

# GUIDE FOR THE INSTALLATION OF CERAMIC MATERIALS



MAPEI has been operating in the building industry for more than 75 years and has been involved in the execution of numerous projects whose durability is a testimony to their reliability and professionalism. MAPEI adopts the same serious approach to each individual project and, thanks to their cutting-edge products and systems, the result of the experience and constant support provided by the company's Research and Development laboratories, they are the ideal partner for all your design work. We must never forget that the durability of any intervention is highly dependent on correct design work, carefully prepared substrates and choosing the most appropriate materials, which is why Mapei Technical Services is always on hand for their clientele to guide them through every phase of a project.

**MAPEI AND ECO-SUSTAINABILITY IN BUILDING WORK**

70% of Mapei's research and development work is dedicated to the development of eco-sustainable products. Mapei was awarded Certiquality certification in 2016 for their EDP (Environmental Product Declaration) issuing process. EPD's are transparent, open documents verified and certified by an external body. They describe the impact of product on the environment during its entire life cycle by measuring its impact using standardised LCA (Life Cycle Assessment) methods. Mapei is also committed to the development of products with low emissions of volatile organic compounds (VOC) that help improve the quality of air in internal surroundings, products which are tested both within the company, thanks to the cutting-edge instruments and equipment available in our Research and Development laboratories, and by external laboratories. To identify those products with low VOC emissions Mapei decided to adopt the voluntary German EMICODE labelling system, particularly strict classification criteria as defined by GEV (Gemeinschaft Emissionskontrollierte Verlegewerkstoffe, Klebstoffe und Bauprodukte).



EPD's and VOC emissions both play their part in obtaining credits in the LEED and BREEAM environmental protocols. GEV only grants the right to use this special marking to those companies which undergo severe periodic quality controls and assessments carried out by the institute and consists in the following classification:

	µg/m <sup>3</sup> after 3 days TVOC	µg/m <sup>3</sup> after 28 days TVOC	µg/m <sup>3</sup> after 28 days TSVOC
EC1 PLUS	≤ 750	≤ 60	≤ 40
EC1	≤ 1000	≤ 100	≤ 50
EC2	≤ 3000	≤ 300	≤ 100

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# 1 Standards and technology for installing ceramic materials

STANDARDS ARE DOCUMENTS THAT DEFINE THE CHARACTERISTICS (DIMENSIONAL, PERFORMANCE, ENVIRONMENTAL, QUALITY, SAFETY, ORGANISATIONAL, ETC.) OF A PRODUCT, PROCESS OR SERVICE IN RELATION TO THE MOST RECENT DEVELOPMENTS IN A GIVEN FIELD AND ARE THE RESULT OF THE WORK OF TENS OF THOUSANDS OF EXPERTS. BY IMPLEMENTING STANDARDS, ALL THOSE OPERATING IN A GIVEN SECTOR HAVE A CLEAR REFERENCE POINT IN TERMS OF TECHNICAL SPECIFICATIONS, QUALITY, YIELD AND RELIABILITY. THEIR AIM IS TO ENSURE THAT PRODUCTS AND SERVICES ARE SUITABLE FOR THEIR INTENDED USE AND THAT THEY ARE COMPARABLE AND COMPATIBLE. STANDARDS APPLIED TO PRODUCTS FOR THE CERAMIC SECTOR ARE BINDING AND IT IS FUNDAMENTAL THAT PRODUCTS CORRESPOND TO THE CRITERIA DEFINED IN THE STANDARDS IN ORDER TO MARKET THEM AND GUARANTEE THEIR REQUIREMENTS IN TERMS OF QUALITY, REPEATABILITY AND PERFORMANCE.

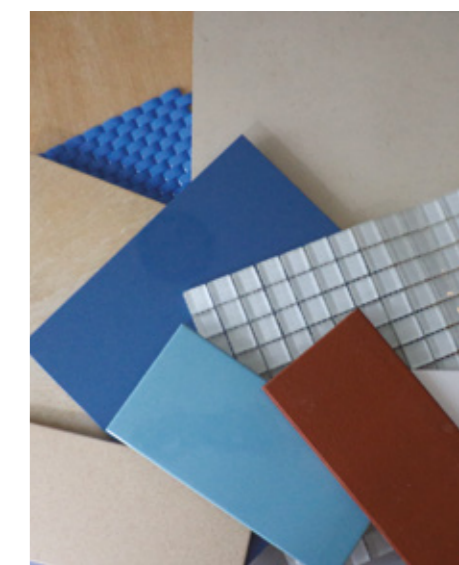
INSTALLATION STANDARDS, ON THE OTHER HAND, ARE VOLUNTARY AND HAVE BEEN DEVELOPED THANKS TO THE EXPERIENCE OF SPECIALISTS. THEY ARE USED TO INTRODUCE INDICATIONS REGARDING DIFFERENT DESIGN SITUATIONS AND TO THE REQUIREMENTS THAT ARE CONSIDERED TO BE FUNDAMENTAL IN ORDER TO INSTALL CERAMIC TILES CORRECTLY IN EACH OF THE SITUATIONS SHOWN.



## 1.1 Wall and floor coverings

When choosing the most appropriate installation system a thorough knowledge of the materials to be installed is essential. The main factors to be taken into consideration regarding wall and floor coverings are absorption and size. In certain cases weight may also become an important factor, especially when installing ceramic on vertical surfaces, and the presence of particular finishes on either the installation surface or on an exposed surface. Most ceramic wall and floor coverings are classified according to EN 14411 Standards, except in the case of certain types of ceramic not covered by the specifications defined in the standard, such as thin tiles or glass wall and floor coverings.

There are also tiles available on the market with special anti-bacterial treatments (the actual technique adopted may vary slightly with each manufacturer) that help combat the main strains of bacteria that accumulate on the surface of wall and floor coverings. These types of treatment will require a suitable and compatible grouting product to guarantee the same performance characteristics as the surface.



Various types of tile

### 1.1.1 EN 14411 Standard: “Ceramic tiles - Definitions, classification, characteristics and marking”

EN 14411 is used to classify ceramic tiles and defines the requirements in order to apply CE marking on such products. The marking includes the characteristics to help choose which product to use in terms of area of use, such as resistance to temperature variations, resistance to freeze/thaw cycles and release of hazardous substances. As far as installation is concerned, the most significant requirement of this standard is water absorption capacity, according to which tiles are divided into three groups:

- Group I: low absorption
- Group II: intermediate absorption
- Group III: high absorption

They are then classified with a letter to identify the manufacturing process:

- A: extrusion
- B: dry pressing
- C: other processes

Products with high water absorption capacity are less difficult to bond than low absorbency or non-absorbent materials. In fact, with the latter type, higher performance adhesives are usually required.

Table 01 lists the most common types of tile available on the market and indicates their water absorption capacity in percentage and their classification code as defined by EN 14411.

Table 01

Type of material	Absorption E (%)	Manufacturing method		EN 14411 group
		Pressed	Extruded	
Majolica	15 - 25	•		BIII
Light single-fired	2 - 7	•		BI - BII
Klinker	0 - 6		•	AI - Alla
Terracotta	3 - 15		•	AII - AIII
Porcelain	0 - 0.5	•		Bla

A) Double-fired: the water droplet is immediately absorbed by the tile.

B) Single-fired: the water droplet sits on the back of the tile and is not absorbed immediately.

C) Klinker: the water droplet remains for longer without being absorbed.

D) Porcelain: the droplet is not absorbed by the back of the tile.

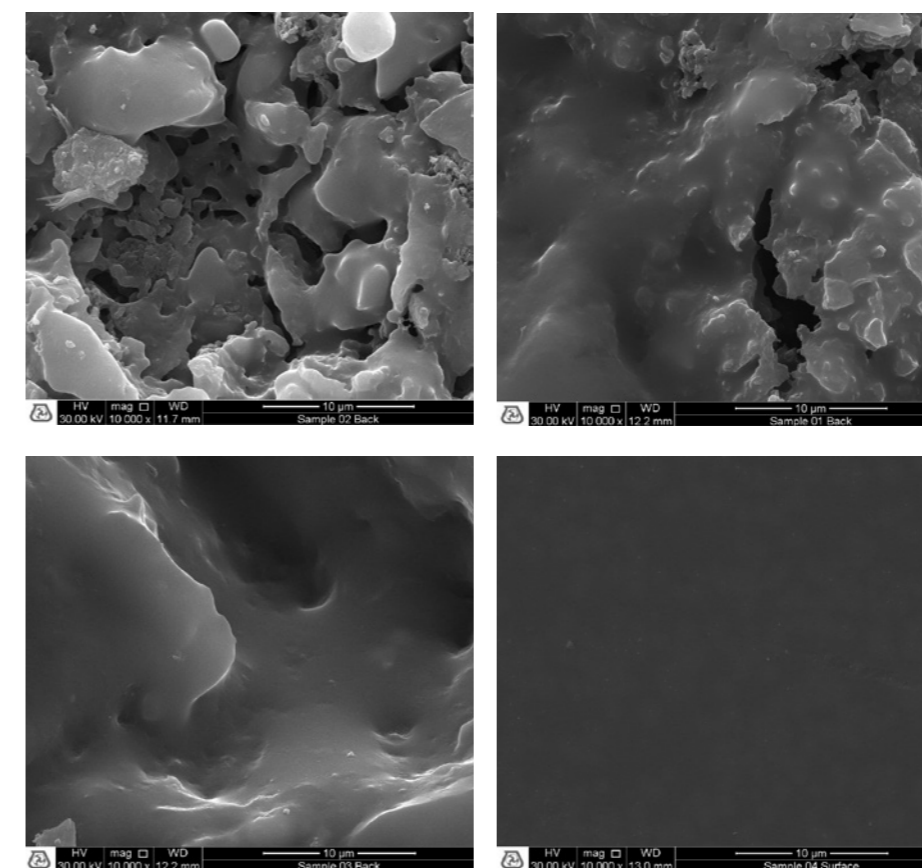
E) Glass mosaic: the droplet is not absorbed; glass is completely non-absorbent.

F) Thin tile with mesh reinforcement: the mesh is fastened to the back of the tile with resin which makes it completely non-absorbent.



Looking at images A to F, showing an empirical test to measure the absorption capacity of different types of tile, it is clear that each type of tile has different requirements regarding the most appropriate type of adhesive to use to bond the tile.

Images taken through an electron microscope of tiles made with different manufacturing processes show their difference in porosity very clearly and, as a result, the behaviour between different types of product.



Enlargement through an electron microscope of the back of a double-fired tile (on the left) and a single-fired tile (on the right) (10 µm): the surface of the double-fired tile has widespread porosity that is reduced slightly in the single-fired tile. This type of surface allows a mechanical grip to be created and, therefore, to obtain an excellent bond, including with cementitious adhesives with low polymer content.

Enlargement through an electron microscope of the back of a porcelain tile (on the left) and a glass tile (on the right) (10 µm): the surface of this type of tile is more closed than the previous examples and normal cementitious adhesives may not be sufficient to guarantee a good bond, and so improved adhesive with polymers will be required.

### 1.1.2 Large-size tiles

Over the course of the last decade, thanks to the development of new manufacturing techniques, thin tiles measuring more than 1 metre by 3 metres have been introduced to the market. These products are not covered by the dimensional limits specified by European standards and, as such, are not classified. Installation of this type of tile is particularly complex when it comes to choosing the most appropriate adhesive and when handling the tile. They are usually handled and moved around using tools with suckers, similar to those used for handling glass.



Double-buttering application of adhesive for a thin tile

Because of the considerable size of the tiles, adhesive with high wetting capacity needs to be used and it must be applied using the double-buttering technique (adhesive is applied on the back of the tile and on the installation substrate) to guarantee uniform distribution without leaving gaps. In fact, gaps in the adhesive could lead to the tiles being fractured if they are hit by a falling object or in case of impact. The absorption capacity of this type of tile is almost zero and high performance installation methods need to be adopted (section 3.2).



The Ultralite range



Handling and manoeuvring thin tiles

### 1.1.3 Glass wall and floor coverings

Another type of wall and floor covering commonly used and which is not covered by the standard is glass. The most widely used glass products are mosaics, but tiles larger than typical mosaic tiles are also often used.



Oriental steam bath, Costa Fascinosa. Glass mosaic has been used to dress the surfaces.

The characteristics of this type of wall and floor covering that have the greatest influence on which installation method should be adopted is their total non-absorbency and transparency. As far their non-absorbency is concerned, the installation systems adopted are high performance cementitious systems or resin-based reactive systems for the larger formats. Transparency is also quite an important aspect: if a conventional adhesive is used, even if it is white, there is a risk of altering the final effect of the material. This is why it is very important to use adhesives with a high white balance and a very fine texture so that the original colour of the glass is not affected. Grout is also very important with this type of material and products have been developed that are semi-transparent to enhance the effect of the glass (section 3.1).



## 1.2 Installation materials

Installing tiles with adhesive is known as the thin-bed method. Adhesives used with the thin-bed method, as with ready-mixed grouts, must meet specific requirements defined by European Standards EN 12004 and EN 13888.

### 1.2.1 Adhesives

Adhesives for bonding ceramic wall and floor coverings undergo numerous tests, as defined by EN 12004 (and ISO 13007-1) standards. These standards allow adhesives to be classified according to a clearly defined, harmonised system that helps identify their main characteristics and, as a result, acts as a guide when choosing which system to adopt.

Firstly, adhesives are identified according to their chemical composition as follows:

- C: Cementitious adhesives
- D: Dispersion adhesives
- R: Reactive adhesives

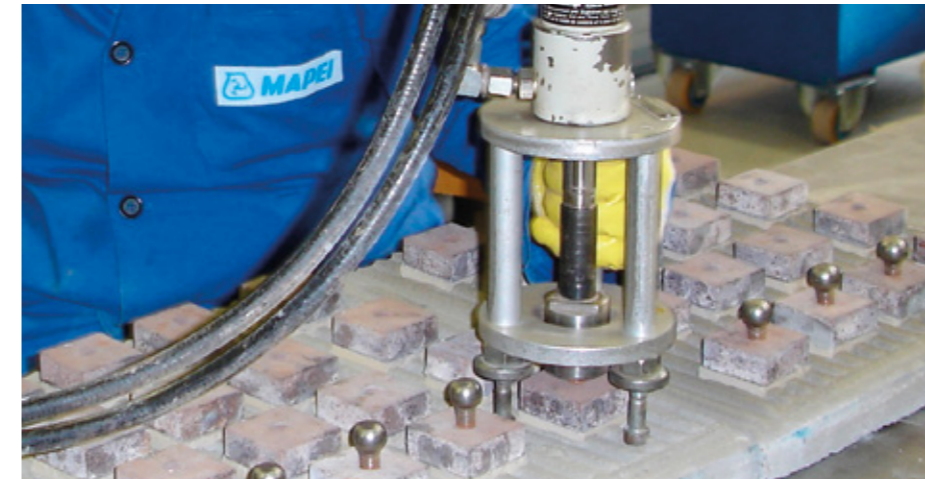
Cementitious adhesives are then sub-divided into different classes according to their adhesion properties and deformability.

Adhesion strength is tested under various conditions and, depending on the results obtained, an adhesive is classified as C1-normal adhesive (complies with the minimum requirements for classification) or C2-high adhesion performance (table 02).

All cementitious adhesives must guarantee an open time of at least 20 minutes, or 10 minutes in the case of rapid adhesives.

Table 02

	Class C1	Class C2
Adhesion strength after 28 days	≥ 0.5 N/mm <sup>2</sup>	≥ 1 N/mm <sup>2</sup>
Adhesion strength after immersion in water	≥ 0.5 N/mm <sup>2</sup>	≥ 1 N/mm <sup>2</sup>
Adhesion strength after application of a heat source	≥ 0.5 N/mm <sup>2</sup>	≥ 1 N/mm <sup>2</sup>
Adhesion strength after freeze-thaw cycles	≥ 0.5 N/mm <sup>2</sup>	≥ 1 N/mm <sup>2</sup>



Pull-off strength tests for adhesives

Dispersion adhesives are also sub-divided into different classes according to the results obtained during pull-off strength tests: they are classified as D1 for values lower than 1 N/mm<sup>2</sup> after dry and hot conditioning or D2 if they reach a value of 0.5 N/mm<sup>2</sup> after immersion in water and 1 N/mm<sup>2</sup> at high temperatures. Dispersion adhesives must have an open time of at least 20 minutes.

Reactive adhesives are classified R1 if their pull-off strength is 2 N/mm<sup>2</sup> after dry curing and immersion in water. Class R2 is used for products that have a pull-off strength of at least 2 N/mm<sup>2</sup> after heat cycles. The open time for all reactive adhesives must be at least 20 minutes.

In the case of rapid adhesives there is also a class F, for cementitious adhesives, which means their adhesion strength is at least 0.5 N/mm<sup>2</sup> after just 6 hours. Apart from the classifications mentioned above, other optional classes may be added to indicate additional properties of an adhesive:

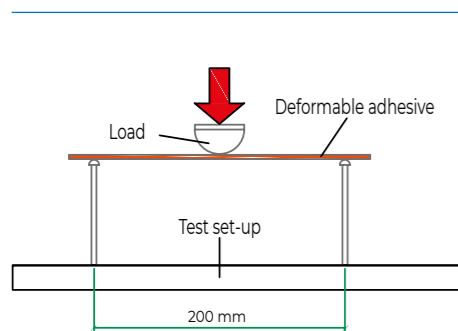
- T: no vertical slip
- E: extended open time



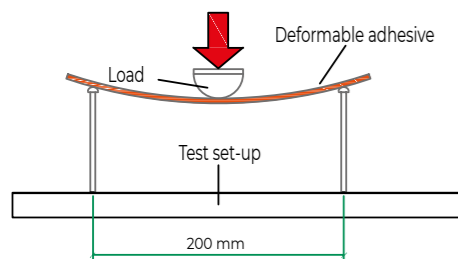
Vertical slip test



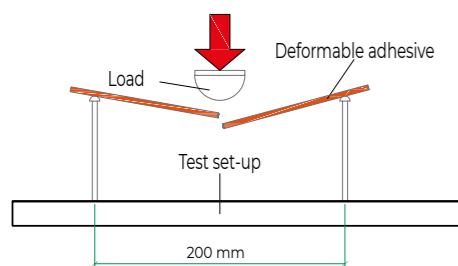
Open time test



1. Test set-up to determine the flexibility of a thin layer of adhesive according to deformation



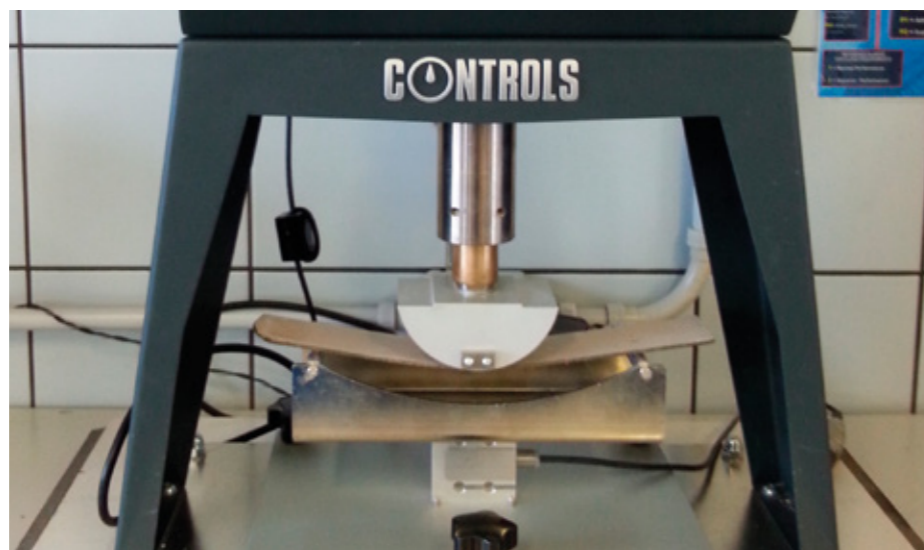
2. Measuring maximum deformation



3. Failure of test piece

Deformability test for cementitious adhesives

For cementitious adhesives only there are also optional deformability classes. To determine this value a sample of the adhesive undergoes flexural tests as illustrated in images 1-3 shown alongside. To achieve class S1 the deformability of the sample must be at least 2.5 mm, while for class S2 it must be at least 5 mm. Deformability plays an important role in certain applications, as discussed in the next sections.



Equipment used to measure the deformability of cementitious adhesives



Mapei class S1 and S2 adhesives

Table 03

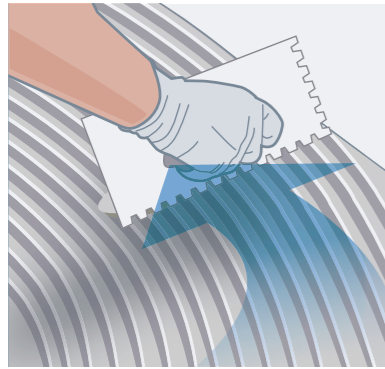
Type of adhesive		C cementitious	D dispersion	R reactive
Main classes of adhesive	Normal adhesives	1	1	1
	Improved adhesives	2	2	2
	Rapid adhesives		F	
Optional classes	Adhesives with no vertical slip		T	
	Adhesives with extended open time		E	
Deformability of cementitious adhesives	Deformable adhesives		S1	
	Highly deformable adhesives		S2	

Apart from the requirements specified by the applicable standards, adhesives also differ for certain specific technologies that have been developed to improve their performance characteristics and to provide advantages for users of the adhesives, such as **ULTRALITE** technology and **LOW DUST** technology, developed in the Mapei Research and Development laboratories.

