18 december 2024

ANIT
HANDBOOKS

# ETICS RENOVATION AND MAINTENANCE

English version

## Solutions for External Thermal Insulation Composite System

ANIT

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# ANIT HANDBOOKS

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# INTRODUCTION

In recent years, a large number of external insulation installations have been carried out, mainly thanks to tax bonuses for the energy efficiency of buildings.
It is therefore predictable that, in the coming years, the issue of proper maintenance of these systems will increasingly arise, both in terms of ordinary situations, for which installation protocols are already in place, and in cases of particular criticality.
In cases where deterioration or pathologies occur, it is important to identify them and take prompt action with the appropriate solutions.
This manual, created in collaboration with MAPEI, aims to describe the main degradation phenomena that may affect an external insulation system and to propose the appropriate interventions to be carried out.

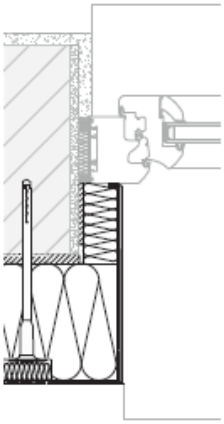
# 1 ETICS

## 1.1 Description

External Thermal Insulation Composite System, also known as ETICS, is a system for thermal insulation of buildings from the outside. It consists of a combination of different products, each with its specific function.
ETICS is also considered as a KIT, meaning a group of components that must be installed together to form the finished system.
The external insulation is a seemingly simple solution, but to ensure excellent performance and durability over time, it is necessary that each product has suitable characteristics and that the installation is carried out professionally and in compliance with regulations.

## 1.2 Before installing

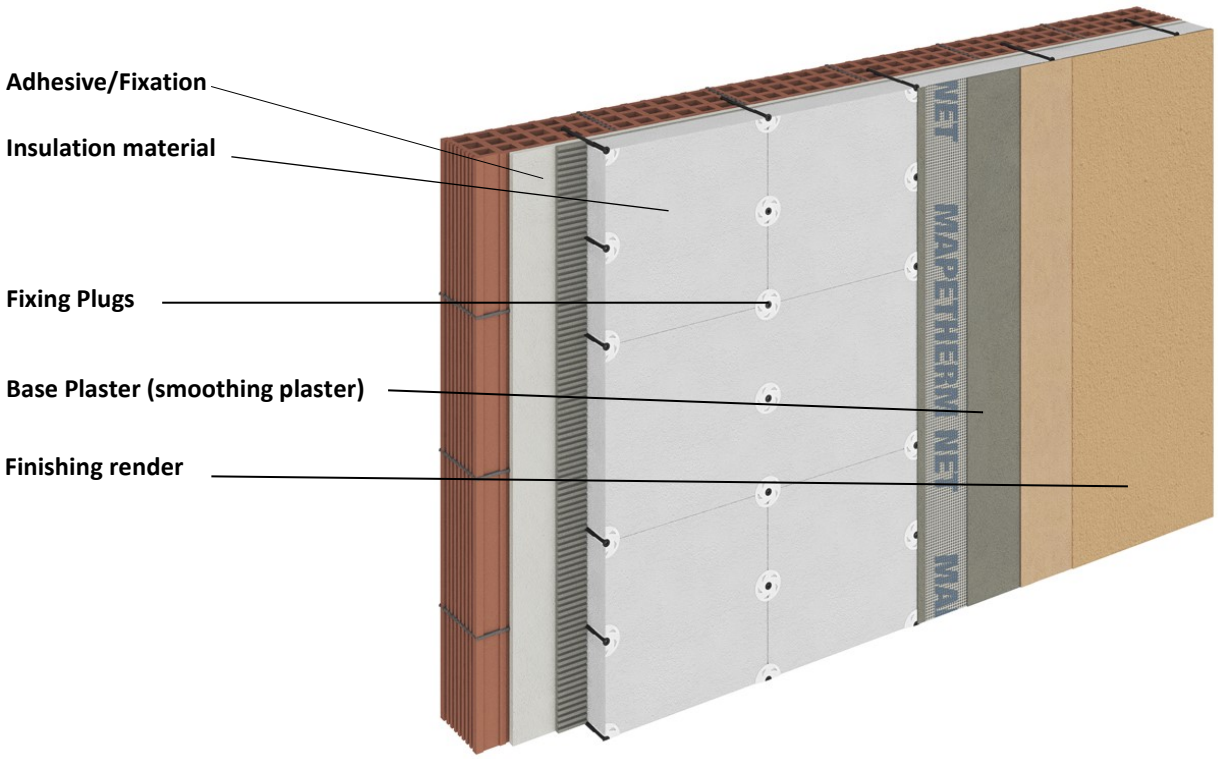
**The Project**
It is important to always design the ETICS system **comprehensively**.
This process includes **the design of all construction details**, such as the window surrounds, the junction between the wall and the roof, and the connection to the ground.
The success of an ETICS also depends on the correct installation phase, supported by detailed guidelines, along with drawings for each specific architectural junction.
An example of a window junction is shown (source: CORTEXA manual).



**The Installation Substrate**
A preliminary inspection should be carried out on the installation substrate of the ETICS. It is important to **examine and test the substrate** to identify any potential issues (poor tear resistance, unevenness, dust presence, etc.). If defects are found, **all necessary restoration and preparation interventions must be performed** to ensure the proper adhesion of the system to be installed.

**The System**
it is very important to choose the right system. The components of the ETICS must have certified performance and be selected for compatibility to create a high-performance, long-lasting system. To ensure the system's performance after installation, it is recommended to **choose a certified system** with a CE marking, obtained through an ETA (see Chapter 2.3). In the case of restoring an existing insulation system, the condition of the system already in place must be carefully evaluated in order to plan the most appropriate actions (see the dedicated chapter).

## 1.3 The system: performance and functions of individual layers




**Adhesive/Fixation**

The adhesive layer secures the thermal insulation system to the underlying substrate. It is therefore a key component, as its performance and correct application determine the proper functioning and durability of the entire system. The adhesive must always be applied according to the manufacturer's instructions and must be able to support vertical loads (the weight of the system itself) and horizontal loads (wind action).

The adhesive also must resist the expansion and contraction of the insulation panels caused by temperature fluctuations.

**Insulation material**

The insulation material is chosen according to the designer's specifications and provides thermal insulation performance in winter and protection from overheating in summer. It is essential that the performance of the insulation material is reliable and certified by accredited laboratories.

**Fixing Plugs**

The system of fixing the insulation also includes the plugs, which contribute to the system's resistance to wind loads and serve as safety elements in case of an unexpected failure of the substrate. The number and placement of the plugs are determined based on the type of substrate, insulation, location, and building height.

**Base Plaster (smoothing plaster)**

The base plaster consists of two layers, with a glass fiber reinforcing mesh in between. Its main function is to absorb both surface stresses due to temperature and moisture fluctuations and those from the layers below, caused mainly by thermal variations. To ensure this performance, the base plaster must be flexible (low modulus of elasticity), meaning it must be rich in polymer binder and specifically formulated (for instance, a normal plaster, in addition to not adhering properly to the insulation, would be too stiff and would quickly crack). The

base plaster is also the main element responsible for the mechanical strength of the system, especially in terms of potential impact.

**Finishing render**

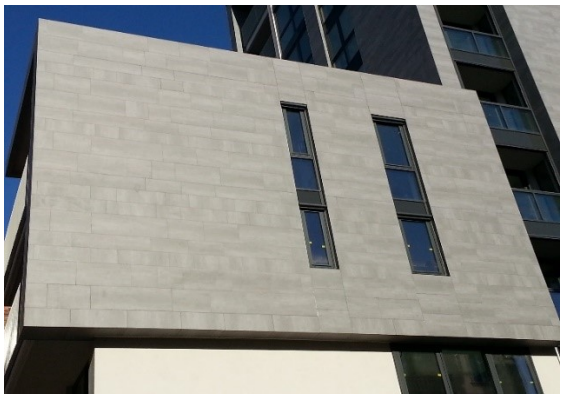
The finish render provides the external aesthetic appearance of the system, including the color and also protecs the system from weathering agents. It must possess several key characteristics, often neglected during the design process:

- CE marking 15824 (from a third-party body).
- Flexible and mechanically resistant (adequate thickness, amount, and type of binder).
- Retain color over time (type and amount of binder, as well as type of pigments used).
- Low water absorption W3 (type and amount of binder) to prevent: disintegrating action of weather agents, reduction of insulation capacity, entry of salts into the system which, upon crystallizing, would create harmful sub-florescences and resulting microcracks, freeze-thaw cycles causing disintegration, mold, and algae in a short time.
- Effective against mold and algae according to EN 15457 and 15458.

