Preface

We are delighted to introduce the first English edition of the Multipor Insulation Guide, which is based on the second German edition. Two years ago, we decided to dedicate an entire handbook to the subject of insulation. It proved to be the right decision, and we have since received very positive feedback. We are particularly pleased to learn that planners are using our design information and builders are putting our practical tips to the test – leading to more technically mature solutions.

With Multipor and the insulation market continuing to develop, the time has come to revisit the contents. Are the energy requirements still up-to-date? To what extent has Building Information Modelling (BIM) become an everyday tool for planners? What has happened in terms of recycling? A great deal has changed in the last two years. Change keeps us on the move. And that’s a good thing. Read the introduction in Chapter 1 to see what changes we have made.

We have developed new products such as the Multipor plinth insulation board, which is particularly relevant in view of discussions about cladding fires. New approvals granted by the German Institute for Building Technology (DIBt) now stipulate that fire barriers must be fitted round the perimeter of the plinth, the ground floor ceiling and the roof of buildings containing flammable facade insulation. However, a fire barrier does not need to be installed when using a Multipor external thermal insulation composite system. This is because with Multipor, the plinth area can be designed to create a single, non-flammable system running from the plinth to the roof. We have also added a new product to the chapter on interior insulation – Multipor compact plus interior insulation. Designed to prevent mold and minimize thermal bridges, this compact, eco-friendly, mineral-based system is particularly useful for enhancing energy performance with a low insulation thickness.

These are just two aspects that have been included in the revised planning and installation sector of the Multipor Insulation Guide. In addition, we have improved several areas and provided additional practical tips. We hope that this information-packed resource will prove useful in helping you achieve successful results in your daily work.

With our extensive experience and your skills, together we can solve all your insulation issues.
Latest edition now on the web!

The Multipor Insulation Guide online

Always available, always up-to-date!

Full information at www.multipor.com/bim.php

The Multipor Insulation Guide containing full details of our mineral insulation systems is available online. The interactive e-book includes a range of useful functions to make it as easy as possible for you to use. It is updated at regular intervals so you can always find the latest information and data.
Natural insulation – we’ve got a system

Multipor insulation systems

Multipor external thermal insulation composite systems (ETICS)

Multipor interior insulation systems

Multipor ceiling insulation systems

Multipor roof insulation systems

Building physics
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Building Information Modelling

Full information at [www.multipor.com/bim.php](http://www.multipor.com/bim.php)
Renovation, refurbishment and modernization

Multipor insulation systems provide an effective means of insulating new buildings and refurbishment projects. Thanks to the special combination of Multipor mineral insulation boards and Multipor clay mortar, the existing fabric of historic half-timbered buildings can be retained when carrying out energy-efficient refurbishments.
Natural insulation – we've got a system

Multipor interior insulation system

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Internal wall

Products and processing
Ytong and Silka building materials*
New and commercial buildings require individual solutions tailored to the needs of each project. Multipor makes it possible to satisfy different energy-performance requirements with ease.
Natural insulation – we’ve got a system

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* MORE INFORMATION ABOUT YTONG AUTOCLAVED AERATED CONCRETE AND SILKA CALCIUM-SILICATE BLOCKS CAN BE FOUND IN OUR CONSTRUCTION GUIDE AT www.ytong-silka.de/baubuch
Natural insulation – we’ve got a system

SYSTEM SOLUTIONS ECO-FRIENDLY SUSTAINABLE HEALTHY NAT
PURELY MINERAL-BASED VERSATILE VAPOR-PERMEABLE NEW
BUILDING INHIBITS MOULD MODERNISATION ENVIRONMENTALL
ECONOMICAL SOUND INSULATION ENERGY-EFFICIENT
RESOURCES-FRIENDLY COST-EFFECTIVE ECONOMICAL VAPOR-PER
MEABLE CAPILLARY-ACTIVE OUTSTANDING ENVIRONMENTAL
FOOTPRINT 100% RECYCLABLE VAPOR-PERMEABLE ENERGY-
EFFICIENT VERSATILE SUSTAINABLE ECO-FRIENDLY ECONOMICA
Natural insulation – we’ve got a system
ECO-FRIENDLY
SUSTAINABLE
HEALTHY

NATURAL INSULATION – WE’VE GOT A SYSTEM
MULTIPOR – SUSTAINABLE AND VERSATILE!

Multipor insulation systems are an ecological solution to sustainable construction and refurbishment. The core component of the system is the Multipor insulation board; an entirely mineral-based insulating material made from sand, lime, cement and water. The material’s special structure, which resembles the tried and tested solid construction material Ytong, gives the lightweight, easy-to-handle boards the perfect combination of key characteristics: Dimensional stability, vapor permeability and non-combustibility.

The insulation systems are used in new and existing buildings to insulate interiors, the underside of ceilings, basements and garages as well as slab, pitched and flat roofs. Multipor mineral insulation boards are also approved for use in external thermal insulation composite systems (ETICS). Thanks to their versatility, Multipor insulation systems can help meet current climate protection targets and achieve a climate-neutral building stock by 2050. With a focus on durability and value retention, the systems also appeal to public procurement bodies and investors involved in the energy-efficient refurbishment of buildings. These target groups need to know they can trust in the reliability and performance of the system across all areas – including deconstruction and disposal of building materials.

Multipor’s future-proof credentials are further enhanced by its compatibility with the new interdisciplinary, model-based process BIM (building information modelling). BIM is designed to make planning and construction workflows more efficient. But what effect does the new BIM planning process have on workflows and what new roles and responsibilities does it entail? We will address these and other issues in this second, revised edition of the Multipor Insulation Guide, now available in English.
THE UNIQUE BENEFITS OF MULTIPOR INSULATION SYSTEMS

The Multipor insulation board is an environmentally friendly, entirely mineral-based insulating material made from sand, lime, cement and water. Thanks to the special structure of the material, the lightweight, easy-to-handle boards combine several key characteristics which offer unique advantages when incorporated into the system.

System supplier
Multipor offers a complete insulation system for all areas of application. From facades and interiors to ceilings and roofs – we provide every system component required to carry out successful insulation work. Our extensive scope of supply includes Multipor mineral insulation boards, accessories, tools and service. This approach ensures that all system components are perfectly compatible with one another.

No burning, no smoldering, no smoke generation
Multipor mineral insulation boards are A-rated, non-combustible construction materials. Even at extremely high temperatures, the insulating material does not produce toxic fumes, smoke or burning droplets. So it’s not surprising that Multipor ETICS with approved finishing render 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 thermal insulation and fire protection requirements.

Solid, dimensionally stable and woodpecker-proof
Pressure-resistant Multipor ETICS mineral insulation boards perform to their strengths – whether on the facade of a school subject to high mechanical loads or in a detached house in need of refurbishment. With a comparatively high bulk density of approx. 110 kg/m³, once bonded they create a monolithic system structure which sounds like a solid wall when tapped. This prevents woodpecker damage; even rodents would have difficulty biting through the solid insulating material.
Protection against algae and fungi – without biocides
Surface moisture causes microbiological contamination. But with the Multipor ETICS, virtually no moisture arises in the first place. Rapid redrying combined with a high heat storage and water absorption capacity prevent the problem occurring in a natural way. This is because mineral systems have optimum diffusion properties. Rather than ‘sealing’ the walls completely, they can absorb and re-release moisture. This automatically creates a stable temperature and moisture balance. Unlike many conventional plastic-bonded insulation materials, the use of Multipor ETICS with a mineral-based finishing render eliminates the need for toxic biocides in the final coat.

Thermal insulation
Mineral-based and therefore fiber-free, Multipor mineral insulation boards take thermal insulation to a new level: Solid and highly thermally insulating with a thermal conductivity of up to $\lambda = 0.042$ W/(mK). Multipor insulation can significantly reduce a building’s energy demand, resulting in long-term energy and cost savings. Insulation not only makes sense in terms of heating costs; optimal thermal insulation also increases the value of a property. Furthermore, the system more than satisfies the increasingly stringent requirements of the German Energy Saving Ordinance (EnEV).

Quick and easy to apply
Multipor mineral insulation boards allow interior insulation to be fitted without using costly vapor barriers. The manageable size and low weight of the insulation boards makes the process virtually effortless. Precision-cutting closers and recesses for pipe penetrations is child’s play. The solid, dimensionally stable material is quick and easy to apply. And being free from fibers, it is pleasant and safe to work with. Multipor mineral insulation boards bond readily using the Multipor lightweight mortar specially formulated for the system. The boards can easily be sanded to remove any surface irregularities.

Moisture control and a healthy indoor climate
Conventional solutions for vapor-resistant interior insulation have led to a variety of problems and costly refurbishments due to vapor barriers being incorrectly installed. In contrast, vapor-permeable and capillary-active Multipor mineral insulation boards can regulate the moisture balance independently. They absorb condensation and release it again without forfeiting their basic product characteristics, and so create a balanced indoor climate.

Eco-friendly insulation system
Multipor mineral insulation boards are produced in an eco-friendly way with the raw minerals lime, sand, cement and water combined with a pore generator. These constituents make Multipor an environmentally safe building material. Multipor mineral insulation boards have been certified by the German Institute for Construction and Environment (IBU) for their outstanding environmental compatibility.

Multipor has also been awarded the natureplus seal of quality by the International Association for Sustainable Building and Living as a sustainable, future-proof product. The certification of Multipor mineral insulation boards confirms that the product is non-polluting, does not release harmful emissions and has an excellent environmental footprint – from the raw materials to the manufacturing process, and finally to disposal.
Natural insulation – we’ve got a system

COMPLETE SYSTEM CONFIGURATION

All relevant data for the design and planning of facade, interior wall, roof or ceiling insulation are available for Multipor. This allows planners to incorporate system solutions with different insulating effects into their projects. Multipor experts have selected more than 150 typical designs for facade insulation (ETICS), internal wall insulation, roof and ceiling insulation from our diverse product range and prepared them as BIM objects. The system solutions include not just Multipor mineral insulation boards, but our other wall elements too, so that users can model the entire system configuration.

ESUCCESSFUL PLANNING AND CONSTRUCTION WITH BIM

The construction industry is undergoing its very own digital revolution. Most Multipor insulation solutions are now available on the Xella website as BIM objects in established Revit and ArchiCAD formats. Data from here can be transferred directly into the planning process.
THE FOURTH DIMENSION
BIM data models can be used to illustrate the entire building life cycle, from inception to recycling of the building. BIM adds a fourth dimension – time – to the modelling process, enabling the entire construction project to be planned and visualized throughout its lifetime. This multidisciplinary approach to modelling helps planners optimize construction site processes and logistics workflows. Quantities, build costs and building materials, machines and personnel are included in the model from the outset, enabling construction and assembly processes to be simulated. Deadlines can be predicted with greater accuracy, and conflicts and problems detected at an early stage. BIM data models are an invaluable basis for building management, demolition, disposal and material recycling.

EASY DOES IT
The Multipor Library contains over 150 typical insulation designs as BIM objects in Autodesk Revit and ArchiCAD file formats. Log on at www.multipor.com/bim.php and download the relevant product free of charge for unlimited use.

TRANSPARENT PROCESSES
When planners adopt the BIM modeling approach, the whole team collaborates on a single data file. All information about every aspect of the project is stored in a data model. Information about possible changes to the design can be accessed directly by all those involved, both as a drawing and a data package. For instance, if you change the thickness of the insulation, the measurements in the model are adjusted accordingly. And when the measurements change, the cost calculation is automatically adjusted. What’s more, interface problems are immediately visible to all those involved in the design process. This creates transparency throughout the entire process, from the planner to the client, and prevents planning errors from the outset. For me, the benefits of planning and construction with BIM are crystal clear – it’s all about transparency.

Dr Holger Griebel, Head of Product Management Multipor
ENEV 2017 ON THE HORIZON

The current version of the German Energy Saving Ordinance (EnEV) only partially transposes the European Energy Performance of Buildings Directive (EPBD). From 2021 onwards, all new buildings should be nearly-zero-energy buildings, whilst public buildings must comply with this requirement as early as 2019.

EnEV
The Energy Saving Ordinance

EnEG
Energy Saving Act

EEWärmeG
Renewable Energies Heat Act

It is assumed that the German government will take this opportunity to simplify existing energy requirements and merge the regulations to create a Building Energy Law. This new law will combine and harmonize the Energy Saving Act (EnEG) and the Renewable Energies Heat Act (EEWärmeG).

More stringent requirements are expected in terms of new buildings, existing buildings and renewable energy to improve climate protection. The German Ministry of Construction is currently examining the impact of existing requirements on residential building costs.
Ultimately, energy-saving requirements have been largely responsible for an increase in general build costs. Whether these additional costs are offset by savings on energy costs, and above all, heating costs will also be examined. Cost considerations should not be overlooked in the implementation of the European Energy Performance of Buildings Directive: “This directive promotes the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.” (Source: European Directive on the Energy Performance of Buildings EPBD). One can only hope that the German amendment takes account of European directives and that the cost-benefit ratio will be preserved. Xella’s Multipor insulation system contributes to cost-effectiveness, whilst at the same time taking energy-saving, value-retention and recycling requirements into account.

MULTIPOR IS READY

With Multipor, we are ideally prepared and so unfazed by the challenges presented by the revised Energy Saving Ordinance. To assist with energy performance planning, the Multipor website provides detail drawings and a digital thermal bridge catalogue for calculating thermal bridges. Thermal bridges are weak spots which reduce the energy efficiency of the building envelope and should be avoided. The additional losses caused by geometric or construction-related thermal bridges increase a building’s heating demand by 25 percent or more.

Well-thought-out detailed solutions can help put a stop to these ‘cold spots’. The Xella Thermal Bridge Catalogue contains typical detail drawings for solid masonry construction and modernization projects. These have proven equivalence with all the details in Supplementary Sheet 2 of DIN 4108. This precise verification process eliminates the need to apply a general – i.e. non-specific – thermal bridge correction factor.

The latest developments and information concerning the Energy Saving Ordinance can be found in the online version of this Insulation Guide. We also publish the latest developments on our website, along with corresponding product solutions.

CHANGE AHEAD

The revision is expected to be published at the start of 2017. So what is likely to change? Substantial changes are anticipated regarding thermal bridges. A project-based thermal bridge correction factor is expected to be introduced in the revised Energy Saving Ordinance. Corrected values may be considered in situations where construction details do not correspond to the design examples in DIN 4108 Supplementary Sheet 2. Drafts of the new DIN V 18599-2 and the planned new supplementary sheet 2 already address these concerns.

2014
EnEV requirements increased

2016
Revised EnEV requirements came into force

2017
New draft law on energy-efficient building expected

2021
Nearly-zero-energy standard for all new buildings and renovation roadmaps for existing building stocks at EU level
Head of Product Management Multipor for Xella Deutschland GmbH Dr Holger Griebel has more than twenty years’ experience in the construction industry. Here he gives us some inspiring and personal insights into his work.

**What’s new at Multipor?**
You’re holding one of our latest achievements in your hand, the 2nd edition of the German Multipor Insulation Guide, now available in English. The guide is designed to provide advice and suggestions about the use of Multipor. In terms of new products, we have launched the plinth insulation board and the compact plus interior insulation. The plinth of a building is subject to significant stresses, so the requirements for insulation in this area are correspondingly high. The Multipor plinth insulation board exceeds these requirements, even in terms of non-combustibility. The Multipor compact plus interior insulation system increases the surface temperature in critical areas and so prevents mold. The trend towards digitalization is another new aspect of the construction market. We have responded swiftly to this development. Our products are BIM-ready.

**In your view, what are the benefits of BIM?**
Projects of all sizes can be handled in one single file. I also like this transparent approach to planning. The model and all its dimensions can be accessed by everyone involved.

**Is BIM likely to catch on in the medium term?**
It’s not a question of if, but when. Overcoming a fear of the unknown is the main hurdle. But you just have to give it a go and get some experience. If you run into difficulties, there are plenty of places to turn to for support. And our specialist staff at Multipor are always happy to help.

**What can we expect from EnEV 2017?**
It seems likely that a project-based thermal bridge correction factor will be introduced. We’re not worried about this. We have an excellent insulating material, low-thermal bridge insulation solutions, detail drawings and a digital thermal bridge catalogue. Our experts are happy to provide help and advice where necessary and in special cases.
Have we seen an end to discussions about fire protection with regard to ETICS?
Yes, absolutely. The engineering specifications are set out in the approvals. Fire barriers are now mandatory for certain insulating materials and building heights. However, the question of the complexity of installation and subsequent recycling still needs to be addressed. It is better to use a single, non-combustible insulating material for the entire facade, from the plinth right up to the roof. Then the issue of fire barriers becomes redundant.

Are ETICS particularly suitable, or unsuitable, for certain project sizes?
We achieve good results in many areas of application, from family homes to large-scale publicly funded projects, and increasingly with housing associations and investors who are particularly concerned about value retention. These target groups require reliability above all else. And no nasty surprises during demolition or when disposing of the building materials.

What is Multipor doing to address the issue of material life cycles?
We provide Multipor Big Bags to collect processing waste on the building site, which is then returned to the production process. So virtually nothing goes to waste and the loop is closed.

Why should a building contractor choose Multipor?
Multipor interior insulation ensures a well-balanced indoor climate. Mold has no chance, because Multipor acts as a moisture buffer, drawing water from the surface. It works in exactly the same way with ETICS. Materials that dry off quickly are less prone to attack. This is why Multipor insulation boards and systems with mineral-based finishing render do not need biocidal treatment. So Multipor is completely safe and eco-friendly.

Two sentences about the new Multipor Insulation Guide?
The industry is facing many changes: New regulations, unknown territory (BIM) and changing customer requirements. We have addressed these changes in the second edition of the Insulation Guide.

What other trends are emerging in the construction industry?
Well, the digitalization of business processes is an obvious one. Not just BIM, but production processes as well, for example. By adapting to these changes quickly, we gain a competitive edge.
RECYCLING – THE ETERNAL CYCLE

People generate a wide variety of different waste types which pollute our environment for prolonged periods because they are excluded from natural material cycles. Valuable resources concealed in the waste are used only once before being irretrievably lost in incineration plants or landfill.

It is an inescapable fact that, in the long term, we must take a leaf from nature’s book and adopt the life-cycle principle. The solution is to take a more considered approach to product design to ensure that all materials used circulate continuously in biological or technical cycles. So right from the start, we should be thinking about what will happen at the end – and focus on continuous product cycles.
Multipor is keen to recycle as many of the raw materials we use as possible on both economic and ecological grounds. So Multipor products are compatible with the life-cycle approach. This means that they can be fed back into the raw material cycle and used in the production cycle to create new Multipor or AAC products.

**XELLA CLOSES THE LOOP WITH BIG BAGS FOR MULTIPOR WASTE**

Xella Deutschland has developed a simple and effective means of closing the loop for Multipor mineral insulation boards. Much too good to throw away: Multipor mineral insulation boards have been a popular insulating material for many years, mainly due to their excellent thermal insulation properties. This is largely down to the air trapped in the pores. And air is known to be a very good insulator. But on most building sites, offcuts and waste end up in the skip. Although the quantities may be small, this waste creates disposal costs for the builder and is irretrievably lost as a raw material. Our search for an ecological and cost-effective solution led us to the Big Bag scheme. Customers can order a building site recycling pack along with their building materials – comprising big bags and coded closures together with a return label and accompanying leaflet.

Multipor offcuts are sorted and collected in big bags on site. The bags are then sealed with coded closures, placed on pallets and returned to the production plant. Here the waste is ground down and fed back into the production process.

Since introducing the Big Bag scheme, more than 412 tonnes of mineral insulation has been fed back into the loop within a year. Not bad, considering that 210 million tonnes of mineral waste are generated each year in Germany – around 60 percent of Germany’s total volume of waste. Another reason why the Multipor material loop is ecologically and economically valuable for the environment.

For more information about recycling, please go to www.multipor.com/recycling.php
A healthy living environment and ecological considerations are important assessment criteria for building materials. Then there’s the question of sustainability, which Multipor has addressed with its recycling strategy. Annette Hillebrandt, Professor of Building Construction, Design and Materials Science at the University of Wuppertal, takes a look at thermal insulation during the transition to clean energy.
This attitude changed when industrialization precipitated the extensive extraction of fossil fuels on a global scale. For decades the ‘energy demand for heating’ parameter, even in simple homes for the majority of the population, was overlooked. The building envelope satisfied the need for stability, protection, water and wind tightness and at best, social status.

It was not until the publication of ‘DIN 4108: Thermal insulation in high-rise buildings’ in the middle of the last century that the term ‘minimum standard of thermal insulation’ was coined, signaling an initial awareness of the issue – even though the primary aim was to satisfy requirements for comfort and hygiene. The impact of the first energy crisis finally convinced us of the need to change the parameters again. This led to the rapid publication of the first German Ordinance on Thermal Insulation (Wärmeschutzverordnung) in 1977. It was not the scientists’ words of warning, but our own experience of energy shortages which brought about this rethink.

Today we have achieved passive house insulation standards; nearly-zero-energy homes and even energy-plus homes are a reality. After centuries, we have come full circle back to the realization that we should aim to minimize the heating demand. The global Paris Climate Agreement and the EU Commission’s new climate protection plans now present us with new challenges. As predicted in “The Limits to Growth”, our quality of life, and ultimately our survival on this planet, depend on two factors: The continuing availability of large quantities of resources – that can be extracted with reasonable effort – and a drastic reduction in environmental pollution.¹

It’s not energy that we are short of, but raw materials, compounded by a vast amount of waste generated by the construction industry, which in Germany amounts to more than 50 percent of the total volume of waste.² This waste contains many hazardous substances. Well-insulated homes can reduce some of the environmental pollution caused by CO₂ emissions from the combustion of fossil fuels. But this proportion, and thus the impact on climate protection, is rapidly diminishing, especially as we gradually switch to renewable fuels.

From a research standpoint, the energy transition has been accomplished and all that remains is to solve the problems of storage (on a large scale) and distribution. The legacy of the energy transition – environmental pollution as a consequence of disposal – is our future concern. A hazard warning label has only recently become mandatory throughout the EU in accordance with the CLP Regulation for hexabromocyclododecane (HBCD), a substance which has been widely used as a flame retardant in polystyrene insulating materials for decades. Now classified as hazardous, it may only be disposed of by incineration in waste disposal facilities which are licensed to handle this type of waste, and supporting documents must be provided.
Products containing HBCD can no longer be recycled. Another disposal problem resulting from the energy transition relates to the generation of renewable energy from wind turbines. Wind turbine blades are usually made from glass-fiber reinforced plastics, materials which cannot be recycled in the foreseeable future.

Policymakers are called upon to swiftly introduce ‘proof of resource conservation’ as a basis for issuing building permits. Before planning permission can be granted, a deconstruction plan must be submitted, together with proof that the building can be disposed of at the end of its life in a way that is cost-neutral for society as a whole. By designing and constructing the house as an ‘urban mine’, in other words, as a structure made from recyclable materials that can readily be dismantled, the owner can generate an income from the sale of the materials when the building is deconstructed. If, on the other hand, the deconstruction process generates waste which is disposed of in landfill or even entails the disposal of hazardous substances, the building permit should only be granted if the owner provides a corresponding reserve fund in the form of a deposit. This is the only way to prevent disposal costs at the end of a building’s life being passed on to society – the decommissioning of nuclear power stations being a notable example.

The future of any product design within “The Limits to Growth” lies in recognizing resource depletion and environmental pollution as key parameters and establishing a “Design for Urban Mining”. All materials and substances used in construction must be recyclable to the same quality grade as the original product. It must be possible to selectively deconstruct and recover all installed materials and components. Future insulating materials will make the leap from the energy transition to the resource transition!

1 Dennis Meadows “The Limits to Growth – A Report for the Club of Rome’s Project on the Predicament of Mankind” dva informativ, Stuttgart 1972
3 German Federal Environment Agency publication ‘Answers to frequently asked questions to hexabromcyclododecane (HBCD)’, Download at https://www.umweltbundesamt.de/publikationen/answers-to-frequently-asked-questions-to
The Environmental Product Declaration from the German Institute for Construction and Environment (IBU), which complies with ISO 14025/14040 ff. and DIN EN 15804, certifies that Multipor mineral insulation boards are low-polluting, do not release harmful emissions and have an excellent environmental footprint.

Multipor has also been awarded the ‘natureplus’ seal of environmental quality in recognition of its high level of environmental compatibility. This prestigious ISO 14024-compliant environmental seal is granted only to construction products from sustainably sourced raw materials which are produced in a climate-friendly, non-polluting way and do not release any harmful substances into the environment.

Indoor air analysis is carried out to measure and compare air pollution in indoor environments. The volatile organic compound (VOC) content of Multipor mineral insulation boards has been tested and certified by the private eco-INSTITUT in Cologne. VOCs can cause symptoms such as headaches, tiredness or a general feeling of unwell. The investigation showed that Multipor is free from harmful concentrations of VOCs. Both Multipor mineral insulation boards and Multipor lightweight mortar achieved the highest standard: A+. The product has therefore been awarded the eco-INSTITUT label in recognition of its environmentally friendly raw materials.
Multipor insulation systems
Multipor insulation systems

2.0 System reliability for a wide range of applications

Multipor insulation systems offer solutions tailored to the area of application (see Fig. 1) and to the requirements of the structure to be insulated.

Multipor external thermal insulation composite system (ETICS)

An environmentally friendly, solid, dimensionally stable and non-combustible Multipor ETICS facilitates the construction of seamless external walls without thermal bridges, from family homes to multistorey buildings. The extensive, mineral-based system also includes a range of accompanying products such as Multipor finishing render. The Multipor ETICS offers unique advantages in terms of building physics, creating a sustainable facade insulation which retains its value and satisfies the energy performance requirements of both the German Energy Saving Ordinance (EnEV) and energy-efficient housing standards. Multipor material and ETICS

After almost 20 years of continuous use, the mineral-based Multipor insulation system has lost none of its innovative power. On the contrary: Its unique characteristics and versatility, both in new buildings and existing stock, place the Multipor insulation system in a class of its own.

The core component of the system is the Multipor mineral insulation board, which is produced in a resource-friendly way using the raw minerals lime, sand, cement and a pore generator. Another outstanding feature of the system is that it provides certainty in terms of design and construction, and functionality in terms of building physics.

The Multipor mineral insulation board thus satisfies the insulation requirements of any construction project sustainably, effectively and efficiently.

