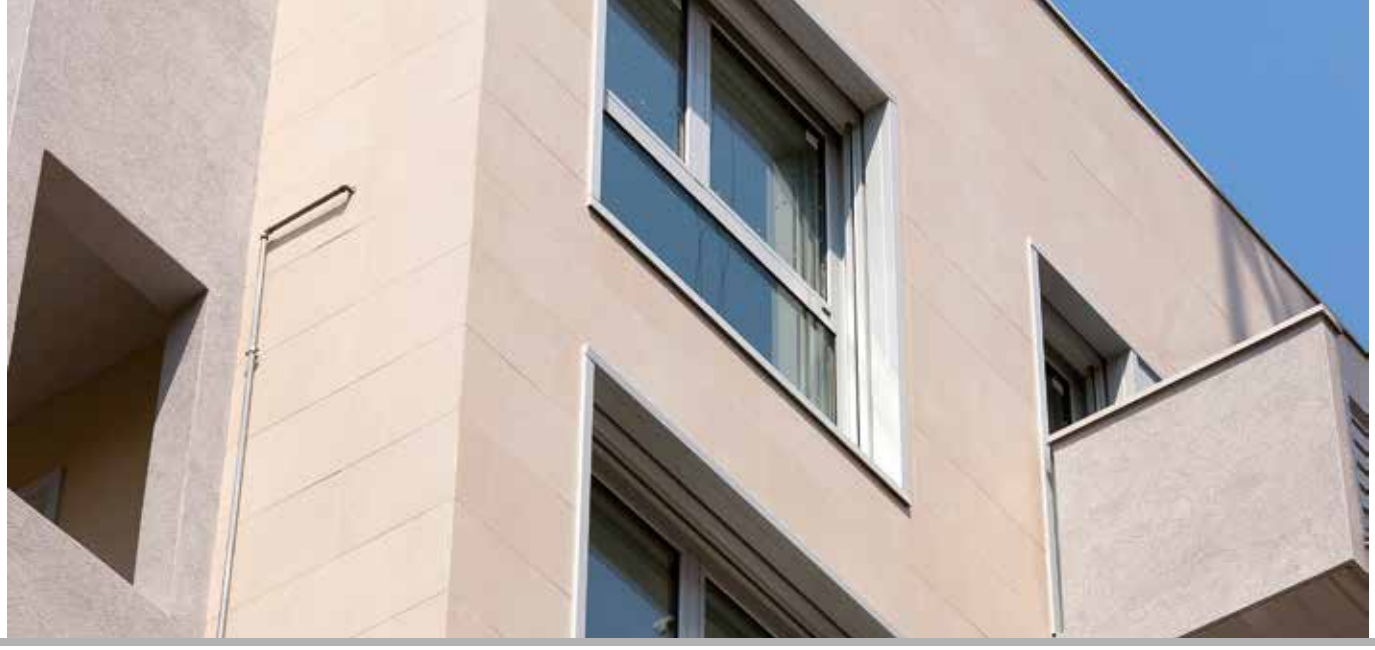

Technical Notebook

MAPETHERM® TILE SYSTEM

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MAPEI®
ADHESIVES • SEALANTS • CHEMICAL PRODUCTS FOR BUILDING

Technical Notebook

MAPETHERM® TILE SYSTEM

1. INTRODUCTION

The aim of this technical notebook is to offer guidelines on the installation techniques and the products and systems available from MAPEI to install the innovative insulating **MAPETHERM® TILE SYSTEM**, correctly and professionally.

The increasingly widespread use of thermal insulation systems, offering improved thermal comfort in buildings, has highlighted the need to study and develop a specific system for installing ceramic covering materials on insulating panels as an alternative to the bonding of ceramic and reconstituted stone coatings on insulating panels.

MAPEI's answer has been to study and develop a system for installing slim porcelain tiles up to 500 x 1500 x 5 mm on to XPS and EPS insulating panels on the façades of buildings up to 20 metres tall, as with the application of elements in reconstituted stone.

Compared with the application of coloured finishing products, as in the tried and tested **MAPETHERM SYSTEM**, the installation of ceramic coverings on façades requires a stronger, more resistant substrate than that offered by the insulating panels used in thermal insulating systems.

MAPEI's experience in the sector of covering materials for façades, and their technical competence and knowledge in structural reinforcement, has led to the company developing and perfecting a system for covering EPS and XPS panels, characterised by its high tensile and compressive strength and low modulus of elasticity capable of withstanding the weight and stresses generated by the covering material.

It is clear that the overall durability of a ceramic covering applied on an external façade may only be guaranteed by:

- correct system design;
- careful preparation of the substrate;
- correct installation of the insulating system;
- the use of specific adhesives, grouting mortars and sealants for this type of application.

Fig. 1.1 - Residential building with MAPETHERM TILE SYSTEM

Fig. 1.2 - Residential building with MAPETHERM TILE SYSTEM

Fig. 1.3 - Residential building with MAPETHERM TILE SYSTEM

Fig. 1.4 - A house dressed with reconstituted stone

2. THERMAL INSULATION

2.1 OVERVIEW

The energy performance of a building, which was not regarded as particularly significant in the past, is becoming more and more important due to environmental restraints and rising energy costs.

This has led to the need to limit heat losses from homes which, in turn, has prompted the development of suitable solutions, and created a fast-growing sector in the modern building industry.

It is no coincidence that the combination of living comfort and the thermal insulation of buildings has become increasingly important, and is becoming the most significant argument of discussion in the modern building history.

The need to reduce fossil fuel emissions into the atmosphere has pushed all the 184 governments which signed up to the Kyoto Protocol in 1997 to issue laws regarding energy efficiency.

Taking into consideration the fact that approximately 40% of the energy in Europe is consumed by air-conditioning systems in residential environments, the European Union issued European Directive 2002/91 to all member states, the scope of which is to instigate a joint programme aimed at improving the energy efficiency of buildings.

Certain specifications regarding the minimum performance requirements have been identified, and their use will become obligatory to certify buildings at an official level.

This system of energy certification is considered to be the simplest instrument to promote a reduction in a building's energy consumption and to spread a culture of eco-sustainable development. In fact energy certification, issued by specialised, approved technicians, is becoming an increasingly important requisite when buying or selling a house.

2.2 ITALIAN REFERENCE LEGISLATION

The Italian government has issued several decrees to meet the requirements of the European directive on energy efficiency, including Decree N° 192 on the 19th of August 2005, followed by Decree 311 which became law in February 2007.

This Decree prescribes the legal limit for dispersions in terms of thermal transmittance (U) for walls, door and window fittings, flat roofs and floors towards non-heated rooms and the outside of buildings.

These reference values vary according to the climatic zones into which Italy is divided. There are six climatic zones in Italy (A, B, C, D, E and F), which have been defined according to the thermal requirements of each geographical area expressed in *daily degrees* (DD); a low value of DD corresponds to a short period of heating or cooling.

The decree also includes a series of checks to guarantee adequate living comfort and to limit the formation of surface condensation and *thermal bridges*.

The areas most affected by this decree are basically the following:

- new build;
- maintenance work on the external elements of existing buildings with a useful surface area of more than 1000 m^2;
- extension work involving more than 20% of a building's existing volume.

Lastly, the obligation to provide energy certification, a direct consequence of the EC Directive has become standard procedure at a national level through the Ministerial Decree issued on the 26th of June 2009, entitled "*National guidelines for the energy certification of buildings*". A building's Energy Certificate is an official document issued by an authorised energy certifier, and has become an indispensible document when selling or purchasing a property (since 2009) or when renting a property (since 2010). The Certificate is also required to qualify for tax exemptions as prescribed by current fiscal legislation.

2.3 CONVENTIONAL THERMAL INSULATION SYSTEMS

2.3.1 DEFINITION

Thermal insulation installed on the outside of a building, known as "cladding", is an insulating system which has become well consolidated over the years for both restoration work and new build.

At an international level, the acronym commonly used to indicate external thermal insulation systems is ETICS *(External Thermal Insulation Composite System)*.

From a technical point of view, this system consists of applying an insulating layer on to the external walls of a building to correct or eliminate any thermal bridges, and to reduce the effects induced on the structure and facing walls by rapid high variations in the outside temperature.

Thermal bridges represent areas of interruptions in the thermal insulation, and form points of heat loss which considerably reduce the overall insulating properties of the wall and, in winter localised cooling of certain areas of the internal surfaces.

The condensation of water vapour will correspond with these thermal bridges, the main cause of mould and bacteria. To prevent this phenomenon, the temperature of the internal surfaces must be higher than the condensation temperature. This may only be achieved if the walls are suitably insulated and if there is sufficient natural or artificial ventilation in the rooms.

The system is quite complex, in that it is composed of various materials and accessories where each single component must be correctly designed and manufactured to suitable quality standards to form a reliable, long-lasting system.

2.3.2 ADVANTAGES

The advantages offered by this insulating system lead to an immediate improvement in the energy performance of a building, in that it has the capacity of making a building thermally stable.

