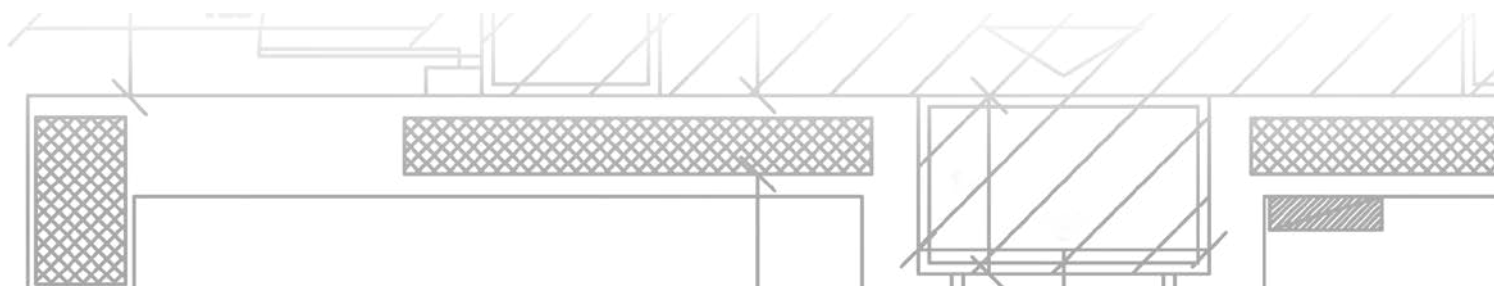




Technical Notebook

LAYING STONE MATERIALS

Materials and systems for the correct
laying of natural and engineered stone



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LAYING STONE MATERIALS

Materials and systems to lay natural
and engineered stone correctly

Front cover image:

THE VICEROY PALM JUMEIRAH, DUBAI – UAE

Instructions contained in this document and their respective suggestions are to be considered merely indicative and cannot represent every possible issue occurring on the building site. For this reason, MAPEI Technical Assistance is always available to find the most suitable solution for your specific intervention. For further information about our products, please refer to the relevant Technical Data Sheets available from our website www.mapei.com.

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1. INTRODUCTION

The aim of this Technical Notebook is to offer useful guidelines to help lay natural and engineered stone materials correctly with long-lasting results using technologically advanced products and systems developed by MAPEI, thanks to the company's experience gained over the years, as well as constant technical support from the company's Research and Development laboratories.

To solve typical problems encountered when laying stone materials, MAPEI offers a complete range of products including screeds, smoothing and levelling compounds, adhesives, grouting mortars and special-purpose sealants.

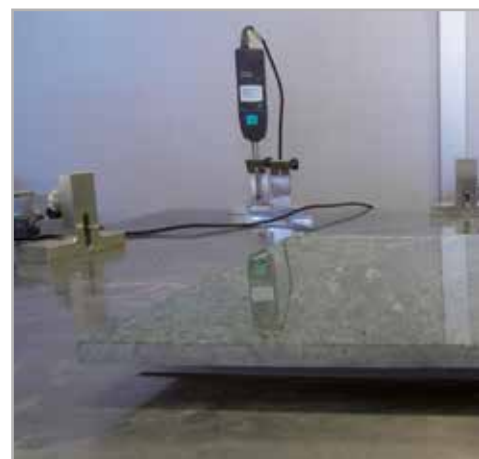
This Technical Notebook also illustrates examples of high-quality, long-lasting laying methods for marble, granite, porphyry and agglomerates for various scopes and intended uses.

2. TYPICAL PROBLEMS WHEN LAYING STONE MATERIALS

Over the years, the market has introduced thinner natural stone slabs compared with conventional thicker slabs, and artificial slabs produced using natural stone mixed with different types of binders. This has resulted in new problems being encountered when laying such products.

If thin tiles are used, it may happen that materials warp or expand due to the presence of damp in the substrate and installation materials, or due to the effect of temperature variations. Also, when water is present, stains or unsightly efflorescence may form on certain types of stone.

These two problems are not necessarily connected and, therefore, must be approached separately.



2.1 DIMENSIONAL INSTABILITY AND WARPING

How sensitive certain types of stone are to warping in the presence of water or temperature variations is a determining factor when choosing which type of adhesive to use for laying. If the wrong adhesive is used, the functionality of the covered surface may be compromised (Fig. 2.1). A material's tendency to warp is common for certain types of green marble (such as Alpine Green), certain types of slate and Pietra Serena and certain engineered materials produced using polyester resin (more sensible to thermic variations), and depends highly on the shape, dimensions and thickness of the slabs. This instability, therefore, is influenced by both the nature of the stone and its geometric characteristics, which makes it practically impossible to predict the material's behaviour when laying and when in service without carrying out in-depth testing on the material before use.

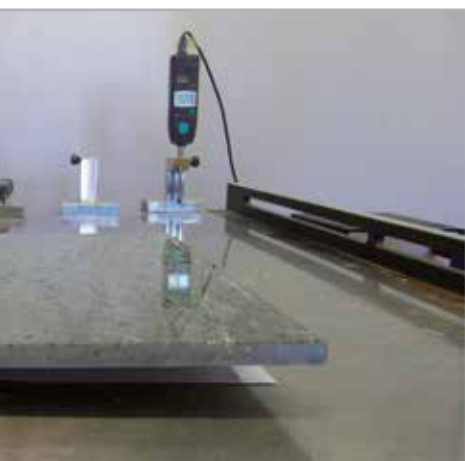


Fig. 2.1 - Warping of a stone slab which is sensible to humidity

2.1.1 DIMENSIONAL STABILITY TEST: CLASSIFICATION OF STONE MATERIALS

MAPEI has designed and developed an analytic classification system (now test method for the Italian norm UNI 11714) for stone materials, based on their sensitivity to water (Table 1). The test method used to develop the classification system is a test rig with a metal support bed and high-precision digital measuring devices, connected to a terminal which carries out a continuous registration of any measurement. In practice, the test is a real simulation of the laying of a slab where any movements at the edges of the slab are continuously measured by means of electronic sensors. The slab is positioned upside-down and is supported on three of its four sides, and is then wetted with a piece of saturated felt on the back face of the slab.