Adhesives containing **ULTRALITE** technology are characterised by their lower density compared with traditional products. The advantages of products from the **ULTRALITE** line are:

- Higher yield
- Lower transport costs; bags of adhesive are lighter (only 15 kg for the same volume, compared with traditional bags weighing 25 kg)
- The mix has a “creamy” consistency which gives it excellent workability and makes application easier and quicker
- High wetting capacity on the back of the tiles
- Environment-friendly: these products contain more than 20% of recycled materials and help obtain LEED credits
- Perfect adhesion to all types of substrate normally used in the building industry
- High white balance for all white adhesives from the **ULTRALITE** range

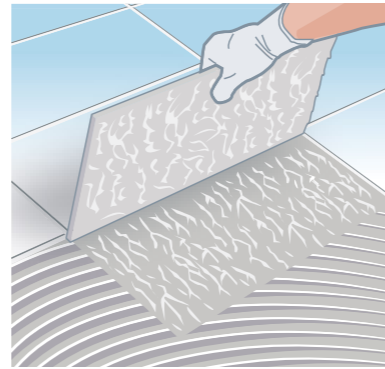




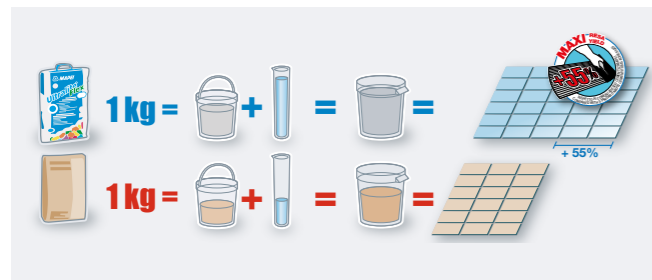
Easier to apply compared with traditional adhesives



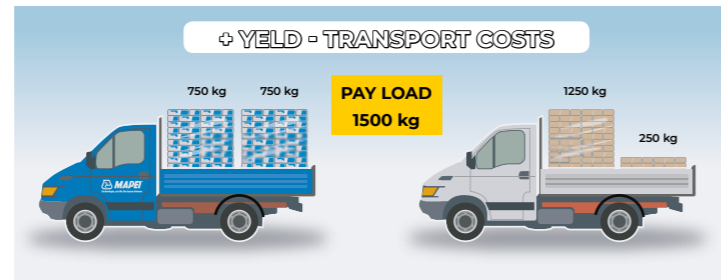
Lighter bags (15 kg) with practical grips for easier handling



Excellent wetting capacity on the back of tiles



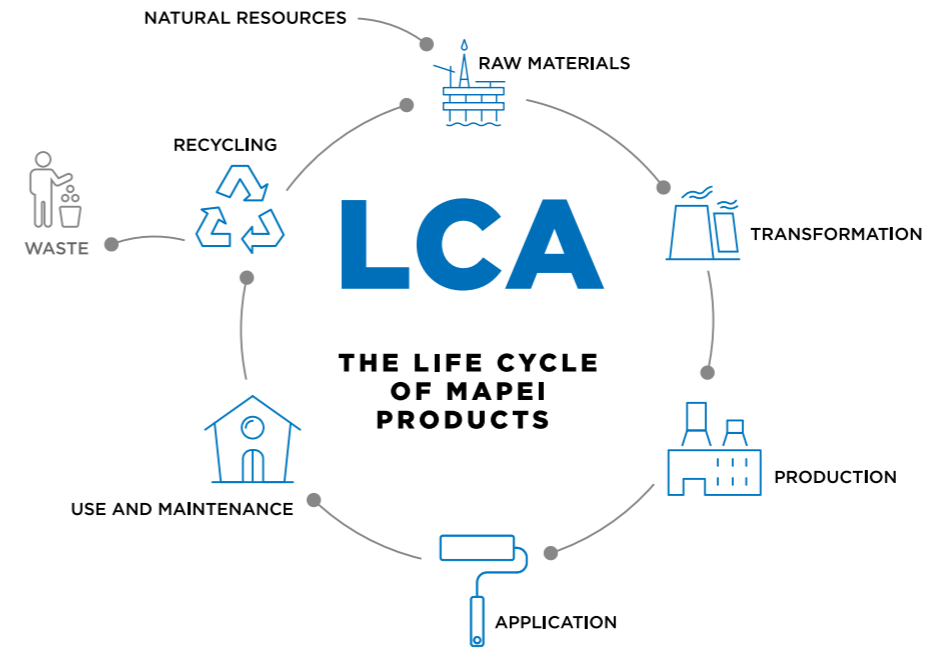
Ultralite Flex has up to 55% higher yield than other adhesives with the same classification



Bags of Ultralite Flex: 100 off  
Yield: approx. 600 m<sup>2</sup>

Bags of conventional adhesive: 60 off  
Yield: approx. 360 m<sup>2</sup>

As mentioned in the introduction to this guide, MAPEI has been awarded certification that allows EPD's to be issued, by measuring the impact that each phase of the life of the products has on the environment using the standardised LCA (Life Cycle Assessment) method.



Mapei has also introduced LOW DUST technology into some of their adhesives. Compared with traditional adhesives, they are characterised by a considerable reduction in the amount of dust given off into the air during handling and mixing. Reducing the amount of dust means a cleaner working environment for users and also the possibility to use these products when work has to be carried out in homes, where cleanliness is extremely important.



This picture shows two jars a few seconds after being shaken, with LOW DUST adhesive on the right and a traditional adhesive on the left

**KERAFLEX MAXI S1 ZERO** was one of the first Mapei products to undergo an LCA (Life Cycle Assessment) study and this allowed its carbon footprint to be measured "from cradle to grave", that is, from extraction of the raw materials to final disposal at the end of its service life.

The amount of residual Green house Gases (CO<sub>2</sub> equivalent) released by **KERAFLEX MAXI S1 ZERO** is offset every year by purchasing certified carbon credits.

**KERAFLEX MAXI S1 ZERO**, therefore, was the first high performance cementitious adhesive with zero climate-change effect.





Table 04

	Classification according to EN 12004	GEV -Emicode	Fast Track	Low Dust	UltraLite	Colour		Description and main areas of use	Set to foot traffic (hours)	Waiting time before putting into service (days)
						White	Grey			
<b>NORMAL-SETTING CEMENTITIOUS ADHESIVES</b>										
KERASET	C1	EC1 R Plus				•	•	Cementitious adhesive for ceramic tiles. Available in 25 kg packs	24	14
KERABOND	C1	EC1 R Plus				•	•	Cementitious adhesive for ceramic tiles. Available in 5 kg and 25 kg packs	24	14
TIXOBOND WHITE	C1 TE	EC1 R Plus				•		Ultra-white, thixotropic cementitious adhesive with extended open time for ceramic tiles (thickness of adhesive up to 15 mm). Available in 25 kg packs	24	14
KERABOND PLUS	C2 E	EC1 R Plus				•	•	High-performance cementitious adhesive with extended open time for ceramic tiles and medium format stone materials. Available in 25 kg packs	24	14
ADESILEX P9	C2 TE	EC1 R Plus				•	•	High-performance, thixotropic cementitious adhesive with extended open time for ceramic tiles and stone materials. The white version has very high white balance and excellent workability. Available in 5 kg and 25 kg packs	24	14
KERAFLEX	C2 TE	EC1 R Plus				•	•	High-performance, thixotropic cementitious adhesive with extended open time for ceramic tiles and medium/large format stone materials. Available in 5 kg and 25 kg packs	24	14
ULTRALITE FLEX	C2 TE	EC1 R Plus		•	•	•	•	One-component, high-performance, thixotropic, lightweight cementitious adhesive with moderate deformability, extended open time, Low Dust technology, very high yield, good trowellability and high wetting capacity for ceramic tiles, stone materials and thin porcelain tiles. Available in 15 kg packs	24	14
ADESILEX P10	C2 TE	EC1 R Plus				•		High-performance, thixotropic, white cementitious adhesive with extended open time for glass mosaics, ceramic and marble. Available in 25 kg packs	24	14
ADESILEX P10 + ISOLASTIC 50%	C2 TE S1					•		Adesilex P10 diluted 50% mixed with Isolastic forms a deformable adhesive.	24	14
KERAFLEX EASY S1	C2 E S1	EC1 R Plus				•	•	Easy-to-apply, high-performance, deformable cementitious adhesive with extended open time and high wetting capacity for ceramic tiles and stone materials. Particularly suitable for bonding porcelain tiles on large spreads of floor. Available in 25 kg packs	24	14
KERAFLEX MAXI S1	C2 TE S1	EC1 R Plus		•		•		High-performance, thixotropic, deformable cementitious adhesive with extended open time, excellent workability, high white balance and Low Dust technology for ceramic tiles. Particularly recommended for bonding porcelain tiles and large format natural stone (thickness of adhesive from 3 to 15 mm). Available in 25 kg packs	24	14

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).

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						White	Grey			
<b>RAPID-SETTING CEMENTITIOUS ADHESIVES</b>										
KERAFLEX MAXI S1 ZERO	C2 TE S1	EC1 R Plus		•			•	Special high-performance, thixotropic, deformable grey cementitious adhesive with extended open time, Low Dust technology, very low emission of volatile organic compounds and offset residual greenhouse gas emissions for bonding ceramic tiles and large format stone materials. Available in 25 kg packs	24	14
ULTRALITE S1	C2 TE S1	EC1 R Plus		•	•	•	•	One-component, easy-to-apply, high-performance, thixotropic, deformable, lightweight cementitious adhesive with extended open time, Low Dust technology, very high yield and good trowellability for ceramic tiles, stone materials and thin porcelain tiles. Available in 15 kg packs	24	14
ULTRALITE S2	C2 E S2	EC1 R Plus			•	•	•	One-component, high-performance, highly deformable, lightweight cementitious adhesive with extended open time, high wetting capacity, very high yield and good trowellability for ceramic tiles and stone materials. Ideal for the tiled thermal cladding system MAPETHERM TILE SYSTEM. Available in 15 kg packs	24	14
KERABOND + ISOLASTIC	C2 E S2						•	Kerabond mixed with neat Isolastic forms a high performance, highly deformable cementitious adhesive.	24	14
KERABOND PLUS + ISOLASTIC	C2 E S2						•	Kerabond Plus mixed with neat Isolastic forms a high performance, highly deformable cementitious adhesive.	24	14
ADESILEX P4	C2 F	EC1 R Plus	•				•	High-performance, self-buttering, quick-setting grey cementitious adhesive for ceramic tiles and stone materials (thickness of adhesive from 3 to 20 mm). Available in 25 kg packs	4	1
ADESILEX P9 EXPRESS	C2 FE	EC1 R Plus	•				•	High performance, rapid-setting cementitious adhesive for bonding ceramic tiles with extended open time. Suitable for repair works in areas exposed to foot traffic, in commercial settings and when floors need to be put back into service quickly. Available in 25 kg packs	4	1
GRANIRAPID	C2 F S1	EC1 R Plus	•				•	Two-component, high-performance, deformable, quick-setting and hydrating cementitious adhesive for ceramic tiles and stone materials (including stone sensitive to moisture). Particularly suitable for bonding in areas exposed to heavy traffic, restoration work that needs to be put back into service immediately and rapid bonding of large formats, including by overlaying. Available in 30.5 kg packs	3-4	1
KERAQUICK MAXI S1	C2 FT S1	EC1 R Plus	•				•	High-performance, quick-setting and hydrating deformable cementitious adhesive for ceramic tiles and particularly suitable for stone materials suitable for application in layers up to 15 mm thick. Recommended for restoration work in areas with heavy traffic that need to be put back into service quickly. For bonding large formats and high thickness.. Available in 5 and 23-25 kg packs	2-3	1

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).

Table 04

	Classification according to EN 12004	GEV -Eimcode	Fast Track	Low Dust	UltraLite	Colour		Description and main areas of use	Set to foot traffic (hours)	Waiting time before putting into service (days)
						White	Grey			
ULTRALITE S1 QUICK	C2 FT S1		•		•	•	•	One-component, high-performance, thixotropic, deformable, lightweight, quick-setting and hydrating cementitious adhesive with very high yield, good trowelability and high wetting capacity for ceramic tiles and stone materials. Specific for bonding thin porcelain tiles, particularly on non-absorbent substrates. Available in 15 kg packs	2-3	1
ULTRALITE S2 QUICK	C2 FE S2	EC1 R Plus	•		•	•	•	One-component, high-performance, highly-deformable, lightweight, quick-setting and hydrating cementitious adhesive with extended open time, high wetting capacity, very high yield and good trowelability for ceramic tiles and stone materials. Ideal for bonding large format, thin porcelain tiles, including by overlaying. Ideal for the tiled thermal cladding system MAPETHERM TILE SYSTEM. Available in 15 kg packs	2-3	1
KERAQUICK MAXI S1 + LATEX PLUS	C2FTS2		•			•	•	KERAQUICK MAXI S1 mixed with LATEX PLUS forms a high-performance, highly-deformable, quick-setting cementitious adhesive. Available in 25 kg packs	2-3	1
ELASTORAPID	C2 FTE S2		•			•	•	Two-component, high-performance, thixotropic, highly-deformable, quick-setting and hydrating cementitious adhesive with extended open time for ceramic tiles and stone materials. Available in 31.25 kg packs	3	1
<b>SYNTHETIC RESIN-BASED ADHESIVES</b>										
ADESILEX P22	D1 TE						•	Ready-mixed, thixotropic adhesive paste with extended open time for ceramic tiles. Available in 1 kg, 5 kg, 12 kg and 25 kg packs	48	7-14
ULTRAMASTIC III	D2 TE						•	High-performance, ready-mixed, thixotropic adhesive paste with extended open time for bonding ceramic wall and floor tiles. Available in 1 kg, 5 kg, 12 kg and 18 kg packs	48	7
<b>REACTIVE ADHESIVES</b>										
KERALASTIC	R2						•	Two-component, high-performance epoxy-polyurethane adhesive for ceramic tiles and stone materials. Available in 5 kg and 10 kg packs	12	7
KERALASTIC T	R2 T						•	Two-component, high-performance, thixotropic epoxy-polyurethane adhesive for ceramic tiles and stone materials. Available in 5 kg and 10 kg packs	12	7
ULTRABOND ECO PU 2K	R2 T						•	Two-component, solvent-free, high-performance, thixotropic polyurethane adhesive for ceramic tiles and stone materials. Available in 5 kg and 10 kg packs	12	7
KERAPOXY ADHESIVE	R2 T						•	Two-component, thixotropic epoxy adhesive for ceramic tiles and stone materials. Available in 10 kg packs	24	4

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).

## 1.2.2 Grouts

Similarly to adhesives, grouting products must also meet specific requirements as defined in EN 13888 (and ISO 13007-3) standards.

Grouting products are identified by a code to indicate its type:

- CG: Cementitious grouts
- RG: Reactive grouts

**Cementitious grouts** may also have additional performance characteristics and are classified as CG1 if they meet the minimum requirements and CG2W, CG2A or CG2WA if they meet additional requirements regarding abrasion (A) and water absorption (W) (see Table 08).

CG1	
Resistance to abrasion	≤ 2000 mm <sup>3</sup>
Flexural strength after 28 days	≥ 2.5 N/mm <sup>3</sup>
Flexural strength after freeze-thaw cycles	≥ 2.5 N/mm <sup>3</sup>
Compressive strength after 28 days	≥ 15 N/mm <sup>2</sup>
Compressive strength after freeze-thaw cycles	≥ 15 N/mm <sup>2</sup>
Shrinkage	≤ 3 mm/m
Water absorption after 30 minutes	≤ 5 g
Water absorption after 240 minutes	≤ 10 g

Table 05

CG2 A - CG2 W - CG2 WA	
Resistance to abrasion	≤ 1000 mm <sup>3</sup>
Water absorption after 30 minutes	≤ 2 g
Water absorption after 240 minutes	≤ 5 g

Table 06

Because of their inherent nature, reactive grouts have high performance characteristics and, as such, have their own single classification according to EN 13888 (see Table 08).

RG	
Resistance to abrasion	≤ 250 mm <sup>3</sup>
Flexural strength	≥ 30 N/mm <sup>3</sup>
Compressive strength	≥ 45 N/mm <sup>3</sup>
Shrinkage	< 1.5 mm/m
Water absorption after 240 minutes	≤ 0.1 g

Table 07

Table 08

Type of grout		CG cementitious	RG reactive
Main classes of grout	Normal	1	1
	Main classes of grout	A	2
		W	

Apart from the performance requirements specified by the standards, grouting products may also have additional characteristics such as **DROPEFFECT** and **BIOBLOCK** technology.

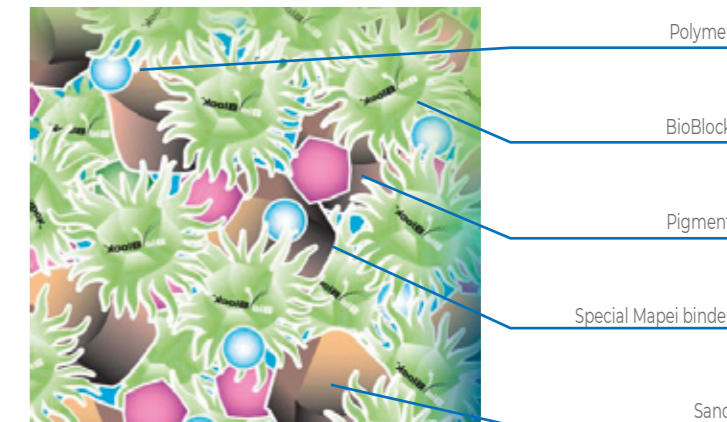
**DROPEFFECT** technology, developed in the Mapei Research and Development laboratories, gives cementitious grouting mortar a water-repellent effect and forms grout lines with high water-repelling properties.

Liquid that falls onto the surface of the grout line forms droplets that are not absorbed immediately: they remain longer on the surface so they may be cleaned off before staining the grout, thereby increasing its durability.

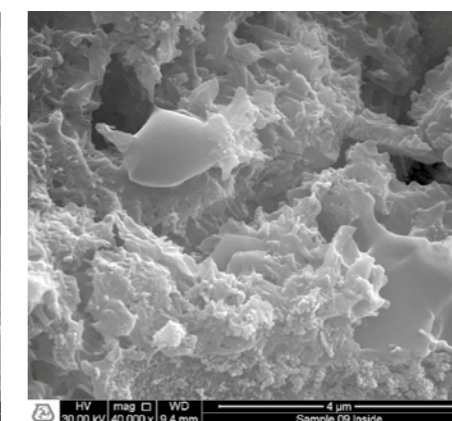
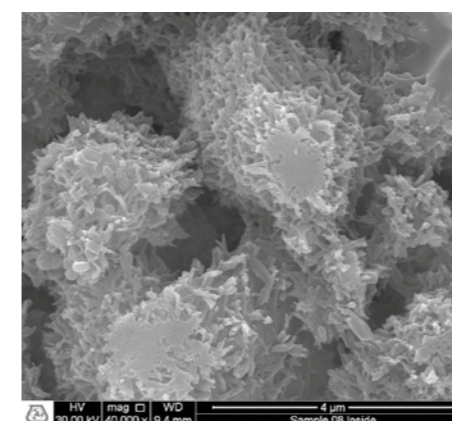


The **BIOBLOCK** system is made up of special molecules evenly distributed within the microstructure of the grout.

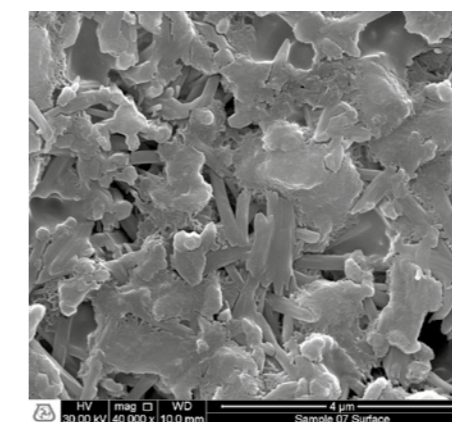
This technology offers enormous advantages regarding hygiene for surfaces and the surroundings: the special additive in the grout impedes the formation and proliferation of surface mould in damp areas.



**ULTRACOLOR PLUS** cementitious grout, which has both of the aforementioned technologies, differs from traditional cementitious grouts in that it does not contain calcium carbonate sources and is immune, therefore, to efflorescence, which means the colour of grout lines remains perfectly stable.



Enlarged image through an electron microscope of KERACOLOR (on the left) and KERACOLOR with FUGOLASTIC (on the right) (4 µm): this enlargement shows how the hydration products of Portland cement in the image on the left can be identified as needle-like structures; in the product with the special additive they are enclosed by the polymer which makes the grout more compact and reduces its porosity



Enlarged image through an electron microscope of ULTRACOLOR PLUS (4 µm): with the same enlargement, we can see that the hydration products are larger due to the different binder. ULTRACOLOR PLUS rapid binder makes the grout stronger, increases its resistance to abrasion and helps maintain its colour without having to include any other additives.

Additional certification is also available for resin-based grouts such as **KERAPOXY CQ**, certified by the University of Modena (Italy) according to ISO 22196:2007 standards as grout with protection against the formation and proliferation of microorganisms.

Table 09

	Classification according to EN 13888	GEV -E-micode	DropEffect®	BioBlock®	Fast Track	Description and areas of use	Width of grout line permitted (mm)	Set to foot traffic (hours)	Waiting time before putting into service (days)
<b>CEMENTITIOUS GROUTS</b>									
ULTRACOLOR PLUS	CG2WA	EC1 Plus	•	•	•	High-performance, anti-efflorescence, quick-setting and drying polymer-modified mortar with water-repellent DropEffect and mould-resistant BioBlock technology. Available in 2 kg, 5 kg and 23 kg packs	2 to 20	3	1
KERACOLOR SF*	CG2WA	EC1 R Plus				Fine-textured, high-performance white cementitious mortar for grout lines up to 4 mm wide. Available in 5 kg and 22 kg packs	up to 4	24	7
KERACOLOR FF*	CG2WA	EC1 R Plus	•			Ready-mixed, high-performance, polymer-modified cementitious mortar with water-repellent DropEffect technology for grout lines up to 6 mm wide. Available in 5 kg and 25 kg packs	up to 6	24	7
KERACOLOR GG*	CG2WA	EC1 R Plus				Ready-mixed, high-performance polymer-modified cementitious mortar for grout lines from 4 to 15 mm wide. Available in 5 kg and 25 kg packs	4 to 15	24	7
<b>EPOXY GROUTS</b>									
KERAPOXY	RG	EC1 R Plus				Two-component, high-performance, thixotropic, anti-acid epoxy mortar and adhesive for bonding and grouting ceramic tiles and stone materials (minimum width of grout line 3 mm). Available in 2 kg, 5 kg and 10 kg packs	at least 3	24	4
KERAPOXY CQ	RG	EC1 R Plus		•		Easy-to-apply two-component, anti-acid epoxy filler with excellent cleanability and anti-bacteria BioBlock® technology, ideal for grouting ceramic tiles and mosaics. Available in 3 kg and 10 kg packs	at least 2	12	3
KERAPOXY DESIGN	RG	EC1 R Plus				Two-component, anti-acid, decorative, translucent epoxy mortar for grouting glass mosaic, ceramic tiles and stone materials for a particularly attractive and high quality finish; may also be used in combination with MAPEGLITTER. Available in 3 kg packs	2 to 7	24	4
KERAPOXY P	RG					Easy-to-apply, two-component, anti-acid epoxy mortar with good cleanability for grout lines at least 3 mm wide. Available in 10 kg packs	at least 3	24	4
KERAPOXY IEG	RG	EC1 R Plus				Two-component epoxy mortar with extremely high chemical resistance for grout lines at least 3 mm wide. Available in 10 kg packs	at least 3	24	4
<b>READY-MIXED GROUT PASTES</b>									
FIX&GROUT BRICK	-	-		•		Ready-mixed, high-performance adhesive paste with anti-mould BioBlock® technology for bonding terracotta strips and decorative features in lightweight cementitious conglomerate and synthetic resin in internal and external areas. Excess adhesive which seeps out through the grout lines may then be smoothed over with a damp brush and acts as grout. Available in 5 kg and 12 kg packs	-	-	-
FLEXCOLOR	-	-	•	•		Ready-to-use polymer filler paste with water-repellent DropEffect and anti-mould BioBlock technology for grout lines in ceramic tiles from 2 to 10 mm wide. Available in 5 kg packs	2 to 10	48	7

\* Products to be mixed with water or FUGOLASTIC

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).

### 1.2.3 Sealants for elastic joints

EN ISO 11600 is the reference standard for sealants. There is no classification system for this type of product but certain factors are important in order to highlight the difference between the various materials employed and to single out the most suitable sealant on a case by case basis, such as extension in service, thixotropy and paintability.