In fact, the presence of external insulating panels allows the heat which accumulates in the walls during the winter to be dispersed, while allowing the walls to be heated directly by the sun during the summer.

The most significant advantages with a thermal insulation system may be summarised as follows:

1. **ECONOMIC**, due to an increase in the value of the building and a drastic reduction in the consumption of combustibles to run air-conditioning systems;

2. **INSTALLATION**, in terms of efficiency and simplicity for renovation work and to meet the requirements of the most recent legislation regarding energy efficiency;

3. **IMPROVED LIVING COMFORT**, in that the degree of thermal insulation obtained is a determining factor in maintaining the temperature of the internal surfaces as high as possible while considerably limiting the formation of condensation and unsightly mould and dark stains;

4. **ENVIRONMENTAL**, in that the lower consumption of fossil fuels leads to considerable energy savings and less pollution;

5. **PERFORMANCE**, in that it offers thermal-hygrometric protection to all the structural elements which have the capacity of reducing thermal and hygrometric stresses, often the cause of dangerous cracking or accelerated deterioration of the materials.

Fig. 3.1 - Residential building with MAPETHERM TILE SYSTEM

3. MAPEI RESEARCH

MAPEI's entrance into the thermal insulation sector came about after a careful and thorough analysis of the stresses to which an insulation system is subjected.

The considerations which emerged from this analysis led to the conclusion that within the system, the adhesive is the key component, in that it has the difficult task of guaranteeing the effective collaboration of all the materials which form a thermal insulation system.

MAPEI has always been a leader in the adhesives sector, and thanks to their constant commitment to research and the development of innovative materials and systems, offer a vast range of products which meet all the requirements regarding the installation of a insulation system.

3.1 ADVANTAGES AND INNOVATIONS OF THE MAPETHERM® TILE SYSTEM

By gathering their experience gained over many years, MAPEI has developed an innovative thermal insulation system called **MAPETHERM® TILE SYSTEM**.

The main innovation of this new system consists in bonding ceramic and reconstituted stone coatings on insulating panels. In order to do this, a substrate characterised by much higher mechanical strength than that of the insulating panels, has had to be developed.

To achieve such an important result, structural render characterised by its high compressive and tensile strength and low modulus of elasticity has been used which, when used in combination with special **MAPETHERM TILE FIX** wall plugs, has the capacity of withstanding the weight and stresses generated by the covering material and by expansion and contraction.

This type of render, which has been used by MAPEI for a number of years in structural strengthening work, is made up of **PLANITOP HDM MAXI** two-component, fibre-reinforced mortar and special **MAPEGRID G 120** A.R. glass fibre mesh, characterised by its high durability in alkaline environments.

Apart from the advantages typically obtained using traditional thermal insulation systems, the covering of thin porcelain tiles and reconstituted stone installed on the structural render also offers other advantages:

- Unique aesthetic characteristics for a wider variety of architectural finishes;
- Easy maintenance;
- Colours which resist exposure to sunlight, chemical attack and smog;
- Higher resistance to impact.

The **MAPETHERM® TILE SYSTEM** is an excellent system for renovating and rebuilding façades, and offers highly successful results and indisputable aesthetic-architectural qualities, with the capacity of limiting all types of staining from which the external surfaces of buildings suffer. MAPEI also has a wide range of products available to satisfy all the requirements of site work and each application stage of the system.

Fig. 3.2 - Residential building with MAPETHERM TILE SYSTEM

Fig. 3.3 - Residential building with MAPETHERM TILE SYSTEM

3.2 SYSTEM DESIGN

It is worth remembering that a combination of correct system design and adequate installation play a fundamental role in guaranteeing the durability of the entire system.

Before installing the **MAPETHERM® TILE SYSTEM**, it is necessary to define the layout of all the construction details to install the system (joints, staggering of the panels, etc.) and to determine any climatic and installation factors which could have an effect on the design choices for the system, such as the direction that the façade faces, exposure to the sun, the geographical position of the building and the schedule for installation work.

Fig. 3.4 - A house dressed with reconstituted stone

Never calculate the type and thickness of the insulating panel by yourself. Basing the choice on economic considerations alone could cause problems which are very difficult to solve.

Use an expert to help design the system to make sure it respects the legal values of thermal transmittance and to classify the building according to its energy performance. This will allow you to get the best value for the building and to benefit from all the advantages of the system.

3.3 SPECIFIC PRECAUTIONS

Choosing the products for the system correctly and following the detailed installation instructions in this manual will make sure the **MAPETHERM®** **TILE SYSTEM** is installed and performs correctly.

The thin porcelain tiles used for the system must be no larger than 50 x 150 cm with a standard thickness of 3.5-5 mm for buildings up to 20 metres tall. Due to their low weight and reduced thickness, coatings in reconstituted stone are also suitable for this system.

Also, choose a light colour for the tiles with a reflection index of more than 20%.

The reflection index indicates the percentage of light that a surface reflects, and the higher the value the lighter the colour of the surface (e.g. 0% = black – 98% = white).

This limitation in the colour of the surface is due to the fact that the surface of a particularly dark coloured façade reaches a very high temperature when it is exposed to the sun, while during the night or following a rainstorm it may cool down quickly and be subject to thermal stress.

For further information, or for systems applied in conditions completely different to those in this technical notebook, please contact the MAPEI Technical Services Department.

4. COMPONENTS OF THE SYSTEM

A thermal insulating system is made up of various components of different nature, and the energy efficiency and durability of the completed insulating system derives from the effective collaboration of the various components. MAPEI has a complete range of quality products that any design and execution requirement of the system may be met.

Since there are so many application requirements, this section presents all of the MAPEI products available for the **MAPETHERM® TILE SYSTEM**, while the application techniques will be presented in the following section. The technical specifications for each of the products in this section are described more fully in the Technical Data Sheet for each product, available online at www.mapei.com.

1 Concrete

2 Adhesive
Mapetherm AR1
ETA 04/0061 - ETA 10/0024 - ETA 10/0025

3 Insulating panel
Mapetherm XPS

4 Smoothing compound
Planitop HDM Maxi

5 AR fibre glass mesh
Mapegrid G 120

6 Adhesive
Ultralite S2

7 Thin porcelain tile

8 Anchors
Mapetherm Tile Fix 15

9 Sealant
Mapesil LM

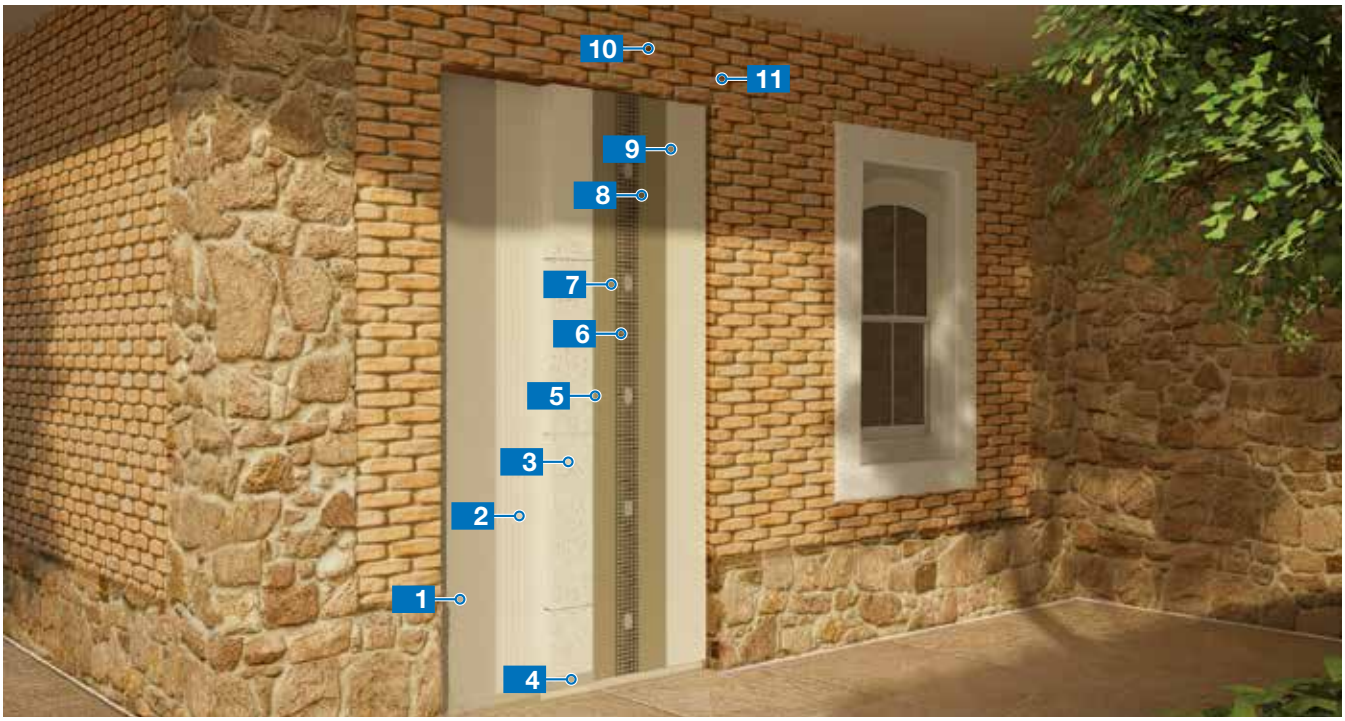
11 Grout
Ultracolor Plus

Fig. 4.1 - MAPETHERM AR1

4.1 ADHESIVES FOR INSULATING PANELS

According to studies carried out on the stresses which act upon an insulation system, it is fundamentally important to use products which guarantee excellent adhesion strength. It is also important to use adhesives with specific performance characteristics to bond the insulating panels, such as:

- **MAPETHERM AR1**: one-component cementitious mortar for bonding panels (Fig. 4.1). When mixed with water, it forms a thixotropic mortar with good workability that may be applied on vertical surfaces without slipping and stops the insulating panels from slipping, including large panels.