Fig. 1: Areas of application as per DIN 4108-10

<table>
<thead>
<tr>
<th>Wall</th>
<th>Roof/ceiling</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Diagram" /></td>
<td><img src="image.png" alt="Diagram" /></td>
</tr>
<tr>
<td>External insulation to wall, behind cladding</td>
<td>Internal insulation to suspended or ground floor (topside) below screed, without sound insulation requirements</td>
</tr>
<tr>
<td><img src="image.png" alt="Diagram" /></td>
<td><img src="image.png" alt="Diagram" /></td>
</tr>
<tr>
<td>External insulation to wall, behind render</td>
<td>Internal insulation to suspended floor (underside) of roof, insulation below rafters/structure, suspended ceiling, etc.</td>
</tr>
<tr>
<td><img src="image.png" alt="Diagram" /></td>
<td><img src="image.png" alt="Diagram" /></td>
</tr>
<tr>
<td>Internal insulation to wall</td>
<td>External insulation to suspended floor or roof, protected from the weather, insulation below waterproofing</td>
</tr>
<tr>
<td><img src="image.png" alt="Diagram" /></td>
<td><img src="image.png" alt="Diagram" /></td>
</tr>
<tr>
<td>Insulation between party walls</td>
<td>External insulation to suspended floor or roof, protected from the weather, insulation below roof covering</td>
</tr>
</tbody>
</table>
approvals ensure safe application at both national and European level.

The insulation system with corresponding approved finishing render is classed as an A-rated construction material. It does not burn, smolder or produce burning droplets, toxic fumes or smoke. Thus the ETICS satisfies all fire protection requirements without the need for customary fire barriers.

With a higher bulk density than other systems, it forms a monolithic system structure which is solid, dimensionally stable, woodpecker-proof and capable of withstanding severe mechanical loads.

The Multipor ETICS combined with a mineral-based, water-vapor-permeable rendering system redries rapidly and has a high heat storage capacity, which stops persistent surface moisture accumulating on insulated external walls. These characteristics prevent the wall from ‘sealing’, and thus inhibit the growth of algae and fungi, based on the principle that ‘the longer it stays dry, the longer it remains algae-free’.

Multipor interior insulation system

The vapor-permeable, capillary-active Multipor interior insulation system can be used to insulate the inside of walls in buildings of historic or cultural value. This system has already been used to upgrade the energy performance of several million square meters of wall – breathing new life into old buildings by creating comfortable living spaces and valuable new uses (adaptive-reuse projects). Listed buildings can also be sensitively modernized in strict accordance with the requirements for historic building conservation – to current energy performance standards and without diminishing the overall appearance. Compatible Multipor system components such as Multipor lightweight mortar and reinforcement mesh make it possible to retrofit modern interior insulation without the need for costly, error-prone vapor barriers. Excess room moisture is absorbed by the mineral insulation boards and subsequently released back to the indoor air. In this way Multipor not only improves the thermal insulation value and the surface temperature, it also regulates the moisture balance in a natural way, which has a beneficial effect on the indoor climate.

Multipor external thermal insulation composite system (ETICS)
The use of Multipor interior insulation systems that have been tested for harmful substances provides the ideal basis for healthy living. This has been confirmed by the latest VOC analysis conducted by the independent eco-INSTITUT in Cologne.

**Multipor interior insulation system with clay mortar**

Multipor mineral insulation boards and Multipor clay mortar are the ideal combination for upgrading the energy performance of half-timbered buildings. Both materials have building-physical properties which complement each other perfectly. The vapor-permeable insulation system compensates for undesirable condensation and prevents moisture damage in the long term. This creates a healthy indoor climate and protects historic wall structures that are worthy of preservation. Multipor clay mortar is a blend of powdered clay and natural sands which contains no chemical aggregates.

Its ecological properties make it suitable for allergy sufferers.

**Multipor ceiling insulation system**

The non-combustibility and thermal insulation of Multipor mineral insulation boards and Multipor lightweight mortar guarantee low heating costs and a high level of fire protection when used to insulate garage and basement ceilings. Quick and straight-forward adhesive installation makes the job of fitting insulation in new or existing buildings particularly cost-effective. This is why mineral-based Multipor ceiling insulation systems are used in residential and office buildings as well as special buildings such as shopping malls and stadiums.

**Ventilation shaft insulation**

Air quality plays an increasingly important role in modern buildings. Fresh air – sometimes in vast quantities – is drawn in via solid, suitably sized ventilations shafts, supplied to air conditioning systems and then distributed around the building. The walls of the ventilation shafts must be insulated with material that meets specific quality requirements. Multipor mineral insulation board together with its system components meets these high standards and is the ideal insulating material for ensuring high indoor air quality.
### Multipor roof insulation systems

There are various ways of insulating pitched and flat roofs, but only Multipor roof insulation systems are capable of handling any conceivable load. Thanks to their non-compressibility, high compressive strength and non-combustibility, they are suitable for all types of application – from loaded to unloaded pitched and flat roofs. ‘Cut-to-fall’ insulation constructed with Multipor mineral insulation boards also guarantees that flat roofs will drain effectively.

### Screed insulation

Multipor mineral insulation boards are used in floor structures due to their high compressive strength and non-compressibility. Whether for refurbishing lofts or as industrial floor screed insulation – with a layer structure of an appropriate thickness, Multipor fulfills all expectations regarding energy conservation and load distribution.

### Thermal insulation

Owners and users of buildings spend around one quarter of Germany’s total energy consumption in maintaining comfortable room temperatures. Modern buildings constructed to the latest energy-saving standards have made little impact on this statistic. In contrast, buildings constructed before 1980 that have not been refurbished are real energy guzzlers. And they account for more than 75% of the entire building stock. Retrofitting Multipor insulation systems can reduce energy consumption significantly, and effectively in terms of building physics. The energy-efficient refurbishment of the existing housing stock not only makes economic sense, it also increases property values and improves housing quality.

Multipor insulation systems always provide a level of thermal insulation compliant with EnEV standards or energy-efficient housing standards. In addition, they markedly improve the insulating properties when fitted to interior walls, ceilings, roofs or external facades. The effectiveness of the insulation is expressed in terms of thermal resistance [R-value in m²K/W] (see Table 1).

### Fire protection

The natural, mineral raw materials contained in Multipor make it a non-combustible class A1 building material as per DIN EN 13501-1.

---

Table 1: Thermal resistance (R-value) [m²K/W] of Multipor mineral insulation boards

<table>
<thead>
<tr>
<th>Design value of thermal conductivity (λ) [W/(mK)]</th>
<th>Board thickness [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.042</td>
<td>60 80 100 120 140 160 180 200 220 240 260 280 300</td>
</tr>
<tr>
<td>0.047</td>
<td>– – – – 2.553 2.979 3.404 3.830 4.255 4.681 5.106 5.532 5.957 6.383</td>
</tr>
</tbody>
</table>

Available by request or as double-layer construction
2.0 Multipor insulation systems

Environmentally friendly production of Multipor mineral insulation boards

Mineral-based, vapor-permeable Multipor insulation systems have a track record going back almost 20 years. Recognizing the need for innovative, user-friendly insulation solutions, we developed Multipor by refining the lower thermal conductivity of Ytong autoclaved aerated concrete (AAC).

Sand, lime, cement and water – the mineral-based natural raw materials found in AAC – provided the inspiration for developing a purely mineral-based natural insulation. Its outstanding building-physical properties can be attributed to the technical expertise gained in Ytong AAC production.

Multipor mineral insulation boards are manufactured in a similar way to Ytong AAC. Ground quartz sand, lime and cement are mixed with other raw materials to form a raw slurry, then a pore generator is added before the mixture is poured into molds. This produces tiny, uniform pores, measuring 0.5 to 1.5 mm. A nature-identical mineral (tobermorite) forms during subsequent steam curing which largely determines the properties of the mineral insulation board. Incidentally, our environmentally friendly processes ensure that any steam, condensate and production waste generated are returned to the production cycle. Finally, Multipor mineral insulation boards are stacked in small, manageable packs on Euro pallets and shrink-wrapped in recyclable film.

Certified environmental protection

Multipor mineral insulation boards are made from natural, environmentally safe raw materials. They contain no fibers or other harmful substances. The European Product Declaration (EPD) issued by the German Institute for Construction and Environment (IBU) establishes their ecological credentials.

Multipor is Europe’s only mineral insulation board to have been awarded natureplus certification and to have been VOC-tested by the eco-INSTITUT in Cologne.

Delivery and handling

Multipor insulation systems together with all system components should ideally be delivered straight to the point of use wherever possible to avoid unnecessary costly and time-consuming interim transport. However, if interim storage is required, a stable, level and dry storage site will ensure a smooth construction workflow and prevent damage to the materials. Our experienced hauliers have vehicles equipped with a hydraulic crane or fork lift to ensure that individually packed or palleted insulating boards are carefully placed on a flat substrate beside the vehicle.

Fig. 2: Loading instructions
It is also possible to set down the materials close to the installation site by arrangement, subject to feasibility.

We can provide more compact vehicles to deliver goods to smaller construction sites by special arrangement. These vehicles are also suitable for supplying small additional quantities. Use only suitable, approved lifting gear for unloading and handling. Pallet trucks can also be used to transport Multipor mineral insulation boards on hard surfaces. The clamp on the lifting gear must pass round the pack and underneath the pallet to grip the load securely during unloading. Under no circumstances should the clamp grip or press the Multipor mineral insulation boards directly (see Fig. 2), nor should pallets be stacked. Care must also be taken to prevent any cables, chains or slings used during unloading from damaging the material.

Small, manageable packs of Multipor mineral insulation boards are bundled on a pallet which is shrink-wrapped to protect it from the weather. The shrink-wrap also serves to keep the packaging unit stable and should not be removed until just before use.

A complete building system
The product range of Multipor insulation systems includes mineral insulation boards, accessories, tools and services which together are designed to offer practical and cost-effective solutions for all component applications. Our Multipor technical advisers will gladly answer any questions about our products. They will advise you on the correct use of the insulating material and help you plan efficiently and with confidence – for instance by conducting building-physical analyses using modern hygrothermal calculation methods.

Find your Multipor technical adviser on the contact page of our website at www.multipor.com.
SYSTEM SOLUTIONS EXTERNAL THERMAL INSULATION COMPOSITE SYSTEM
FAÇADE INSULATION AESTHETIC ECO-FRIENDLY HIGHLY INSULATING
ENERGY-EFFICIENT VAPOR-PERMEABLE CAPILLARY-ACTIVE UNIFORM
NEW BUILDING REFURBISHMENT INHIBITS ALGAE BUILDING AUTHORIZATION
APPROVAL COST-EFFECTIVE PERFORMANCE RELIABILITY SOLID DIMENSIONALLY STABLE WOODPECKER-PROOF NON-COMBUSTIBLE
RECYCLABLE SUSTAINABLE HEALTHY SOUND INSULATION REFURBISHMENT COST-EFFECTIVE AESTHETIC FACADE INSULATION VAPOR-PERMEABLE
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.

1. No burning, no smoldering, no smoke generation

2. Protection against algae and fungi – without biocides

3. Solid, dimensionally stable and woodpecker-proof

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 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).

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.

The specific product characteristic values are available to download on the online DGNB navigator at http://www.dgnb-navigator.de/
General introduction and planning 3.1

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>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>≥ 300 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>$\lambda = 0.043 W/(mK)$ – declared value $\lambda_{10,ay} = 0.042 W/(mK)$ – limit value $\lambda_{10,ay} = 0.18 W/(mK)$</td>
<td></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>–</td>
</tr>
<tr>
<td></td>
<td>– Long-term (28 d) as per DIN EN 12087</td>
<td>W_p, = 2.0 kg/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W_{pp}, = 3.0 kg/m²</td>
</tr>
<tr>
<td>Water absorption</td>
<td>– Water absorption coefficient due to capillary action as per DIN EN 1015-18</td>
<td>W2, c ≤ 0.2 kg/(m² 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 mm (in increments of 20)*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>600x500 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d = 50 – 300 mm (in increments of 25)**</td>
<td></td>
</tr>
<tr>
<td>Material requirement</td>
<td>4.3 boards/m²</td>
<td>approx. 30 l/20 kg; sufficient for approx. 6 m² reinforcement with a 5-mm layer thickness</td>
</tr>
</tbody>
</table>

* from the Stulln and Cologne/Porz factories
** from the Dobrich factory
Multipor external thermal insulation composite systems (ETICS)

3.0 General introduction and planning

3.1 General introduction and planning

load-bearing capacity of external walls (e.g. in multistorey buildings). Table 2 summarizes the U-values that can be obtained.

Table 2: U-values of functional walls with Multipor ETICS mineral insulation board – new buildings

<table>
<thead>
<tr>
<th>Designation</th>
<th>Ytong AAC PP 4-0.50 / $\lambda = 0.12$ W/(mK)</th>
<th>Silka calcium-silicate block PP 2-0.35 / $\lambda = 0.09$ W/(mK)</th>
<th>XL Basic 20-1.8 / $\lambda = 0.99$ W/(mK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall thickness $B_1$ in cm</td>
<td>15.0 20.0 24.0 30.0 36.5</td>
<td>17.5 30.0</td>
<td></td>
</tr>
<tr>
<td>Multipor insulation thickness $B_2$ in cm</td>
<td>U-values [W/(m²K)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.35 0.31 0.28 0.20 0.18</td>
<td>0.56 0.53</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0.30 0.27 0.25 0.19 0.16</td>
<td>0.45 0.43</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.27 0.24 0.22 0.17 0.15</td>
<td>0.37 0.36</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>0.24 0.22 0.20 0.16 0.14</td>
<td>0.32 0.31</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>0.22 0.20 0.19 0.15 0.13</td>
<td>0.28 0.27</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>0.20 0.18 0.17 0.14 0.12</td>
<td>0.25 0.24</td>
<td></td>
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<tr>
<td>18</td>
<td>0.18 0.17 0.16 0.13 0.12</td>
<td>0.22 0.22</td>
<td></td>
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<tr>
<td>20</td>
<td>0.17 0.16 0.15 0.12 0.11</td>
<td>0.20 0.20</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>0.16 0.15 0.14 0.12 0.11</td>
<td>0.19 0.18</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>0.15 0.14 0.13 0.11 0.10</td>
<td>0.17 0.17</td>
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<tr>
<td>26</td>
<td>0.14 0.13 0.12 0.11 0.10</td>
<td>0.16 0.16</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>0.13 0.12 0.12 0.10 0.09</td>
<td>0.15 0.15</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.12 0.12 0.11 0.10 0.09</td>
<td>0.14 0.14</td>
<td></td>
</tr>
</tbody>
</table>

- $\leq$ Reference value [0.28 W/(m²K)]
- Recommendation for passive houses
- Recommendation for energy-efficient houses
- Recommendation for EnEV standard 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, $\lambda_{ext, 0.9} = 0.18$ W/(mK) (Multipor lightweightmortar)

$R_{n} + R_{se} = 0.17$ 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>Wall thickness $B_1$ in cm</td>
<td>24.0</td>
<td>30.0</td>
<td>36.5</td>
</tr>
<tr>
<td>Multipor insulation thickness $B_2$ in cm</td>
<td>U-value [W/(m²K)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.50</td>
<td>0.48</td>
<td>0.46</td>
</tr>
<tr>
<td>8</td>
<td>0.41</td>
<td>0.40</td>
<td>0.38</td>
</tr>
<tr>
<td>10</td>
<td>0.35</td>
<td>0.34</td>
<td>0.33</td>
</tr>
<tr>
<td>12</td>
<td>0.30</td>
<td>0.29</td>
<td>0.29</td>
</tr>
<tr>
<td>14</td>
<td>0.27</td>
<td>0.26</td>
<td>0.25</td>
</tr>
<tr>
<td>16</td>
<td>0.24</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>18</td>
<td>0.22</td>
<td>0.21</td>
<td>0.21</td>
</tr>
<tr>
<td>20</td>
<td>0.20</td>
<td>0.19</td>
<td>0.19</td>
</tr>
<tr>
<td>22</td>
<td>0.18</td>
<td>0.18</td>
<td>0.17</td>
</tr>
<tr>
<td>24</td>
<td>0.17</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>26</td>
<td>0.16</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>28</td>
<td>0.15</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>30</td>
<td>0.14</td>
<td>0.13</td>
<td>0.13</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.
Multipor plinth insulation board

Multipor plinth insulation board is always used in conjunction with mineral-based, flexible Multipor waterproofing slurry [Table 6].

**Fire protection**

It is important to ensure that any planned ETICS complies with all thermal and fire protection requirements. This also means checking on a case-by-case basis that the intended insulating material complies with regional planning regulations (in Germany, the building codes of the respective federal states).

A Multipor ETICS with mineral-based finishing render is a non-combustible system that complies with all fire safety requirements without the need for costly solutions such as fire barriers. Multipor plinth insulation board, which is also non-combustible, is the perfect companion for this system. For further questions, please contact your Multipor technical adviser on the contact page of our website at www.multipor.com.

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.

---

### Table 5: Characteristic values of Multipor plinth insulation board

<table>
<thead>
<tr>
<th>Approval</th>
<th>National technical approval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Z-23.11.-1501</td>
</tr>
<tr>
<td></td>
<td>European technical assessment</td>
</tr>
<tr>
<td></td>
<td>ETA 05/0093</td>
</tr>
<tr>
<td>Dry bulk density</td>
<td>100 – 115 kg/m²</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>≥ 300 kPa</td>
</tr>
<tr>
<td>Transverse tensile strength</td>
<td>≥ 80 kPa</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>$\lambda = 0.043$ W/(mK) (\text{declared value})</td>
</tr>
<tr>
<td>Water vapor diffusion resistance factor</td>
<td>$\mu = 3$</td>
</tr>
<tr>
<td>Dimensions</td>
<td>600 x 390 mm (d = 100 – 300 \text{ mm (in increments of 20)})</td>
</tr>
<tr>
<td>Material requirement</td>
<td>4.3 boards/m²</td>
</tr>
</tbody>
</table>

### Table 6: Technical data: Multipor waterproofing slurries

<table>
<thead>
<tr>
<th>Delivery form</th>
<th>Bagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive strength</td>
<td>min. 15 MPa</td>
</tr>
<tr>
<td>Fresh mortar thickness</td>
<td>approx. 2.0 g/m²</td>
</tr>
<tr>
<td>Layer thickness</td>
<td>4.0 mm</td>
</tr>
<tr>
<td>Coverage:</td>
<td></td>
</tr>
<tr>
<td>– bonding</td>
<td>5.0 kg/m²</td>
</tr>
<tr>
<td>– coating</td>
<td>5.0 kg/m²</td>
</tr>
<tr>
<td>Weight per bag</td>
<td>25 kg</td>
</tr>
<tr>
<td>Pallet content</td>
<td>40 bags</td>
</tr>
</tbody>
</table>
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.

### Table 7: Results of acoustic tests

<table>
<thead>
<tr>
<th>Wall structure</th>
<th>Weighted sound reduction index $[R_{w}]$</th>
<th>Difference in weighted sound reduction index $[R_{w}]$ compared with uninsulated wall</th>
</tr>
</thead>
</table>
| Silka calcium-silicate block  
d = 17.5 cm  
Bull density = 1,800 kg/m³  
+ 6 cm Multipor ETICS  
+ 20 cm Multipor ETICS | 52 dB  
54 dB  
52 dB | (+2) dB  
(+/-0) dB |
| Ytong AAC  
d = 24 cm  
Bull density = 350 kg/m³  
+ 20 cm Multipor ETICS | 46 dB  
46 dB | (+/-0) dB |
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 \( C_t \) 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 \( \Delta (R_w + C_t) \) 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.

\[
\Delta R_w = R_{w, \text{ETICS}} - R_{w, \text{wall}} \\
\Delta C_t = C_{t, \text{ETICS}} - C_{t, \text{wall}} \\
\Delta (R_w + C_t) = \Delta R_w + \Delta C_t
\]

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.
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).

See Chapter 3.4 to determine the number of anchors required.
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

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

---

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. 15mm. Fully insulate cavities with mineral wool.

Keep the joint free from mortar

* Screw-in / hammer-in anchor
** Leave 2-3 mm wide joint between wall and ceiling insulation

Download these and other detail drawings at www.multipor.com/detaildrawings.php
Detail drawings for Multipor ETICS
System configuration, bonded double layer up to 300 mm

Horizontal section of window

Return with joint profile

Vertical section of window area

Layer structure must conform to approval

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**

*Minimum thickness 60 mm*

**Connection to overhanging eaves**

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

**Connection to roller shutters with plaster baseboard II**

*Minimum thickness 60 mm*

**Parapet wall with small flashing for low building heights**

For low building heights

---

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
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

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

* Lighting or similar 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

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.
Multipor external thermal insulation composite systems (ETICS)

3.3 ETICS transitions, connections and edges

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.

Multipor W32-plus finishing profile for doors and windows

Multipor W36-plus finishing profile for doors and windows

Multipor W31 finishing profile for shutters

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>

Multipor ETICS
Window sill connection
As with any other connection, connections to windowsills must be executed with the utmost care. Multipor pre-compressed 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 pre-compressed 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].

**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.

**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.
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 [14]. Connections to penetrations must be permanent and sealed to protect against driving rain.

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.

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).
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 hygro-thermal 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 less 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
3.0 Multipor external thermal insulation composite systems (ETICS)

3.4 Mechanical fastening of ETICS

Wind suction also occurs on the lee-ward 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 \( v_{w,\text{ref}} \) and wind velocity pressures \( q_{w,\text{ref}} \) (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 \( v_{b,0} \) and associated velocity pressures \( q_{b,0} \) depending on the wind zone

<table>
<thead>
<tr>
<th>Wind zone</th>
<th>( v_{b,0} ) (m/s)</th>
<th>( q_{b,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 elevation

Plan view:

Elevation:

- A
- B
- C

Fig. 3: Wind suction zones
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 buildings 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.

### Table 2: Extract from DIN EN 1991-1-4

<table>
<thead>
<tr>
<th>Wind zone</th>
<th>Wind velocity pressure $q_{p}$ in kN/m² for a building height $h$ within the limits of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$h \leq 10$m</td>
</tr>
<tr>
<td>1 Inland</td>
<td>0.50</td>
</tr>
<tr>
<td>2 Inland</td>
<td>0.65</td>
</tr>
<tr>
<td>Coast and islands in the Baltic Sea</td>
<td>0.85</td>
</tr>
<tr>
<td>3 Inland</td>
<td>0.80</td>
</tr>
<tr>
<td>Coast and islands in the Baltic Sea</td>
<td>1.05</td>
</tr>
<tr>
<td>4 Inland</td>
<td>0.95</td>
</tr>
<tr>
<td>North Sea and Baltic Sea coast and islands in the Baltic Sea</td>
<td>1.25</td>
</tr>
<tr>
<td>Islands in the North Sea</td>
<td>1.40</td>
</tr>
</tbody>
</table>

### Table 3: Aerodynamic coefficient $c_{pe,1}$ for vertical walls of rectangular buildings

<table>
<thead>
<tr>
<th>Zone</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$h/d$</td>
<td>$c_{pe,1}$</td>
<td>$c_{pe,1}$</td>
<td>$c_{pe,1}$</td>
</tr>
<tr>
<td></td>
<td>$\geq 5$</td>
<td>$\leq 0.25$</td>
<td>$\leq 0.25$</td>
<td>$\leq 0.25$</td>
</tr>
<tr>
<td>A</td>
<td>-1.7</td>
<td>-1.7</td>
<td>-1.7</td>
<td>-1.7</td>
</tr>
<tr>
<td>B</td>
<td>-1.1</td>
<td>-1.1</td>
<td>-1.1</td>
<td>-1.1</td>
</tr>
<tr>
<td>C</td>
<td>-0.7</td>
<td>-0.7</td>
<td>-0.7</td>
<td>-0.7</td>
</tr>
<tr>
<td>E</td>
<td>-0.5</td>
<td>-0.5</td>
<td>-0.5</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

Intermediate values should be interpolated.

Clarification of $h/d$: $h$ is the building height, $d$ the length or width of the building, whichever is the lesser.
For building heights \( \leq 7 \) m the following applies: \( q_p(z) = 1.5 \cdot q_b \).