Similarly to grouting products, some sealants include **BIOBLOCK** technology (see Table 10) and may have GEV environmental certification.

Table 10

	GEV -E-micode	BioBlock®	Description and areas of use	Type of application			Extension in service	Packaging
				Paintable	Pourable	Thixotropic		
<b>ELASTIC SEALANTS</b>								
MAPESIL AC	EC1 Plus	•	Pure acetic silicone sealant, ideal for floor joints and ceramic tiling in damp environments and swimming pools			•	25%	310 ml
MAPESIL LM	EC1 Plus	•	Neutral silicone sealant, ideal for joints in natural stone tiling and façades			•	25%	310 ml
MAPESIL Z PLUS	EC1 Plus		Pure acetic silicone sealant, ideal for fillet joints between bathroom fittings, shower booths and sinks			•	20%	280 ml
MAPEFLEX PU20			Two-component epoxy-polyurethane sealant, ideal for industrial floors, car-parks, garages, courtyards and commercial areas		•		10%	5 and 10 kg
MAPEFLEX PU21			Two-component epoxy-polyurethane sealant, ideal for internal joints in covered car parks, supermarkets, warehouses and storage areas		•		5%	5 and 10 kg
MAPEFLEX PU30			Two-component epoxy-polyurethane sealant, ideal for vertical and horizontal joints in car-parks, garages, courtyards, commercial areas and warehouses			•	10%	5 and 10 kg
MAPEFLEX PU40			One-component polyurethane sealant, ideal for expansion and fillet joints in pre-fabricated buildings and traditional and ventilated façades	•		•	25%	300 and 600 ml
MAPEFLEX PU45 FT			One-component polyurethane sealant and adhesive, ideal for sealing joints in domestic and industrial floors	•		•	20%	300 and 600 ml
MAPEFLEX PU50 SL			One-component polyurethane sealant, ideal for domestic and industrial floors, shopping centres, car-parks and runways	•	•		25%	600 ml or 12 kg
MAPEFLEX MS45	EC1 R Plus		Hybrid elastic sealant and adhesive, ideal for sealing joints in domestic and industrial floors, suitable also for damp substrates	•		•	20%	300 ml

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).

## 1.3 Products for preparing substrates

### 1.3.1 Primer




The first category of product for preparing substrates is primers. Primers may be divided into three main types:

- adhesion promoters (used, for example, on dusty and/or porous surfaces or in the case of non-absorbent surfaces)
- consolidating primers (used, for example, in the case of substrates not strong enough for the intended use)
- waterproofing primers (used, for example, in the case of damp substrates)

The following table lists some of the primers from the MAPEI range divided according to type of use.

Table 11

CEV - E-micode	Fast Track	Characteristics and areas of use	Adhesion promoter	Consolidating primer	Waterproofing primer
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ADHESION PROMOTERS					
PRIMER G		EC1	Synthetic resin primer in water dispersion with very low content of volatile organic compounds (VOC).	•	
ECO PRIM T		EC1 Plus	• Solvent-free acrylic primer with very low emission of volatile organic compounds (VOC) for absorbent and non-absorbent substrates.	•	
ECO PRIM GRIP		EC1 Plus	Ready-mixed, low-odour synthetic acrylic resin-based adhesion promoter and primer with silica aggregates with very low emission of volatile organic compounds (VOC) for render applied on non-absorbent substrates, skim coats and adhesives for ceramic tiles.	•	

PROSFAS			Water-based, solvent-free consolidator with high penetration properties for cementitious substrates.	•	
PRIMER MF			Fluid epoxy resin to consolidate cementitious substrates and reduce their moisture content.	•	•
PRIMER MF EC PLUS		EC1 R Plus	Two-component, solvent-free epoxy primer used as adhesion promoter for products from the MAPEFLOOR line, for consolidating and waterproofing cementitious surfaces against residual moisture and as an anti-dust impregnator on concrete floors.	•	•
ECO PRIM PU 1K		EC1 R	One-component, solvent-free, moisture-hardening polyurethane primer with very low emission of volatile organic compounds (VOC.) for consolidating and waterproofing cementitious screeds.	•	•
TRIBLOCK P			Three-component epoxy-cementitious primer for waterproofing damp, non-absorbent substrates.		•

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).



Application of ECO PRIM GRIP on a non-absorbent substrate



Application of adhesion promoter on an absorbent substrate



Application of consolidating-waterproofing primer

### 1.3.2 Smoothing and levelling products

In all the cases mentioned in the section regarding different types of substrate, if you need to even out the laying surface, bring a surface to the correct level or form a slope, the surface needs to be smoothed and levelled off with a suitable product.

Various types of smoothing and levelling products are available, which differ according to the following characteristics:

- Normal-setting or rapid-setting
- Thixotropic or self-levelling
- Applied in thin, medium or thick layers
- Strength and deformability class
- For internal or external environments

MAPEI has a wide range of smoothing and levelling products available and the table below defines their main characteristics and areas of use.





Table 12

	EN 13813	EN 1504-2	EN 998-1	CEV - Eimicode	Fast Track	
<b>SELF-LEVELLING</b>						
ULTRAPLAN		•			EC1 R Plus	• Self-levelling, ultra rapid-hardening smoothing compound applied in layers 1 to 10 mm thick. TECHNICAL DATA: Areas of use: internal floors. Workability time: 20-30 mins. Thickness applied: 1 to 10 mm. Set to foot traffic: approx. 3 hours. Waiting time before bonding: 12 hours. Colour: pinky grey. Available in 23 kg bags.
NOVOPLAN MAXI		•			EC1 R Plus	• Rapid-hardening, fibre-reinforced, free-flowing cementitious levelling mortar with high thermal conductivity applied in layers 3 to 40 mm thick. TECHNICAL DATA: Areas of use: covering compact, under-floor heating/cooling systems and levelling off all types of existing heated floors. Workability time: 30-40 mins. Thickness applied per layer: 3 to 40 mm. Set to foot traffic: 3 hours. Waiting time before bonding: ■ floors not sensitive to moisture 12-24 hours; ■ floors sensitive to moisture 2 days per cm of thickness. Available in 25 kg bags.
ULTRAPLAN MAXI		•			EC1 R Plus	• Self-levelling, ultra rapid-hardening smoothing compound applied in layers 3 to 40 mm thick. TECHNICAL DATA: Areas of use: internal floors. Workability time: 30-40 mins. Thickness applied: 3 to 40 mm. Set to foot traffic: approx. 3 hours. Waiting time before bonding: 12 to 72 hours. Colour: grey. Available in 25 kg bags.

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).

Table 13

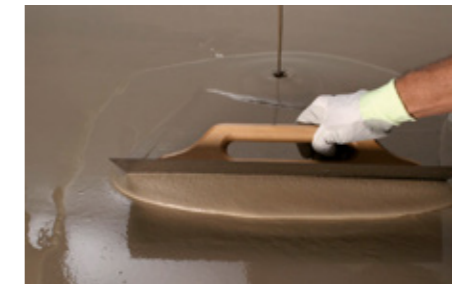
		EN 13813	EN 1504-2	EN 998-1	GEV-Eimicode	Fast Track	Characteristics and areas of use
<b>THIXOTROPIC CEMENTITIOUS SKIMMING PRODUCTS</b>							
PLANITOP FAST 330			•	•		•	Rapid-setting, fibre-reinforced cementitious mortar applied in layers 3 to 30 mm thick to even out internal and external floors and walls. TECHNICAL DATA: Areas of use: internal and external walls and floors. Workability time: approx. 20 mins. Thickness applied: 3 to 30 mm. Waiting time before bonding: • 4 hours for ceramic; • 24 hours for waterproofing layers. Available in 25 kg bags.
NIVORAPID		•			EC1 R Plus	•	Ultra rapid-drying, thixotropic, cementitious smoothing compound for internal use applied in layers 1 to 20 mm thick, also suitable for vertical surfaces. TECHNICAL DATA: Areas of use: internal walls and floors. Workability time: 15 mins. Thickness applied: 1 to 20 mm. Set to foot traffic: approx. 2 hours. Waiting time before bonding: 4-6 hours Colour: grey. Available in 25 kg bags.
LATEX PLUS							Latex elasticising admixture mixed with NIVORAPID or PLANIPATCH for levelling off internal substrates in sheet steel, wood, rubber, PVC, etc.
ADESILEX P4					EC1 R Plus	•	Rapid-hardening cementitious smoothing compound applied in layers 3 to 20 mm thick to even out internal and external floors. TECHNICAL DATA: Areas of use: floors only. Workability time: more than 60 minutes. Thickness applied: 3 to 20 mm. Set to foot traffic: approx. 4 hours. Colour: grey. Available in 25 kg bags.

NIVOPLAN						•	Smoothing mortar for internal and external walls and ceilings applied in layers 2 to 20 mm thick. TECHNICAL DATA: Areas of use: walls only. Workability time: 2-3 hours. Thickness applied: 2 to 20 mm. Waiting time before bonding: 24 hours. Colours: grey and white. Available in 25 kg bags.
PLANICRETE							Synthetic latex rubber to improve adhesion and strength of cementitious mortar and to make bonding slurry for cementitious screeds.

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).



Application of thixotropic smoothing and levelling compound on a floor



Application of self-levelling smoothing and levelling compound



Application of render



Application of thixotropic smoothing and levelling compound on a wall

### 1.3.3 Waterproofing systems

As far as the products mentioned in section 2.2.4 (Waterproofing systems applied under tiles) are concerned, the MAPEI range includes various types of product, each with its own specific characteristics, as listed in the table below:

Table 14

CEMENTITIOUS WATERPROOFING SYSTEMS						
		EN 1504-2	EN 14891	CEV -Emicode	Fast Track	Characteristics and areas of use
MAPELASTIC		•	•	•		Two-component elastic cementitious mortar for waterproofing balconies, terraces, bathrooms and swimming pools. ■ May be reinforced with MAPENET 150 alkali-resistant glass fibre mesh.
MAPELASTIC SMART		•	•	•		Two-component, high-elasticity cementitious mortar (with crack-bridging capacity > 2 mm) applied with a spreader or roller for waterproofing balconies, terraces, bathrooms and swimming pools. ■ May be reinforced with MAPENET 150 alkali-resistant glass fibre mesh or MAPETEX SEL macro-perforated, non-woven polypropylene fabric
MAPELASTIC TURBO		•	•	•	•	Two-component, rapid-drying, elastic cementitious mortar for waterproofing terraces and balconies, including at low temperatures and on substrates not completely dry. ■ May be reinforced with MAPENET 150 alkali-resistant glass fibre mesh or MAPETEX SEL macro-perforated, non-woven polypropylene fabric
MONOLASTIC			•			One-component cementitious waterproofing mortar. ■ May be reinforced with MAPENET 150 alkali-resistant glass fibre mesh or MAPETEX SEL macro-perforated, non-woven polypropylene fabric

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).



Example of the deformability of a sample of MAPELASTIC



Application of MAPELASTIC TURBO



Application of MAPELASTIC

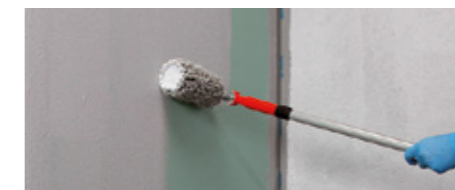
Table 15

WATERPROOFING SYSTEMS WITH READY-MIXED ELASTIC LIQUID MEMBRANES						
		EN 1504-2	EN 14891	CEV -Emicode	Fast Track	Characteristics and areas of use
MAPELASTIC AQUADEFENSE						Ready-mixed, ultra rapid-drying, elastic liquid membrane for waterproofing internal and external surfaces. ■ May be reinforced with MAPETEX SEL macro-perforated, non-woven polypropylene fabric.
MAPEGUM WPS						Rapid-drying, elastic liquid membrane for waterproofing internal surfaces. ■ May be reinforced with MAPENET 150 alkali-resistant glass fibre mesh or MAPETEX SEL macro-perforated, non-woven polypropylene fabric

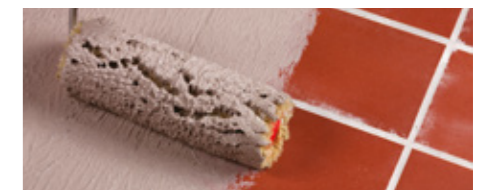
The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).



Spreading MAPELASTIC AQUADEFENSE with a roller



Application of MAPEGUM WPS on a wall



Application of MAPELASTIC SMART

Waterproofing systems include a range of accessory items that are used to guarantee the continuity of the waterproofing layer between joints, around fillet joints, between adjacent surfaces, between horizontal and vertical surfaces and around any breaks or interruptions in general.

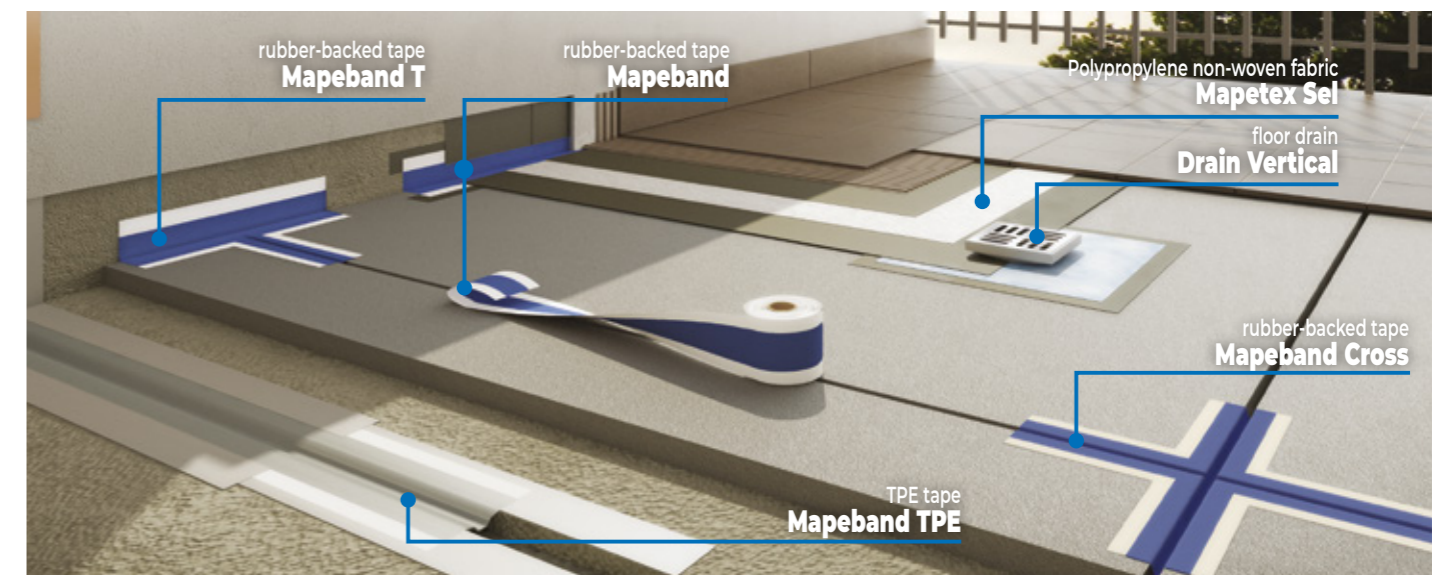




Table 16








Characteristics and areas of use		
PRODUCTS FOR WATERPROOFING HORIZONTAL AND VERTICAL BREAKS IN JOINTS		
MAPEBAND		Alkali-resistant rubber-backed tape with felt for cementitious waterproofing systems and liquid membranes. To complete the system, frames for through holes, 90° and 270° angle pieces and T and cross fittings are also available.
MAPEBAND EASY		Rubber tape sandwiched between two layers of non-woven fabric to form elastic joints in waterproofing systems.
MAPEBAND TPE		TPE tape for elastic sealing and waterproofing of expansion joints and cracks subject to movements.
MAPEBAND PE 120		PVC tape for MAPELASTIC AQUADEFENSE and MAPEGUM WPS waterproofing systems for elastic waterproofing of edges and corners, expansion joints and around through-pipes and drains in bathrooms, showers, kitchens, etc.
MAPEBAND SA		Self-adhesive butyl rubber tape sandwiched to a layer of alkali-resistant non-woven fabric.

Table 17

Characteristics and areas of use		
DRAIN LINE: SPECIAL FITTINGS FOR PARAPET AND FLOOR DRAINS		
DRAIN VERTICAL AND DRAIN LATERAL		Complete floor drain kit comprising: <ul style="list-style-type: none"> <li>vertical or lateral polypropylene drain-pipe available in three diameters (50, 70 and 100 mm) with a welded 400x400 mm polypropylene drain-cover;</li> <li>telescopic extension piece;</li> <li>"anti-odour" plug;</li> <li>removable stainless steel grate, ideal for water draining off from terraces, balconies, bathrooms, boiler rooms, laundries, etc.</li> </ul>
DRAIN FRONT		Waterproofing around drainage outlets in parapets must be carried out using DRAIN FRONT TPE angular pipe unions for balconies.

The figures in the table are for indication purposes only; always refer to the Technical Data Sheet for each product available on our website [www.mapei.com](http://www.mapei.com).

## 2

## Criteria for choosing an installation system

CHOOSING THE CORRECT INSTALLATION SYSTEM IS A FUNDAMENTAL PHASE WHEN DESIGNING TILING AND IS ESSENTIAL IN ORDER TO GUARANTEE THE DURABILITY OF THE WORK. VARIOUS FACTORS HAVE TO BE TAKEN INTO CONSIDERATION WHEN MAKING THIS CHOICE SUCH AS AREA OF USE, TYPE OF SUBSTRATE, EXPOSURE, ETC. THIS IS WHY, DURING THE DESIGN PHASE, IT IS IMPORTANT THAT ALL THE FEATURES AND ELEMENTS ARE CAREFULLY ANALYSED TO PREVENT ANY RISK THAT MAY ARISE DUE TO THE WRONG MATERIALS BEING CHOSEN.

THE MAIN FACTORS TO BE TAKEN INTO CONSIDERATION WHEN DESIGNING TILING ARE AS FOLLOWS:

- AREA OF USE
- SUBSTRATE FOR THE TILING
- FORMAT AND TYPE OF TILES



### 2.1 Area of use

Ceramic can be used anywhere and in any surroundings, as long as the material and installation system have been chosen by taking into consideration project calculations and data, and any stresses or loads in the area of use.

The following must be considered:

- Position of the tiling
- Internal or external use
- Intended use: private, commercial or industrial. Depending on the position of the tiling, the area of use can have considerable influence on the intensity of the loads expected and whether the loads are static or dynamic.
- Factors connected to the specific activity to be carried out in the area of use such as the presence of water, chemicals, aggressive substances, etc.

#### 2.1.1 Position

The tiles may be installed horizontally, vertically or, in certain cases, on ceilings. Firstly, the position has an influence on the types of load expected: the loads and stresses on wall tiles are undoubtedly different to those on floor tiles. Also, when choosing the installation system, ceramic installed on a vertical or sloping surface will require the use of thixotropic products: thixotropic smoothing and levelling compounds if the substrate needs to be evened out and non-slip adhesives (optional class T).



Application of thixotropic smoothing and levelling compound on a wall



Installing ceramic on a vertical surface with thixotropic adhesive



### 2.1.2 Exposure

The choice of the most suitable installation system may be heavily influenced by whether the tiling is installed in internal or external surroundings. Internal surroundings normally only require the expected static and dynamic loads to be calculated. With external surroundings, on the other hand, numerous factors need to be taken into consideration such as the weather, exposure to sunlight, the type of traffic expected, etc.

Also, these factors must be taken into consideration during both installation and normal service.

The main factors to be taken into consideration during installation are:

- temperature: at low temperatures it is advisable to use rapid-setting adhesive (class F) to shorten the waiting time required before putting into service, whereas rapid-setting adhesives must be avoided when installing ceramic at high temperatures and you should choose adhesive with extended open time (optional class E);



Installation carried out on surfaces exposed to the sun: surfaces must be protected from direct sunlight when the surrounding temperature is high

- winds: in windy weather adhesive tends to form a surface skin more quickly and this may affect the correct transfer of adhesive on the back of the tile; in these circumstances it is preferable to use adhesive with extended open time (optional class E)



Installation during windy weather. The skin formed on the surface of the adhesive inhibits it from being transferred on the back of the tile.

As far as service conditions are concerned, on the other hand, the most important factors to take into consideration when choosing an installation system are:

- the internal and external static and dynamic design loads. With high loads, for example, using a rapid adhesive (class F) will help achieve higher mechanical strength. The durability of tiling under intense loads also depends on the continuity of the installation surface: in this type of situation it is advisable to install tiles using the double-buttering technique to prevent leaving voids to the back of the tile.



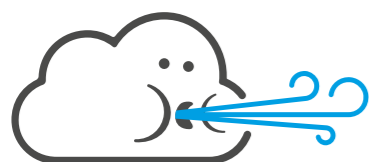
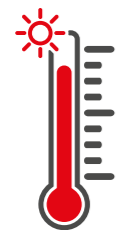
Flooring subjected to dynamic loads



Tiling damaged by a concentrated load



Floor in a supermarket subjected to stresses and loads from the constant passage of concentrated loads that requires the full wet bed installation method



- exposure to the sun: surfaces exposed to direct sunlight may deform due to thermal expansion and this phenomenon is also influenced by the colour of the tiling, which is why it is preferable to opt for lighter shades. For surfaces exposed to direct or indirect sunlight, deformable (optional class S1) or highly deformable (optional class S2) adhesive must be used. In such conditions, the grout lines must be wide and proportional to the size of the tiles, and expansion joints in the tiling must also be calculated accordingly.



Installing tiles on surfaces exposed to sunlight using deformable adhesive (optional class S1-S2)

Apart from influencing the type of adhesive to use, the exposure of the tiling also has a heavy influence on the size of the grout lines and on the expansion and distribution joints. The higher the stresses and loads on the tiling, the wider the grout lines to avoid the risk of encountering compressive load phenomenon. It is usually recommended to have 2 mm wide grout lines for normal tiles installed on stable, internal substrates and grout lines up to 6-8 mm wide when installing tiles on external substrates or on substrates subjected to higher stresses and loads.

As far as the size of the joints is concerned, it is recommended to form square or rectangular bay areas around 25 m<sup>2</sup> for internal tiling and every 9-16 m<sup>2</sup> for external tiling (smaller bay areas due to the effect of higher thermal stresses and loads). Joints must also be formed around the perimeter of the tiling and in correspondence with corners, edges and breaks or interruptions in the tiling. Their width must be calculated by taking into consideration the size of the bay areas, the stresses acting on the tiling and the coefficient of thermal expansion of the tiling (see section 3.3 "Installing ceramic on façades"). As a general guide, joints are usually from 5 mm wide for lighter stresses up to 10-12 mm wide for heavier stresses.

