

MATHIOS
STONE
INSTALLATION
INSTRUCTIONS
MANUAL

MATHIOS *stone*[®]

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GENERAL CONSIDERATIONS

- MATHIOS REFRACTORIES guarantees that the products are in compliance with the Technical Brochures and free from defects, ideal for their intended uses, within the natural tolerances of the production process.
- Customers recognize that, due to handmade nature of the products and the nature of the raw materials, may be certain differences in the shades and optical characteristics of the product.
- Temperature and humidity changes during the manufacturing, can cause changes in the shade of the final products. To avoid inhomogeneity, it's suggested you should buy the entire required quantity, considering the wall dimensions from edge to edge, and use different random cartons during the installation.
- Any product inconsistencies should be reported to MATHIOS REFRACTORIES only in the special form, within two days of the arrival of the products. Any defect report should be accompanied by all information relating to the product inconsistency and it must be completed and submitted PRIOR to any use or application of the merchandise.
- The colors and textures of the products in evidence on company's publications are as accurate as current photography and printing techniques allow them to be. We recommend that you see samples of the actual products before you order or buy them at points of sales.
- MATHIOS REFRACTORIES reserves the right to make product improvements without prior notice.
- Any warranties provided by MATHIOS REFRACTORIES shall no longer be valid if the recommended installation instructions are not followed. Any users who need more detailed instructions than those written on this brochure should contact one of our sales persons or visit our website at www.mathios.com

BASIC GUIDELINES

- Mathios Stone may be applied to any structurally sound and load bearing wall surface.
- Non-load bearing walls may require alterations and we recommend you consult with a construction engineer.
- Mathios Stone may be applied directly to clean untreated porous concrete and masonry surfaces.
- A successful project requires the use of quality materials, proper design and detailing for the application. High installation standards should be ensured.
- Following the suggestions above, a system can perform as intended for decades.
- Do not start the installation procedure during high humidity days and stop immediately the whole process when it rains. Protect and cover the unfinished wall.
- The execution of this procedure can be subject to value-engineering resulting in materials selected based solely on price and installation techniques that focus on speed rather than affecting the quality of the project.
- Building code requirements vary from area to area. You are strongly advised to check with local authorities for building code requirements applicable to your area and project.

MATHIOS TOOLS

Safety equipments



Mask / Gloves



Goggles



Helmet



Safety Shoes

Tools



Hammer



Application gun for installing the joint mortar



Notch trowel



Circular cutting saw with diamond disc / angle grinder



Pliers



Metallic brush / Paint brush



Spirit level



Round shaped trowel for spreading mortar



Wheelbarrow / Hoe (mortar preparation)



Trowel joint



Square shaped trowel for spreading the glue



Measuring Tape

MATERIALS GLOSSARY

BACKUP — The interior or exterior assembly to which systems are installed.

CMU — Concrete masonry unit.

CORROSION RESISTANT — A material that is intrinsically resistant to degradation or physically or chemically treated to be so under expected exposure conditions. Examples include: plastic-based materials stabilized for exposure to UV light, galvanized ferrous metals, and stainless steel.

FASTENERS — Corrosion resistant hardware used to secure lath, screed, and flashing materials to backup systems.

FLASHING — Corrosion resistant material used to restrict the movement of water around any intersection or projection of materials in an assembly.

LATH — Corrosion resistant mesh building material fastened to the substrate to act as base for adhering mortar.

MORTAR — A mixture of cementitious material, water, and aggregate, with or without the addition of admixtures or additives to alter one or more plastic or hardened properties, used to bond masonry construction materials together and fill spaces between.

POINTING MORTAR — Also known as grouting mortar, mortar mixture used to fill joints and cavities in construction.

MORTAR SCRATCH COAT — Base coat of mortar used during the installation of MATHIOS STONE VENEER; cross-raked to improve bond of subsequent mortar layers.

MORTAR SCREEN — Sheet material installed to prevent the mortar scratch coat from filling the drainage space behind an MATHIOS STONE VENEER assembly containing a rainscreen system.

MORTAR SETTING BED — Mortar used to adhere the MATHIOS STONE VENEER to the substrate or scratch coat.

WATER RESISTIVE BARRIER (WRB) — Material used to restrict the transmission of water to the surface behind.

EXTRASTONEGLUE



MATHIOS
Grout



MATERIAL REQUIREMENTS

Flashing: all flashing and flashing accessories must be corrosion resistant. For exterior applications, flashing must be installed at all through-wall penetrations and at lower boundaries of MATHIOS STONE VENEER installations. Flashing is not required for interior applications of MATHIOS STONE VENEER surfaces not exposed to water.

Rainscreens: are optional building techniques used to improve the drainage of incidental water behind the cladding and reduce drying time. Rainscreen products (such as drainage mats or formed polymer sheeting) or construction techniques (such as strapping or furring) that create a capillary break/air space between the cladding and the water resistive barrier can be effectively incorporated into stone applications.

Weep Screeds: and Casing Beads
Weep screeds and casing beads must be corrosion resistant.

Lath: multiple lath materials can be used successfully for the installation.

Fasteners

Mortar: mortars used for the installation of stone systems can be grouped into three different categories; scratch coat mortar, setting bed mortar, and pointing mortar.

Cement Board: Cement may be used in place of lath and scratch coat, if requested.

