fixings**

Wind suction forces are absorbed by the anchors, which invariably require national technical approval when used in conjunction with an external thermal insulation composite system. Wind suction forces generally constitute the greatest load exerted on anchors and are therefore used as the basis for determining the design value, even if other loads are absorbed by the anchor.

The length and type of anchor depends on the substrate, e.g. concrete, solid block, perforated block or AAC, as well as the thickness of the insulation.

**Determining wind suction forces**

The wind load acting on the facade is determined in accordance with DIN EN 1991-1-4 together with the relevant national application document DIN EN 1991-1-4/NAD. The Federal Republic of Germany as a whole is divided into 4 wind zones with different wind velocities $v_{b,0}(v_{ref})$ and wind velocity pressures $q_{b,0}$ (Table 1). As the wind zone map (Fig. 2) shows, most of Germany is covered by Zones 1 and 2. The relevant wind load for a building can either be taken from the wind zone map or from an online table published by the German Institute for Building Technology (DIBt).
The length, width and height of each face of the building must be geometrically measured. There are four different wind suction zones in total (A, B, C and E). Zone D describes the windward side where wind pressure forces are generated (see Fig. 3). The length of each wind suction zone is determined by the geometrical constraints and DIN EN 1991-1-4 regulations.

The strongest wind suction forces occur in Zone A and decrease significantly in the direction of the wind (Zone B, C) (see Fig. 1 and 3). Zone E is on the leeward side of the building and corresponds in absolute terms to Zone C. The windward side of the building is defined as Zone D. The compressive stress generated by the wind has a positive value. Wind suction in wind zones A, B, C and E has a negative value. Since the wind can blow from any direction, Zone A may equally occur at any corner of the building. Thus separate calculations must be performed for all four wind directions on a rectangular plan view to determine the effect on the building and the results from each calculation must be superimposed on each wall.

There are three different ways of calculating the critical wind load – and thus the number of anchor fixings required – the simplified method, the practical method and the detailed method.

Simplified method
The simplified method assumes that the velocity pressure for buildings up to 25 m tall is constant over the entire height of the building in accordance with the standard. The maximum height is critical. The corresponding critical velocity pressures for the different wind suction zones are shown in Table 2.

Practical method
The practical method is even easier to use. Like the simplified method, it applies only to:
- building heights up to 25 m
- rectangular buildings
- height-to-width ratio h/d < 2

This method can be used only for wind zones 1 to 3. The classification of wind suction into different zones as shown in Figure 3 does not apply with this method.

All you have to do is determine the required number of anchor fixings for the area where the wind suction forces are greatest (Zone A). Then fit the resulting number of anchor fixings uniformly to all wall surfaces.

Detailed method
The detailed calculation method is always used with buildings over 25 m tall, although it can be used for any other building too.

### Table 1: Basic wind velocities $v_{w,0}$ and associated velocity pressures $q_{w,0}$ depending on the wind zone

<table>
<thead>
<tr>
<th>Wind zone</th>
<th>$v_{w,0}$ (m/s)</th>
<th>$q_{w,0}$ (kN/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22.5</td>
<td>0.32</td>
</tr>
<tr>
<td>2</td>
<td>25.0</td>
<td>0.39</td>
</tr>
<tr>
<td>3</td>
<td>27.5</td>
<td>0.47</td>
</tr>
<tr>
<td>4</td>
<td>30.0</td>
<td>0.56</td>
</tr>
</tbody>
</table>

### Fig. 3: Wind suction zones

Wind

Plan view

A

B

C

D

E

Elevation

A

B

C

Multipor ETICS
A detailed wind load calculation must be carried out in accordance with DIN EN 1991-1-4 and subject to the national application document (NAD) for all building for which the simplified or practical method does not apply (the maximum height is critical).

The velocity pressures and aerodynamic coefficients must be calculated for all areas of the building facade, differentiated by height and subject to the shape of the building. It is customary and indeed advisable to use software to calculate wind suction, because it enables specific wind suction loads for a given building to be determined. This calculation method can also be used with buildings which permit the simplified wind load calculation method.

Compared with the simplified method, this detailed calculation method can reduce the number of anchor fixings required – especially for building heights of just over 10 or 18 m – and thus reduce costs.

### Critical wind loads

To calculate critical wind loads, you need to know the wind zone, the associated basic velocity pressure $q_{b,0}$, the height-related peak velocity pressure $q_p(z)$ and the aerodynamic coefficients $c_{pe}$ (Table 1). These are also known as external pressure coefficients. External pressure coefficients have a negative value and are shown in Table 3. A negative external pressure coefficient indicates that wind suction occurs at the area under investigation.

The critical (peak) velocity pressure $q_p(z)$ depends on the height of the building and is calculated in accordance with DIN 1991-1-4, NA.B3.3.
For building heights \( \leq 7 \) m the following applies: \( q_p(z) = 1.5 \cdot q_b \).

The critical wind loads \( w_s = q_p(z) \cdot c_{pe} \) for the respective suction zones are derived from the product of the peak velocity pressure \( q_p(z) \) and the external pressure coefficients.

**Comparison of wind suction loads calculated by means of the detailed and the simplified method (Table 4)**

Calculating the effective wind suction load using the detailed calculation method:

Small building, \( h = 7 \) m, \( h/d = 2 \), wind zone 1

Peak velocity wind pressure \( q_p(z) \), as a function of height, as per DIN EN 1991-1-4, NA.B.1:

\[
q_p(z) = 1.5 \cdot q_b,0 = 1.5 \cdot 0.32 \text{ kN/m}^2 = 0.48 \text{ kN/m}^2
\]

**Note:** The value is smaller than the value given in Table 2 (0.50 kN/m²). This is because the values in Table 2 are designed for the simplified calculation method and include a safety margin.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Design wind suction</th>
<th>Simplified calculation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>( w_{s,a} = q_p(z) \cdot c_{pe,a} = 0.48 \text{ kN/m}^2 \cdot -1.475 )</td>
<td>( 0.50 \cdot -1.475 = -0.74 \text{ kN/m}^2 )</td>
</tr>
<tr>
<td>B</td>
<td>( w_{s,b} = q_p(z) \cdot c_{pe,b} = 0.48 \text{ kN/m}^2 \cdot -1.1 )</td>
<td>( 0.50 \cdot -1.1 = -0.55 \text{ kN/m}^2 )</td>
</tr>
<tr>
<td>C (and E)</td>
<td>( w_{s,c} = q_p(z) \cdot c_{pe,c} = 0.48 \text{ kN/m}^2 \cdot -0.55 )</td>
<td>( 0.50 \cdot -0.55 = -0.28 \text{ kN/m}^2 )</td>
</tr>
</tbody>
</table>

\(^{1)}\) numerical values interpolated

The values obtained can be used to determine the number of anchor fixings required. The comparative values shown in the right-hand column are derived from the simplified calculation method. These values can be read straight from Table 2 without having to calculate the height-related peak velocity pressure and are then simply multiplied by the aerodynamic (external pressure) coefficients.

Once the wind suction loads have been calculated, the quantity of anchor fixings required can be determined from Table 7.

The following examples illustrate the differences between the two methods.