1 Old render

2 Adhesive
Mapetherm AR1

3 Insulating panel
Mapetherm EPS
ETA 10/0025

4 Aluminum backets
Mapetherm BA

5 Smoothing compound
Planitop HDM Maxi

6 Fibre glass mesh
Mapegrid G 120

7 Anchors
Mapetherm Tile Fix 15

8 Smoothing compound
Planitop HDM Maxi

9 Adhesive
Keraflex Maxi S1

10 Recomposed stone coating

11 Grout
MapeWall Muratura Fine

- **MAPETHERM AR1 GG**: one-component, coarse-grained cementitious mortar for bonding panels (Fig. 4.2). When mixed with water, it forms a thixotropic mortar with good workability that may be applied on vertical surfaces without running and stops the insulating panels from slipping, including large panels.

Fig. 4.2 - MAPETHERM AR1 GG

4.2 INSULATING PANELS

The type and thickness of the insulating panel is the responsibility of the technician that calculates the dimensions of the system, by taking into consideration the type of building (new or old), the stratigraphic layout of the walls, the load-bearing structure (concrete, bricks, poroton, stone, etc.), the area where the building is located and current norms and regulations.
The panels (Fig. 4.3) used in the system are as follows:

- **MAPETHERM XPS**: extruded polystyrene insulating panel with no outer skin (compliant with UNI 13164 standards). It has a rough surface to improve adhesion of the adhesive and is characterised by its low water absorption, good compressive strength and excellent insulating properties.

  Thermal conductivity:
  λ = 0.032 – 0.036 [W/mK]
  Water vapour diffusion resistance:
  μ= 80-100

The panel has the European Technical Approval **ETA** 04/0061, issued by the ITC Institute of San Giuliano Milanese.


Fig. 4.3 - MAPETHERM XPS and EPS

- **MAPETHERM EPS**: sintered polystyrene insulating panel (compliant with UNI 13163 standards). This type of panel is characterised by its very competitive price, is easy to install and has excellent insulating properties.

  Thermal conductivity:
  λ = 0.034 – 0.040 [W/mK]
  Water vapour diffusion resistance:
  μ= 30-70

Fig. 4.4 - PLANITOP HDM MAXI

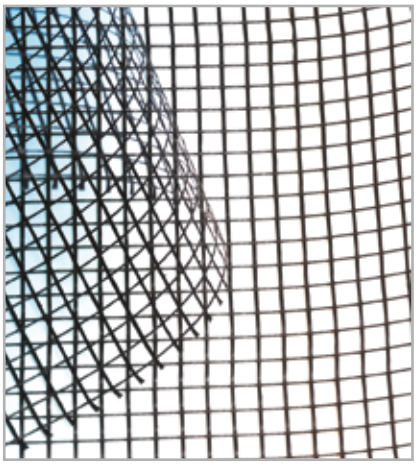


Fig. 4.5 - MAPEGRID G 120


Fig. 4.6 - MAPETHERM TILE FIX 15

The panel has the European Technical Approval **ETA** 10/0025, issued by the OIB Institute of Vienna.

The panels used for the system are available in thicknesses of 40, 50, 60, 80 and 100 mm. If other types of panel are used, they must have the same mechanical and thermal characteristics as **MAPETHERM XPS** or **EPS**. Of particular importance is the surface of the panels, in that if it is too smooth (surface “skin”) it could impede their adhesion to the substrate.

4.3 REINFORCED STRUCTURAL RENDER

Unlike normal coloured finishing products used in the approved **MAPETHERM SYSTEM**, substrates for ceramic and reconstituted stone coatings need to be stronger than traditional skimming compounds normally applied on insulating panels.
For this reason, the support for the ceramic covering is from the structural render and wall plugs, comprising the following products:

- **PLANITOP HDM MAXI**, two-component, high-strength, high-ductility, pozzolanic-reaction mortar amalgamated with glass fibres, (Fig. 4.4) classified R2 according to EN 1504-3 standards;

- **MAPEGRID G 120**, special mesh made from A.R. glass fibres, (Fig. 4.5) characterised by its high ductility in alkaline environments. These characteristics mean that the mesh acts as reinforcement for the render. The mesh is interposed between the two layers of **PLANITOP HDM MAXI**;

- **MAPETHERM TILE FIX 15**, nylon wall plugs with steel nails with an insulated head, inserted at a rate of 4-5 studs per m^2 (Fig. 4.6). The studs are fastened into the underlying structure until the washer is held against the **MAPEGRID G 120** mesh.

Thanks to the high content of synthetic resins in **PLANITOP HDM MAXI** and the characteristics of the **MAPEGRID G 120** mesh embedded in the mortar, the render, approximately 7-10 mm thick, forms a tough, compact layer which is impermeable to water and resistant to freeze-thaw cycles, ideal for installing a ceramic covering.

4.4 ADHESIVES FOR INSTALLING CERAMIC

4.4.1 FACTORS WHICH INFLUENCE INSTALLATION ON FAÇADES

When installing covering materials on external surfaces, special attention must be made to the difference in movement between the covering material and the substrate, especially when it is installed on insulating materials.

These movements, which depend on variations in temperature during the day and in different seasons, could cause considerable stress in the covering material.

The amount of deformation in play depends on various factors, such as the direction the façade is facing, the amount it is exposed to the sun, its geographical position and the colour of the tiles.

In fact, darker colours and black attract and accumulate more solar energy, which is transformed into heat and therefore into higher thermal expansion of the tiles.

For the aforementioned reasons, installation on façades and in particular on insulating systems, requires the use of adhesives with special adhesion characteristics and high deformability (class S2 according to EN 12004), which have the capacity of following the different movements in the covering so as to absorb the stresses generated in the underlying substrate and prevent detachment of the covering material.

The deformability of an adhesive is measured using a flexure test, in which the amount of deflection of a sample of the adhesive being tested is determined by applying a pre-set load. The higher the deflection, the higher the deformability of the adhesive. The test method defined in

Fig. 4.7 - EN 12004 flexure test for adhesives

Fig. 4.8 - ULTRALITE S2

Fig. 4.9 - KERABOND + ISOLASTIC

Fig. 4.10 - ULTRALITE S2 QUICK

EN 12004 (Fig. 4.7) defines three classes of deformability according to the amount of deflection. If the deflection is less than 2.5 mm, the adhesive is classified as non-deformable, whereas if the deflection is between 2.5 mm and 5 mm or higher than 5 mm, the adhesive is classified as deformable (S1) and highly deformable (S2).

Which adhesive to use and the best installation technique to adopt is also influenced by the format and type of tile. In fact when installing large formats, wider joints between the tiles and more elastic distribution joints are required.

Lastly the site schedule and the climatic conditions when installing the system are often determining factors when choosing which adhesive to use.

4.4.2 CHARACTERISTICS OF ADHESIVES FOR INSTALLING CERAMIC

The adhesives proposed by MAPEI for the installation of tiling on **MAPETHERM® TILE SYSTEM** in compliance with UNI 11493 standards for wall and floor tiling and according to the stresses acting on the system and specific project specifications, are shown in the following table:

ADHESIVES FOR INSTALLING CERAMIC			
Normal setting		Fast setting	
Adhesive	CLASS EN 12004 - ISO 13007	Adhesive	CLASS EN 12004 - ISO 13007
ULTRALITE S2	C2 E S2	ULTRALITE S2 QUICK	C2 FE S2
KERABOND + ISOLASTIC	C2 E S2	ELASTORAPID	C2 FTE S2
		KERAQUICK S1 + LATEX PLUS	C2 FT S2

EN 12004 standards (or ISO 13007) define the classification of adhesives for ceramic and stone, the minimum requirements of a product, test methods and the performance levels measured.

On the basis of the considerations made previously, the installation of ceramic tiles on façades, and in particular on thermal insulating systems, requires the use of cementitious adhesives with the following performance characteristics:

- **Improved adhesion** (class **C2** according to EN 12004 or ISO 13007) to offer higher durability and strength to the system;
- **Highly deformable** (class **S2** according to EN 12004 or ISO 13007) adhesive to resist the strains and different movements induced between the substrate and the covering material by variations in temperature during the day or different seasons.