The critical wind loads \( w_e = q_p(z) \cdot c_{pe} \) 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_{eA} = q_p(z) \cdot c_{peA,1A} = 0.48 \text{ kN/m}^2 \cdot -1.475 = -0.71 \text{ kN/m}^2 )</td>
<td>( 0.50 \cdot -1.475 = -0.74 \text{ kN/m}^2 )</td>
</tr>
<tr>
<td>B</td>
<td>( w_{eB} = q_p(z) \cdot c_{peB,1B} = 0.48 \text{ kN/m}^2 \cdot -1.1 = -0.53 \text{ kN/m}^2 )</td>
<td>( 0.50 \cdot -1.1 = -0.55 \text{ kN/m}^2 )</td>
</tr>
<tr>
<td>C (and E)</td>
<td>( w_{eC} = q_p(z) \cdot c_{peC,1C} = 0.48 \text{ kN/m}^2 \cdot -0.55 = -0.26 \text{ kN/m}^2 )</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: \( w = 15 \text{ m}, l = 34 \text{ m}, h = 24 \text{ m} \)
  
  ![Fig. 4: Wind zones for gable and side elevation](image)

  ![Fig. 5: Wind zones for longitudinal and transverse plan view](image)

<table>
<thead>
<tr>
<th>Zone</th>
<th>( w_e ) (kN/m²)</th>
<th>( n_{\text{anchor}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.74</td>
<td>4.4</td>
</tr>
<tr>
<td>B</td>
<td>0.55</td>
<td>3.3*</td>
</tr>
<tr>
<td>C</td>
<td>0.28</td>
<td>1.6*</td>
</tr>
</tbody>
</table>

* Minimum number of fixings 1 anchor/plate; 4.3/m²
Table 6: Comparison of wind suction force \( w_e \) in kN/m², simplified and detailed method

<table>
<thead>
<tr>
<th>Wind zone</th>
<th>( w_e )</th>
<th>( n_{\text{anchor}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simplified calculation method</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gable end</td>
<td>1.11</td>
<td>0.83</td>
</tr>
<tr>
<td>Long side</td>
<td>1.08</td>
<td>0.83</td>
</tr>
<tr>
<td>Zone</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>( w_e ) = [kN/m²]</td>
<td>6.8</td>
<td>6.8</td>
</tr>
<tr>
<td>( n_{\text{anchor}} ) = [unit/m²]</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Longitudinal side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>( w_e ) = [kN/m²]</td>
<td>1.11</td>
<td>0.83</td>
</tr>
<tr>
<td>( n_{\text{anchor}} ) = [unit/m²]</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Gable elevation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>( w_e ) = [kN/m²]</td>
<td>1.11</td>
<td>0.83</td>
</tr>
<tr>
<td>( n_{\text{anchor}} ) = [unit/m²]</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Short side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>( w_e ) = [kN/m²]</td>
<td>1.11</td>
<td>0.83</td>
</tr>
<tr>
<td>( n_{\text{anchor}} ) = [unit/m²]</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

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.
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>Wind zone (h/d ≤ 2)</th>
<th>Building height</th>
<th>&lt; 10 m</th>
<th>A</th>
<th>B</th>
<th>C/E</th>
<th>&lt; 18 m</th>
<th>A</th>
<th>B</th>
<th>C/E</th>
<th>&lt; 25 m</th>
<th>A</th>
<th>B</th>
<th>C/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind zone 1 – Inland</td>
<td>$w_w$ [kN/m²]</td>
<td>0.738</td>
<td>0.55</td>
<td>0.275</td>
<td>0.959</td>
<td>0.715</td>
<td>0.358</td>
<td>1.106</td>
<td>0.825</td>
<td>0.413</td>
<td>1.106</td>
<td>0.825</td>
<td>0.413</td>
</tr>
<tr>
<td></td>
<td>Anchor load class $w_{lm}$ [kN]</td>
<td>0.1</td>
<td>4.4</td>
<td>3.3</td>
<td>1.6</td>
<td>5.7</td>
<td>4.3</td>
<td>2.1</td>
<td>6.6</td>
<td>4.9</td>
<td>2.5</td>
<td>6.6</td>
<td>4.9</td>
</tr>
<tr>
<td>Wind zone 2 – Inland</td>
<td>$w_w$ [kN/m²]</td>
<td>0.959</td>
<td>0.715</td>
<td>0.358</td>
<td>1.18</td>
<td>0.88</td>
<td>0.44</td>
<td>1.328</td>
<td>0.99</td>
<td>0.495</td>
<td>1.328</td>
<td>0.99</td>
<td>0.495</td>
</tr>
<tr>
<td></td>
<td>Anchor load class $w_{lm}$ [kN]</td>
<td>0.1</td>
<td>9.6</td>
<td>7.2</td>
<td>3.6</td>
<td>11.8</td>
<td>8.8</td>
<td>4.4</td>
<td>13.3</td>
<td>9.9</td>
<td>5.0</td>
<td>13.3</td>
<td>9.9</td>
</tr>
<tr>
<td>Wind zone 2 – Coast and islands in the Baltic Sea</td>
<td>$w_w$ [kN/m²]</td>
<td>1.254</td>
<td>0.935</td>
<td>0.468</td>
<td>1.475</td>
<td>1.13</td>
<td>0.55</td>
<td>1.828</td>
<td>1.21</td>
<td>0.605</td>
<td>1.828</td>
<td>1.21</td>
<td>0.605</td>
</tr>
<tr>
<td></td>
<td>Anchor load class $w_{lm}$ [kN]</td>
<td>0.1</td>
<td>12.5</td>
<td>9.4</td>
<td>4.7</td>
<td>14.8</td>
<td>11.0</td>
<td>5.5</td>
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<td>12.1</td>
<td>6.1</td>
<td>16.2</td>
<td>12.1</td>
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<td>Wind zone 3 – Inland</td>
<td>$w_w$ [kN/m²]</td>
<td>1.18</td>
<td>0.88</td>
<td>0.44</td>
<td>1.401</td>
<td>1.045</td>
<td>0.523</td>
<td>1.623</td>
<td>1.21</td>
<td>0.605</td>
<td>1.623</td>
<td>1.21</td>
<td>0.605</td>
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<td></td>
<td>Anchor load class $w_{lm}$ [kN]</td>
<td>0.1</td>
<td>11.8</td>
<td>8.8</td>
<td>4.4</td>
<td>14.0</td>
<td>10.5</td>
<td>5.2</td>
<td>16.2</td>
<td>12.1</td>
<td>6.1</td>
<td>16.2</td>
<td>12.1</td>
</tr>
<tr>
<td>Wind zone 3 – Coast and islands in the Baltic Sea</td>
<td>$w_w$ [kN/m²]</td>
<td>1.569</td>
<td>1.155</td>
<td>0.578</td>
<td>1.77</td>
<td>1.32</td>
<td>0.66</td>
<td>1.918</td>
<td>1.43</td>
<td>0.715</td>
<td>1.918</td>
<td>1.43</td>
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<td></td>
<td>Anchor load class $w_{lm}$ [kN]</td>
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<td>15.5</td>
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<td>14.3</td>
<td>7.2</td>
<td>19.2</td>
<td>14.3</td>
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<tr>
<td>Wind zone 4 – Inland</td>
<td>$w_w$ [kN/m²]</td>
<td>1.401</td>
<td>1.045</td>
<td>0.523</td>
<td>1.696</td>
<td>1.265</td>
<td>0.633</td>
<td>1.918</td>
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<td>14.3</td>
<td>7.2</td>
<td>19.2</td>
<td>14.3</td>
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<tr>
<td>Wind zone 4 – North Sea and Baltic Sea coast and islands in the Baltic Sea</td>
<td>$w_w$ [kN/m²]</td>
<td>1.844</td>
<td>1.375</td>
<td>0.688</td>
<td>2.065</td>
<td>1.54</td>
<td>0.77</td>
<td>2.286</td>
<td>1.705</td>
<td>0.863</td>
<td>2.286</td>
<td>1.705</td>
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<td>15.4</td>
<td>7.7</td>
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<td>17.1</td>
<td>8.5</td>
<td>22.9</td>
<td>17.1</td>
</tr>
<tr>
<td>Wind zone 4 – Islands in the North Sea</td>
<td>$w_w$ [kN/m²]</td>
<td>1.844</td>
<td>1.375</td>
<td>0.688</td>
<td>2.065</td>
<td>1.54</td>
<td>0.77</td>
<td>2.286</td>
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<td></td>
<td>Anchor load class $w_{lm}$ [kN]</td>
<td>0.1</td>
<td>20.7</td>
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<td>19.2</td>
<td>10.1</td>
<td>25.1</td>
<td>19.2</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 · 600 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: $2 \text{ longitudinal sides} \cdot 2 \text{ anchors/m}^2 \cdot 15 \text{ m (height)} \cdot 30 \text{ m (length)} = 1,800 \text{ anchors}$

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 ($c_{p_e}$)
- Calculate the height, graduations in height and height-related velocity pressures ($q_{zl}$)
- 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](http://www.multipor.com).
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.
3.5 Back-ventilated facades

2: Back-ventilated facade system structure

Substructure (timber battens or aluminum profiles)

Anchoring base (existing wall)

Insulation

Back-ventilation (secondary ventilation)

Weather protection (external cladding)

External cladding

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).

The external cladding is mounted visibly or discreetly to the subframe, which is typically made from wood or metal.

Air gap

The air gap is a key element of back-ventilated cladding systems. It is connected to the outdoor air via supply and exhaust air vents to ensure continuous secondary ventilation. The subframe of battens and counter battens must therefore be arranged so as not to hinder air circulation.

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 gaps.
- 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.
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 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 ($s \leq 0.12$ 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.
3.0 Multipor external thermal insulation composite systems (ETICS)

3.6 Multipor facade insulation reference projects

REFERENCE PROJECT: KEMPTEN HIGH-RISE BLOCK

The nine-story high-rise block in 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 offcuts 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
Multipor external thermal insulation composite systems (ETICS)

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.

The Fachverband der Stuckateure für Ausbau und Fassade (Germany’s trade association of plasterers for internal finishes and facades) has created a calculation tool for systems with different thermal resistances which allows you to calculate materials for your insulation project in consultation with your technical Multipor adviser (Fig. 2).

Materials requirement
Our Multipor technical advisers are happy to help you calculate your material requirements.

Contact your technical adviser, who will send you a form to determine the materials required for your Multipor ETICS project and then prepare a quotation.

Calculating the material requirements for the Multipor ETICS
Please complete this form as fully as possible and fax it to us at +499435-9479.

<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.

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>

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.
3.0 Multipor external thermal insulation composite systems (ETICS)

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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].

Substrate test preparation

Plaster substrate test
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
3.0 Multipor external thermal insulation composite systems (ETICS)

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least 30 cm above ground level. 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 –
Multipor external thermal insulation composite systems (ETICS)

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3.0

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.

2. The other 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.
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 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. Then float the Multipor ETICS mineral insulation board into position and press against the substrate.

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.

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. 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 boards

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.
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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.

Table 3: Use categories for ETICS anchors

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concrete</td>
<td>Solid clay, calcium silicate</td>
<td>Perforated bricks or</td>
<td>Lightweight aggregate</td>
<td>Autoclaved aerated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or lightweight concrete</td>
<td>hollow blocks</td>
<td>concrete</td>
<td>concrete</td>
</tr>
</tbody>
</table>

Curved face of facade

Anchor arrangement

Inserting anchor fixing

Mesh angle bead on external corner

Mesh angle bead on opening
Using a suitable notched trowel, apply a 5-mm layer of Multipor lightweight mortar to the Multipor ETICS mineral insulation boards. 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. 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.

**Applying the finishing render**

Points to consider before applying the finishing render:

- 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.
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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 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.

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.

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### 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></td>
<td>4.5 kg/m² for edge bead-point bond up to 1cm</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></td>
<td>Grain size 0 – 3 mm – 4.0 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>
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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* Lighting or similar loads
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

Download these and other detail drawings at www.multipor.com/detaildrawings.php
4 Multipor interior insulation systems
Older buildings often have poor insulation, if any at all. Inadequate thermal insulation on the outside walls favors mold growth on the inside and leads to increased energy consumption in winter and high indoor temperatures in summer. This creates an uncomfortable indoor climate and may even cause significant structural damage.

When renovating old buildings, it is no longer enough to simply replace the heating system and fit new windows. It’s also a matter of preserving architecturally diverse exteriors and at the same time increasing their energy efficiency in a meaningful yet sensitive way. Creating a comfortable living space is also an important factor.

Multipor interior insulation systems are the perfect solution for mold remediation, thermal bridge optimization and interior insulation projects requiring the highest level of energy efficiency. Multipor satisfies all the requirements for modern interior insulation with the slender, space-saving 30 or 40 mm thick Multipor compact plus system or the interior insulation system from 60 to 300 mm.

**Good structural reasons for insulating a building with a Multipor interior insulation system:**
- Increases surface temperature and so prevents condensation forming at the surface
- This in turn prevents moisture-related mold growth on the surface of the walls
- Improves thermal comfort
- Extends the life of the building by going beyond minimum thermal insulation requirements

In existing buildings, a comfortable indoor climate can be achieved even with a low insulation thickness
- Satisfies the highest energy efficiency standards, including passive house standards where achievable.

The use of Multipor mineral insulation boards for interior insulation is far more than a mere cosmetic solution. To improve the energy efficiency and overall comfort of a building and operate the property economically in the long term, it is often the only solution.

- Cost-effective interior insulation systems for old and new buildings
- Special thermal and moisture transmission properties for a comfortable indoor climate
- Ideal for preventing mold
- Preserving the facades of listed buildings
- Perfect for half-timbered buildings and basements
- Useful if an adjacent property excludes the use of an ETICS
- May be eligible for DGNB certification and KfW grants
- Healthy, environmentally friendly systems certified by natureplus, IBU declaration and highest A+ rating from the eco-INSTITUT
**Multipor interior insulation**
The Multipor interior insulation system is a cost-effective and energy-efficient means of insulating old and new buildings. Available in insulation thicknesses ranging from 60 to 300 mm, it is suitable even for complex refurbishment projects, including listed buildings. Multipor mineral insulation boards enable rooms to heat up quickly and ensure optimal heat retention. Their excellent permeability and capillary structure reliably insulates even half-timbered buildings without the need for vapor barriers.

- Perfect solution for high quality energy-efficient refurbishments
- Cost-effective interior insulation system for new buildings too
- Vapor-permeable and capillary-active – no need for a vapor barrier
- Preserves the facades of listed and historic buildings
- Perfect for half-timbered buildings and basements
- Useful if an adjacent property excludes the use of an ETICS
- Can generally be fitted quickly, easily and securely without additional anchor fixings
- Healthy, environmentally friendly system certified by natureplus, IBU declaration and highest A+ rating from the eco-INSTITUT.

**Multipor compact plus**
Multipor compact plus is an excellent choice if the main aim is to prevent mold and reduce thermal bridging. At just 30 or 40 mm thick, with these slender, compact insulation boards you don’t have to forfeit much living space. They effectively increase the surface temperature of the walls to prevent mold formation and create a more comfortable indoor climate. They reduce heating costs too.

- Improves the energy performance of existing walls to prevent mold formation
- More comfortable indoor climate
- Vapor-permeable and capillary-active – no need for a vapor barrier
- Provides effective thermal insulation with \( \lambda = 0.045 \text{ W/(mK)} \), despite space-saving format
- Quick, clean and easy installation
- Packed in cardboard boxes for effortless transportation to site and easy handling
- Healthy, environmentally friendly system certified by natureplus, IBU declaration and highest A+ rating from the eco-INSTITUT.
Experience proves us right

Millions of square meters of interior walls insulated with Multipor or Multipor compact plus interior insulation are the result of our extensive experience in the field of interior insulation, which now spans over 20 years. Experience which enables you to fit up-to-date, energy-efficient insulation to existing buildings.

Advantages at a glance

- Vapor-permeable and capillary-active – the system needs no vapor barrier
- Best fire protection – non-combustible insulating material (Class A1 fire rating)
- Thermal insulation and thermal storage combined
- Sounds solid – like monolithic masonry
- High compressive strength combined with mesh-reinforced plaster
- Safe and easy-to-use
- Can frequently be applied to existing surfaces
- Versatile surface finishes from interior silicate paints and mineral plasters to wallheaters mounted to Multipor mineral insulation boards offer scope for creative freedom.
- Pioneering specialists in the field of capillary-active interior insulation
- Tried and tested.

Healthy, natural and environmentally friendly

Thanks to its natural constituents, Multipor mineral insulation board is an ecologically valuable, non-toxic insulating material. The environmental product declaration (EPD) issued by the German Institute for Construction and Environment (IBU) documents its ecological properties. You can find it in the download area of our website at www.multipor.com. The insulation board has also been awarded the natureplus eco-label in recognition of its environmental compatibility. Finally, the eco-INSTITUT in Cologne confirmed that the board meets the strictest requirements on pollutants and emissions by awarding

| Table 1: Characteristic values of Multipor interior insulation systems |
|---------------------------------|---------------------|---------------------|
| Regulations                     | Multipor mineral insulation board | Multipor compact plus | Multipor lightweight mortar |
| European technical assessment ETA-05/0093 | European technical assessment ETA-05/0093 | Lightweight mortar LW as per EN 998-1 |
| Dry bulk density                | 85 – 95 kg/m³        | 100 – 115 kg/m³     | approx. 770 kg/m³          |
| Compressive strength            | ≥ 200 kPa            | ≥ 300 kPa           | CS II; 1.50 – 5.0 N/mm²    |
| Thermal conductivity (rated value) | λ = 0.042 W/(mK) | λ = 0.045 W/(mK) | λ_{10, v} = 0.18 W/(mK) |
| Water vapor diffusion resistance factor | μ = 2 | μ = 3 | μ ≤ 10 |
| Building material class         | A1; non-combustible  | A1; non-combustible  | A2-s1, d0; non-combustible |
| Dimensions / delivery quantity  | 600 x 390 mm d = 60 – 300 mm (in increments of 20) Special format d = 50 mm with λ = 0.045 W/(mK) | 500 x 390 x 30/40mm (L x W x D) | 20 kg/bag |

- Pioneering specialists in the field of capillary-active interior insulation
- Tried and tested.
it the highest Category A+ rating. Rooms insulated with Multipor mineral insulation boards do not emit harmful VOC emissions via their insulation systems.

**Non-combustibility for peace of mind**

When redeveloping existing housing stock, very careful consideration should be given to fire protection. The existing walls may have been built at a time when little or no thought was given to the matter. Multipor mineral insulation board has been designated a Class A1 construction and insulating material (non-combustible) in accordance with DIN EN 13501-1. Together with the accompanying Multipor lightweight mortar, the systems are entirely safe because in the event of fire, even at extremely elevated temperatures, they do not produce smoke, toxic fumes or burning droplets – advantages that can save lives.

**Sound insulation with Multipor**

Insulating materials often change a building’s acoustic performance – and interior insulation in particular can have a significant impact on the wall’s sound insulation. So at the Xella Technology and Research Centre, we have been investigating the factors affecting both the insulated component and the subsequently installed partition walls.

On the test bed we measured sound transmission through adjacent walls insulated with Multipor and studied the impact on the weighted sound reduction index of the partition wall in different installation conditions (Fig. 1).

During the course of these measurements, we did not find any significant impact on the sound reduction index of the partition wall.

Subsequently installed dry-lined internal walls thus continue to offer complete flexibility when it comes to configuring the living space, since the interior insulation – in terms of sound insulation – does not have to be breached to connect the partition walls (Fig. 1).

A test report from the Xella Research and Development Center is available on request.
Creative surface finishes
The versatility of Multipor and Multipor compact plus interior insulation systems offers tremendous scope for creativity in terms of the surface finish. Here are a few examples:
- Thin-film felted, textured or smooth finishing plaster on the reinforcing layer
- Vapor-permeable wallcoverings and paints
- Dry lining solutions on subframe
- Tiles on the reinforcing layer.

Please see Chapter 4.4 for more information on surface finishes, or download the surface finish guide from the download section of our website at www.multipor.com.

Thorough building survey provides sound basis for planning
As the level of insulation in buildings increases, so too does the planning complexity. And it is important to bear in mind that the maximum thickness of energy-saving insulation is not always the most sensible solution for existing buildings. In addition to energy efficiency, consideration should also be given to a healthy indoor climate with reference to DIN 4108-3 [Thermal protection and energy economy in buildings; Part 3: Protection against moisture subject to climate conditions]. Although levels of thermal insulation that comply with today’s standards may not be possible in many existing buildings, a reduced insulation thickness can nevertheless significantly increase housing quality and noticeably reduce energy consumption.

For this reason, it is important to carry out a survey of the existing building as shown in Figure 2 before planning the interior insulation. The purpose of this survey is to obtain information about the aim of the insulation measure as defined by the client/building contractor (e.g. achievement of minimum thermal insulation standard) alongside any usage or listed building requirements that may apply. This step ensures the lasting success of the construction and refurbishment work.

A site visit – involving visual inspections at the very least – is essential to gain a reliable and comprehensive understanding of the existing structure. The visit should focus less on thermal performance and more on assessing the overall structural situation, including moisture, sound and (where appropriate) fire protection.

The following criteria should be agreed in writing by the building contractor/client and planner:
- Assessment of the building’s location (protected or exposed position etc.)
- General condition of the masonry/existing fabric of the building
- Situation regarding moisture levels in the building, with reference to salt deposits where relevant
- Protection against driving rain (cladding, paint, plaster) and driving rain load on the external facade, exposure level of individual facades (as per Table 2)
- Other sources of moisture within the structure (rising damp, defective guttering etc.)
- Indoor climate
- Assessment of the condition of the building, including any damage, mapping where necessary and collating data on the property.
- Subsequent use of the building and of rooms designated for energy efficiency upgrades.

A pleasant indoor climate is all-important
Multipor interior insulation achieves the minimum thermal insulation standard and is therefore guaranteed to improve the energy-efficiency of buildings. At the same time, by increasing the surface temperature it also enhances well-being and counteracts mold growth. However, consideration should always be given to connected structures and adjacent ceilings and walls when carrying out refurbishment work. Further improvements to the thermal insulation can be achieved with relatively little effort here by reducing existing thermal bridges to harmless levels.

With Multipor interior insulation, spaces used only occasionally – such as churches or other public buildings – heat up quickly to ensure greater comfort. The heat energy remains in the room instead of seeping straight out through the cold internal walls.
A comfortable indoor climate requires a well-coordinated overall plan

Old, draughty windows result in high air exchange rates within the building, thereby reducing the risk of mold formation. On the downside, they also lead to high heating costs. Consequently, a well-coordinated overall energy-efficiency plan is needed when installing new high-performance windows, because without corresponding interior insulation, there is an increased risk of mold. So we always recommend insulating external walls, including the window reveals, at the same time as replacing windows since moisture...
Multipor interior insulation systems

4.2 General introduction and planning

Fig. 3: Thermal comfort during sedentary activity, moderate activity and with suitable clothing as a function of the average surface temperature of the surfaces enclosing the room and the indoor air temperature; See Chapter 7.1 for further details

Requirements for interior insulation

Retrofitted interior insulation influences the building-physical behavior of the existing building. Special consideration must be given to water vapor diffusion from inside to outside, combined with the potential for condensation to form on the original, now cold inner surface of the structure. The external wall will also dry much more slowly after exposure to driving rain due to a decrease in the average temperature of the wall. Careful planning, a high-quality system such as Multipor interior insulation and meticulous workmanship will nevertheless guarantee successful insulation work.

The Multipor and Multipor compact plus interior insulation systems are regarded as forerunners in the field of vapor-permeable internal insulation. Their products and material characteristics have raised awareness of the importance of building physics in ensuring a simple, reliable construction process. This is borne out by a study which showed that a housing development insulated with Multipor almost 20 years ago was still free from damage. Our experts at Multipor will gladly work with you to ensure the success of your upcoming refurbishment project.

does not condense on warm surfaces – a key requirement for avoiding mold formation. And the perception of comfort noticeably increases.

Creating a comfortable indoor climate is an important objective when selecting construction materials and insulation. DIN EN ISO 7730 defines thermal comfort above all as a sense of satisfaction with the ambient climate. Although everyone perceives this feeling differently, it is perfectly possible to define generally applicable comfort zones (Fig. 3). The following key factors contribute to a comfortable indoor climate:

- Average temperature of the enclosing walls, including floors and ceilings
- Average indoor air temperature
- Average indoor relative humidity

Chapter 7 on building physics contains in-depth information on the subject of indoor climate with detailed examples.

Practical tip:

Multipor interior insulation allows rooms that are used only occasionally to heat up rapidly and maintain high levels of comfort.
Current EnEV requirements for existing buildings

The current German Energy Saving Ordinance (EnEV) discusses the requirement levels for the refurbishment of existing buildings. The minimum thermal insulation standard is the minimum requirement for insulation on the inside of external walls, although the current EnEV no longer governs interior wall insulation for refurbishment purposes. A recommended U-value of 0.35 W/(m²K) for interior insulation can easily be achieved with Multipor, both technically and in terms of building physics.

Multipor interior insulation systems provide optimal solutions which comply with the latest general requirements for the exterior walls of existing buildings. The ordinance also stipulates that the impact of construction-related thermal bridging on heat energy consumption in old buildings should be kept to a minimum.

The general thermal bridge correction factor for interior insulation could spoil what initially seemed to be a well-conceived, energy-efficient solution, resulting in an uneconomical thickness of insulation. This area offers further potential for energy savings of up to 30% based on a building’s annual heating demand. See Chapter 7.1.6 for more information on the EnEV.

As a service to you, we provide specimen structural calculations for selected thermal bridges in a wide range of constructions. Find the checklist in the download section of our website at www.multipor.com.

Types of interior insulation system

There are basically two options for interior insulation:

1. Vapor-retardant and vapor-impermeable interior insulation systems (Fig. 4):

These systems, such as stud wall constructions with mineral wool and vapor-retardant membranes or virtually vapor-impermeable synthetic foams, prevent the diffusion of water vapor into the walls from outside to inside, which also prevents existing walls drying inwards, as they would tend to do in summer. These vapor-retardant and vapor-impermeable systems must be handled with particular care during installation and subsequent use and require a high standard of workmanship – especially around details and connections. Experience shows that such systems – especially around connections – can easily be damaged during construction or subsequent use.

2. Vapor-permeable, capillary-active interior insulation systems (Fig. 5):

These modern, safe and well-tested systems allow water vapor to diffuse into the wall; they absorb any moisture arising, buffer it and transport it back to the inner surface by capillary action. This means that not only are moisture levels within the walls continuously reduced to a non-critical level, but the walls also remain vapor-permeable, which enables them to absorb
4.0 Multipor interior insulation systems

4.2 General introduction and planning

Moisture peaks from the indoor air and to dry increased moisture loads in the existing structure inwards. Multipor interior insulation systems are ideal for this purpose. The numerous areas of application are explained in more detail further in this guide.

Chapter 7 on building physics explains how the different systems work.

---

**Fig. 4:** Operating principle of vapor-retardant interior insulation

**Fig. 5:** Operating principle of vapor-permeable interior insulation

- **Temperature and vapor pressure trend**
  - Interior
  - Exterior
  - Virtually no vapor flow
  - No condensation

- **Temperature and vapor pressure trend**
  - Interior
  - Exterior
  - Higher vapor flow
  - Condensation
  - Capillary flow
Dr.-Ing. Hartwig M. Künzel from the Fraunhofer Institute for Building Physics in Holzkirchen on the subject of certifying the hygrothermal performance of interior insulation systems:

Mention the subject of ‘moisture transport in building materials’, and most practitioners will think of vapor diffusion, dew point and the Glaser method described in DIN 4108. Once a building element has been classified as ‘safe according to Glaser’, all is over and done with as far as the planner is concerned. The search for alternative assessment methods will only take place if moisture damage unexpectedly occurs or if the designed building element does not pass the standard Glaser assessment. Since condensation in winter due to vapor diffusion (which is what Glaser investigates) is only one of a large number of possible moisture loads, a positive assessment according to DIN 4108 may imply moisture safety which does not actually exist.

Indoor air convection, precipitation or rising damp are not usually considered. The same goes for construction moisture, which is becoming increasingly problematic in view of today’s deadline pressures. In order to allow for these affects too, we need to switch from Glaser’s simple steady-state assessment method to a realistic simulation of hygric processes in building elements. To this end, new non-steady-state calculation methods have gained acceptance among practitioners in recent years due to their reliability. This fact is also recognized in the redrafted DIN 4108-3, which now admits these methods.