Backup Wall System	Sheathing/ Substrate	Water Resistive Barrier	Lath Type	Lath Fasteners	Setting Bed/ Scratch Coat
Concrete or CMU*	Not Applicable	Optional	Optional	Not Applicable	See Mortar Table in Material Specs
Exterior Wood or Steel Stud Framing; maximum spacing 16 in. (406 mm)	<ul style="list-style-type: none"> • Gypsum Wall Board • Plywood • OSB • Fiber Board • Cement Board 	Minimum two layers WRB *Optional for interior use	Any approved lath	Corrosion resistant; minimum penetration 3/4 in. (19 mm) into wood framing member or 3/8 in. (10 mm) into steel framing member	See Mortar Table in Material Specs
Coursed Brick or Stucco	Not Applicable	Optional	Any approved lath	Corrosion resistant concrete screws, masonry nails, or powder actuated fasteners	See Mortar Table in Material Specs

MATERIAL REQUIREMENTS

Type of Application	Type N Mortar (ASTM C270 or ASTM C1714)	Type S Mortar (ASTM C270 or ASTM C1714) or ANSI A118.1 Mortar	ANSI A118.4 or ANSI A118.15 Mortar
Interior Applications			
Less than 3 m in height above finished floor	Recommended	Recommended	Recommended
All other interior applications	Not Recommended	Recommended	Recommended
Exterior Single Family Residential Applications			
Grouted ²	Not Recommended	Recommended	Recommended
All other exterior single family residential applications	Not Recommended	Recommended	Recommended
Exterior Commercial Applications			
Less than 3 m in height above finished grade	Not Recommended	Recommended	Recommended
All other exterior commercial applications	Not Recommended	Not Recommended	Recommended
Special Applications			
Installed directly on cement board	Not Recommended	Not Recommended	Recommended
Non-vertical applications ³	Not Recommended	Not Recommended	Recommended

Mortar Type	Proportions by volume (cementitious materials)		Aggregate Ratio - Measured in damp, loose conditions
	Cement	Lime	
M	1	¼	Not less than 2¼ and not more than 3 times the sum of the separate volumes of cementitious materials
S	1	Over ¼ to ½	
N	1	Over ½ to 1¼	
O	1	Over 1¼ to 2½	

SURFACE PREPARATION

Proper surface preparation is important for adhesion and keeping water infiltration to a minimum. Walls/ surfaces must be clean and free from release agents, paints, stains, sealers or other bond-break materials that may reduce strength of mortar adhesion.

Verify that the surface to which the stone is going to be installed is structurally sound, free of any coatings or materials that would inhibit bonding, and capable of supporting the intended veneer system. Backup systems consisting of wood or steel framing with rigid sheathing and concrete or concrete masonry construction; however, virtually any backup system can be used when properly designed and prepared to receive Mathios Stone. Masonry walls, poured-in-place concrete walls, and concrete tilt up panels must be free of dirt, waterproofing, paint, form oil, or any other substance that could inhibit the mortar bond and must readily accept/absorb water might achieve good bond.

If necessary, cleaning may be done with power washing or mechanical methods (i.e. shot or bead blasting). If a bondable surface cannot be achieved, attach lath and scratch coat before installing MATHIOS STONE VENEER. This guide does not address the installation of MATHIOS STONE VENEER systems over open stud backup systems.

SURFACE PREPARATION

Waterproofing

Mathios stone is not a waterproof material, however construction techniques and selection of materials in accordance with the manufacturer's recommendations and based on the local climatic conditions, can prevent water infiltrations.

1. Provide good drainage

- Correctly install waterstops, flashing, weepholes, and copings per design details.

2. Construct good mortar joints

- Tool all mortar joints with a V- or concave-shaped jointer to compact the mortar at the exposed surface and create a tight bond between mortar and masonry unit. Weeping, raked, and untooled struck joints are not recommended in exposed applications
- Assure that joints are properly filled. Deteriorated or defective mortar joints should be repointed to keep moisture out of the wall.
- Assure adequate hydration of cementitious materials by protecting masonry from cold temperatures, premature drying, or improper use of admixtures.

3. Limit water entry

- Apply proven protective treatment to the outside surfaces.
- Caulk around window and door openings.
- Seal or otherwise repair cracked joints in walls.
- use through-wall flashing at ground level to prevent capillary rise of ground moisture.
- prevent water infiltration due to capillary action on external walls leaving a minimum gap from the ground.
- Install vapor barriers in exterior walls (interior surfaces of exterior walls) or apply vaporproof paint to interior surfaces.
- Carefully plan the installation of lawn sprinklers or any other water source so that walls are not subjected to unnecessary wetting.
- If feasible, use top covers to protect walls from rainfall.

SURFACE PREPARATION STAGES

- Installation on **Concrete**
see page 12
- Installation on **Stucco / Bricks**
see page 14
- Installation on **Thermal Insulation**
see page 16
- Installation on **Wooden surface**
see page 21
- Installation on **Gypsum board**
see page 23
- Installation on **Metal surface**
see page 25
- Installation on **Retaining walls**
see page 27

INSTALLATION ON CONCRETE





In sequence:

- 1 Concrete
- 2 Mortar setting bed
- 3 Mathios Stone® architectural stone veneer