### 2.1.3 Intended use

Installing ceramic in areas for private use does not normally generate intense stresses and loads. When installing ceramic in commercial or industrial areas, on the other hand, the requirements in terms of strength and safety are higher. Apart from foot traffic and static loads to which tiling is exposed, dynamic loads from manual and electric pallet-trucks, for example, must also be taken into consideration. In certain types of surroundings surfaces that can support the passage of vehicles may be required. Increasing the stresses and loads acting on a surface means that stronger installation products will be required, such as high performance (class 2) or rapid (F) adhesive which, as mentioned previously, reaches higher levels of mechanical strength. The presence of intense loads, including foot traffic, may require the use of deformable (class S1 or S2) adhesive which is better at withstanding the loads and stresses acting on the tiling. In the case of intense loads, or for surfaces used by vehicles, the continuity of the installation bed plays a very important role in the durability of the tiling. It is highly recommended, therefore, that tiling is installed using the double-buttering technique and to use adhesive that guarantees that the back of the tiles is wetted evenly and that covers as much of the surface as possible.



Areas subjected to high stresses and loads

## 2.1.4 Examples of special installation

Apart from the usual factors mentioned previously, there are certain types of surroundings which are subjected to specific stresses and other factors need to be taken into consideration when choosing the installation system.

Special examples of installation are discussed below:

- **Heated floors:** this type of floor is subjected to different thermal stresses compared with traditional floors and, for this reason, it is often recommended to use deformable adhesive (optional class S1 or S2). The system must also contribute to the heating function of the floor which means the continuity and compactness of all the elements that make up the tiling play an important role.



Substrate with an underfloor heating system

- **Swimming pools:** when installing ceramic in swimming pools its constant immersion in water and the effect of obligatory cleaning and sanitising operations must be taken into consideration. For this reason substrates must be waterproofed, installation products must have high performance characteristics and ceramic must be installed using the full wet bed technique.



Dalaondes, Canazei. Installing ceramic in a swimming pool

- **Spa centres:** in this type of environment the constant action of water and heat, as well as the presence of chemicals in the spa water itself, must all be taken into consideration. In this case, too, substrates must be impermeable to both water and steam and the installation system must be chosen on a case by case basis by taking into consideration the specific type and intensity of the stresses.



Spa centre, Bormio. Installing ceramic in a Wellness Area

- **Terraces and balconies:** in this type of environment the hygro-thermal stresses and the need to guarantee a waterproof surface must all be taken into consideration. The best solution to guarantee the durability of the intervention is to apply a waterproofing layer immediately below the installation bed so that it protects the substrate below. It is recommended to install ceramic with high performance (class 2) deformable (optional class s1 or s2) adhesive to ensure both the water-tightness of the bond over the years and its capacity to absorb expansion and shrinkage phenomenon in the ceramic and substrate.



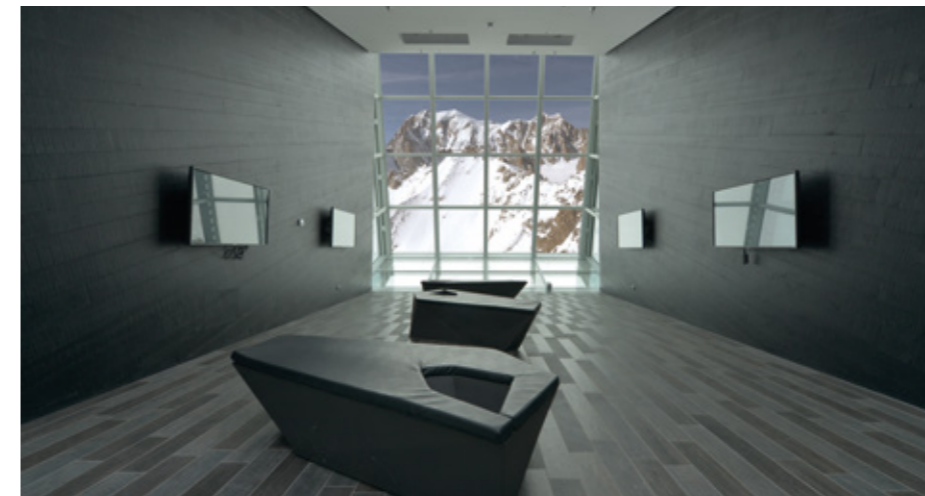
Hilton Imperial, Dubrovnik. Installation of ceramic on terraces and balconies

- **Surfaces exposed to acid:** this category includes tiling in industrial environments which come into contact with potentially aggressive chemical substances for long periods. When designing this type of surface, materials with the capacity to resist aggressive chemicals without being damaged or losing their functionality must be chosen, such as epoxy resin-based products.



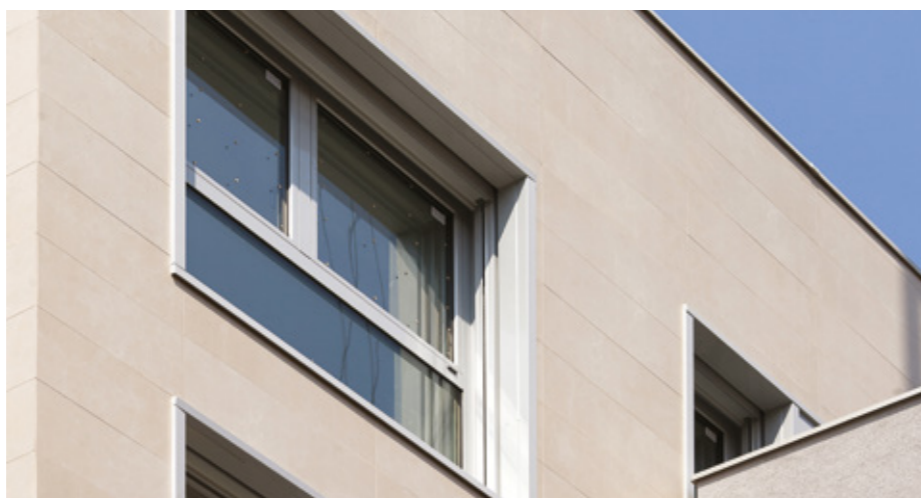
Installation of ceramic in areas exposed to aggressive chemicals

- **Large format tiles:** apart from their general properties, large formats also tend to provide more rigidity in the tiling and it is usually more difficult to apply an even layer of adhesive. For this reason it is recommended to increase the size of the grout lines (this will help obtain a more regular pattern in the tiling), to take great care when designing the layout of the expansion joints and to adopt the double-buttering technique when applying the adhesive or, alternatively, to use an adhesive that guarantees excellent wetting of the back of the tiles.



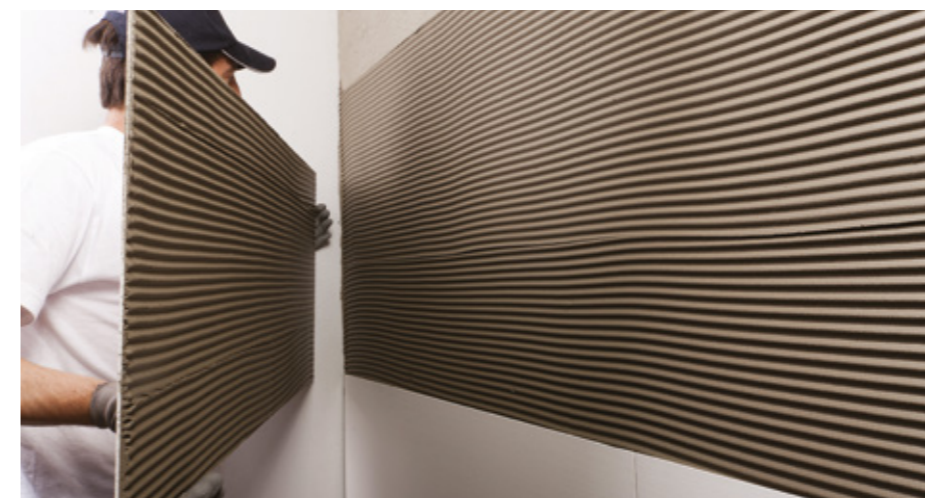
New Mont Blanc cable-car - Courmayeur. Installing large format tiles

- **Façades:** the particular feature of this type of application is the safety risk from detached tiles. The level of risk may increase due to thermal-hygrometric stresses acting on the surface and extra precautions need to be taken, such as verifying the strength of the substrate ( $> 1 \text{ N/mm}^2$ ), using the double-buttering technique to apply adhesive, the use of high performance (class 2) deformable (optional class S1 or S2) adhesive and, depending on the size of the tiles and their height above ground, the use of mechanical safety fixings.



Installation of ceramic on façades

- **Thin tiles:** using the full wet bed technique with this type of tile is particularly important. In fact, with this type of tile, any voids in the adhesive bed could lead to the tiles fracturing. It is very important, therefore, that the full wet bed and double-buttering techniques are adopted or that special adhesive is used. Also, since this type of tile is usually quite large, it is even more important to use the same precautions as for large format tiles, especially when calculating the size of joints and grout lines.



Installing thin tiles using the double-buttering technique

## 2.2 Type of substrate: installation conditions required

A substrate for tiling is defined as the base on which ceramic is to be installed. Well installed tiling, and its durability, are highly dependent on correct preparation of the substrate.

The fundamental requirements of the main types of substrate commonly used are described in the section below. Whatever the type of ceramic, at the moment of installation, all substrates must meet certain fundamental requirements.



- **Integrity:** it must have no cracks or areas that are loose or detached;



Sealing cracks in a substrate with EPORIP



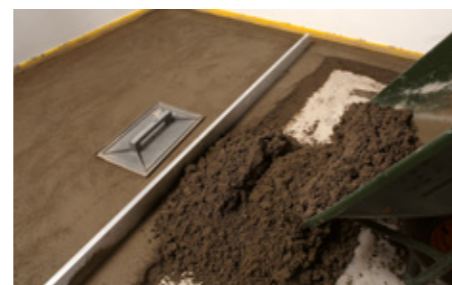
- **Mechanical strength:** it must be strong enough to withstand the loads and stresses acting on the tiling when in service;



Substrate unsuitable for installing ceramic



- **Curing:** it must be dimensionally stable and all hygrometric shrinkages must have taken place;

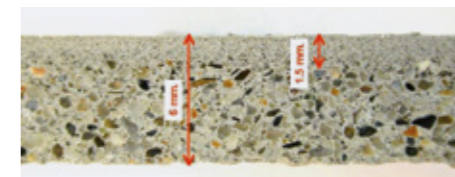


Laying a controlled-shrinkage, quick-drying screed made from TOPCEM PRONTO

- **Compactness and regularity:** there must be no areas with differing mechanical characteristics on the surface or throughout the thickness;



Detachment of a skim coat on a screed with irregular areas of strength



A screed with surface segregation

- **Drying:** the substrate must be dry and the level of residual moisture must be compatible with the type of ceramic to be installed and such that it will have no effect on its durability or cause it to deteriorate;



Application of waterproofing primer on a damp substrate

- **Cleaning:** contaminants and debris on the surface could affect adhesion of the materials required to install tiling;



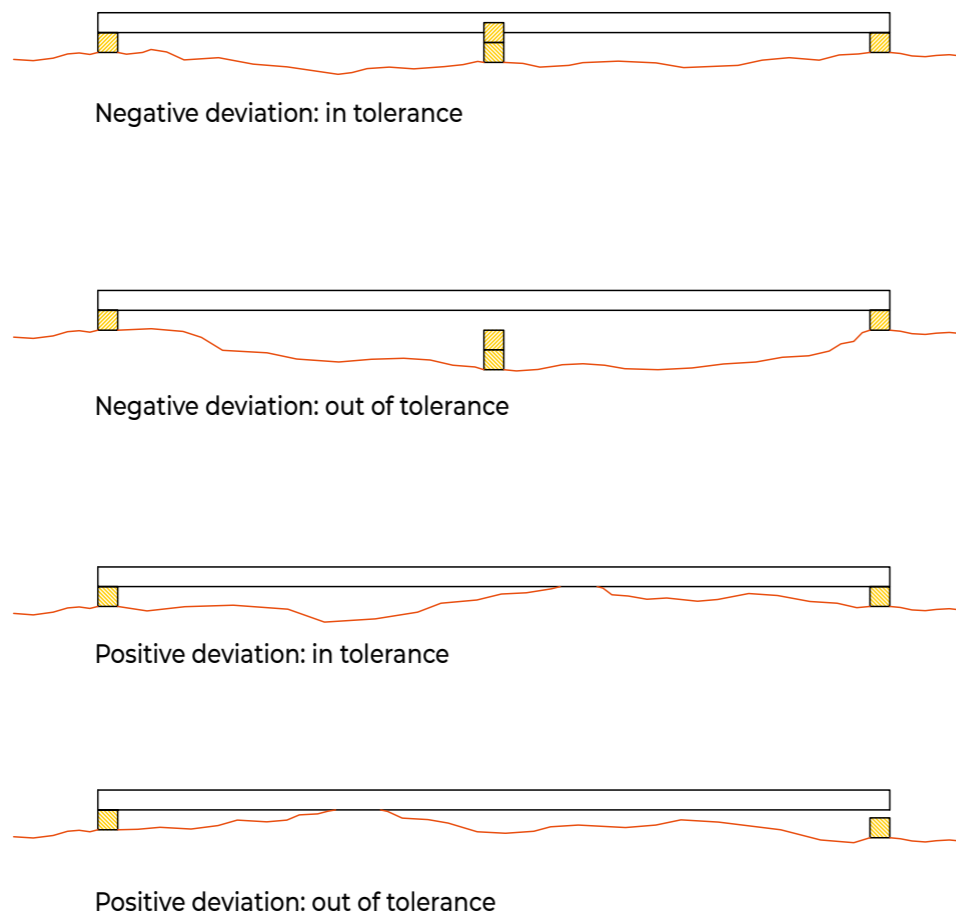
Tiling detached due to poor cleaning of the substrate

- **Flatness/evenness:** installation beds for both wall and floor tiling must be flat and even; flatness in the installation bed directly influences the flatness and evenness of the surface of tiling.



Application of self-levelling smoothing and levelling compound





Tolerance limits for the flatness of an installation bed measured using a 3 mm foil




In order to choose the most suitable installation system, the most important characteristics to take into consideration are the chemical nature and absorbency of the substrate. Also, there are specific parameters and characteristics that must be verified for each different type of substrate before installing ceramic tiles and these are described in more detail in the following sections.

## 2.2.1 Screeds





Mapei's Technical Notebook "Installation of Heated Screeds and Substrates for Laying Flooring" may be used as a reference guide to help choose the correct materials and methods to lay a screed.

For a screed to be suitable for installing ceramic, it must be made according to the criteria described in the aforementioned Notebook and must meet the criteria previously defined as per the following table:

Table 18

GUIDELINES FOR CHECKING AND ASSESSING SUBSTRATES	
REQUIRED CHARACTERISTICS	DESCRIPTION
Integrity	 <p>The screed must be sound and have no cracks. The continuity of the screed is a fundamental condition to guarantee the durability of the flooring installed, otherwise cracks could form and the flooring could detach.</p> <p>Gaps or hollows in the screed must be in-filled with quick-setting mortar applied using the wet-on-wet technique over bonding slurry made from water, cement and PLANICRETE, or with EPORIP. Layer of mortar applied over pipe runs must be at least 2.5 cm thick above the pipes and thin mesh must be positioned over the pipes. Cracks must be monolithically sealed by filling them with epoxy or polyester resin (such as EPORIP, EPORIP TURBO or EPOJET, depending on the size of the cracks). The resin must then be sprinkled while still wet with dry sand to help adhesion of the next layers.</p>
Strength	 <p>The level of strength required for installing ceramic depends on its area of use. A screed's requirements vary accordingly with the loads and stresses acting on it (e.g. 16 MPa for a screed without underfloor heating in residential surroundings, or 40 MPa for a screed in industrial surroundings).</p> <p>In the case of screeds that do not meet the minimum requirements, but are nonetheless sufficiently compact, in internal surroundings their mechanical strength may be improved by applying consolidating primer such as PRIMER MF, PRIMER MF EC PLUS, ECO PRIM PU 1K or PROSFAS.</p>
Curing	 <p>Cementitious screeds made from a traditional mix require around 7-10 days curing per centimetre of thickness. During this period, most of the hygrometric shrinkage in the screed will take place.</p> <p>When installation times are particularly tight, screeds must be made from controlled-shrinkage, ready-mixed mortars or special binders such as TOPCEM, TOPCEM PRONTO, MAPECEM or MAPECEM PRONTO. It is never possible to reduce the curing time for traditional screeds.</p>



<p>Compactness and regularity</p>		<p>The surface of the screed must be compact and strong. In certain cases, a surface may appear to be compact but will still have surface bleeding. The strength of the surface will be lower than the design strength and could cause detachment if not checked carefully before installing ceramic.</p> <p>Compactness can be checked empirically with a rubber mallet and surface bleeding is examined by cutting into the surface with a punch or bradawl. Any bleeding must be removed mechanically and the surface must then be repaired by applying a coat of primer and a layer of smoothing and levelling mortar.</p>
<p>Drying</p>		<p>Apart from being correctly cured, the screed must also be dry. It is usually recommended to install ceramic on screeds with a maximum of 3% residual moisture (measured with a carbide or electronic hygrometer).</p> <p>If the level of residual moisture is higher than 3% you must wait until it is completely dry. Alternatively, the substrate may be waterproofed (if the level of residual moisture is less than 6% for screeds up to 6 cm thick) by applying primer such as <b>PRIMER MF</b>, <b>PRIMER MF EC PLUS</b> or <b>ECO PRIM PU 1K</b>. If there is continuous rising damp, the only solution is to install a new screed over a vapour barrier.</p>
<p>Cleaning</p>		<p>The screed must be clean and have no traces of dust, oil, detached areas or any other material or substance that could affect adhesion of the ceramic (cement laitance, old adhesive, paint, etc.). The screed must be cleaned mechanically or with a specific product, depending on the type of contaminant on the surface.</p>
<p>Flatness/ evenness</p>		<p>The maximum tolerances for horizontal surfaces depend on the tolerances allowed for the finished floor. Unless otherwise specified, a surface is considered sufficiently flat if any gaps under a 2 metre straight edge are within <math>\pm 3</math> mm.</p> <p>If a slope is required to drain off water, the evenness of the surface still needs to be checked and the slope must be at least 1%.</p> <p>If a screed does not meet the requirements for flatness, evenness or slope, a suitable levelling product may be applied to correct the difference; which product to use depends on whether it is for internal or external use, whether a slope needs to be formed and on the thickness that needs to be reintegrated.</p>




As far as the influence of the screed on the installation system is concerned, it is particularly important to analyse the chemical nature of the binder used to make the screed and the surface finish of the screed:





- Chemical nature:** for cementitious screeds, no particular precaution is required when choosing a levelling compound or adhesive. An anhydrite-based screed must be primed with a film-forming product, such as **ECO PRIM T** or **PRIMER G** diluted with water, to make it suitable for applying cementitious levelling compound or adhesive. These types of primer separate the gypsum-based surface and the cementitious product and prevents the development of reactive chemical expansive products at the interface between the two materials (which would provoke detachment of the skim coat/adhesive from the screed).
- Surface finish/absorption:** adhesion of skimming products and adhesive to the screed will increase as surface porosity increases. In the case of particularly closed surfaces, or surfaces with low absorbency, the surface of the screed must be sanded or treated with a product that helps improve adhesion of the levelling compound. If ceramic is to be bonded directly on the screed, as porosity and absorption of the screed decreases, we suggest using a high performance adhesive (class 2).



## 2.2.2 Existing wall and floor coverings

In the renovation sector, tiling often needs to be installed over an existing floor or wall covering. For a surface to be suitable for installing ceramic the following requirements must be met:

GUIDELINES FOR CHECKING AND ASSESSING SUBSTRATES		
REQUIRED CHARACTERISTICS	DESCRIPTION	
Integrity		<p>The floor or wall covering must be well bonded to the substrate. Any damaged, detached or cracked areas must be removed.</p> <p>If any elements are either detached or have been removed, the integrity of the underlying substrate must be assessed and, if necessary, it must be repaired (see section 2.2.1). The missing areas will then have to be in-filled a suitable compound.</p>
Strength		<p>The existing wall or floor covering must be well bonded to the substrate and the substrate itself must be strong enough for the type of use required.</p> <p>If the substrate is not strong enough the wall or floor covering must be removed and the substrate must be repaired. Depending on the condition of the substrate, it can be either consolidated or, alternatively, removed and replaced with a new one.</p>
Curing		<p>If it has been patched up or cable or pipe runs have been filled, before installing ceramic, it will be necessary to make sure the product used for the repair work is fully cured.</p> <p>In order to complete this type of work more quickly, we suggest using a rapid product for patching areas or carrying out repairs.</p>


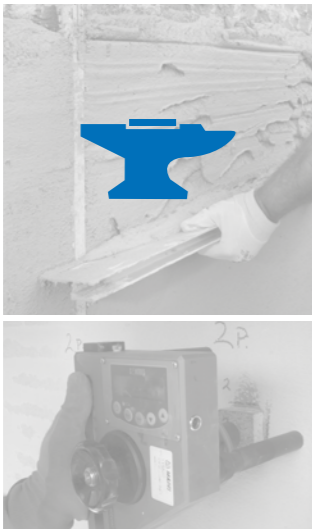

Compactness and regularity		<p>Existing wall and floor coverings must be in good condition. Apart from being well bonded there must be no areas that are either detached or cracked.</p> <p>If the existing wall or floor covering is well bonded but cracked, to prevent it affecting the tiling, the ceramic must be installed after positioning an anti-fracture membrane (MAPETEX SYSTEM).</p>
Drying		<p>The floor or wall covering must be dry.</p> <p>Non-absorbent substrates, such as old tiling and stone, may be waterproofed by applying TRIBLOCK P epoxy-cementitious waterproofing primer.</p>
Cleaning		<p>All surfaces must be thoroughly cleaned and have no detached areas or substances that could affect adhesion (cement laitance, oil, wax, etc.).</p> <p>Before installing ceramic, we recommend cleaning it with a product suitable for the type of contaminant on the surface: an acid cleaning solution to remove cement, water and caustic soda or a specific de-waxing product to remove oil, wax, etc.</p>
Flatness/ evenness		<p>Tolerances for flatness are the same as those for screeds. Also, when forming a slope, make sure the existing slope meets the requirements, or reintegrate the slope if it is either inexistent or insufficient.</p> <p>After thoroughly cleaning an existing wall or floor covering, smooth it over with a smoothing and levelling product suitable for the position of the wall or floor covering and for the thickness of the layer required.</p>

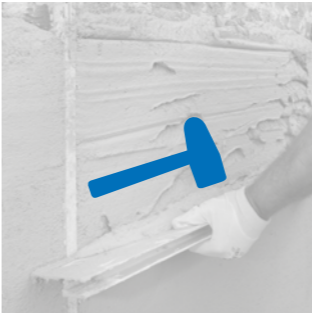



Details on the types of intervention and methods to adopt when overlaying existing ceramic or stone floors with new ceramic are described in more detail in section 3.10.