**Examples of simplified and detailed calculation method**

1. **Sample wind suction load calculation**

   **Initial conditions:**
   - Small, rectangular house, simplified method
   - Wind load zone 1
   - Dimensions: \( w = 10 \) m, \( l = 14 \) m, \( h = 10 \) m

   Calculated action of the wind loads:
   - Figures 4 and 5 show the forces exerted by wind that have to be considered in accordance with the standard. It is clear from Figure 4 that wind suction and wind pressure respectively are assumed to be constant across the height of the building.
The wind suction load is greatest at the corners (edge zone) within the first fifth of the longer windward side of the building or the height (the smaller value applies).

Since the wind can come from any direction, these wind suction loads can occur vertically at any corner area. A corresponding wind suction load is also applied to the other sections of walls which run parallel to the wind direction.

This example shows that to factor in the two wind directions that are relevant to Zone A on the gable end, 40% of the surface of the gable wall must be regarded as the corner area.

When dealing with low wind loads and low buildings and to avoid design faults, it is therefore advisable to design the anchors for these corner margins and use the same spacing and number across the entire surface of the building (practical method).

**Determining the number of anchor fixings**

Using the wind suction forces derived from the simplified calculation method, it is now possible to work out the number of anchor fixings required per square meter from Table 7.

Zone A is critical. The number of anchor fixings used must not fall below the minimum number specified in the national technical approval (one anchor per mineral insulation board).

### 2. Sample wind suction load calculation

**Initial conditions:**
- Tall rectangle building, flat roof, detailed and simplified calculation method
- Wind load zone 1
- Dimensions: \( w = 15 \) m, \( l = 34 \) m, \( h = 24 \) m

(Fig. 6 and 7)
Wind distribution across the plan view is equivalent to the previous example in qualitative terms. Figures 6 and 7 show the critical zones (taking account of all wind directions), the loads and the number of anchor fixings required based on the simplified and the detailed calculation method.

**Table 6: Comparison of wind suction force \( w_e \) in kN/m\(^2\), simplified and detailed method**

<table>
<thead>
<tr>
<th>Wind zone</th>
<th>( w_e ) [kN/m(^2)]</th>
<th>( n_{anchor} ) [unit/m(^2)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplified calculation method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1.11</td>
<td>8</td>
</tr>
<tr>
<td>B</td>
<td>0.83</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>0.41</td>
<td>8</td>
</tr>
<tr>
<td>Detailed calculation method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculated &gt; 15 m</td>
<td>1.05</td>
<td>8</td>
</tr>
<tr>
<td>Calculated &lt; 15 m</td>
<td>0.88</td>
<td>6</td>
</tr>
<tr>
<td>Short side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total height</td>
<td>1.08</td>
<td>8</td>
</tr>
</tbody>
</table>
With the detailed method, the wind forces are no longer constant over the height of the building (Fig. 7).
The critical reference heights and height ranges are determined in accordance with DIN EN 1991-1-4 specifications.

Fig. 7 shows that it is advisable on economic grounds to determine the wind loads for the different zones and to calculate the number of anchors required using Table 7.

The geometric constraints of this example, whereby the smaller width is smaller than the height, means that no height differentiation is carried out on the gable end.

General determination of the number of anchors
With the aid of these wind suction forces it is now easy to work out the number of anchor fixings required – based on one square meter and allowing for the anchor load class.

<table>
<thead>
<tr>
<th>Table 7: Design number of anchor fixings required per m² as a function of height and wind zone, based on the simplified method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building height</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td><strong>Wind zone 1</strong></td>
</tr>
<tr>
<td>Wind zone 1 - Inland</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Wind zone 2 - Inland</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Wind zone 2 - Coast and islands in the Baltic Sea</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Wind zone 3 - Inland</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Wind zone 3 - Coast and islands in the Baltic Sea</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Wind zone 4 - Inland</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Wind zone 4 - North Sea and Baltic Sea coast and islands in the Baltic Sea</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Wind zone 4 - Islands in the North Sea</td>
</tr>
<tr>
<td>Anchor load class w_{ins} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
<tr>
<td>Anchor load class w_{RD} [kN]</td>
</tr>
</tbody>
</table>

1 Insulation thickness 60/80 mm 2 Insulation thickness 100 bis 300 mm 3 Minimum number of anchors 1 anchor/board; 4.3/m²
Sample calculation of the number of anchors as per Table 7

- Incident wind force $w_e$: 0.96 kN/m²
- Force $w_{RD}$ absorbed per anchor: 0.167 kN/anchor
- Number of anchors required: $n_{anchor} = \frac{w_e}{w_{RD}} = \frac{0.96 \text{ kN/m}^2}{0.167 \text{ kN/anchor}} = 5.7 \text{ anchor/m}^2$
- Selected: 6 anchor/m² or 1.5 anchor per board (390 \times 600 \text{ mm})

The comparison between the simplified and detailed method in Examples 1 and 2 indicates that there is relevant scope for savings, especially with building heights up to 15 m, although a detailed calculation of the number of anchors required for a residential home (maximum height 10 m) yields no appreciable savings.

It is clear from Example 2 that the number of anchors required can be reduced when calculating wind loads using the detailed method compared with the simplified method (see Figures 6 and 7). A wind load calculation of this type should be undertaken by an engineering office.

In the calculated example, 2 anchors/m² can be saved over a height of 15 m and a width of 30 m on the two longitudinal sides (excluding Zone C, where no savings can be made).

Number of anchors saved: 2 longitudinal sides \times 2 anchors/m² \times 15 m \text{ (height)} \times 30 m \text{ (length)} = 1,800 anchors

The cost of anchor fixings includes material and labor costs. It is clear that the detailed method is a more cost-effective option for the building in this example. At the same time, the building contractor is responsible for ensuring that the calculated number of anchors is actually installed in accordance with the static wind load calculation.

The steps for calculating the wind load and number of anchors required are summarized below.

- Determine the wind zone according to the location of the building
- Consider the prevailing wind directions, determine the wind suction zones (A, B, C) and how they are overlaid
- Calculate the aerodynamic coefficients ($c_{pe}$)
- Calculate the height, graduations in height and height-related velocity pressures ($q_{h}$)
- Calculate the peak suction forces by multiplying the velocity pressures by the aerodynamic coefficients for all surface areas.

The wind loads obtained in this way can then be used to calculate the number of anchors required. The rules of DIN EN1991-1-4 and the associated national annex must be complied with.

The procedure for the simplified method is similar, except there is no need to calculate the height-related velocity pressures, since the wind pressure is assumed to be constant across the entire height of the building.

With the practical method, all you need to do is multiply the wind pressure from Table 2 by the aerodynamic coefficient for Zone A (ledge zone), then apply the number of anchors obtained to the entire building.

The relevant anchor load class depends on the thickness of the insulation.

Our Multipor technical advisers are happy to help you determine the precise anchor dimensions. You can find your technical adviser on the contact page of our website at www.multipor.com.
3.5 Back-ventilated facades

Is a back-ventilated facade system with Multipor inconsistent with the use of an ETICS or is it in fact an improvement?

We think it’s a useful addition!

Just like ETICS, back-ventilated facade systems with the right insulation thickness provide an opportunity to upgrade existing buildings to meet tougher energy efficiency standards without losing valuable living space. Although technically complex, back-ventilated facades create a robust building envelope in terms of building physics and mechanical resilience.

The advantage of a back-ventilated facade is that numerous materials such as brick slips or thick plaster coatings can be used to make a creative statement. Through the use of color and combinations of different surface materials, the design can be matched to the building’s architecture to create individual facades.