* See page 29 for Mathios Stone® application procedure

Surface Preparation

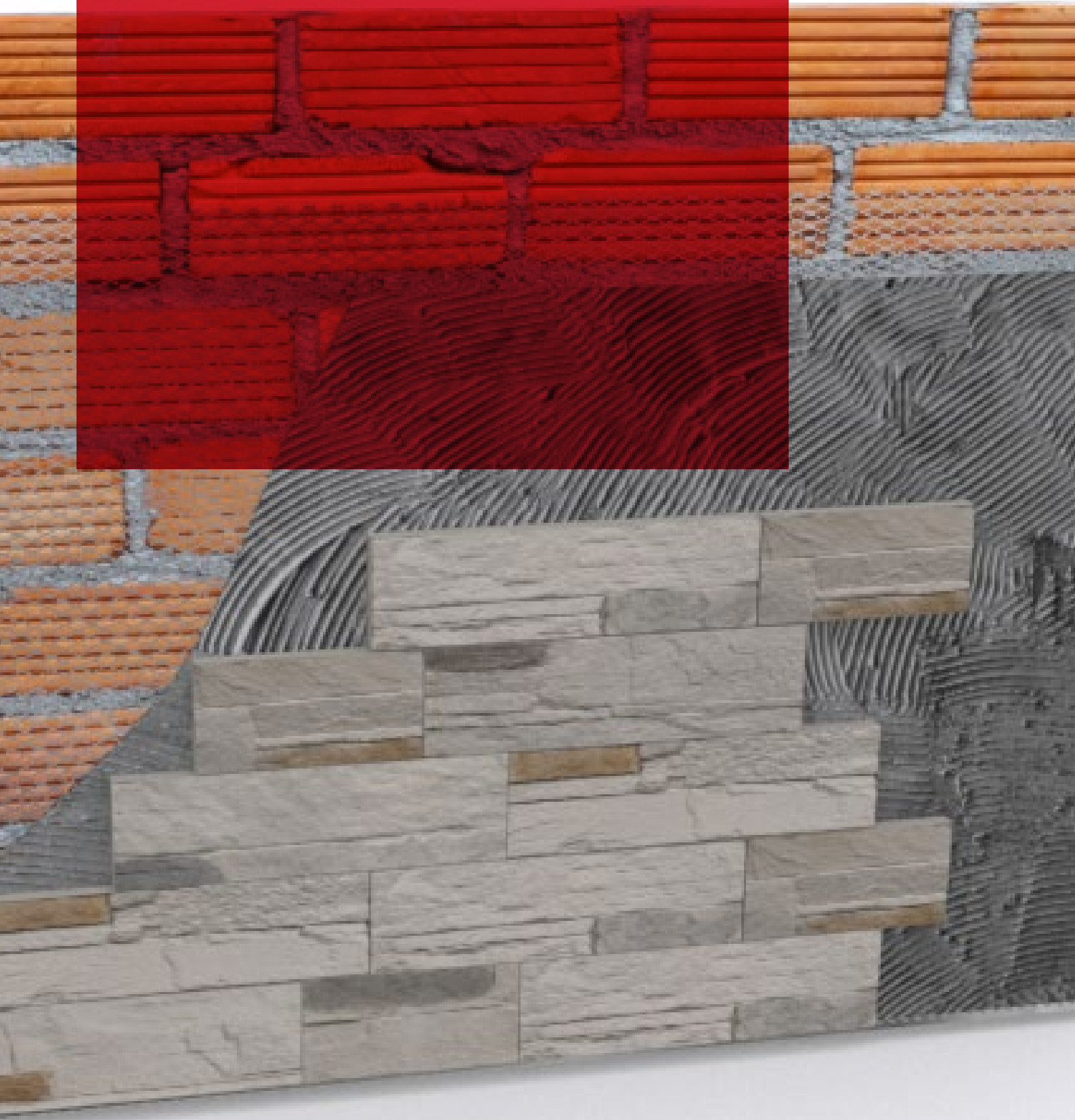
The substrate must be free of dust and dirt. Level out the first line of where the stones will be placed.

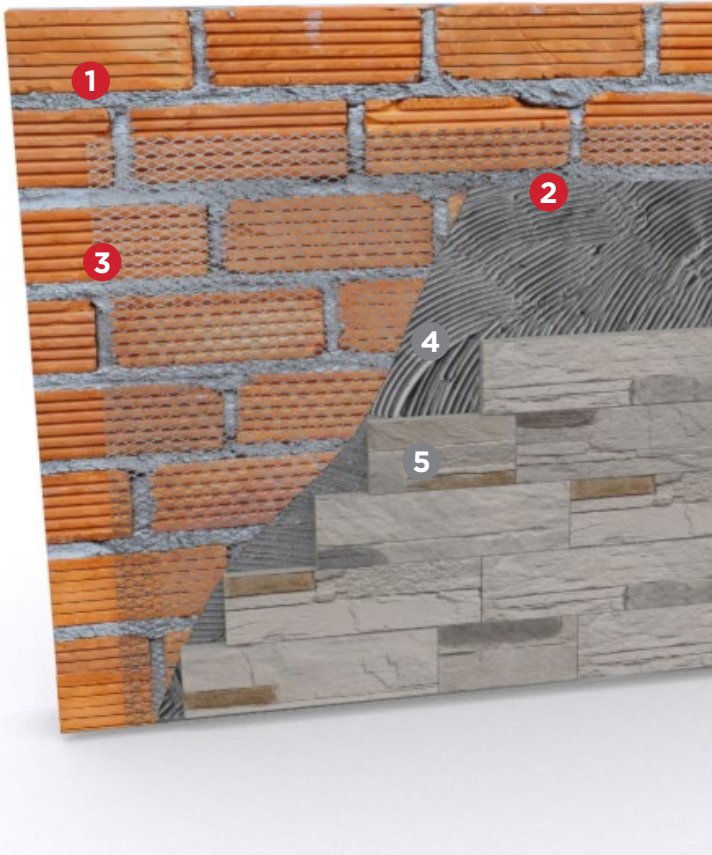
Scratch Coat

The mortar scratch installation should be from ~ 1.5-2cm thickness, by using a trowel or spray application. Use sufficient material and pressure to fully engage and encapsulate the lath. After scratch coat installation there should be no lath material visible.

NOTE: Key aspects to lath corrosion resistance and physical performance characteristics are scratch coat thickness and proper encapsulation.

INSTALLATION ON **STUCCO / BRICKS**





In sequence:

- 1 Brick / Stucco
- 2 Mortar setting bed
- 3 Galvanized metal lath
- 4 Mortar setting bed
- 5 Mathios Stone® architectural stone veneer

* See page 29 for Mathios Stone® application procedure

Scratch Coat

The mortar scratch installation should be from ~ 1.5-2cm thickness, by using a trowel or spray application. Use sufficient material and pressure to fully engage and encapsulate the lath. After scratch coat installation there should be no lath material visible.

NOTE: Key aspects to lath corrosion resistance and physical performance characteristics are scratch coat thickness and proper encapsulation.

INSTALLATION ON THERMAL INSULATION





In sequence:

- 1 Wall
 - 2 Adhesive for bonding the thermal
 - 3 EPS thermal insulation panels
 - 4 First base coating leveling layer of adhesive
 - 5 Alkali resistant plastic mesh
4-5mm, weight: $\geq 145\text{g/m}^2$, tensile strength $\geq 2000\text{ N/50 mm}$
 - 6 Anchors and application of the second base coating leveling layer of adhesive
 - 7 Stone adhesive according to C2TE category EN 12004 and EN 12002
 - 8 Mathios Stone® or Decostone handmade stone veneer
- Mortar joint (optional)

Important notice!