### 2.2.3 Render

When installing ceramic materials on walls they often have to be bonded to render. For a surface to be suitable for installing ceramic the following requirements must be met:

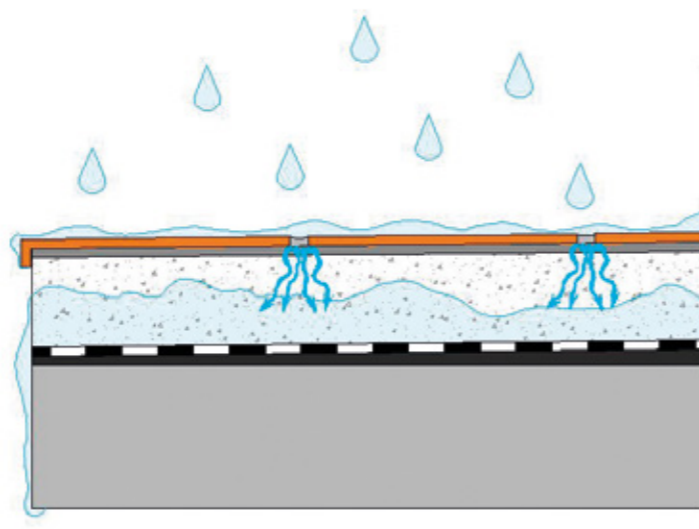
#### GUIDELINES FOR CHECKING AND ASSESSING SUBSTRATES

REQUIRED CHARACTERISTICS	DESCRIPTION
<p><b>Integrity</b></p> 	<p>The render must be sound and have no cracks. Cracked render may cause cracks to form in the ceramic or lead to it becoming detached.</p> <p>If the render has only small cracks and is bonded soundly to the substrate it may be smoothed over with a skim coat a few millimetres thick with alkali-resistant glass fibre mesh embedded in the layer. If there are cracks in the render due to breaks or gaps in the substrate it is better to apply a new layer of reinforced render, especially in correspondence with any breaks or gaps (e.g. string-courses).</p>
<p><b>Strength</b></p> 	<p>The render must be able to support the tiles and any stresses or loads acting on the tiles. The minimum adhesion strength of the render to the substrate must be checked before installing the ceramic. For example, internal render on a substrate in traditional material must have at least 0.5 N/mm<sup>2</sup> adhesion strength, while the adhesion strength for external render must be more than 1 N/mm<sup>2</sup>.</p> <p>The adhesion strength of render must be checked by means of pull-off tests. If it doesn't meet the minimum specified limits, it is preferable to remove the render and apply a new layer that meets the requirements.</p>
<p><b>Curing</b></p> 	<p>Before installing ceramic the render must be fully cured; curing times vary according to the type of binder used and the surrounding conditions. In general, in normal conditions, traditional lime/cement based render needs to be cured for 7-10 days per cm of thickness.</p> <p>If the render is not fully cured you must wait longer for the curing cycle to be completed. If the time available to install the ceramic is limited we suggest using quick-drying products. Quick-drying skimming products are also recommended for local repairs, such as PLANITOP FAST 330, in order to reduce the time required for installation of the ceramic.</p>

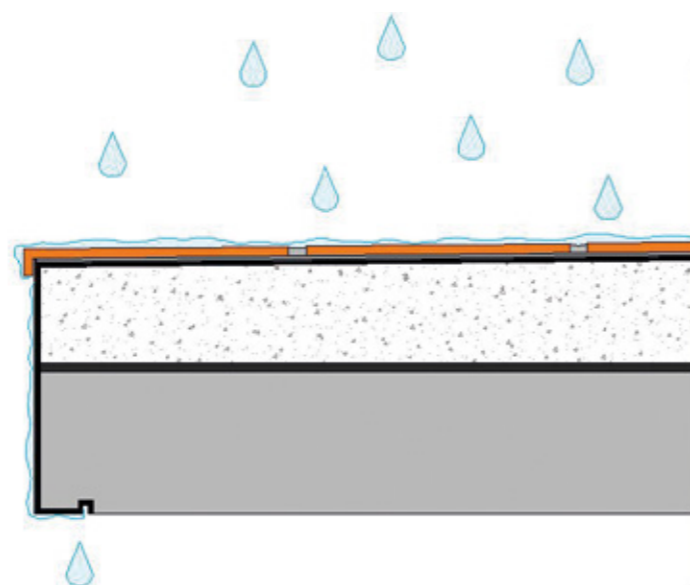
<p><b>Compactness and regularity</b></p> 	<p>Render must be compact and regular and have no crumbling areas on the surface.</p> <p>Consolidating weak render onto which ceramic is to be installed is usually not recommended. In such cases the render will have to be re-done.</p>
<p><b>Drying</b></p> 	<p>Render must be dry before installing ceramic. It is normally inadvisable to install ceramic on damp walls or on walls with rising damp. If there is rising damp, preventative treatment may be taken into consideration by creating a chemical barrier using MAPESTOP.</p>
<p><b>Cleaning</b></p> 	<p>Render must be clean and have no detached areas, old paint or other substances that could affect adhesion of the ceramic.</p> <p>All possible contaminants must be removed prior to installation. Old paint, oil and traces of old adhesive in particular must be removed.</p>
<p><b>Flatness/ evenness</b></p> 	<p>Render must be flat and even before installing ceramic. This may be checked with a straight-edge. Areas out of plumb must be restored with a product suitable for the thickness to be restored such as PLANITOP FAST 330 or NIVOPLAN admixed, where required, with PLANICRETE to improve its adhesion.</p>

### 2.2.4 Waterproofing systems applied under tiles

Amongst the types of surfaces on which tiling is installed, waterproofing systems applied under tiles are often used. These systems are different to traditional membranes in that they provide an impermeable protective layer for the substrate, which remains dry and less prone to damage from water, such as surface efflorescence, or detachment caused by freezing weather.



Waterproofing system applied under the substrate



Waterproofing system applied under tiles

These systems may be of a various chemical nature, such as cementitious, resin-based or polyurethane-based.

#### GUIDELINES FOR CHECKING AND ASSESSING SUBSTRATES

REQUIRED CHARACTERISTICS		DESCRIPTION
Integrity		The waterproofing system must be sound and seamless before commencing installation. Its water-tightness may be checked, if required, before installing tiles.  Depending on the type of waterproofing system applied, critical areas where leaks occur in the waterproofing layer must be repaired with the same type of material before installing tiles.
Strength		The waterproofing layer must be well bonded to the substrate to which it is applied. Since these systems are quite thin, the strength required is given by the actual substrate.  If the substrate is not strong enough to support the tiling it must be repaired and a new waterproofing system must be applied.
Curing		Waterproofing products have their own curing times which must be adhered to before installing ceramic.  Installing ceramic materials on materials that are not fully cured will affect the efficiency of the waterproofing system and adhesion of the tiling.
Compactness and regularity		The waterproofing product must be applied evenly over the entire surface.  If there are any interruptions or gaps, products compatible with the waterproofing system must be used to guarantee the continuity of the waterproof layer.
Drying		The waterproofing layer must be dry before installing ceramic materials.  If the installation surface is wet you must wait until it is completely dry; tiles must not be installed on surfaces with standing water.
Cleaning		Installation surfaces must be clean and sound and must have no contamination or substances that could affect the bond of the tiling.  Any contaminant present on the surface of the waterproofing layer must be removed before installing ceramic with a product suitable for both the type of waterproofing layer to be applied and the type of contaminant to be removed.
Flatness/ evenness		Waterproofing layers must meet the same flatness criteria as for substrates discussed previously.  Uneven areas in the surface that are out of flat must be levelled off with products suitable for the area of use and the thickness required before applying the waterproofing system.



Application of skimming compound on lightweight concrete blocks

## 2.2.5 Special substrates

Apart from the substrates mentioned previously, which cover most installation conditions, there are other types of surface that are less commonly found. These surfaces require extra attention and may influence which installation system is chosen.

- **Lightweight concrete blocks:** this type of material is characterised by a high rate of absorption and its tendency to constantly form dust on the surface. Installing ceramic on this type of internal substrate may be carried out after applying a product such as **PRIMER G**, which evens out absorbency and improves the workability and adhesion of skimming products and adhesive used to install tiles. It is not possible to install ceramic directly on external substrates made from this type of material. This type of substrate must be rendered and the render must be reinforced with galvanized mesh fastened mechanically to the structure so that it is strong enough to support the tiles.
- **Cement-fibre panels:** these types of panel are often used to line external walls, including over existing substrates, to make surfaces more even before they are painted or tiled. In the case of ceramic tiling, continuity of the surface must be guaranteed with a skim coat and by placing glass fibre mesh over the joints between the panels. This type of intervention may be carried out with **MAPEFINISH** and **MAPENET 150**. Once the substrate has been prepared as described, ceramic may be installed with class S1 or S2 high-performance, deformable adhesive.
- **OSB panels:** this type of panel is often used in building work using the dry construction technique and are widely used for floors, in roofs and for lining walls. These engineered panels are made from chips of wood bonded together with synthetic resin which are then pressed together to form layers. If ceramic is to be bonded directly to this type of surface it must be primed with **ECO PRIM T** or **ECO PRIM GRIP** and then a class C2F, deformable class S1 or reactive adhesive must be used to bond the ceramic. The tiles must be bonded with wide grout lines and as many expansion joints as possible.



Skim coat on cement-fibre panels



Structure made from OSB panels

- **Plasterboard panels:** plasterboard panels must be firmly fastened to the frame of the structure to make them suitable for installing ceramic. If a certain amount of flexibility remains in the panels it is preferable to install ceramic with deformable class S1 or S2 adhesive. If the joints between the panels are skimmed with a gypsum-based product these areas must be treated with **PRIMER G** or **ECO PRIM T** diluted with water before installing ceramic. An alternative solution is to install the ceramic directly, including over the areas with the gypsum-based skimming compound, using ready-mixed adhesive paste (if compatible with the format of the tiles and the area of use).



Installing ceramic on plasterboard panels

- **Metal surfaces:** metal substrates must be fastened securely in place and they must be clean and have no traces of oil, paint, grease, rust, etc. This type of substrate is non-absorbent and ceramic must be installed with reactive adhesive such as **KERAPOXY ADHESIVE**, **KERAPOXY**, **ULTRABOND ECO PU2K**, **KERALASTIC** or **KERALASTIC T**. In internal surroundings not subjected to high deformations, if the surfaces are roughened up sufficiently, the use of **KERAQUICK MAXI S1** admixed with **LATEX PLUS** may also be considered. In internal surroundings it is recommended to use epoxy-polyurethane or polyurethane products such as **ULTRABOND ECO PU2K**, **KERALASTIC** and **KERALASTIC T**, in that their high deformability is better at absorbing any expansion that takes place in the metal substrate. If an internal metal substrate needs to be skimmed, and the substrate is sufficiently clean, it is possible to apply a deformable skim coat with high adhesion properties by mixing **NIVORAPID** with **LATEX PLUS**.



Installing ceramic on metal substrates



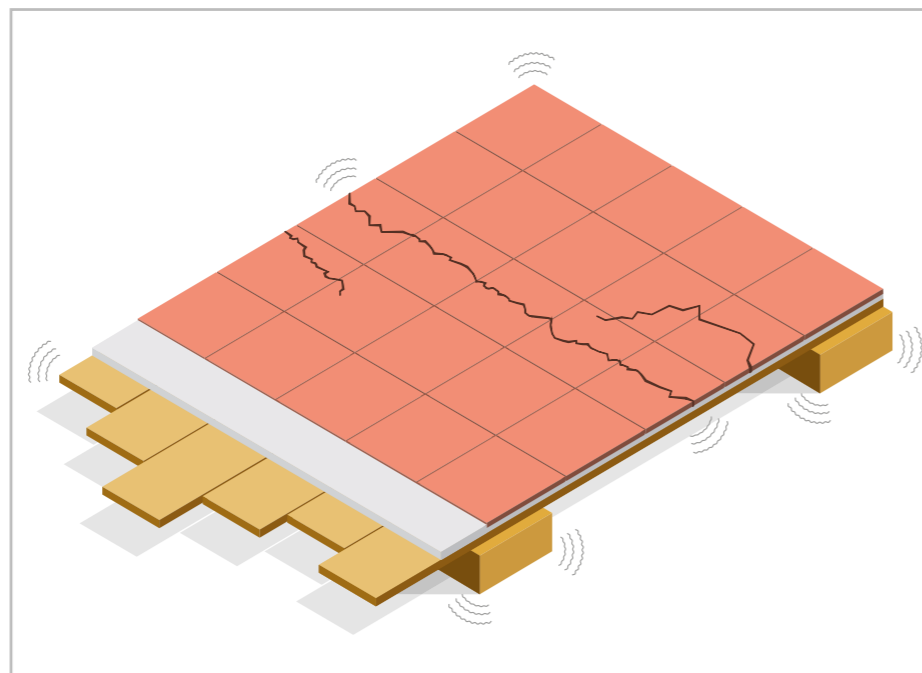
Casting a concrete floor slab



Installing ceramic on a wooden floor

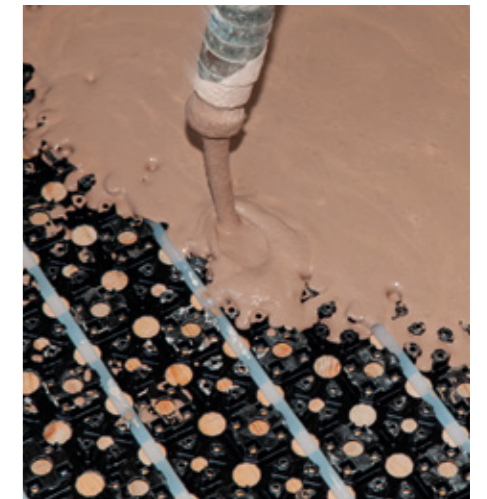
- **Concrete:** to install ceramic on cast and prefabricated concrete all the requirements previously discussed regarding concrete substrates must be met: integrity, strength, curing, compactness and regularity, drying, cleaning and flatness and evenness. It is particularly important to make sure surfaces have no form-release compound on them. To prevent problems caused by the presence of contaminants, it is recommended to hydro-blast or sandblast the surfaces before installing ceramic. Exposed cracks or spacers on the surface need to be opened up with a grinder and then filled with epoxy resin such as **EPORIP**, **EPOJET** or **ADESILEX PG1** (choose which product to use according to the size of the cracks to be filled). The surfaces may then be skimmed to make them flat with **PLANITOP FAST 330** or **NIVOPLAN** admixed with **PLANICRETE**. If render needs to be applied the surface may need to be roughened to improve adhesion or treated with a suitable primer such as **ECO PRIM GRIP**.

- **Wooden surfaces:** installing ceramic on wood (old parquet, marine play, etc.) requires the use of two-component reactive adhesive such as **ULTRABOND ECO PU2K**, **KERALASTIC** or **KERALASTIC T**. If the substrate is stable and prone to only slight deformations, the use of **KERAQUICK MAXI S1** mixed with **LATEX PLUS** may be considered. Installing ceramic on wood, however, may only be carried out in internal surroundings on stable, clean substrates. In the case of old parquet all traces of old paint or wax must be removed. If the surface needs to be skimmed it is possible to apply a deformable skim coat with high adhesion properties by mixing **NIVORAPID** with **LATEX PLUS**.



Cracks in rigid flooring installed on a deformable substrate

- **Low thickness heating systems:** renovation work on residential buildings often involves installing tiles over compact underfloor heating systems. These systems may be installed leaving layers only 1.5-2 cm thick. The panels that make up these systems may be made from either self-adhesive plastic or cement-fibre/gypsum-fibre. Systems made from different kinds of materials, such as plastic panels usually require a coat of **ECO PRIM T** to act as an adhesion promoter, then the panels are installed and all the cavities and gaps are filled with a self-levelling product such as **NOVOPLAN MAXI** to form a layer around 3 mm thick above the dimples in the panel. With systems made from cement-fibre/gypsum-fibre panels, on the other hand, the panels are bonded to the substrate with **ULTRABOND MS RAPID** applied in beads around 30 cm apart on the back of the panels. Then install the piping for the heating system and apply the primer **ECO PRIM T**, adhesion promoter and level off the surface of the panels with a layer of **NOVOPLAN MAXI** up to 3 mm thick over the top of the panels. Because the skim coat over the heating panels is so thin, the tiling will be more prone to thermal stresses and loads and therefore deformable or highly deformable S1 or S2 adhesive will be required.



Forming a substrate over a compact heating system

## 2.3 Format and type of tiles

As discussed in section 1.1, tiles have a wide range of different characteristics and this has an influence when choosing the most suitable installation system. It is generally possible to install small format, absorbent tiles and form a good bond using adhesives with lower performance characteristics. As the size of the tiles increase and their absorbency decreases, on the other hand, the performance characteristics of the adhesive system must be increased and the choice will tend to favour products with high performance characteristics. Apart from these general considerations there are also other examples of special installations.

### 2.3.1 Installing large format tiles

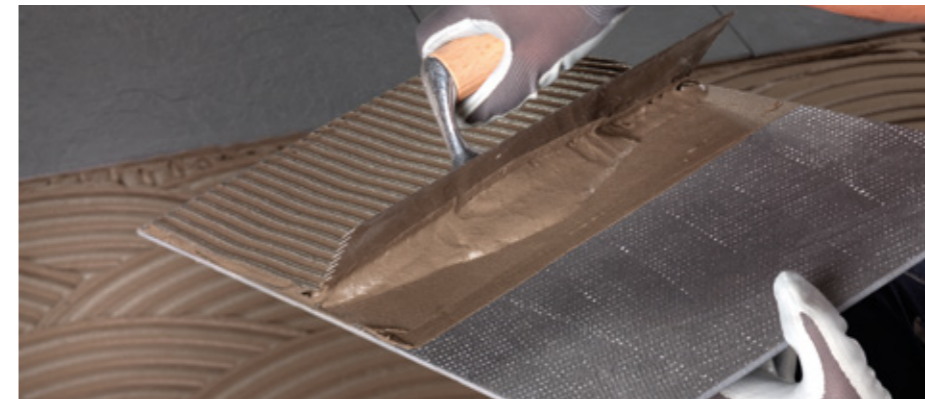
Large format tiles are those with at least one side greater than 60 cm in length. Large format tiles are usually made from porcelain and, as such, have a low rate of absorbency and require the use of high-performance cementitious adhesive (class C2 according to EN 12004 standards). Also, because of their sheer size, these types of tile are not always perfectly flat and it is more difficult to obtain even distribution of the adhesive. For this reason it is recommended to use the double-buttering technique when applying the adhesive. For further information we recommend consulting the "Manual for installing large format ceramic tiles".



Installing large format tiles with a wood-effect finish

### 2.3.2 Thin porcelain slabs

The installation of thin slabs is a particularly critical type of installation: these are special tiles around 3-5 mm thick in formats up to 1 m x 3 m. They may be reinforced with glass fibre mesh backing and, apart from the same precautions adopted for large formats in general, it is obligatory to apply the adhesive using the double-buttering technique. In fact, if the adhesive is not applied evenly over the back of the tiles, gaps may be left after they have been installed and form potential weak points in the tiling that could easily fracture. For further information we recommend consulting the "Manual for installing large format ceramic tiles".



Installing thin tiles using the double-buttering technique

### 2.3.3 Glass and glass mosaic wall and floor coverings

When installing glass mosaic, in spite of the small size of the single tiles, the complete non-absorbency of glass, the weight of sheets of tiles, the reduced thickness and transparency of the tiles must never be overlooked.



Doi Inthanon Royal Ghedi, Thailand. Installation of glass mosaic

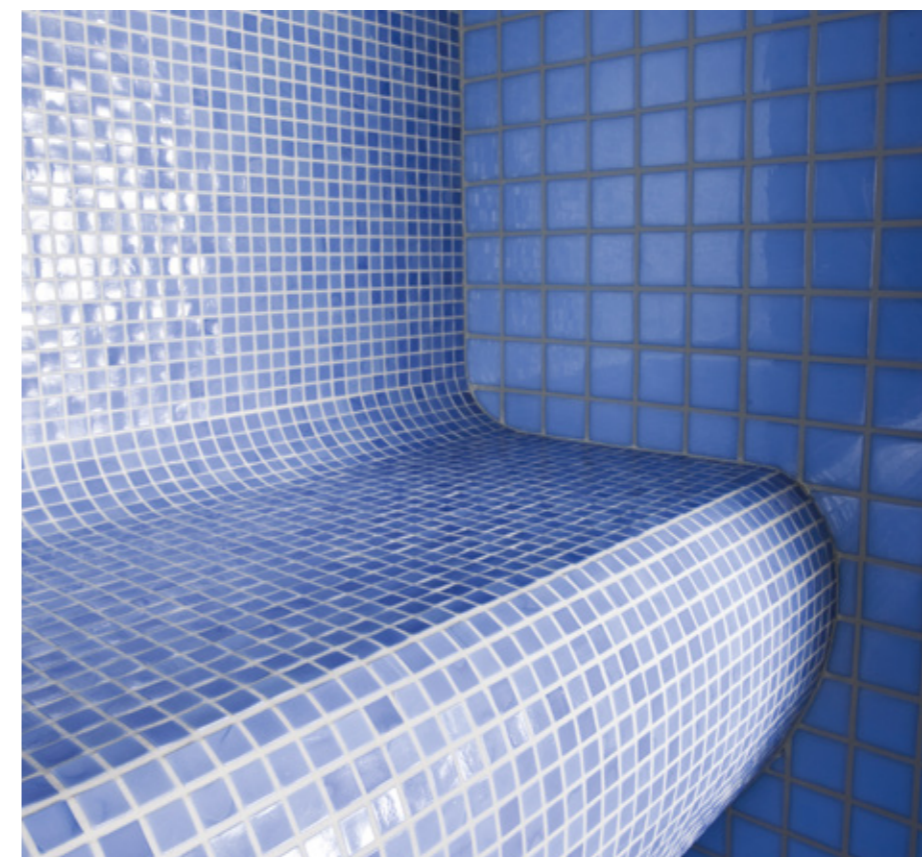
# 3

## Special installation examples

UP UNTIL THIS POINT THIS GUIDE TO THE INSTALLATION OF CERAMIC MATERIALS HAS DEFINED THE PROPERTIES OF THE MATERIALS EMPLOYED, THE CHARACTERISTICS OF THE SUBSTRATES AND MATERIALS AND THE MAIN FACTORS WHICH INFLUENCE THE INSTALLATION SYSTEM TO BE USED. WE WILL NOW ANALYSE A NUMBER OF SPECIAL INSTALLATION EXAMPLES, THE CHARACTERISTICS WHICH MAKE THEM DIFFER FROM THE MORE COMMON INSTALLATION SITUATIONS AND THE SOLUTIONS PROPOSED BY MAPEI TO INSTALL THEM CORRECTLY WITH HIGHER DURABILITY.



### 3.1 Installing glass mosaic



- **NON-ABSORBENCY**
- **WEIGHT (slippage of sheets of mosaic tiles)**
- **TRANSPARENCY**
- **REDUCED THICKNESS**
- **LINING UP JOINTS**

As discussed in section 2.3.3., when installing glass mosaics, the adhesive system must be chosen according to the following characteristics:

- **Non-absorbency:** glass wall and floor coverings must be installed using adhesive with high adhesion characteristics, which means class 2 according to EN 12004 standards (high-performance)
- **Weight:** when installing glass mosaic on vertical surfaces thixotropic adhesive must be used (class T).
- **Reduced thickness:** the reduced thickness of glass tiles and mosaic increases the possibility of adhesive seeping out of the grout lines during installation. For this reason, if a product with an inadequate particle size is chosen, it may lead to a poor finish on the surface of the grout lines once installation has been completed. It is important, therefore, to choose a product with a fine texture.
- **Transparency:** because this type of material is transparent the colour of the installation bed is very important. In fact, the colour of the substrate may affect the colour of the surface of the mosaic. For this reason it is very important to use brilliant white adhesives to install glass tiles and mosaic.