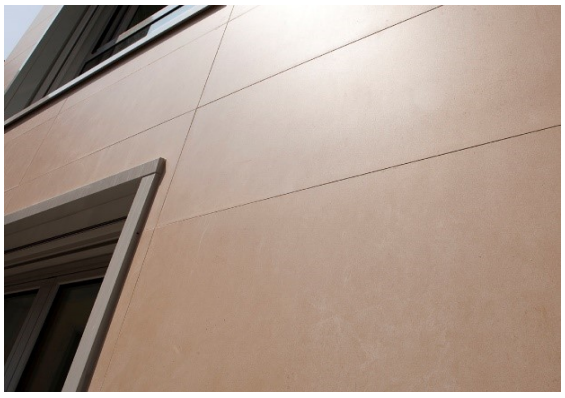
The ETICS can also be finished with modular coatings such as ceramics or with decorative effects like travertine, corten, etc


*Oxidised Effect*


*Travertine Effect*



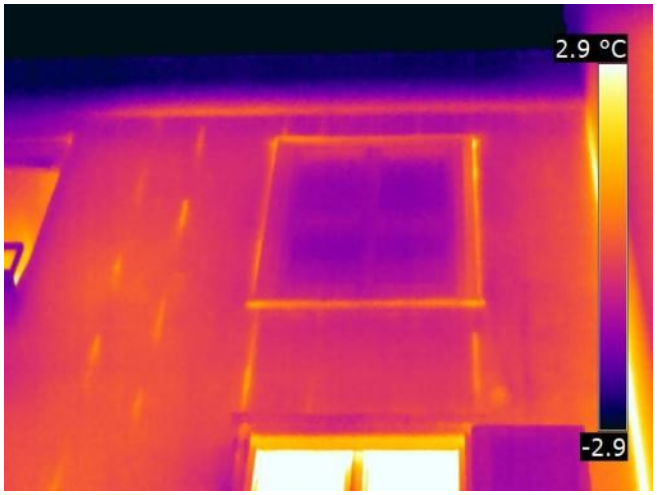
*Modular Coating*



*Modular Coating*

## 1.4 Focus on thermal insulation performance (thermal conductivity)

The level of insulation in a building structure largely depends on the insulating layer, if present.
The characteristic of the material that determines its insulating property is thermal conductivity λ (W/mK).
Thermal conductivity expresses a material's tendency to be traversed by a heat flow, so the lower the conductivity, the more insulating the material is. It is therefore clear the importance of using a conductivity value that is fully reliable for calculations: a CE-marked thermal insulation offers significant guarantees in this regard.
The system must be installed correctly, especially with regard to the bonding and positioning of the insulating panels.
Poor panel alignment can lead to the creation of widespread thermal bridges, which may not cause significant issues from an energy point of view (additional limited heat loss), but can be very relevant from an aesthetic point of view, as the creation of areas with uneven surface temperature can lead to the formation of stains.
It is necessary to ensure proper adhesive application, as the infiltration of outside air behind the insulating panels can compromise the insulation level of the structure and cause degradation of the system. Full-surface bonding can help prevent this phenomenon.



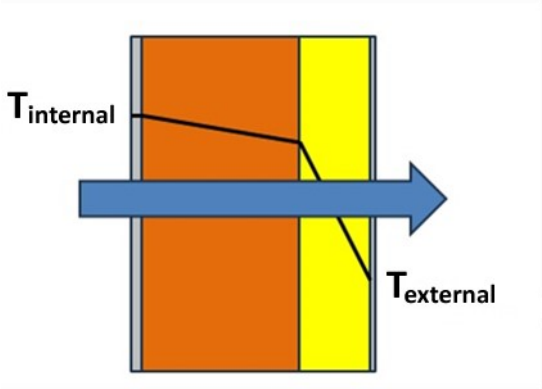

*Thermographic investigation of coat with incorrect panel matching*

## 1.5 Focus on hygrometric performance (vapour permeability)

During the cold season, there is always a flow of vapour migrating from the heated indoor environment to the outside. As this vapour passes through the building structures, if it encounters a cold layer, the phenomenon of interstitial condensation may occur, which is the appearance of condensed water inside the materials. This is a phenomenon to avoid if the durability of the structure and the performance of the materials are to be ensured.
To prevent interstitial condensation, it is necessary to pay attention to design of layer structure.
Two simple rules can be helpful:

- Place the layers with **the highest resistance to vapour flow <u>on the interior side</u>**;
- Place the layers with **the highest thermal resistance <u>on the exterior side</u>**.

The first rule ensures that the minimum possible amount of vapour reaches the most external and thus coldest layers of the structure. The second rule ensures that most of the layers remain warm, so the vapour passing through them does not encounter cold zones and therefore does not risk condensation.




The external thermal insulation system (ETICS) is the most advantageous configuration to prevent interstitial condensation, as the insulation is placed on the outside, keeping the entire structure at a sufficiently high temperature to avoid condensation.
The temperature drop occurs outside the insulating layer, i.e., before the plaster and finish. Therefore, it is important to choose the right plaster and finish, meaning those with sufficient vapour permeability to ensure the vapour flow is not blocked or condensed, leading to possible efflorescence or blistering.

The reduction of the wall's vapour permeability is often attributed to external thermal insulation systems. In practice, the vapour permeability of walls is very limited even without insulation: from the walls of a building, only a small amount of vapour, of a few hundred grams per day, can be carried off. The internal production of vapour is, however, of several kilograms (just one person breathing produces about 200g/hour of vapour, and in addition, all other activities, such as cooking, must be considered). Therefore, the installation of an insulating layer does not negatively impact this aspect, but it is essential to design and maintain adequate ventilation in the indoor spaces through window openings and VMC.

# 2 NORMATIVE FRAMEWORK

There are several reference standards to know when approaching the design or renovation of an external thermal insulation system (ETICS). These standards cover every aspect of the process of implementing a thermal insulation system, from design to installation, maintenance, and restoration, also defining the professional skills required for installers.

## 2.1 UNI TR 11715 (for Italy)

In 2018, the **UNI TR 11715** italian standard "Thermal Insulation for Construction - Design and Installation of External Thermal Insulation Systems (ETICS)" was published.
This standard represents the state of the art in the design and installation of external thermal insulation systems (ETICS) and is used as a reference for the correct implementation of an ETICS.
It is a comprehensive document that examines in detail each phase of the design and construction of an ETICS, from substrate preparation to the design of details.
The standard also addresses maintenance and restoration, which is the subject of this publication.
The main chapters are:

- System Components
- Substrate Preparation
- Insulation Requirements
- System Installation
- Design and Execution of Junctions
- Maintenance and Restoration of Insulation Systems

Therefore, it is a key reference in Italy for all professional figures related to the world of ETICS: designers, contractors and technicians tasked with verifying installation errors or performing restoration work on deteriorated systems. It is important that all these parties are familiar with and deepen their understanding of the standard, with the aim of speaking a "common language" that ensures the highest quality in the implementation of these systems.

## 2.2 UNI 11716 (for Italy)

The **UNI 11716:2018** italian standard "Non-Regulated Professional Activities - Professional Figures Performing the Installation of Composite External Thermal Insulation Systems (ETICS) - Knowledge, Skills, and Competence Requirements" was published in June 2018.
It outlines the procedure for certifying the competencies of the professionals who install the external thermal insulation systems. The competencies defined are different for basic operators and team leaders.
Currently, the certification of installers is not mandatory, but the use of certified labor certainly guarantees the quality of the work performed and, therefore, the durability and effectiveness of the installed system.

## 2.3 CE Marking of the Insulation System

**EU Regulation 305/2011** is the reference for the CE marking of construction products.
Products subject to CE marking are those for which there is a harmonized European standard. Products for which no such standard exists can obtain CE marking through a voluntary procedure, the ETA (European Technical Assessment), granted based on an EAD (European Assessment Document), which is a guiding document outlining the performance criteria and methodology to evaluate the product.