We strongly recommend the use of a universally compatible primer coat as moisture control and bonding agent on the wall before the installation of the insulating panels as well as on the second base coating leveling of the adhesive before the stone installation.

The typical application presented above has various stages which are analytically shown on the following pages.

Application stages:



1

Ensure a clean substrate free of dust, moisture and wax areas, apply a primer.

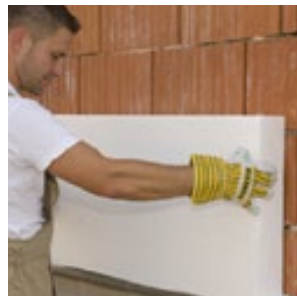


2

Install the leveled base profile.



3



Fix the thermal insulation panels, applying the adhesive for bonding thermal insulation panels using a "Rim-bulge method". Leave at least 24 hours idle time till the next step.



4

Seal all joints that exist between panels with low expansion polyurethane foam.



5

After setting (drying +hardening Idle time 3 to 7 days, depending on weather conditions) of the system, the insulation boards are sanded and cleaned.



6

6.1 Apply the 1st base coating layer of adhesive mortar with a stainless notched trowel 10mm of tooothing,

6.2 embed the alkali resistant mesh,

6.3 apply the anchors through the mesh carefully. Be sure that the mesh is securely embedded and no twisting occur. The anchors must be flush mounted.

6.4 apply a second layer of base coating and cover the head of the anchors

6.5 after a minimum of 7 days proceed to the application of Mathios Stone or Decostone.



* See page 29 for Mathios Stone® application procedure

IMPORTANT GENERAL NOTES

- Do not cover expansion joints with MATHIOS STONE veneer product.
- Do not install the product if it is not in compliance with proper specifications. Contact your supplier as soon as possible, and adduce the relevant purchasing invoices.
- The proper number of anchors per m² should be described at the static calculation of the system and is part of customers' responsibility.
- However an indicative calculation of the required no of anchors can be found in the table above, where are described two cases based on: the weight of the covering system/m² (stone + stone adhesive mortar + grout) the building height the wind speed (m/s) and the climatic conditions of the geographical area.
- Mathios Refractories recommends the use of XPS (extruded polystyrene panel) on the first 50 to 60 cm above ground which has a better performance against high moisture conditions which exist at that particular area. In any case the design and the application method should take into consideration the avoidance of moisture penetration in all areas that edges exist (windows, doors, ground, roof ending etc) to ensure the durability and effectiveness of the thermal insulation system.
- Do not use pressurized water or sandblasting to clean the stones.
- Do not use oxides or corrosive compounds to clean the stones.
- Avoid using a stone surface treatment other than those that increase impermeability.
- We strongly suggest the use of MAT PROTECT, a product that is specially developed for the protection of the stone against water absorption which simultaneously maintains the pores of the stone open, a fact that permits breathability of the material.
- MATHIOS REFRACTORIES guarantees that the products supplied are in compliance with the Technical Brochures and free from defects, which makes them ideal for their intended uses, within the accepted tolerances of the production process.
- Customers recognize that, due to the technical characteristics of the products they purchase, there may be certain differences at the shading and visual characteristics of the product.
- Temperature and humidity changes in the handmade production process used for the manufacture of the cladding stones produced by MATHIOS STONE can cause changes in the shade of such stones. We suggest that you buy the entire required quantity, taking into consideration the walls from edge to edge, and use different random cartons during the installation.
- Any product inconsistencies should be reported to MATHIOS REFRACTORIES only in written form, within 2 days of arrival of merchandise. Any defect reports should be accompanied by all information relating to the taking over and it must be completed PRIOR to any use or application of the merchandise.
- The colors and textures of the products depicted on company publications are as accurate as current photography and printing techniques allow them to be. We suggest that you see samples of the actual products before you purchase them at points of sales. MATHIOS REFRACTORIES reserves the right to make product improvements without prior notice.
- Any warranties provided by MATHIOS REFRACTORIES shall no longer be valid if the recommended installation instructions are not followed faithfully. Any users who need more detailed instructions than those printed on this.

LAND CLASSIFICATION

Land category II

Areas with low vegetation such as grass and various obstacles like trees and Buildings with intervals of at least 20 times the obstacle height.

Land category IV

Areas where at least 15% of their surface is covered with buildings having an average height of 15m.