The test is carried out as follows:

1. The slab is overturned and supported on three of its four edges on a metal board. A piece of felt saturated with water is placed on the back face (Fig. 2.2) to simulate the damp of the laying bed (sand and cement mortar or conventional adhesive).

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2. The digital sensors, positioned in various points on the slab to record deformations in all directions at the edges of the slab, continuously transmit all the movements in the slab due to the damp felt to the terminal.

3. According to the entity of the deformations (δ), measured 6 hours after applying the damp felt, the stone is divided into three classes:

- a) **Class A:** $d < 0.3$ mm
- b) **Class B:** $0.3 < d < 0.6$ mm
- c) **Class C:** $d > 0.6$ mm

4. Materials in the class A group are considered stable and the choice of which adhesive used does not depend on its tendency to warp. Other factors will have to be considered, such as its sensitivity to staining or the formation of efflorescence, the size of the slabs, the type of substrate and the service conditions of the coating.

5. For those materials which are not in class A after simulating their bonding with a damp felt, the test described previously must be repeated by replacing the damp felt with a layer of quick-hardening cementitious adhesive (class F in compliance with EN 12004) (Fig. 2.3).

6. According to the entity of the deformation (d) measured 6 hours after applying the adhesive, the material is classified as follows:

- a) **Class B*:** $d < 0.3$ mm – materials become class A after simulating bonding with rapid adhesive.
- b) **Class C**:** $d > 0.3$ mm – materials are still classified as class B or C, even after simulating bonding with rapid adhesive.

According to the results of the dimensional stability test, combined with other particular characteristics or foreseen service conditions, it is possible to define the most suitable laying system to guarantee a durable coating.

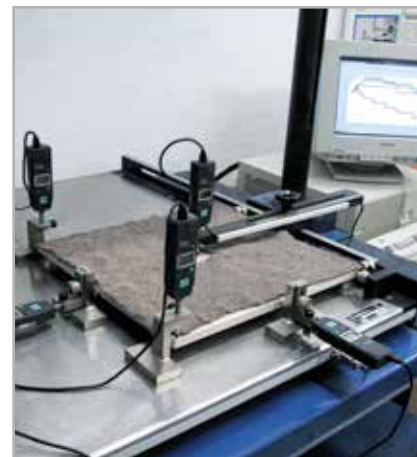


Fig. 2.2 - Dimensional stability test by simulation with damp felt



Fig. 2.3 - Dimensional stability test by bonding with quick-hardening adhesive

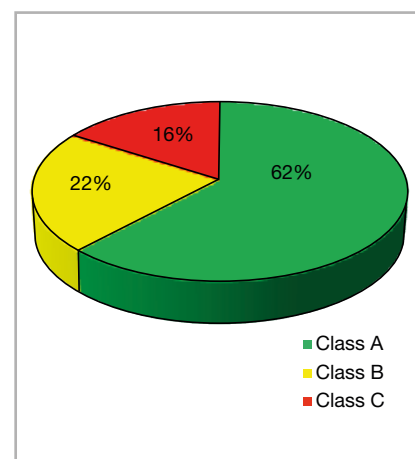
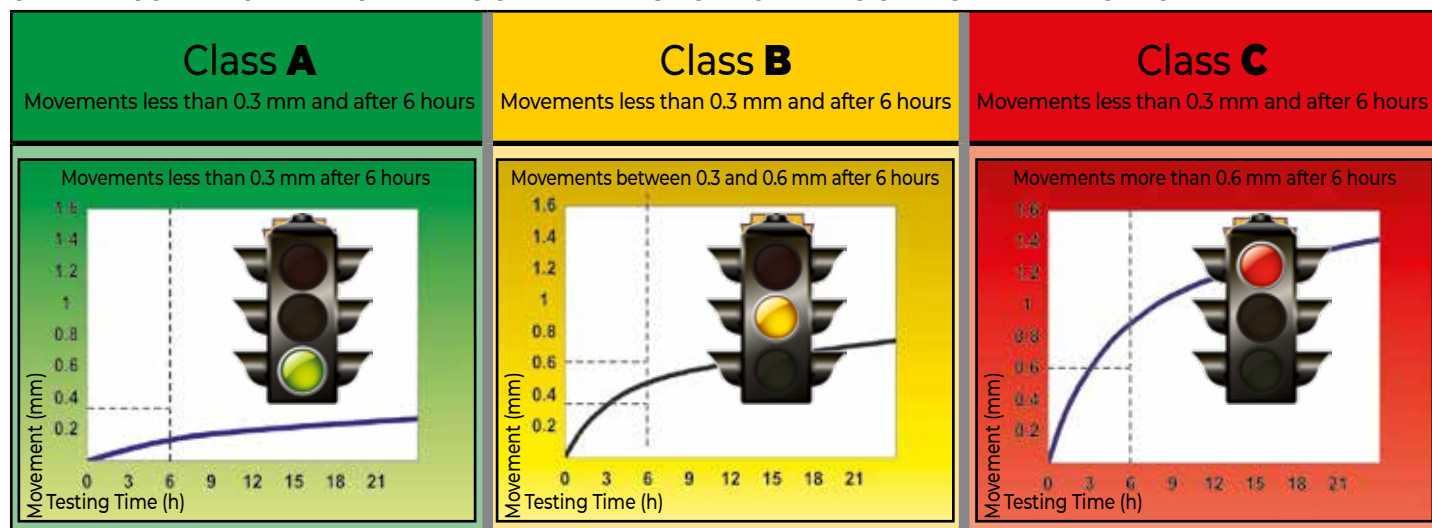