According to EU Regulation 305, a construction product refers to a single product or a "kit." The term "kit" refers to a product placed on the market by a single manufacturer as a set of at least two distinct components that must be assembled for installation in completed works. The insulation system is an example of a kit.

Currently, **there is no harmonized product standard for ETICS**. To develop external thermal insulation systems that can be CE marked voluntarily and meet the minimum requirements of the construction products directive, reference is made to EAD 040083-00-0404, the document for the creation of an ETA (European Technical Assessment) for ETICS.
Most ETICS in Italy are still equipped with ETA granted by ETAG 004 (a document prior to the EAD). These systems, having an ETA, are fully compliant and usable. However, starting in 2021, the issuance of new ETAs is based on EAD 040083-00-0404.

The CE marking of an ETICS offers greater assurance regarding the system's performance and durability. This is because it is tested in a laboratory, ensuring that the products in the kit are compatible.
By using CE-marked systems, the manufacturer, or the system holder, guarantees the performance of the individual components of the insulation system and, consequently, the system as a whole.
It is therefore highly recommended to choose a CE-marked system. This recommendation is also echoed by the ENEA note for Italy on insulation materials (December 2020), which explains how to declare thermal performance for materials used in projects eligible for tax incentives.

# 3 PATHOLOGIES AND FORMS OF DETERIORATION

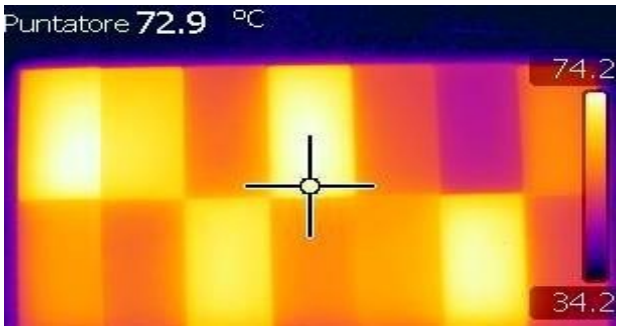
External thermal insulation systems (ETICS), like any building system, can experience various forms of degradation due to multiple factors such as the use of low-quality materials, exposure to weather conditions, poor design, construction defects, inadequate or lack of maintenance, etc.

The pathologies to which they are subject are potentially numerous. Below, the most common ones are addressed, with suggestions for possible restoration interventions..

## 3.1 Discoloration

This type of deterioration, caused by exposure to sunlight, affects the pigment used for coloring. Such chromatic inhomogeneity can appear even after a short period due to poor material choice and/or low-quality materials. The phenomenon is more pronounced with very dark or particularly bright colors, which are generally not recommended in the literature. Lighter shades, with a high solar light reflection index (IR > 20%), are preferred instead, to limit overheating of the façades and optimize the performance of the insulation system (*the image below shows how, with thermographic analysis, lighter colors present a lower surface temperature, despite equal incident radiation*).

***Proposed solutions: 4.2 + 4.5 + 4.16 (alternative 4.15.b)*** ***Download the full treatment 3.1***




*Different color finishes for ETICS. The thermographic image on the right shows the highest temperature surfaces in yellow.*

## 3.2 Efflorescence and stains

These appear as whitish patches on the surface of the finish. They can be caused by salts or carbonates rising from the underlying cementitious materials, as a result of water infiltration and/or the application of the finish on an uncured plaster.

***Proposed solutions: 4.3 + 4.5 + 4.15***
***Download the full treatment 3.2***

## 3.3 Crumbling/Dusting

In this form of deterioration, the surface of the finish is damaged, unstable, tends to crumble, and releases color. This can be caused by a degradation of the binder due to application in unsuitable environmental conditions (too hot, too cold, or in the presence of rain...), improper application (insufficient product applied, excessive use of water during installation...), or the use of low-quality materials.

*Exemplo of crumbling*
*Source: "Linee guida - Formazione applicatori: i prodotti vernicianti per edilizia" by Avisa-Federchimica*

***Proposed solutions: 4.2 + 4.5 + 4.15*** ***Download the full treatment 3.3***

## 3.4 Snail tracks

These appear as translucent whitish streaks caused by rain on finishes that have not completed the film-forming process*. In these cases, rainwater dissolves certain substances present in the finish (wetting agents and dispersants) and carries them to the surface.
The problem is purely aesthetic and can be resolved with subsequent rains or by performing simple washes with clean water (optionally using a soft-bristled brush: foam will form, which must be thoroughly rinsed).
Note: Do not make the mistake of repainting without thoroughly washing first, or the problem will recur exactly as before.

***Proposed solutions: 4.2***
***Additional solution (only if snail tracks are still visible after thorough washing): 4.15.b***
***Download the full treatment 3.4***

## 3.5 Biological colonization (molds, algae, etc.)

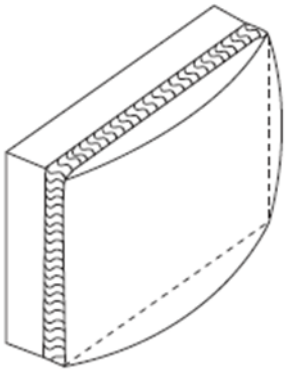
The risk of facade colonization is never attributable to a single cause but to numerous factors, often in combination with each other (constructional, environmental, climatic aspects, poor materials, etc.).
The proliferation of these pathogens is primarily linked to the presence of water and/or persistent moisture on the surface and is favored by the presence of hairline cracks and fissures that create further water accumulation.
An effective external thermal insulation system, by preventing the escape of internal heat, has the side effect of maintaining very low temperatures on the external surface of the finish, making it more prone to moisture.
Where sunlight is low (such as on north-facing facades), airborne spores can settle more easily, leading to selective darkening, leaving the areas affected by thermal bridges lighter because they tend to dry out faster than the well-insulated portions. Another form of differential darkening occurs on surfaces partially protected from precipitation, such as below window sills; these areas tend to be lighter because they are less likely to develop mold. To prevent the occurrence of these phenomena, it is essential for the finish layer of the insulation system to have high water repellency (W3 class according to EN 1062-3) and be appropriately additive with substances capable of effectively combating the proliferation of mold, algae, and fungi (efficacy tested according to European standards EN 15457 and EN 15458).

***Proposed solutions: 4.1 + 4.2 + 4.6 + 4.15*** ***Download the full treatment 3.5***

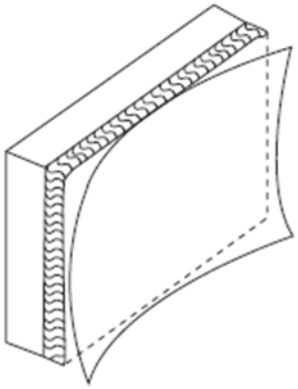
* Curing of a wet paint product on a given substrate by solvent evaporation or by a chemical cross-linking process of the binder.

## 3.6 Mattress effect of the panels

The italian standard UNI/TR 11715:2018 defines the "mattress effect" as the behavior of an insulating panel that is dimensionally unstable to thermal variations when it is free to deform, for example, when it is not properly glued or is incorrectly glued.

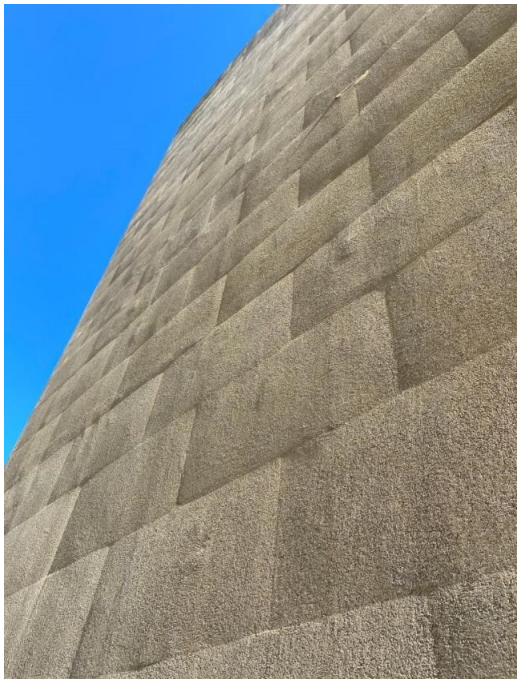


**Outside Hot**



**Outside Cold**

Mattress effect appears initially as an aesthetic issue but will soon lead to more damaging pathologies, such as cracks and subsequent problems caused by water infiltration into the system. Other causes of thermal expansion could include: low-quality adhesives, settling of supports that were not properly prepared, insufficiently thick reinforced renders, improper placement of meshes, etc.; each of these issues can be resolved with specific treatments.