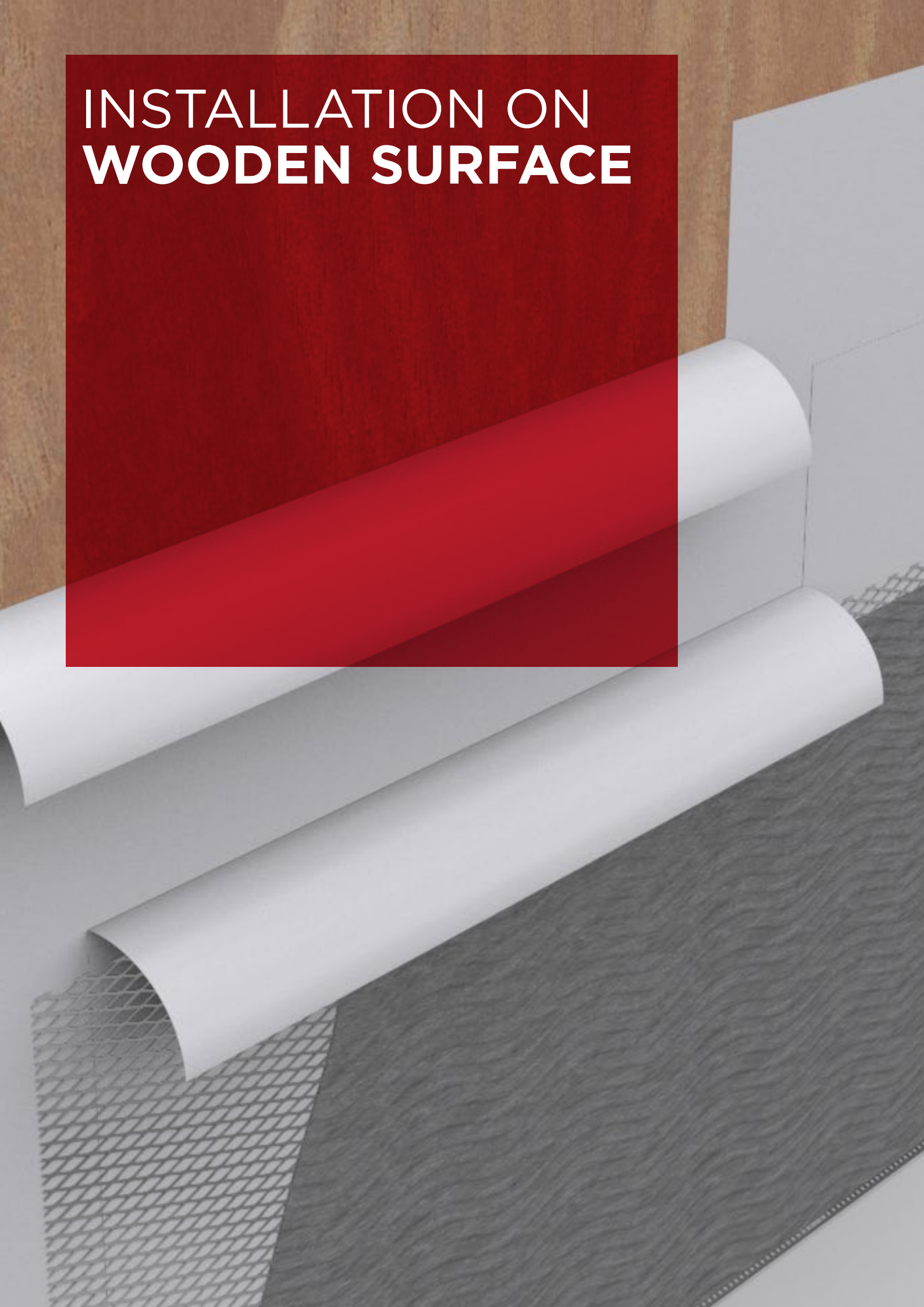
Land category III

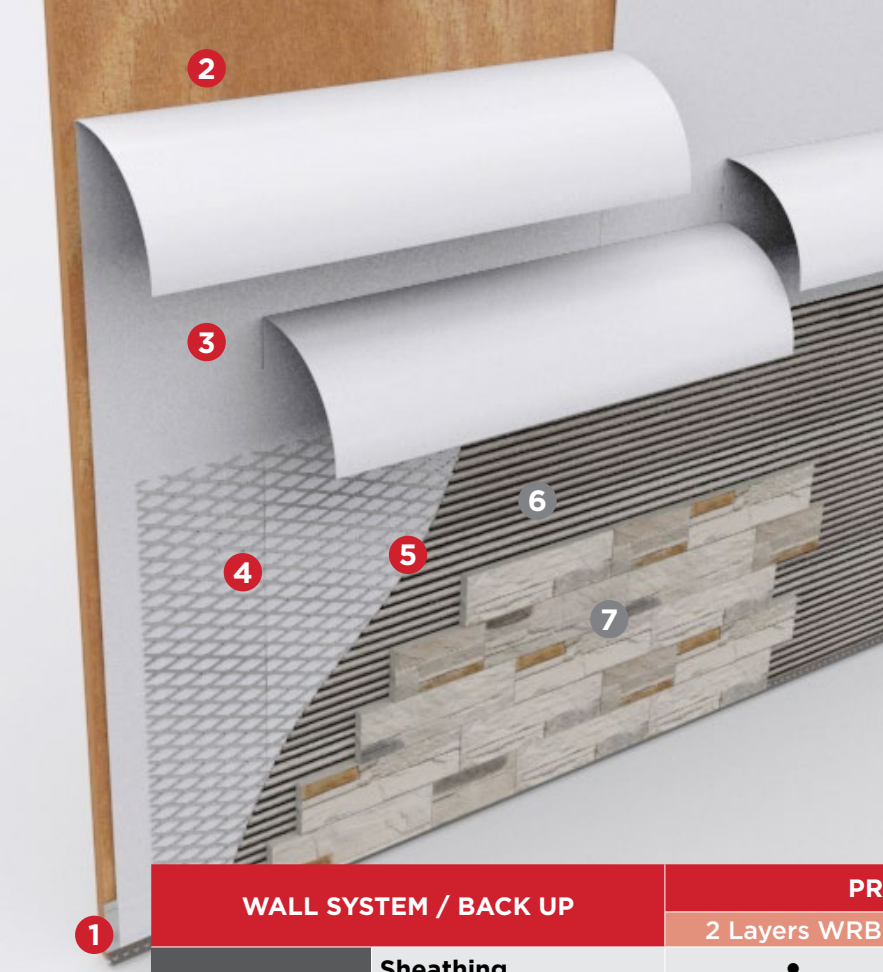
Areas with uniform vegetation or buildings or with individual objects with intervals of less than 20 times obstacle height (i.e. Villages, suburban development, forest areas).

