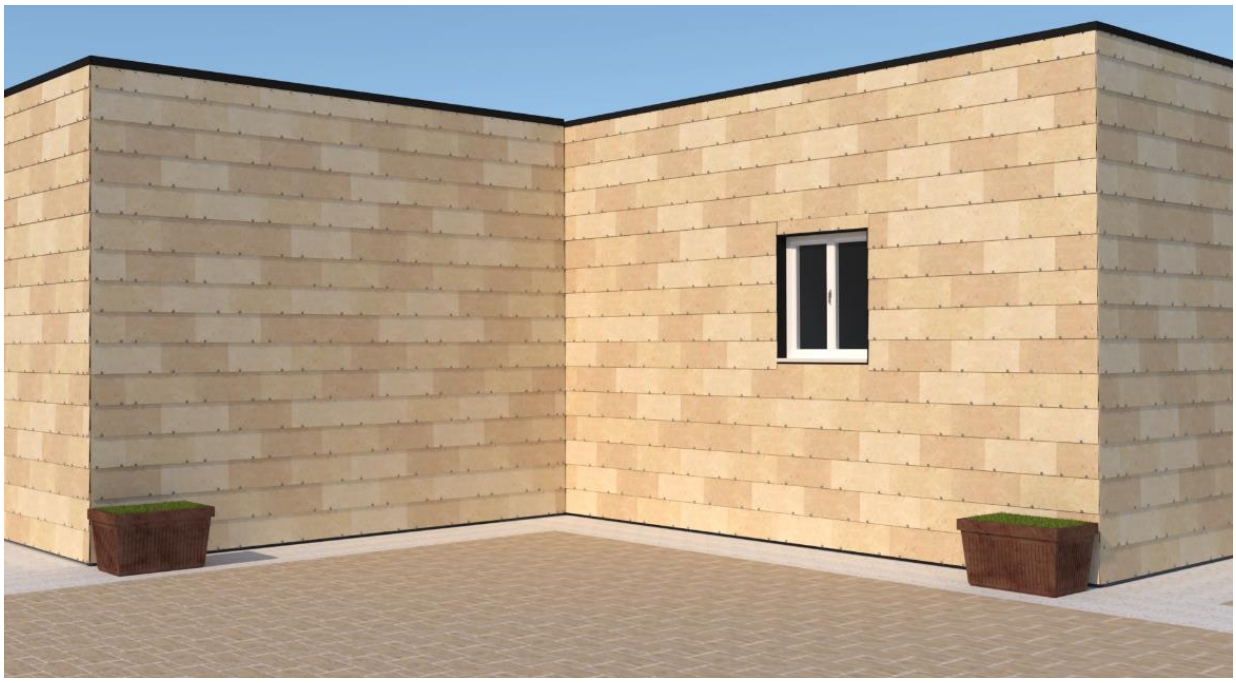
REPORT 1.2.3

BEST PRACTICE REPORT ON METHODS, SKILLS AND COMPETENCES IN RELATION TO STONE PRODUCTS

CONSTRUCTION PROCESS OF A NATURAL STONE VENTILATED FACADE



Content

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

1. INTRODUCTION

1. Background

The BIMstone project was born from the fusion of three lines of action whose convergence is a consolidate a didactic material base for the training in the stone sector. These three lines of actions are:

- BIM (Building Information Modeling).
- LCA (Life Cycle Assessment).
- Digitisation of stone products placement methodologies.

The European Commission is focused on the construction sector on the criteria of smart growth (knowledge and innovation-based development and economy) and inclusive growth (ensuring social and territorial cohesion through employment).

According to the above context, the general aim of BIMstone project is to increase the skills of workers in the field of placing the stone products particularly in placing different type of floors and walls in buildings and urban environments, in order to increase the quality of the final work, the permanence of the work and the environmental sustainability, by using methods without non-recyclable and/or eco-friendly materials. For that reason, it is necessary to define and compile the most suitable execution systems and placement methods for stone products.

The first task of the BIMstone project "O1. *Establishment of common learning outcomes on stone placing methods, Life Cycle Analysis (LCA) and regulations*" encompasses a number of specific tasks among which we find the elaboration of this report.

This best practice report addresses the establishment of skills and competencies, as well as the definition of the most sustainable and environmentally friendly implementation processes.

Of all the natural stone construction elements selected in this project, this report focuses on the execution of a ventilated facade with natural stone slabs, describing in detail some of their characteristics, both constructive and environmental, and the construction process to be followed to achieve an optimum result.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

2. ENVIRONMENTAL CONSIDERATIONS

The Environmental Product Declarations (EPDs) are the clearest, most rigorous and internationally accepted way to provide the environmental profile of a product throughout its life cycle.

The EPD "***Tiles and Slabs from natural stone***" include natural stone slabs which main function is for flooring, cladding, stairs, monuments, kitchen tops, cubic building elements and many other applications. The EPD considered for data compilation in this project was developed by European & International Federation of Natural Stone Industries (EUROROC) and has been verified and published in Institut Bauen und Umwelt e.V. (IBU).

The EPD of tiles and slabs from natural stone has been carried out according to the LCA methodology with quantified environmental information for 1 ton of tiles and slabs, which is equivalent to 9.11 m^2. That is to say, the EPD of these materials is of the "cradle-to-gate" LCA study, as can be seen in the following table, which includes the transport to costumers. So, it covers all the production steps from raw materials in the earth (i.e., the cradle) to finished products (i.e., the gate) ready to be installed at the customers (including the transportation to installation site).

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Source: IBU - Institut Bauen und Umwelt e.V.

This EPD has been developed and verified according to the EN 15804:2012.04+A1 2013: Sustainability of construction works – Environmental Product Declarations – Core rules for the product category of construction products, DIN EN ISO 14025:2011-10: Environmental labels and declarations – Principles and procedures and PCR (Product Category Rules) 2013, Part B: PCR Guidance – Texts for Building-Related Product and Services. From the range of Environmental Product Declarations of Institute Construction and Environment e.V (IBU). Part B: Requirements on the EPD Dimension stone for roof, wall and floor applications, 2013.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

The results of the LCA – Environmental Impact are:

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 ton tiles and slabs from natural stone			
Parameter	**Unit**	**A1 - A3**	**A4**
Global warming potential	[kg CO_2-Eq.]	2.55E+2	2.05E+1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	5.81E-8	3.58E-10
Acidification potential of land and water	[kg SO_2-Eq.]	7.25E-1	1.3E-1
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	6.75E-2	3.12E-2
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	4.17E-2	-4.69E-2
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	3.2E-5	7.64E-7
Abiotic depletion potential for fossil resources	[MJ]	3.39E+3	2.83E+2

RESULTS OF THE LCA - RESOURCE USE: 1 ton tiles and slabs from natural stone			
Parameter	**Unit**	**A1 - A3**	**A4**
Renewable primary energy as energy carrier	[MJ]	5.52E+2	1.11E+1
Renewable primary energy resources as material utilization	[MJ]	0.0E+0	0.0E+0
Total use of renewable primary energy resources	[MJ]	5.52E+2	1.11E+1
Non renewable primary energy as energy carrier	[MJ]	3.88E+3	2.84E+2
Non renewable primary energy as material utilization	[MJ]	0.0E+0	0.0E+0
Total use of non renewable primary energy resources	[MJ]	3.88E+3	2.84E+2
Use of secondary material	[kg]	0.0E+0	0.0E+0
Use of renewable secondary fuels	[MJ]	0.0E+0	0.0E+0
Use of non renewable secondary fuels	[MJ]	0.0E+0	0.0E+0
Use of net fresh water	[m^3]	8.29E-1	1.23E-2

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 ton tiles and slabs from natural stone			
Parameter	**Unit**	**A1 - A3**	**A4**
Hazardous waste disposed	[kg]	8.44E-2	0.0E+0
Non hazardous waste disposed	[kg]	5.23E+2	3.68E-2
Radioactive waste disposed	[kg]	1.96E-1	3.95E-4
Components for re-use	[kg]	0.0E+0	0.0E+0
Materials for recycling	[kg]	0.0E+0	0.0E+0
Materials for energy recovery	[kg]	0.0E+0	0.0E+0
Exported electrical energy	[MJ]	0.0E+0	0.0E+0
Exported thermal energy	[MJ]	0.0E+0	0.0E+0

Source: IBU - Institut Bauen und Umwelt e.V.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

3. CONSTRUCTIVE CONSIDERATIONS

The ventilated facade is a constructive solution for the external covering of building facades, consisting of an empty chamber between the covering and the support. In this way, it allows air to circulate freely, improving thermal insulation, energy savings and environmental protection, as well as complying with the requirements of current building regulations.