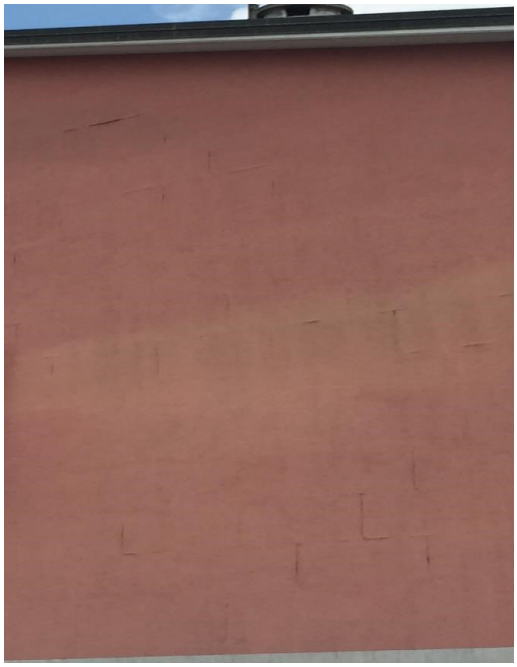


*Mattress effect*

*Detachment of the old finish coating*

***Proposed solutions for mattress effect caused by settling of the underlying support (plaster, coating, paint, etc.): total removal of the old system + 4.2 + 4.5 + installation of the new system.***

***Download the full treatment 3.6.a***



*Low-quality and/or poorly applied adhesive*

***Proposed solutions for mattress effect caused by low-quality adhesive or insufficient or incorrect application: 4.4 + 4.2 + 4.12 + 4.5 + 4.26 + 4.21 + 4.18***
***Download the full treatment 3.6.b***

*Misplaced mesh and insufficient thickness of the render*

***Proposed solutions for insufficient thickness of reinforced render or misplaced mesh: 4.4 + 4.2 + 4.5 + 4.20 + 4.8 + 4.17.b***
***Download the full treatment 3.6.c***

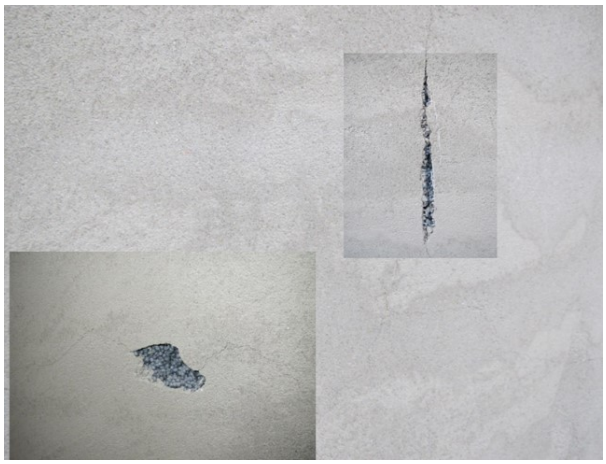
## 3.7 Micro-craking

Micro-cracking are fissures that, like the mattress effect, tend to follow the joints between the insulating panels, revealing the installation pattern.
In addition to the aesthetic damage, cracks can quickly degenerate into functional damage as they create favorable conditions for infiltrative phenomena and water stagnation on the surface of the external thermal insulation system.
This type of degradation can be caused by the drying shrinkage of materials, or by a finish that is too rigid, or applied with an unseasoned cement-based render, or applied with direct sun exposure, or on very hot supports, or in excessive thickness.

***Proposed solutions: (4.2) + 4.9 + 4.18***
***Download the full treatment 3.7***

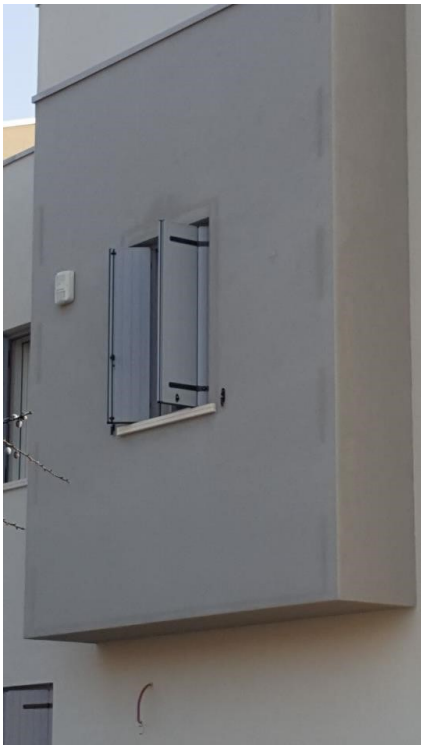
## 3.8 Cracking (non-structural)

The appearance of cracks in an external thermal insulation system not only represents a clear aesthetic damage but also a functional damage and a significant vulnerability point that facilitates the onset of other pathologies. The reinforced base coat and finish layers form a protective shell for the insulation, designed to protect it from hygrothermal stresses and mechanical impacts (such as knocks).
The cracking patterns affecting these layers can be caused by various design or installation errors or the use of low-quality materials: unaddressed mattress effect (incorrectly applied adhesive and/or poor-quality adhesive and/or support failure and/or insufficiently thick reinforced base coat – see section 3.6), cement-based render used to "fill" gaps between ill-fitting insulation panels, incorrectly positioned mesh (too deep or even resting against the insulation panel), incorrect or missing diagonal mesh reinforcements ("diagonal patches") at corner openings, lack of proper overlap of mesh strips, lack of sealing tapes, too dark a finish color, or a finish that is too rigid.



*Non-overlapping mesh*

*Misplaced mesh*



*Filled gaps*

***Solution for insufficiently thick base coat or "filled" gaps* or mispositioned mesh or mesh not overlapped or too dark a finish color: 4.4 + 4.2 + 4.5 + 4.20 + 4.8 + 4.17.b***

*(*Note: this treatment will not solve the thermal bridge)*

***Download the full treatment 3.8.a***

*Failure or misplacement of diagonal mesh patches*

*Failure to place the sealing tapes*

***Proposed solutions for incorrect/missing positioning of " diagonal mesh patches": 4.4 + 4.2 + 4.10 + 4.13 + 4.20 + 4.8 + 4.17.b Download the full treatment 3.8.b***

***Proposed solution for incorrect positioning of sealing tapes: 4.4 + slight opening of the crack/joint + 4.11 + 4.10 + 4.9 + 4.18 Download the full treatment 3.8.c***

*Excessive thickness of cement-based render*

***Proposed solutions for excessive thickness of cement-based render (localized and minor cracks): (4.2) + 4.10 + 4.9 + 4.18*** ***Download the full treatment 3.8.d***

***Proposed solutions for excessive thickness of cement-based render (widespread and significant cracks): 4.4 + 4.2 + 4.10 + 4.20 + 4.8 + 4.17.b*** ***Download the full treatment 3.8.e***

## 3.9 Detachment of surface layers (reinforced base coat and/or finish coat)

Other consequences of detachment of the finish layer of an external thermal insulation system may include: water penetration into the system, freeze-thaw cycles, sub-efflorescence caused by the infiltration of salts carried by water, lack of adhesion between layers, or application in unsuitable environmental conditions (rain, excessive heat or cold, etc.).

In the following images, it can be seen that the lifting of the finish layer follows the path of the joints between the insulation panels. This occurs because the differential tensile stresses to which the panels are subjected are not properly absorbed by the reinforcement mesh, due to insufficient base coat thickness, which should embed the mesh, or lack of collaboration between the mesh and the finish layer.