Multipor ETICS mineral insulation boards have a German national technical approval in accordance with Z-23.11-1501 for use as insulation in back-ventilated facade systems and are governed by DIN 4108-10 when used in this way (as WAB – insulation to external wall, behind cladding).

Back-ventilated façade

A back-ventilated facade is a type of building envelope widely used in European industrial and office buildings and occasionally in residential buildings, which is characterized by an air gap between the insulated building and the weatherproof shell. This air gap continuously ventilates the back of the external cladding, evacuating moisture and excess heat, and separates it from the insulated supporting structure.

This separation also makes it possible to apply a sealed insulating layer to the outside of the building which is not in contact with the...
cladding. The cladding acts as a rain screen, protecting the building from the weather. In winter, this type of facade can protect critical areas from condensation – for example, due to snow accumulation.

**Multipor as insulation for back-ventilated facades**

Multipor offers many advantages as an insulating material for back-ventilated facades:

- **Multipor ETICS mineral insulation boards** are pressure-resistant and dimensionally stable.
- The subframe can be fastened directly to Multipor, which significantly reduces thermal bridging losses compared with conventional systems (see Figures 1 and 2).
- Multipor ETICS mineral insulation boards come in convenient, handy sizes, are easy to install and can be laid vertically or horizontally.
- The vapor-permeable, capillary-active material characteristics enable moisture to be transported from the inside to the outside by vapor diffusion. During extreme weather events, moisture that cannot be completely excluded is safely absorbed and released back into the air gap.
- In addition to the above-mentioned advantages, Multipor ETICS mineral insulation boards are designated a non-combustible Class A1 material which does not produce smoke or burning droplets in accordance with DIN EN 13501-1.

**Surface finish**

A back-ventilated facade system may consist of an outer cladding of brick slips mounted on a suitable support plate combined with Multipor ETICS mineral insulation boards as the insulating material. Alternatively, ‘thick plaster’ coatings or alternating layers of material may form the outer skin. The scope for creative freedom is virtually unlimited!

There is no conflict between the use of Multipor in back-ventilated facade systems and external thermal insulation composite systems. The Feldberger Hof Familotel, which features back-ventilated cladding with Multipor ETICS mineral insulation boards is a good example of this (Fig. 1; see Chapter 3.6).

**System structure of back-ventilated facade**

Back-ventilated facades are governed by DIN 18516. The main components are the external cladding, air gap, insulating layer and substructure.
The external cladding may consist of various materials, for example:
- high-pressure laminates
- metal sheeting and sandwich materials
- plastics
- fiber-cement panels
- mineral panel materials
- natural stone panels and brick slips mounted on a support plate.

The external cladding also serves as a weather-proof layer to repel driving rain and prevent moisture ingress. It is fastened to a subframe which generally comprises battens and counter battens mounted to the main building structure either directly or with brackets. Since the fasteners penetrate the insulating layer, they generally create thermal bridges or weak points in the structure of the back-ventilated cladding (see Figures 1 and 2).

Depending on the outer skin, the air gap may be slightly or well ventilated.

When calculating thermal resistance, air gaps in components are regarded as a special case.

Static air gaps provide thermal insulation. They are deemed to be static when their vent to the external environment complies with the following requirements:
- Air cannot flow through the gap.
- Openings have a surface area of max. 500 mm² per m length for a vertical air gap.
- Openings have a surface area of max. 500 mm² per m² surface for horizontal air gaps.

The thermal resistance of these air gaps depends on both their thickness and the direction of heat flow.

Air gaps are deemed to be slightly ventilated if the vent is:
- over 500 mm² to 1,500 mm² per m length for vertical air gaps
- over 500 mm² to 1500 mm² per m² surface area of horizontal air gaps

The thermal resistance of slightly ventilated air gaps can be calculated in accordance with DIN EN ISO 6946.

Air gaps are deemed to be well-ventilated when the size of the opening:
- exceeds 1,500 mm² per m length for vertical air gaps
- exceeds 1,500 mm² per m² surface area for horizontal air gaps.
A brief description of how to calculate the thermal resistance of back-ventilated cladding with air gap can be found in Chapter 7.1.1. The type of secondary ventilation to choose depends largely on the facade structure itself, although allowance must also be made for the effect of the air gap. When calculating the thickness of insulation, a slightly thicker layer is usually enough to offset the effects of a structure with or without a static air gap.

**Main building structure**
The main building structure absorbs the forces and encloses the rooms within it.

All loads from the back-ventilated facade are transferred to the main building structure via the subframe and the connections to it. Windows and doors are normally mounted directly to the main building structure.

**Insulating layer/insulating material**
Ideally, the insulating layer seamlessly encloses the entire building and all opening elements (windows and doors) lie with this layer. Mineral wool,wood fiber and extruded polystyrene are typically used as insulating materials.

The thickness of insulation may vary and should be designed in conjunction with the subframe.

**In combination with Multipor ETICS**
Multipor ETICS mineral insulation boards lend themselves for use in back-ventilated facades in public buildings where the facade is subject to heavy wear and tear (e.g. the entrance areas of schools).

The upper floors which are not exposed to increased mechanical loading can then be constructed as Multipor ETICS. This creates a cost-effective and durable solution which satisfies requirements.

One advantage of back-ventilated facades is that damaged individual facade elements can more easily be repaired or replaced than is the case with external thermal insulation composite systems.

**Residential buildings**
A combination of back-ventilated facade and ETICS can also be used to good effect in small family houses.

A back-ventilated facade on the windward side of the building can meet driving rain and intense solar radiation literally head-on and improve thermal protection in the summer. The ETICS areas on the other walls are exposed to lower hygrothermal loads. Consequently, the building can be designed to take account of all four cardinal points to minimize maintenance costs and maximize durability.

**Conclusion**
There is no conflict between the use of Multipor ETICS mineral insulation boards in back-ventilated facades and in external thermal insulation composite systems; in fact, it is a useful technical and/or stylistic addition. It creates an extremely robust solution and diverse surface designs for facades exposed to high hygrothermal loads. The subframe can be mounted directly to the Multipor insulation boards. There is no need for timber battens or aluminum profiles running all the way through to the main building structure.

The use of Multipor in the construction of back-ventilated facades alleviates the thermal bridging problems associated with conventional systems.

Considering the specific qualities of the two design variants, numerous useful combinations and systems can be created in this way.

If you have any further questions, please contact our Multipor technical advisers. You can find your technical adviser on the contact page of our website at www.multipor.com.
3.6 Multipor facade insulation reference projects

RREFERENCE PROJECT: PREFABRICATED APPARTMENT BLOCK IN EISENACH

Improving the thermal insulation of their prefabricated apartment blocks often presents a particular challenge to apartment operators in East Germany. When refurbishing the facade of a large prefabricated apartment block in Eisenach, the municipal housing association was won over by the structural and technical benefits of a mineral-based external thermal insulation composite system (ETICS). Despite difficult substrate conditions, the Multipor ETICS used, comprising two layers of insulation, proved a cost-effective and durable solution for achieving a high level of structural thermal insulation.

High degree of thermal insulation and attractive appearance
In addition to modernizing the heating and plumbing systems in the prefabricated block, there was a need to significantly improve the level of thermal insulation as part of the facade refurbishment. The housing association also used the ETICS to improve the building’s appearance.