Insulation thickness $10 \leq d \leq 20$													
Least number of Anchors n				N° of Pieces/m ² for Wind load									
MATHIOS 40	$\leq 40\text{kg/m}^2$	Base: Rule Wind velocity m/s		area	Land Classification								
		up to			II			III			IV		
					Relevant Building Height m \leq								
					10	25	35	10	25	35	10	25	35
	\leq	23,2	Rule		8	8	8	8	8	8	8	8	8
			Edges		8	8	10	8	8	8	8	8	8
	\leq	25,1	Rule		8	8	8	8	8	8	8	8	8
			Edges		8	10	10	8	8	10	8	8	8
	\leq	28,3	Rule		8	10	10	8	8	10	8	8	8
			Edges		10	12	12	8	10	10	8	8	10
MATHIOS 70	$\leq 70\text{kg/m}^2$	Base: Rule Wind velocity m/s		area	Land Classification								
		up to			II			III			IV		
					Relevant Building Height m \leq								
					10	25	35	10	25	35	10	25	35
	\leq	23,2	Rule		8	10	10	8	10	10	8	8	8
			Edges		10	10	12	10	10	10	8	10	10
	\leq	25,1	Rule		10	10	10	8	10	10	8	8	10
			Edges		10	12	12	10	12	12	10	11	10
	\leq	28,3	Rule		10	12	12	10	10	12	8	10	10
			Edges		12	*	*	10	12	*	10	10	12

*more than 12

INSTALLATION ON WOODEN SURFACE





In sequence:

- 1 Install the leveled base profile
- 2 Sheathing
- 3 Two layers of water resistive barrier (WRB)
- 4 Galvanized metal lath
- 5 Scratch coat
- 6 Mortar setting bed
- 7 Mathios Stone® architectural stone veneer

* See page 29 for Mathios Stone® application procedure

WALL SYSTEM / BACK UP		PREPARATION REQUIREMENTS		
		2 Layers WRB	Lath	Scratch Coat
WOOD FRAME	Sheathing	•	•	•
	Plywood	•	•	•
	OSB	•	•	•

Water Resistive Barrier (WRB) Installation

A WRB should be installed in two different layers, in shingle fashion. The manufacturer’s installation includes instructions for fasteners, fastening schedule, vertical and horizontal lap requirements. The WRB layers must be installed in a continuous manner, specifically inside and outside corners.

Lath Installation

Install it in conformity with the manufacturer’s installation instructions and evaluation report.

Scratch Coat

The mortar scratch installation should be from ~ 1.5-2cm thickness, by using a trowel or spray application. Use sufficient material and pressure to fully engage and encapsulate the lath. After scratch coat installation there should be no lath material visible.

NOTE: Key aspects to lath corrosion resistance and physical performance characteristics are scratch coat thickness and proper encapsulation.

INSTALLATION ON GYPSUM BOARD





In sequence:

- 1 Install the leveled base profile
- 2 Sheathing
- 3 Two layers of water resistive barrier (WRB)
- 4 Galvanized metal lath
- 5 Scratch coat
- 6 Mortar setting bed
- 7 Mathios Stone® architectural stone veneer

* See page 29 for Mathios Stone® application procedure

1	WALL SYSTEM / BACK UP		PREPARATION REQUIREMENTS		
			2 Layers WRB	Lath	Scratch Coat
GYPSUM BOARD	Sheathing	•	•	•	

Water Resistive Barrier (WRB) Installation

A WRB should be installed in two different layers, in shingle fashion. The manufacturer’s installation includes instructions for fasteners, fastening schedule, vertical and horizontal lap requirements. The WRB layers must be installed in a continuous manner, specifically inside and outside corners.

Lath Installation

Install it in conformity with the manufacturer’s installation instructions and evaluation report.

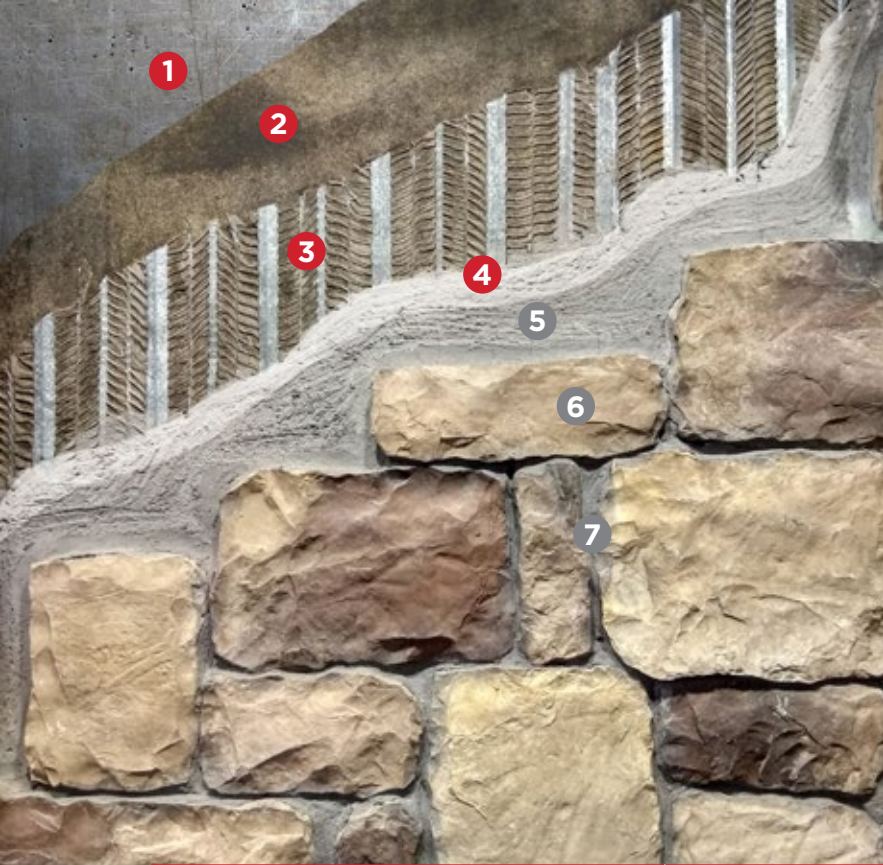
Scratch Coat

The mortar scratch installation should be from ~ 1.5-2cm thickness, by using a trowel or spray application. Use sufficient material and pressure to fully engage and encapsulate the lath. After scratch coat installation there should be no lath material visible.

NOTE: Key aspects to lath corrosion resistance and physical performance characteristics are scratch coat thickness and proper encapsulation.