*Distacco parziale rivestimento di finitura da rasatura armata*

***Proposed Solutions (if partial removal of the finish layer is necessary): 4.4 + 4.2 + 4.5 + 4.18 (used to level the removed surfaces) + 4.9 + 4.18***
***Download the full treatment 3.9.a***

*Distacco rasatura armata da pannello isolante*

***Proposed Solutions (if complete removal of both reinforced base coat and finish layer is necessary): 4.4 + 4.3 + 4.21 + 4.18***
***Download the full treatment 3.9.b***

*Total detachment finishing coat from reinforced skim coat*

***Proposed Solutions (if complete removal of the finish layer is necessary): 4.4 + 4.2 + 4.5 + 4.9 + 4.18***
***Download the full treatment 3.9.c***

## 3.10 Lack of planarity

In these cases, the surface of the thermal insulation system does not appear smooth and flat as it should, but shows more or less visible undulations under slanted sunlight (crumpled paper effect) or noticeable steps between the panels.

This lack of planarity results from errors during:

- Insulation installation: poor attention to planarity or failure to level irregularities by grinding or sanding the panels or using compensatory coatings.
- Anchor installation: the tightening action of the anchors can cause compression or loss of planarity in the insulation panels if the adhesive has not been given enough time to harden, or if the anchors were placed too exposed compared to the insulation panel surface.
- Adhesive application: Rough application on the surface without leveling the thickness.

***Proposed Solutions: 4.2 + 4.20 + 4.8 + 4.17.b***
***Download the full treatment 3.10***

## 3.11 Accidental breaks

These are often caused by occasional impacts, particularly in critical areas such as the baseboard and, in particular, the corners at the base of the walls. In facades that are particularly exposed to impacts, it may be a good practice to separate the baseboard area from the upper elevation. This way, any necessary maintenance can be carried out solely on those parts without affecting the entire system.
As a preventive measure, the design can consider the use of systems with extremely high mechanical resistance – see paragraph 3.12 (hail perforation).

***Proposed Solutions for Cracks Limited to the Surface Layer: See 3.12 (hail perforation)***
***Proposed Solutions for Large Breakages: Completely remove the old system in the affected area + adequately prepare the support + 4.24 + 4.25 + any accessories (profiles, sealing tapes, "fazzoletti" mesh, etc.) + 4.14 (level the surfaces) + 4.19 + 4.8 + 4.17.b***
***Download the full treatment 3.11***

## 3.12 Hail Perforation

Depending on the severity of the phenomenon, hailstorms can either superficially damage only the outer layer (mild hailstorms) or create actual holes, leading to the crumbling of the cement-based plaster and sometimes even breaking the underlying reinforcement mesh (severe hailstorms).

The increasingly frequent occurrence of catastrophic events like hail suggests the need to implement significant prevention systems. In this regard, it is possible to restore or create insulation systems with high impact resistance, capable of withstanding hailstones the size of a tennis ball.

Note: Hail is classified, by international convention, using the **TORRO Hailstorm Intensity Scale**, which is based on the diameter of the hailstones (Table 1) or the extent of the damage they cause (Table 2). Each class is associated with an intensity category, ranging from H0 (weak hail, causing no damage) to H10 (super hail or exceptional hail). This intensity (last column of Table 1) varies depending on various factors: hailstone diameter, hardness, fall velocity, fall inclination, shape of the hailstone, and wind.

| Size code | Maximum diameter (mm) | Description |
|---|---|---|
| **0** | 5-9 | Pea |
| **1** | 10-15 | Mothball |
| **2** | 16-20 | Marble, grape |
| **3** | 21-30 | Walnut |
| **4** | 31-40 | Pigeon's egg > squash ball |
| **5** | 41-50 | Golf ball > Pullet's egg |
| **6** | 51-60 | Hen's egg |
| **7** | 61-75 | Tennis ball > cricket ball |
| **8** | 76-90 | Large orange > soft ball |
| **9** | 91-100 | Grapefruit |
| **10** | >100 | Melon |

*Table 1. TORRO Scale - Hail size and diameter*

| Scale | Intensity category | Size code range | Typical damage impact |
|---|---|---|---|
| **H0** | Hard hail | 1 | No damage |
| **H1** | Potentially damaging | 1-3 | Slight general damage to plants, crops |
| **H2** | Significant | 1-4 | Significant damage to fruit, crops, vegetation |
| **H3** | Severe | 2-5 | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| **H4** | Severe | 3-6 | Widespread glass damage, vehicle bodywork damage |
| **H5** | Destructive | 4-7 | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| **H6** | Destructive | 5-8 | Bodywork of grounded aircraft dented, brick walls pitted |
| **H7** | Destructive | 6-9 | Severe roof damage, risk of serious injuries |
| **H8** | Destructive | 7-10 | (Severest recorded in the British Isles) Severe damage to aircraft bodywork |
| **H9** | Super Hailstorms | 8-10 | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| **H10** | Super Hailstorms | 9-10 | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

*Table 2. TORRO Scale - Hailstorm Intensity Scale (H0 to H10) in relation to typical damage and hail size codes.*

***Proposed solutions for minor signs (no damage to the mesh): 4.4 + 4.3 + 4.5 + 4.18 (filling cracks and leveling surfaces) + 4.9 + 4.18 Download the full treatment 3.12.a***

***Proposed solutions for significant signs (achieving category I with 10J impact): 4.4 + 4.3 + 4.5 + 4.27 + 4.19 + 4.9 + 4.18 Download the full treatment 3.12.b***

***Proposed solutions for achieving surfaces with increased mechanical resistance (achieving category I with 15J impact): 4.4 + 4.3 + 4.5 + 4.28 + 4.21 + 4.18 Download the full treatment 3.12.c***

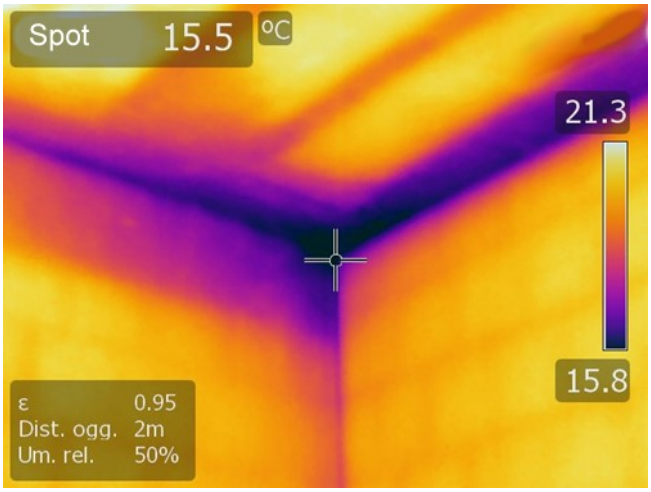

1. Old cracked ETICS
2. Acrylic primer MALECH
3. Elastic skim coat MAPETHERM FLEX RP
4. Fiberglass mesh MAPETHERM NET
5. Elastic skim coat MAPETHERM FLEX RP
6. Elastomeric sanitizing coating ELASTOCOLOR TONACHINO PLUS

***Proposed solutions for achieving surfaces with very high mechanical resistance (achieving category I with 100J impact): 4.4 + 4.3 + 4.5 + 4.28 + 4.22 + 4.7 + 4.18 Download the full treatment 3.12.d***

Significant hail resistance can be achieved if ETICS is constructed with all the necessary criteria, i.e., if certified systems are used and properly installed by qualified installers.
In the ETA certification of exterior insulation systems (based on EAD 040083-00-0404), values are provided for hard body impact resistance tests (UNI EN ISO 7892 test method).
To achieve the highest use category according to EAD (Category I), the external insulation system must withstand impacts of 10 J without damage. Traditional ETICS (Category II) generally do not deteriorate with a 3 J impact, but show surface damage with a 10 J impact equivalent to the impact of a ping-pong ball-sized hailstone.
Impact resistance up to 100 J, which is roughly equivalent to the impact of a tennis ball-sized hailstone, can be achieved with technologically advanced systems designed specifically for that purpose.

## 3.13 Insufficient Insulation

This problem happens when the thickness of the insulation is undersized compared to current energy standards. Insufficient insulation can lead to localized condensation phenomena and resulting mold on interior surfaces, interstitial condensation, poor living comfort, and high energy consumption.