This construction system has been consolidated with great acceptance among architects and builders, especially for its high quality, aesthetic possibilities and its undeniable advantages of thermal and acoustic insulation. In fact, it is one of the most widely used sustainable construction systems today. The natural stone ventilated facade system consists of 3 main parts:

- Supporting wall:
- A layer of insulation anchored or projected onto the support.
- A layer of cladding linked to the building by means of an anchoring structure, generally made of aluminium.

Scheme of natural stone ventilated facade with visible fixings.
SOURCE: CUPAPIZARRAS (www.cupapizarras.com).

In addition to the good structural behaviour, from a functional point of view, this façade presents an excellent hygrothermal behaviour as it allows the passage of an air chamber and continuous thermal insulation in front of the structure, thus avoiding thermal bridges in the fronts of slabs and pillars.

The elimination of the cold bridges from the fronts of floor and pillars reduces the energy demand of the building, as well as the risk of formation of surface condensations at these points, allowing the construction of buildings with a very high level of energy efficiency.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

Likewise, if the impermeability requirements make it advisable, ventilated facades with natural stone cladding allow the ventilation of the air chamber, achieving a facade with the advantages of ventilated facades (with a higher degree of impermeability and a lower risk of interstitial condensation forming on the enclosure) and other additional advantages associated with natural stone (such as durability, low maintenance, etc.).

For all the above reasons, this construction system is the optimum solution for ventilated natural stone facades in the construction of Nearly Zero Energy Consumption Buildings (EECN) and Passivhaus.

On the other hand, from the constructive point of view, as the use of platelets to cover the fronts of slabs and pillars is not necessary, nor of cut pieces or special pieces to adjust the stakeout to the height of each floor, the execution process is simplified, the performance on site is improved and a perfect finish of the façade is achieved. In addition, this construction system allows a perfect lead and flatness of the outer leaf of the façade to be achieved, regardless of the geometric deviations of the structure, as well as homogeneity in the tonality of the cloth of the façade.

3.1. Advantages of ventilated natural stone facades

Natural stone provides multiple technical and aesthetic advantages in the installation of ventilated facades. Among all of them, the following stand out:

- It is a great thermal insulator, with the consequent significant savings in electricity consumption derived from the use of temperature control installations, as well as CO_2 emissions.
- It is a non-flammable material, with class A1 behaviour in reaction to fire.
- It is a material that, due to its characteristics, contributes to the certification of buildings according to the LEED system in the areas of energy efficiency, materials and natural resources, indoor environmental quality and regional priority. It is worth noting the low environmental impact (neutral) during its manufacture in comparison with products manufactured in "ovens" such as ceramics or glass.
- Mitigation of the "heat island" effect.
- It is a material that, helped by the Chimney effect, eliminates humidity and water condensation easily. This effect increases energy savings by 20 to 30%.
- Durability: natural stone reacts very well to the passage of time which translates into the reduction of maintenance costs in its life cycle.
- Aesthetically, it is a material that offers a wide range of colours, textures and formats presenting a wide variety of possibilities for the final finish of any type of project.
- Improved well-being due to better use of light, ventilation...

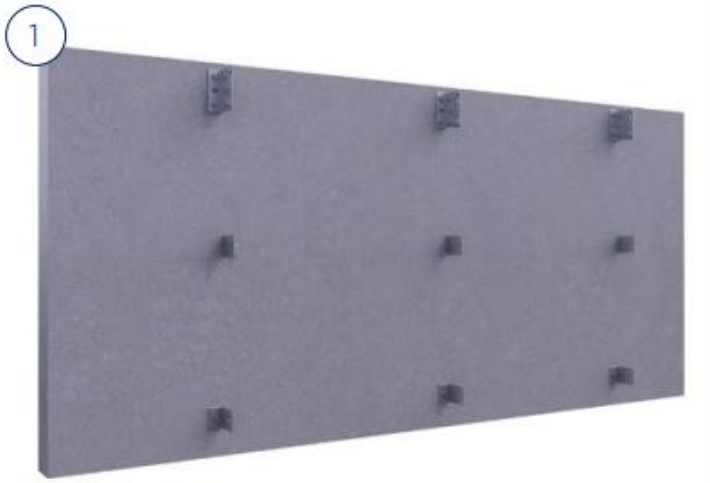
Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

3.2 Auxiliary elements

The stability and resistance of the self-supporting façade against horizontal actions is resolved with retention anchors and tendel reinforcement, which have a structural function in self-supporting façades.

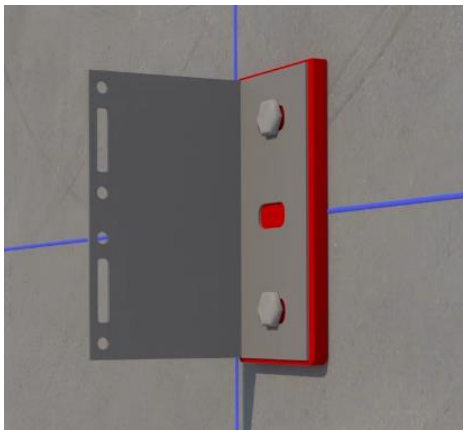
3.2.1. Metal brackets

The metal brackets are installed in alternate courses on each side of the vertical profile. It is required to use both fixed point metal brackets (on the upper end of each profile) and brackets with a sliding point to allow for the profile movement.



Metal brackets for ventilated natural stone facade with visible fixings.
SOURCE: CUPAPIZARRAS (www.cupapizarras.com).

To improve the insulating properties of these metal brackets, neoprene pieces are usually placed between the metal brackets and the sheet on which the ventilated facade is to be placed. In this way, the thermal bridge generated between these two surfaces is interrupted.



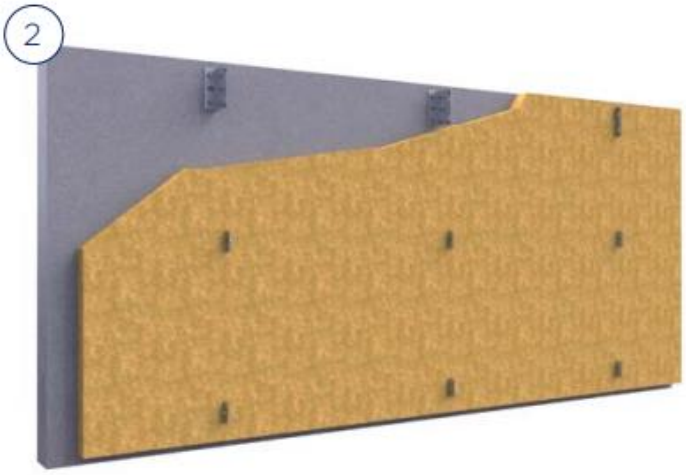
Thermal break material on ventilated facades.
SOURCE: BIMstone project website.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

3.2.2. Insulation

Depending on the requirements of the project and the climatic conditions of the area in which it is to be installed, the most suitable insulation will be chosen. At all times, the instructions specified by the manufacturer for the placement and fixing of the insulation materials shall be followed.