Mineral-based and vapor-permeable
The facade of the prefab was renovated in the 90s to upgrade the thermal insulation, but was already showing signs of deterioration. As well as the weather causing some of the rendering to detach, there was widespread algal growth and woodpecker damage. So it was decided to install a robust Multipor ETICS with a mineral-based finishing render. Since this system is vapor-permeable, moisture does not build up on the external wall surface.
This reduces the risk of microorganism attack without the need for biocides.

**Fire protection and sound insulation**
The chosen ETICS had other positive characteristics which found favor with the planners and building contractors. The non-combustible insulating material (Class A fire rating) provided a high degree of fire protection without requiring the installation of fire barriers, as well as an improvement in sound insulation of up to 2 decibels compared with an uninsulated wall.

**Easy installation**
The ease of processing the mineral insulation boards was a further plus point.

The design of the facade, which featured projections, recesses, window reveals and cornices, could easily be accomplished using Multipor without the need for additional flashings.

**Problematic substrate**
The substrate had to be sufficiently load-bearing to allow the new ETICS to be bonded to it. So once the defective EPS insulation had been removed, the old coats of paint dating back to the time of the former German Democratic Republic were also removed. The uneven substrate was a particular challenge. In consultation with the housing association, the planners decided on a two-layer ETICS comprising a bonded and mechanically fastened first layer of boards with a second layer bonded to it. The base layer of insulation was used to divide up the surface of the facade and level out certain areas. Larger uneven areas were evened out by trimming or sanding the insulation boards.

**Rapid completion of ETICS**
Refurbishment began in June 2015. By December 2015 the project was completed on schedule. So residents were able to reap the benefits of greatly improved thermal insulation even before the onset of winter.
Multipor facade insulation reference projects

The Feldberger Hof Family Hotel is situated in the Black Forest in the highest village in Germany. When the owners decided to renovate the facade, they sought a solution that would provide long-term protection from the weather. Multipor ETICS mineral insulation boards were chosen for their building-physical characteristics as the insulation behind the cladding in the back-ventilated facade. Made entirely from mineral-based natural raw materials, Multipor ETICS mineral insulation boards provide economical and effective thermal insulation that complies with all relevant fire protection requirements.

Exposed to severe weather
The aim was to upgrade the energy performance of the hotel and apartment complex by refurbishing the facade. The exposed mountain setting at 1300 m above sea level and prevailing weather conditions – with frequent and often extreme driving rain and gale-force winds up to 200 km/h – placed exceptional demands on the insulating material.

The facade was to be renovated in two construction phases to bring it up to date with the latest requirements.

Pressure-resistant, weather-proof and fireproof
Both the structure and the insulation had to provide long-term weather resistance, guarantee a high level of fire protection and be quick to install. Furthermore, the back-ventilated facade structure had to have high compressive strength.
Multipor ETICS mineral insulation boards were ultimately chosen because they met all these requirements.

**Eco-friendly too**
Awards from natureplus, the German Institute for Construction and Environment and the eco-INSTITUT document and confirm that Multipor ETICS mineral insulation board is an ecological, sustainable and healthy construction product.

**High driving rain load**
The exposed position makes the facade construction vulnerable to driving rain. However, this does not pose a problem for back-ventilated facades insulated with Multipor ETICS mineral insulation board, since the mineral insulation board can store moisture temporarily and re-release it in a controlled manner.

**Installation**
In total, some 500 m² of Multipor ETICS mineral insulation boards were needed for each construction phase to renovate the apartment complex. The system was fitted to an existing wall consisting of 24-cm thick calcium silicate blockwork with a 2-cm thick layer of lime-cement plaster on the inside. Combined with the 18-cm thick Multipor ETICS mineral insulation board, this created a virtually monolithic system structure. In this case the insulation was designed to form part of a back-ventilated facade.

A weatherproof membrane with 5 m ≤ 0.12 m was applied to the insulation board, then the sub-frame required to support the large-format high-pressure laminated cladding panels was installed using anchor fixings inserted into the existing solid calcium-silicate wall.

Suction bolts designed specifically for the project were used to transfer the vertical loads.

Since the larch subframe on the weatherproof membrane was fixed directly to the Multipor ETICS mineral insulation board using suction and dynamic bolts, there was no thermal bridging. The facade structure now has a U-value of 0.216 W/(m²K).

This project clearly illustrates the versatility of Multipor insulation systems.
REFERENCE PROJECT: KEMPTEN HIGH-RISE BLOCK

The nine-story high-rise block in the Kempten, Bavaria, had to be completely refurbished because the existing back-ventilated facade contained asbestos materials and had also sustained moisture damage over the years. Keen to avoid further complications, the local social housing association Sozialbau Kempten Wohnungs und Städtebau GmbH was particularly concerned to choose the right external thermal insulation composite system. Key points on the list of requirements included fire protection, protection against algae and fungi, ecology and recycling.

An insulation system that's up to the challenge
The Multipor external thermal insulation composite system met the housing association’s strict requirements and largely thanks to its mineral composition, ticked all the boxes.

Fire protection
The Multipor ETICS invariably provides the required level of fire protection because the purely mineral-based Multipor ETICS mineral insulation boards are non-combustible and have a class A1 fire rating. The system as a whole, including Multipor lightweight mortar, Multipor reinforcement mesh and the mineral-based finishing render with silicate-based paint, is also non-combustible and has an A2 fire rating.
Algae and fungi
The building owners also demanded assurances when it came to algae and fungi, since the tower block is situated right beside the Iller mountain river. This proximity to the water had resulted in widespread algal and fungal growth on the previous facade. Any future system had to result in a long-lasting, pristine facade which was ecologically compatible – and that meant no biocides. The Multipor ETICS was particularly suitable for this purpose due to its high degree of permeability, which prevents a buildup of moisture on the surface of the insulated wall. The vapor-permeable combination of compatible system components prevents moisture accumulating on the wall surface because the wall absorbs moisture, temporarily stores it and releases it again as it rapidly dries. The Multipor ETICS with mineral-based finishing render also makes the use of biocides and other chemicals completely unnecessary.

Ecology and recycling
Multipor ETICS met the requirements for ecology and recycling with ease thanks to its environmental certificates.

These include the natureplus environmental seal, which is renowned for its strict ecological standards, and the environmental performance declaration of the German Institute for Construction and Environment (IBU). Multipor ETICS mineral insulation board has been awarded numerous certificates due to its natural, mineral-based composition consisting only of lime, sand, cement and water.

As a result, recycling is not an issue since the mineral-based raw materials can be recovered and reused. The system is very straightforward – Multipor off-cuts are sorted into separate fractions, collected in big bags and returned to the production cycle.
3.7 Installing Multipor ETICS

The Multipor ETICS is a high-quality insulation system that satisfies all modern construction requirements. The products undergo continuous internal and external quality inspections in our production plants. Combined with careful handling of Multipor mineral and plinth insulation boards during installation and finishing, this ensures a consistently high quality of execution.

Fig. 1: Overview of Multipor external thermal insulation composite system and its components
**Installing Multipor ETICS**

1. Multipor lightweight mortar for bonding Multipor ETICS mineral insulation boards to the substrate. If necessary, sandy or chalky substrates/old render can be consolidated with Multipor primer.

2. Insulating layer comprising Multipor ETICS mineral insulation boards 60 to 300 mm thick, preferably two layers.

3. 4 x 4 mm Multipor reinforcement mesh is embedded in the top third of the 5 to 6 mm thick reinforcement layer of Multipor lightweight mortar. The mesh strips must overlap by at least 10 cm. For additional reinforcement in impact-prone areas, Multipor armored mesh can be inserted beneath the surface reinforcement without overlapping.