INSTALLATION ON METAL SURFACE





In sequence:

- 1 Sheathing
- 2 Two layers of water resistive barrier (WRB)
- 3 Galvanized metal lath
- 4 Scratch coat
- 5 Mortar setting bed
- 6 Mathios Stone® architectural stone veneer
- 7 Mortar joint (optional)

* See page 27 for Mathios Stone® application procedure

WALL SYSTEM / BACK UP		PREPARATION REQUIREMENTS		
		2 Layers WRB	Lath	Scratch Coat
METAL FRAME	Sheathing	•	•	•
	Plywood	•	•	•
	OSB	•	•	•
	Exterior Gypsum or Cement Board		•	•

Water Resistive Barrier (WRB) Installation

A WRB should be installed in two different layers, in shingle fashion. The manufacturer’s installation includes instructions for fasteners, fastening schedule, vertical and horizontal lap requirements. The WRB layers must be installed in a continuous manner, specifically inside and outside corners.

Lath Installation

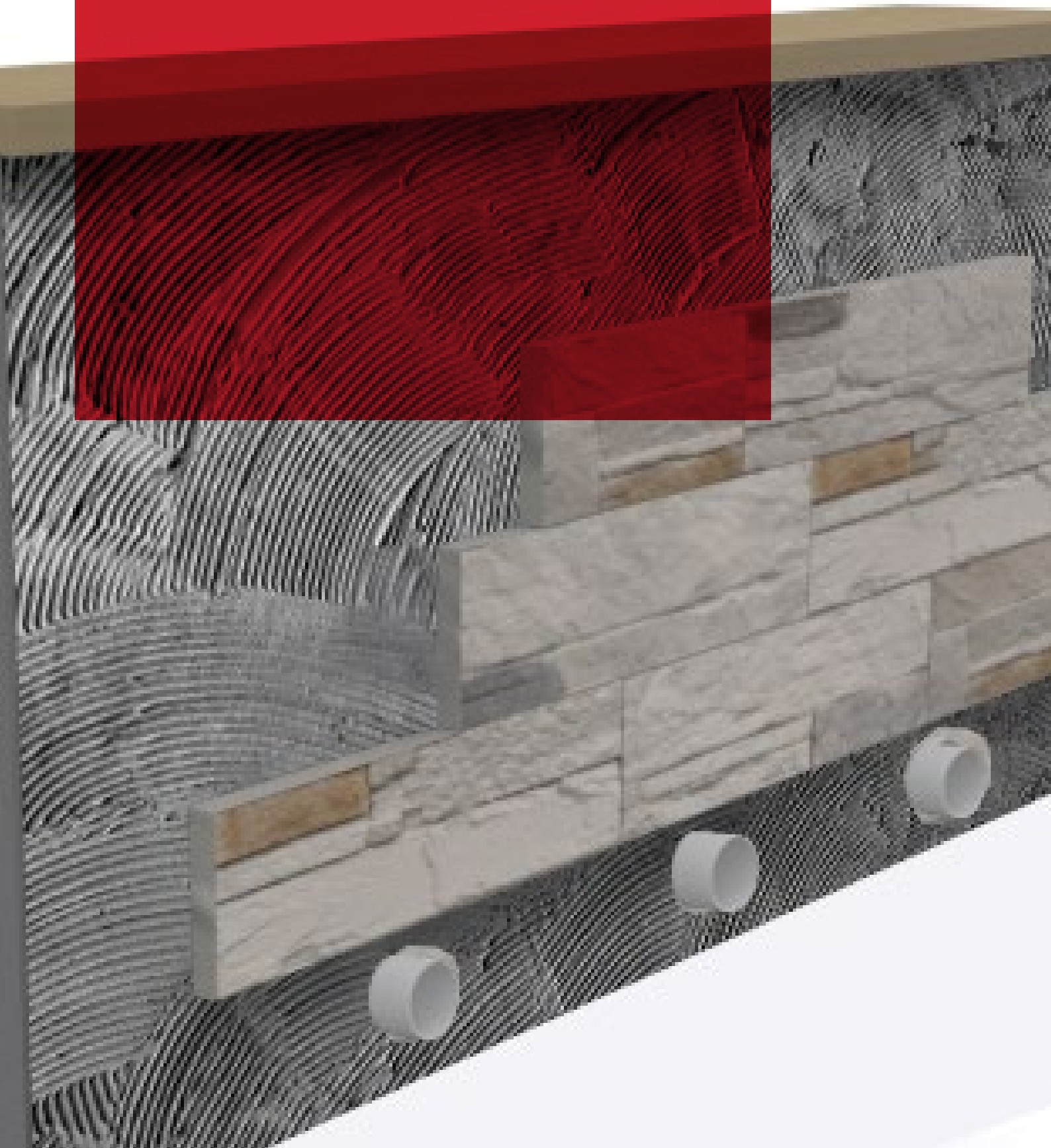
Install it in conformity with the manufacturer’s installation instructions and evaluation report.