Fig. 2.4 - Spread of materials tested for dimensional stability in MAPEI's research laboratories

GENERAL OUTLINE OF THE MOVEMENTS OF MATERIALS DURING DIMENSIONAL STABILITY TESTING



EXAMPLES OF MATERIALS TESTED IN MAPEI'S RESEARCH LABORATORIES (MAPEI CLASSIFICATION):

Class A		Class B*		Class C**	
Granite:	Impala Blue Black Red Green Aosta Green	Granite:	Byzantine Green	Granite:	Grey-Green Peruvian Porphyry Predazzo Red Speranza Green Purple
Various:	Pietra Lara Piedra del sol Volvic Stone (France) Mexican Stone (pink) Brazilian Pink Quarzite Crystalline Alabaster Onyx	Various:	Sardinian Red Ignimbrite Brazilian Ardesia Carniglia Stone	Various:	Cantera Stone Matraia Stone Pietra Serena Slate Green Jade
Marble:	Carrara White Rose African Red Botticino Orobis Arabesque White Brazilian Classic White Venetian Yellow Motrico Grey Jacaranda Jura blaugelb gemischt Marquina Black Shiny Paradise Portuguese Rose Laguna Red Verona Red Valmalenco Serpentine Veined Statuario S. Pietro Travertin	Marble:	Amethyst Italian Green Aver Green Saint Denise Green Rio Branco	Marble:	Pearl White Alpine Green Veined Alpine Green Issoire Green Mergozzo Green Guatemala Green
Engineered:	White Bianco Carrara (cement) Botticino (cement) Breccia Aurora (resin) Levanto Red (resin)	Engineered:	Diorite (cement) Zandobbio White (cement) Amarelo (resin) Onyxed Breccia (resin)	Engineered:	Carnico Grey (cement) Ruby Red (cement) Copper Red (resin) Portoro (resin)

Tab. 1 - The classifications in the table above correspond to MAPEI's test results carried out on samples of materials and must be considered, therefore, as merely an indication and must not be considered as representative of all types of stone material from the same mineral group.

* Materials which are in class B and C after simulation of bonding with damp felt and come back to class A ($\delta < 0.3$ mm) after repetition of dimensional stability testing with rapid adhesives.

** Materials which are in class B and C after simulation of bonding with damp felt and remain in class B ($0.3 < \delta < 0.6$ mm) or C ($\delta > 0.6$ mm) after repetition of dimensional stability testing with rapid adhesives.

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2.2 STAINING AND EFFLORESCENCE

Staining and /or the formation of efflorescence on the surface of stone may occur when there is water present and may be due to various factors:

- stone laid conventionally on a bed of mortar or with a normal-setting adhesive;
- material laid on a substrate which is not sufficiently isolated from rising damp from the ground;
- material laid on a substrate which is not completely dry with a high level of humidity while laying.

The formation of efflorescence may occur on all types of stone, although only certain types of stone are prone to staining, such as marble, quartz, granite and light-coloured engineered stone (such as Carrara marble, Thassos, pink Quarzite, etc.).

The problem may be traced to the presence of substances in the stone itself which dissolve in alkali water rising from the substrate or laying bed (in the case of soluble salts) or which react with the water (mainly in the case of ferrous minerals).

In the first case, the soluble substances are transported towards the surface of the material by the water on the back face of the slabs and form widespread staining or efflorescence. In the case of reactive substances, the combined action of the water, oxygen and light cause them to oxidise and cause unsightly stains on the coating. The use of quick-hardening cementitious adhesives, which reduce the period of time in which the stone is in contact with the water and stops it rising to the surface of the stone, or of reactive adhesives, may avoid such defects showing up. Staining and efflorescence may show up, however, if the substrate has not been correctly prepared.



Fig. 2.5 - Example of stains caused by pyrite on white Carrara marble



Fig. 2.6 - Example of stains on a granite floor



Fig. 2.7 - Example of efflorescence caused by rising damp from the substrate



Fig. 3.1 - Mixing MAPECEM PRONTO screed



Fig. 3.2



Fig. 3.3 - Carrying out a MAPECEM PRONTO screed

3. PREPARATION OF THE SUBSTRATE

Substrates must be prepared according to specific requirements to make them suitable for laying stone coatings, which vary according to the final use of the floor. The most significant characteristics of the substrate which must be assessed before laying are as follows:

- **thickness:** the most suitable thickness depends on the type of substrate. For materials sensitive to water and, therefore, prone to staining and warping, the substrate must always be checked to make sure there is no rising damp. Make sure that screeds have a suitable vapour barrier or, with new screeds, form a layer at least 4 cm thick which is isolated from the substrate with polyethylene sheets to block rising damp.
- **mechanical strength and compactness:** mechanical strength requirements must be assessed according to service conditions and final use. A value of 20 MPa is generally considered sufficient for substrates for residential applications, which should be increased to around 30 MPa in commercial and industrial environments. For render on façades, check strength by tear tests. The value must be at least 1 MPa.
- **curing:** before laying the material, make sure the substrate is well cured. The curing time for cementitious substrates is around 7-10 days per centimetre of thickness. During this period, screeds and render are subject to hygrometric shrinkage which may form cracks. If coatings are laid without respecting curing times, the cracks may be transferred to the coating with the risk of detachment.