***Proposed solutions: prepare the support adequately + 4.23***
***Download the guidelines for installation 3.13***

## 3.14 Infiltrations at Junctions

Water stagnation can occur at junctions between different materials (e.g., insulation and marble window sills, insulation and anchors for external elements such as flashing, canopies, and installation networks).
If not properly addressed with suitable seals, these joints can become areas where infiltration phenomena are triggered, leading to swelling and blistering.

***Proposed solutions: 4.4 + slight opening of the crack/joint + 4.11 + 4.10 + 4.9 + 4.18***
***Download the full treatment 3.14***

## 3.15 Surface absorption of the finish

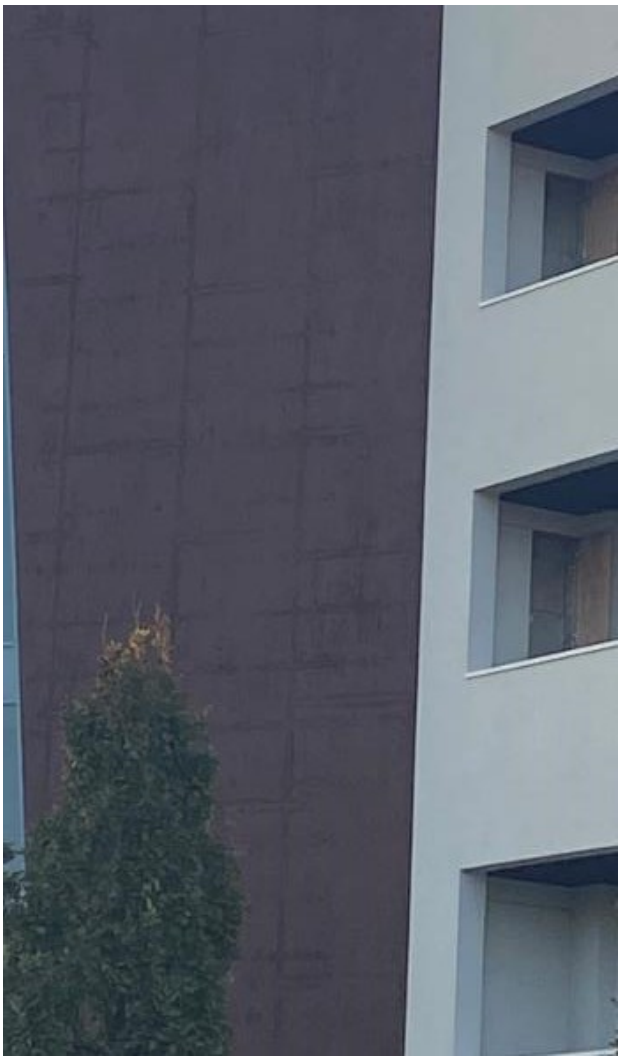
This problem initially has an aesthetic nature but can quickly lead to structural damage to the system.

The water that penetrates the system causes:

- A reduction in the insulating capacity of the system;
- The transportation of salts inside the system, which, when crystallizing and increasing in volume, could cause cracks;
- The dissolution of salts and carbonates contained within the cement-based plaster, and their movement onto the surface of the finish, generating unsightly white efflorescence or, worse, beneath the finish, leading to harmful sub-efflorescence that can detach the finish itself;
- Harmful internal freezing phenomena;
- The swelling of the insulation if it is absorbent;
- The proliferation of mold and algae.

***Proposed solutions: 4.2 + 4.6 + 4.15.a***

***Download the full treatment 3.15***



# 4 STRUCTURED SOLUTIONS

The preparation of the Specification requires particular attention to the condition of the substrate, the selected materials, and the resolution of critical junctions in the building. Therefore, it must be written specifically for each project. Below are the main treatments that can be carried out to address the most common issues found on deteriorated ETICS.

## 4.1 Sanitization

On surfaces affected by mold and algae, supply and application of a broad-spectrum sanitizing detergent based on active anti-algae and anti-mold compounds in aqueous solution, for cleaning the wall surfaces. The solution should be left to act for at least 24 hours, repeating the operation multiple times to achieve maximum penetration.

***Download solution 4.1***

## 4.2 Water pressure washing

Performing a thorough cleaning of surfaces using water pressure washing with pressures and flows suited to the characteristics of the substrate, in order to eliminate traces of dirt, dust, or any substance that may compromise the adhesion of products to be applied later. The substrate must be clean, cohesive, and mechanically resistant. When water pressure washing is not possible, an alternative method is dry cleaning (4.3).

***Download solution 4.2***

## 4.3 Dry cleaning

Manual or mechanical brushing and cleaning to remove traces of dirt, dust, or any substances that may compromise the adhesion of products to be applied later. The substrate must be clean, cohesive, and mechanically resistant.

***Download solution 4.3***

## 4.4 Removal of non-cohesive parts

Mechanically remove the old finishing coat and/or layers of render that are not adequately bonded to the substrate.

***Download solution 4.4***

## 4.5 Consolidating primer

Supply and application of a highly penetrating and consolidating primer based on micronized acrylic resins in an aqueous solution, properly diluted with water, to reduce the absorption of the substrate and eliminate residual surface "dusting."

***Download solution 4.5***

## 4.6 Sanitizing primer

Supply and application of a siloxane-based primer, sanitizing, uniforming, and resistant to mold and algae (efficacy tested according to European standards EN 15457 and EN 15458), appropriately diluted with water.
***Download solution 4.6***

## 4.7 Filling primer

Supply and application of a pigmented acrylic primer, for both exterior and interior use, uniforming, filling, and promoting adhesion.
***Download solution 4.7***

## 4.8 Sanitizing primer

Supply and application of a pigmented siloxane-based primer, for both exterior and interior use, water-repellent, sanitizing, and resistant to algae and mold (efficacy tested according to European standards EN 15457 and EN 15458).
***Download solution 4.8***

## 4.9 Elastic filling primer

Supply and application of a high-thickness, high-fill elastomeric fiber-reinforced primer/finish. The product is properly diluted with water and has a crack resistance of A3 class (>0.5mm) according to EN 1062-7.
***Download solution 4.9***

## 4.10 Elastic acrylic sealant

Treating "static" cracks present on surfaces by supplying and applying a one-component, paintable acrylic sealant with a "plaster effect" in aqueous dispersion, after appropriate widening, cleaning, and slight consolidation of the substrate with a micronized primer with high penetrating and consolidating power, properly diluted with water.
***Download solution 4.10***

## 4.11 Pre-compressed sealant tape

Supply and application of a self-expanding sealing tape to seal system connection joints and compensate for thermal expansion. The product prevents any point of contact between the insulating panel and the exterior, compensates for the expansion and shrinkage movements of different materials in contact, and seals the joints.
***Download solution 4.11***

## 4.12 Polyurethane adhesive

Supply and application of one-component, low-expansion polyurethane adhesive foam for bonding insulating panels. Proceed by injecting the foam through the insulation and onto the underlying substrate, making holes approximately every 40 cm for the injection of the polyurethane foam.
***Download solution 4.12***

## 4.13 Reinforcements ("patches") of mesh

At the corners of openings, supply and application of additional reinforcement for the mesh by placing patches of fiberglass mesh treated with a special sizing to resist alkalis, tested according to testing method EAD 040083-00-0404, approximately 30x40 cm in size, placed diagonally across the openings and carefully aligned with the edges. Apply these "patches" using fine or medium-grain one-component cementitious mortar.

***Download solution 4.13***

## 4.14 Lightweight skim coat for high thickness application

Supply and application of a skim coat layer, aimed at achieving perfect surface flatness, using one-component lightweight cement mortar, A1 fire reaction class, for bonding and leveling thermal insulation panels and ETICS, to be applied up to 10mm per layer.

***Download solution 4.14***

## 4.15 Sanitizing Paint

**4.15.a Alternative 1 – Siloxane**

Supply and application of siloxane-based sanitizing paint, for surfaces particularly exposed to the degrading action of algae, mold, and fungi, highly water-repellent ($W \leq 0.06 kg/(m^2 \cdot h^{0.5})$), highly breathable ($SD \leq 0.06m$), resistant to mold and algae (efficacy tested according to European standards EN 15457 and EN 15458), with $CO_2$ emissions fully compensated over the entire lifecycle, in colors chosen by the Project Management, with a light reflection index greater than 20%.