4. Thin-layer mineral renders, Multipor silicate render, or Multipor silicone resin render in various grain sizes complete the system. Multipor structural render (scratch plaster/smooth plaster) and Multipor Munich-style rough render (rolled plaster finish) are optionally available with a grain size of 2 or 3 mm. To increase the working life of thin-layer structural finishing render, the reinforcement layer can be treated beforehand either with Multipor primer for absorbent surfaces, which reduces the absorbency of the substrate, or Multipor plaster primer.

5. System-compatible Multipor screw fixings for anchoring wall and plinth insulation.

6. Corner bracing for diagonal reinforcement of all corners of windows and doors beneath the surface reinforcement.

7. Mesh angle bead for reinforcing corners and edges. Inserted before the surface reinforcement.

8. Joint sealing tape or connection profile for a tight, flexible transition/connection to wood, sheet metal, plastic, steel etc.

9. W32-plus or W36-plus plaster finishing profile with mesh for a raintight plaster junction at windows, doors and similar structures.

10. Multipor reveal board for insulating door and window reveals without changing materials.

11. The W50-3 movement joint profile is used within the wall and at internal and external corners to accommodate small movements, e.g. in terraced houses. Suitable expansion joint profiles must be inserted in the ETICS to accommodate larger deformations.

12. Load distribution plate for absorbing light loads, e.g. letterboxes, lighting etc.

13. SOLI-TEX, S61 plinth rail with optional W63 extension profile.

14. W62-2 plug-in profile, which can also be used for side edges.

15. Damp-proof membrane.

16. Multipor waterproofing slurry as watertight seal for Multipor plinth insulation board.

17. Multipor plinth insulation board for insulating walls in contact with the ground.

18. 4 x 4 mm Multipor reinforcement mesh is embedded in the Multipor waterproofing slurry to reinforce the plinth.

19. Multipor lightweight mortar with smooth felted finish as plinth render.

20. 20 Drainage mat.

21. 21 Gravel backfill/paving.
Calculating material and labor costs
In order to calculate the cost of an external thermal insulation composite system, you have to work out the time and materials costs. The Multipor ETICS has nothing to fear from a cost comparison.

Standard time allowances
Our extensive experience shows that standard time allowances are virtually the same as for conventional ETICS.

Table 1 indicates the standard time allowance for Multipor ETICS with a thermal resistance of R of 3.5 m²K/W.

Table 1: Guide values for processing times

<table>
<thead>
<tr>
<th>Operation</th>
<th>Time requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonding</td>
<td>12–20 min/m²</td>
</tr>
<tr>
<td>Anchor fixing</td>
<td>2–3 min/anchor</td>
</tr>
<tr>
<td>Reinforcement/mesh filling</td>
<td>15–20 min/m²</td>
</tr>
<tr>
<td>Finishing render</td>
<td>8–12 min/m²</td>
</tr>
</tbody>
</table>

Health and safety on the construction site
Relevant health and safety regulations must be adhered to at all times to prevent accidents.

The processing of Multipor insulation systems is covered by safety requirements relating to working platforms and scaffolding as well as general construction site safety. Other technical rules and regulations also apply to ensure that construction site operations run smoothly. These include general personal safety and hygiene measures such as the wearing of safety goggles and dust masks during sanding operations, especially when working overhead.

Constructional requirements:
- All necessary connections (such as pipe penetrations, electrical installations etc.) must be completed before commencing installation.
- Fully functional vertical and horizontal barrier membranes must be fitted to all wall structures to protect against moisture ingress and rising damp.
- During processing, the air temperature and the component temperature must not fall below 5 °C.
- Adequate provision must be made for roof overhangs.
- Allowance must be made at the planning stage for the installation of recessed and surface-mounted fittings such as awnings, blinds, letterboxes, downpipes etc.
- Suitable profiles must be inserted in Multipor ETICS for movement and expansion joints.
- Suitable finishing profiles, joint sealing tapes or similar must be fitted to windows, external doors, window sills etc. for subsequent connection of the ETICS.

**Inspection and pretreatment of substrate**

The system approval sets out the following requirements for the condition of the substrate:

- Very absorbent or sandy substrates must be consolidated with a suitable primer.
- The wall surface must be stable, dry and free from dust and grease. Specialist advice must be sought to verify that any existing coatings are compatible with the adhesive mortar.

- The wall must have sufficient load-bearing capacity to allow the use of anchor fixings. It can generally be assumed that substrates made from masonry or concrete regulated by standards have sufficient strength, without the need for further verifications.
- Uneven areas up to 1 cm/m can be covered over, but larger uneven areas must be levelled by mechanical means (e.g. sanding) or with plaster in accordance with DIN EN 998-1.

Substrates with layers of old plaster and paint, especially in older buildings, must be checked by an expert. An on-site test can be carried out to verify whether an existing, unknown coating is compatible with Multipor lightweight mortar.

This involves sticking an entire Multipor ETICS mineral insulation board to the wall either with a fully-filled bond or using the buttering and floating technique if there are large areas of unevenness. Where there are different types of substrate, test each particular substrate separately. Leave the board in place for at least one week to ensure that the adhesive has had sufficient time to cure and dry out, and then pull it off. An alternative option is to embed mesh into a layer of adhesive mortar, cover it with foil, and then remove it after a week. If the adhesive does not bond to the substrate, or the old coating shows signs of softening, the substrate is assumed to be incompatible [1][2].

This a quick on-site test. Substrate testing is not regulated by standards.

Depending on the local conditions, different measures may be required to prepare the substrate. The insulation specialist is responsible for carrying out this work (Table 2).

---

**Table 2: Inspection of substrate prior to bonding Multipor ETICS**

(according to the Bundesausschuss Farbe und Sachwertschutz – Federal committee for paints and the protection of property)

<table>
<thead>
<tr>
<th>Inspection of</th>
<th>Test method</th>
<th>Detection</th>
<th>Technical information and measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface strength</td>
<td>Scratch test with solid, angular object</td>
<td>Moderate pressure damages the surface</td>
<td>Remove loose or friable material manually or by machine; soft coatings do not provide a stable substrate for ETICS</td>
</tr>
<tr>
<td></td>
<td>Rub surface by hand</td>
<td>Mild abrasion</td>
<td>Apply plaster-strengthening primer</td>
</tr>
<tr>
<td></td>
<td>Wet with water until saturation point is reached and then perform scratch test</td>
<td>The wetting test softens the surface</td>
<td>Remove unsound plaster, apply levelling plaster if necessary</td>
</tr>
</tbody>
</table>

cont. >
Table 2 continued: Inspection of substrate prior to bonding Multipor ETICS (according to the Bundesausschuss Farbe und Sachwertschutz – Federal committee for paints and the protection of property)