The now widely used dynamic simulation model WUFI® [see Chapter 7] analyzes the relevant climatic and material data and the accuracy of the calculations, offering numerous advantages to practitioners. Some areas of application and novel possibilities for assessing the hygrothermal behavior of building components exposed to natural climatic conditions – which go significantly beyond Glaser – are listed below:

- realistic simulation of condensation during the heating period, allowing for water vapor sorption and capillary conduction
- drying of construction moisture
- summer condensation due to reverse diffusion
- solar radiation, driving rain load and surface condensation on roofs and facades
- effect of moisture on energy consumption.

The results for moisture and temperature fields in the component are available in any desired spatial or temporal resolution and may be used for:

- extrapolating experimental results
- transferring proven construction methods to different climatic conditions
- planning new buildings or renovation measures for old buildings
- developing and optimizing building products
- determining maximum permissible indoor moisture loads
- determining the hygrothermal requirements for and the limits of proper application of building materials and components.

In recent years, these advantages of hygrothermal simulations have created strong demand for computational investigations, especially in the context of renovating old buildings, since standard solutions are often not applicable here. Multipor mineral insulation board is already widely used for successful interior insulation. Since this product is stored in the WUFI® database, dynamic simulations of different structural components can be performed at any time.

In 1997 the WTA [International Association for Science and Technology of Building Maintenance and Monuments Preservation] established a WTA working group whose task is to draw up practical guidelines and regulate the use of hygrothermal simulation methods in the construction industry.
4.2 General introduction and planning

**Fig. 6: Example wall construction with Multipor interior insulation**

**Solid interior insulation without vapor barrier: Wall composition from left to right**

<table>
<thead>
<tr>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS II exterior render</td>
</tr>
<tr>
<td>Masonry (brickwork)</td>
</tr>
<tr>
<td>CS II interior plaster</td>
</tr>
<tr>
<td>Multipor lightweight mortar</td>
</tr>
<tr>
<td>Multipor mineral insulation board</td>
</tr>
<tr>
<td>Reinforcement</td>
</tr>
<tr>
<td>(Multipor lightweight mortar)</td>
</tr>
<tr>
<td>Finishing plaster/felted</td>
</tr>
<tr>
<td>(Multipor lightweight mortar or fine lime plaster)</td>
</tr>
</tbody>
</table>
Wall construction with Multipor interior insulation systems

Multipor mineral insulation boards in thicknesses of 60 to 140 mm are ideal where the main aim is to provide an effective level of thermal insulation. Even thicker boards are suitable for energy-efficient refurbishment to the highest standards. At this level, it is easily possible to cut heating oil consumption and CO₂ emissions by 80%, depending on the component.

Practical tip:
The following rule of thumb applies:
$$U \times 10 = \text{heating oil consumption in liters per m}^2 \text{ of heated area and heating period, } U \times 10 \times 3 = \text{CO}_2 \text{ emissions in kg per m}^2 \text{ of heated area and heating period.}$$

Figure 6 shows an example configuration of a Multipor interior insulation system. The U-value calculations for different wall types shown in Tables 3 and 4 are based on this system configuration.

It’s a different matter if the primary purpose of the refurbishment is to improve the indoor climate and/or prevent mold. In this case, due to the reduced thickness of insulation, it is only possible to achieve a ‘still comfortable’ indoor climate (Fig. 3).

Tables 3 and 4 illustrate the potential of interior insulation for different wall types, depending on the aim of refurbishment. Whilst the main aim of insulating with Multipor compact plus is to increase the temperature of the external wall on the inside, the use of thicker insulation illustrates the potential of energy-efficient refurbishment to significantly improve the U-value.

Wall structures with Multipor interior insulation systems

Using numerical climate modeling, we have verified all the layer configurations with Multipor mineral insulation board shown below. We did this by applying the temperature, relative humidity, direct and indirect solar radiation and driving rain typical of the mid-German climate to the outside of the building while maintaining a constant air temperature of 20°C and 50% relative humidity on the inside – in accordance with DIN 4108.

The result: The rising moisture level in the cold half of the year – mainly in gaseous form as relative humidity in the pore air – is non-critical because, without exception, it dries out completely during the evaporation phase. Nevertheless, it is important to comply with the latest directions for use when installing Multipor interior insulation to ensure its long-term structural performance within the system configuration.

### Table 3: The use of Multipor interior insulation to improve the U-value of double-leaf walls

<table>
<thead>
<tr>
<th>Wall construction before</th>
<th>Thickness [mm]</th>
<th>U-values [W/(m²·K)]</th>
<th>Wall construction with Multipor compact plus λ = 0.045 W/(m·K)</th>
<th>Wall construction with Multipor λ = 0.042 W/(m·K)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>30 [mm]</td>
<td>40 [mm]</td>
<td>60 [mm]</td>
</tr>
<tr>
<td>Calcium-silicate block λ = 0.99 W/(m·K)</td>
<td>115</td>
<td>U-value before 2.43 2.43 2.43 2.43 2.43 2.43 2.43</td>
<td>U-value after 0.92 0.76 0.54 0.43 0.36 0.30 0.27</td>
<td>U-value before 1.86 1.86 1.86 1.86 1.86 1.86 1.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>240</td>
<td>U-value before 1.67 1.67 1.67 1.67 1.67 1.67 1.67</td>
<td>U-value before 0.78 0.66 0.49 0.40 0.33 0.29 0.25</td>
</tr>
</tbody>
</table>

Assumptions: Solid brick: λ = 1.2 W/(m·K), t = 11.5 cm, no air gap, masonry as per table, interior plaster: λ = 0.51 W/(m·K), t = 15 mm, After refurbishment: Lightweight mortar: λ,sub = 0.18 W/(m·K), t = 10 mm, thermal resistance: Rₗ = 0.13 m²K/W, Rₑ = 0.04 m²K/W.
### 4.0 Multipor interior insulation systems

#### 4.2 General introduction and planning

<table>
<thead>
<tr>
<th>Wall construction before</th>
<th>Thickness [mm]</th>
<th>U-values [W/(m²K)]</th>
<th>Wall construction with Multipor compact plus $\lambda = 0.045$ W/(mK)</th>
<th>Wall construction with Multipor $\lambda = 0.042$ W/(mK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bricks $\lambda = 0.86$ W/(mK)</td>
<td>115</td>
<td>U-value before 2.76</td>
<td>2.76</td>
<td>2.76</td>
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<tr>
<td></td>
<td>175</td>
<td>U-value after 0.97</td>
<td>0.80</td>
<td>0.56</td>
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<tr>
<td>Calcium-silicate block $\lambda = 0.99$ W/(mK)</td>
<td>240</td>
<td>U-value before 2.31</td>
<td>2.31</td>
<td>2.31</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>U-value after 0.91</td>
<td>0.76</td>
<td>0.54</td>
</tr>
<tr>
<td>Autoclaved aerated concrete (AAC) $\lambda = 0.21$ W/(mK)</td>
<td>365</td>
<td>U-value before 1.53</td>
<td>1.53</td>
<td>1.53</td>
</tr>
<tr>
<td></td>
<td>115</td>
<td>U-value after 0.76</td>
<td>0.65</td>
<td>0.48</td>
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<tr>
<td>AAC mounting component $\lambda = 0.14$ W/(mK)</td>
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<td>U-value before 2.46</td>
<td>2.46</td>
<td>2.46</td>
</tr>
<tr>
<td></td>
<td>240</td>
<td>U-value after 0.93</td>
<td>0.77</td>
<td>0.55</td>
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<tr>
<td>Concrete $\lambda = 2.1$ W/(mK)</td>
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<td>U-value before 1.88</td>
<td>1.88</td>
<td>1.88</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>U-value after 0.83</td>
<td>0.70</td>
<td>0.51</td>
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</table>

Assumptions: Masonry as per table, interior plaster: $\lambda = 0.51$ W/(mK), $t = 20$ mm; exterior render: $\lambda = 1.0$ W/(mK), $t = 20$ mm; Thermal resistance: $R_i = 0.13$ m²K/W, $R_o = 0.04$ m²K/W

Table 4: Improving the U-values of monolithic existing walls with Multipor interior insulation
Our Multipor technical advisers will gladly discuss specific customer requirements and different building and component types in more detail.

As a special service to our customers, at Multipor we can certify the hygrothermal performance of a wide range of building components and structures using dynamic simulation programs (see Chapter 7.2.5). Our expertise in this area is the result of several thousand hygrothermal analyses translated into successful building practice. To help you plan with confidence, download the checklist from the download section of our website at www.multipor.com.

Follow the WTA recommendations for internal insulation

The International Association for Science and Technology of Building Maintenance and Monuments Preservation (WTA) publishes several sets of guidelines on the subject of interior insulation. WTA Guidelines for Division 6 [Physical and chemical fundamentals] cover interior insulation and its certification, while guidelines for Division 8 [Half-timbered constructions] contain a wealth of useful information about the energy-efficient refurbishment of half-timbered buildings.

As a supporting member of the WTA, Xella Deutschland GmbH helps to ensure that the Association’s latest findings and insights – and more besides – are published promptly.

By using the simulation methods referred to above and following the advice in the relevant WTA Guidelines, it is possible to successfully certify and safely install vapor-permeable, capillary-active Multipor interior insulation systems. Here is an extract from the latest, greatly extended “Technical guidelines for insulating the inside of external walls using interior insulation systems” [Technischen Richtlinie zur Innendämmung von Außenwänden mit Innendämm-Systemen] published by Germany’s ETICS trade association [Fachverband WärmedämmVerbundsysteme e. V.] in 2016:

“Successful certification means that the moisture content of the individual layers of material is limited by the system, damage does not occur and accumulated moisture can dry out again, i.e. the overall moisture content of the structure does not rise continuously over a period of several years.” Multipor interior insulation systems have been proven to satisfy this requirement with unerring reliability.

This simulation process also allows component connections – such as connected ceiling joists – to be included in the hygrothermal analysis. This ensures a safe wall structure and greater planning certainty when it comes to sensitive construction details.

Countless computational verifications confirm that the solid, entirely mineral-based systems function perfectly in practice. Numerous positive user experiences with Multipor interior insulation systems further highlight their effective and enduring contribution to energy-efficient thermal and moisture control.
Reference building

Thomasblock (former Donnerschwee Barracks), Oldenburg

- Redevelopment and sensitive conversion of barracks to residential development
- Preservation of listed facade
- Comfortable indoor climate and long-term environmental compatibility
- High level of thermal insulation and optimum fire protection
- Rapid installation without vapor barrier

<table>
<thead>
<tr>
<th>Project data</th>
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<tbody>
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<td>Location</td>
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<td>Application</td>
<td>Interior insulation</td>
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<td>Products used</td>
<td>Multipor mineral insulation board, $t = 100$ mm</td>
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<tr>
<td></td>
<td>Multipor lightweight mortar</td>
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</table>
Reference building

Primary school, Duisberg

- Energy-efficient refurbishment of a listed school building
- Attainment of EnEV standard applicable at the time
- Energy costs savings of 70 %
- High standards of environmental health
- Quick and economical installation of around 1400 m² Multipor mineral insulation boards

**Project data**

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<table>
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<td>500 m² Multipor mineral insulation board t = 60 mm</td>
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<td>Multipor lightweight mortar</td>
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4.3 Detail drawings for interior insulation systems

Detail drawings for interior insulation systems

Horizontal window section

Vertical window section

Cross-section of foundations/interior insulation to external wall

Timber ceiling with exposed joists/interior insulation to external wall

<table>
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* Plaster-finishing profile

Interior insulation 16-001

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* Plaster-finishing profile

Interior insulation 16-002

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Interior insulation 16-003

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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Interior insulation 16-004

006 Thermal insulation
039 Impact sound insulation
040 Floating screed
067 Horizontal damp-proofing/barrier membrane
111 Separation or protective layer
117 Flexible sealing tape
006 Pre-compressed sealing tape
039 Existing masonry
040 Existing interior plaster
067 (or levelling plaster)
111 Timber joists
117 Multipor lightweight mortar
117 Multipor reinforcement mesh
173 Corner protectors
175 Multipor reveal board
178 Multipor hemp-felt insulation strips
178 Multipor interior insulation
250 System-compatible interior plaster
330 Screed-edge insulation strips

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

**Timber ceiling without exposed joists/interior insulation to external wall**

**Reinforced concrete ceiling with insulating wedge/interior insulation to external wall**

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

**Roof connection to timber joist ceiling**

**Roof connection to slab ceiling**

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

---

**Materials:**
- 007 Reinforced concrete ceiling
- 040 Floating screed
- 135 Plasterboard
- 168 Existing masonry
- 169 Existing interior plaster (or levelling plaster)
- 170 Existing ceiling plaster
- 172 Timber joists
- 173 Multipor lightweight mortar
- 174 Multipor reinforcement mesh
- 178 Multipor hemp-felt insulation strips
- 180 Trowel joint
- 250 Multipor internal insulation
- 254 Multipor insulating wedge
- 286 System-compatible interior plaster
- 328 Floorboards
- 329 Dry screed
- 330 Screed-edge insulation strips
- 333 Reed board

Download these and other detail drawings at www.multipor.com/detaildrawings.php
4.0 Multipor interior insulation systems

4.3 Detail drawings for interior insulation systems

Detail drawings for interior insulation systems

Cross-section with wall heating

Wall heating – three-dimensional view

Timber framework/
Interior insulation with Multipor lightweight mortar

Timber framework/
Interior insulation with Multipor clay mortar

Interior insulation
16-007
Interior insulation
16-008
Interior insulation
16-011
Interior insulation
16-012

005 Exterior render
026 Membrane under roof, vapor-permeable
133 Lightweight mortar
168 Existing masonry
169 Existing interior plaster (or levelling plaster)
172 Timber joists
173 Multipor lightweight mortar
174 Multipor reinforcement mesh
182 Multipor reinforcement mesh 7 x 7 mm
250 Multipor interior insulation
286 System-compatible interior plaster
287 Multipor clay mortar
326 Multipor screw-in anchor (though mesh, approx. 4 anchors per m²)

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

Ytong slab roof with Multipor mineral insulation board on the underside, eaves detail

Ytong slab roof with Multipor mineral insulation board on the underside, verge detail

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

Ytong slab roof with Multipor mineral insulation board on the underside, ridge detail

001 Ytong masonry
006 Thermal insulation
007 Reinforced concrete ceiling
023 Rafters
024 Gutter
025 Roof tile/slate
026 Membrane under roof, vapor-permeable
028 Sarking board
030 Battens
081 Interior plaster
096 Mesh insert
100 Ring beam
139 Battens
150 Ytong roof panel
169 Existing interior plaster
173 Multipor lightweight mortar
174 Multipor reinforcement mesh
180 Trowel joint
211 Ytong precision panel
218 Galvanized steel angle
286 System-compatible interior plaster

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

Download these and other detail drawings at www.multipor.com/detaildrawings.php
4.0 Multipor interior insulation systems

4.3 Detail drawings for interior insulation systems

Detail drawings for interior insulation systems

Intersecting existing interior wall with straight insulation board

Intersecting existing interior wall with insulating wedge

Direct connection of plasterboard wall to external wall

Direct connection of plasterboard wall to Multipor insulation

006 Thermal insulation
013 Steel profile
135 Gypsum fiberboard
168 Existing masonry
169 Existing interior plaster (or levelling plaster)
173 Multipor lightweight mortar
174 Multipor reinforcement mesh
178 Multipor hemp-felt insulation strips
180 Trowel joint
250 Multipor interior insulation
254 Multipor insulating wedge
286 System-compatible interior plaster

Download these and other detail drawings at www.multipor.com/detaildrawings.php
4.4 Products and system components

Solid, dimensionally stable Multipor and Multipor compact plus mineral insulation boards come in lightweight, handy formats which can quickly and easily be cut to size and sanded smooth to give a neat finish. Installation is also quick and straightforward; the boards are simply bonded with Multipor lightweight mortar, so in most cases there is no need for additional mechanical fastening. The products undergo continuous internal and external production quality control before they arrive at the point of use or place of interim storage. A high degree of system reliability during subsequent use is further confirmation of product quality.

Delivery and handling
Multipor interior insulation systems together with all system components should ideally be delivered straight to the point of use wherever possible to avoid unnecessary costly and time-consuming interim transport. However, if interim storage is required, a stable, level and dry storage site should be provided. Our experienced haulage companies have vehicles equipped with a hydraulic crane or fork lift which carefully places insulating boards in individual packs or pallets on a flat substrate beside the vehicle.

It is also possible to set down the materials close to the installation site by arrangement, subject to feasibility. We can provide more compact vehicles to deliver goods to smaller construction sites by special arrangement. These vehicles are also suitable for supplying small additional quantities.

Only suitable, approved lifting gear is to be used for unloading and handling. Pallet trucks can also be used to transport Multipor mineral insulation boards on hard surfaces.

The clamp on the lifting gear must pass round the pack and underneath the pallet to grip the load securely during unloading. Under no circumstances should the clamp grip or press the Multipor mineral insulation boards directly (see Fig. 1), nor should pallets be stacked. Care must also be taken to prevent any cables, chains or slings used during unloading from damaging the material.

Small, manageable packs of Multipor mineral insulation boards are bundled on a pallet which is shrink-wrapped to protect it from the weather. The shrink-wrap also serves to keep the packaging unit stable and should not be removed until just before use.

Multipor compact plus comes in handy boxes which are palletized for delivery to the construction site or wholesaler.
Multipor tools
For safe and easy application

Multipor insulating wedges designed to reduce thermal bridging are also packed securely in handy boxes. The packaging can be disposed of responsibly (e.g. in Germany in compliance with Interseroh Contract No. 31560) – another way in which we help to protect the climate and environment.

Tools and resources
Construction progress is fast and proficient when you use tools designed for Multipor interior insulation systems.

Fine-toothed Multipor handsaw
Multipor mineral insulation boards can be trimmed to size accurately and effortlessly using a fine-toothed Multipor handsaw [1] [7 – 10].

Multipor notched trowel
Multipor notched trowels are designed to apply a full bed of Multipor lightweight mortar to the mineral insulation boards. Notch size per board thickness:
- 12-mm notched trowel for insulation thickness up to 140 mm
- 15-mm notch trowel for insulation thickness of 160 mm or above.
Clean notched trowels thoroughly immediately after use for perfect troweling every time [2].

Multipor paddle mixer
Multipor lightweight mortar should ideally be mixed to a workable consistency in a Multipor graduated bucket using a low-speed mixer with a long, sturdy paddle. Clean paddle mixers thoroughly after use for optimal mixing results [3].

Multipor sanding board
Multipor and Multipor compact plus mineral insulation boards can be sanded with ease. After sanding, remove the sanding dust with a hand
brush or industrial vacuum cleaner to ensure optimum adhesion of the Multipor lightweight mortar.

**Multipor bucket**

Multiple buckets are ideal for mixing Multipor lightweight mortar. The bucket is graduated so you can easily measure the required amount of water accurately — 4 l for 10 kg and 8 l for a 20 kg-bag.

**System components**

**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. Note for example, that Multipor lightweight mortar should not be used if the air or surface temperature is below 5° C. The level indicator on the Multipor bucket simplifies the task of mixing the lightweight mortar (20 kg/bag) for subsequently bonding the Multipor mineral insulation boards, applying the reinforcement layer and smoothing if necessary. To obtain a workable consistency it is advisable to use a low-speed mixer with a long, sturdy paddle. Leave the mortar to stand for around 5 minutes and then stir again before use.

---

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

- Add 8 l of water per 20kg bag of Multipor lightweight mortar and mix with the paddle mixer.
- Processing time: approx. 1.5 hours, depending on the weather. Do not use if the surface or ambient air temperature is below 5° C.
- Multipor lightweight mortar has a high coverage rate; one bag yields 30 l of fresh mortar, which is enough to cover up to 6 m² with a 5-mm layer thickness, depending on the condition of the substrate.
Multipor lightweight mortar can also be applied with conventional plastering machines. The settings required vary, depending on the machine.

Always follow the technical data sheet 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 production.

Use only Multipor lightweight mortar, otherwise we cannot guarantee the performance of the Multipor insulation system.

Multipor hemp-felt insulation strips
Special care must be taken to ensure that the first course of internal insulation is plumb and level, allowing for any height differences in the adjacent floor construction. It is also important to isolate any structures likely to exhibit different expansion or settling behavior from the insulation board with decoupling strips. Multipor hemp-felt insulation strips are particularly suitable for ensuring optimal sound insulation and for decoupling Multipor and Multipor plus mineral insulation boards when fitting interior insulation up to intersecting flexible components (ceilings, floors or interior walls) [12].

### Table 1: Technical data for Multipor lightweight mortar

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight mortar</td>
<td>LW as per EN 998-1</td>
</tr>
<tr>
<td>Compressive strength class</td>
<td>CS II; 1.5–5.0 N/mm²</td>
</tr>
<tr>
<td>Diffusion resistance factor</td>
<td>μ ≤ 10</td>
</tr>
<tr>
<td>Water absorption due to capillary action</td>
<td>W2, c ≤ 0.2 kg/(m² min⁰⁵)</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>λ₁₀,dry = 0.18 W/(mK)</td>
</tr>
<tr>
<td>Building material class</td>
<td>A2-s1, d0; non-combustible</td>
</tr>
<tr>
<td>Weight per bag</td>
<td>20 kg</td>
</tr>
<tr>
<td>Pallet content</td>
<td>40 bags</td>
</tr>
</tbody>
</table>

### Table 2: Technical data for Multipor hemp-felt insulation strips

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approval</td>
<td>Construction Products List C</td>
</tr>
<tr>
<td>Bulk density</td>
<td>155–210 kg/m³</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>λ₁₀,dry = 0.047 W/(mK)</td>
</tr>
<tr>
<td>Water vapor diffusion resistance factor</td>
<td>μ = 1 to 2</td>
</tr>
<tr>
<td>Building material class</td>
<td>E</td>
</tr>
<tr>
<td>Spec. heat capacity</td>
<td>c = 2300 J/(kgK)</td>
</tr>
<tr>
<td>Roll size L x W x H</td>
<td>25 m x 50 mm x 5 mm, 25 m x 100 mm x 5 mm</td>
</tr>
</tbody>
</table>
4.0 Multipor interior insulation systems

4.4 Products and system components

<table>
<thead>
<tr>
<th>Table 3: Technical data for Multipor reveal board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry bulk density</td>
</tr>
<tr>
<td>Compressive strength</td>
</tr>
<tr>
<td>Tensile strength</td>
</tr>
<tr>
<td>Thermal conductivity</td>
</tr>
<tr>
<td>Water vapor diffusion resistance factor</td>
</tr>
<tr>
<td>Building material class</td>
</tr>
<tr>
<td>Dimensions, delivery format</td>
</tr>
<tr>
<td>600 x 250 x 20</td>
</tr>
<tr>
<td>600 x 250 x 30</td>
</tr>
<tr>
<td>600 x 250 x 40</td>
</tr>
</tbody>
</table>

**Multipor reveal boards**

Multipor reveal boards are ideal for reducing thermal bridging round window reveals. Boards are available in thicknesses of 20, 30 and 40 mm, depending on space and requirements, and are processed in the same way as Multipor and Multipor compact plus mineral insulation boards [13] [14].

<table>
<thead>
<tr>
<th>Table 4: Technical data for Multipor insulating wedge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry bulk density</td>
</tr>
<tr>
<td>Compressive strength</td>
</tr>
<tr>
<td>Thermal conductivity</td>
</tr>
<tr>
<td>Water vapor diffusion resistance factor</td>
</tr>
<tr>
<td>Building material class</td>
</tr>
<tr>
<td>Dimensions, delivery format</td>
</tr>
<tr>
<td>390 x 500 x 60/20</td>
</tr>
</tbody>
</table>

**Multipor insulating wedge**

Fit 500-mm wide Multipor insulating wedges to interior walls and ceilings where they intersect the external wall to reduce thermal bridging. Apply in the same way as Multipor mineral insulation boards [15] [16].
Multipor interior insulation systems

Products and system components

Multipor interior insulation systems 4.0

嵌入 Multipor 支撑网

将 Multipor 支撑网轻轻地嵌入新鲜涂抹的轻质砂浆的上三分之一处，注意确保接缝重叠至少 10 cm [17] [18]。覆盖面积：1.10 m²/m²。该网可用于1 m 宽的卷材和25或50 m 长度 [19]。

健康与安全建设现场

安全始终是首要优先。

Multipor 复合纤维网

包含抗碱玻璃纤维网用于内部和外部，白色

<table>
<thead>
<tr>
<th>性能</th>
<th>详细信息</th>
</tr>
</thead>
<tbody>
<tr>
<td>克重</td>
<td>160 +/- 5 g/m²</td>
</tr>
<tr>
<td>网眼</td>
<td>4 x 4 mm</td>
</tr>
<tr>
<td>强度</td>
<td>≥ 1750 N/5 cm</td>
</tr>
<tr>
<td></td>
<td>≥ 50 % und ≥ 1000 N/5 cm</td>
</tr>
<tr>
<td>卷长</td>
<td>1 m</td>
</tr>
<tr>
<td></td>
<td>25 or 50 m</td>
</tr>
<tr>
<td>覆盖</td>
<td>约 1.1 m²/m²</td>
</tr>
</tbody>
</table>

健康和安全的建设现场

安全必须始终是首要任务。

Multipor 绝缘系统的设计和加工必须符合安全要求，包括工作平台和脚手架的安全以及一般建设现场安全。其它技术规则也应遵守以确保建设现场操作顺利。

这些包括一般安全和卫生措施，如在打磨操作时佩戴安全眼镜和防尘口罩，尤其是当工作在头顶时。
Insulation applied to the inside of external walls is often the only option for upgrading the thermal insulation of elaborate or listed historic facades. Multipor or Multipor compact plus interior insulation systems can also be used in new buildings with exposed concrete facades, for example. Water-vapor-permeable, capillary-active Multipor interior insulation systems are ideal for insulating the inside of different solid wall materials, without the hassle of installing a vapor barrier.