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Curing times may be reduced if required by using quick or rapid-drying, pre-blended mortar or binders such as:

- **TOPCEM**, special hydraulic binder for normal setting, fast drying (4 days) and controlled shrinkage screeds. Topcem is certified by GEV Institut as a product with very low emission levels of volatile organic compounds (EMICODE EC1 PLUS).

- **TOPCEM PRONTO**, ready-to-use, normal setting, quick-drying mortar with high thermal conductivity, classified CT-C30-F6-A1fl according to EN 13813 standard, and certified by GEV Institut as a product with very low emission levels of volatile organic compounds (EMICODE EC1 PLUS).

- **MAPECEM**, special fast setting and drying (24 hours) hydraulic binder for shrinkage-compensated screeds.

- **MAPECEM PRONTO**, pre-blended, ready-to-use, quick-setting and drying (24 hours), controlled-shrinkage mortar for screeds, class CT-C60-F10-A1fl according to EN 13813.

- **drying**: especially when laying materials sensitive to water, or to avoid the risk of efflorescence forming on the surface, it is extremely important to check that the substrate is dry; the level of residual humidity can be measured using a carbide hygrometer;

- **cleaning**: surfaces on which materials are to be laid must be sufficiently clean and free of dust, grease, oil, paint, loose portions and any other substance which could compromise the bond;

- **no cracks**: all cracks must be sealed before laying coatings with a suitable product, such as **EPORIP**, **EPOJET** or **EPORIP TURBO**. As an alternative, an anti-fracture layer may be applied on cracked substrates, such as **MAPETEX** or **MAPEGUARD UM 35**, depending on the specific requirements of the building site. (Progress 1 page 18);



Fig. 3.4 - Using a straight-edge on the screed



Fig. 3.5 - Floating the screed's surface



Fig. 3.6 - Applying a primer as bonding promoter



Fig. 3.7 - Levelling a cementitious screed with ULTRAPLAN



Fig. 3.8 - Evening out a concrete wall with NIVOPLAN+PLANICRETE



Fig. 3.9 - Evening out a wall with PLANITOP FAST 330

- **flatness**: if the laying surface is particularly uneven, it may be levelled off using a suitable product such as:

FOR INTERNAL SURFACES

- **NIVORAPID**, ultra-fast setting, thixotropic, cementitious levelling compound for horizontal and vertical surfaces, from 1 to 20 mm thick layer. Class CT-C40-F10-A2fl according to EN 13813 standard, certified by GEV Institut as a product with a very low emission level of volatile organic compounds (EMICODE EC1 PLUS). When mixed with **LATEX PLUS** instead of water, it forms a highly flexible smoothing and levelling compound with excellent bond strength even on metal surfaces and existing floors in rubber, PVC, chipboard, parquet, linoleum, etc.;

- **ULTRAPLAN/ULTRAPLAN MAXI**, ultra-fast drying self-levelling compound for thicknesses from 3 to 40 mm, classes CT-C30-F7-A2fl-s1 and CT-C35-F7-A2fl-s1 according to EN 13813 standard, certified by GEV Institut as products with a very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

FOR EXTERNAL APPLICATIONS

- **ADESILEX P4**, high performance, rapid-setting, full contact, cementitious adhesive for ceramic tile and stone material installations; smoothing compound for interiors and exteriors; mortar for brick and concrete block walls, class C2F according to EN 12004, certified by GEV Institut as a product with a very low emission level of volatile organic compounds (EMICODE EC1 PLUS);

- **PLANITOP FAST 330**, quick-setting, fibrereinforced cementitious mortar for internal and external floors and walls, applied at a thickness from 3 to 30 mm to smooth out irregularities, certified by GEV Institut as products with a very low emission level of volatile organic compounds (EMICODE EC1);

- **NIVOPLAN**, indoor and outdoor levelling mortar for walls and ceilings for

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thicknesses from 2 to 20 mm. When mixed with 1 or 2 kg of **PLANICRETE** per bag, it improves its consistency when it is applied in thin layers.

For more detailed information on the preparation of a new screed, please consult the Technical Notebook "Installation of heated screeds and substrates for laying floors".

4. THE BEST LAYING SOLUTIONS ACCORDING TO MATERIAL CLASSIFICATION

4.1 CHOOSING THE ADHESIVE SYSTEM

4.1.1 **CLASS A** NATURAL AND ENGINEERED CEMENT-BASED MATERIAL NOT SENSITIVE TO THE FORMATION OF STAINS AND EFFLORESCENCE

When laying this class of materials, the adhesive must be chosen according to the size of the slabs, the type of substrate and the service conditions of the coating. We recommend the following products:

- **KERAFLEX**, high-performance cementitious adhesive with no vertical slip and extended open time for ceramic tiles and stone material, class C2TE according to EN 12004. Especially suitable for laying on internal floors and walls and on external surfaces not subject to deformation or high stresses. The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS).
- **KERAFLEX MAXI S1/KERAFLEX MAXI S1 ZERO special** high performance, deformable cementitious adhesives, available in white (**KERAFLEX MAXI S1**) or grey (**KERAFLEX MAXI S1 ZERO**) with extended open time and no vertical slip, for ceramic tiles and stone material, with Low Dust® technology, class C2TE S1 according to EN 12004. The adhesives are certified by GEV Institut