***Download solution 4.15.a***

**4.15.b Alternative 2 – Acryl-Siloxane**

Supply and application of acryl-siloxane-based sanitizing paint, water-repellent ($W \leq 0.15 kg/(m^2 \cdot h^{0.5})$), breathable ($SD \leq 0.14m$), resistant to mold and algae (efficacy tested according to European standards EN 15457 and EN 15458), ideal for prolonging the durability of the most critical colors, in colors chosen by the Project Management, with a light reflection index greater than 20%.

***Download solution 4.15.b***

## 4.16 Elastomeric sanitizing paint

Supply and application of elastomeric sanitizing and crack-resistant paint, with permanent elasticity, high chemical resistance, resistant to algae and mold (efficacy tested according to European standards EN 15457 and EN 15458), with $CO_2$ emissions fully compensated over the entire lifecycle, ideal for prolonging the durability of the most critical colors, in colors chosen by the Project Management, with a light reflection index greater than 20%.

***Download solution 4.16***

## 4.17 Breathable sanitizing plastic finish coating

**4.17.a Alternative 1 – Siloxane**

Supply and application of siloxane-based sanitizing finish coating, water-repellent, breathable, and resistant to algae and mold (efficacy tested according to European standards EN 15457 and EN 15458), with low water absorption (W3 class according to EN 1062-3: W=0.04Kg/(m·$h^{0.5}$)) and high vapor permeability (V1 class according to EN ISO 7783: SD=0.09m), in the granulation and colors chosen by the Project Management with a light reflection index greater than 20%.

***Download solution 4.17.a***

**4.17.b Alternative 2 – Acryl-Siloxane**

Supply and application of an acryl-siloxane finish coating, water-repellent, resistant to algae and mold (efficacy tested according to European standards EN 15457 and EN 15458), with low water absorption (W3 class according to EN 1062-3: W=0.05Kg/(m·$h^{0.5}$)) and high vapor permeability (V1 class according to EN ISO 7783: SD=0.11m), ideal for prolonging the durability of the most critical colors, in the granulation and colors chosen by the Project Management with a light reflection index greater than 20%.

***Download solution 4.17.b***

## 4.18 Elastomeric sanitizing finish coating

Supply and application of an elastomeric paste-based finish coating with elastomeric-silicone resin in aqueous dispersion, low dirt pickup, high elasticity (A3 crack resistance class (>0.5mm) according to EN 1062-7), water-repellent, sanitizing against mold and algae (efficacy tested according to European standards EN 15457 and EN 15458), ideal for prolonging the durability of the most critical colors, with a granulation of 1.2mm, in the colors chosen by the Project Management with a light reflection index greater than 20%.

***Download solution 4.18***

## 4.19 Reinforced cementitious plaster

Supply and application of:

- A first layer of plaster, approximately 2.5-3mm thick, using medium-grain one-component cement mortar, A1 fire reaction class, for bonding and leveling thermal insulation panels and for external thermal insulation systems (ETICS).
- While the plaster is still fresh, apply fiberglass mesh treated with a special sizing to resist alkalis, tested according to testing method EAD 040083-00-0404, from top to bottom, ensuring an overlap of at least 10 cm between sheets.
- After about 24 hours, or when the first layer has fully dried, proceed with the application of a second layer of medium-grain one-component cement mortar, A1 fire reaction class, approximately 1-1.5mm thick, forming a homogeneous and uniform layer in which the mesh should no longer be visible and should be covered with at least a 1mm layer.
- Recommended total thickness for the reinforced layer: 4mm (but never less than 3mm).
- The mortar used should have A1 fire reaction Euroclass, a water vapor permeability coefficient μ<15, and capillary water absorption <0.10Kg/($m^2$·$min^{0.5}$).

***Download solution 4.19***

## 4.20 Lightweight reinforced cementitious plaster

Supply and application of:

- A first layer of plaster, with a thickness ranging from 2.5 to 5mm, using lightweight one-component cement mortar, A1 fire reaction class, for bonding and leveling thermal insulation panels and for external thermal insulation systems (ETICS).
- While the plaster is still fresh, apply fiberglass mesh treated with a special sizing for alkali resistance, tested according to testing method EAD 040083-00-0404, from top to bottom, ensuring an overlap of at least 10 cm between sheets.
- After about 24 hours, or once the first layer has fully dried, proceed with the application of a second layer of lightweight one-component cement mortar with glass microspheres, A1 fire reaction class, with a thickness ranging from 1.5 to 4mm, forming a homogeneous and uniform layer where the mesh should no longer be visible and should be covered with at least 1mm of the plaster.
- Recommended total thickness of the reinforced layer: at least 4mm.
- The mortar used must have A1 fire reaction Euroclass, a water vapor permeability coefficient $\mu<15$, and capillary water absorption $<0.13 Kg/(m^2 \cdot min^{0.5})$.

***Download solution 4.20***

## 4.21 Elastic reinforced plaster

Supply and application of:

- A first layer of plaster, approximately 2-2.5mm thick, using a one-component, cement-free, colorable paste, highly elastic and resistant to biological attack by algae and mold (efficacy tested according to European standards EN 15457 and EN 15458), ideal also for the restoration of external thermal insulation systems, with a granulation of 1.5mm.
- While the plaster is still fresh, apply fiberglass mesh treated with a special sizing for alkali resistance, tested according to testing method EAD 040083-00-0404, from top to bottom, ensuring an overlap of at least 10 cm between sheets.
- After about 24 hours, or once the first layer has fully dried, proceed with the application of a second layer, approximately 1.5mm thick, of a one-component, cement-free, colorable paste, highly elastic and resistant to biological attack by algae and mold (efficacy tested according to European standards EN 15457 and EN 15458), ideal for restoring thermal insulation systems, with a granulation of 1.5mm, forming a homogeneous and uniform layer where the mesh should no longer be visible and should be covered with at least 1mm of plaster.
- Recommended total thickness of the reinforced layer: at least 3.5mm (but never less than 3mm).

***Download solution 4.21***

## 4.22 Elastic reinforced plaster with fiberglass mesh

Supply and application of:

- A first layer of plaster, approximately 2-2.5mm thick, made from a one-component, cement-free, colorable paste that is highly elastic and resistant to biological attacks from algae and mold (efficacy tested according to European standards EN 15457 and EN 15458), ideal for restoring thermal insulation systems, with a granulation of 1.5mm.
- While the plaster is still fresh, apply fiberglass mesh treated with a special sizing to provide alkali resistance, tested according to testing method EAD 040083-00-0404, from top to bottom, ensuring the sheets are closely fitted (without overlapping).
- After at least 48 hours, and once the previous layer has fully dried, apply a second layer of plaster, approximately 2-2.5mm thick, of the same one-component, cement-free, colorable paste, highly elastic and resistant to algae and mold, with a granulation of 1.5mm.
- While the second layer is still fresh, apply a second layer of fiberglass mesh, treated for alkali resistance, tested according to the same method (EAD 040083-00-0404), from top to bottom, ensuring the sheets overlap by at least 10 cm compared to the previous mesh layer.
- After at least 48 hours, and once the previous layer has fully dried, apply a third layer of plaster, approximately 1.5mm thick, using the same highly elastic, cement-free, colorable paste, to form a homogeneous and uniform layer where the mesh is no longer visible and is covered by at least 1.5mm of plaster.
- Recommended total thickness of the reinforced layer: approximately 5.5mm.

***Download solution 4.22***

## 4.23 Double layer of thermal insulation

This type of installation is feasible in most cases, but it can only be carried out after a thorough analysis of the existing conditions and a careful preliminary preparation of the substrate.
As it is a complex installation that needs to be carefully evaluated in all its phases and implications, a dedicated in-depth analysis will be prepared soon. The images below show two examples of a double insulation layer system.