<table>
<thead>
<tr>
<th>Inspection of</th>
<th>Test method</th>
<th>Detection</th>
<th>Technical information and measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load-bearing capacity of old coating</td>
<td>Scratch test with solid, angular object</td>
<td>Areas of coating chip off when only moderate pressure is applied, scratch mark is jagged or bulging</td>
<td>Remove old paint/plaster, apply levelling plaster if necessary</td>
</tr>
<tr>
<td>Compatibility with existing old paint</td>
<td>Tear-off test</td>
<td>Detachment</td>
<td>Remove old paint/plaster, apply levelling plaster if necessary</td>
</tr>
<tr>
<td>Moisture</td>
<td>Visual inspection, and scratch test if necessary</td>
<td>Damp areas, water stains and discoloration evident</td>
<td>Building contractor to rectify structural causes, leave to dry out</td>
</tr>
<tr>
<td>Efflorescence</td>
<td>Visual inspection</td>
<td>Mainly white salts or leaching lime</td>
<td>Building contractor to rectify structural causes, then leave to dry out and remove salts</td>
</tr>
<tr>
<td>Moss and algal growth</td>
<td>Visual inspection</td>
<td>Mainly white salts or leaching lime</td>
<td>Remove mechanically or by pressure-washing with hot water, disinfect the affected areas as well if necessary</td>
</tr>
<tr>
<td>Other soiling</td>
<td>Visual inspection, feel test</td>
<td>Color, lubricating effect, stickiness</td>
<td>Remove</td>
</tr>
<tr>
<td>Absorption capacity</td>
<td>Wetting test with water</td>
<td>Rapid absorption of water and darkening indicates strong absorption capacity</td>
<td>Apply primer to highly absorbent substrates or substrates with varying levels of absorption</td>
</tr>
</tbody>
</table>

**Plinth insulation**

The plinth area is exposed to greater mechanical and hygric loads than other parts of the facade. As a result, perimeter and/or plinth insulation boards need to be installed in this area.

Before fitting the plinth insulation, the external wall must be tanked with a vertical damp-proof membrane as per DIN 18195. Then the boards can be applied using a suitable adhesive, taking care to ensure that the plinth insulation extends at least 30 cm above ground level [3–6].
Please refer to brochures, product data sheets and other technical specifications for general technical information about the use and installation of Multipor plinth insulation board. Multipor plinth insulation board is designed for use in the plinth area only and must not be used as perimeter insulation on basement walls. Nor should it be used in areas exposed to standing water or water under pressure.

The maximum embedment depth below ground level is 20 cm. In accordance with DIN 55699 (Processing of external thermal insulation composite systems), the height of the splash zone should extend at

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3.0 Multipor external thermal insulation composite systems (ETICS)

3.7 Installing Multipor ETICS

The substrate must be completely sound and clean in order to receive the mineral-based flexible slurry. A suitable mineral bonding bridge must be applied to damp-proof membranes made from thick bitumen coatings before bonding the Multipor plinth insulation board. Damp-proof membranes made from bitumen or plastic sheeting are not a suitable substrate for Multipor plinth insulation board.

Always bond Multipor plinth insulation boards with mineral-based, flexible Multipor waterproofing slurry. The bottom edge of the Multipor plinth insulation board can be cut at an angle of 45° [7]. This tapered edge makes it easier to subsequently seal the insulation board and to completely backfill the area without leaving any voids when completing the ground works. Cut faces must be primed. If the insulation board is butt-jointed straight on to projecting foundations or an existing perimeter insulation, leave the bottom edge uncut. Using a 10-mm notched trowel, spread the Multipor waterproofing slurry evenly over the entire surface of the plinth insulation board [8], then float the board into position [9] to ensure a full-surface bond.

Unlike internal and external insulation to walls, suspended floors and roofs, the butt joints and any bed joints in the plinth area must also be filled with waterproofing slurry. As a general rule, Multipor waterproofing slurry is always applied in a minimum thickness of 4 mm. The plinth insulation board is then secured with Multipor anchor fixings [10]. Fit one anchor fixing per insulation board, which equates to approximately 4.3 units/m². This also applies to boards that have been cut. Fit the anchor fixings before applying the reinforcement or surface coating and always above the 15-cm zone of the damp-proof membrane.

The reinforcing layer consists of 4x4 mm Multipor reinforcement mesh and “Multipor waterproofing” slurry. Wait at least one day before applying this layer to give the bond sufficient time to dry. Apply the waterproofing slurry with a 10-mm notched trowel and embed the mesh into the upper third of the reinforcing layer [11] [12]. At the bottom edge, take the coating – including the reinforcement mesh –
10 cm beyond the end of the board to form a waterproof seal right down to the damp-proof membrane.

The following variants are suitable for use as finishing render:
- Multipor lightweight mortar, felted finish, thickness approx. 3 mm
- Finishing render in compliance with Multipor ETICS approval (Z-33.43-596)

If the same thickness of insulation is used for the plinth insulation and the Multipor ETICS, a double layer of reinforcement with 4x4 mm Multipor reinforcement mesh is always applied.

Due to the variety of different finishing renders available, it is important to ensure that any water-repellent paints used are compatible with the rendering system. The area where the finishing render and paint is in contact with the ground must be protected from moisture. A further coat of mineral Multipor waterproofing slurry is suitable for this purpose [13]. An additional protective layer (e.g. dimpled membrane) must always be inserted between the waterproofing slurry and the external grounds. The top edge of both measures generally finishes 50 mm above ground level. The adjacent paved areas must be constructed with a fall or provision made for a linear drainage system (channel drain). Gravel strips approx. 30 to 50 cm wide are an effective means of reducing the impact of water splash [14].

**Plinth closure**

There are two equivalent methods available:
1. One option is to fit a suitable trough-shaped plinth rail (SOLI-TEX) using screws/anchor fixings appropriate for the insulation thickness, combined with compatible plinth connectors. Align the rail with a spirit level and fasten it to the wall roughly every 30 cm [15]. The plinth rail should not be tightly joined to allow for thermal expansion. Prefabricated elements (mitered) can be used to reinforce external corners and as spacers to accommodate unevenness in the wall behind the plinth rails. A combination of the W63 extension profile and the W62-2 plug-in profile can easily be inserted at the transition between the Multipor ETICS mineral insulation board and the recessed plinth insulation for a quick, thermal-bridge-free alternative. The welded-on reinforcement mesh is then embedded in the surface reinforcement and together with the integrated drip edge forms a neat finish to the finishing render.

---

**Lay a strip of gravel**

**Apply the Multipor reinforcement mesh and plaster it in**

**Coat the finishing render with Multipor waterproofing slurry in the plinth area in contact with the ground.**

**Fit the plinth rails**
2. The alternative method is to fit a mesh angle bead to the wall by embedding it in Multipor lightweight mortar and then lay the first course of Multipor ETICS mineral insulation board in it. A W40-2 mesh angle bead with drip edge fitted to the front edge of the first course ensures that the underside of boards is enveloped in mesh [16][17], thus enabling the plinth to be fully rendered.

**Mixing Multipor lightweight mortar**
Mix the Multipor lightweight mortar with the quantity of water indicated on the mortar bag according to the directions and the safety precautions. These state, for example, that Multipor lightweight mortar should not be used if the air or component temperature falls below 5°C. The Multipor bucket is graduated to make it easy to measure the quantity of water accurately. Once mixed, Multipor lightweight mortar can then be used to bond, reinforce and where necessary render Multipor ETICS mineral insulation boards. To obtain a workable consistency it is advisable to use a low-speed mixing machine and a robust mixer with long paddles [18]. Leave the lightweight mortar to cure for around five minutes, then mix again before use.

**Practical tip:** The graduated Multipor bucket makes it easy to add the correct quantity of water when mixing the Multipor lightweight mortar.