There are various types of insulation on the market suitable for ventilated claddings. The nature and thickness of the insulation must be carefully calculated on an individual project basis taking into account the varying factors (type of building, location and exposure…).



Insulation in ventilated natural stone facade with visible fixings.
SOURCE: CUPAPIZARRAS (www.cupapizarras.com).

3.2.3. Profiles

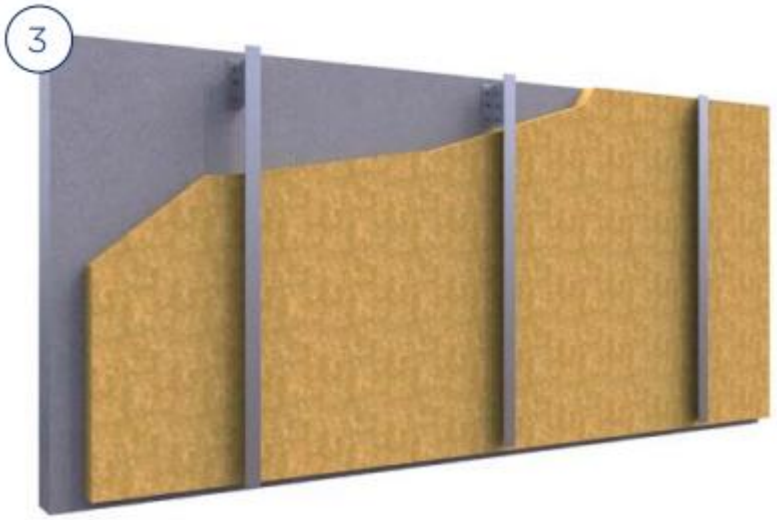
In this type of ventilated facade with self-supporting structure, two types of profiles are necessary:

- "L" Shaped vertical profiles: These profiles must allow for an air cavity between the insulation and the cladding material. For an optimal air circulation, the cavity must:
  - Allow minimum of 2 cm width in the narrow areas.
  - Both ventilation inlet and outlet must allow enough air circulation. In order to calculate it, it must be considered the dimensions of the ventilation openings at the top and bottom of the cladding (measured in cm^2 per lineal meter of cladding). They should be at least:

Building height (m)	Minimum surface for ventilation(cm^2/ml)
≤ 3m	50
de 3 a 6m	65
de 6 a 10m	80
de 10 a 18m	100
de 18 a 24m	115

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

At the first course of the cladding, the opening at the inner channel must include a ventilated profile that also incorporates a mesh to prevent the entry of insects and small mammals.



Vertical profiles for ventilated natural stone facade with visible fixings.
SOURCE: CUPAPIZARRAS (www.cupapizarras.com).

- Horizontal profiles: These profiles will be fixed on the vertical profiles with a separation that depends on the dimensions of the slabs, for example, if the slabs are 60 x 30 cm, the separation between the horizontal profiles should be 260 mm.

Horizontal profiles for ventilated natural stone facade with visible fixings.
SOURCE: CUPAPIZARRAS (www.cupapizarras.com).

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

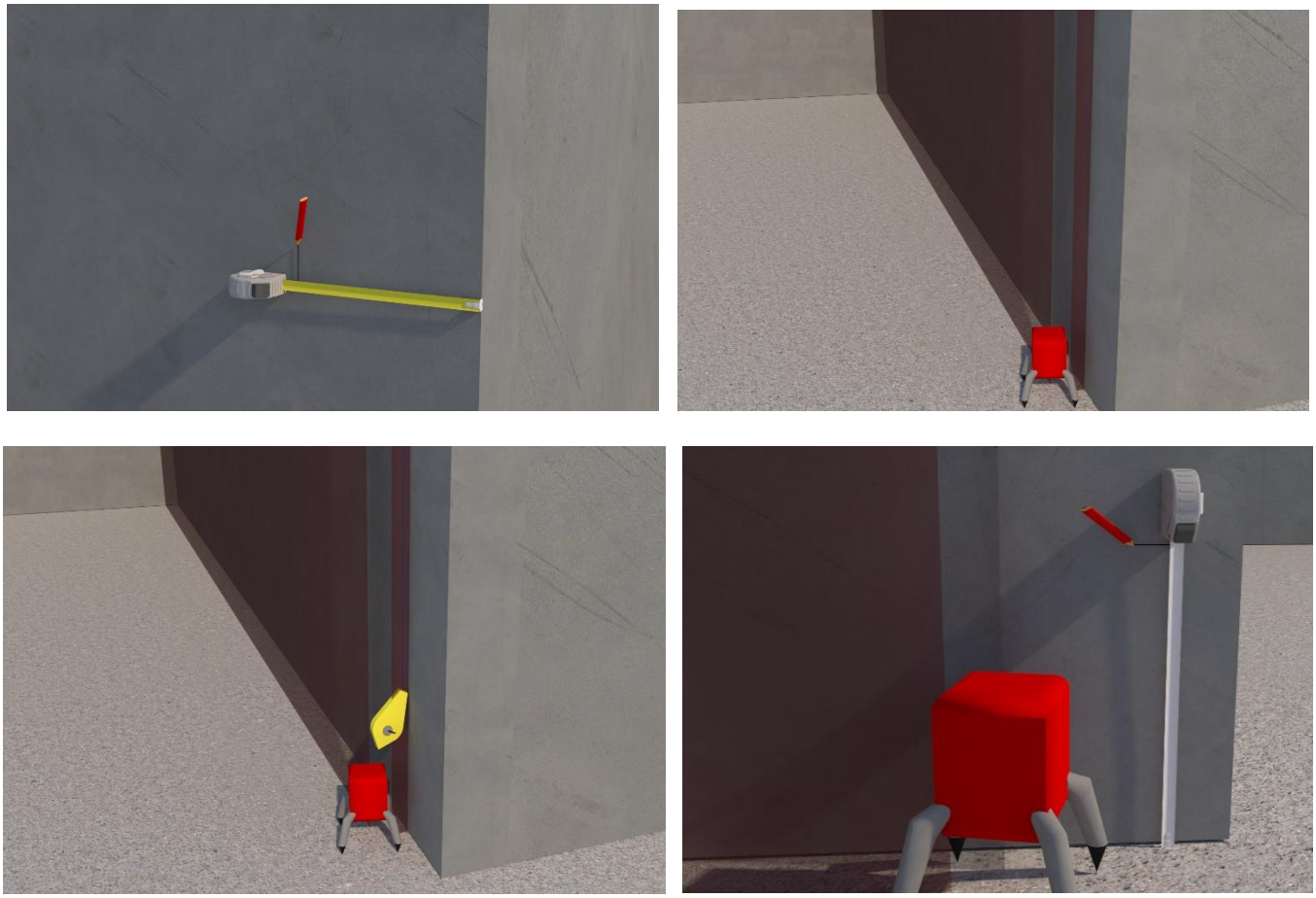
4. CONSTRUCTION PROCESS

4.1. Layout of the metal brackets

Prior to the construction of the ventilated facade, a preliminary study is carried out in which, on the plans, the most suitable solution is proposed for each particular case: type of stone, modulation, treatment of gaps, anchoring systems, etc.