According to specific environmental conditions and particular installation requirements, other characteristics of the adhesives may also be considered, such as:

- **Extended open time** (class **E** according to EN 12004 or ISO 13007), essential when installation is carried out in unfavourable climatic conditions, such as high temperatures, dry winds, etc.;
- **Fast setting** (class **F** according to EN 12004 or ISO 13007), especially when an adhesive with the capacity of reaching high adhesion strength after just a few hours is required, such as in cold weather. The speed at which an adhesive sets, in fact, ensures that the setting capacity of the layer of adhesive is not reduced if the mixing water freezes;
- **Reduced vertical slip** (class **T** according to EN 12004 or ISO 13007).

Fig. 4.11 - ELASTORAPID

Fig. 4.12 - KERAQUICK S1 + LATEX PLUS

4.4.3 ADVANTAGES OF ULTRALITE S2 AND ULTRALITE S2 QUICK

ULTRALITE S2, and its respective rapid version **ULTRALITE S2 QUICK**, are cementitious adhesives developed in the MAPEI research and

Fig. 4.13 - Wetting capacity of adhesive with Ultralite technology

development laboratories. They have innovative characteristics and are perfectly compatible with the **MAPETHERM® TILE SYSTEM**.
The advantages in using these products compared with traditional two-component products may be summarised as follows:

- one-component, highly deformable (S2) adhesive which does not need to be mixed with latex, thus eliminating the risk of using the wrong amount of latex;
- **Ultralite** technology which, by using special hollow micro-spheres of glass, makes cementitious adhesive less dense and easier to apply, leading to lower transportation and storage costs;
- around 80% higher yield per square metre compared with MAPEI adhesives with the same classification;
- thanks to the **Ultralite** technology and content of recycled materials, it contributes to the attribution of points for LEED certification;
- high wetting capacity (Fig. 4.13), ideal especially for thin tiles, in that it prevents the formation of air pockets and therefore dangerous stresses between the adhesive and the tiles when applied on external façades.

The advantages described above are a perfect answer to problems connected with the installation of the latest generation of slim and large-format ceramic tiles.

4.5 GROUTING PRODUCTS

When grouting joints on façades, it is important to use products characterised by their high mechanical strength and reduced water

absorption, class CG2 WA according to EN 13888 standards. The joint must be around 5 mm wide and be sufficient to absorb any movements between the tiles. For this reason, the system includes the use of the following cementitious products:

CEMENTITIOUS GROUTS		TECHNICAL CHARACTERISTICS
ULTRACOLOR PLUS		• CG2 WA ACCORDING TO EN 13888, FAST SETTING AND HARDENING • ANTI-EFFLORESCENCE AND MOULD-RESISTANT (BIOBLOCK® TECHNOLOGY) • WATER-REPELLENT (DROPEFFECT®) • AVAILABLE IN 30 COLOURS
KERACOLOR GG	+ FUGOLASTIC	• CG2 WA ACCORDING TO EN 13888 • PRE-BLENDED, HIGH-PERFORMANCE CEMENTITIOUS MORTAR • WATER-REPELLENT (DROPEFFECT®) • POLYMER-MODIFIED • AVAILABLE IN 18 COLOURS
KERACOLOR FF		

Mixing **KERACOLOR** (**GG** or **FF**) with **FUGOLASTIC** synthetic resin-based polymer admixture, instead of with water, improves the final characteristics of the grout and makes it stronger, increases its resistance to abrasion and reduces its water absorption. With these characteristics, their performance levels are sufficient for even the most demanding service conditions.

DropEffect® technology, developed by MAPEI, is based on the use of special polymers, which allow surfaces to be created which attract less dirt and are characterised by their high water repellence and excellent durability.

BioBlock® technology, developed by MAPEI, consists of special organic molecules which, by distributing themselves homogeneously in the micro-structure of the joints, block the formation of the micro-organisms which cause mould to grow in the presence of damp.

Fig. 4.14 - MAPESIL LM and MAPEFLEX PU40

Fig. 4.15 - MAPETHERM BA

Fig. 4.16 - Positioning MAPETHERM BA support profiles

Fig. 4.17 - MAPETHERM FIX B

Fig. 4.18 - MAPETHERM PROFIL

Fig. 4.19 - MAPEFOAM

4.6 SEALANTS

To seal joints in ceramic coverings, we recommend the use of:

ELASTIC JOINTS	TECHNICAL CHARACTERISTICS
MAPESIL LM	ONE-COMPONENT, ODOURLESS, NEUTRAL-RETICULATION SILICONE SEALANT FOR JOINTS SUBJECTED TO ELONGATION OF UP TO 25% WHEN IN SERVICE
MAPEFLEX PU40	SILICONE-POLYURETHANE SEALANT FOR JOINTS SUBJECTED TO ELONGATION OF UP TO 20% WHEN IN SERVICE

The use of these sealants impedes the formation of unsightly stains and marks which generally form along the edges of the joints, especially in coating materials on façades made from light-coloured ceramic tiles when normal acetic-reticulation silicone is used.

4.7 AUXILIARY AND SUPPORT ITEMS

The auxiliary items used in the system are as follows:

- **MAPETHERM BA**, aluminium support profiles with drip channels;
- **MAPETHERM FIX B**, nylon wall plugs for support profiles;
- **MAPETHERM PROFIL**, aluminium corner support profiles with pre-mounted glass fibre mesh, which is embedded in the structural render in the corners between adjacent walls;
- **MAPEFOAM**, closed-cell extruded polyethylene foam cord. This is used to support the sealants and to calibrate the depth of the joints.

5. INSTALLATION PHASES

Even though installation of the system is relatively simple, make sure you follow the instructions on the sequence of operations, the weights and amount of products to use, the waiting times indicated and the installation techniques recommended for each of the layers which make up the system.

5.1 SUBSTRATE PREPARATION

Correct preparation of the substrate is the most important phase in order to obtain a good bond for the panels and therefore good thermal insulation.
Whatever type of substrate is encountered on site, it is important that the surface is:

- **Flat and even** to avoid having a poor bond between the substrate and the panels due to the formation of voids, which would then reduce the efficiency of the insulating layer. This type of defect is very difficult to eliminate during application of the render and installation of the covering material;

- **Mechanically strong**;

- **Correctly cured**;

- **Perfectly clean** with no traces of substances or materials which could potentially compromise adhesion between the panel and the substrate (such as detached portions, traces of dust, dirt, grease, form release agents, old paintwork, deteriorated coloured plaster, etc.).

The following section contains a series of preparation cycles for the most widely used substrates in the building industry.

5.1.1 RENDERED SURFACES

On buildings that have already been rendered, make sure the render adheres well to the substrate and remove any areas that are in danger of becoming detached.

Repair the areas of detached render with cementitious mortar, such as **NIVOPLAN** mixed with **PLANICRETE** latex, or **PLANITOP FAST 330**.

To successfully install a thermal insulation system, the tensile strength of the render must be around 1.00 MPa. There are no reference standards for this parameter and the value proposed is based on the company's experience over the years and its compatibility with the adhesives used to install the system. If you opt for a pre-blended render, any product chosen must comply with this value. They are normally known as “anti-pull-off”, and must be certified and guaranteed by the manufacturer.

5.1.2 STRUCTURES WITH A REINFORCED CONCRETE FRAME AND BUFFER WALLS

On structures with a reinforced concrete frame, or on buffer walls, it is essential that the render has a similar anti-pull-off value to the one in the previous paragraph.

It is also important to install a mesh to hold the render in relation to where the concrete meets the brickwork.

This render must be made using **NIVOPLAN** mixed with **PLANICRETE**, or **PLANITOP FAST 330**.

5.1.3 EXISTING BRICK OR STONE MASONRY

On buildings with an exposed brick or stone finish (not rendered), the consistency of the stone blocks and the condition of the surface of the bricks must be checked, and all flaky or loose parts must be eliminated.

For porous stone blocks with a powdery or dusty surface, you may decide to use a primer (such as **PRIMER 3296** acrylic polymer-based primer in

water dispersion or **MALECH** micronized acrylic resin-based primer in water dispersion used to prepare the surface of masonry work in general), which is applied on the surface of the masonry with a brush or by spray. If the joints between the stone or bricks have been worn away by the leaching action of rainwater, they will need to be pointed using mortar with adequate elastic-mechanical properties, such as **MAPE-ANTIQUE MC** pre-blended, de-humidifying mortar used for renovating damp stone, brick and tough masonry or **POROMAP INTONACO** pre-blended, de-humidifying, salt-resistant grey insulating mortar used for renovating stone, brick and tough masonry.

If the wall is particularly out of plumb or uneven due to the type of construction materials used (such as rough-cut or rounded stone blocks), the surface will have to be levelled off and/or made vertical by applying a layer of render as described below.

The characteristics of the render used must guarantee excellent adhesion to the substrate and it must have a low modulus of elasticity and good tensile and flexural strength.