- 8 l of water per 20 kg bag of lightweight mortar for mixing with the paddle mixer
- Processing time: approx. 1.5 hours, depending on the weather
- Multipor lightweight mortar has a high coverage rate; 30 l of fresh mortar per bag is enough to cover approximately 5 m² as an adhesive mortar applied with a 10-mm notched trowel or approximately 6 m² as a reinforcement layer. The buttering-and-floating or ‘edge bead-point’ methods each require a greater quantity of adhesive, depending on the condition of the substrate.

Always follow the storage instructions and directions for use on the mortar bag. Multipor lightweight mortar can be stored on a pallet in a dry place for up to 12 months from the date of manufacture.

Do not use any mortar other than Multipor lightweight mortar with Multipor ETICS. We cannot guarantee the performance of the adhesive bond or the overall system if a different adhesive mortar is used.

**Installing Multipor ETICS mineral insulation boards**
Make sure that the following tasks have been completed before installing the Multipor ETICS mineral insulation boards:
- Windows and doors fitted.
- Finishing profiles fitted to windows, doors etc. [19].
- Pre-compressed joint sealing tape or suitable plaster finishing profile inserted between the Multipor ETICS mineral insulation board and the adjacent component at all connections (e.g. window sills) [20].
Apply a full bed of Multipor lightweight mortar to the back of the board using a suitable notched trowel [21] to a thickness of 10 to 12 mm to compensate for up to 5 mm substrate unevenness.

For larger areas of unevenness (up to 10 mm), the mortar can also be applied using the buttering-and-floating method or edge bead-point technique, where at least 70% of the board is covered with adhesive mortar [22]. Then float the Multipor ETICS mineral insulation board into position and press against the substrate [23].

When using a plastering machine, apply the Multipor lightweight mortar to the back of the board and comb it through.

Start by applying the first course of boards at the bottom corner of the building, butting each board up flush with the next in a bonded pattern with an overlap of at least 15 cm.

Cut notches in the insulation boards to fit them round the corners of windows and doors. This avoids corner joints and thus prevents cracking [24].

At the corners of buildings, stagger alternate courses of Multipor ETICS mineral insulation board by overlapping the end of one board beyond the corner of the building by the thickness of the board, including the mortar [25]. After curing, any excess adhesive mortar can easily and quickly be removed with a Multipor sanding board.

Defects or gaps in the insulating layer can be rectified with Multipor ETICS mineral insulation board or Multipor filler.
Connection to windows, window sills and roller shutters, see Chapter 3.3

Points to consider:
- Connect the Multipor ETICS to reveals or window frames either by inserting pre-compressed sealing tape in a troweled groove or using a suitable finishing profile. The mesh wings of the finishing profile can be embedded straight into the surface reinforcement.
- Insulate the frames of surface-mounted windows or windows flush with the masonry to a minimum thickness of 3 cm [26].
- Make sure window sills have an adequate fall (> 5%)
- Take the greatest possible care when installing window sills and connecting them to other elements.
- Insert the rubber seals before fitting the screw plate to the window frame.
- Fit additional window sill brackets to window sills with an overhang > 150 mm. Fasten these to the load-bearing wall before installing the window sill.
- The window sill must be arranged so that the inside of the edge beading forms a flush seal with the finishing render. Fit slip joint connectors to window sills > 3 m to allow for thermal expansion and contraction.
- Recommendation: Insert a sound-absorbing strip beneath the window sill for sound insulation.
- Joint sealing tape can be used to connect the bottom of the window sill to the Multipor ETICS.
- Roller shutter boxes within the insulation layer must be clad with insulation (to a minimum thickness of 60 mm) [28]. Use render baseboard if the window opening is large or the front face of the roller shutter box does not provide a suitable substrate for bonding.
- Finishing profiles can be used at the front and sides to connect blind and roller shutter guide rails to the Multipor ETICS [29].
- For surface-mounted roller shutter boxes which project beyond the insulation layer, take the insulation right up to the box (but not too tightly) and connect with suitable finishing profiles.
Cutting/processing Multipor ETICS mineral insulation board

Points to consider:

- Multipor ETICS mineral insulation boards can be trimmed to size accurately and effortlessly using a fine-toothed handsaw [30]. Dust is not a problem, unless you are making extensive use of high-speed sawing machines.
- Slight variations in height after bonding can be quickly rectified with the Multipor sanding board [31]. The sanding board can also be used to shape the insulation boards to the contours of the building [32] [33]. It may be necessary to prime sanded surfaces before applying the reinforcement.

Installing anchor fixings to Multipor ETICS mineral insulation boards

Points to consider before installing anchor fixings:

- Use at least one approved Multipor anchor fixing (washer diameter ≥ 60 mm) per insulation board to mechanically fasten Multipor ETICS mineral insulation boards. Allow at least one day for the adhesive mortar to cure before installing the anchors. Insert the Multipor anchor fixings before applying the reinforcing render and mesh [34] [35].
- DIN EN 1991-1-4 governs actions on structures, including wind actions. The number of anchors required may need to be increased in accordance with this standard, depending on the wind load.
- The anchoring depth depends on the manufacturer’s specifications and the substrate (Table 3).
- When selecting a suitable anchor, make sure it is approved for the system and that the use category indicated on the anchor fixing corresponds to the substrate. If the substrate does not obviously fit any category, pull-out tests must be conducted on site.
Fitting corner beading and profiles

Points to consider:
- Before applying surface reinforcement, mesh angle beads must be fitted to the corners of the building and the window and door reveals with Multipor lightweight mortar to strengthen the edges [36] [37].
- Corner reinforcing mesh embedded in Multipor lightweight mortar or a piece of mesh cut to size (approx. 20 x 40 cm) prevents stress cracking at the corners of window and door openings. These must also be inserted before applying the surface reinforcement [38].

Reinforcing mineral insulation boards

Points to consider before applying the reinforcement render:
- The adhesive mortar beneath the Multipor ETICS mineral insulation boards must be sufficiently firm.
- All Multipor anchor fixings must be flush with the surface.
- The surface of the Multipor ETICS mineral insulation boards must be level, dry and free from defects and soiling. Check that the board joints are smooth and that any height variations have been sanded down.
- Any open gaps between the Multipor ETICS mineral insulation boards must be sealed with insulating material or with Multipor filler mortar.
- Connections to other components (e.g. penetrations or window frames) must be completed.
- Partially inserted mesh angle beads, finishing profiles and corner reinforcement mesh must be secured with Multipor lightweight mortar. Make sure the lightweight mortar is sufficiently dry and cured.
Using a suitable notched trowel, apply a 5-mm layer of Multipor lightweight mortar to the Multipor ETICS mineral insulation boards [39]. Then press vertical or horizontal strips of Multipor reinforcement mesh into the wet mortar with a trowel or float, making sure there are no creases [40]. Overlap the mesh strips by at least 10 cm where they join and make sure that the Multipor reinforcement mesh lies in the top third of the reinforcement layer.

In areas with extra reinforcement (window reveals etc.), the Multipor reinforcement mesh should overlap the mesh angle beads in the same way as the surface reinforcement. It may be necessary to apply an additional layer of mortar wet-on-wet to completely cover the mesh [41].

**Applying the finishing render**

Points to consider before applying the finishing render [42]:

- The reinforcement layer must be dry and cured as far as possible. As a rule of thumb: Allow 1 day’s drying time per 1 mm render thickness under normal weather conditions.