Fig. 4.1 - Example of installation of stone material on floor with KERAFLEX MAXI S1 - Spa Rác & Hotel, Budapest - Hungary



Fig. 4.2 - Example of installation of stone material with KERAFLEX MAXI S1 - "Loop 5" Shopping Centre - Weiterstadt - Germany



Fig. 4.3 - Example of installation of natural stone on façade - "La Llotja" Congress Centre, Lleida - Spain

as products with very low emission level of volatile organic compounds (EMICODE EC1 PLUS). The increased thickness of adhesive which may be applied makes it particularly suitable for laying on uneven surfaces or for laying tiles with an uneven back face (Progress 2 page 18).

- **ULTRALITE SI FLEX** one-component, high-performance, flexible, lightweight, cementitious adhesive with no vertical slip and long open time, Low Dust® technology and extremely high yield. Easy to apply by trowel with excellent wetting properties, stone and thin porcelain tiles, class C2TE S1 according to EN 12004. The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS). This product guarantees better buttering of tiles than conventional adhesives, which makes it particularly suitable for use in environments subject to intense traffic or, in general, when a continuous bed of adhesive is required.

- **KERABOND + ISOLASTIC**, highly deformable adhesive system, particularly suitable for laying on external surfaces and façades, class C2E S2 according to EN 12004 (Progress 3 page 19).



4.1.2 CLASS A ENGINEERED RESIN-BASED MATERIAL, NOT SENSITIVE TO THE FORMATION OF STAINS (FOR INTERNAL APPLICATIONS)

For this type of stone material, which is only suitable for laying on internal surfaces, we recommend the use of the following adhesives:

- **KERAFLEX**, high-performance cementitious adhesive with no vertical slip and extended open time for ceramic tiles and stone material, class C2TE according to EN 12004. Especially suitable for laying on internal floors and walls and on external surfaces not subject to deformation or high stresses. The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

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- **KERAFLEX MAXI S1/KERAFLEX MAXI S1 ZERO special** high- performance, deformable cementitious adhesives, available in white (**KERAFLEX MAXI S1**) or grey (**KERAFLEX MAXI S1 ZERO**) with extended open time and no vertical slip, for ceramic tiles and stone material, with Low Dust® technology, class C2TE S1 according to EN 12004. The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS). The increased thickness of adhesive which may be applied makes it particularly suitable for laying on uneven surfaces or for laying tiles with an uneven back face (Progress 2 page 18).

- **ULTRALITE S1 FLEX** one-component, high-performance, flexible, lightweight, cementitious adhesive with no vertical slip and long open time, Low Dust® technology and extremely high yield. Easy to apply by trowel with excellent wetting properties, stone and thin porcelain tiles, class C2TE S1 according to EN 12004. The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS). This product guarantees better buttering of tiles than conventional adhesives, which makes it particularly suitable for use in environments subject to intense traffic or, in general, when a continuous bed of adhesive is required.

When choosing which laying system to use for these materials, the final use of the coating must always be taken into consideration. Some of these products are characterised by a high coefficient of thermal expansion which, under certain laying conditions such as surfaces exposed to direct sunlight, may generate high strains due to the coating's tendency to expand being impeded. In such cases, to avoid the sides of the tiles and slabs pressing against each other and lifting due to the effect of expansion, they must be laid with wide joints between them and low-pitch flexible expansion joints must be formed using a highly flexible adhesive, such as:

- **ULTRABOND ECO PU 2K**, two-component, solvent-free, high- performance



Fig. 4.4 - Example of installation of white Carrara marble with GRANIRAPID white – University Bocconi, Milan – Italy



Fig. 4.5 - Example of installation of granite with GRANIRAPID – Bloor Street, Toronto – Canada



Fig. 4.6 - Example of installation of natural stone with GRANIRAPID – Train station of Marseille – France

polyurethane adhesive for ceramic and stone tiles, class R2T in compliance with EN 12004 standard. The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

- **KERALASTIC**, two-component, high-performance polyurethane adhesive for ceramic tiles and stone materials, class R2 according to EN 12004.



4.1.3 CLASS A NATURAL, ENGINEERED CEMENT-BASED AND ENGINEERED RESIN-BASED MATERIAL (FOR INTERNAL APPLICATIONS) SENSITIVE TO THE FORMATION OF STAINS AND EFFLORESCENCE

For these types of stone, we suggest the use of the following adhesives to avoid the formation of stains:

- **GRANIRAPID**, two-component, high-performance, fast-setting and hydrating cementitious adhesive for ceramic tiles and stone materials, class C2F S1 according to EN 12004 (Progress 4 page 19). The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

- **KERAQUICK MAXI S1**, high-performance, deformable, fast setting, cementitious adhesive with no vertical slip, very low emission level of organic volatile compounds, for ceramic tiles and stone material, class C2FT S1 according to EN 12004 (Progress 5 page 20). The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

- **ULTRALITE S1 FLEX QUICK**, One-component, high-performance, deformable, lightweight, rapid-setting and hydrating cementitious adhesive with no vertical slip, good trowelability, high wetting capacity and extremely high yield, for ceramic tiles, stone and thin porcelain tiles, class C2FT S1 in compliance with EN 12004.