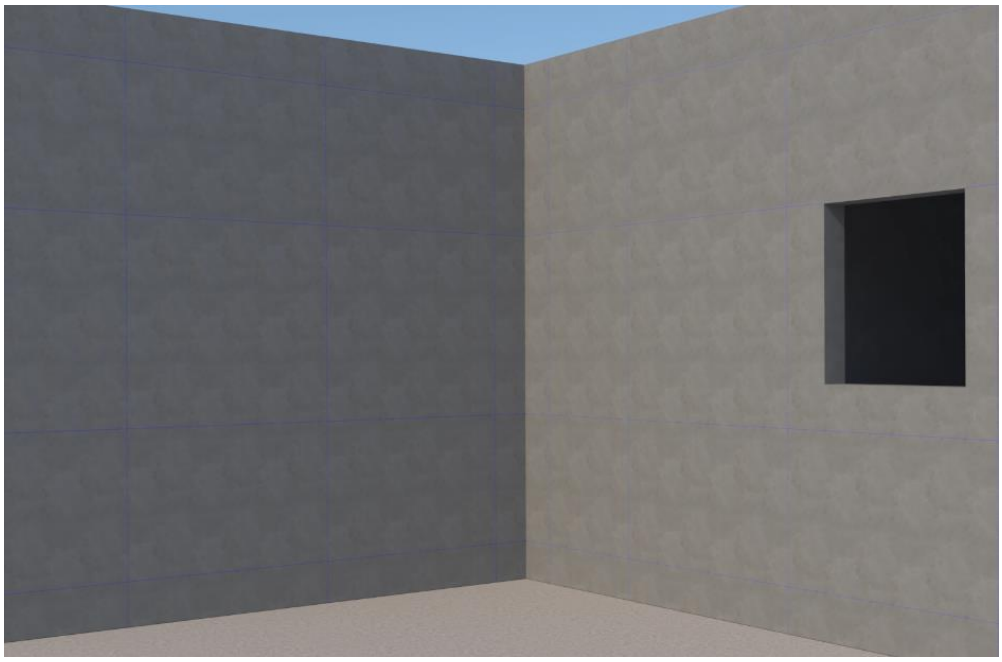
To begin with the construction process of ventilated facade cladding, the metal brackets will be laid out. To do this, a laser level will be used, and the line strip will be used to leave marks on the support on which the whole façade's supporting structure will be placed. With this layout, the exact position of the pieces and the profiling that will be necessary will be determined according to the plans.

The factors to be taken into account when setting out the layout of a building are the flatness, the collapses of the enclosure and the cohesion of the support.



Source: BIMstone project website.

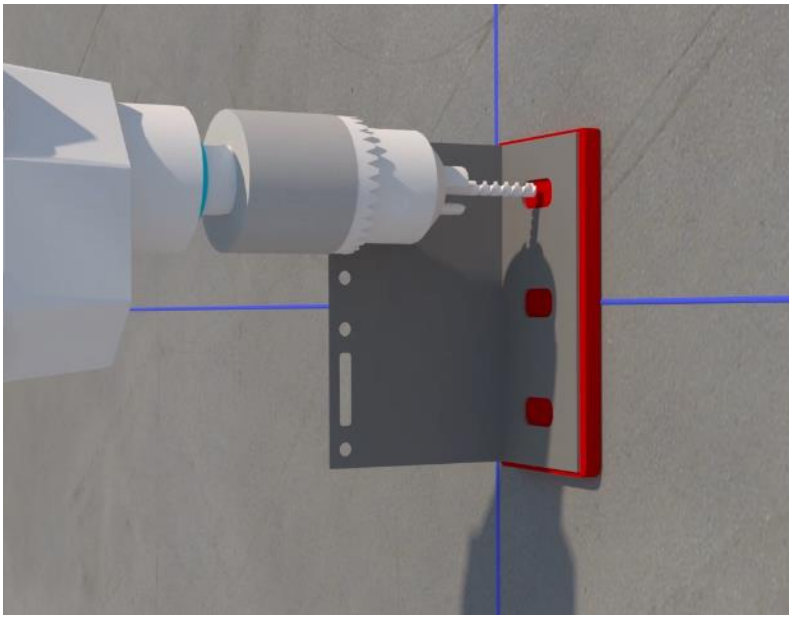
Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)



Source: BIMstone project website.

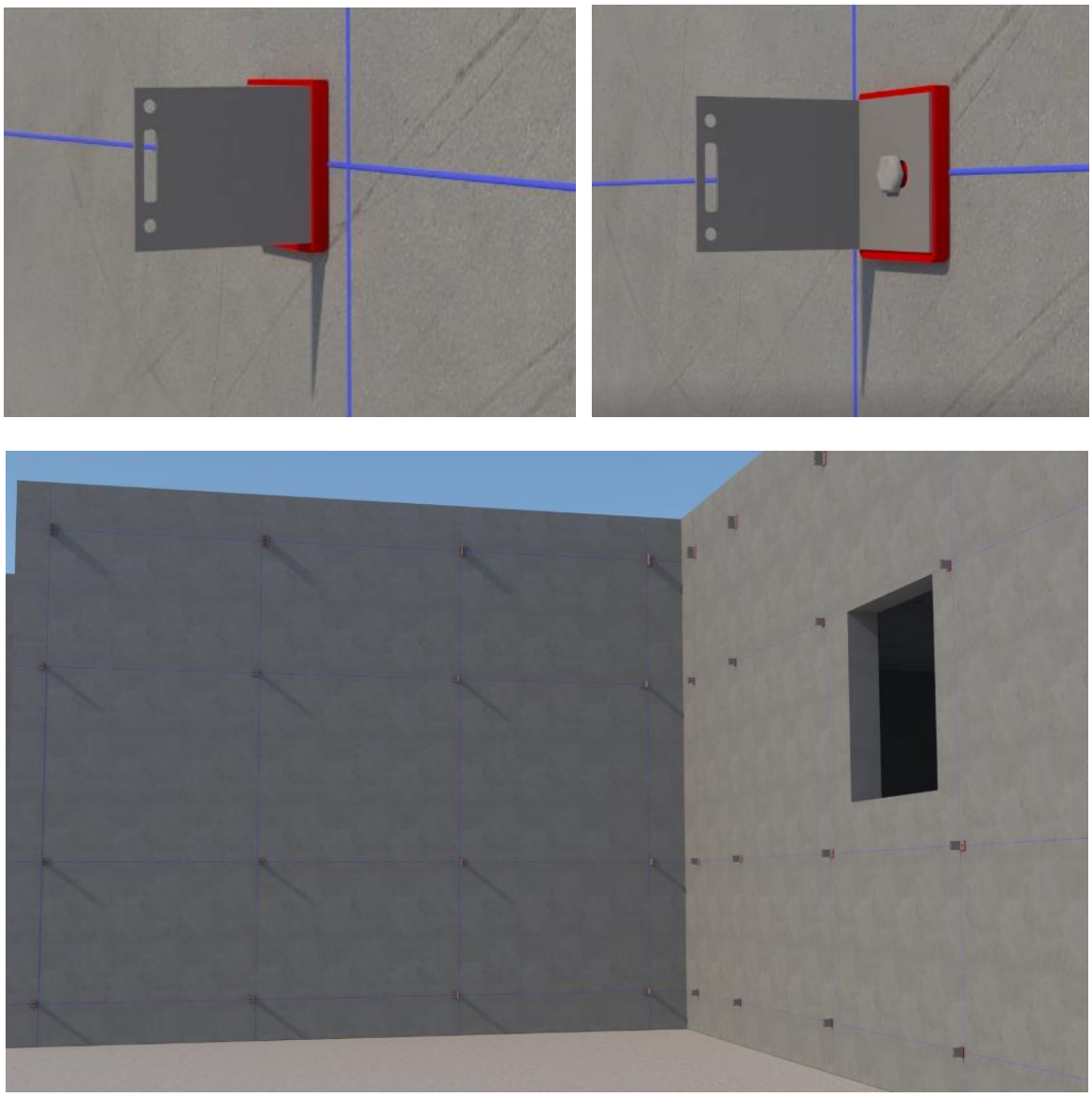
4.2. Fixing the metal brackets (fixed point and sliding point)

The metal brackets will be installed in a staggered manner on each side of the vertical profile. The fixed-point brackets (at the top of each profile) and the sliding point brackets (allowing the profile to expand freely) will be combined.