In such cases, therefore, we recommend using **NIVOPLAN** levelling mortar for walls mixed with **PLANICRETE** synthetic latex instead of water, or **PLANITOP FAST 330**.

5.1.4 PRECAST AND CAST REINFORCED CONCRETE SUBSTRATES

New concrete walls will need to be washed down with high-pressure water jets (120 atm) to remove all traces of form-release compound and anti-evaporation agents from the surface.

Clean the surface of existing structures thoroughly to remove all loose parts, surface laitance and all traces of dust, oil, grease and dirt in general.

If the concrete is deteriorated and there are corroded reinforcing rods

showing through, or if there are areas of delaminated and/or detached concrete, repair these areas as follows:

1. remove the deteriorated concrete;

2. clean the reinforcing rods with a stiff brush, by sand-blasting or hydro-blasting;

3. protect the rods by applying a cementitious passivating mortar (such as **MAPEFER 1K** one-component, anti-corrosion cementitious mortar for reinforcing rods);

4. reconstruct the area using one of the following shrinkage-compensating mortars:

   - **MAPEGROUT T40**, medium-strength, fibre-reinforced thixotropic mortar for repairing concrete;

   - **MAPEGROUT BM**, two-component thixotropic mortar with a low modulus of elasticity;

   - **PLANITOP SMOOTH & REPAIR**, fibre-reinforced, rapid-setting, controlled-shrinking, thixotropic, cementitious mortar for repairing and smoothing concrete, applied in layers from 3 mm to 40 mm thick in a single application.

After rebuilding the area, wait until the substrate is fully cured before applying the thermal cladding system.

5.2 INSTALLATION OF THE SYSTEM

5.2.1 INSTALLATION OF THE INSULATING PANELS

Before installing the insulating panels, fasten **MAPETHERM BA** (Fig. 5.2) support profiles in place with **MAPETHERM FIX B** wall plugs while checking that the walls are perfectly smooth and flat (plumb) (Fig. 5.1).

Bond the **MAPETHERM XPS** or **EPS** insulating panels to the substrate with a pre-blended adhesive such as **MAPETHERM AR1** or **MAPETHERM AR1 GG** mixed with water.

Bond the panels by spreading an even layer of adhesive over all of the back face of the insulating panel and the surface of the wall, making sure that at least 80% of the surface area is bonded.

This type of application, called *double buttering* (Figg. 5.3, 5.4), ensures that the entire surface of the panel to bond, and guarantees that there are no gaps in the adhesive which could fill with rainwater and then be subject to dangerous freeze-thaw cycles.

In fact, from MAPEI's experience over the years in the field of insulating buildings, the stresses the layer of adhesive must absorb are mainly generated by having to contrast deformations induced by high temperature variations caused by direct sunlight or domestic central heating systems.

The traditional *spot and bed* method of applying adhesive on insulating panels is not acceptable for the **MAPETHERM® TILE SYSTEM**, in that it does not guarantee that stresses in the system are absorbed correctly.

The panels must be pressed down slightly (Fig. 5.5) to make sure the adhesive is perfectly transferred onto their back faces, but make sure the adhesive does not seep into the joints between the panels, otherwise thermal bridges can be formed.

Fig. 5.1 - Checking the flatness of the substrate

Fig. 5.2 - Applying a MAPETHERM BA support profile

Fig. 5.3 - Spreading adhesive on the back of a panel

Fig. 5.4 - Spreading adhesive on the substrate

Fig. 5.5 - Installing a panel

Fig. 5.6 - Application of PLANITOP HDM MAXI on the surface of EPS panels

The thickness of the adhesive should only be the amount required to cover the surface of the panel evenly and/or compensate for any differences in flatness in the substrate, which must be less than 4 mm. Use a N° 10 notched trowel with rectangular notches to form the recommended thickness of adhesive.

Install the insulating panels starting from the lower part of the wall and work upwards, with the longest side placed horizontally and the vertical joints staggered by at least 10 cm.

Use only whole or half panels at the corners of the building, butting their ends together in an "interlocking" pattern to make sure they absorb stresses correctly.

We recommend positioning the panels so that the joints do not coincide with openings in the façade, such as doors and windows.

In order to get the maximum adhesion strength, install the panels immediately after spreading the adhesive on the back of the panels, especially in hot or windy weather.

After installing the panels, if the vertical joints between the panels are wider than 2 mm, fill the gaps with inserts made from insulating material so there is a continuous insulating layer.

5.2.2 APPLICATION OF THE REINFORCED STRUCTURAL RENDER

The structural render must be only applied once the layer of adhesive used to bond the panels has completely hardened (usually at least 48 hours, depending on the surrounding climatic conditions).

The render, 8-10 mm thick, is made from **PLANITOP HDM MAXI**, two-component cementitious mortar.

Apply the products using one of the following methods:

- If the thickness to be applied for each single layer is 3.5 mm or less, use a metal trowel with rounded notches with a radius of at least 9 mm (Fig. 5.6);

- If the thickness to be applied for each layer is more than 3.5 mm, or if it is applied on large areas, we recommend using a rendering machine (Fig. 5.7) (with a worm screw feeder for wet mortar and a stator buffer of 40 bar, internal Φ of the feeder tube 25 mm fitted with a 10-12 mm nozzle) and then spreading **PLANITOP HDM MAXI** with a metal trowel with rounded notches to even out the thickness (Fig. 5.8).


Fig. 5.7 - Application of PLANITOP HDM MAXI with a rendering machine


Fig. 5.8 - Spreading with a metal trowel

While the mortar is still fresh, lay **MAPEGRID G 120** primed, A.R. (alkali-resistant) glass fibre mesh, which will act as reinforcement for the render (Fig. 5.9).

Lay the mesh vertically and embed it in the mortar by pressing it down with a trowel. Overlap the edges of the strips of mesh widthways and/or lengthways by at least 5-10 cm.

Around the corners of openings for windows, doors, etc., we recommend applying additional strips of **MAPEGRID G 120** (30x40 cm) at 45° to the openings (Fig. 5.10).

Before the first layer of the mortar hardens, insert at least 4-5/m² **MAPETHERM TILE FIX 15** wall plugs per square metre into the render (Fig. 5.11).

Insert the wall plugs to a depth of 4 to 8 cm until the washer is against **MAPEGRID G 120**, and make sure the fire-break plug is closed.

Fasten lengths of **MAPETHERM PROFIL** around the corners between the walls by pressing them firmly so that the adhesive seeps through the holes in the profiles. No studs or wall plugs are required.

Within 24-36 hours of applying the first layer of **PLANITOP HDM MAXI**, apply the second layer 3.5-5 mm thick to form the total thickness required,

Fig. 5.9 - Positioning MAPEGRID G 120 reinforcing mesh

Fig. 5.10 - Positioning pieces of MAPEGRID G 120 around the edges of openings

approximately 1 cm (Fig. 5.12). Use a metal straight-edge to smooth over the surface of the mortar (Fig. 5.13).

Fig. 5.11 - Application of MAPETHERM TILE FIX 15

Fig. 5.12 - Application of the second layer of PLANITOP HDM MAXI

Fig. 5.13 - Levelling off the surface with a metal straight-edge

Fig. 5.14 - Application of ULTRALITE S2 on the back face of porcelain tiles

6. INSTALLATION OF PORCELAIN TILE

6.1 APPLICATION OF THE ADHESIVE FOR THE CERAMIC COVERING

Once you have chosen the most suitable adhesive to install the ceramic covering, based on the requirement described in the previous sections, wait at least ten days after applying **PLANITOP HDM MAXI** and install the ceramic covering according to the following guidelines:

- Whatever type of adhesive and covering material has been chosen, it must be installed using the **double-buttering** method, which, as defined in UNI 11493 norm, means applying the adhesive on both the substrate and the back face of the tiles (Figg. 6.1, 6.2) to prevent the formation of dangerous air pockets. This application method is also