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- **ELASTORAPID**, two-component, high-performance, highly deformable, quick-setting and drying cementitious adhesive with no vertical slip and extended open time for ceramic tiles and stone material, class C2FTE S2 in compliance with EN 12004.

- **KERAQUICK MAXI S1 + LATEX PLUS**, quick-setting, highly deformable adhesive system, class C2F S2 according to EN 12004. The high flexibility of this adhesive system makes it particularly suitable for laying on external surfaces, on façades or on surfaces more subject to deformation.

The aforementioned adhesives are efficient in solving the problems mentioned above thanks to the quick hydration of the binder with which they are formed. This property limits the humidity content in the adhesive in just a few hours to a level which does not provoke the formation of unsightly stains on the slabs of stone laid. Also, the use of quick products reduces the risk of the formation of efflorescence.

4.1.4 CLASS B* STONE MATERIALS

This class includes all the types of stone with deformation less than 0.3 mm following the bonding test with a quick-type adhesive (class C2F or C2FT).

Use one of the following adhesives to lay this category of materials:

- **GRANIRAPID**, two-component, high-performance, fast-setting and hydrating cementitious adhesive for ceramic tiles and stone materials, class C2F S1 according to EN 12004 (Progress 4 page 19). The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

- **KERAQUICK MAXI S1**, high-performance, deformable, fast-setting cementitious adhesive with no vertical slip, for ceramic tiles and stone material, class C2FT S1 according to EN 12004 (Progress 5 page 20). The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic compounds (EMICODE EC1 PLUS).



Fig. 4.7 - Example of installation of marble with ELASTORAPID – Marina Bay Sands Resort – Singapore



Fig. 4.8 - Example of installation marble flooring with KERAQUICK – Casino Hall, Feuchtwangen – Germany



Fig. 4.9 - Example of installation of Verde Alpi marble flooring with KERALASTIC – Rolex Hall – Bienne – Switzerland

• **ULTRALITE S1 QUICK**, one-component, high-performance, deformable, lightweight, rapid-setting and hydrating cementitious adhesive with no vertical slip, good trowelability, high wetting capacity and extremely high yield, for ceramic tiles, stone and thin porcelain tiles, class C2FT S1 in compliance with EN 12004.

• **ELASTORAPID**, two-component, high-performance, highly deformable, quick-setting and drying cementitious adhesive with no vertical slip and extended open time for ceramic tiles and stone material, class C2FTE S2 according to EN 12004.

• **KERAQUICK MAXI S1 + LATEX PLUS**, quick-setting, highly deformable adhesive system, class C2F S2 according to EN 12004. The high flexibility of this adhesive system makes it particularly suitable for laying on external surfaces, on façades or on surfaces more subject to deformation.

4.1.5 CLASS C STONE MATERIALS**

This class includes all the types of stone with deformation higher than 0.3 mm even after the bonding test with a quick-type adhesive.

The extreme sensitivity of these products means they may only be laid with adhesives which contain absolutely no water:

• **KERALASTIC**, two-component, high-performance, polyurethane adhesive for ceramic tiles and stone materials, class R2 according to EN 12004 (Progress 6 page 20).

• **KERAPOXY ADHESIVE**, two-component, epoxy adhesive with no vertical slip for ceramic tiles and stone material, class R2T according to EN 12004.

• **ULTRABONDECO PU 2K**, two-component, solvent-free, high-performance, polyurethane adhesive for ceramic and stone tiles. The adhesive is certified by GEV Institut as a product with very low emission level of volatile organic

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compounds (EMICODE EC1 PLUS), class R2T in compliance with EN 12004 standard.

4.2 CHOOSING THE RIGHT GROUT AND SEALANT FOR THE JOINTS

MAPEI has a wide array of grouting mortars and sealants for expansion joints which are suitable for application on natural stone coatings.

4.2.1 PRODUCTS FOR GROUTING JOINTS

- **KERACOLOR**, high-performance, polymer-modified, cement-based grout, available in a choice of versions: **SF** in white, for joints up to 4 mm wide; **FF** water-repellent with DropEffect® for joints up to 6 mm wide, or **GG** for joints from 4 to 15 mm. **KERACOLOR FF** and **KERACOLOR GG** are available in 14 different colours. In the case of stone floors to be polished after laying, **KERACOLOR** may be mixed with FUGOLASTIC (polymer latex for **KERACOLOR SF, FF** and **GG** to reduce the absorption of water and to improve the bond of the grout). **KERACOLOR** and **KERACOLOR + FUGOLASTIC** are class CG2WA according to EN 13888 and are certified by GEV as products with a very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

- **ULTRACOLOR PLUS**, high-performance, anti-efflorescence, quick-setting and drying, polymer-modified mortar with water-repellent DropEffect® and mould-resistant BioBlock® technology for grouting joints up to 40 mm wide, and is available in 40 colours. **ULTRACOLOR PLUS** is class CG2WA according to EN 13888 and is certified by GEV as a product with a very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

4.2.2 PRODUCTS FOR SEALING EXPANSION JOINTS

Special care must be taken when choosing the product to seal joints in stone material, because certain sealants, and in particular the acetic-crosslinking



Fig. 4.10 - Example of staining on natural stone installed with acetic cross-linking silicone sealant



Fig. 4.11 - Example of staining on natural stone installed with acetic cross-linking silicone sealant



Fig. 4.12 - Sealing joint on façade with MAPESIL LM

type, may stain the stone (Fig. 4.10 and 4.11). In the MAPEI product range, the most suitable sealants for this application are:

- **MAPESIL LM** neutral, mould-resistant, silicone sealant for stone and marble, certified by GEV as products with a very low emission level of volatile organic compounds (EMICODE EC1 PLUS).