Source: BIMstone project website.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)



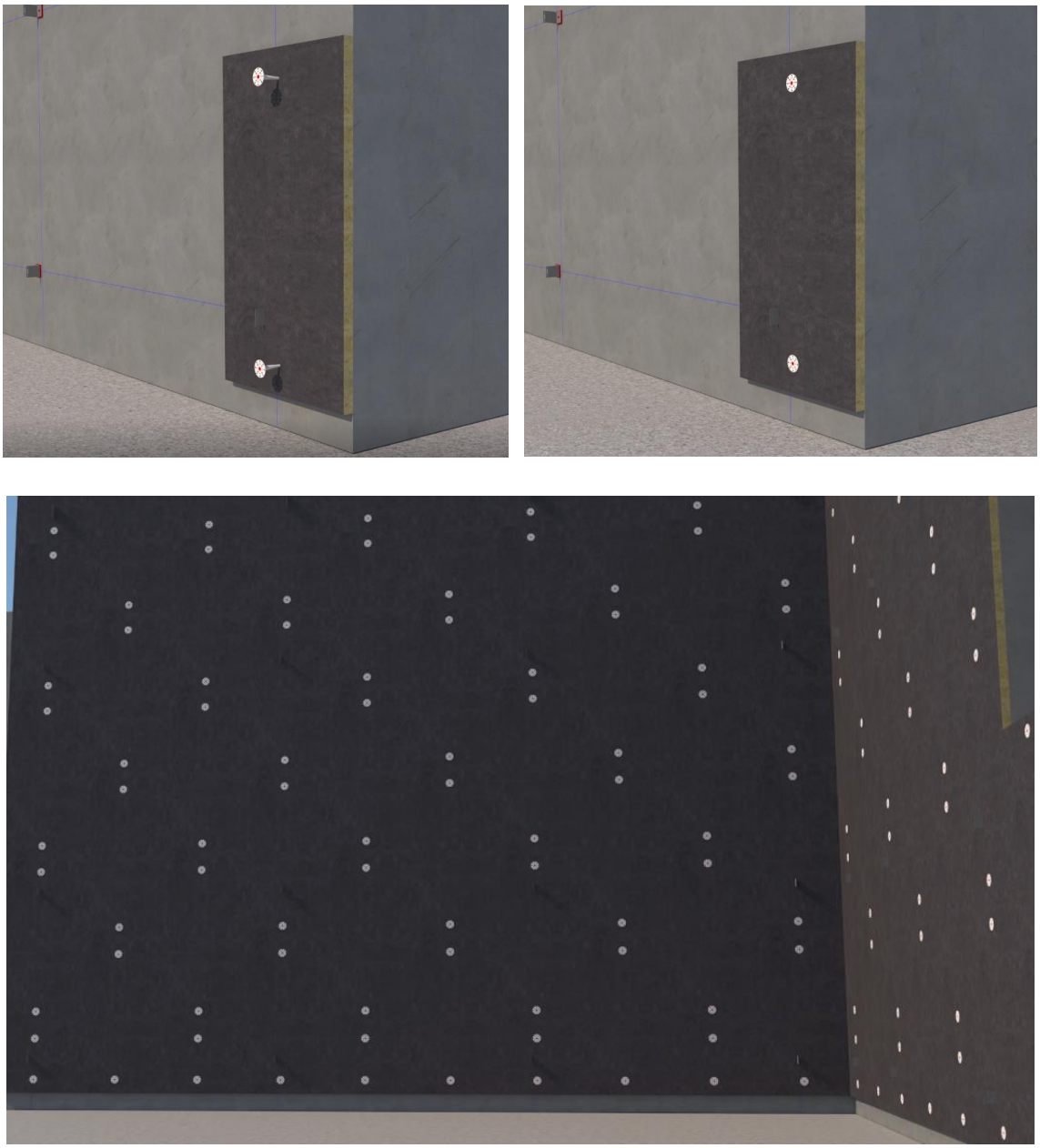
Source: BIMstone project website.

4.3. Installation and fixing of the insulation.

The choice of the specific insulator for the ventilated facade that is best suited to the requirements of the project is one of the most important points in the process, as this element reduces the energy consumption of the building. They can vary from rock wool to polyurethane spraying

The insulator must be mechanically fixed according to the manufacturer's recommendations.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)



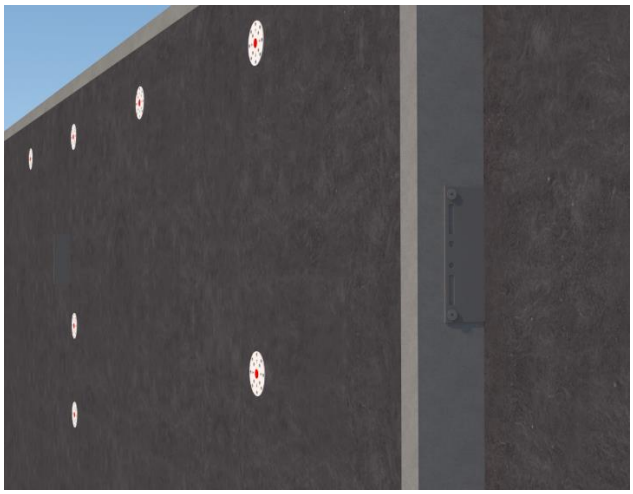
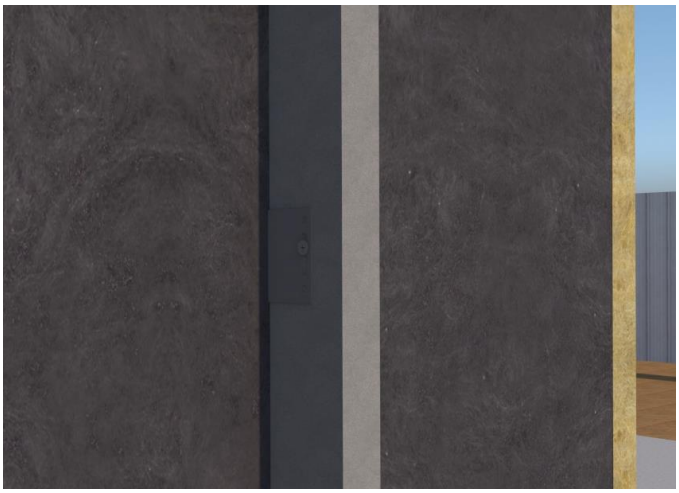
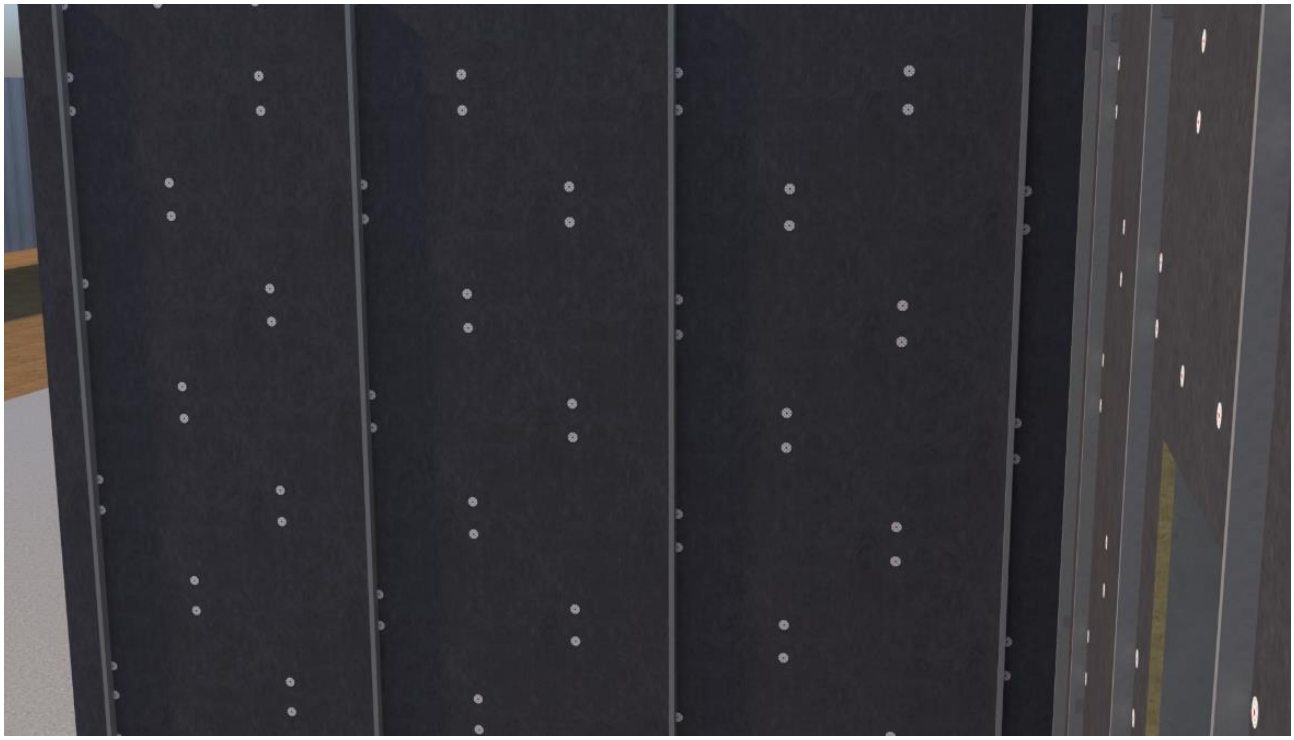
Source: BIMstone project website.