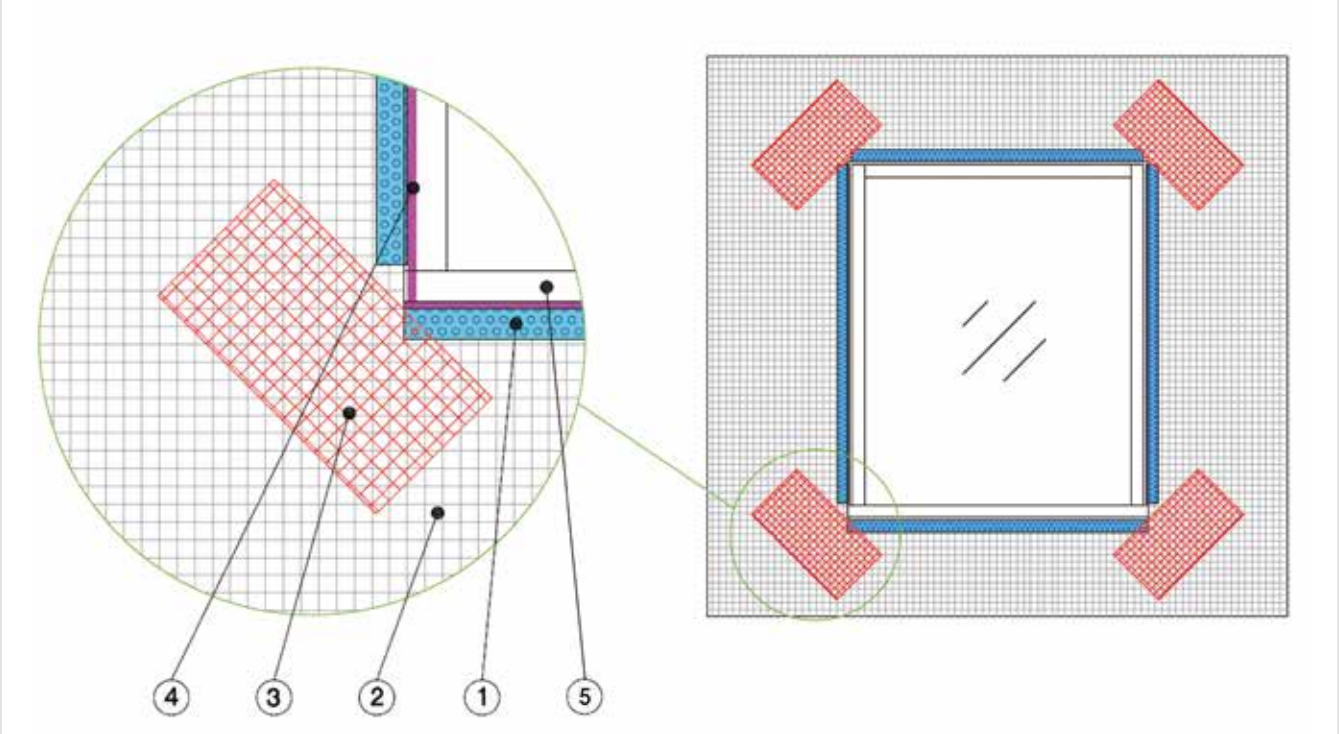


Fig. 6.1 - Detailed view of the position of reinforcement mesh around windows and openings.
1) MAPETHERM PROF; 2) MAPEGRID G 120; 3) Portions of MAPEGRID G 120 reinforcing mesh; 4) Sealed joint: MAPEFOAM + MAPESIL LM; 5) Natural stone slab.

Fig. 6.2 - Application of ULTRALITE S2 on PLANITOP HDM MAXI structural render

Fig. 6.3 - Installing porcelain tiles using the double-buttering method

necessary to prevent the formation of efflorescence on the façade and to evenly distribute stresses generated by the different movements between the ceramic covering and the substrate, due to variations in temperature for example;

- Make sure the tiles are either tapped or pressed down sufficiently during installation to get better wetting of the surfaces;

- Install the tiles while the adhesive is still fresh and within its open time to guarantee perfect transfer of the adhesive onto the back of the tiles (Fig. 6.3);

- When laying slim ceramic tiles (3.5-5 mm), even more care must be taken when spreading on the adhesive to make sure it is distributed evenly on the back of the tiles to prevent them being damaged. For further information about installing this type of material, please refer to the MAPEI Technical Notebook “Systems for laying thin porcelain tiles”.

6.1.1 GROUTING THE TILE JOINTS

As indicated in section 7.10.2 of UNI 11493, “butt joints” will no longer be permitted and the width of the joint will depend on various factors, including the type and size of the tiles, the final use of the area in which they are installed and the mechanical properties of the installation materials. Because of the conditions when installing tiles on façades using the **MAPETHERM® TILE SYSTEM**, the width of the joint must be sufficient to cushion movements between the tiles, and must be at least 5 mm in all cases.

Because the tiles are so thin, it is essential that any excess adhesive which seeps into the joints must be removed right down to the level of the substrate while it is still fresh.

Fig. 6.4 - Grouting the joints with ULTRACOLOR PLUS

The joint plays a very important part in ceramic tiling, especially large formats installed on façades (Fig. 6.4), for the following reasons:

- Differences in flatness between each single tile are less noticeable;
- The joints are sealed with a cementitious product with lower physical-mechanical characteristics than the tiles (Ejoints = 14-21 MPa; Etiles = 50-80 MPa). Therefore, if there are deformations in the substrate and in the ceramic covering due to temperature variations, for example, the joints prevent high stresses being transmitted to the adhesive and causing detachment of the tiles.

6.1.2 SEALING THE JOINTS

To prevent water, air or dust entering into the joints between the cladding system and other parts or elements of the building, they must be "protected" with metal guards (aluminium or stainless steel) or with a suitable sealant.

As indicated in section 7.11 of the new UNI 11493 standard, joints (separation joints, expansion joints, perimeter joints and structural joints) must also be included, and the width of the joints must be calculated according to various factors, including the final use of the area in which they are installed, service conditions, substrate characteristics, etc.

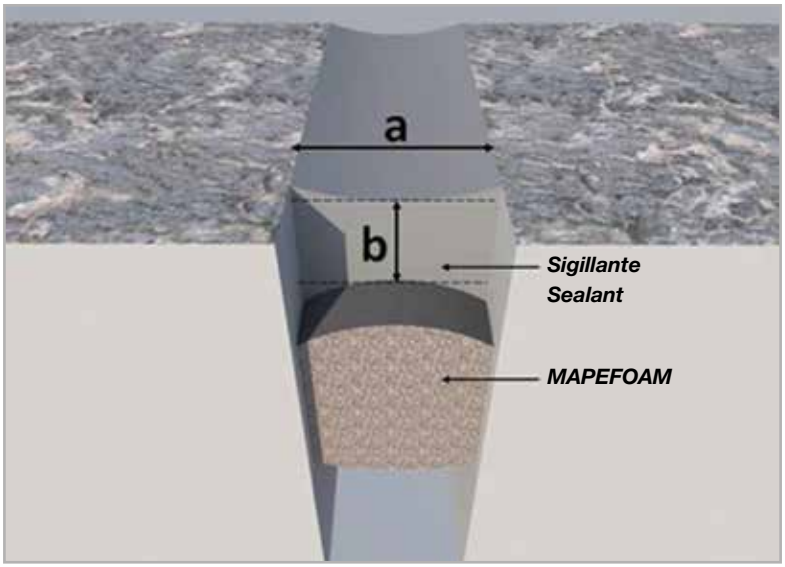
Whatever type of product is used, adequate distribution joints must be created every 9-12 m^2 of ceramic covering and in correspondence with string-courses, corners and edges. The joint must be sized according to the elongation capacity of the sealant used to seal the joint, and must never be less than 6 mm wide.

It is also important that the size and layout of existing structural joints is copied.

The sealant will only function correctly in terms of water-tightness and

duration if the joints are the correct size. As a general rule, sealing must be carried out according to the indications in the following table:

a - width of joint	b - depth of joint
from 0 to 4 [mm]	make a wider joint
from 5 to 9 [mm]	b = a
from 10 to 20 [mm]	b = 10 [mm]
from 21 to 40 [mm]	b = a/2 [mm]
more than 40 [mm]	make a narrower joint



To calibrate the depth of the sealant (according to the indications in the table above) and prevent it sticking to the bottom of the joint, insert **MAPEFOAM** closed-cell polyethylene cord in the joint by pressing it down lightly with a specially shaped trowel or wooden slat.

7. BONDING CAST STONE

7.1 CHARACTERISTICS OF ADHESIVES FOR BONDING CAST STONE

A particularly difficult case is when bonding cast stone with an “exposed” finish to dress surfaces. This type of coating material is mainly cement-based and is mass-produced by binding sand, quartz or lightweight aggregates to produce an exposed masonry effect.

The techniques adopted to bond this type of product are very similar to those for bonding ceramic tiles on façades. The stresses to which it is exposed are mainly thermal and their effect depends on whether surfaces are exposed to sunlight, the geographical area where they are applied and the colour of the coating material. Substrates used for bonding this type of material, therefore, must be strong enough to resist the levels of stress they are designed for. For this reason, the concepts discussed in the previous sections regarding bonding thin porcelain tiles using the **MAPETHERM TILE SYSTEM** must be taken into consideration.

Cast stone slabs must also be bonded using the double-buttering technique, that is, the adhesive is spread on both the substrate and the back of the slab using an appropriate notched spreader to guarantee there is an even layer of adhesive on all the back face of the slab (Figs. 7.7, 7.8 and 7.9). The adhesive must be chosen according to the surrounding conditions and the type and format of the cast stone slab and its performance characteristics must increase as the bonding conditions become more difficult.