5. SPECIAL LAYING CASES

5.1 LAYING DECORATIVE ELEMENTS IN CEMENT-BASED ENGINEERED MATERIAL

MAPEI also has a solution for laying this type of material:

- **FIX & GROUT BRICK** (Fig. 5.1 and 5.2) ready-to-use, high-performance mould-resistant adhesive paste with no vertical slip and BioBlock® technology class D2T. The special characteristics of this adhesive makes it suitable for bonding decorative elements in lightweight cementitious conglomerate and synthetic resin. Excess adhesive which seeps out from joints may also be smoothed over with a damp brush to act as a grout for the joints.



Fig. 5.1 - Laying engineered decorative elements with FIX & GROUT BRICK



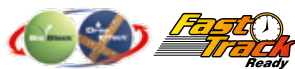
Fig. 5.2 - An example of an application using FIX & GROUT BRICK for both bonding and grouting

LAYING STONE MATERIALS

Materials and systems to lay natural and engineered stone correctly

Travertine

Laying on an anti-fracture membrane



ULTRACOLOR PLUS

- High-performance, anti-efflorescence, quick-setting and drying, polymer-modified mortar with water-repellent DropEffect® and mould-resistant BioBlock® technology for grouting joints from 2 to 20 mm wide, class **CG2WA** (EN 13888) and **EC1 Plus**



KERAQUICK MAXI S1 white + LATEX PLUS

- Quick-setting, highly deformable adhesive system, class **C2F S2** according to EN 12004

MAPETEX SYSTEM

- Non-woven fabric used to form an anti-fracture and isolating layer when laying on old, damaged floors without having to observe the existing distribution joints



KERAQUICK MAXI S1 grey + LATEX PLUS

- Quick-setting, highly deformable adhesive system, class **C2F S2** according to EN 12004

Old screed

Old flooring in ceramic material with microcracks

Concrete

Laying interlocking stone on concrete

Interlocking stone



KERAFLEX MAXI S1 ZERO

- Special, high-performance, deformable, white, cementitious adhesives, with extended open time and no vertical slip, with Low Dust® technology, class **C2TE S1** according to EN 12004 and **EC1 Plus**



KERACOLOR GG

- High-performance, polymer-modified, cement-based grout for joints from 4 to 15 mm, class **CG2WA** (EN 13888) and **EC1 Plus**

Progress 1

Progress 2

Laying on façades

Verona Rosso



MAPESIL LM

- Neutral, mould-resistant, silicone sealant for stone and marble, ECT1 Plus



KERACOLOR GG

- High-performance, polymer-modified, cement-based grout for joints from 4 to 15 mm, class CG2WA (EN 13888) and ECT1 Plus



KERABOND + ISOLASTIC

- Highly deformable adhesive system, class C2E S2



NIVOPLAN + PLANICRETE

- Levelling mortar for walls and ceilings

Carrara marble

Laying on heated screeds



KERACOLOR FF

- High-performance, polymer-modified, water-repellent, cement-based grout with DropEffect® technology for grouting joints of up to 6 mm, class CG2WA (EN 13888) and ECT1 Plus



GRANIRAPID

- Two-component, high-performance, fast-setting and hydrating cementitious adhesive, for ceramic tiles and stone materials, class C2F S1 (EN 12004), and ECT1 Plus



TOPCEM PRONTO

- Ready-to-use, normal-setting, quick-drying with high thermal conductivity, class CT-C30-F6-A1_h-S1 (EN 13813) and ECT1 Plus

System with heated elements

Progress 3

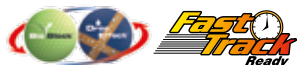
Progress 4

LAYING STONE MATERIALS

Materials and systems to lay natural and engineered stone correctly

Granite

"Eco" System



ULTRACOLOR PLUS

- High-performance, anti-efflorescence, quick-setting and drying, polymer-modified mortar with water-repellent DropEffect® and mould-resistant BioBlock® technology for grouting joints from 2 to 20 mm wide, class CG2WA (EN 13888) and ECT1 Plus



KERAQUICK MAXI S1

- High-performance, deformable, fast setting cementitious adhesive with no vertical slip, class C2FT S1 (EN 12004) and ECT1 Plus



ULTRAPLAN

- Ultra-fast drying self-levelling compound, class C30-F7-A2-s1 and ECT1 Plus



PRIMER G

- Synthetic, resin-based water-dispersion primer with very low volatile organic compounds (ECT1)



TOPCEM PRONTO

- Ready-to-use, normal-setting, quick-drying with high thermal conductivity, class CT-C30-F6-A1-s1 (EN 13813) and ECT1 Plus



Progress 5

Alpine green

Laying dimensionally-unstable stone material



KERACOLOR FF

- High-performance, polymer-modified, water-repellent cement-based mortar with DropEffect® technology for grouting joints of up to 6 mm, class CG2WA (EN 13888) and ECT1 Plus



KERALASTIC

- Two-component, apolyurethane adhesive, class R2 (EN 12004)



MAPECEM PRONTO

- Pre-blended, ready-to-use, quick-setting and drying (24 hours), controlled-shrinkage mortar for screeds, class CT-C60-F10-A1 (EN 13813) and ECT1 Plus



Progress 6

Marble mosaic



KERACOLOR GG

- High-performance, polymer-modified cement-base grout for joints from 4 to 15 mm, class **CG2WA** (EN 13888) and **ECT1 Plus**