4.4. Fixing the vertical profiles

The vertical profiles will be fixed to the metal brackets in such a way as to ensure a ventilated air chamber with a minimum thickness of 2 cm. To achieve this minimum separation, regulation spacers shall be used.

The vertical profiles must be perfectly levelled to receive the rest of the components of the ventilated facade construction system.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

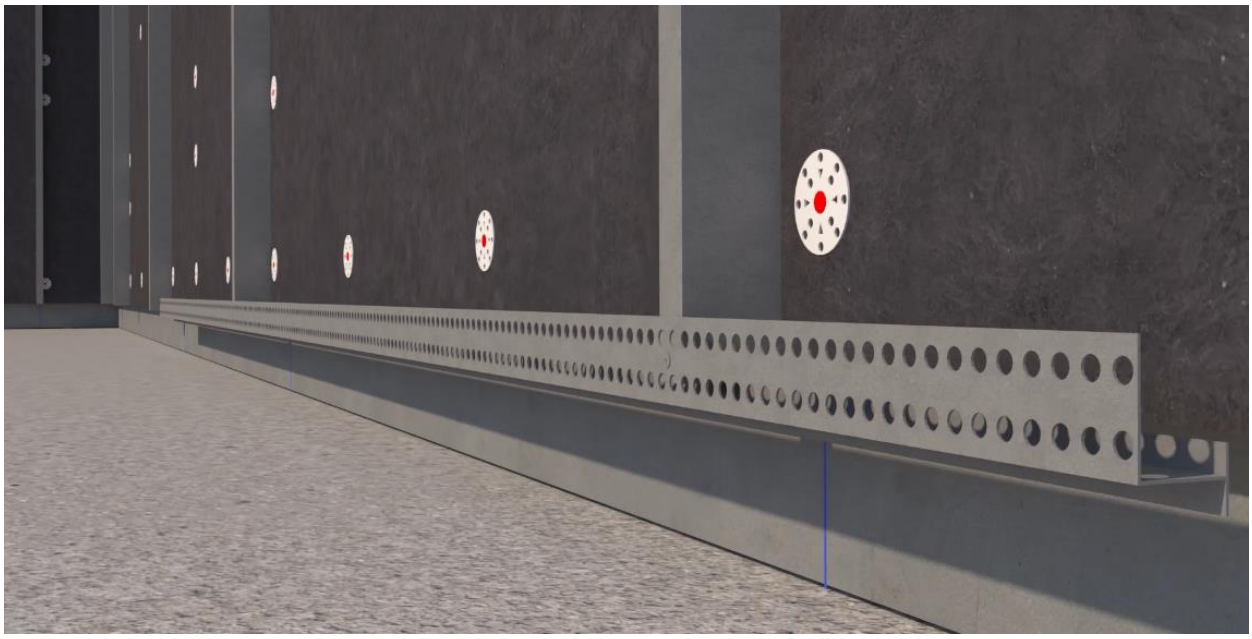




Source: BIMstone project website.

4.5. Fixing the starter profile

The starting profile is of the perforated type to avoid the entrance of insects and small mammals and will be installed in the lower part of the façade.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

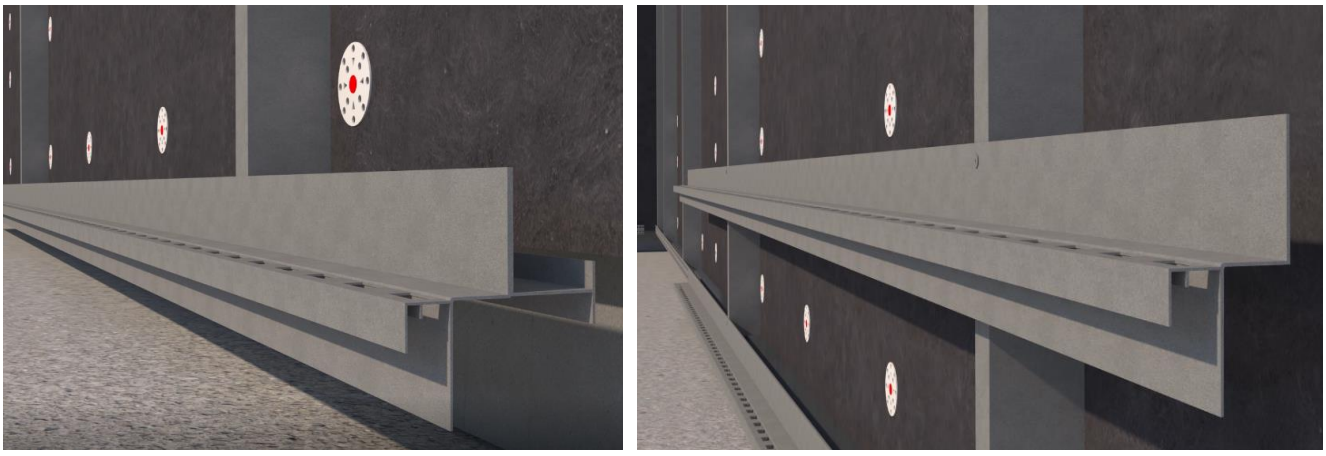


Source: BIMstone project website.