1 Old deteriorated ETICS
2 Sanitiser Silancolor Cleaner Plus
3 Primer Malech
4 Adhesive Mapetherm AR1 GG
5 Insulation panel: CAM-compliant EPS
6 Dowels Mapetherm-Ejotherm S1
7 Reinforced skim coat Mapetherm Flex RP + Mapetherm Net
8 Final thick coating Elastocolor Tonachino Plus

*Mapetherm X2 System: doubling of the insulation system with a reinforced cycle*


1 Old deteriorated ETICS
2 Sanitiser Silancolor Cleaner Plus
3 Primer Malech
4 Adhesive Mapetherm AR1 GG
5 Insulation panel: CAM-compliant EPS
6 Dowels Mapetherm-Ejotherm S1
7 Reinforced skim coat Mapetherm AR1 GG + Mapetherm Net
8 Coat Silincolor Base Coat Plus
9 Final thick coating Elastocolor Tonachino Plus

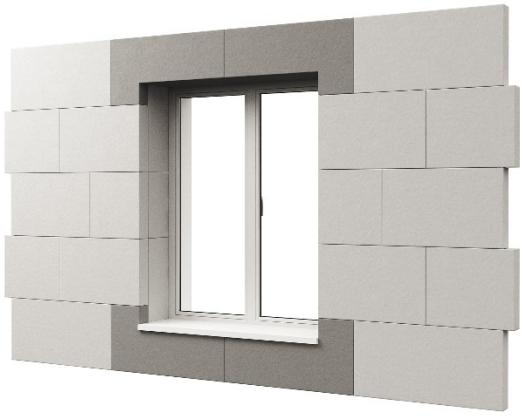
*Mapetherm X2 System: doubling of the insulation system with a standard cycle*

***View detailed insights 4.23***

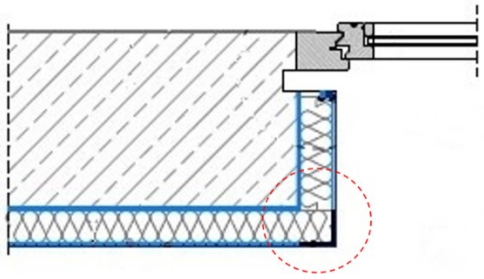
## 4.24 Bonding of new insulation panels

Supply and installation of thermal insulation panels of appropriate type and thickness for the specific case, suitable for ETICS, with squared profiles, free of projecting edges:

- The panels must be protected from possible rain during both the application phase and storage phase.
- Install the thermal insulation panels from bottom to top, placing them with the longest side in a horizontal position on the starting profile.
- Bond the panels to the surfaces using a one-component cementitious adhesive, applying a uniform layer of the adhesive to the back of the panel (total bonding) or, in cases where there is insufficient flatness (level differences greater than 0.5cm), apply the adhesive in cords and dots on the back of the panel, ensuring at least 40% of the surface is covered by the adhesive.
- The mortar used must have A1 fire reaction Euroclass, a water vapor permeability coefficient $\mu<15$, and a capillary water absorption of $<0.1 Kg/(m^2 \cdot min^{0.5})$.
- Ensure the adhesive application system prevents air from passing between the insulation panel and the support.
- Place the panels on the support in horizontal rows, ensuring they are staggered by 50% of their length (never less than 25cm), interlocking them with the remaining old panels, aligning them carefully without leaving gaps, and pressing them to the surface to better distribute the adhesive.
- At the openings for doors and windows, full panels should be used, with the corners cut out.



- For the insulation of door and window reveals (spallets), panels should be placed on the façade surface extending beyond the raw edge of the opening by the thickness of the insulation (including the adhesive thickness). Any excess protruding part can be trimmed later. Additionally, apply transition insulation to the window frame.



- Near the building corners, the panels should be applied in overlapping, staggered rows. This process is crucial for the correct distribution of stresses and for ensuring the system's robustness and longevity.

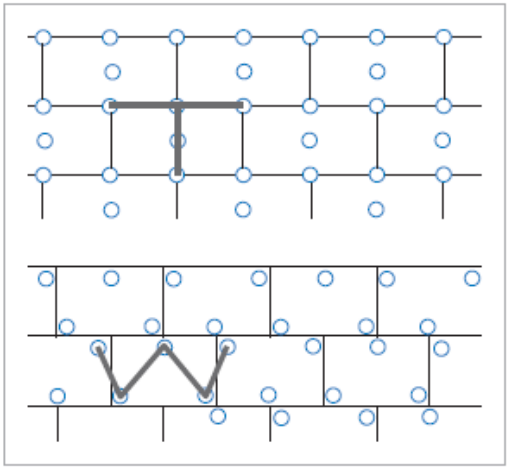
- During installation, respect any existing or design structural joints, which should be protected with specific joint profiles (linear and/or vertical).
- To achieve a high-quality aesthetic finish, while the adhesive is still fresh, check and, if necessary, adjust the flatness of the insulation panels using an aluminum leveling bar.
- Once the adhesive has dried, further refine the surface flatness through manual mechanical abrasion.
- Any gaps between the insulation panels should be filled completely with the same insulation material. For gaps not exceeding 5mm, polyurethane foam can be used; avoid "filling" gaps with finishing render.

***Download solution 4.24***

## 4.25 Anchor fixing on new insulation panels

Supply and installation of fixings for attaching external thermal insulation systems (ETICS), with specific ETA evaluation according to EAD-330196-01-0604, applied by screwing (recommended) or percussion:

- Apply the fixings once the adhesive has hardened, at the same level and until the load-bearing portion of the substrate is reached.
- The length of the fixing should be dimensioned by adding the thickness of the insulation panel, the adhesive, the plaster (if present), and the depth of anchoring for the specific fixing type to the wall substrate (consult the technical data sheet).
- Holes for the fixings should be made once the adhesive has hardened (about 2-3 days after installation) to prevent damaging the flatness of the installed panels. Use drill bits with the same diameter as the shaft of the fixing, and use rotary percussion only if the substrate is concrete or solid brick.
- Install the fixings according to the "T" pattern for synthetic panels, which helps the adhesive and finishing coat resist thermal expansion of the panels, or in a "W" pattern for fibrous panels to prevent pull-through.



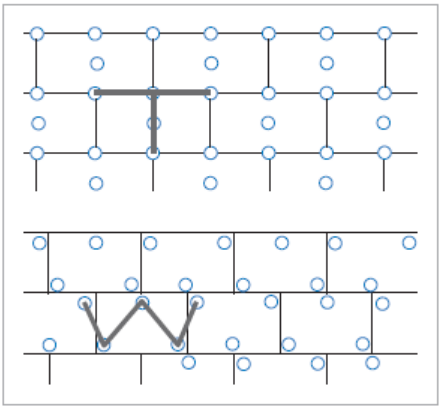
- Position the fixings so that the plate remains flush with the surface of the insulation panels.
- Depending on environmental conditions, the state of the substrate, position, orientation, shape, and height of the building, reinforced fixing may be necessary, especially in the perimeter areas of the building (near corners).
- Every installed fixing must be perfectly anchored; if it is not, it should be removed, the hole filled with appropriate insulating foam, and a new fixing installed nearby.

***Download solution 4.25***

## 4.26 Fixing on existing insulation system

Supply and installation of screws for fastening external thermal insulation systems (ETICS), equipped with specific ETA evaluation based on EAD-330196-01-0604, using a screwing method:

- The length of the fixing must be calculated by adding the thickness of the outer layer (finish coating + reinforced skim coat), insulation panel, adhesive, plaster (if present), and the anchoring depth of the specific fixing on the wall substrate (consult the technical data sheet).
- Holes for the fixings should be drilled with bits having the same diameter as the fixing's shaft, using the rotary percussion mode only for concrete or solid brick substrates.
- Install the fixings strategically based on the existing system, generally following the "T" pattern for synthetic panels, which helps the adhesive and finishing coat counteract thermal expansion of the panels, or in a "W" pattern for fibrous panels to prevent pull-through.



- Depending on environmental conditions, the condition of the existing system, and the position, shape, and height of the building, reinforced fixing may be required, especially in perimeter areas (near corners).
- Each installed fixing must be perfectly anchored. If not, remove it, fill the hole with appropriate insulating foam, and install a new fixing nearby.

***Download solution 4.26***

## 4.27 Crack repair and surface leveling with cementitious skim coat

Repair of cracks and leveling of surfaces by supplying and installing a medium-grain, monocomponent cement-based mortar, A1 fire resistance class.

***Download solution 4.27***

## 4.28 Crack repair and surface leveling with elastic paste skim coat

Repair of cracks and leveling of surfaces by supplying and installing a monocomponent paste skim coat, free of cement, colorable, extremely elastic, and resistant to biological aggression from algae and mold (effectiveness tested according to European standards EN 15457 and EN 15458).

***Download solution 4.28***

# CONTACTS

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