### Table 1: Multipor mineral insulation boards – dimensions and thermal resistance $R \ [\text{m}^2\text{K}/\text{W}]$

<table>
<thead>
<tr>
<th>Thermal conductivity [W/(mK)]</th>
<th>Board thickness [mm]</th>
<th>Multipor compact plus</th>
<th>Board thickness [mm]</th>
<th>Multipor interior insulation system</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.042$</td>
<td>30, 40, 50, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300</td>
<td>1.429, 1.905, 2.381, 2.857, 3.333, 3.810, 4.286, 4.762, 5.238, 5.714, 6.190, 6.667, 7.143</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.045$</td>
<td>0.667, 0.889, 1.111</td>
<td>– – – – – – – – – – – – – – – – –</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Insulation thicknesses of 220 mm and above available on request.

### Protection against driving rain

DIN 4108-3 provides guidance for assessing whether the external facade offers sufficient protection against driving rain, which is part of the initial planning process. If resistance to driving rain cannot be determined unequivocally by this means, it is possible to conduct an initial water absorption test on external facades using a gauge known as a Karsten or Rilem tube. Further information can be found under the following link: [https://ktauniversity.com/wind-driven-rain-resistance-testing/](https://ktauniversity.com/wind-driven-rain-resistance-testing/).

More detailed wall tests may then be required, depending on the results. Any damage or shortcomings found – e.g. defective joint mortar – must be rectified using carefully selected methods. Moisture-adaptive impregnation is one means of effectively protecting against driving rain, and must be renewed at specified intervals – in consultation with the manufacturer of the protective wall coating.
Further information and recommendations for assessment can be found in WTA Guidelines 6–4 “Interior insulation as per WTA I: Planning guide” (Innendämmung nach WTA I: Planungsleitfaden), 6–5 “Interior insulation as per WTA II: The use of numerical calculation methods to verify interior insulation systems” (Innendämmung nach WTA II: Nachweis von Innendämmssystemen mittels numerischer Berechnungsverfahren), 8–4 “Restoration of half-timbered constructions as per WTA IV: External cladding” (Fachwerkinstandsetzung nach WTA IV: Außenbekleidungen) and 8–5 “Restoration of half-timbered constructions as per WTA V: Interior insulation” (Fachwerkinstandsetzung nach WTA V: Innendämmung).

### Table 2: Assessment of substrates for interior insulation

<table>
<thead>
<tr>
<th>Existing substrate</th>
<th>Measure</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth, fully mortared masonry</td>
<td>None</td>
<td>Remove dust, dirt and paint if necessary</td>
</tr>
<tr>
<td>Uneven substrate</td>
<td>Apply levelling plaster</td>
<td>CS II lime-cement plaster</td>
</tr>
<tr>
<td>Uneven or flaking old plaster</td>
<td>Level out or remove</td>
<td>If necessary, level with CS II lime-cement plaster</td>
</tr>
<tr>
<td>Lime or lime-cement plaster</td>
<td>None</td>
<td>Remove dust, dirt and flaking parts and patch if necessary</td>
</tr>
<tr>
<td>Gypsum plaster</td>
<td>Remove</td>
<td>Completely remove gypsum plaster</td>
</tr>
<tr>
<td>Old paint</td>
<td>Remove</td>
<td>Completely remove old paint (e.g. by sanding)</td>
</tr>
<tr>
<td>Wallpaper</td>
<td>Remove</td>
<td>Wash and scrape off, remove residual paste</td>
</tr>
<tr>
<td>Waterlogged masonry</td>
<td>Seal, leave to dry</td>
<td>Replace horizontal or vertical membrane, leave to dry out</td>
</tr>
<tr>
<td>Half-timbered wall with clay plaster on the inside</td>
<td>Level with clay plaster if necessary</td>
<td>Use clay plaster system (see Chapter 4.5)</td>
</tr>
<tr>
<td>Lightweight construction</td>
<td>Unsuitable substrate</td>
<td>Not suitable for Multipor insulation</td>
</tr>
<tr>
<td>Existing insulation [e.g. lightweight wood-wool boards or similar]</td>
<td>Remove</td>
<td>Remove old insulating materials, level with CS II lime-cement plaster if necessary</td>
</tr>
</tbody>
</table>

Non-load-bearing old plaster, barrier membranes, coats of paint wallpapers etc. must be removed beforehand and defective areas repaired. Silicate paints, on the other hand, often provide a suitable substrate for bonding due to their silicifying properties. If the interior plaster is completely removed, a levelling layer may need to be used in some circumstances – for example to fill large joint cavities. A ‘dubbing out’ coat of plaster can be applied to the existing substrate to level out larger areas of unevenness. Defects are best repaired and plastered with a CS II plaster mortar as per DIN EN 998-1 with a compressive strength of at least 1.5 to 5 N/mm², such as Multipor lightweight mortar for example. The plaster substrate must be carefully tested by the specialist contractor to verify its suitability for adhesion. Please contact your Multipor technical advisor for more information about surface testing.

Freshly plastered substrates need a defined drying period before Multipor mineral insulation boards can be applied. Please refer to the plaster manufacturer’s directions.
4.5 Using Multipor interior insulation systems with lightweight mortar

Construction site conditions
During the processing and setting of Multipor lightweight mortar the room temperature and surface temperature of the structure must not fall below > 5 °C. Relative humidity should not exceed 80%.

Components in contact with the ground
The floor and wall area of structural components adjacent to the ground must be permanently protected against rising damp and moisture penetration. This is normally done by applying a waterproof membrane to the outside of the building at the time of construction. The same applies to the base plate (sole plate). Bitumen or plastic sheeting is suitable for retrofit waterproofing.

Mixing Multipor lightweight mortar
Mix Multipor lightweight mortar (20 kg/bag) with the quantity of water indicated on the mortar bag. The Multipor bucket is graduated to make it easy to add the right quantity. To obtain a workable consistency we advise using a low-speed mixer with a long, sturdy paddle. Leave the mixed mortar to stand for about 5 minutes before re-stirring. 20 kg of lightweight mortar combined with the required amount of water yields approximately 30 liters of fresh mortar.

Clean tools and mixers thoroughly after use or before long breaks to ensure optimal mixing and processing results.

Bonding Multipor mineral insulation boards
Using a 12-mm notched trowel, apply a full bed of Multipor lightweight mortar to the back of the Multipor mineral insulation board and comb to create an optimum adhesive bond. Depending on the thickness of insulation, we recommend using different trowel sizes to obtain the right ridge thickness required for full-surface bond:
- 12-mm notched trowel for insulation thickness up to 140 mm
- 15-mm notch trowel for insulation thickness of 160 mm or above
Using Multipor interior insulation systems with lightweight mortar

Slight unevenness in the substrate can also be levelled out in this way. If necessary, Multipor mineral insulation boards can be laid wet-on-wet (buttering and floating method) to level out further uneven areas. The following points must be strictly observed when using vapor-permeable, capillary active systems such as Multipor or Multipor compact plus interior insulation:

- Bond with a full bed of Multipor lightweight mortar
- Slide and press the Multipor mineral insulation board into position correctly
- Mortar-free head and bed joints [12–14].

Larger tolerances in the substrate must be evened out with a suitable leveling plaster before starting the insulation work. Table 2 ”Assessment of substrates for interior insulation” provides useful guidance on this subject.

Special care must be taken to ensure that the first course is plumb and level, allowing for any height differences in the adjacent floor construction. Structures like to exhibit different expansion or settling behavior (e.g. timber joist ceilings and floors) must be decoupled from the insulation board using Multipor hemp-felt insulation strips [8]. Bond the Multipor mineral insulation boards with a minimum joint offset of 15 cm using a full bed of Multipor lightweight mortar [9–11]. After applying the bonding mortar, position the Multipor mineral insulation boards on the wall surface and press down to ensure the entire surface is fully bonded. Only a full-surface bond will prevent warm, damp indoor air flowing behind the insulation and in addition to regulating humidity, it also guarantees the long-term performance of the interior insulation in terms of building physics. Figures [12–14] illustrate how the ridges of Multipor lightweight mortar should respond to ensure correct positioning of Multipor mineral insulation boards. It is not necessary to interlock the insulation boards with intersecting internal walls; they simply need to butt up tightly against one another. During subsequent reinforcement, do not run the mesh around internal corners.
Cutting and shaping
It is easy to cut Multipor mineral insulation board to fit the features of the room. Closers can also be quickly cut to size using a fine-toothed Multipor handsaw. Small areas of unevenness can be sanded smooth with the Multipor sanding board before applying subsequent coatings. Remove any sanding dust from the surface of the insulation boards before applying the reinforcement plaster, and re-prime the sanded area if necessary.

Solid intermediate floors
Vapor barriers between two storeys are unnecessary.

Floorboards on top of a timber-joist ceiling
Tongue-and-groove floorboards or engineered wooden boards may be laid on top of a timber-joist ceiling. When renovating old buildings, the structural condition of the timber joists and flooring should be checked and if necessary repaired before installing the insulation boards. There should be no give or spring in the floor (screw down loose floorboards).

Where possible, Multipor mineral insulation boards should be installed on the unfinished floor and the subsequently laid screed should be decoupled by inserting screed-edge insulation strips between the screed and the insulation boards. If it is not possible to lay the insulation boards on the unfinished floor, the first course must be laid straight on to the top edge of the finished floor, against the wall (the resulting thermal bridge created by the ceiling must be assessed at the planning stage – see Chapter 7.1.3). The insulation must also be decoupled from flexible components (such as wooden flooring) using Multipor hemp-felt insulation strips.

Intersecting timber-joist ceilings must also be decoupled from Multipor mineral insulation boards at the point of intersection using the same decoupling strips. The strips absorb any vibrations from these components to prevent them transferring to the insulation.

Reinforcing the insulated wall
To reinforce the insulated surface, apply reinforcement plaster (Multipor lightweight mortar) with an average thickness of 5 mm to the entire surface using a 10-mm or 12-mm notched trowel. Then press in the alkali-resistant Multipor reinforcement mesh and work carefully into the upper third of the reinforcement layer.

Where possible, Multipor mineral insulation boards should be installed on the unfinished floor and the subsequently laid screed should be decoupled by inserting screed-edge insulation strips between the screed and the insulation boards. If it is not possible to lay the insulation boards on the unfinished floor, the first course must be laid straight on to
Reinforcement: Multipor lightweight mortar approx. 3 to 4 kg/m² for a 5-mm layer thickness
Mesh: Multipor reinforcement mesh 4 x 4 mm approx. 1.1 m²/m² (overlap approx. 10 cm)

For additional reinforcement, use alkali-resistant armored mesh to increase the compressive strength of impact-prone areas of interior walls (e.g. stairwells, public buildings such as schools). Embed the additional mesh in the Multipor lightweight mortar before the normal reinforcement layer, with the edges butting up rather than overlapping. Allow the armored reinforcement to dry before applying the normal reinforcement layer to the entire surface. This armored mesh can also be inserted before fitting edge protectors and expansion joint profiles.

Coatings
The surface of Multipor and Multipor compact plus interior insulation systems can be finished in various ways – for example plastering, painting or tiling. Clay plasters or plasterboard (drywall boards) are another option and offer great scope for creating decorative finishes.

Applying finishing plaster to the reinforcement layer
Apply a finishing coat of Multipor lightweight mortar or Multipor fine lime plaster [21] in a 2 to 3-mm layer thickness and smooth with a felted float before it sets [22] [23]. Multipor lime finishing plaster is applied in a 2-mm layer thickness and is suitable for a creating superior quality finish.

Once this is done, you can apply wallpaper or paint the walls with Multipor interior silicate paint. Alternatively, apply Class CS I/CS II CR finishing plaster to EN 998-1 or silicate textured plaster, e.g. Multipor silicate plaster, with a trowel ‘to grain thickness’ and texture when still wet [24]. Apply gypsum finishing plasters in a maximum layer thickness of 3 mm and lime or fine lime plasters in a 3 to 5-mm layer thickness. The total thickness of plaster
4.0 Multipor interior insulation systems

4.5 Using Multipor interior insulation systems with lightweight mortar

[reinforcement layer and finishing plaster] should not exceed 8 mm. The plaster surfaces can then be finished with Multipor interior silicate paint. Allow the plaster to dry fully before painting.

Coverage:
- Finishing plaster with Multipor lightweight mortar: approx. 2 kg/m² for a 2 to 3-mm layer thickness
- Finishing plaster with Multipor smooth lime plaster: approx. 2 kg/m² for a 2-mm layer thickness (see Table 3)
- Please refer to the respective manufacturer’s technical data sheets for coverage of other suitable plasters.

Other mineral-based lightweight plasters can also be used as a finishing plaster, provided that they do not exceed compressive strength class CS II. As a basic rule, the finishing plaster should have a maximum thickness of 3 mm, the base plaster and reinforcing layer ≤ 8 mm and never thicker than the reinforcing layer underneath. It is also important to ensure that the finishing plaster bonds effectively with the Multipor lightweight mortar – it’s a good idea to conduct plaster tests beforehand to check this.

Wallpaper
Wallpapers can also be applied to Multipor insulation system for a decorative finish. We recommend the following types and materials:
- woodchip wallpapers
- embossed wallpapers
- printed wallpapers.

Under typical conditions in a home (20°C and average relative humidity 50% to maximum 60%), there are no restrictions in terms of building physics.

Woodchip, embossed and glass-fiber wallpapers should ideally be applied to a plaster substrate of Multipor lightweight mortar.
Multipor fine lime plaster or Multipor smooth lime plaster is a more suitable substrate for finer quality wallpapers, depending on the quality of surface finish required (Q1 to Q4, see information sheet published by the German Gypsum Industry Association: “Plaster surfaces in interiors” [Putzoberflächen im Innenbereich]).

**Paint**

Various types of paint can be used. We generally recommend vapor-permeable silicate interior wall paint to DIN 18363 to avoid compromising the performance of the Multipor interior insulation system. Multipor interior silicate paint [25] is ideal for this purpose: It can be applied to Multipor fine lime plaster, Multipor lightweight mortar or any other mineral-based substrates to give a decorative interior finish. Free from preservatives and softeners, it prevents the growth of bacteria and fungi on the surface in a natural way. Supplied in ready-to-use 15-liter buckets, the paint just needs a quick stir before applying one or two coats with a brush, roller or airless sprayer [26] [27].

Undiluted coverage per coat is approx. 0.15 l/m² – depending on the absorption capacity and texture of the substrate.

With a particle size below 100 μm, the silicate paint gives a flat, matt finish which is naturally white.

Water-soluble, lime-fast pigments can be added for a colored finish.

Walls in rooms that don’t require a high quality decorative finish (e.g. underground garages, storerooms) can be painted directly with a brush, roller or sprayer – without adversely affecting the diffusion capability. Multipor interior silicate paint is ideal for enhancing the surface of Multipor mineral insulation boards, provided that any dust is removed before painting. Hairline cracks occasionally develop across board joints if Multipor lightweight mortar is applied directly to the insulation boards as a thin skim coat without the necessary reinforcement mesh.

**Practical tip:** Mineral-based finishing render and paints ideally complement Multipor mineral insulation systems.

**Plasterboards (drywall boards)**

Fasten the framing for this type of surface finish – timber battens for example – to the load-bearing substrate through the Multipor mineral insulation boards using suitable fixing devices. First smooth any raised areas in the head and bed joints with a sanding board.

Then fasten the plasterboard to the timber battens. Follow the plasterboard manufacturer’s instructions at each stage. When the plasterboards are fastened to the framing, a cavity is created within the stud wall which is ideal for accommodating service installations such as wiring, cavity wall sockets, pipework etc. Since the cavity is located immediately in front of the fully bonded insulating layer, warm damp indoor air is prevented from flowing behind the insulation. Consequently, it has no adverse effect on the insulation’s performance in terms of building physics.

**Surface finishes for plasterboard**

Please contact the plasterboard manufacturer for information about suitable surface finishes. We recommend using vapor-permeable coatings to ensure the long-term performance of the interior insulation.

**Wet rooms and waterproofing / using a vapor barrier**

Domestic kitchens and bathrooms, like living rooms and offices, are classed as ‘dry rooms’ in accordance with DIN 4108-3. When used as intended and with appropriate heating and ventilation, the average relative humidity is not significantly higher than in living areas, so in most cases additional waterproofing is not required. In areas subject to splashing – for example behind baths or in shower cubicles – a liquid sealant must be applied to the existing layer of reinforcing plaster in accordance with approved codes of practice and the ZDB information sheet below. ZDB stands for Zentralverband Deutsches Bauge- werbe and is the umbrella organization of the German construction industry.
Further information can be found in the latest version of the ZDB information sheet “Waterproof seals used in conjunction with tiles and panels” (Abdichtungen im Verbund mit Fliesen und Platten).

These guidelines do not apply to areas subject to heavy moisture loads (commercial wet rooms, catering kitchens, spa/wellness areas and swimming pools). In such cases, individual non-steady-state simulations are essential to verify the hygrothermal performance of the overall structure (see “Insulation Checklist” in the download area of our website at www.multipor.com).

Anchor fixings in special situations
Multipor mineral insulation boards applied to a substrate suitable for adhesion do not generally require anchor fixings. One exception is sandy old plaster which has been consolidated with a silicate primer. In this case, a Multipor screw-in anchor (plate diameter ≥ 60 mm) must be screwed through the middle of the insulation board into the load-bearing substrate to ensure full-surface bonding [28].

Tiling Multipor interior insulation systems
Multipor mineral insulation boards can generally be tiled, provided that the substrate is load-bearing and suitable for adhesion [29]. The reinforcement layer must be additionally secured by inserting screw-in anchors (plate diameter ≥ 60 mm) wet-on-wet through the mesh into the load-bearing substrate. A smooth, level substrate is particularly important for large-format tiles or stoneware panels (e.g. 60 x 60 cm). This will ensure that the tiles are fully supported and securely retained.
The following points should be considered when tiling Multipor interior insulation systems:

- max. tile weight 25 kg/m²
- anchor fixing with plate diameter ≥ 60 mm for insulation
- number of anchors: approx. 4 per m² wet-on-wet through the reinforcing layer.

We recommend fixing tiles in a thin bed of flexible adhesive and using a flexible grout. Multipor compact plus insulation is not suitable for tiling.

We recommend tiling only 2/3 to maximum 3/4 of the way up the wall to retain the moisture-regulating function of the wall.

**Reveals**

Multipor reveal boards are ideal for insulating a wide variety of reveals. Apply a full bed of Multipor lightweight mortar to the Multipor reveal board with a 12-mm notched trowel and comb though.

The height of the troweled ridge should be around 10 mm. It is important to avoid butting the reveal insulation boards tightly up to the window or door frames. Instead, insert suitable flexible decoupling profiles (e.g. Multipor plaster-stop beads). This helps to prevent subsequent cracking [31] [32].

**Insulating wedges**

To reduce thermal bridging, interconnecting interior walls can be insulated to a depth of approx. 50 cm where they insect with the external wall. Multipor mineral insulation board or a Multipor insulating wedge, which is processed in the same way as the mineral insulation board, can be used for this purpose. The wedge does not have to dovetail with the insulation boards on the inside of the external wall [33] [34].

**Electrical installations**

Interior insulation systems improve the heat retention of poorly insulated external walls. To prevent thermal bridging, it is best to avoid routing electrical switches, wiring and sockets through the insulation. Instead, they should be installed in less sensitive areas such as internal walls. Surface-mounted systems (cable ducts/skirting boards) are also possible. If these options are undesirable or unfeasible, the following points must be borne in mind before carrying out the actual insulation work:

- Note the exact position of switch boxes, distribution boxes and socket outlets
- Route wiring and fixtures for new installations in the existing wall or on the substrate.

**Practical tip:** Heating and water pipes should be considered separately during the design stage.

If cables are routed on the existing wall, cut a chase in the back of the Multipor mineral insulation boards before installing [35] [36].
4.0 Multipor interior insulation systems

4.5 Using Multipor interior insulation systems with lightweight mortar

We recommend using the new Multipor interior insulation sockets to securely fix switches, sockets and other devices to exterior walls insulated on the inside without thermal bridging [37] [38]. They are designed specifically for use in vapor-permeable Multipor interior insulation systems with an insulation thickness of 30 to 100 mm.

Benefits:
- Designed to be installed in insulated interior walls
- Thermal bridge-free installation guaranteed
- Moisture-regulating and insulating at the same time
- Prevent moisture-related structural damage.

The Institute of Building Climatology at the TU Dresden has conducted extensive building materials testing which confirms the performance of Multipor interior insulation sockets. The study shows that the new interior insulation socket prevents hygrothermally induced damage.

The Multipor socket extension kit, which consists of a mounting plate and an extension ring [39], is another proven option. It is designed to ensure secure fastening to the insulated substrate. The length can be extended in 5 mm increments to suit the insulation thickness, making it particularly suitable for existing installations. The socket kit extends existing device and junction boxes to enable socket outlets, for example, to be securely fastened to retrofitted insulation.

Fill any gaps between the socket and the insulation with Multipor filler. Then apply the chosen final surface finish, as described above.

Electrical installations must be fastened to a load-bearing substrate [40]. Switch boxes, distribution boxes, socket outlets and other electrical devices must be securely mechanically fastened to the existing wall using mounting plates and extensions before carrying out the insulation work [41] [42].

![Multipor interior insulation socket](image1)

![Installed Multipor interior insulation socket](image2)

Fasten front section to the wall.

Snap off the screw tabs on the ISO extension ring and screw the ring to the front section (40 mm screws).

Several ISO extension rings can be connected together to adapt the socket to the insulation thickness.
Multipor telescopic device mounts and Multipor telescopic device boxes can also be steplessly adjusted to suit the insulation thickness. Electrical devices can then be mounted securely with ease [43] [44].

We do not advise mounting electrical sockets and cables directly to Multipor mineral insulation boards since this is not generally considered a proper and secure method of installation. In the case of plasterboard, fasten electrical installations to the stud wall and route cables in the cavity in front of the insulation board.

**Other fittings: Insulating roller shutter boxes**

After windows, roller shutter boxes are the main cause of significant heat loss in old buildings, often associated with drafts due to outdated construction methods. Since roller shutter boxes are generally poorly insulated and insufficiently airtight, if at all, they create thermal bridges which significantly increased heating costs. In construction terms, roller shutter boxes should be considered part of the wall, because they separate the indoor and outdoor climate.

Although they account for a relatively small percentage of the overall wall surface, in terms of energy performance they are the weakest component.

With attention increasingly turning to roller shutter boxes within the context of energy efficient refurbishments, well-known manufacturers now offer suitable interior remediation systems for virtually any roller shutter situation. Your Multipor technical adviser will gladly advise you in this matter.

**Mounting radiators**

Radiator recesses originally had an aesthetic function. Since old-fashioned radiators were very deep, the recesses prevented them projecting too far into the living space. However, these recesses reduced the thickness of the external wall, creating a ‘design-related’ thermal bridge which allowed heat to flow outside more quickly than via the remaining building envelope. Up to 6% of heat energy can be lost via this weak spot alone.

To improve energy performance in these areas, the recesses can be initially filled in with Ytong precision blocks during renovation work. The newly installed radiators can then be fastened directly to the solid Ytong precision block using suitable wall anchors. Failing this, it is a good idea to insulate the radiator recesses with Multipor interior insulation systems of a suitable thickness and connect them to the remaining wall surface.
4.0 Multipor interior insulation systems

4.5 Using Multipor interior insulation systems with lightweight mortar

If the recesses are sealed with Multipor interior insulation systems, make sure that the anchor fixings for the radiators pass through the insulation into the load-bearing substrate. There are several ways of doing this:
- Extend the existing brackets by the thickness of the insulation.
- Fit brackets to the interior insulation by screwing them through the insulation to the load-bearing substrate using suitably sized fasteners.
- Fasten new telescopic brackets to the existing wall and fit insulation round them.
- Mount the radiators on the floor.

In areas subject to increased loading, for example in schools or discotheques, we recommend using angle brackets or floor-mounting the radiators.

VDI Standard 6036 “Fasteners of radiators - requirements for planning and design” provides more detailed information on this subject. It is advisable to choose a suitable fastening option on the basis of this standard. Reputable radiator manufacturers are also a useful source of help.

Guide values for processing times
Allow 10 to 15 minutes to bond 1.0 m² Multipor mineral insulation board, depending on the level of experience. This does not include preparing the plaster and other preparatory work such as removing separating layers. Insulating reveals, surface adjustment and similar are not included. Provision must also be made for other tasks (e.g. plaster profiles) where necessary. Profit and risk must be included in the calculation. The time allowance thus shows wide variation: from 0% to approx. 12%. Direct transport to the site and setup times must also be included.

Multipor interior insulation systems
Multipor interior insulation systems consist of carefully matched, specially developed system components with good material compatibility. They offer solutions for any insulation project or energy-efficient refurbishment scheme. Please contact your Multipor technical advisor for the complete product range.

You can find your dedicated technical adviser on the contact page of our website at www.multipor.com.

### Table 4: Consumption of basic components

<table>
<thead>
<tr>
<th>Material</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipor mineral insulation board</td>
<td>4.3 boards/m²</td>
</tr>
<tr>
<td>Multipor compact plus mineral insulation board</td>
<td>5.2 boards/m²</td>
</tr>
<tr>
<td>Multipor lightweight mortar (adhesive)</td>
<td>approx. 3.5 kg/m² for a max. 5 mm layer thickness</td>
</tr>
<tr>
<td>Multipor lightweight mortar (reinforcement)</td>
<td>approx. 3.5 kg/m² for a max. 5 mm layer thickness</td>
</tr>
<tr>
<td>Multipor reinforcement mesh</td>
<td>approx. 1.1 m/m²</td>
</tr>
</tbody>
</table>

**Alternative components**

<table>
<thead>
<tr>
<th>Material</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipor lightweight mortar (finishing plaster)</td>
<td>approx. 2.5 kg/m² for a max. 5 mm layer thickness</td>
</tr>
<tr>
<td>Multipor screw-in anchor</td>
<td>4.3 units/m²</td>
</tr>
<tr>
<td>Multipor reveal boards</td>
<td>1.66 units/lm</td>
</tr>
<tr>
<td>Multipor insulating wedge</td>
<td>2.56 units/lm</td>
</tr>
<tr>
<td>Multipor smooth lime plaster</td>
<td>approx. 2.0 kg/m² for a max. 2 mm layer thickness</td>
</tr>
<tr>
<td>Multipor fine lime plaster</td>
<td>approx. 5.0 kg/m² for a max. 3 mm layer thickness</td>
</tr>
<tr>
<td>Multipor interior silicate paint</td>
<td>approx. 0.3 l/m²</td>
</tr>
</tbody>
</table>
Using Multipor interior insulation systems with clay mortar

- Eco-friendly, healthy and climate-regulating. Environmentally compatible solutions are particularly important for refurbishment projects - and Multipor clay mortar is ideal for this purpose.