4.6. Fixing the horizontal profiles

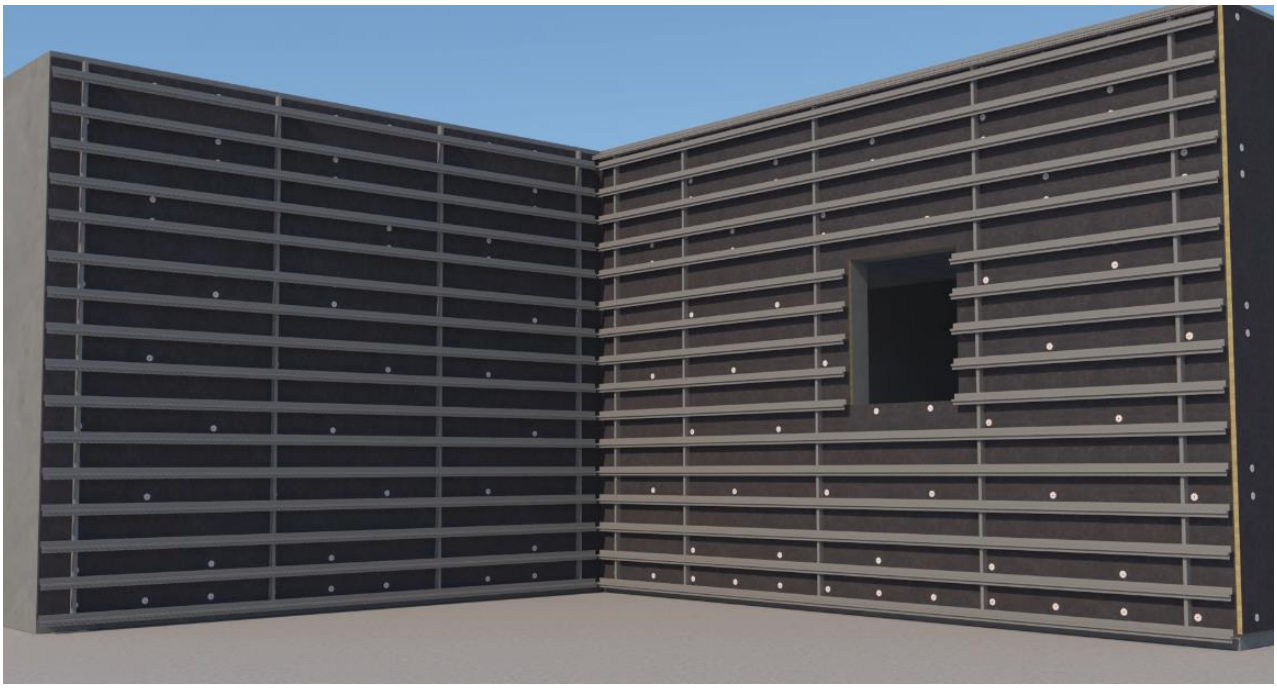
Once the vertical profiles are in place, the horizontal profiles will be installed and fixed to the vertical ones at each intersection. The separation between horizontal profiles is 260 mm, for slabs or pieces of 600 x 300 mm, with this separation a regular overlap of the tiles is ensured.

The horizontal profiles must be perfectly level as their position will dictate the final position of the slabs.



Source: BIMstone project website.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)



Source: BIMstone project website.

4.7. Placing the finishing plates at the corners of the building

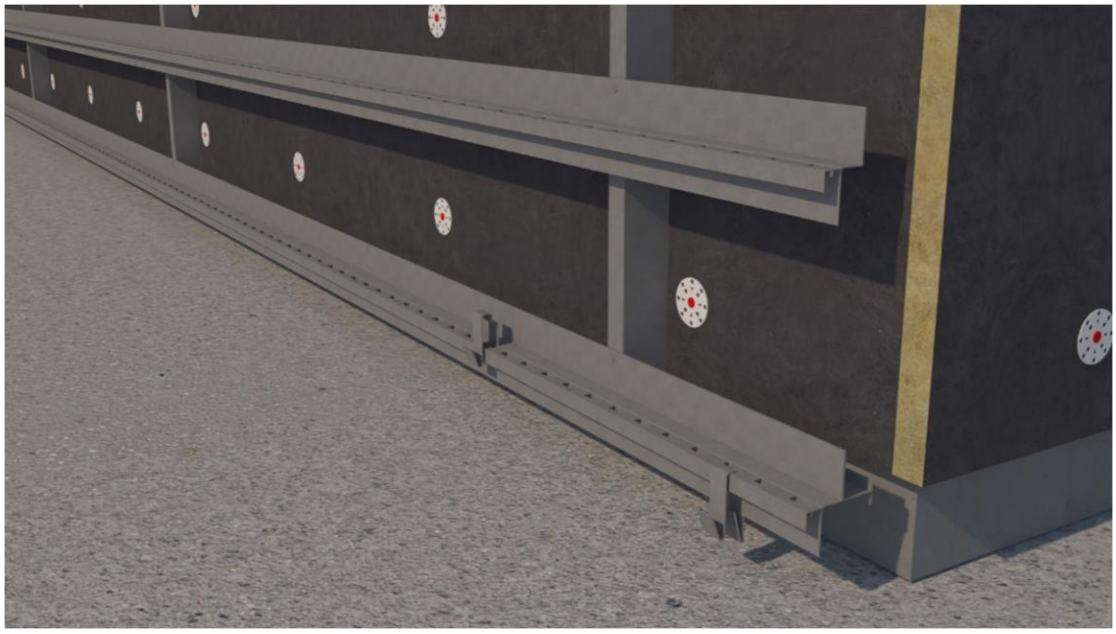
After that, the finishing plates will be installed in all the corners and singular points of the building.

Source: BIMstone project website.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

4.8. Fixing the slabs supports

The supports of the slabs will be introduced in the existing slots in the horizontal profiles and will clamp the slabs.



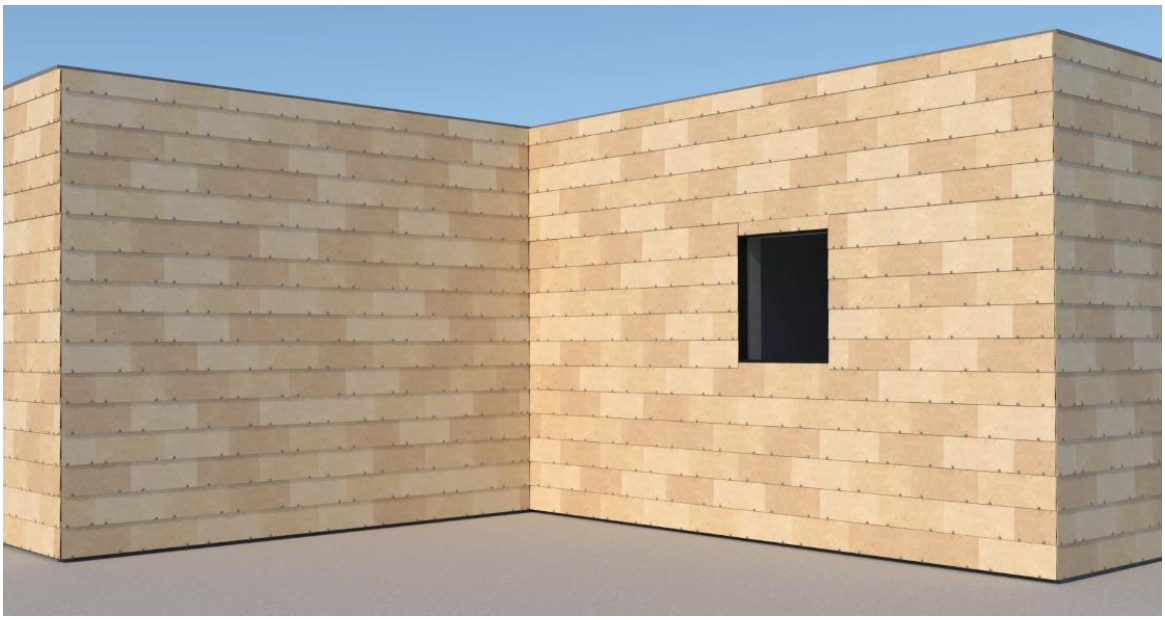
Source: BIMstone project website.