Amongst the normal-setting adhesives available, one of the following products should be chosen: **ULTRALITE S1**, **KERAFLEX MAXI S1**, **ULTRALITE S** or **KERABOND + ISOLASTIC.** If, on the other hand, a rapid-setting product is required, one of the following products should be used: **ULTRALITE S1 QUICK**, **ELASTORAPID**, **ULTRALITE S2 QUICK** or **KERAQUICK S1 + LATEX PLUS.**

Fig. 7.1 - ULTRALITE S2

Fig. 7.2 - KERAFLEX MAXI S1

Fig. 7.3 - ULTRALITE S2 QUICK

Fig. 7.4 - MAPE-ANTIQUE MC

Fig. 7.5 - MAPE-ANTIQUE ALLETTAMENTO

Fig. 7.6 - MAPEWALL MURATURA FINE

ADHESIVES FOR BONDING CAST STONE			
Normal-setting adhesives		Rapid-setting adhesives	
Adhesive	Classification according to EN 12004 - ISO 13007	Adhesive	Classification according to EN 12004 - ISO 13007
ULTRALITE S2	C2 E S2	ULTRALITE S2 QUICK	C2 FE S2
KERABOND + ISOLASTIC	C2 E S2	ELASTORAPID	C2 FTE S2
ULTRALITE S1	C2 TE S1	KERAQUICK S1 + LATEX PLUS	C 2 FT S2
KERAFLEX MAXI S1	C2 TE S1	ULTRALITE S1 QUICK	C2 FT S1

Once the slabs have been bonded in place, they have to be carefully tapped to make sure the adhesive is distributed correctly and evenly over the back (Fig. 7.10).

Cast stone slabs must be positioned so as to leave a sufficient joint between them (around 5 mm wide) and expansion joints should be included in pitch areas of up to a maximum of 12 m^2. The end result will be a wall with a very similar effect to natural stone but with its own natural, realistic finish (Fig. 7.11).

7.1.2 GROUTING JOINTS

This type of slab is often bonded without grouting the joints, but it is preferable to seal the joints with one of the following products, depending on site conditions and the colour required: **MAPE-ANTIQUE MC**, **MAPE-ANTIQUE ALLETTAMENTO** or **MAPEWALL MURATURA FINE**.

GROUTING PRODUCTS	
MAPE-ANTIQUE MC	CEMENT-FREE, LIME AND ECO-POZZOLAN BASED MORTAR FOR SALT-RESISTANT, MACRO-POROUS, DEHUMIDIFYING RENDER
MAPE-ANTIQUE ALLETTAMENTO	CEMENT-FREE, SALT-RESISTANT, TRANSPIRANT, NATURAL HYDRAULIC LIME AND ECO-POZZOLAN MORTAR FOR POINTING EXPOSED MASONRY
MAPEWALL MURATURA FINE	HIGH-PERFORMANCE, TRANSPIRANT, NATURAL HYDRAULIC LIME MORTAR FOR POINTING EXPOSED MASONRY

7.1.3 SEALING JOINTS

Elastic joints must also be created around corners, edges, window and door fittings and all other features and fittings that form gaps in the dressed surface. These joints may be sealed with **MAPESIL LM**. The size and layout of structural joints must also be taken into consideration and the same pattern must be traced in the dressing when it is bonded in place.

7.2 APPLYING ADHESIVE TO BOND CAST STONE

Fig. 7.7 Spreading adhesive on the back of the stone

Fig. 7.8 Spreading adhesive on the substrate

Fig. 7.9 Bonding stone using the double-buttering technique

Fig. 7.10 Tapping a block of reconstituted stone into position

Fig. 7.11 Close-up of a finished wall

Fig. 7.12 Overview of a finished wall

8. MAPEI TECHNICAL SPECIFICATIONS FOR INSTALLING THE MAPETHERM® TILE SYSTEM

8.1 ADHESIVES AND SMOOTHING MORTARS

- **PLANITOP FAST 330**

Application of rapid-setting, fibre-reinforced cementitious mortar applied at a thickness of from 3 to 30 mm for levelling off internal and external vertical and horizontal surfaces (such as **PLANITOP FAST 330** produced by MAPEI S.p.A.).

The smoothing product must have the following characteristics:

- Density: 1750 kg/m^3
- Compressive strength after 28 days (EN 12190): > 20 MPa
- Adhesion to concrete (EN 1542): ≥ 20 MPa
- Thermal conductivity λ (EN 1745): 0.85 W/m-K°
- Reaction to fire: Euroclass E
- Consumption: 1.45 kg/m^2 per mm of thickness

- **MAPETHERM AR1 GG**

Bonding insulating panels by applying a one-component, cementitious mortar with selected sand, synthetic resins and special admixtures and

grain size up to 0.6 mm (such as **MAPETHERM AR1 GG** produced by MAPEI S.p.A.). When used as adhesive, it must be applied all over the back face of the panels and on the substrate with a 10 mm notched trowel.
The mix must have the following performance characteristics:

- Mixing ratio: 100 parts of **MAPETHERM AR1 GG** with approximately 20-24 parts in weight of water
- Density of mix (g/cm^3): 1.40
- pH of mix: 13
- Pot life of mix: 3 h
- Dry solids content: 100%
- Consumption when used as adhesive: 4-6 kg/m^2 with a N.10 notched trowel.

• **MAPETHERM AR1**

Bonding insulating panels by applying one-component, cementitious mortar with selected sand, synthetic resins and special admixtures (such as **MAPETHERM AR1** produced by MAPEI S.p.A.). When used as adhesive, it must be applied all over the back face of the panels and on the substrate with a 10 mm notched trowel.
The mix must have the following performance characteristics:

- Mixing ratio: 100 parts of **MAPETHERM AR1** with approximately 22 parts in weight of water
- Density of mix (g/cm^3): 1.40
- pH of mix: 13
- Pot life of mix: 3 h
- Dry solids content: 100%
- Consumption when used as adhesive spread over all the panel: 4-6 kg/m^2 with a N.10 notched trowel

8.2 INSULATING PANELS

• **MAPETHERM XPS**

Supply and application of extruded polystyrene insulating panels with a rough surface to improve the grip of the ceramic covering. The panels must have square corners with no outer frame, measure 1200x600 mm, comply

with EN 13164 standards, have Euroclass E fire reaction certification and thermal conductivity λ of 0.032-0.036 (such as **MAPETHERM XPS** marketed by MAPEI S.p.A.); thickness according to design calculations.

- **MAPETHERM EPS**

Supply and application of expanded polystyrene (EPS 100) insulating panels with a rough surface to improve the grip of the ceramic covering. The panels must have square corners with no outer frame, measure 1200x600 mm, comply with EN 13164 standards, have Euroclass E fire reaction certification and thermal conductivity λ of 0.034-0.040 (such as **MAPETHERM EPS** produced by MAPEI S.p.A.); thickness according to design calculations.

8.3 STRUCTURAL SMOOTHING MORTARS

- **PLANITOP HDM MAXI + MAPEGRID G 120 + MAPETHERM TILE FIX 15**

Application of reinforced render using two-component, high-strength, high ductility, pozzolanic-reaction binder-based mortar reinforced with glass fibres applied in layers up to 25 mm thick in a single application (such as **PLANITOP HDM MAXI** produced by MAPEI S.p.A.) and alkali-resistant glass fibre mesh (such as **MAPEGRID G 120** produced by MAPEI S.p.A.). The mortar obtained after mixing the two components must be applied in two layers by trowel or by spray on a perfectly clean substrate, with the glass fibre mesh positioned on the first layer while it is still fresh. The following are included and calculated in the price:

- positioning of the mesh between the two layers of smoothing mortar;
- positioning of 30x40 cm portions of mesh at 45° around the corners of openings for windows, doors, etc.;
- 4-5 wall plugs per m^2 fastened into the underlying structure through the first layer of smoothing mortar while still fresh, with a 7 mm diameter zinc-plated steel screw, 10 mm diameter nylon plug and a fire-break washer (such as **MAPETHERM TILE FIX 15** produced by MAPEI S.p.A.);

- finishing operations using a flat trowel or sponge float before the mortar starts to set and all other duties and operations to consign a completed job;
- insertion of nylon wall plugs and steel screws before the first layer of mortar sets.

The mortar must have the following characteristics:

- Compliant with the minimum requirements of EN1504-3 for non-structural mortars: class R2
- Density of the mix: (kg/m^3): 1850
- Pot life of mix: 60 minutes (at +20°C)
- Compressive strength according to EN 12190 (MPa): > 25 (after 28 days)
- Flexural strength according to EN 196/1 (MPa): > 8 MPa (after 28 days)
- Compressive modulus of elasticity: 11 MPa (after 28 days)
- Consumption: 1.85 kg/m^2 per mm of thickness.

The glass fibre mesh must have the following characteristics:

- Type of fibre: A.R. glass fibre
- Weight: 125 g/m^2
- Mesh size: 12.7 x 12.7 mm
- Tensile strength: 30 kN/m
- Elongation at failure (%): < 3

8.4 INSTALLING THE CERAMIC COVERING WITH CEMENTITIOUS ADHESIVES

8.4.1 INSTALLING THE CERAMIC COVERING WITH NORMAL-SETTING CEMENTITIOUS ADHESIVES

Installation of ceramic tiles suitable for final use in compliance with EN 14411 standards, with a maximum size of 30x60 cm x 2 thick or 100x50 cm x 0.35 or 0.45 thick, with open joints at least 8-10 mm wide

between the tiles, on the **MAPETHERM® TILE SYSTEM** thermal insulating system using one of the following adhesives applied using the double-buttering technique:

- high-performance, highly-flexible, cementitious adhesive, class C2ES2 according to EN 12004 or ISO 13007 standards (such as **KERABOND** mixed with **ISOLASTIC** produced by MAPEI S.p.A.);

- high-performance, highly-flexible, lightweight, cementitious adhesive, class C2ES2 according to EN 12004 or ISO 13007 standards (such as **ULTRALITE S2** produced by MAPEI S.p.A.).