The Multipor interior insulation system with clay mortar can be used as interior wall insulation for energy-efficient refurbishments and as interior plaster systems on masonry such as Ytong autoclaved aerated concrete and Silka calcium-silicate blocks when a health-conscious approach to modernization is required.

Consisting of a blend of powdered clay and natural sand, Multipor clay mortar conforms to current regulations for building with clay and to DIN 18947 “Earth plasters” (see Table 1).

The fact that it dries purely by mechanical means, can be reused and contains no chemical additives qualifies it as a healthy building material. Furthermore, with high capillary conductivity, it absorbs and distributes moisture to speed up the drying process.

**Multipor clay mortar can be used in a wide variety of ways:**
- Single or multi-layer levelling plaster up to 40 mm layer thickness for uneven substrates
- Adhesive mortar for Multipor mineral insulation boards, in accordance with the relevant directions for use
- Reinforcement plaster with mesh insert on Multipor mineral insulation boards
- Interior plaster on Multipor mineral insulation boards, Ytong AAC masonry and Silka calcium-silicate masonry
- Wall heating plaster in accordance with manufacturer’s instructions.

It is very easy to use and, as a 100% natural material, can be remixed time and again: If the material sets to soon, just add more water and mix again to reproduce a workable consistency. Any remaining mortar can be stored indefinitely, and is also fully compostable.

**Refurbishing half-timbered buildings**

Another important area of application for Multipor clay mortar is the refurbishment of half-timbered buildings. Combined with Multipor mineral insulation boards, the two materials complement other perfectly, having the ideal building physical properties for creating an optimum indoor climate while at the same time protecting historic, listed wall structures. Clay mortar has traditionally been used to protect the timber components of half-timbered buildings thanks to its ability to rapidly remove moisture. Further processing instructions and data sheets are available in the download section of our website at [www.multipor.com](http://www.multipor.com).

Multipor clay mortar can also be used as interior plaster on numerous surfaces (both in new buildings and refurbishment projects). Apply a 3 to 5-mm layer of clay mortar to the dried substrate and smooth with a trowel or sponge float to the desired texture. With good ventilation, the mortar sets well enough within 3 to 5 days for the surface finish to be applied.

**Natural clay**

Ecological Multipor clay paint is the perfect partner for Multipor clay mortar.
Two to three coats of this natural, solvent-free, clay-based wall paint, applied with a brush or roller, is sufficient to create a white, vapor-permeable and therefore breathable decorative finish for interior walls and ceilings. Mineral-based stains and pigments can be added to create different color and textural effects.

**Special benefits for healthy living**

In brief, the Multipor interior insulation system with clay mortar is an ecological and environmentally friendly solution for surface finishes and energy efficient refurbishments. Healthy products – also suitable for allergy sufferers – can be applied to a wide variety of substrates to significantly enhance comfort and quality of life.

**Multipor 7x7 mm reinforcement mesh**

7 x 7 mm reinforcement mesh (see Table 2) has been designed specifically for use with Multipor interior insulation systems with clay mortar. Embed it gently into the upper third of the freshly applied Multipor clay mortar, taking care to overlap the joints by at least 10 cm. Coverage: 1.10 m²/m². The mesh is available in 1 m wide rolls and 25 or 50 m lengths.

**Bonding Multipor mineral insulation boards with clay mortar**

Mix the Multipor clay mortar with approx. 6 l of water per bag (25 kg) to a smooth, uniform consistency using a suitable mixer [1]. Bond Multipor mineral insulation boards to the substrate in a staggered pattern using a full bed of Multipor clay mortar. Apply a full bed of clay mortar to the back of the Multipor insulation board with a notched trowel (12-mm notch) and comb [2].

<table>
<thead>
<tr>
<th>Table 1: Technical data for Multipor clay mortar manufactured to DIN 18947/LPM-0/0.8 m - S II - 2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal conductivity</td>
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<tr>
<td>Water vapor permeability coefficient</td>
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<tr>
<td>Heat capacity</td>
</tr>
<tr>
<td>Bulk density</td>
</tr>
<tr>
<td>Shrinkage</td>
</tr>
<tr>
<td>Flexural strength</td>
</tr>
<tr>
<td>Compressive strength</td>
</tr>
<tr>
<td>Equilibrium moisture content, wt%</td>
</tr>
<tr>
<td>Building material class</td>
</tr>
<tr>
<td>Processing temperature</td>
</tr>
<tr>
<td>Storage</td>
</tr>
<tr>
<td>Delivery form</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Technical data for Multipor reinforcement 7 x 7 mm mesh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkali-resistant glass fiber mesh for interior use</td>
</tr>
<tr>
<td>Grammage</td>
</tr>
<tr>
<td>Mesh width</td>
</tr>
<tr>
<td>Strength - on delivery</td>
</tr>
<tr>
<td>- after ageing</td>
</tr>
<tr>
<td>Roll size - width</td>
</tr>
<tr>
<td>- length</td>
</tr>
<tr>
<td>Coverage</td>
</tr>
</tbody>
</table>
After combing, the troweled ridges should be at least 10 mm high. The existing wall surface can also be prefilled with clay mortar to a maximum depth of 10 mm using a smoothing trowel prior to fitting the insulation board wet-on-wet. After applying the clay mortar, position the Multipor mineral insulation board on the wall and press down firmly [3].

This ensures a thin adhesive bond and complete mortar coverage. Butt the head and bed joints of the Multipor mineral insulation boards up tightly rather than mortaring them [4].

Special care must be taken to ensure that the first course is plumb and level, allowing for any height differences in the adjacent floor construction. If structures are likely to exhibit different expansion or settling behavior, they should be decoupled from adjacent components with Multipor hemp-felt insulation strips.

Closers for Multipor mineral insulation boards can be cut to any size using a fine-toothed Multipor handsaw.

Practical tip: You can add more water repeatedly to dried out Multipor clay mortar to achieve the required consistency.

Reinforcement plaster/base plaster
To use Multipor clay mortar as a reinforcing layer, mix to a workable consistency by adding approx. 4.5 l of water per bag. Note that reinforcement plaster requires less water than adhesive plaster. Then comb the Multipor clay mortar onto the surface of the insulation board with a 12-mm notched trowel [5].

The troweled ridges should be around 10 mm high. Then embed reinforcement mesh with a mesh width of 7 x 7 mm into the upper third of the reinforcement plaster. Once troweled smooth, this gives an average layer thickness of 5 mm [6].

Installing anchor fixings
Multipor mineral insulation boards generally require mechanical fastening when Multipor clay mortar is used as the adhesive in energy-efficient refurbishments. This is done using thermally decoupled screw fasteners with plate head (minimum 60 mm diameter).
In the case of half-timbered buildings, screw-in anchors should be inserted in the timber frame to avoid damaging the space in between. Use at least four Multipor screw-in anchors per m². We recommend using one anchor per board on all free edges (e.g. window recesses). Interlock the insulation boards where they intersect at corners.

**Screwing in the anchors**

- Screw-in anchors are normally inserted in the middle of the board.
- If the plaster is >10 mm thick (reinforcement and base coat), insert the screw-in anchors through the reinforcement layer wet-on-wet [7].
- Slit a cross in the reinforcement mesh with a knife before inserting the screw.
- If wall heating is to be installed on walls insulated with Multipor mineral insulation boards, insert the anchors screws through the reinforcement layer wet-on-wet after plastering in the wall heating pipes. For more detailed guidance, please refer to our technical information on wall heating which you can find on the download section of our website at www.multipor.com.

**Multipor clay mortar as finishing plaster**

Multipor clay mortar can be applied to prepared, dry substrates as a decorative finish. Apply a 3 to 5-mm layer of Multipor clay mortar to the existing reinforcing layer with a notched trowel [8] and then smooth with a trowel or sponge float to the desired texture [9].

**Surface finish/paint**

The surface can be painted as soon as the finishing plaster is dry [10] – we recommend using our Multipor clay paint which we supply as white powder paint in 2 or 8 kg sacks. To obtain the right consistency for the substrate, add water in a ratio of no more than 1:10 and stir well with a mechanical mixer – then it’s ready for immediate use. The paint is easy to apply with a brush or roller. Apply two to three coats to ensure complete coverage, allowing three hours’ drying time between coats under normal ambient conditions.

**Practical tip:** Shrinkage and drying cracks may occur on clay plastered surfaces, depending on the material. These emphasize the natural character of Multipor clay mortar. They do not constitute a defect and can easily be rectified by lightly dampening the affected area (e.g. using a spray bottle) and closing them back up again with a float.

Commercially available mineral tints and pigments can be added to our Multipor clay paint to achieve the desired color.
### Table 3: Recommended coverage

<table>
<thead>
<tr>
<th>Multipor clay mortar to DIN 18947</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Delivery form</td>
<td>25 kg/bag</td>
</tr>
<tr>
<td>Yield per bag</td>
<td>approx. 15 l of fresh mortar is sufficient for approx. 1.5 m² with a 10-mm layer thickness</td>
</tr>
<tr>
<td>Water requirement per bag</td>
<td>approx. 6.0 l bonding, approx. 4.5 – 5 l reinforcement</td>
</tr>
<tr>
<td>Bonding</td>
<td>approx. 7 – 8 kg/m²</td>
</tr>
<tr>
<td>Reinforcement</td>
<td>approx. 7 – 8 kg/m²</td>
</tr>
<tr>
<td>Finishing plaster</td>
<td>approx. 5 kg/m² (for 3 mm) to approx. 8 kg/m² (for 5 mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multipor clay paint (powder paint)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery form</td>
<td>2 – 8 kg containers</td>
</tr>
<tr>
<td>Quantity of water required</td>
<td>1.5 l/kg dry powder</td>
</tr>
<tr>
<td>Materials requirement per coat</td>
<td>approx. 90 g/m² and coat</td>
</tr>
<tr>
<td>Drying time</td>
<td>approx. 2 hours at normal room temperature (20 °C, 50 % RH)</td>
</tr>
</tbody>
</table>

### Supplementary notes

When improving the energy performance of buildings, consideration must be given to the avoidance of thermal bridging where components connect (e.g. walls and ceilings). Connections should be included in the assessment from an early stage as part of the planning process. The product range for Multipor clay-based interior insulation systems includes suitable companion products such as Multipor reveal boards and insulating wedges.

#### Building physics in half-timbered structures

Upgrading the energy performance of half-timbered buildings often represents a major problem for planners and building contractors since it requires a great deal of specialist knowledge and expertise, particularly with regard to assessing the hygrothermal performance.

Multipor provides a “Checklist for insulating the inside of half-timbered buildings” in the download section of our website at www.multipor.com.

Once completed, the checklist can be used to carry out a realistic analysis of hydrothermal interactions within the building. We perform this service on request.
Reference building

Half-timbered building, Soest

- Total energy-efficient refurbishment of a stripped out half-timbered building
- Multipor interior insulation system with clay mortar used throughout
- Multipor clay mortar used as levelling plaster, adhesive and reinforcement layer and finishing plaster
- Multipor clay paint as high quality surface finish
- Satisfies stringent requirements for environmentally friendly and healthy construction methods and material

**Project data**

<table>
<thead>
<tr>
<th>Building type</th>
<th>Half-timbered house</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Soest</td>
</tr>
<tr>
<td>Application</td>
<td>Interior insulation with clay</td>
</tr>
<tr>
<td>Products used</td>
<td>Multipor mineral insulation board, t = 80 mm</td>
</tr>
<tr>
<td></td>
<td>Multipor clay mortar</td>
</tr>
<tr>
<td></td>
<td>Multipor clay paint</td>
</tr>
</tbody>
</table>
Reference building

Half-timbered building, Warendorf

- Preservation of listed facade
- Multipor interior insulation system with clay mortar used throughout
- Multipor clay mortar used as levelling plaster, adhesive and reinforcement layer and finishing plaster
- Satisfies KfW Efficiency House Standard for listed buildings
- Satisfies stringent requirements for environmentally friendly and healthy construction methods and materials

<table>
<thead>
<tr>
<th>Project data</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Building type</td>
<td>Half-timbered house</td>
</tr>
<tr>
<td>Location</td>
<td>Warendorf</td>
</tr>
<tr>
<td>Application</td>
<td>Interior insulation with clay</td>
</tr>
</tbody>
</table>
| Products used         | Multipor mineral insulation board
                       | Multipor clay mortar     |
4.7 Insulating air ducts with Multipor interior insulation systems

- Quick, cost-effective adhesive installation
- Non-combustible, A1-rated material in compliance with DIN EN 13501-1
- Does not generate smoke, burning droplets or toxic gases in the event of fire
- Purely mineral-based, free from fibers and harmful substances
- Pressure-resistant and deformation-free
- Dimensionally stable, no bowing or shrinkage
- Safe, ecologically certified building material

Modern buildings are increasingly fitted with intelligent ventilation and air conditioning technology. The fresh air supply for these systems is usually drawn in via suitably sized air ducts, and then distributed around the building after treatment. Residual heat is recovered from the used air before it is fed back outside via other air ducts.

In large buildings (office complexes, hospitals, function rooms), these air ducts can be substantial. To mitigate heat loss in adjacent rooms, air ducts can be insulated or reduced to a non-critical size.

Due to its ecological properties, the Multipor interior insulation system (see Table 1) is ideal for this purpose. As well as being resistant to pests, the high alkalinity of the product effectively inhibits mold growth. Furthermore, Multipor is non-toxic and solvent-free.

The latest certificate from the eco-INSTITUT in Cologne confirms the ecological properties of Multipor mineral insulation boards and Multipor lightweight mortar: The indoor air contains no harmful VOC concentrations (VOC stands for volatile organic compounds).

| Table 1: Technical data for Multipor mineral insulation board and Multipor lightweight mortar |
|----------------------------------|----------------------------------|
| Regulations                      | Multipor mineral insulation board | Multipor lightweight mortar      |
| European technical assessment ETA-05/0093 | Lightweight mortar LW as per EN 998-1 |
| Dry bulk density                 | 85–95 kg/m³                       | approx. 770 kg/m³                |
| Compressive strength             | ≥ 200 kPa                         | CS II; 1.50–5.0 N/mm²            |
| Thermal conductivity             | $\lambda = 0.042$ W/(mK) [design value] | $\lambda_{10, av} = 0.18$ W/(mK) |
| Water vapor diffusion resistance factor | $\mu = 2$                        | $\mu \leq 10$                   |
| Building material class          | A1; non-combustible               | A2-s1, d0; non-combustible       |
| Dimensions/delivery quantity     | 600 x 390 mm d = 60 – 300 mm [in increments of 20] special format d = 50 mm with $\lambda = 0.045$ W/(mK) | 20 kg/bag                       |
Table 2: Technical data for Multipor reinforcement 4 x 4 mm mesh

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammage</td>
<td>160 +/- 5 g/m²</td>
</tr>
<tr>
<td>Mesh width</td>
<td>4 x 4 mm</td>
</tr>
<tr>
<td>Strength on delivery</td>
<td>&gt;= 1750 N/5 cm</td>
</tr>
<tr>
<td>Strength after aging [ETAG 004]</td>
<td>&gt;= 50 % and &gt;= 1000 N/5 cm</td>
</tr>
<tr>
<td>Roll size - width</td>
<td>1 m</td>
</tr>
<tr>
<td>Roll size - length</td>
<td>25 or 50 m</td>
</tr>
<tr>
<td>Coverage</td>
<td>approx. 1.1 m²/m²</td>
</tr>
</tbody>
</table>

Please refer to VDI Standard 6022 for more information about hygiene requirements for ventilation and air conditioning systems. Part 3 of this standard defines the structural, technical and organizational measures required for the design, manufacture, installation, operation and maintenance of heating, ventilation and air conditioning systems (HVAC systems).

The maximum air velocity in the air duct has a major bearing on the design of the surface finish. In some cases, it may be up to 30 m/s (108 km/h) and certain measures must be put in place to allow for this. Table 3 lists a range of air velocities with corresponding construction guidance.

Using Multipor interior insulation system for air ducts

The instructions for using the Multipor interior insulation system and Multipor ceiling insulation system must be complied with.

The individual components of the Multipor interior insulation system for insulating air ducts are carefully matched to ensure the greatest possible degree of system safety, combined with easy processing and installation. With this logical system, it is possible to eliminate thermal bridging at adjacent components/rooms or reduce them to a non-critical level. Make sure that the substrate of the supply and exhaust air ducts is load-bearing and suitable for adhesion. Remove any mold oil residues or other components that may inhibit adhesion.

Smooth down any rough areas on the surface to be insulated to ensure full-surface adhesion. Level out uneven areas with a depth of up to 3 mm using the combed bed method. Always apply the adhesive to the Multipor mineral insulation boards. Substrate unevenness to a maximum of 5 mm can be rectified using the buttering-and-floating method – in this case the adhesive is applied both to the Multipor mineral insulation boards and the substrate to be insulated.

Apply a full bed of Multipor lightweight mortar to the back of the board with a 12-mm notched trowel (use a 15-mm notched trowel for boards with a thickness of 160 mm and above). Set the mortared board onto the surface to be insulated. Uneven areas in the insulated surface can easily be smoothed out with the Multipor sanding board.
### Insulating air ducts with Multipor interior insulation systems

#### Additional guidance notes on air duct insulation

If airflow speeds inside the ventilation shafts do not exceed 10 m/s, the surface of the Multipor mineral insulation boards can simply be painted with Multipor interior silicate paint. Use a roller or sprayer to apply the paint to the insulation boards (two coats).

For airflow speeds of up to 20 m/s, we advise skimming the boards with Multipor lightweight mortar in a thickness of approx. 3 mm. In this case, mesh reinforcement is not strictly necessary, but will increase the resistance.

For airflow speeds up to max. 30 m/s, mechanical fasteners are additionally required. These must be screwed through the reinforcement layer (wet-on-wet) into the load-bearing substrate and the anchor plate must also be skissed. Build up the layers as follows:

- Bond Multipor mineral insulation board to the load-bearing substrate with Multipor lightweight mortar
- Reinforce the surface of the insulation board with Multipor lightweight mortar and reinforcement mesh, including wet-on-wet mechanical fastening with Multipor screw-in anchors. Slight a hole in the mesh first with a sharp knife.
- Apply the final coating as required (either Multipor lightweight mortar, Multipor fine lime plaster or Multipor smooth lime plaster for a smooth finish)
- Apply Multipor interior silicate paint if required.

### Quality of surface finish for air duct insulation

Multipor lightweight mortar and Multipor fine lime plaster applied to the reinforcement layer of Multipor lightweight mortar satisfy the requirements for a Q2 grade surface finish.

Multipor smooth lime plaster (see Table 4) applied to the Multipor lightweight mortar reinforcement layer can satisfy the requirements for a Q3 surface finish.

<table>
<thead>
<tr>
<th>Airflow speed</th>
<th>Construction/surface</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 10 m/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply fully mortared Multipor mineral insulation board</td>
<td>Apply paint with roller or airless sprayer</td>
</tr>
<tr>
<td></td>
<td>Paint surfaces with Multipor interior silicate paint</td>
<td>Two coats of paint are normally required</td>
</tr>
<tr>
<td>up to 20 m/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply fully mortared Multipor mineral insulation board</td>
<td>Skim coat thickness approx. 3 mm (hairline cracking may occur where the insulation boards join)</td>
</tr>
<tr>
<td></td>
<td>Apply an additional skim coat of Multipor lightweight mortar</td>
<td>Additional mesh reinforcement increases surface strength and minimizes the risk of hairline cracking</td>
</tr>
<tr>
<td></td>
<td>Finish with Multipor interior silicate paint if required</td>
<td></td>
</tr>
<tr>
<td>up to max. 30 m/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply fully mortared Multipor mineral insulation board</td>
<td>Use Multipor screw-in anchors with a plate diameter of at least 60 mm</td>
</tr>
<tr>
<td></td>
<td>Mechanically fasten the Multipor mineral insulation boards by inserting anchors screws through the reinforcement layer wet-on-wet</td>
<td>Insert mesh in the reinforcing layer</td>
</tr>
<tr>
<td></td>
<td>Always use Multipor lightweight mortar for reinforcement</td>
<td>Fit one anchor per Multipor mineral insulation board</td>
</tr>
<tr>
<td></td>
<td>Use Multipor lightweight mortar, Multipor fine lime plaster or Multipor smooth lime plaster for the finishing coat</td>
<td>Select the anchor based on the fire protection requirements for the building concerned</td>
</tr>
<tr>
<td></td>
<td>Finish with Multipor interior silicate paint if required</td>
<td></td>
</tr>
</tbody>
</table>

---

**Table 3: Insulation of air ducts with Multipor mineral insulation board**

<table>
<thead>
<tr>
<th>Airflow speed</th>
<th>Construction/surface</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The maximum plaster thickness (reinforcement and finishing plaster) is 8 mm.
If construction requirements call for thicker plaster, it is essential to provide additional mechanical fastening by inserting Multipor screw-in anchors through the reinforcement layer when still wet. The maximum surface load should be determined in consultation with your Multipor technical adviser.

If the surface of the insulation boards has to be sanded down, remove any dust and loose fragments before applying any further coatings (e.g. with a fine brush). However, it is not necessary to prime the surface before applying Multipor lightweight mortar. Multipor interior silicate paint can also be applied without further substrate preparation.

**Practical tip:** The hygiene requirements of ventilation and air conditioning systems are described in VDI Standard 6022.

**Weathering**
Areas subject to indirect weathering (transition to outside air) must be protected by a metal plate or similar. Areas directly exposed to weathering must be treated in the same way as Multipor ETICS mineral insulation board, i.e. the Multipor mineral insulation boards must be fully bonded and additionally fastened with one screw-in anchor per insulation board, inserted beneath the mesh into the load-bearing substrate. For airflow speeds of 20 to 30 m/s, fasten anchor fixings through the mesh. The surface coating always consists of mesh-reinforced base plaster, followed by finishing plaster and then paint.

**Accessible walkways (floors of inspection areas)**
If air ducts have to be accessed on foot, the insulation boards must be protected with additional boarding and the adjacent insulation must be finished accordingly.

Cement-bonded lightweight boards with a laminated structure are suitable for this purpose, laid horizontally over the full surface. Bond the boards in a full bed of Multipor lightweight mortar and butt up tightly together. Fill any gaps between individual panels with Multipor lightweight mortar. Cut boards to size with a standard circular saw with dust extraction. Multipor mineral insulation boards installed with additional boarding in areas that can be walked on must have a minimum thickness of 120 mm.

**Smoke extraction ducts**
It is generally possible to install Multipor mineral insulation boards around smoke extraction ducts. Due to variations in air temperature and speed, each project must be assessed individually. Our Multipor technical advisers will gladly explain the services we provide in this area.

**Scope of services**
- Project-based consultation
- Support with tendering
- On-site training for contractors
- Preparation of structural calculations to verify the performance of the structure if necessary.

### Table 4: Technical data for Multipor smooth lime plaster

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive strength</td>
<td>&gt; 1.0 N/mm²</td>
</tr>
<tr>
<td>Water vapor permeability coefficient</td>
<td>$\mu \leq 25$</td>
</tr>
<tr>
<td>Bulk density</td>
<td>984 kg/t</td>
</tr>
<tr>
<td>Building material class</td>
<td>A1; non-combustible</td>
</tr>
<tr>
<td>Air and ambient temperature</td>
<td>$\geq 5 , ^\circ$C</td>
</tr>
<tr>
<td>Processing time</td>
<td>approx. 120 Min.</td>
</tr>
<tr>
<td>Delivery form</td>
<td>20 kg/bag, 48 bags per pallet</td>
</tr>
<tr>
<td>Storage</td>
<td>dry, approx. 6 months</td>
</tr>
<tr>
<td>Water requirement per bag</td>
<td>approx. 8–9 l/bag</td>
</tr>
<tr>
<td>Yield per bag</td>
<td>approx. 10 m² for a 2-mm layer thickness</td>
</tr>
<tr>
<td>Coverage per m²</td>
<td>approx. 2.0 kg/m² for a 2-mm layer thickness</td>
</tr>
</tbody>
</table>
4.8 Attaching loads to Multipor interior insulation systems

Different loads may be fastened directly to the Multipor / Multipor compact plus mineral insulation board or through the insulation into the load-bearing substrate, depending on the type of load. Wall plugs, anchors and screws are standard items in a builder’s toolkit. In the construction industry, specialist knowledge of the anchor substrate, fastening systems and connection method is essential for ensuring safety and reliability.

Experience suggests that the greatest challenge lies in correctly gauging the requirements and choosing the right fastener. It is also wise to seek agreement between the various trades. The following aspects should be taken into account when selecting a suitable fastener:

- What is the condition of the substrate (building material, strength class)?
- What are the dimensions of the components? Do you have to comply with specific hole depths, edge distances and spacings?
- What is the structural condition of the assembly to be mounted? What forces will be transferred?
- What stress conditions are present in the substrate (tensile or compression zone)?
- Are there any special requirements concerning corrosion protection, fire protection or temperature resistance?
- Does the fastener require approval as a structural fastening?
- Can you ensure compliance with the manufacturer’s installation requirements?

Anchor types and their operating principles

Three types of anchor fixing are suitable for fastening components to Multipor mineral insulation boards or into the load-bearing substrate:

- Steel or plastic expansion anchor
- Bonded anchor in cement or synthetic resin
- Undercut anchor with mechanical interlock.

The operating principles vary as follows:

- Friction locking: Generated by friction between the anchor and the substrate, whereby the anchorage is achieved by expansion of the segments. The expansion segments may be made from plastic or steel. A distinction is made between torque-controlled anchors (maximum load after applying a prescribed tightening
torque and deformation-controlled anchors (expansion is achieved by driving a cone a defined length of travel into the substrate).

- Structural bonding: Bonded anchors are anchored in the substrate by bonding to the sides of the drilled hole with an adhesive, without expansion.
- Mechanical interlocking: This method requires an undercut hole or suitable cavity. The anchor is fastened so that it can support itself without generating expansion forces.