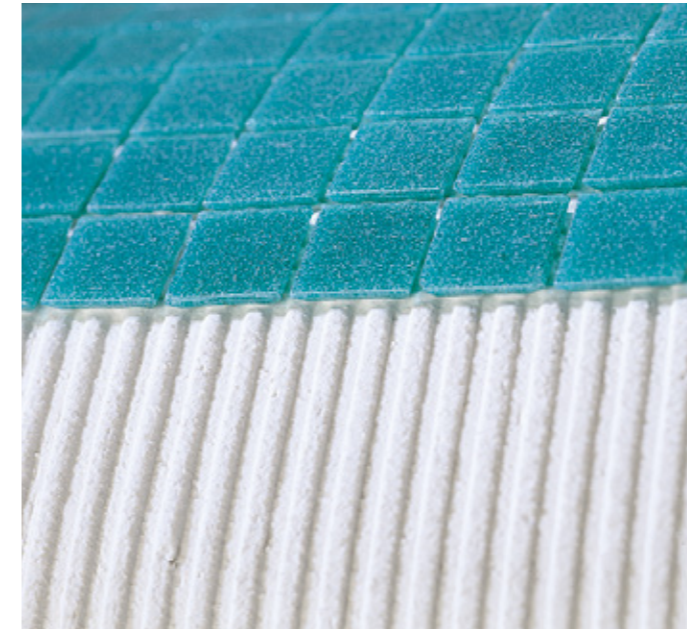
To meet all the above requirements, Mapei has developed a specific adhesive to install glass tiles and mosaic: **ADESILEX P10** high-performance, thixotropic cementitious adhesive with extended open time (class C2TE according to EN 12004) and brilliant white colour. When installing glass in critical areas, such as swimming pools, **ADESILEX P10** may be mixed with **ISOLASTIC** to partially replace the mixing water (1:1 parts by weight). **ADESILEX P10** mixed with **ISOLASTIC** improves its adhesion and deformability characteristics to form a class C2E S1 adhesive according to EN 12004 standards.



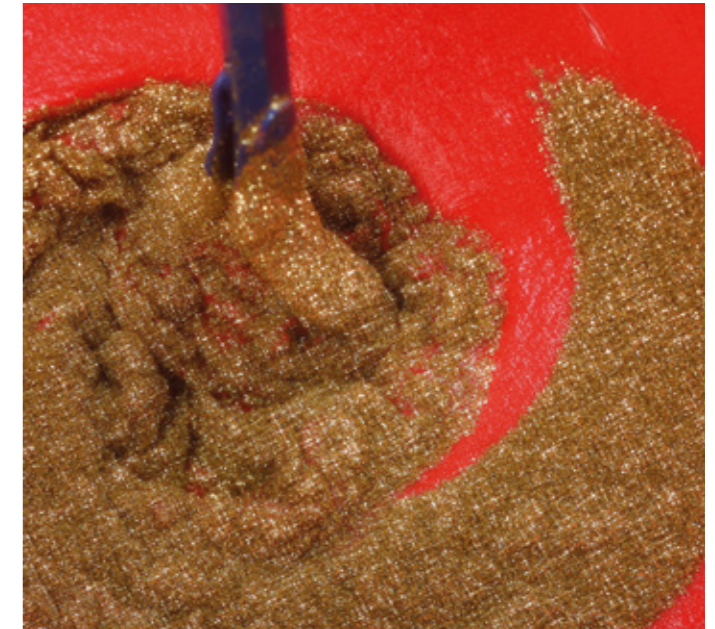
Comparison between mosaic bonded with **ADESILEX P10** (on the left) and traditional white adhesive (on the right): how it affects the final finish of the mosaic

The special characteristics of mosaic must also be taken into consideration when filling the grout lines. Fine-textured grout is essential to guarantee the grout lines are filled correctly and completely.

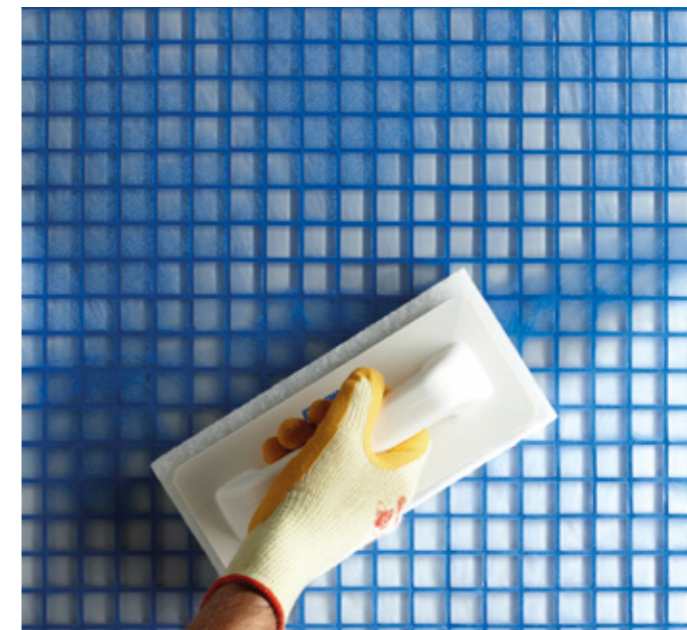
To highlight the transparency of mosaic Mapei has developed **KERAPOXY DESIGN**, a specific epoxy mortar for grouting glass tiles and mosaic which can also be used as adhesive. **MAPEGLITTER** can also be incorporated to give a distinctive finish.



Installing mosaic with **ADESILEX P10** adhesive



Mixing **KERAPOXY DESIGN** with **MAPEGLITTER**



Cleaning glass mosaic after grouting



Glass mosaic grouted with **KERAPOXY DESIGN** and **MAPEGLITTER**

## 3.2 Installing large-size tiles



- LARGE SIZES
- WEIGHT
- REDUCED THICKNESS  
(for low-thickness slabs)



Installing thin tiles on a façade; Sant'Anna apartment complex, Bari

There are various sizes and thicknesses of large format tiles currently available on the market, with some formats reaching dimensions of up to 3.2 m x 1.6 m and slim tiles with thicknesses ranging from as low as 3 mm up to 12 mm. The technique used for the correct handling, substrate preparation and installation is the same for both slim tiles and large format tiles. The information contained in this document is based on current local norms and standards and the experience Mapei has matured in this sector.

The use of thin tiles offers certain advantages, particularly in renovation work, in that they can be bonded over existing wall and floor dressings without significantly increasing their overall thickness, thereby reducing demolition costs. Another important advantage is the lower weight of this type of tile compared with traditional tiles, which means less impact on the structure, a characteristic which makes it the preferred choice for installing on vertical surfaces, especially façades.

At the same time, however, their reduced thickness means that certain precautions

need to be taken during handling, when preparing substrates and when actually bonding the tiles.

Large-size tiles are particularly appreciated because they allow to obtain an almost seamless surface with only few interruptions. This type of tile may be laid on **MAPETEX SYSTEM** anti-fracture membrane, using **ULTRALITE S2** or **ULTRALITE S2 QUICK** for bonding both the fabric and the tiles in order to enhance the seamless effect.

Handling and moving the large format tiles, require more people and the use of tools with special suckers, similar to those used for handling and moving sheets of glass. Particular care must be taken when handling these large format tiles to avoid chipping the corners.



Moving slabs using equipment with special suckers

The installation substrate must be as even and flat as possible. To install large-size tiles the flatness of the substrate must be within 1.5 mm with a 2 metre straight-edge. Any areas not within this tolerance must be repaired before commencing installation.

Tiles must be installed on a compact bed of adhesive (full wet bed method) that guarantees high wetting capacity. This requirement may be met by using adhesive specifically developed for this type of use, such as products from the **ULTRALITE range**, and by using the double-buttering technique, that is, applying the adhesive on both the substrate and on the back of the tile. The adhesive should be spread on both surfaces in the same direction.

The adhesive must be applied in straight lines parallel to the short side of the tile to reduce the distance travelled by the air being pushed out.



Spreading adhesive on the substrate



Spreading adhesive on the back of a tile



Installing a tile



Checking complete wetting of the back of the tile

Products from the **ULTRALITE** range are characterised by their high wetting properties which improves the compactness of the layer of adhesive and minimises the presence of gaps on the back of the tiles.

The sheer size of the tiles may lead to the formation of air pockets between the substrate and the back of the tile. This is why it is important to bed the tiles down by tapping them with a rubber spreader or vibro-plate, particularly when installing tiles on external substrates where water may collect in the gaps, which means this operation is extremely important.



The Ultralite range



Ferrari and Maserati showroom, Saudi Arabia

- 1 Concrete substrate
- 2 Damp proofing barrier
- 3 Screed
- Topcem Pronto**
- 4 Adhesive  
**Ultralite S2 / Ultralite S2 Quick**
- 5 Non-woven fabric sheet  
**Mapetex System**
- 6 Adhesive  
**Ultralite S2 / Ultralite S2 Quick**
- 7 Grout  
**Ultracolor Plus**
- 8 Thin porcelain tiles

For further information on the preparation of the substrates, installation technique of large-size porcelain tiles and the choice of the adhesive, we recommend consulting the "Manual for installing large format ceramic tiles".

Thin tiles may also be used to dress façades in thermal cladding systems as specified for the **MAPETHERM TILE SYSTEM** (for more information refer to the "Mapetherm Tile System" Technical Notebook).

### 3.3 Installing ceramic on façades



- THERMAL LOADS AND STRESSES
- WEIGHT
- CLEANING
- SAFETY



Le Magnolie residential complex, Lodi

When installing ceramic materials on external façades (at more than 3 m above ground level) you must take into consideration the differential movements between the substrate and ceramic due mainly to temperature variations and, therefore, their exposure to direct sunlight, their geographical location and the colour of the tiles (dark coloured tiles have a higher coefficient of thermal expansion).

These stresses and loads, combined with the need to support the weight of the actual ceramic material, means it is very important to check the mechanical strength of the substrate:

- the cohesive tensile strength of the substrate (measured as adhesion strength to the structure) must be at least 1 N/mm<sup>2</sup> and its resistance to stresses and loads parallel to the installation bed must be  $\geq 1.2$  N/mm<sup>2</sup>. If the substrate does not meet these requirements new reinforced render fastened to the structure with the above mentioned characteristics must be applied.
- For masonry substrates (bricks, lightweight blocks, etc.) ceramic must not be installed directly; render with the characteristics mentioned previously must be applied beforehand.
- Installing ceramic on an existing wall covering is not recommended.
- It is preferable to use the double-buttering technique to apply adhesive; in particular this technique is mandatory for tiles with one side longer than 30 cm.
- For tiles with one side longer than 30 cm the combined use of mechanical safety hooks is recommended.
- The adhesive used to install ceramic material on façades must be a high-performance (class S2), deformable or highly deformable (class S1 or S2) cementitious product, depending on the loads and stresses acting on the surface and the format of tiles installed. When installing tiles with one side longer than 30 cm on façades, we recommend using deformable class S1 or S2 adhesive. An alternative solution is to use reactive adhesive (see table of products on page 14).
- The tiles must be installed with wide grout lines and their width must be calculated according to the size of the tiles and the local climatic conditions.
- Expansion joints with the capacity to absorb movements and thermal expansion of the tiles must also be included. The layout of the joints must be designed during the design phase to form maximum pitch areas of 9-12 m<sup>2</sup>. Expansion joints must also be included in correspondence with string-courses, corners, edges, windows and openings.



Differential thermal expansion depending on the colour of the ceramic



Bonding a test sample to carry out a pull-off test on render



Assessing the render following the results of the pull-off test



Failure of render unsuitable for bonding ceramic



The correct method to install tiles on a façade using the double-buttering technique



Tile detached from a substrate due to incorrect application of the adhesive (spot bonding)

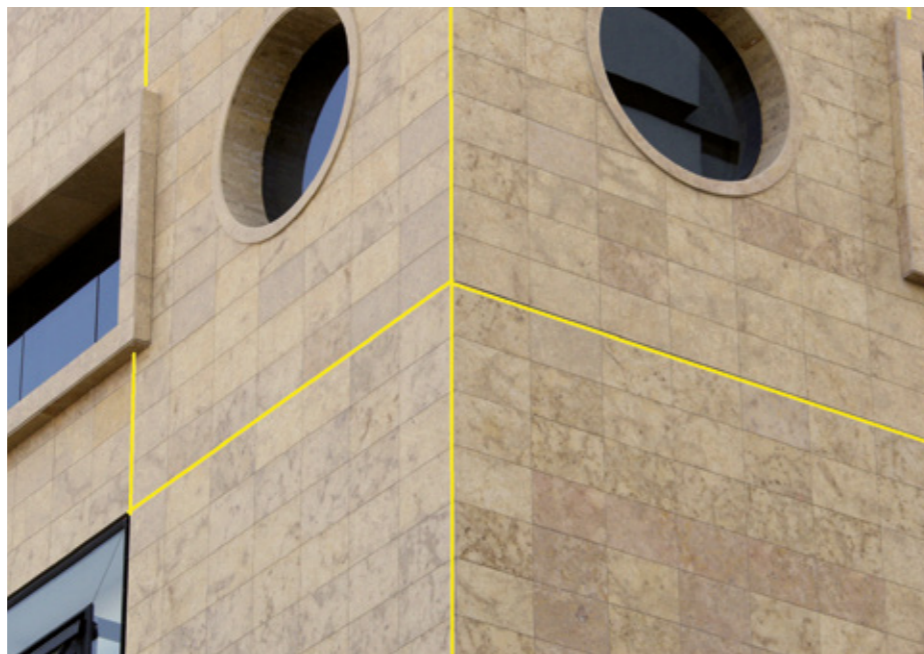


Detached ceramic installed on a substrate without joints

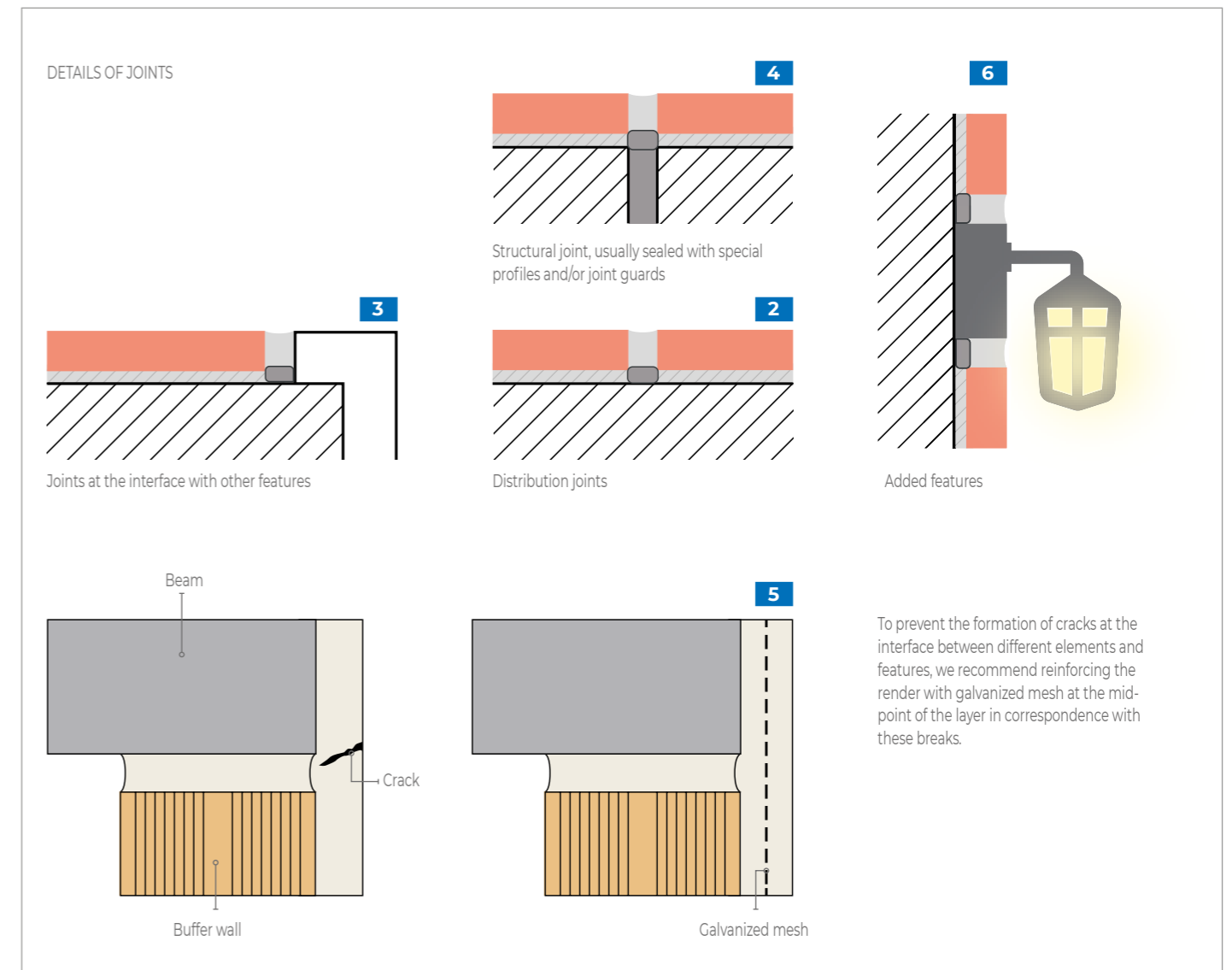
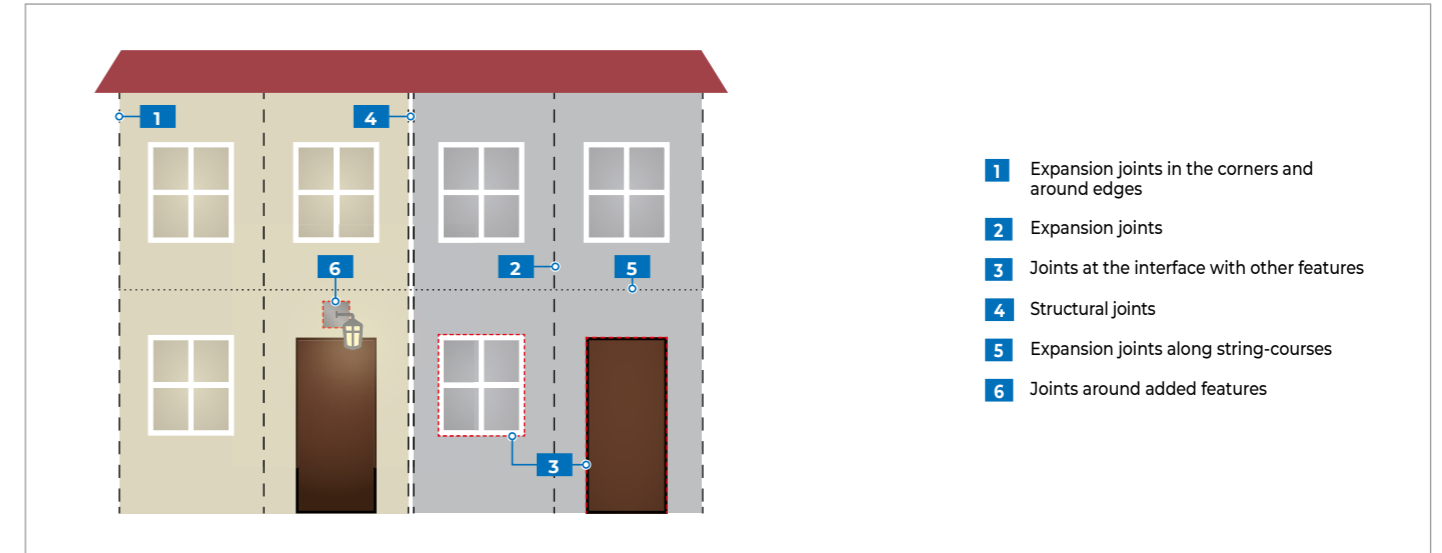
Elastic joints must be at least 6 mm wide and they must be calculated during the design phase according to the following factors:

- Spacing between joints (L)
- Maximum expected temperature variation when in service ( $\Delta T$ )
- Elongation capacity of the sealant (E)
- Coefficient of thermal expansion for the tile ( $\alpha$ )

Using the following formula:  $L_g$  (width of joint) =  $(\alpha \times \Delta T \times L) / E$



Example layout of elastic joints to be formed in the ceramic dressing on a façade



### 3.4 Installing external flooring



- THERMAL LOADS AND STRESSES
- ATMOSPHERIC AGENTS
- STRENGTH
- RISING DAMP



"Forum" Shopping Centre, Madeira



"Zelene Mesto" residential complex, Czech Republic

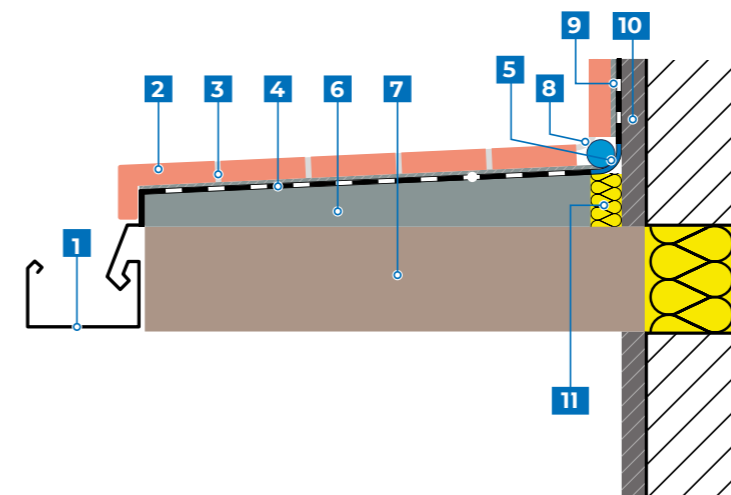
When you need to install external flooring the problems most frequently encountered are caused by the atmospheric conditions to which the flooring is exposed. The presence of water is undoubtedly one of the factors that can have the most damaging effect on the appearance and safety of external flooring, whether it is rainwater or moisture from rising damp. Another extremely important factor to be taken into consideration is temperature. When installing external flooring it is extremely important to calculate the stresses and loads acting on the flooring when in service so that the minimum strength requirements of the substrate can be defined correctly.

Secondly, external installation beds must always be waterproofed sufficiently. Applying a protective waterproofing layer for the substrate before installing ceramic material, such as one of the products from the **MAPELASTIC** range, offers numerous advantages, such as:

- it keeps the screed dry, particularly in cold weather, and avoids damage being caused by water collecting and freezing;
- it protects the surface and the rooms below from infiltrations of water;
- it forms a waterproof tank, in that it can be folded up over walls and the front edges of balconies and terraces, and prevents the risk of water rising up vertical surfaces, infiltrations at corners, around edges and in joints and leaching (e.g. the front edges of balconies);
- protects flooring against salts rising from the ground and forming unsightly surface efflorescence on the surface of tiles or grout lines.