8.4.2 INSTALLING THE CERAMIC COVERING WITH RAPID-SETTING CEMENTITIOUS ADHESIVES

Rapid installation of ceramic tiling suitable for final use in compliance with EN 14411 standards, with a maximum size of 30x60 cm x 2 thick or 100x50 cm x 0.35 or 0.45 thick, with open joints at least 8-10 mm wide between the tiles, on the **MAPETHERM® TILE SYSTEM** thermal insulating system using one of the following adhesives applied using the double-buttering technique:

- high-performance, highly-deformable, rapid-setting cementitious adhesive with extended open time and reduced vertical slip, class C2FTES2 according to EN 12004 or ISO 13007 standards (such as **ELASTORAPID** produced by MAPEI S.p.A.);

- high-performance, highly-deformable, rapid-setting cementitious adhesive with reduced vertical slip, class C2FTES2 according to EN 12004 or ISO 13007 standards (such as **KERAQUICK S1** mixed with **LATEX PLUS** produced by MAPEI S.p.A.);

- one-component, high-performance, highly-deformable, rapid-setting and hydrating, lightweight cementitious adhesive with extended open

time, high wetting capacity, very high yield and good trowelability, class C2FES2 according to EN 12004 or ISO 13007 standards (such as **ULTRALITE S2 QUICK** produced by MAPEI S.p.A.).

8.5 GROUTING THE TILES

Grout the tile joints with one of the following types of material:

- high-performance, rapid-setting and drying, water-repellent cementitious mortar with anti-efflorescence and mould resistant properties, class CG2WA according to EN 13888 standards (such as **ULTRACOLOR PLUS** produced by MAPEI S.p.A.);
- high-performance, polymer-modified, water-repellent cementitious mortar, class CG2 according to EN 13888 standards (such as **KERACOLOR FF** produced by MAPEI S.p.A.) mixed with special synthetic resin-based latex (such as **FUGOLASTIC** produced by MAPEI S.p.A.);

- high-performance, polymer-modified cementitious mortar, class CG2 according to EN 13888 standards (such as **KERACOLOR GG** produced by MAPEI S.p.A.) mixed with special synthetic resin-based latex (such as **FUGOLASTIC** produced by MAPEI S.p.A.);

Includes cleaning of the surface with suitable detergent, rinsing of the surface and elimination of excess water with suitable equipment, and any other operations required to complete work according to specifications.

8.6 SEALING THE TILES

Seal the joints with one of the following:

- Solvent-free, neutral-reticulation, mould-resistant silicone sealant (such as **MAPESIL LM** produced by MAPEI S.p.A.) with mould-resistant

BioBlock® technology, with the capacity to absorb movements when in service of up to 25% the initial size of the joint;

- One-component, rapid-hardening, thixotropic polyurethane sealant with a high modulus of elasticity (such as **MAPEFLEX PU45** produced by MAPEI S.p.A.) for sealing expansion and separation joints subject to movements of up to 20% of the average width of the joint.

8.7 BONDING CAST STONE WITH CEMENTITIOUS ADHESIVE

8.7.1 BONDING CAST STONE WITH NORMAL-SETTING ADHESIVE

Supply and installation of cast stone slabs in various sizes and thicknesses, with open joints at least 5 mm wide between the slabs, on MAPETHERM TILE SYSTEM thermal cladding system using one of the following adhesives applied using the double-buttering technique:

- high-performance, highly-deformable, lightweight cementitious adhesive, class C2ES2 according to EN 12004 or ISO 13007 standards (such as **ULTRALITE S2** produced by Mapei S.p.A.)

- high-performance, highly-deformable cementitious adhesive, class C2ES2 according to EN 12004 or ISO 13007 standards (such as **KERABOND** mixed with **ISOLASTIC** produced by Mapei S.p.A.)

- high-performance, deformable, lightweight cementitious adhesive, class C2TES1 according to EN 12004 or ISO 13007 standards (such as **ULTRALITE S1** produced by Mapei S.p.A.).

- high-performance, deformable cementitious adhesive, class C2TES1 according to EN 12004 or ISO 13007 standards (such as **KERAFLEX MAXI S1** produced by Mapei S.p.A.)

8.7.2 BONDING CAST STONE WITH RAPID-SETTING ADHESIVE

Supply and rapid installation of cast stone slabs in various sizes and thicknesses, with open joints at least 5 mm wide between the slabs, on **MAPETHERM TILE SYSTEM** thermal cladding system using one of the following adhesives applied using the double-buttering technique:

- one-component, high-performance, highly-deformable, rapid-setting and hydrating, lightweight cementitious adhesive with extended open time, high wetting capacity, very high yield and good trowelability, class C2FES2 according to EN 12004 or ISO 13007 standards (such as **ULTRALITE S2 QUICK** produced by MAPEI S.p.A.);

- high-performance, highly-deformable, rapid-setting and hydrating, non-slip cementitious adhesive with extended open time, class C2FTES2 according to UNI EN 12004 or ISO 13007 standards (such as **ELASTORAPID** produced by MAPEI S.p.A.);

- high-performance, highly-deformable, rapid-setting and hydrating, non-slip cementitious adhesive with extended open time, class C2FTS2 according to EN 12004 or ISO 13007 standards (such as **KERAQUICK S1** mixed with **LATEX PLUS** produced by MAPEI S.p.A.);

- one-component, high-performance, deformable, rapid-setting and hydrating, non-slip, lightweight cementitious adhesive with high wetting capacity, class C2FTS1 according to UNI EN 12004 or ISO 13007 standards (such as **ULTRALITE S1 QUICK** produced by MAPEI S.p.A.).

8.8 GROUTING CAST STONE

The joints between the cast stone slabs must be a suitable width and grouted with one of the following products:

- cement-free, lime and eco-pozzolan based mortar with natural sand and micro-fibres with very low emission of volatile organic compounds (EMICODE EC1 R Plus) for salt-resistant, macro-porous, dehumidifying render (such as **MAPE-ANTIQUE MC** produced by MAPEI S.p.A.);

- cement-free, salt-resistant, transpirant, natural hydraulic lime (NHL) and Eco-Pozzolan based mortar with natural sand and micro-fibres for pointing exposed masonry (such as **MAPE-ANTIQUE ALLETTAMENTO** produced by MAPEI S.p.A.);

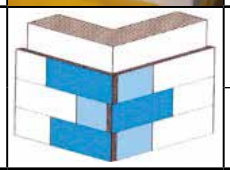
- high performance, transpirant, natural hydraulic lime based mortar with very low emission of volatile organic compounds (EMICODE EC1 R Plus) for pointing "exposed" stone, brick and tuff masonry (such as **MAPEWALL MURATURA FINE** produced by MAPEI S.p.A.).

8.9 SEALING JOINTS IN CAST STONE

Solvent-free, neutral-curing silicone sealant with mould-resistant BioBlock technology for stone and marble with the capacity to absorb movements in joints when in service of up to 25% of their original width (such as **MAPESIL LM** produced by MAPEI S.p.A.). Because of its special chemical composition, there is no surface bleeding or migration of plasticisers that could stain the material which makes it ideal for use with stone and marble.

9 APPENDIX

9.1 SUMMARY OF THE INSTALLATION PHASES

	INSTALLATION PHASE		PRODUCT	
1°	Positioning the support profiles		MAPETHERM BA	
2°	Application of the adhesive for the panels		MAPETHERM AR1	
			MAPETHERM AR1 GG	
3°	Installation of the insulating panels		MAPETHERM XPS	
			MAPETHERM EPS	
4°	Application of a 7 to 10 mm thick layer of structural render		PLANITOP HDM MAXI	
			MAPEGRID G 120	
			MAPETHERM PROFIL	
			MAPETHERM TILE FIX 15	
			PLANITOP HDM MAXI	
5°	Application of the adhesive for the ceramic		Normal setting	ULTRALITE S2
				KERABOND + ISOLASTIC
			Fast setting	ULTRALITE S2 QUICK
				ELASTORAPID
				KERAQUICK S1 + LATEX PLUS
6°	Installation of the ceramic		INSTALLATION OF THE CERAMIC	
7°	Grouting		Normal setting	KERACOLOR GG + FUGOLASTIC
				KERACOLOR FF + FUGOLASTIC
			Fast setting	ULTRACOLOR PLUS
8°	Sealing		MAPESIL LM	
			MAPEFLEX PU 40	

Notes:

Notes:

Technical Notebook
MAPETHERM®
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