- Depending on the weather and the finishing render, a primer for absorbent surfaces or an adhesion promoter can be applied between the base coat and finishing coat.

- The air and surface temperature must be at least 5 °C.

- The following finishing renders are approved for use on top of a reinforcing layer of Multipor lightweight mortar: Multipor lightweight mortar, Multipor structural render, Multipor rough render, Multipor silicate render and Multipor silicone resin render.

- Paints and self-colored finishing renders must have a luminosity ≥ 30.

Apply the render to the entire surface using a stainless steel trowel, strike off to grain thickness then immediately trowel to a uniform smooth or textured finish. The finished thickness of the finishing render should correspond to a grain thickness of 2 to 3 mm [42] [43].
3.7 Installing Multipor ETICS

Render the surface continuously and without interruption to avoid visible transitions in the surface finish. Drying times may vary depending on the temperature, layer thickness, relative humidity and wind conditions.

A list of suitable, approved finishing renders that meet the above-mentioned requirements is available on request.

Ceramic cladding

Ceramic cladding in the form of brick slips, tiles, natural stone panels or thick-bed finishing render cannot be applied directly to the Multipor ETICS. Cladding made from thick materials must be applied to a cement-based plaster baseboard and a suitable substructure.

More information about back-ventilated facades can be found in Chapter 3.5.

Painting

We recommend the following paints for Multipor ETICS:

- Mineral paints
- Vapor-permeable silicate paints (pay attention to coating thickness)

Recommendation: Use Multipor silicate facade paint to obtain a good surface finish.

It may be necessary to prime the substrates (mineral finishing render), depending on the type of paint. As with finishing renders, the luminosity must be not less than ≥ 30.

Multipor ETICS

Multipor ETICS mineral insulation boards combined with system-compatible components create a complete external thermal insulation composite system. Table 4 indicates the approximate coverage of basic components. Table 4: Coverage of basic components

<table>
<thead>
<tr>
<th>Material</th>
<th>Approximate coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipor lightweight mortar for bonding</td>
<td>3.5 kg/m² for full-bed bond with 12-mm notched trowel</td>
</tr>
<tr>
<td>Multipor mineral insulation boards</td>
<td>4.3 boards/m²</td>
</tr>
<tr>
<td>Multipor screw-in anchor</td>
<td>min. 1 anchor/board corresponds to 4.3 anchor/m²</td>
</tr>
<tr>
<td>Multipor reinforcement mesh</td>
<td>1.1 m²/m²</td>
</tr>
<tr>
<td>Multipor lightweight mortar for reinforcement</td>
<td>3.5 kg/m² – one 20kg bag is thus sufficient for 6 m² with 5-mm layer thickness</td>
</tr>
<tr>
<td>Multipor finishing render, mineral-based</td>
<td>Grain size 0 – 2 mm – 3.2 kg/m²</td>
</tr>
<tr>
<td>Multipor silicate render</td>
<td>Grain size 0 – 2 mm – 3 kg/m²</td>
</tr>
<tr>
<td>Multipor silicone resin render</td>
<td>Grain size 0 – 3 mm – 4.3 kg/m²</td>
</tr>
<tr>
<td>Multipor lightweight mortar as finishing render</td>
<td>Grain size 0 – 2 mm – 2.5 kg/m²</td>
</tr>
</tbody>
</table>

If you have any further questions, please contact our Multipor technical advisers. You can find your dedicated technical adviser on the contact page of our website at www.multipor.com.
The method of load attachment depends on the anticipated load and the stress. The choice of fastening mechanism and its location largely depends on these factors too.

- Mechanical fastening of light loads to the Multipor ETICS mineral insulation board
- Mechanical fastening of heavy loads through the Multipor ETICS mineral insulation board

**Note:** In buildings regularly visited by the public, loads should be anchored to the load-bearing substrate to prevent vandalism.

**Attaching light loads**

Spiral anchor: Light, static loads such as lightweight signs [1] or house numbers with a pull-out load up to 6 kg and a maximum hole spacing of 600 mm can be mounted directly to the Multipor ETICS mineral insulation board using the Multipor spiral anchor [2].

The anchor can be inserted directly without drilling. To avoid damaging the facade and the Multipor ETICS mineral insulation board, carefully slit the render and the reinforcement mesh with a Stanley knife [3], before screwing in the Multipor spiral anchor (50 mm, 85 mm, 120 mm) with a T 40 Torx bit [4].

Objects fastened to external components must be sealed all the way round to prevent moisture ingress.

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**Diagram:**

1. Lighting or similar loads
2. Multipor ETICS spiral anchor
3. Carefully slit the render coat
4. Insert the Multipor spiral anchor

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3.0 Multipor external thermal insulation composite systems (ETICS)

3.8 Attaching loads to Multipor ETICS

**Multipor telescopic device mount**
This mount can be used for installing lights, motion sensors and other devices without using anchor fixings. With a minimum center distance of 120 mm, it can be combined and extended both vertically and horizontally as desired. It must be installed before fitting the insulation. With integrated cable routing, it is safe and easy to connect electric wiring. The device mount is suitable for loads up to 5 kg [5][6].

**Attaching heavy, dynamic loads**
We recommend attaching loads over 6 kg and all movable and variable loads as well as dynamic loads/stresses to the load-bearing substrate rather than the Multipor ETICS mineral insulation board.

**Multipor load distribution plate**
The Multipor load distribution plate is suitable for objects which exert pressure on the facade after installation [7]. It thus provides a particularly suitable substrate for letterboxes and newspaper holders. The outer cover of electric speaker and bell systems can also be securely mounted on load distribution plates.

**Multipor mounting cylinders and blocks**
Multipor mounting cylinders [8] and Multipor mounting blocks [9] are suitable for the attachment of loads up to 14 kg, such as window shutters, lights or rainwater downpipes. They are easy to cut to the thickness of the insulation and are bonded with Multipor lightweight mortar in the Multipor ETICS mineral insulation board and to the substrate. The mounting cylinders and blocks are made from high bulk density EPS and can easily be plastered with system-compatible render. They are available by the length or as individual elements, depending on the thickness of insulation. Screws can be screwed in repeatedly without adversely affecting the stability of the mounting elements.
Offset mounting systems

There are various offset mounting systems made by different manufacturers on the market. Choose the offset mounting system to suit the load. Suitable system solutions for the following applications may have to be sourced separately.

- Attaching rainwater downpipes [10]
- Attaching canopies
- Attaching awnings (in accordance with DIN EN 13561 “External blinds and awnings – Performance requirements, including safety”, awnings must be anchored to the load-bearing substrate using an offset mounting system [11].)
- Hanging baskets
- Ladder hooks

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COST-EFFECTIVE HEALTHY CAPILLARY-ACTIVE VAPOR-PERMEABLE REFURBISHMENT MODERNISATION LISTED FACADE HALF-TIMBERED BUILDING BASEMENT ECO-FRIENDLY NATURAL SUSTAINABLE HIGH INSULATING ENERGY-EFFICIENT EXECUTION RELIABILITY INHIBITS MOULD COMFORTABLE INDOOR CLIMATE NON-COMBUSTIBLE SOLID CREATIVE SURFACE FINISH SOUND INSULATION PLANNING CERTAINTY EXECUTION RELIABILITY CAPILLARY-ACTIVE VAPOR-PERMEABLE COST-EFFECTIVE REFURBISHMENT BASEMENT FACADE