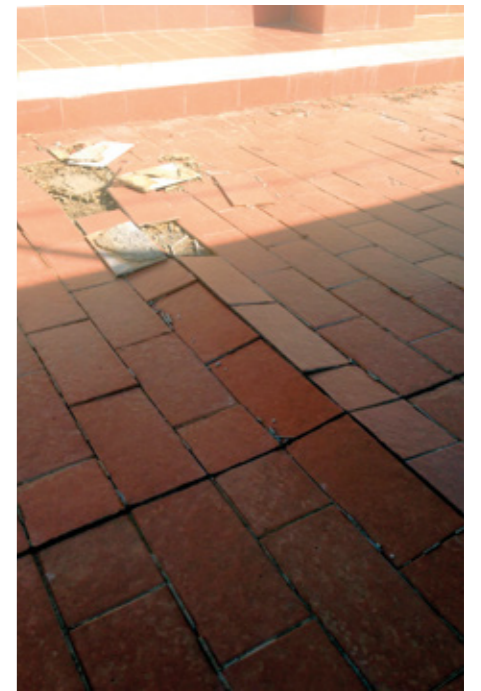
For further information on the application of products from the **MAPELASTIC** range on external surfaces refer to the "Technical Notebook for Waterproofing Terraces and Balconies".

Similarly to installing ceramic on façades, the thermal stresses and loads acting on external floors must also be thoroughly analysed. First and foremost, such stresses and loads means that tiles must be installed with wide grout lines. There must also be distribution joints in the tiling to reduce the risk of compressive loads which could lead to detachment of the tiles. It is usually recommended that the installation pattern includes pitch areas with elastic joints of around 9 m<sup>2</sup>. These joints must be sealed with elastic material so they can follow and absorb expansion/contraction to which the flooring is inevitably subjected.



- |  |  |
|--|--|
| 1 Guttering  | 6 Screed with a sloping layer <b>Topcem Pronto</b> |
| 2 Tile   | 7 Concrete floor slab                              |
| 3 Cementitious grout <b>Ultracolor Plus</b>            | 8 Sealant <b>Mapesil AC</b>                        |
| 4 Cementitious waterproofing product <b>Mapelastic</b> | 9 Adhesive <b>Keraflex Maxi SI</b>                 |
| 5 Rubber-backed tape <b>Mapeband</b>                   | 10 Render  |
|  | 11 Isolating layer                                 |

Section of a waterproofing system and installation of external flooring



Detachment caused by compressive loads acting on an external floor due to a lack of joints

### 3.5

## Installing a covering with an “exposed finish”



- THERMAL LOADS AND STRESSES
- SAFETY



A particularly difficult case is the installation of stone veneer to dress surfaces with an “exposed” finish. This type of 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 install this type of product are very similar to those for installing ceramic on façades. The loads and stresses acting on this type of material are mainly thermal and their effect depends on whether surfaces are exposed to sunlight, the geographical area where they are installed and the colour of the material. Substrates on which this type of material is installed, therefore, must be strong enough to resist the loads and stresses that will be acting on them.

Stone veneer elements must be installed 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 the back of the slab.

The adhesive must be chosen according to the surrounding conditions and the

type and format of the stone veneer slab and its performance characteristics must increase as the installation conditions become more critical.

Amongst the normal-setting adhesives available there is a choice between products such as **ULTRALITE S1**, **KERAFLEX MAXI S1** or **ULTRALITE S2**. If a quick-setting product is required, on the other hand, the choice will be for adhesives such as **ULTRALITE S1 QUICK**, **ELASTORAPID** or **ULTRALITE S2 QUICK**.

After installing the slabs they have to be carefully tapped into place to make sure the adhesive is distributed correctly and evenly over the back.

Stone veneer elements must be positioned so as to leave a sufficient grout line between them (around 5 mm wide) and expansion joints should be included in areas of up to a maximum of 9 m<sup>2</sup>.

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

Elastic joints must also be formed around corners, edges, window and door fittings and all other features and fittings that form breaks in the dressed surface. These joints may be sealed with **MAPESIL LM** or **MAPEFLEX PU45 FT**.

The size and layout of structural joints must also be respected their pattern must be maintained in the stone covering when it is installed.

This type of material may also be used on façades in thermal cladding systems as specified for the **MAPETHERM TILE SYSTEM** (for more information refer to the “Mapetherm Tile System” Technical Notebook).



Installing stone veneer with an “exposed” finish

### 3.6 Installing ceramic in commercial and industrial surroundings



- **STATIC/DYNAMIC LOADS**
- **LARGE SURFACES**
- **CHEMICAL ATTACK**
- **HYGIENE**



Cerna Hora Brewery, Czech Republic



"Il Centro" Shopping Centre, Arese

Ceramic installed in commercial and industrial surroundings must be able to withstand higher loads and stresses than in civil surroundings. These loads and stresses vary considerably, depending on the area of use (such as supermarkets, warehouses, airports, chemical industry, dairies, etc.). Whatever the type of surroundings, however, surfaces must be strong, durable and easy to clean and maintain. It is not possible to meet these requirements by considering just the

installation system but also the tiles themselves must be chosen in order to meet these requirements.

The durability of these tiles, which often have to withstand intense static and dynamic loads, depends firstly on the substrate, which must be strong enough for the area of use. As a general guide, in commercial/industrial areas, we recommend that the compressive strength of substrates is at least 30 N/mm<sup>2</sup> for floors and the pull-off strength is at least 1 N/mm<sup>2</sup> for walls.

The adhesive must be able to reach a high level of mechanical strength (and in certain cases good resistance to chemicals), which means you must opt for high-performance adhesive (C2 or R2 according to EN 12004 standards). Also, choosing rapid-setting adhesive (class F) generally allows higher mechanical performance characteristics to be achieved than with normal-setting adhesive (see paragraph 3.11 "Rapid installation systems").

To guarantee the durability of the system the installation bed must be compact, which is why ceramic must be installed using the double-buttering technique using adhesives such as **KERAFLEX MAXI S1** or, as an alternative, by using adhesives with high wetting capacity (such as adhesives from the **ULTRALITE** range).

Commercial and industrial areas often cover large surface areas and their design must take into consideration the correct size of grout lines and expansion and distribution joints (when overlaying existing flooring the layout of the joints in the old flooring must be followed).

To be more specific, because of the sheer size of such areas, it is recommended to install ceramic with wide grout lines for the following reasons:

- dimensional irregularities in the tiling will have less effect
- the tiling will be less rigid, thereby reducing the risk of compressive loads in the ceramic, which could then lead to cracks or detachment
- filling the grout lines can be controlled more easily, which guarantees higher strength and increased durability.

Distribution joints must be formed around the perimeter of the rooms with pitch areas of 25 m<sup>2</sup> in internal surroundings and 9 m<sup>2</sup> in external surroundings.

A high level of resistance to chemicals is often required in industrial surroundings. In such cases the grout lines may be filled and, where required, the ceramic may be bonded, with an epoxy product from the **KERAPOXY** range. These products also allow another important requirement to be met: the level of hygiene. In fact, with epoxy grout, completely non-absorbent, easy to clean surfaces may be created: **KERAPOXY CQ** in particular has been analysed at the University of Modena and has been certified as a product with high anti-bacterial properties.





The Kerapoxy range

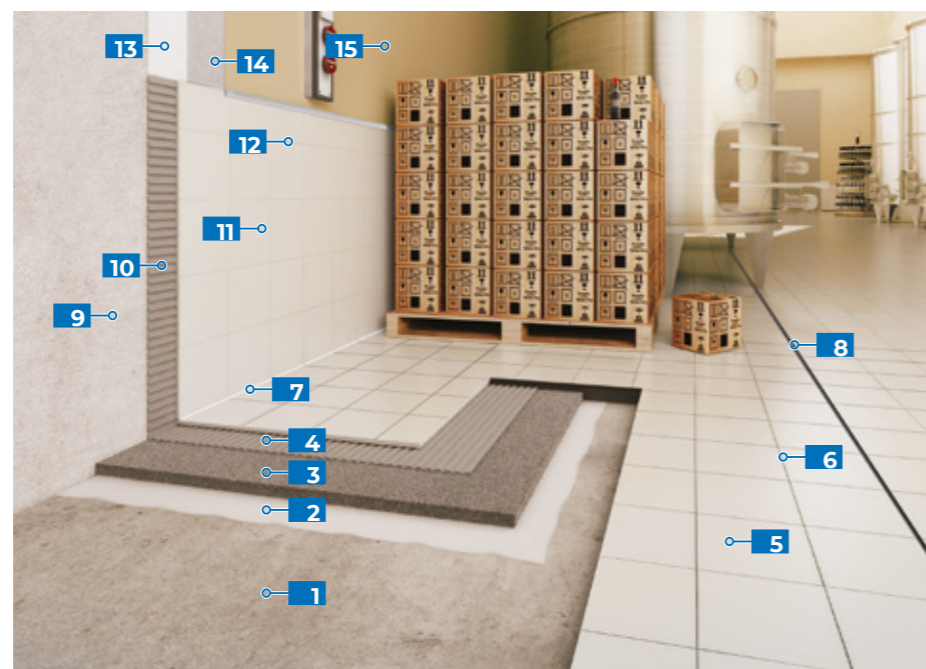
Products from the **KERAPOXY** line allow floors, walls, worktops, etc. to be made which comply with the HACCP system and the requirements of EC Regulation No. 852/2004 regarding the hygiene of foodstuffs.

A particularly special example is for flooring exposed to attack from oleic acid and aromatic hydrocarbons. With this type of installation, grouts need to be filled with **KERAPOXY IEG** two-component epoxy mortar with very high resistance to chemicals, suitable for use on floors in meat processing plants and in cooking and stripping areas, where the grouting mortar remains in contact with animal fats and oleic acid for long periods and has to be cleaned frequently with hot water under pressure.

When the substrate also needs to be impermeable to acids, before installing the ceramic, we recommend applying **MAPEGUM EPX**, two-component epoxy resin which forms a flexible, impermeable layer resistant to chemicals.

Rapid systems are often required in commercial/industrial environments, so that access to areas where installation work is taking place remains closed down for as short a period of time as possible, especially when repairing or relaying tiling. For such cases Mapei has various rapid substrate and grouting systems available, which allow areas to be reopened to foot traffic within just a few hours (see section 3.11).

- Reinforced cement floor slab **1**
- Adhesion promoter **2**  
**Eporip**
- Screed **3**  
**Topcem Pronto**
- Adhesive **4**  
**Elastorapid**
- Oversized klinker **5**
- Grouting **6**  
**Kerapoxy CQ**
- Sealant **7**  
**Mapeflex PU20**
- Sealant **8**  
**Mapeflex PU45 FT**
- Render **9**
- Adhesive **10**  
**Ultralite S1**
- Porcelain tiles (20x20 cm) **11**
- Grouting **12**  
**Kerapoxy CQ**
- Skimming compound **13**  
**Planitop 540**
- Primer **14**  
**Mapecoat I 600 W**
- Finish **15**  
**Mapecoat I 24**



System for installing ceramic in areas subjected to intense traffic and aggressive chemicals

### 3.7 Installing ceramic in swimming pools and wellness areas



Borovika Hotel, Slovakia



- **PERMANENT WATER CONTACT**
- **MECHANICAL LOADS AND STRESSES**
- **CHEMICAL ATTACK**
- **HYGIENE**



In areas such as swimming pools, wellness areas and SPA centres, surfaces are subjected to high mechanical loads and stresses (such as hydrostatic pressure), thermal loads and stresses (such as temperature variations), chemical attack (such as cleaning and sanitising products, spa waters, etc.) and constant or frequent contact with water. To guarantee the durability of tiling over the years in such areas, substrates need to be completely protected by applying waterproofing membranes such as **MAPELASTIC** or **MAPELASTIC SMART**. The installation system, as well as the ceramic dressing material, must be chosen so that they withstand the design loads and stresses.

Ceramic must be installed in these types of surroundings using adhesives with the following requirements according to EN 12004 standards:

- Class C2 to guarantee high adhesion strength, including on non-absorbent substrates or when in permanent contact with water;
- Class S1 or S2 deformability in order to absorb any deformations induced by the mechanical or thermal loads and stresses acting on them.

In these types of surroundings we suggest using the double-buttering technique to guarantee the layer of adhesive is compact and to prevent the formation of gaps.

The loads and stresses present in these types of surroundings need extra care when calculating the correct size and layout of grout lines and joints. Grouting products must be chosen according to the substances that could come into contact with the grout and the type and frequency of the sanitising treatments required. In wellness areas and spa centres the presence of chemical products in the air and water in contact with the tiles must also be taken into consideration. In certain cases the tiles will need to be grouted (and sometimes also installed) using products with high resistance to chemicals from the **KERAPOXY** range. These products have certain advantages, such as:

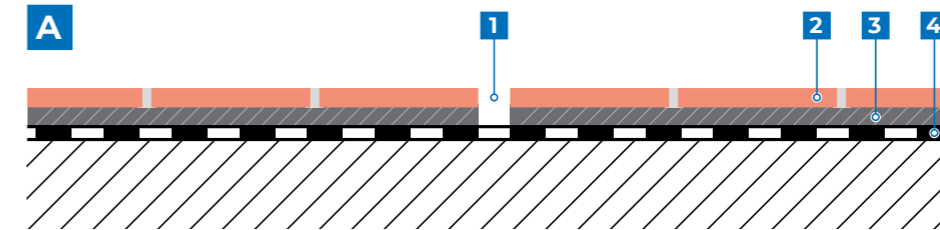
- High mechanical strength and high resistance to chemicals
- More resistance to spa and salty waters and chemical products in general that are usually aggressive when in contact with cementitious mortar, including products used to sanitise water
- No porosity, impermeability and, therefore, better protection for substrates
- Very hygienic

When choosing installation products for swimming pools, the time required before putting them into service must be taken into consideration: normal-setting products take quite a long time before being put into service; to reduce such time, rapid systems need to be used, such as **PLANITOP FAST 330** to level off substrates, **GRANIRAPID** or **ELASTORAPID** to bond the ceramic and **ULTRACOLOR PLUS** to fill the grouts. For further information on installing ceramic materials in swimming pools refer to the Technical Notebook "Waterproofing Baths and Swimming Pools".

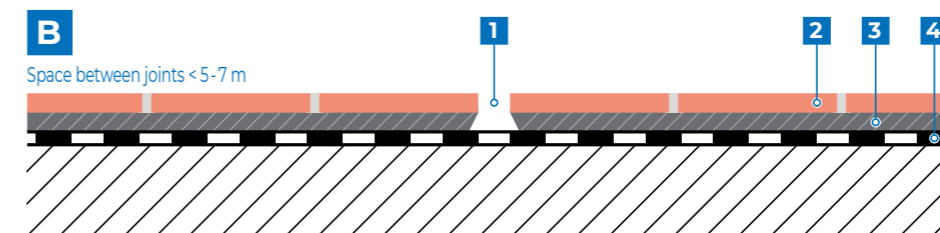


MAPEI rapid installation products for swimming pools

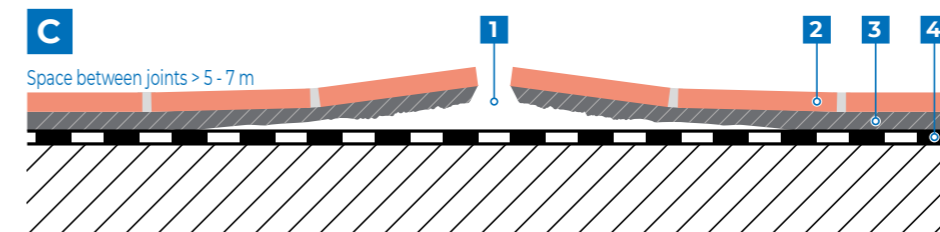
It is also extremely important to calculate the correct size and layout of joints in the ceramic when building swimming pools.



Ceramic dressing with an expansion joint



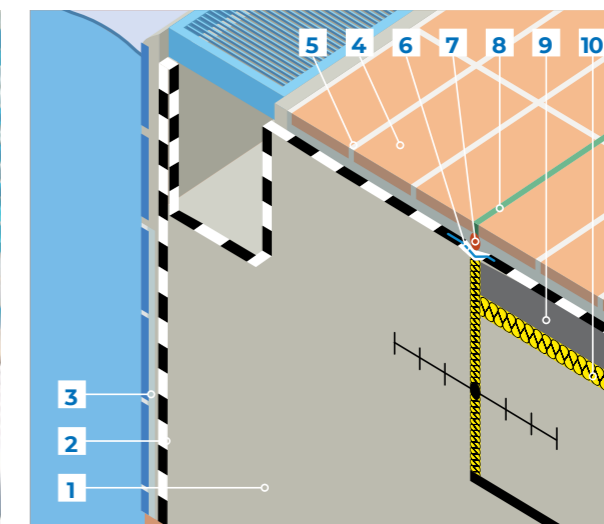
Thanks to the expansion joints, stresses in the tiling have a single escape route and they are unable to reach levels high enough to cause compressive loads or detachment of the tiles



If the pitch areas for the joints are too large (e.g. every 8-10 m) stresses can build up: the tiles along the sides of the joint are compressed and become detached.

- 1 Expansion joint
- 2 Tile

- 3 Deformable cementitious adhesive
- 4 Waterproofing layer



- 1 Concrete
- 2 **Mapelastic**
- 3 Deformable adhesive **Granirapid**
- 4 Tile
- 5 Cementitious grout **Ultracolor Plus**
- 6 Rubber-backed tape **Mapeband**
- 7 Foam polyurethane cord **Mapefoam**
- 8 Elastic sealant **Mapesil AC**
- 9 Screed
- 10 Isolating layer

Example of a critical area in a waterproofing system in a swimming pool and a detailed view of the correct installation system

### 3.8 Installing ceramic in bathrooms and kitchens



- CONTACT WITH WATER
- CHEMICAL ATTACK
- THERMAL LOADS AND STRESSES
- HYGIENE



Hotel Alpina Dolomites, Alpe di Siusi, Bolzano



Installing ceramic in bathrooms and kitchens may be considered another example, although less critical, of the installation system discussed in section 3.7.

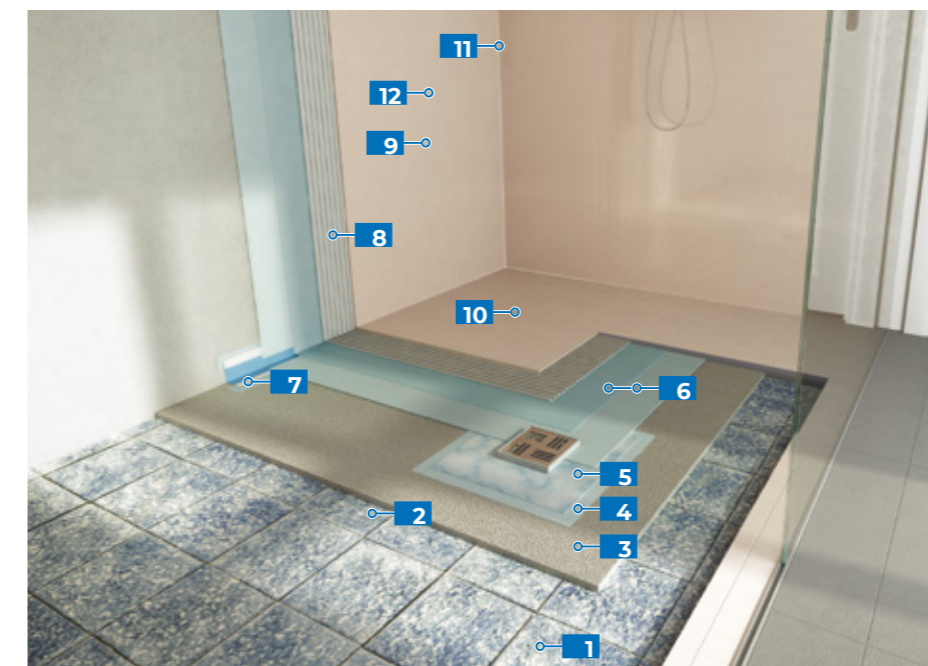
Waterproofing for the installation beds in these types of surroundings is recommended but not always necessary. Ready-mixed products may be used to waterproof surfaces in these types of areas, such as **MAPEGUM WPS** or **MAPELASTIC AQUADEFENSE**.

The choice of which adhesives to use to install ceramic in these surroundings depends principally on the absorption of the substrate and the type of tile to be installed.

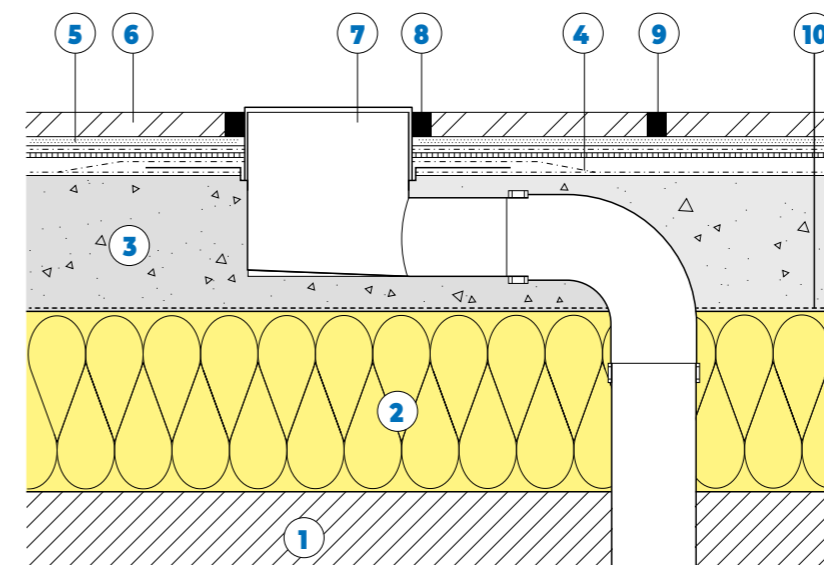
Some types of substrate may require a special treatment. In bathrooms with plasterboard walls, for example, we recommend treating surfaces with **PRIMER S** water-based waterproofing primer to improve the resistance of surfaces when water and moisture are present.

For kitchen worktops with a marine ply substrate we also suggest installing ceramic with elastic reactive adhesive, such as **KERALASTIC** or **ULTRABOND ECO PU 2K**: this product may be used in such surroundings by applying a first coat down to a feather-edge to waterproof the surface and protect it from water, followed by a second coat applied with a notched spreader to bond the ceramic dressing.

The cleanability of surfaces in these types of surroundings is a very important requirement so the grouts must be filled with specific products, such as **ULTRACOLOR PLUS** cementitious grout with **DROPEFFECT** and **BIOBLOCK** technology, or epoxy grout from the **KERAPOXY** range.



- Existing tiles
- Primer **Eco Prim T**
- Smoothing layer **Planitop Fast 330**
- Ready-mixed waterproofing product **Mapelastic AquaDefense**
- Floor drain **Drain Vertical**
- Ready-mixed waterproofing product **Mapelastic AquaDefense**
- Rubber-backed tape **Mapeband**
- Adhesive **Elastorapid**
- Glass mosaic
- Grouting **Kerapoxy Design + MapeGlitter**
- Sealant **Mapesil AC**
- Grouting **Kerapoxy Design**



- Reinforced concrete structure
- Insulation material
- Topcem Pronto**
- Mapelastic AquaDefense**
- Elastorapid**
- Flooring
- Drain Lateral**
- Mapesil AC**
- Kerapoxy Design**
- PE sheet

Sectional view of a Drain Lateral

### 3.9 Installing ceramic on traditional and low-thickness heated screeds



- THERMAL SHOCK
- MECHANICAL LOADS AND STRESSES
- THERMAL LOADS AND STRESSES



Conventional and compact heated screeds are further examples of special installations.