**Anchor installation**

Multipor offers a range of system-compatible fasteners. Please refer to the product specifications for guidance on anchor installation and be aware that each type of anchor requires a specific insertion depth and tightening torque. The product specifications and technical data sheets also provide information about requirements such as embedment depth, edge distances and spacings.

For example, it is easy to make a drill hole perpendicular to the surface with a hammer drill. Here too, information about hole depths and diameters can be found in the respective anchor manufacturers’ data sheets. The substrate determines the type of drill to use, and the settings.

A choice of suitable fasteners can be found under ‘technical information’ on our website at [www.multipor.com](http://www.multipor.com).

**Anchoring boards to walls**

Fasten the mineral insulation boards to the wall using system-compatible anchors if substrates are unsuitable for secure adhesive bonding of Multipor mineral insulation boards or if insulated interior walls are to be subsequently tiled.

For example:

- Ytong AAC: Three-piece drive tool (6 mm, 8 mm, 10 mm)
- Silka calcium-silicate block: Drill with a hammering and rotary action
- Vertically perforated bricks and lightweight materials: Drill with a rotary action
- Other anchor substrates: Drill with a hammering and rotary action.

Clean the drilled hole with a brush or blower, because the drill dust can adversely affect the frictional behavior of friction-locking anchors and the surface penetration behavior of bonded anchors.

**Fixtures**

The method of load attachment depends on the anticipated load and the stress. The choice of fastening mechanism and its location depends on these factors too.

**Fastening mechanism:**

- Plate-fastening for non-load-bearing substrates
- Mechanical fastening of light loads to Multipor mineral insulation board
- Mechanical fastening of heavy or dynamic loads through the Multipor mineral insulation board into the substrate.
4.0 Multipor interior insulation systems

4.8 Attaching loads to Multipor interior insulation systems

**Fastening to non-load-bearing substrates, tiled surfaces etc.**

- Not possible with Multipor compact plus
- Multipor interior wall insulation with Multipor screw-in anchor [1]
- Screw length 115 for up to 60 mm interior insulation
- Screw length 135 for up to 80 mm interior insulation
- Screw length 155 for up to 100 mm interior insulation.

Bond Multipor mineral insulation boards to the wall with a full bed of mortar. Then fasten mechanically, screwing Multipor screw-in anchors through the fresh reinforcement layer (Multipor screw-in anchor, plate diameter ≥ 60 mm wet-on-wet) and the mesh into the load-bearing substrate [2].

**Fastening light loads to insulation on the inside of external walls (≤ 3 kg)**

- Multipor flat anchor: Suitable for fastening light loads of up to 3 kg to Multipor or Multipor compact plus mineral insulation board.

Light loads can be fastened directly to the Multipor flat anchor in the Multipor mineral insulation board. Hammer the flat anchor into the Multipor mineral insulation board with the open side facing inwards (the side with the tapered corners), then insert the screw provided in the center corrugation and tighten [3] [4] [5].

- Multipor spiral anchor: Suitable for fastening light loads of up to 6 kg (lengths: 50 mm, 85 mm, 120 mm) to Multipor mineral insulation board [6]. This fastening system is not suitable for Multipor compact plus.

Slit the plaster and reinforcement mesh with a Stanley knife before carefully screwing in the spiral anchor (50 mm, 85 mm, 120 mm) with a T 40 Torx bit [7] [8].
**Fastening heavy loads (≥ 6 kg)**

Do not fasten loads over 6 kg and dynamic loads directly to Multipor or Multipor compact plus mineral insulation board, fasten them to the substrate instead.

- Fastening single loads: Fasten light fittings and cabling through the Multipor or Multipor compact plus mineral insulation boards into the load-bearing substrate. Point loads are distributed with the aid of a 30-mm washer [9].

- Fastening single loads: Fasten light fittings and cabling through the Multipor or Multipor compact plus mineral insulation boards into the load-bearing substrate. Point loads are distributed with the aid of a 30-mm washer [10 – 13].
Multipor ceiling insulation systems

FAST COST-EFFECTIVE NON-COMBUSTIBLE VERSATILE BASEMENT SURFACE
FINISH UNDERGROUND GARAGES ECO-FRIENDLY SOLID DIMENSIONALLY
STABLE WOODPECKER-PROOF BASEMENT ENERGY-EFFICIENT SUSTAINABLE
100% RECYCLABLE EASY TO INSTALL EXECUTION RELIABILITY GARAGES
MOISTURE CONTROL FIRE PROTECTION NATURAL PURELY MINERAL-BASED
BASEMENT WOODPECKER-PROOF SUSTAINABLE NON-COMBUSTIBLE
EXECUTION RELIABILITY SURFACE FINISH ECO-FRIENDLY VERSATILE
DIMENSIONALLY STABLE FAST GARAGES UNDERGROUND GARAGES
5.0 Multipor ceiling insulation systems

5.1 General introduction and planning

- Quick, cost-effective adhesive installation
- Bright, welcoming surface finish
- Non-combustible, A1 construction material, improves fire resistance rating (subject to building design)
- Purely mineral-based, free from fibers and harmful substances
- Simple adhesive installation prevents backflow of air
- Various surface finishes
- Insulation and sound absorption in one

Whether in large-scale underground car parks or domestic basements in existing buildings or new ones, the Multipor ceiling insulation system has satisfied energy efficiency standards and fire protection requirements safely and reliably for over 20 years. Furthermore, it is a certified non-toxic, environmentally safe insulating material – with seals of approval from the German Institute for Construction and Environment (IBU), natureplus and the independent eco-iINSTITUT, which awarded the product its highest A+ rating based on indoor air analysis.

Ceiling insulation for underground car parks
Nowadays it would be virtually unthinkable to design a new building or an inner-city development of offices and commercial buildings without an [insulated] underground garage. Multipor ceiling insulation systems reduce construction times and costs in this area because they can be installed quickly and safely, and without anchor fixings. The open-pored surface of the mineral insulation boards also absorbs sound in underground garages. They provide superior fire protection for refurbished buildings, and in addition the bright, white boards create a welcoming atmosphere in underground car parks.
National technical approval Z-23.11-1501 stipulates the area of application for the Multipor mineral-based ceiling insulation system.

Ceiling insulation for basements

Many basement ceilings in existing buildings are inadequately insulated – if at all – and often fail to comply with current fire protection requirements. Refurbishment with a Multipor ceiling insulation system can remedy this situation. The versatile and cost-effective insulation system can be adapted to any circumstances to improve safety and reduce heating costs.

Home occupants frequently complain about cold floors, which can drastically reduce their sense of comfort. At the same time, a great deal of space heating is lost to the basement, leading to elevated heating costs. Multipor ceiling insulation board is the ideal solution for improving thermal comfort and cutting heating costs, and may be eligible for grant funding (e.g. KfW in Germany). Even at a low thickness, Multipor ceiling insulation boards – simply bonded to the underside of the existing ceiling – can significantly reduce heating costs. Multipor ceiling insulation boards are quick, straightforward and economical to fit by specialist installers and competent DIY homeowners alike. They are a simple and effective means of insulating and finishing the underside of ceilings of various styles and shapes. Multipor ceiling insulation boards come in a handy 600 x 390 mm format designed for speedy installation – in conjunction with easy-to-process, high-yielding Multipor lightweight mortar.

Uneven surfaces can be sanded smooth with the Multipor sanding board. The insulated ceiling can be left untreated, primed and painted, skimmed with Multipor lightweight mortar or plastered to protect the surface of the boards from mechanical damage.

Simple adhesive installation – just apply to the existing ceiling

<table>
<thead>
<tr>
<th>Regulations</th>
<th>Multipor ceiling insulation board</th>
<th>Multipor lightweight mortar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry bulk density</td>
<td>85–95 kg/m³</td>
<td>approx. 770 kg/m³</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>≥ 200 kPa</td>
<td>CS II: 1.50–5.0 N/mm²</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>λ = 0.042 W/(mK) (design value)</td>
<td>λ₀, 0.45 = 0.18 W/(mK)</td>
</tr>
<tr>
<td>Water vapor diffusion resistance factor</td>
<td>μ = 2</td>
<td>μ ≤ 10</td>
</tr>
<tr>
<td>Building material class</td>
<td>A1; non-combustible</td>
<td>A2-s1, d0; non-combustible</td>
</tr>
<tr>
<td>Dimensions/delivery quantity</td>
<td>600 x 390 mm</td>
<td>20 kg/bag</td>
</tr>
</tbody>
</table>

Table 1: Characteristic values of Multipor DI ceiling insulation system
Fire protection requirements
Non-combustible Multipor ceiling insulation used with Multipor lightweight mortar creates total peace of mind in underground garage and basement ceilings and passageways. Even when exposed to extremely high temperatures during fire, the Multipor ceiling insulation system does not generate toxic fumes or smoke. Neither does it produce dangerous droplets of burning material. Since Multipor ceiling insulation boards are non-combustible, they do not constitute an additional fire load in the event of fire – making them ideal for insulating escape routes.

Multipor ceiling insulation boards have an A1 fire rating in accordance with DIN EN 13501-1. In combination with Multipor lightweight mortar, which is an A2-rated building material, the system as a whole satisfies all building regulation requirements for non-combustible building materials (class A).

Fire protection of garages
In Germany, the requirements for the fire protection of garages are governed by the ‘Garage Ordinances’ of the respective federal states. Some individual states, e.g. North Rhine Westphalia, have also produced successor regulations. In addition, the German Building Control Commission (Fachkommission Bauaufsicht) has produced the Model Garage Ordinance (Muster-Garagenverordnung). Virtually all these regulations include the following section (extract from the Model Garage Ordinance M-GarVO § 6 [6]):

Cladding and insulating layers beneath ceilings and roofs
1. in large garages (over 1000 m²) must consist of non-combustible materials and
2. in medium-sized garages (100–1000 m²) of flame-retardant materials at the very least.

Since the Multipor ceiling insulation system comprises non-combustible materials, it satisfies all requirements in this area, whichever regulation takes precedence.

Optimizing fire protection in refurbishments
Multipor ceiling insulation boards are ideal for upgrading the fire protection of ‘old’ concrete ceilings and improving fire protection in old and new buildings alike. If existing load-bearing ceiling structures have inadequate fire protection, e.g. due to insufficient concrete cover of the embedded steel reinforcement bars, Multipor has the answer.

Ceiling insulation made from Multipor mineral insulation boards may be used to upgrade the concrete cover to comply with current fire protection requirements in accordance with DIN EN 13501. Our sales representatives will gladly provide the corresponding certificates on request. A higher fire resistance rating that complies with current requirements can be achieved by combining the existing concrete cover with the additional protection provided by the Multipor ceiling insulation system.

Moisture control
Exposure to moisture during construction due to site-related conditions does not have a lasting adverse effect on the Multipor ceiling insulation system. Underground garages in risk-prone areas may be subject to even greater environmental influences (e.g. flooding).

We conducted a field test to analyze the moisture loads in these types of extreme situation:

We bonded Multipor ceiling insulation boards to a concrete ceiling element and left them fully immersed in water for several days.
The results were persuasive: The boards remained dimensionally stable and mechanically undamaged, the adhesive bond remained fully intact and the insulating performance was fully restored just a few days after subsequent air-drying due to the vapor-permeable characteristics of the Multipor mineral insulation boards.

**Energy requirements**

Ceilings adjoining heated habitable spaces must be insulated for reasons of energy efficiency and to comply with statutory requirements (EnEV). Furthermore, the insulation must comply with the U-values defined in the latest EnEV and the requirements of DIN 4108-2 “Reducing thermal bridges in open garages”. The Multipor ceiling insulation system is a completely homogenous material with a consistently low U-value; thermal transmittance throughout the entire thickness of the mineral insulation board is \( \lambda = 0.042 \text{ W/(mK)} \). The full-surface bond and homogenous structure of the boards eliminates thermal bridging that typically occurs with rail or anchor systems and multilayer boards.

Bonding the insulation boards directly to the ceiling in a full bed of adhesive mortar has the additional advantage of preventing air flowing behind the layer of insulation, thereby avoiding system-related heat losses such as those associated with ‘loose’ layers of insulation (i.e. with air gaps).

**Working around joists and walls**

In conjunction with Multipor ceiling insulation boards, the Multipor insulating wedge is ideal for connecting to joists and intersecting elements. Joint profiles are not normally required due to the dimensional stability of the insulation board. Multipor ceiling insulation boards can be precision-cut to accommodate round or rectangular penetrations, thus avoiding thermal bridges.

**Bright and welcoming atmosphere**

Lighting is essential in underground garages, but energy-efficiency considerations also have to be taken into account. Multipor ceiling insulation boards have a bright, welcoming surface appearance, which is retained even when boards have been sanded down thanks to the material’s homogenous structure. And they can of course be painted with silicate paints.

The surface can be further enhanced with a colorless silicate primer, Multipor interior silicate paint, a thin skim of plaster or a mechanically anchored reinforcement layer, followed by a final finishing plaster. Thus the insulation system not only makes economic sense, it can also be tailored to suit the building’s style and function.
Reference building

Underground garage insulation in Limbecker Platz Shopping Centre, Essen

- Insulating the ceiling of an underground visitor car park
- Quick adaptation to existing geometry
- Quick and easy installation
- Outstanding fire protection, visual appearance and acoustics

<table>
<thead>
<tr>
<th>Project data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Building type</td>
<td>Underground garage</td>
</tr>
<tr>
<td>Location</td>
<td>Essen</td>
</tr>
<tr>
<td>Application</td>
<td>Ceiling insulation</td>
</tr>
<tr>
<td>Products used</td>
<td>- Multipor ceiling insulation board, t = 80 mm</td>
</tr>
<tr>
<td></td>
<td>- Multipor lightweight mortar</td>
</tr>
</tbody>
</table>

5.0 Multipor ceiling insulation systems
5.1 General introduction and planning
Reference building

Underground garage insulation, Parkend residential complex, Frankfurt am Main

- Insulating the ceiling of an underground car park
- Quick adaptation to existing geometry
- Visually appealing solution
- Sound-absorbing properties ensure peace and calm in habitable areas above the underground garage

<table>
<thead>
<tr>
<th>Project data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Building type</td>
<td>Underground garage</td>
</tr>
<tr>
<td>Location</td>
<td>Frankfurt am Main</td>
</tr>
<tr>
<td>Application</td>
<td>Ceiling insulation</td>
</tr>
</tbody>
</table>
| Products used | - Multipor ceiling insulation board, t = 160 mm  
- Multipor lightweight mortar |
5.0 Multipor ceiling insulation systems

5.2 Detail drawings for ceiling insulation

5.2 Detail drawings for ceiling insulation

Detail drawings for ceiling insulation: Basement and underground car park ceilings

Joist cladding

Ceiling step

Ceiling step with edge profile

Ceiling step with joint profile

* Leave 2-3 mm wide joint between wall and ceiling insulation
fill open joints with flexible sealant

007 Reinforced concrete ceiling
044 Butt joint (unmortared)
130 Flexible joint
173 Multipor lightweight mortar
196 Joint profile
251 Multipor ceiling insulation
Multipor ceiling insulation systems

Detail drawings for ceiling insulation

Detail drawings for ceiling insulation: Basement and underground car park ceilings

Ceiling cladding

Example installation (without anchors)

Example installation (with anchors)

Fastener connection

007 Reinforced concrete ceiling
130 Flexible joint
155 Drop-in anchor/compact anchor
156 Threaded rod
157 Nut with washer Ø 30 mm
158 Pipe clamp

168 Existing masonry
173 Multipor lightweight mortar
251 Multipor ceiling insulation
326 Multipor screw-in anchor

* Leave 2-3 mm wide joint between wall and ceiling insulation
* Fill open joints with flexible sealant

Download these and other detail drawings at www.multipor.com/detaildrawings.php
5.0 Multipor ceiling insulation systems

5.2 Detail drawings for ceiling insulation

Detail drawings for ceiling insulation: Basement and underground car park ceilings

Sidewall insulation

* Leave 2-3 mm wide joint between wall and ceiling insulation
fill open joints with flexible sealant

Sidewall insulation with joint profile

* Leave 2-3 mm wide joint between wall and ceiling insulation
fill open joints with flexible sealant

Sidewall insulation with ceiling fastener

* Leave 2-3 mm wide joint between wall and ceiling insulation
fill open joints with flexible sealant

Sidewall insulation with insulating wedge

* Leave 2-3 mm wide joint between wall and ceiling insulation
fill open joints with flexible sealant

Ceiling insulation 17-006

Ceiling insulation 17-008

Ceiling insulation 17-007

Ceiling insulation 17-009

007 Reinforced concrete ceiling
130 Flexible joint
168 Existing masonry
173 Multipor lightweight mortar

196 Joint profile
251 Multipor ceiling insulation
254 Multipor insulating wedge
327 Multipor ceiling fastener (depending on requirements)

Download these and other detail drawings at www.multipor.com/detaildrawings.php
Installing Multipor ceiling insulation systems

Typical areas of application:
- Ceilings of underground garages and basements
- Insulation of adjacent sidewalls to minimize thermal bridging
- Air duct insulation (see Chapter 4.6)

Benefits:
- Quick, straightforward overhead installation
- Low board weight
- Easy to work round columns and walls
- Easy adhesive installation
- Bright, attractive appearance
- High coverage rate of Multipor lightweight mortar; one bag yields approx. 30 l of fresh mortar

Substrate inspection and preparation
When insulating the ceilings of both new and existing buildings, it is important to check the suitability and load-bearing capacity of the substrate beforehand (see Table 1). Make sure it is clean, dry and free from residues that may impair adhesion, such as mold oil. Pay particular attention to strength development, stripping times and concrete drying. Multipor lightweight mortar has a very high water retention capacity, so additional priming is not normally necessary, provided that substrates are otherwise load-bearing. Sandy and highly absorbent substrates, which often occur in existing buildings, must be primed or treated, e.g. with a Multipor lightweight mortar skim coat.

Careful consideration must be given to stripping times and strength development, especially with cast-in-place concrete.

Remove paint, soiling and unsound plaster and make good any defective areas with standard lime-cement plaster. Remove any concrete burrs; this can usually be done by simply scraping them off with a trowel [1] and then brushing the surface [2]. Concrete surfaces that have been treated with release agents must be suitably pretreated and cleaned. Allow sufficient time for freshly plastered substrates to dry.
5.0 Multipor ceiling insulation systems

5.3 Installing Multipor ceiling insulation systems

### Table 1: Substrate preparation

<table>
<thead>
<tr>
<th>Existing substrate</th>
<th>Measure</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grease, mold oil or other release agents</td>
<td>Remove</td>
<td>Pressure wash with suitable detergent, rinse with clean water, allow to dry</td>
</tr>
<tr>
<td>Dust, dirt, diesel soot</td>
<td>Remove</td>
<td>Brush down, wash off</td>
</tr>
<tr>
<td>Unsound, sandy plaster</td>
<td>Remove</td>
<td>Remove mechanically, secure mineral insulation boards with anchors if necessary</td>
</tr>
<tr>
<td>Old/unidentified paint</td>
<td>Remove</td>
<td>Remove all traces of paint (e.g. stripping/sanding)</td>
</tr>
<tr>
<td>Wallpaper</td>
<td>Remove</td>
<td>Remove all traces of wallpaper (e.g. stripping/sanding)</td>
</tr>
<tr>
<td>Unidentified substrates</td>
<td>Check suitability for adhesion</td>
<td>Remove coating, prepare substrate for adhesion and additionally secure mineral insulation boards with anchors</td>
</tr>
</tbody>
</table>

### Mixing lightweight mortar

Mix Multipor lightweight mortar with the quantity of water indicated on the mortar bag according to the directions and the safety precautions. Do not use if the air or component temperature is below 5° C. See Table 2 for technical data. The graduated Multipor bucket makes it easy to mix Multipor lightweight mortar (20 kg/bag) for skimming, bonding and reinforcing Multipor ceiling insulation boards. To obtain the desired consistency, we recommend using a low-speed mixer with a long, sturdy paddle [3]. Depending on the weather, leave the mortar to cure for five minutes, then mix again before use. Clean paddle mixers thoroughly after use for optimal mixing results.

- Approx. 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; one bag yields 30 l of fresh mortar, which is enough to cover approx. 5 m² for bonding or approx. 6 m² for reinforcement, depending on the condition of the substrate.
- Multipor lightweight mortar can also be applied with conventional plastering machines.

1. Scrape off raised concrete burrs ...
2. ... and brush down
3. Easy-to-mix mortar
Multipor ceiling insulation systems

Installing Multipor ceiling insulation systems

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

Multipor lightweight mortar can be stored on a pallet in a dry place for up to 12 months from the date of manufacture. As with any other product, please follow the directions and safety precautions on the pack.

Applying lightweight mortar to Multipor ceiling insulation boards

Apply a full bed of lightweight mortar to the back of the insulation boards with a notched trowel and comb into ridges to create an optimal adhesive bond between the lightweight mortar and the insulation board [4]. Use different trowel sizes to obtain the right ridge height to suit the thickness of insulation:

- 12-mm notched trowel for insulation thickness up to 140 mm
- 16-mm notch trowel for insulation thickness of 160 mm or above (up to 200-mm single-layer thickness)

Slight unevenness in the substrate can also be levelled out in this way. If necessary, Multipor ceiling insulation boards can be laid wet-on-wet (buttering-and-floating method) to level out larger uneven areas.

Bonding Multipor ceiling insulation boards

Bond Multipor ceiling insulation boards with a joint offset ≥ 15 cm using a full bed of Multipor lightweight mortar [5]. Use a mounting board to simplify overhead installation and apply pressure more evenly. Butt the head joints in the insulation boards up tightly, but do not fill them. To ensure full-surface adhesion, check that the board faces are square before installation and mark reference lines with a chalk line or laser.

Bond, slide into position and press either manually or with the aid of a mounting board. For optimum adhesion, always slide the insulation boards into position at right angles to the mortar ridges [6 – 7].

---

Table 2: Technical data for Multipor lightweight mortar

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightweight mortar</td>
<td>LW lightweight mortar as per EN 998-1</td>
</tr>
<tr>
<td>Compressive strength class</td>
<td>CS II; 1.5–5.0 N/mm²</td>
</tr>
<tr>
<td>Diffusion resistance factor</td>
<td>μ ≤ 10</td>
</tr>
<tr>
<td>Water absorption</td>
<td>W2, c ≤ 0.2 kg/(m²min⁰.⁵)</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>λ₉₁₀_W₂ = 0.18 W/(mK)</td>
</tr>
<tr>
<td>Building material class</td>
<td>A2-s1, d0; non-combustible</td>
</tr>
<tr>
<td>Weight per bag</td>
<td>20 kg</td>
</tr>
<tr>
<td>Pallet content</td>
<td>40 bags</td>
</tr>
</tbody>
</table>

---

![Image of Multipor ceiling insulation systems](image-url)
For insulation thicknesses > 200 mm bond two layers of Multipor ceiling insulation boards to the ceiling (Table 3). Fit the first layer as described above, then bond a second layer – thinner or the same thickness – to the first layer in a full bed of Multipor lightweight mortar with staggered head and bed joints. An 8-mm or 10-mm notched trowel is usually sufficient for applying the intermediate layer of adhesive mortar. Regardless of whether one or two layers are applied, if the total thickness of insulation exceeds 160 mm or if the underside of the Multipor ceiling insulation boards is fully plastered, the insulation boards must be anchored to the substrate.

The two-layer method automatically optimizes thermal bridging due to the offset joints in the layers of insulation. Furthermore, any unevenness in the substrate which has transferred to the first layer can easily be rectified by sanding smooth before applying the second layer. Always brush down sanded surfaces.

### Dealing with movement and expansion joints/connected elements

Large underground garages and connected large structural elements are particularly susceptible to static and thermal effects which can produce stresses strong enough to cause cracking in the structural elements. To prevent this, the structural elements are separated from one another with movement joints – often referred to as expansion joints. These joints must be carried through into the insulation layer in both new and existing buildings.

Under no circumstances should existing expansion joints be covered with insulation, since this may result in movements in the structural element causing damage to the insulation.

Even in smaller buildings with no existing expansion joints, always install the Multipor ceiling insulation boards such that any movements within the building or between the insulation and building cannot cause any damage. For instance, when completely cladding the underside of a ceiling with insulation boards [8], leave a gap all the way round the perimeter by cutting saw grooves.

Newer underground garages are often constructed from precast concrete elements. Movements can occur in these statically determinate structures – especially in joists with plain bearings. The joists expand and contract due to temperature loads and time-dependent material behavior.
Furthermore, their self-weight and vertical loads may cause them to deflect. When a uniform load is applied, this deflection is greatest in the middle of the joist. In turn, the deflection produces torsion which is greatest on the bearing surface. Sufficient provision must be made to accommodate these movements to prevent coercive stresses between the Multipor ceiling insulation boards and the existing structure.

Connections between the joist and the existing wall in particular must be constructed in such a way that they are able to absorb these movements. It is clear from the reasons outlined above that connections between the wall and ceiling must also allow for movement. Open joints can be sealed on the room side with flexible sealing materials. Chapter 5.2 ‘Detail drawings for ceiling insulation’ provides further guidance on this subject.

Cutting and reshaping Multipor ceiling insulation boards

Boards and closers are easy to cut to any size using a fine-toothed Multipor handsaw [9].

Multipor ceiling insulation boards can also be quickly adjusted to accommodate existing electrical wiring or recesses in the wall or ceiling and so ensure a uniform layer of insulation [10][11].

It is very easy to round or square off the edges of the board using a Multipor sanding board [12][13].

Multipor ceiling insulation board with anchor fixings

From a thickness > 160 mm each insulation board must be additionally secured with one anchor fastening in accordance with the Construction Products List Part C. It is often difficult to assess whether the substrate of solid existing ceilings is able to support a bonded insulation system.
If the insulation thickness exceeds 160 mm or the substrate can only be assessed to a limited extent, insert an anchor fixing in the middle of each Multipor ceiling insulation board for additional security [14] [15]. Use suitable ceiling fasteners approved for this purpose. Suitable anchor fixings can be found in the download section of our website at www.multipor.com.

**Practical tip:** When installing two layers of insulation board, only the first layer requires anchor fixings in addition to bonding. The second layer – maximum 160 mm thick – is simply bonded to the first layer. This approach cuts costs by using shorter anchors and at the same time, creates an attractive appearance.