Waterproofing and laying in bathrooms and shower cubicles



ELASTORAPID white

- Two-component, high-performance, highly-deformable, quick-setting and quick-drying cementitious adhesive with no vertical slip and extended open time, class **C2FTE S2** (EN 12004)



MAPEGUM WPS

- Quick-drying, flexible, liquid membrane for waterproofing internal surfaces



NIVOPLAN + PLANICRETE

- Levelling mortar for walls and ceilings



Progress 7

Granite



ULTRACOLOR PLUS

- High-performance, anti-efflorescence, quick-setting and drying, polymer-modified mortar with water-repellent **DropEffect**® and mould-resistant **BioBlock**® technology for grouting joints up to 20 mm wide, class **CG2WA** (EN 13888) and **ECT1 Plus**



MAPESIL LM

- Neutral, mould-resistant, silicone sealant for stone and marble, **ECT1 Plus**

MAPEFOAM

- Closed cell polyethylene foam cord as a support to elastomeric sealants, for correct sizing of joints



ELASTORAPID grey

- Two-component, high-performance, highly deformable, quick-setting and drying cementitious adhesive with no vertical slip and extended open time, class **C2FTE S2** (EN 12004)

MAPEBAND

- Rubber tape with alkali-resistant fabric for cementitious waterproofing systems and liquid membrane



MAPELASTIC

- Two-component cementitious mortar, flexible down to -20°C, for waterproofing balconies, terraces, bathrooms and swimming pools, certified **ECT1 PLUS**

MAPENET 150

- Alkali-resistant (according to ETAG 004 directive) fibre glass mesh used to reinforce waterproof protection layers, antifracture membranes and cementitious smoothing and levelling layers

Existing flooring in ceramic material with microcracks

Waterproofing and laying on balconies and terraces



Progress 8

LAYING STONE MATERIALS

Materials and systems to lay natural and engineered stone correctly

Marble mosaic

Laying over existing
cementitious ceramic
flooring

MAPEFLEX PU20

- Self-levelling, two-component polyurethane sealant for flooring joints subject to movements of up to 10% certified **F-7.5- P ISO11600**



ULTRACOLOR PLUS

- High-performance, anti-efflorescence, quick-setting and drying, polymer-modified mortar with water-repellent **DropEffect®** and mould-resistant **BioBlock®** technology for grouting joints up to 20 mm wide, class **CG2WA** (EN 13888) and **EC1 Plus**



KERAQUICK MAXI S1 grey + LATEX PLUS

- Two-component, high-performance, highly-deformable, quick-setting adhesive system with no vertical slip, class **C2F S2** (EN 12004)



Existing ceramic flooring

Progress 9

Granite



ULTRACOLOR PLUS

- High-performance, anti-efflorescence, quick-setting and drying, polymer-modified mortar with water-repellent **DropEffect®** and mould-resistant **BioBlock®** technology for grouting joints up to 20 mm wide, class **CG2WA** (EN 13888) and **EC1 Plus**



ULTRALITE S1 FLEX

- One-component, high-performance, flexible, lightweight, cementitious adhesive with no vertical slip and long open time, **Low Dust®** technology and extremely high yield. Easy to apply by trowel with excellent wetting properties, class **C2TE S1** (EN 12004) and **EC1 Plus**



Water-repellent gypsum board

Progress 10

7. REFERENCES



BOCCONI UNIVERSITY, MILAN - ITALY

Installation of white Carrara marble with TOPCEM PRONTO, MAPELASTIC, ELASTORAPID and GRANIRAPID



SHEIKH ZAYED BIN SULTAN AL NAHYAN GRAND MOSQUE, ABU DHABI - UAE

Installation of marble slabs in interiors and marble mosaics on the main dome with ADESILEX P10, KERABOND T, ISOLASTIC, KERACOLOR FF, FUGOLASTIC, KERAPOXY, MAPESIL LM

LAYING STONE MATERIALS

Materials and systems to lay natural
and engineered stone correctly



CENTRAL TRAIN STATION, FRANKFURT AM MAIN - GERMANY

Installation of natural stone on
platform with EPORIP, MAPECEM,
MAPESTONE 1, KERALASTIC,
ULTRACOLOR PLUS



HOTEL KEMPINSKI, ŠTRBSKÉ PLESO - SLOVACCHIA

Waterproofing and installation
of marble slabs with TOPCEM
PRONTO, PRIMER G, MAPELASTIC,
MAPELASTIC SMART, KERAFLX
MAXI S1, GRANIRAPID, KERAPOXY,
MAPESIL AC



**1 WILLIAM STREET HOTEL,
BRISBANE - AUSTRALIA**

Installing slabs of granite with
KERAFLEX MAXI S1, ULTRACOLOR
PLUS



**SAGRADA FAMILIA,
BARCELONA - SPAIN**

Installing natural stone
with KERAQUICK S1,
ULTRACOLOR PLUS

LAYING STONE MATERIALS

Materials and systems to lay natural
and engineered stone correctly



FASHION DRIVE SHOPPING CENTER, SAN PEDRO GARZA GARCIA - MEXICO

Installing marble and granite
with ULTRAFLEX LFT,
FLEXCOLOR CQ, MAPESIL



FAVILLA APARTMENT COMPLEX - PIETRASANTA (LUCCA) - ITALY

Installing natural stone on a
façade with MAPELASTIC,
KERAFLEX MAXI S1, KERALASTIC
and MAPEFLEX PU45

Technical Notebook

LAYING STONE MATERIALS

Materials and systems to lay nat-ural
and engineered stone cor-rectly

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