With both types the installation bed is an extremely important factor in guaranteeing the durability of tiling. The sub-layer varies in thickness and is interrupted in certain areas by the heating elements that create areas of discontinuity and weakness. For this reason it is very important that the products used to embed the heating system are compact and very strong.



Installation of pipework in an underfloor heating system



Sub-layer with the heating elements for the system embedded in TOPCEM PRONTO



Final flooring over an underfloor heating system



Low-thickness heated substrate made from NOVOPLAN MAXI



With conventional heated screeds the thickness of the screed above the elements and the dimples in the heating system must be at least 3 cm and metallic mesh must be incorporated in this layer to increase its resistance to cracking.

Screeds must be made using products with high thermal conductivity, such as **TOPCEM PRONTO**, which is certified with a value of  $\lambda = 2,008$  W/mK.

With compact heating systems the thickness of the layer above the dimples on the heating system can be only as low as 3 mm, but the product chosen to fill the gaps must be able to guarantee excellent performance characteristics like **NOVOPLAN MAXI** that is characterised by high thermal conductivity  $\lambda = 1,7$  W/mK. This type of heating system is widely used nowadays because it offers the possibility of installing new systems in buildings being renovated without having to remove the old flooring.



With both types of heating system ceramic cannot be installed until they have been commissioned and tested with a test cycle as specified by current standards (EN 1264-4).

- Concrete substrate **1**
- Soundproofing membrane **2**  
*Mapesilent Comfort*
- Soundproofing strip **3**  
*Mapesilent Band R*
- Soundproofing tape **4**  
*Mapesilent Tape*
- Vapour barrier **5**
- Underfloor heating system **6**
- Screed **7**  
*Topcem Pronto*
- Adhesive **8**  
*Keraflex Maxi S1 zero*
- Sealant **9**  
*Mapeflex PU45 FT*
- Grouting **10**  
*Keracolor FF*
- Sealant **11**  
*Mapesil AC*
- Smoothing layer **12**  
*Planitop 560*
- Primer **13**  
*Malech*
- Glass fibre wallpaper **14**  
*EQ Dekor*
- Finish **15**  
*Colorite Performance*



System for installing ceramic on a heated screed

The testing cycle usually involves switching the system on at the lowest temperature and then raising the temperatures by 5°C each day until it reaches its maximum working temperature. This temperature is held constant for around three days and then a reverse cycle is carried out by decreasing the temperature by 5°C each day until it reaches room temperature.

This aim of this cycle is:

- To check the water-tightness of the system
- To generate a thermal shock before installing the ceramic to highlight any stresses and the formation of cracks that can then be repaired before installing the flooring
- To help the sub-layer dry out completely.

To install ceramic on this type of substrate you need to use deformable adhesive (class S1 or S2 according to EN 12004 standards) that can absorb mechanical and thermal phenomena acting on the flooring.

As a general guide, when installing ceramic on heated cementitious or anhydrite screeds inside residential buildings, we suggest using class S1 or s2 deformable adhesive when one side of the tiles is longer than 90 cm.

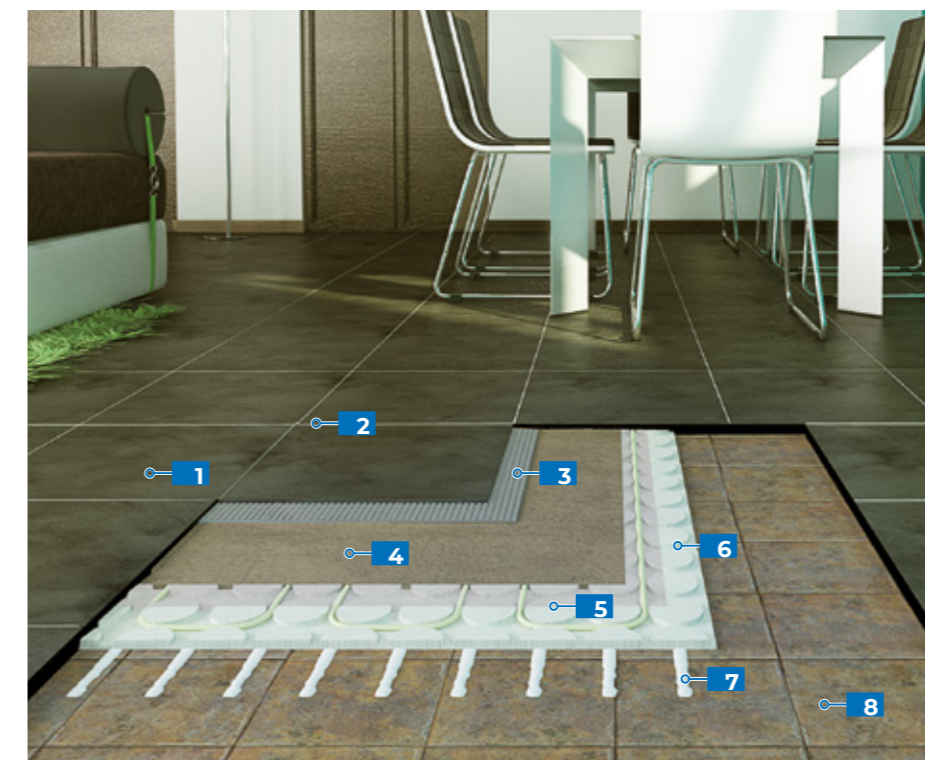
While the type of adhesive is important, it is even more important that they are installed with wide grout lines and that the expansion joints are the right size (which must also follow the same pattern as the joints in the heating system).

The grouts should preferably be sealed with cementitious products from class CG2 according to EN 13888 standards.

The material used to seal expansion joints must be chosen according to the service temperature, making sure the coefficient of elongation of the product is compatible with the movements expected when in service.



- 1** Existing ceramic flooring
- 2** Primer  
*Eco Prim T*
- 3** Compact underfloor heating system
- 4** Smoothing layer  
*Novoplan Maxi*
- 5** Adhesive  
*Ultralite S1*
- 6** Thin porcelain tiles
- 7** Grouting  
*Keracolor FF*
- 8** Sealant  
*Mapeflex PU45 FT*
- 9** Smoothing layer  
*Planitop 560*
- 10** Primer  
*Dursilite Base Coat*
- 11** Finish  
*Dursilite*



- 1** Thin porcelain tiles
- 2** Grouting  
*Ultracolor Plus*
- 3** Adhesive  
*Ultralite S1*
- 4** Smoothing layer  
*Novoplan Maxi*
- 5** Primer  
*Eco Prim T*
- 6** Gypsum-fibre or cement-fibre panels
- 7** Adhesive  
*Ultrabond MS Rapid*
- 8** Existing floor

System for installing ceramic on a low-thickness underfloor heating system

### 3.10 Installing ceramic on existing wall/floor coverings



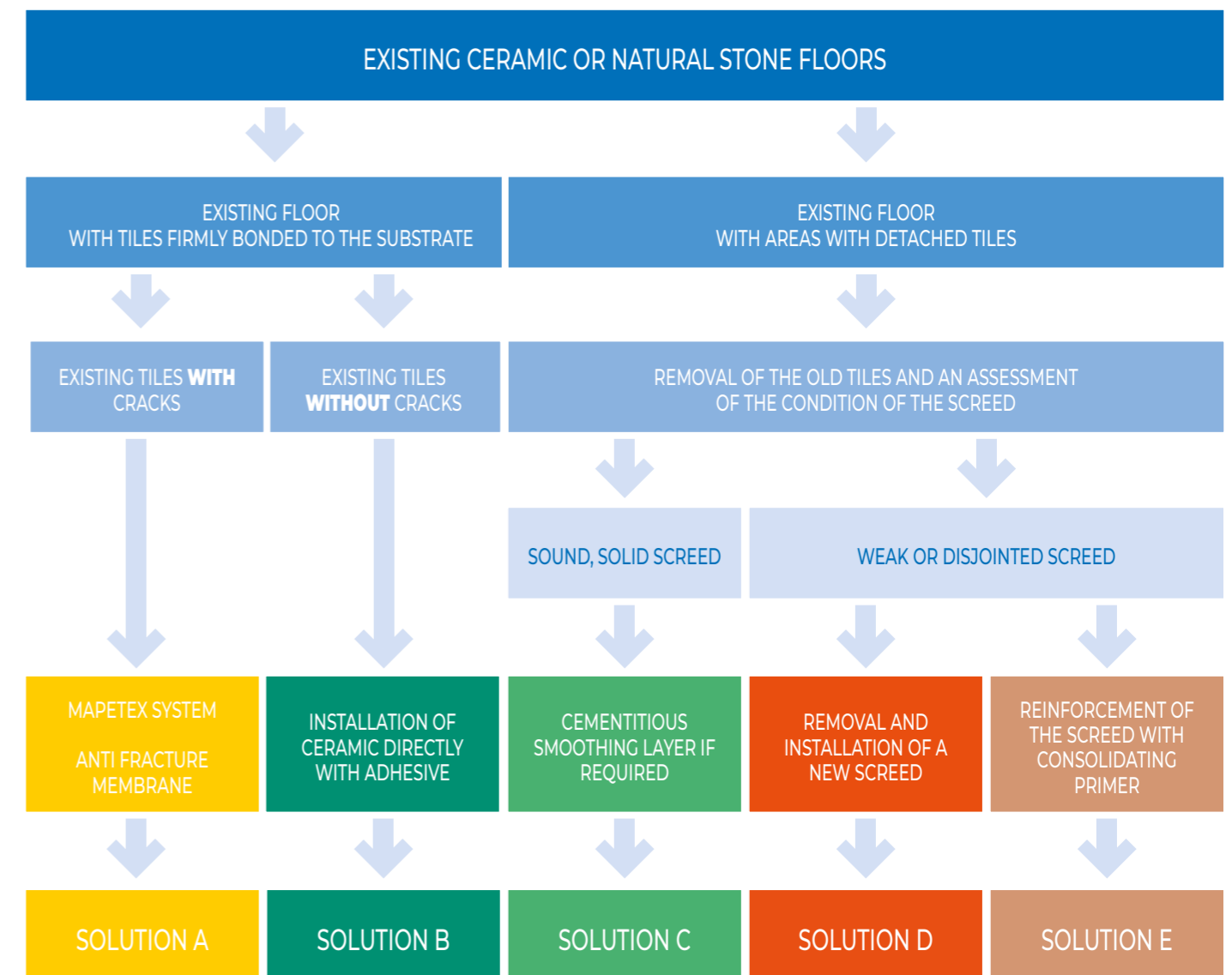
- **CONDITION OF EXISTING SUBSTRATE**
- **NON-ABSORBENCY**
- **CLEANING**
- **LAYOUT OF EXISTING JOINTS**



The first thing to do when installing ceramic on an existing floor is to thoroughly clean the surface with water and caustic soda or a special de-waxing product. Particularly shiny floors may need to be lightly sanded or treated with an adhesion promoting primer, such as **ECO PRIM GRIP** or **ECO PRIM T**. Overlaying existing floors is similar to installing ceramic on non-absorbent substrates, which means high-performance class C2 adhesive must be used, or reactive class R2 adhesive if you need to obtain higher performance characteristics.

With this type of installation it is extremely important to replicate the layout of the expansion and distribution joints in the old floor. The joints must be set in the same position in the new flooring, unless a **MAPETEX SYSTEM** anti-fracture membrane is inserted.

After checking the condition of the existing surface the various solutions that may be adopted to prepare substrates and install ceramic are illustrated schematically below.



## SOLUTION A



### INSTALLING CERAMIC ON AN OLD FLOOR WITH CRACKED TILES FIRMLY BONDED TO THE SUBSTRATE

If the existing tiles are firmly anchored to the substrate but have light surface cracks (not caused by subsidence in the substrate), new ceramic flooring may be installed by applying a **MAPETEX SYSTEM** isolating/anti-fracture layer.

This type of membrane is made from special non-woven fabric that may be used as:

- An **anti-fracture membrane** to prevent cracks in the substrate spreading and appearing in the new floor.
- An **isolating membrane** to install ceramic in internal rooms without having to copy the layout of the existing distribution joints.
- A **removable substrate** for installing new flooring and to safeguard the existing floor so that it may be used again.

## SOLUTION B



### INSTALLING CERAMIC ON AN OLD FLOOR WITH TILES WITHOUT CRACKS FIRMLY BONDED TO THE SUBSTRATE

Overlaying existing tiles (firmly anchored with no cracks) must be carried out by leaving wide grout lines and by copying the layout of the distribution and expansion joints in the old flooring, or with joints at least every 25 m<sup>2</sup>.

Before installing ceramic directly on the existing tiles thoroughly clean them with water and caustic soda or a special de-waxing product, and sand the surface if required.

New flooring must be bonded with high performance adhesive (class C2 according to EN 12004). The adhesive chosen to bond the new flooring must be suitable for the type and format of the new tiles, the surrounding weather conditions on site and the waiting time before putting it into service.

If a smoothing and levelling layer is required over the existing flooring use a suitable levelling mortar such as **PLANITOP FAST 330** or **ULTRAPLAN** after cleaning the surface as specified above and application of primer **ECO PRIM GRIP** or **ECO PRIM T**.

## INSTALLING CERAMIC ON A SOUND, SOLID EXISTING SCREED

After removing all traces of old adhesive and any detached areas, remove all the dust from the surface and apply an adhesion promoting primer such as **PRIMER G** or **ECO PRIM T**. Any gaps due to missing tiles or hollows in the surface must be in-filled with cementitious mortar, such as **PLANITOP FAST 330** or **ULTRAPLAN**, to form a seamless installation bed.

## INSTALLING CERAMIC AFTER REMOVING AN EXISTING SCREED

If the existing screed is unsuitable for the installation of new flooring it will have to be removed and a new cementitious screed will need to be installed according to the specifications in the Technical Notebook for the installation of screeds.

## INSTALLING CERAMIC ON A WEAK EXISTING SCREED

If the screed is not strong enough for its intended use it may be consolidated with a suitable primer such as:

- **PROSFAS** solvent-free consolidator in water solution with high penetration properties for cementitious substrates;
- **PRIMER MF** two-component solvent-free epoxy primer.

Immediately after applying the consolidating product, the surface of the treated screed must be broadcast with dry sand to form a surface with good mechanical grip for the next layers (smoothing compound or installation adhesive).

## SOLUTION C



## SOLUTION D



## SOLUTION E



### 3.11 Rapid installation systems



- SPEED
- MECHANICAL LOADS AND STRESSES
- THERMAL LOADS AND STRESSES
- HYGIENE



Iper Shopping Centre, Varese

Because of particular environmental conditions and areas of use, flooring often has to be installed in a very short space of time. Installing new tiling in supermarkets, airports, hospitals and in surroundings where normal activities can only be interrupted for up to a few hours are typical examples.

When choosing the most appropriate installation system for these types of surroundings, time constraints must be taken into consideration, and the choice tends to be for products that are not only rapid, but which also allow the new surfaces to be reopened for normal service after just a few hours.

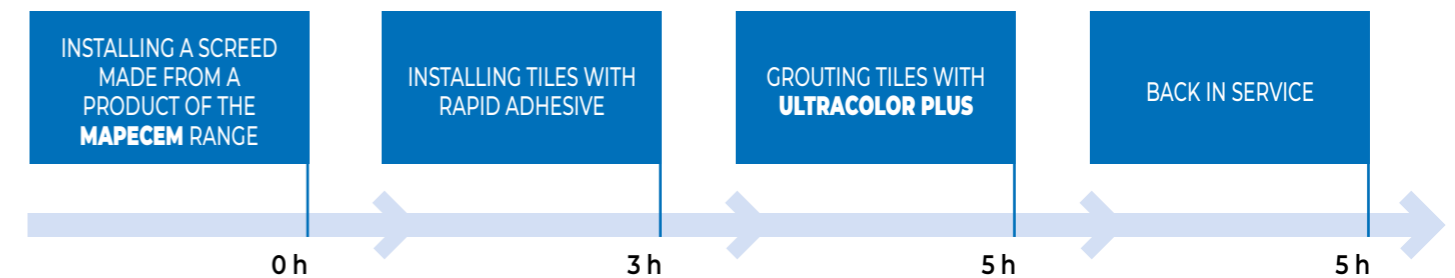
A rapid system proposed for this type of work could be as follows:

- **MAPECEM/MAPECEM PRONTO:** pre-blended, rapid-setting and hardening binder and mortar. Using these products allows ceramic tiles to be installed approximately 3 hours after installing the screed.
- **PLANITOP FAST 330:** cementitious levelling mortar applied in layers from 3 to 30 mm thick for internal and external floors and walls. Levelling off the installation bed with this product allows tiling to be installed after approximately 4 hours.
- **ADESILEX P9 EXPRESS, ELASTORAPID, GRANIRAPID, KERAQUICK MAXI S1, ULTRALITE S1 QUICK and ULTRALITE S2 QUICK:** rapid, high-performance cementitious adhesives which allows grouting approximately 2-3 hours after bonding the tiles.
- **ULTRACOLOR PLUS:** high-performance, rapid-setting cementitious grout. Tiles grouted with this product may be reopened to foot traffic after around 3 hours.

Adopting this system allows surfaces to be cordoned off, or to cordon off smaller areas in phases if the entire area cannot be closed down, and then reopened to foot traffic after just 8 hours.



Rapid installation of ceramic flooring in a shopping centre



Fast Track



### 3.12 Installing ceramic in tunnels



- EVENNESS OF THE SUBSTRATE
- MECHANICAL LOADS AND STRESSES
- SAFETY
- CLEANING



Base tunnel on the Variante di Valico Highway, Bologna

When building new tunnels, or where the existing substrates are even enough after radical repair work, it is becoming more common to use ceramic wall coverings to finish off internal surfaces. Compared with traditional materials (lime, paint, etc.), this type of finish has important advantages: it is more durable over the years, surfaces are stronger and more resistant to chemicals, it provides more light inside tunnels, it has low dirt pick-up properties and it can be cleaned more easily and less frequently.

Large, thin tiles are being used more and more frequently in this special type of installation. These tiles have a better surface finish compared with traditional ceramic.

The main problem encountered when installing ceramic in tunnels is the evenness of the substrate, especially when large tiles need to be installed. To be suitable for installing ceramic the substrate must be even enough to provide the right level of mechanical strength.

Installation surfaces must be thoroughly cleaned to remove all the dirt, dust, bleeding, form-release compounds and paint that could affect adhesion. This type of construction site generally creates a lot of dust so cleaning must not be carried out until a few hours before commencing installation operations.

Each dressing element must be installed and positioned very carefully, sometimes with the help of laser equipment.

The adhesives used to install the ceramic must be high-performance class C2 and deformable to at least class S1 and, to guarantee good adhesion, the adhesive must be applied using the double-buttering technique. Because the surface area of the tunnel piers is so large, the application method and time required may be considerably improved by choosing products that can be applied by spray, such as **KERAFLEX MAXI S1**.

This product may be applied in much thicker layers than traditional cementitious adhesive, a characteristic which makes it particularly suitable for reintegrating uneven areas in the substrate.

Then, by applying adhesive on the back of the tiles with a spreader, you can form a fully wet installation bed without leaving any gaps.



Spray-application of adhesive on the installation bed



Spreading adhesive on the back of the tiles



Bonding a tile to a tunnel pier

The grouting product chosen for this type of installation must also guarantee total resistance to de-icing salts and the high level of abrasion it is subjected to during cleaning operations and must have good cleanability so it is easier to remove smog, dust, etc. For this reason we suggest using an epoxy product such as **KERAPOXY CQ**.

The sealant used for the expansion joints must also meet the same technical requirements: and for this operation we recommend using **MAPEFLEX PU45 FT**. The layout of the joints must be defined during the design phase of the ceramic dressing and it must be compatible with the loads and stresses acting on the joints when in service.

And lastly, as far as safety is concerned, apart from the adhesive, we suggest using anti-rotating mechanical hooks to hold the tiles to stop them falling or becoming detached due to unforeseen loads or stresses.

Possible systems of products for the mentioned special installation examples		Adhesive	Grouting
3.1	Installing Glass Mosaic	ADESILEX P10	KERAPOXY DESIGN
3.2	Installing Large-size tiles	ULTRALITE lite	KERAPOXY CQ
3.3	Installing ceramic on façades	KERABOND+ISOLASTIC ULTRALITE S2/ULTRALITE S2 QUICK	ULTRACOLOR PLUS
3.4	Installing external floorings	KERAFLEX MAXI S1 ULTRALITE S1 QUICK	KERACOLOR+FUGOLASTIC ULTRACOLOR PLUS
3.5	Installing a covering with an "exposed finish"	KERAFLEX MAXI S1 ULTRALITE S1 QUICK	MAPEWALL MURATURA FINE
3.6	Installing ceramic in commercial and industrial surroundings	KERAFLEX MAXI S1 ELASTORAPID KERAPOXY ADHESIVE*	KERAPOXY KERAPOXY CQ KERAPOXY IEC*
3.7	Installing ceramic in swimming pools and wellness areas***	KERAFLEX MAXI S1 GRANIRAPID ADESILEX P10+ISOLASTIC**	ULTRACOLOR PLUS KERAPOXY CQ KERAPOXY DESIGN**
3.8	Installing ceramic in bathrooms and kitchens***	KERAFLEX MAXI S1 ELASTORAPID ULTRABOND ECO PU 2K	ULTRACOLOR PLUS KERAPOXY CQ KERAPOXY DESIGN**
3.9	Installing ceramic on traditional and low-thickness heated screeds	KERAFLEX MAXI S1 ULTRALITE S1	KERACOLOR FF ULTRACOLOR PLUS
3.10 Solution A	Installing ceramic on existing wall/floor coverings with cracks	ULTRALITE S2 QUICK (also to bond MAPETEX)	ULTRACOLOR PLUS
3.10 Solution B	Installing ceramic on existing wall/floor coverings without cracks****	KERAFLEX KERAFLEX MAXI S1 GRANIRAPID	ULTRACOLOR PLUS
3.11	Rapid installation systems	ADESILEX P9 EXPRESS KERAQUICK MAXI S1 ULTRALITE S2 QUICK	ULTRACOLOR PLUS
3.12	Installing ceramic in tunnels	KERAFLEX MAXI S1	KERAPOXY CQ

\* in case of chemical stress  
 \*\* in case of glass mosaic  
 \*\*\* onto MAPEI waterproofing systems  
 \*\*\*\* after application of ECO PRIM GRIP

The information and advice contained in this manual are for indication purposes only and do not reflect all the different situations that may be encountered on site. In the event of situations or conditions not covered by this manual, the MAPEI Technical Services team is available to help identify the most appropriate solution for each specific intervention. For further details about our products consult the relative product Technical Data Sheets available on our website [www.mapei.it](http://www.mapei.it).

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