**Loads suspended from the ceiling**
Wiring and cable trays are often retrofitted beneath the ceiling. This does not require the insulation to be removed; instead loads can be fastened through the Multipor ceiling insulation boards into the substrate with a threaded rod and washer (see Page 157, Example 17-012). Please refer to Chapter 5.4 for more information on fasteners.

**Easy to sand**
The insulation boards can easily be sanded with a Multipor sanding board to smooth out any uneven surfaces [16].

**Practical tip:** It’s easy to smooth down uneven surfaces with the Multipor sanding board. Because the material is homogenous, the structure and color of the sanded surface of Multipor ceiling insulation boards is exactly the same as the unsanded surface.

Applying insulation to the ceiling is a quick, clean process. The bright Multipor mineral insulation boards basically require no further treatment. If large areas of the underside of the ceiling have been sanded down, a colorless silicate primer can be applied to give a uniform visual appearance. Remove any loose material and dust from the surface before priming.

**Optional surface finishes**
The chosen finish depends on the requirements. Boards can be painted, skimmed or plastered: The range of options is enormous.
Optional painted finishes
We recommend using Multipor interior silicate paint in accordance with DIN 18363 to introduce some color to the insulation boards. Apply with a brush, roller or sprayer to the dust-free surface.

Optional skim finish
For a skim finish, apply Multipor lightweight mortar thinly to grain thickness – maximum 3.0 mm – to the surface of the Multipor ceiling insulation boards and smooth with a felted float before it sets [17]. This method is recommended mainly for rooms with less stringent requirements for surface quality since hairline cracking may occur around the board joints. 2 to 2.5 kg/m² Multipor lightweight mortar is enough for a 2 to 3 mm coating thickness (10 to 12 m²/bag).

Optional plastered finish
For a plastered finish, first apply a reinforcing layer of Multipor lightweight mortar to the Multipor ceiling insulation boards – with an average layer thickness of 5mm including reinforcement mesh [18] [19]. Then screw anchor fixings through the fresh plaster and the reinforcement mesh into the load-bearing substrate [wet-on-wet]. Carefully slit the reinforcement mesh with a sharp knife before drilling a hole and inserting the Multipor screw-in anchor [20]. This enables the anchor to be screwed in without dragging the embedded mesh out of place [21] [22]. The area around the anchor may need patching after screwing in the anchor. Allow four anchors/m². You can find an overview of other fasteners in the download section of our website at www.multipor.com.

Note the following instructions, depending on the chosen finish:

Thin-film plaster and skim plaster:
- Apply a 2 to 3-mm thick finishing coat of Multipor lightweight mortar and smooth with a felted float before it sets.
- Apply Multipor fine lime plaster or Multipor smooth lime plaster as a skimming coat or for a smooth plaster finish on top of the reinforcement layer.

The total thickness of plaster (reinforcement layer and finishing plaster) should not exceed 8 mm. The finishing coat should be around 3-mm thick, or slightly thinner for Multipor fine lime plaster and Multipor smooth lime plaster (see directions for use).
**Insulating joists and structural elements**

The various connection details shown below illustrate the ease of installation of Multipor ceiling insulation boards. Connections to curved or rectangular shapes can easily be formed without the need for additional tools or profiles. The insulation boards do not need edging with metal profiles to prevent chipping or damage [23 – 25].

When insulating joists, it is important to insulate the underside of the joist first, and then the sides [26 – 28].

Apply the adhesive mortar for the underside of the joist to the mineral insulation board so that the overhanging areas remain free of adhesive. This prevents the horizontal and perpendicular faces of Multipor ceiling insulation boards bonding together and the insulation board breaking off due to deflection of the beam. The insulation on the ceiling runs up to the insulation on the side of the joists [29]. The connection in this area must also be unrestrained and, depending on the fire protection requirements, flexible. When connecting the joist insulation to the walls, follow the instructions for expansion and movement joints.
Rigid connections between walls and ceilings must be avoided. Form a flexible connection instead, for example using flexible sealing tape [30].

**Fixtures**

Mount light fittings to the load-bearing substrate, which provides a stable bearing surface in conjunction with the mineral insulation board and plaster. Always check the fire protection regulations first.

**Expansion joints subject to fire protection requirements**

Existing expansion joints must always be carried through into the insulating layer. Unprotected openings in structural elements do not comply with fire protection requirements and are not permitted. This includes movement joints. We recommend sealing joints ≤ 30 mm wide between solid ceilings and walls with a flexible fire-protection mastic with an F90 fire resistance rating in compliance with DIN 4102-2. This will prevent fire and smoke transmission for 90 minutes and absorb joint movements up to +/- 15% of the joint width. [30 – 32].

**Calculation guide**

Table 3 gives guideline material quantities and time allowances for the various stages.

<table>
<thead>
<tr>
<th>Material</th>
<th>Coverage</th>
<th>Time allowance</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grundpositionen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multipor ceiling insulation board</td>
<td>4.3 boards/m²</td>
<td>approx. 15 min/m²</td>
<td>for bonding</td>
</tr>
<tr>
<td>Multipor lightweight mortar</td>
<td>approx. 3.5 kg/m²</td>
<td>approx. 15 min/m²</td>
<td>for bonding</td>
</tr>
<tr>
<td>Alternative components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multipor lightweight mortar</td>
<td>approx. 3.5 kg/m²</td>
<td>approx. 10 min/m²</td>
<td>for reinforcement</td>
</tr>
<tr>
<td>Multipor screw-in anchor without fire protection requirement</td>
<td>4.3 units/m²</td>
<td>approx. 8 – 10 min/m²</td>
<td>place the anchors in the middle of the board or arrange evenly over the plastered surface</td>
</tr>
<tr>
<td>Multipor lightweight mortar</td>
<td>approx. 2.5 kg/m²</td>
<td>approx. 10 min/m²</td>
<td>as the finishing plaster (final coat)</td>
</tr>
<tr>
<td>Multipor screw-in anchor with fire protection requirements</td>
<td>4.3 units/m²</td>
<td>approx. 8 – 10 min/m²</td>
<td>place the anchors in the middle of the board or arrange evenly over the plastered surface</td>
</tr>
<tr>
<td>Multipor insulating wedge</td>
<td>5.2 units/m²</td>
<td>approx. 15 min/m²</td>
<td>for bonding</td>
</tr>
</tbody>
</table>

The specimen calculations are based on the following assumptions:

- There are no major openings, level changes, reveals or similar in the surface to be insulated.
- No provision has been made for levelling plaster and other preparatory work.
- Allowance must be made for other tasks (e.g. plaster profiles) if necessary – see the latest tender texts.
- Multipor screw-in anchor with or without fire protection requirements
- Direct transport to the site and setup times must also be included.
Construction site safety
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.

5.4 Attaching loads to Multipor ceiling insulation systems

The method of load attachment depends on the anticipated load and the type of stress. The choice of fastening mechanism and its location depends on these factors too.

Types of fastener:
- Mechanical fastening of light loads to Multipor ceiling insulation board
- Mechanical fastening of heavy loads through the Multipor ceiling insulation board into the substrate.

A selection of suitable fasteners can be found under 'technical information' on the download section of our website at www.multipor.com.

Attaching light loads
Light, static loads with a pull-out load up to 6 kg and 600-mm hole spacing can be mounted directly to the Multipor ceiling insulation board using the Multipor spiral anchor [1]. Make a cross-shaped slit in the plaster layer with a Stanley knife before carefully screwing in the spiral anchor (50 mm, 85 mm, 120 mm) with a T 40 Torx bit [2].

Practical tip: All loads in underground car parks with public access should be fastened to the load-bearing substrate to prevent vandalism.

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 as required. It must be installed before fitting the insulation. Electric wiring can be safely connected with ease thanks to integrated cable routing. The Multipor telescopic mount is suitable for loads up to 5 kg [3] [4].

**Attaching heavy loads**
We recommend attaching loads over 6 kg and all dynamic loads to the load-bearing substrate rather than the Multipor ceiling insulation board.

**Attaching single loads**
Fasten brackets for cable trays through the Multipor ceiling insulation board into the load-bearing substrate. Use a washer to distribute point loads [5].

![Installed Multipor telescopic device mount](image1)

![Fastening through Multipor ceiling insulation board](image2)

![Strip light attachment](image3)

![Sprinkler system attachment](image4)

![Cable tray attachment](image5)
Multipor roof insulation systems

- Optimum stability
- Pressure-resistant
- Non-combustible
- From fibers
- Purely mineral-based
- Vapor-permeable
- Resistant to ageing
- Dimensionally stable
- Easy to install
- Volumetrically stable
- Cost-effective
- Sustainable execution
- Reliability
- Pitched roofs
- 100% recyclable
- Economical performance
- Reliable
- Free from fibers
- Volumetrically stable
- Flat roof
- Vapor-permeable performance
- Reliability
- Purely mineral-based
- Cost-effective execution
- Reliability
- Pitched roofs
- Non-combustible
Multipor roof insulation systems
6.0 Multipor roof insulation systems

6.1 General introduction and planning

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

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

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

Roof utilization
A distinction is made between the following types of flat roof:
- Unutilized roof areas (extensive green and/or graveled roofs exposed to weather), accessed only occasionally, e.g. for maintenance purposes
- Utilized roof areas (intensive green roofs as well as balconies, terraces and rooftop parking).

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

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

Roof pitch
The pitch of the roof should be taken into account during the planning phase, since standing water significantly impairs the life expectancy of the waterproofing system. DIN 18531-1 thus classifies flat roof constructions in two categories, depending on their intended use:
Category K2 (high-quality roof constructions): This defines structures with a longer service life and lower maintenance requirements. In this category, the minimum standard fall in the waterproofing layer is at least 2% and in the valleys, at least 1%. Only high quality waterproofing products defined as such in DIN 18531-1 may be used. Substrate unevenness and design tolerances must also be taken into account at the design stage.

Category K1 (standard roof constructions): This category represents the minimum requirements for a roof construction. K1 roof waterproof roofing membranes may be used here. However, if the pitch falls below the level specified for category K2, higher quality K2 waterproof membranes must be used, even if the end result is still a K1 roof.

Multipor cut-to-fall boards enable the construction of perfectly functioning pitched roofs with virtually any fall to suit the architect’s whim.

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

### Table 1: Characteristic values for Multipor roof insulation board

<table>
<thead>
<tr>
<th>Designation</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design value of thermal conductivity (λ)</td>
<td>W/(mK)</td>
<td>DAA* 0.045, DAA* 0.047, DAD** 0.045</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>kPa</td>
<td>≥ 300</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>kPa</td>
<td>≥ 80</td>
</tr>
<tr>
<td>Deformation</td>
<td></td>
<td>≤ 1 mm for 1000 N point load</td>
</tr>
<tr>
<td>E modulus</td>
<td>N/mm²</td>
<td>200</td>
</tr>
<tr>
<td>Bulk density</td>
<td>kg/m³</td>
<td>approx. 115</td>
</tr>
<tr>
<td>Water vapor diffusion resistance factor (μ)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Specific heat capacity (c)</td>
<td>J/(kgK)</td>
<td>850</td>
</tr>
<tr>
<td>Thermal expansion coefficient (αₜ)</td>
<td>1/K</td>
<td>1*10⁻³</td>
</tr>
<tr>
<td>Water absorption (short-term) as per DIN EN 1609</td>
<td>kg/m³</td>
<td>≤ 2</td>
</tr>
<tr>
<td>What absorption (long-term) as per DIN EN 12087</td>
<td>kg/m³</td>
<td>≤ 3</td>
</tr>
<tr>
<td>Board size (L x W)</td>
<td>mm</td>
<td>600 x 390</td>
</tr>
<tr>
<td>Fire protection/material class as per DIN EN 13501-1</td>
<td></td>
<td>A1, non-combustible</td>
</tr>
</tbody>
</table>

### Table 2: Areas of application for Multipor mineral insulation board as per DIN 4108-10

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

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

6.1 General introduction and planning

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

**Uplift protection**

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

There are various ways of providing wind uplift protection for flat roof constructions:

- Adequately dimensioned applied load (ballast) for loose-laid roof systems (e.g. gravel, vegetation, paving)
- Frictional bonding of all roof layers
- Mechanical fastening of waterproofing to the supporting structure.

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

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

**Cost-effectiveness**

Roofs generally have a life expectancy of several decades. However, hastily chosen construction products and processing errors can cause structural damage, leading to substantial losses. High quality roof constructions with a high-quality combination of insulation and waterproofing – such as Multipor mineral insulation board with proven waterproofing systems – thus constitute a worthwhile investment and ensure durability and reliability.

Multipor roof insulation boards are one of the most economical insulating materials on the market for flat roofs due to their optimal properties in terms of

- fire protection
- compressive strength
- non-compressibility
- ecology
- thermal insulation.
Multipor roof insulation systems

General introduction and planning

6

Fire protection
Buildings and roofs with high fire protection requirements must have non-combustible insulation. As a high-performance insulating material with an A1 fire rating, Multipor roof insulation board is a completely safe option in this respect. Unlike conventional insulating materials, roofs insulated with Multipor satisfy strict requirements for non-combustibility, compressive strength and non-compressibility. All in one material.

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

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

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

GHOTEL HOTEL & LIVING, WÜRZBURG

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

**Project data**

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

Kö-Bogen, Düsseldorf

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

<table>
<thead>
<tr>
<th>Project data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building type</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Application</td>
</tr>
<tr>
<td>Products used</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
6.0 Multipor roof insulation systems

6.2 Detail drawings for flat roof insulation

Detail drawings for flat roof insulation

Parapet, green roof

Parapet connection, gravel ballast

Railing detail

Drainage with roof gutter

001 Ytong masonry
006 Thermal insulation
007 Reinforced concrete ceiling
009 Waterproof membrane
010 Gravel fill
011 Flashing
012 Timber board
024 Gutter
061 Balcony flooring
069 Rendering, lime-cement mortar
084 Ytong ceiling support block, concealed
085 Ytong ceiling
087 Drainage
100 Ring beam
111 Separation or protective layer
112 Root barrier
113 Seepage layer
115 Vegetation layer
173 Multipor lightweight mortar
174 Multipor reinforcement mesh
190 Vapor barrier
191 Gravel stop profile
192 Roof inlet
197 Roof bolt
198 Bonded joint
211 Ytong precision panel
249 Multipor ETICS mineral insulation board
253 Multipor flat roof insulation
285 System-compatible finishing render
326 Multipor screw-in anchor

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

**Wall connection, ballasted roof**

**Wall connection, terrace**

**Wall connection/balcony above habitable area**

**Drainage system with roof flat drain**

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

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

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

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

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

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

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

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

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

Loose-laid ballasted flat roof construction

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

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

1. Timber supporting structure
2. Vapor barrier, aluminum composite foil
3. Multipor roof insulation board
4. Plastic sheeting
5. Gravel ballast on protective layer

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table 1: Parameters for dimensioning the load distribution plate WLG 047

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive strength</td>
<td>350 kPa</td>
</tr>
<tr>
<td>E modulus</td>
<td>200 N/mm²</td>
</tr>
<tr>
<td>Bedding class $C_b$ (3 mm bitumen adhesive + 10 cm Multipor + 12 mm bitumen sheeting)</td>
<td>270 MN/m³</td>
</tr>
<tr>
<td>Load distribution plate</td>
<td>2.5 x 2.5 m</td>
</tr>
</tbody>
</table>
Multipor roof insulation systems

Flat roof construction with rooftop parking

Table 2: Typical design values for load distribution plate

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

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

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

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

Detail drawing of concrete load distribution plate

Detail drawing of interlocking paving on bed of grit
6.6 Installing Multipor flat roof insulation

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

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

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

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

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

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

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

For multi-layer installation, each layer must be at least 120 mm thick.

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

**Table 1: Multipor cut-to-fall roof system (example of 2% pitch)**

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

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

**Multipor wedged profile**

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

Lay Multipor wedged profiles alongside the rising structure (wall, parapet etc.) and bond to the previously laid flat or cut-to-fall boards with Multipor lightweight mortar, PU insulation adhesive or hot bitumen [2]. Wedged profiles are neither necessary nor desirable with plastic or elastomer sheeting. System accessories (interior and exterior corners, connecting collars, parapet gullies etc.) are available in local product ranges.

**Priming**

With bonded roof constructions, a bitumen primer is required in accordance with DIN 18195 and DIN 18531 to achieve a non-positive...
connection between the bituminous membrane and the substrate. A bitumen primer is not needed for loose-laid ballasted or mechanically fastened roof constructions.

**Applying the vapor barrier**

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

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

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

**Installing insulation boards**

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

Installing in a bonded roof construction: There are various ways of achieving a non-positive connection (friction fit) between the Multipor roof insulation boards and the substrate, as shown in Table 2.

Installing on loose-laid ballasted roofs and mechanically fastened roofs: Loose-lay the Multipor roof insulation boards on loose-laid ballasted roofs. For mechanically fastened roof constructions, loose insulation boards which are not secured by the fasteners for the waterproof membrane must be secured with adhesive or additional fasteners. We recommend using a PU cartridge adhesive to even out any unevenness in the substrate.
### Table 2: Different methods of installing Multipor roof insulation boards

<table>
<thead>
<tr>
<th>Installation method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot bitumen</td>
<td>Lay the Multipor roof insulation boards in a full bed of hot-poured bitumen (8) [e.g. grade 100/25] to ensure full-surface adhesion to the vapor barrier. Apply the hot-poured bitumen at a rate of approximately 3 kg/m² (9).</td>
</tr>
<tr>
<td>Vapor barrier with thermally active upper surface</td>
<td>Use a torch to heat the thermally active adhesive strips on the upper surface of the vapor barrier. Then lay the Multipor roof insulation boards immediately in these liquefied bituminous strips (10).</td>
</tr>
<tr>
<td>Liquid vapor barrier</td>
<td>Apply the liquid vapor barrier, then lay the Multipor roof insulation boards as described for hot-poured bitumen above (11). Pay careful attention to the pot life of the liquid vapor barrier and follow the manufacturer’s instructions.</td>
</tr>
<tr>
<td>PU foam insulation adhesive</td>
<td>Apply the PU foam insulation adhesive to the vapor barrier in accordance with the manufacturer’s instructions, taking into account the wind suction load. Refer to the manufacturer’s instructions for coverage. Then lay the Multipor roof insulation boards on top. We recommend a PU cartridge adhesive (12).</td>
</tr>
</tbody>
</table>

7  Sanding down raised areas
8  Applying hot bitumen
9  Laying insulation boards in hot bitumen
10 Laying insulation boards on thermally active vapor barrier
11 Laying insulation boards in liquid vapor barrier
12 Laying insulation boards in PU foam insulation adhesive
Several options are also available for installing the insulation boards in two layers or in conjunction with cut-to-fall boards (see Table 3). Always ensure that joints in subsequent layers are staggered.

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

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

<table>
<thead>
<tr>
<th>Installation method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipor lightweight mortar</td>
<td>Apply a full bed of Multipor lightweight mortar to the upper surface of the first layer of boards using a 12-millimetre notched trowel. Gently float the boards for the second layer into the bed of adhesive and butt up the unmortared longitudinal and transverse joints tightly (without adhesive). Apply further layers of insulation in the same way as the second layer. When applied with a 12-mm notched trowel, the lightweight mortar will cover approximately 3.5 kg/m².</td>
</tr>
<tr>
<td>PU foam insulation adhesive</td>
<td>Apply the PU foam insulation adhesive in accordance with the manufacturer’s instructions, taking into account the wind suction load. Then lay the second layer of mineral insulation boards in the fresh adhesive. Butt the unmortared longitudinal and transverse joints up tightly (without adhesive). Apply further layers of insulation in the same way as the second layer and refer to the manufacturer’s instructions for information about coverage.</td>
</tr>
<tr>
<td>Hot bitumen</td>
<td>Lay the Multipor roof insulation boards in a full bed of hot-poured bitumen (e.g. grade 100/25) to ensure full-surface adhesion to the first layer. Butt the unmortared longitudinal and transverse joints up tightly (without adhesive). Apply further layers of insulation in the same way as the second layer. Apply the hot-poured bitumen at a rate of approximately 2.5 kg/m².</td>
</tr>
</tbody>
</table>
Waterproof membrane

Waterproof membranes must always be laid in accordance with the manufacturer’s instructions and the building regulations governing flat roofs. Various design options are shown in the following tables. Note that all the layers of a bonded roof construction must be bonded together by means of a non-positive connection. The waterproof membranes of loose-laid ballasted and mechanically fastened roof constructions are normally loose-laid.

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

6.7 Installing Multipor flat roof insulation

Table 5: High-polymer waterproof membranes

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

Further roof construction / Further loads

Bonded and mechanically fastened roof constructions need no further ballast and are exposed to the weather. Loose-laid roof constructions, on the other hand, require a layer of ballast suitably designed for the wind suction load. Depending on the planned usage, this may take the following form:

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

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

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

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

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

Installing Multipor pitched roof insulation

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

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

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

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

¹ Load-bearing part
Multipor roof insulation systems

6.8 Installing Multipor pitched roof insulation

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

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

To obtain a workable consistency, mix the mortar thoroughly using a low-speed mixer with a long, sturdy paddle.

Leave to cure for approx. 5 minutes – depending on the weather conditions – then stir the lightweight mortar again before use. Clean paddle mixers thoroughly after use for optimal mixing results.

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

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

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

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

Cutting and shaping Multipor roof insulation board

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

Two-layer installation for thicker insulation

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

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

Fastening the subsequent timber structure to the Ytong roof elements

The first counter battening is made from grade S10 softwood in accordance with DIN 4074-1 and strength class C24 as per DIN 1052 as a minimum requirement. Fasten the timber batten (minimum dimension 40/60 mm, predrilled if necessary) through the Multipor roof insulation board straight into the Ytong roof element using a Ytong roof bolt or other approved fastener [7] [8] [9]. The number of roof bolt/anchors required depends on the static calculation.
6.0 Multipor roof insulation systems

6.8 Installing Multipor pitched roof insulation

Installing the sarking membrane with counter battens
When the primary counter battens have been installed, fit the sarking membrane ($s_d \leq 0.2$ m) connecting it to penetrations and joint areas in accordance with standard building practice. Then fit the secondary counter battens. This creates two ventilation gaps above and below the sarking membrane, which also improves thermal insulation in summer.

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

Completed roof with integrated solar modules.
Detail drawings for Ytong roof elements with Multipor pitched roof insulation

Eaves

ETICS wall solution 08-002

Ridge

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

Download these and other detail drawings at www.multipor.com/detaildrawings.php
Detail drawings for Ytong roof elements with Multipor pitched roof insulation

Verge with overhang

Verge with parapet

Verge without overhang

Ridge without overhang

011 Flashing/cover plate
012 Timber board
024 Gutter
025 Roof tile
028 Sarking board
030 Battens
037 Insect protection
081 Interior plaster
096 Mesh insert
100 Ring beam
119 Render edging strip
139 Battens
149 Pre-compressed sealing tape
150 Ytong roof element
200 Ytong/Silka masonry
249 Multipor ETICS mineral insulation board
252 Multipor pitched roof insulation
309 Ytong roof bolt
326 Multipor screw-in anchor

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The Multipor Insulation Guide containing full details of our mineral insulation systems is also available online. The interactive e-book includes a range of useful functions to make it as easy as possible for you to use. It is updated at regular intervals so you can always find the latest information and data.

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DIN 1055 Actions on structures
DIN 4074 Strength grading of wood
DIN 4095 Planning, design and installation of drainage systems protecting structures against water in the ground
DIN 4102 Fire behaviour of building materials and building components
DIN 4108 Thermal insulation and energy economy in buildings
DIN 4108-10 Thermal protection and energy economy in buildings – Part 10: Application-related requirements for thermal insulation materials – Factory made products
DIN 4109 Sound insulation in buildings; Minimum requirements and verification of compliance
DIN 4223 Application of prefabricated reinforced components of autoclaved aerated concrete
DIN 18130 Soil – investigation and testing; Determination of the coefficient of water vapour permeability
DIN 18195 Waterproofing of buildings
DIN 18202 Tolerances in building construction – Buildings
DIN 18234 Fire safety of large roofs for buildings
DIN 18345 German construction contract procedures (VDB) – Part C: General technical specifications in construction contracts (ATV) – Thermal insulation composite systems
DIN 18350 German construction contract procedures (VDB) – Part C: General technical specifications in construction contracts (ATV) – Plastering and rendering
DIN 18363 German construction contract procedures (VDB) – Part C: General technical specifications in construction contracts (ATV) – Painting and coating work
DIN 18516 Cladding for external walls, ventilated at rear
DIN 18531 Waterproofing of roofs – Non-utilised roofs
DIN 18533 Waterproofing of elements in contact with soil/Waterproofing in and under walls
DIN 18547 Earth plasters – Terms and definitions, requirements, test methods
DIN 55699 Application and processing of external thermal insulation composite systems (ETICS)
DIN EN 1052 Methods of test from masonry
DIN EN 1062 Paints and varnishes – Coating materials and coating systems for exterior masonry and concrete
DIN EN 12087 Thermal insulation products for building applications – Determination of long-term water absorption by immersion
DIN EN 13501 Fire classification of construction products and building elements
DIN EN 13561 External blinds and awnings – Performance requirements, including safety
DIN EN 13707 Flexible sheets for waterproofing – Reinforced bitumen sheets for roof waterproofing – Definitions and characteristics
DIN EN 13914-1:2005 and DIN 18550-1:2014 External rendering and internal plastering
DIN EN 15026 Hygrothermal performance of building components and building elements – Assessment of moisture transfer by numerical simulation
DIN EN 1609 Thermal insulating products for building applications – Determination of short-term water absorption by partial immersion
DIN EN 1991-1-1 Eurocode 1: Actions on structures
DIN EN 998-1 Specification for mortar for masonry – Part 1: Rendering and plastering mortar
DIN EN ISO 10211 Thermal bridges in building construction - Heat flows and surface temperatures – Detailed calculations
DIN EN ISO 10466 Building components and building elements – Thermal resistance and thermal transmittance – Calculation method
DIN EN ISO 717 Acoustics - Ratings of sound insulation in buildings and of building elements
DIN EN ISO 7730 Ergonomics of the thermal environment – Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria
DIN V 18599 Energy efficiency of buildings – Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting
DIN V 4701-10 Energy efficiency of heating and ventilation systems in buildings – Part 10: Heating, domestic hot water supply, ventilation