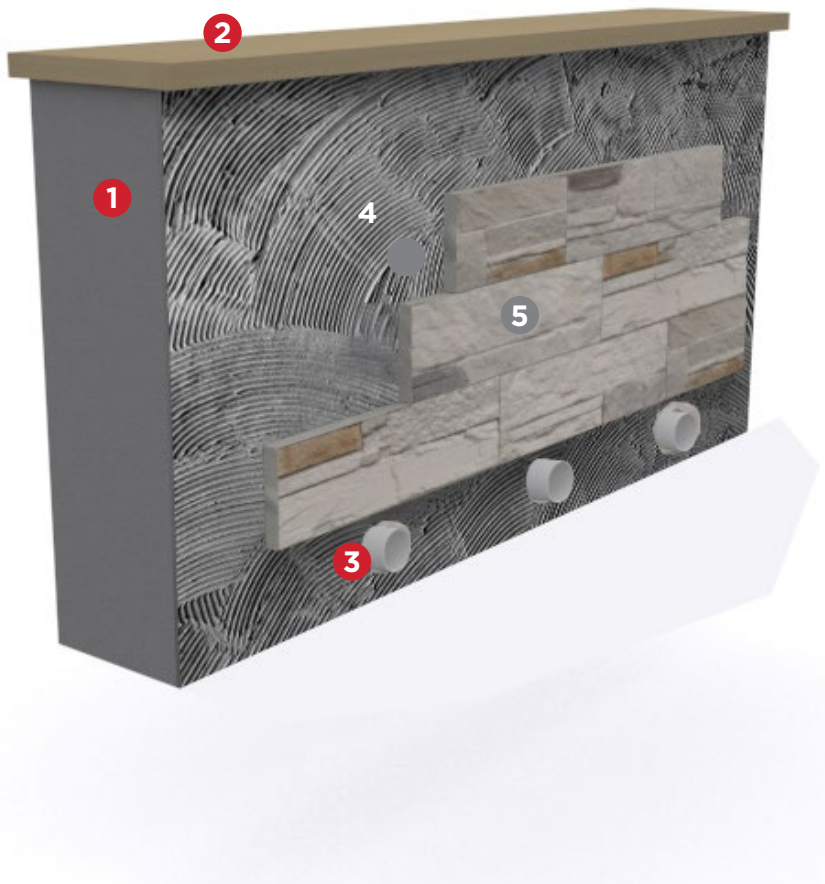
Scratch Coat

The mortar scratch installation should be from ~ 1.5-2cm thickness, by using a trowel or spray application. Use sufficient material and pressure to fully engage and encapsulate the lath. After scratch coat installation there should be no lath material visible.

NOTE: Key aspects to lath corrosion resistance and physical performance characteristics are scratch coat thickness and proper encapsulation.

INSTALLATION ON RETAINING WALLS





In sequence:

- 1 Exterior wall fence
- 2 Cover wall cap
- 3 Water drainage
- 4 Mortar setting bed
- 5 Mathios Stone® architectural stone veneer

* See page 29 for Mathios Stone® application procedure

In the case of retaining walls there must be suitable waterproofing on the side facing towards the soil, otherwise water infiltrations could cause detachment or the appearance of chronic efflorescence. To prevent this issue it is advisable to make holes for water drainage (and include the wall covering), or put up false asbestos cement walls to separate the stone from the wall. There is no waterproofing solution on the visible side (facing away from the soil) that will provide long-lasting protection.

MATHIOS STONE INSTALLATION PROCEDURE STEP BY STEP

Mathios Stone installation instructions **without joints**



Lay out stones and mix from various cartons at least 2m² to create a balance between different colors, shapes, thickness and textures.



The substrate must be free of dust and dirt. Level out the first line of where the stones will be placed.



If we work on an absorbent substrate like gypsum board or wood, we have to apply primer to reduce the absorbency.



4 Prepare mortar taking into consideration the amount of water for good accretion and the right consistency.



5 Apply mortar on the installation surface as much as needed so that it does not dry out when installing the stone.



6 If the installation includes corners, then begin from the corner of the wall & continue the installation in line with the flat elements.



7 Using the spatula or resembling tool, perimetrically clean the stone from overlapping concrete for better installation. Since the back surface of the stone is dry wet it with water to avoid the absorption of water of the mortar.



If empty gaps are large, fill them with stones by cutting them to the size needed.



Apply mortar at the back surface of the Stone as much as possible so there is no gap between the stone and the surface.



Place the stone by pressing hard to ensure a very good adherence of the mortar in the back surface of the stone.



Fill the perimetric channel of the stone with mortar by using the spatula. Remove any excess mortar using a towel.

12



In the installation of stone use a rubber mallet (rubber hammer) not to damage the stone.

13



Clean the stone surface from mortar residues with a soft wire brush before the hardening of the mortar

Important notice!

Do not try to clean when mortar is fresh.

Mathios Stone installation instructions **with joints**



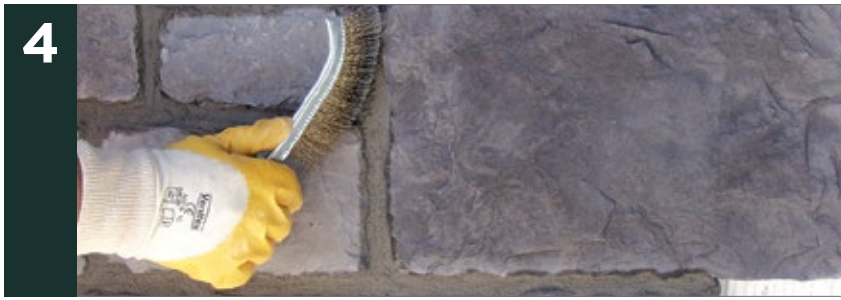
1
Provided that there is a joint, to stabilize the stones small spacers can be used where it is needed.



2
For the installation use a pastry bag or a grouting gun. In both cases effectively cut the end until the desirable width for the joint is achieved.



3
Lay the mortar with a spatula or special tool.



If mortars get on the surface of the stone before it hardens (after 1/2 or 1 hour) brush off the mortar with a soft wired brushed or hard plastic, do not use metal.



Clean the stones by using a dry paint brush.

SPECIAL PRECAUTIONS

Mathios stone veneer® does not increase the sturdiness of the structures.

- When fitting cupboards or walls with Mathios stone veneer® ensure they are secured to the loadbearing of the structure.
- Mathios stone veneer does not act as barrier against rain. Substrates must be suitably elaborated before installation.
- Colour irregularities often described as fading is attributed to efflorescence.
- Efflorescence occurs due water infiltrations. prevent efflorescence formation waterproofing between the substrate and the wall covering
- Do not use on areas with running or dripping water or slush containing salts or other chemical substances used to melt snow and ice. Dripping or running water can mark the material; if it is unavoidable, treat the wall covering when completely dry.
- Prolongated contact to water may cause discoloration/fading.
- At temperatures above 180 °C, color conversion may occur, e.g. - black gradually converts to red - yellow color shift towards red.

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