4.9. Positioning of the slabs

Each natural stone slab will be supported by two lower clips and held by the other two upper clips. Once the first row has been laid, the same procedure shall be followed until the entire load-bearing structure has been completed.

Source: BIMstone project website.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

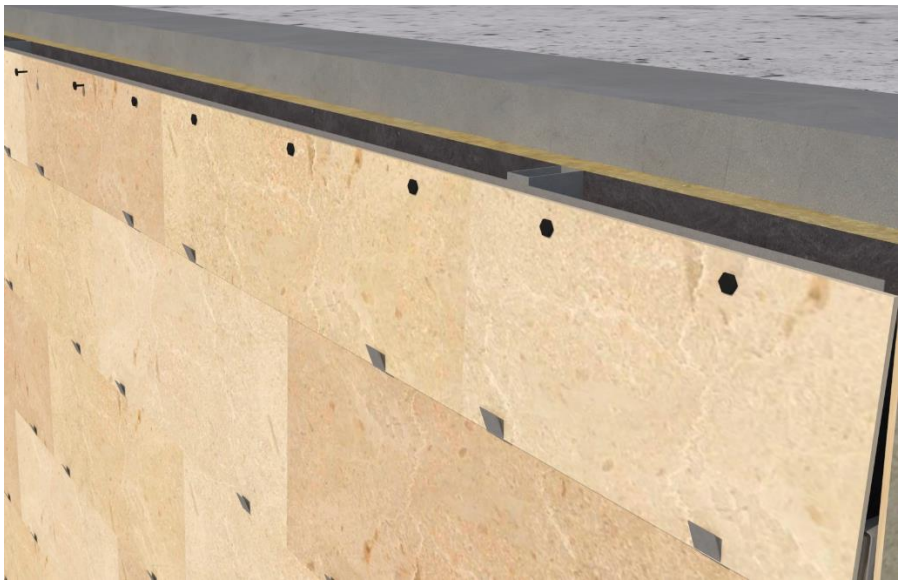


Source: BIMstone project website.

4.10. Screwed from the last row.

To ensure the stability of the last row of panels, all panels shall be screwed in at the same distance from the bottom clips. In the case of upper joints with gutters or copings, a special profile is used on which the natural stone slab is supported and fixed with two self-drilling screws or two rivets.

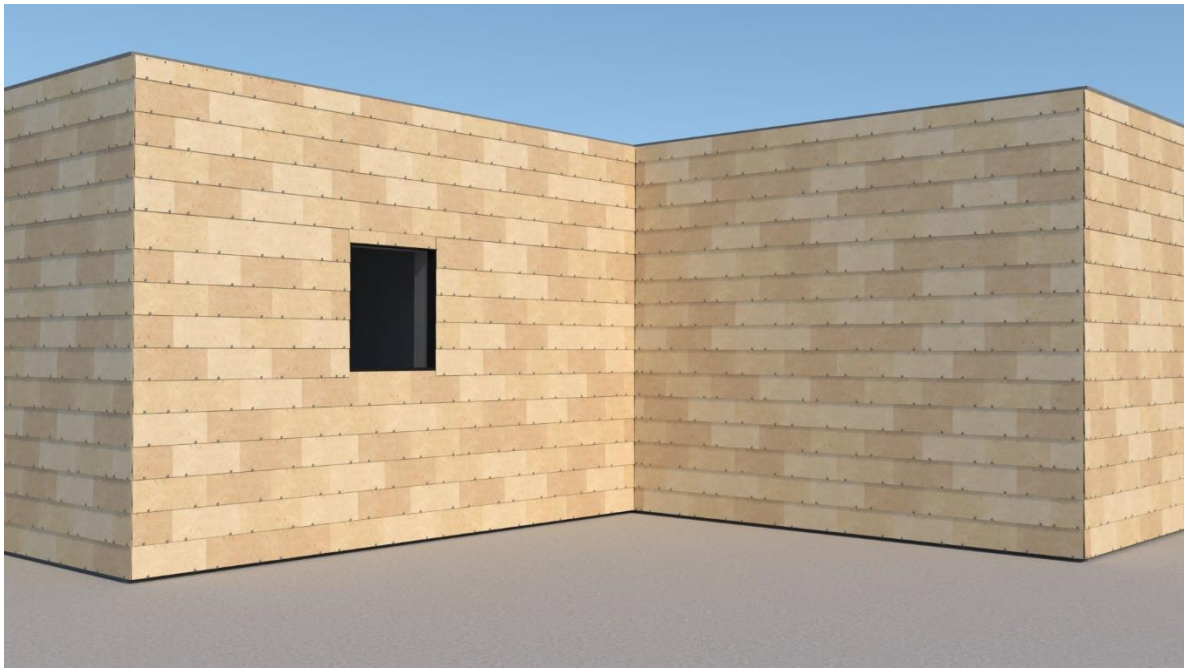
Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)



Source: BIMstone project website.

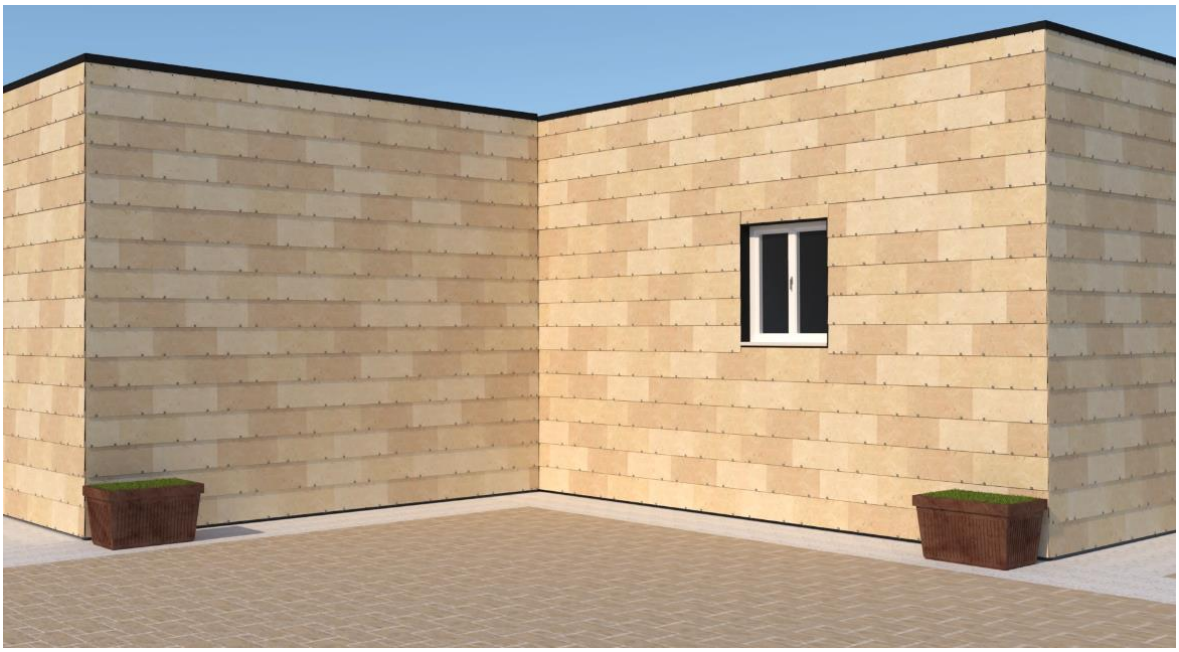
4.11. Termination of gaps (windows and doors)

Finally, the window and door openings will be finished by installing the special profiles for these details.



Source: BIMstone project website.

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)



Source: BIMstone project website

5. SUMMARY. STEPS TO FOLLOW IN THE CONSTRUCTIVE PROCESS

The construction processes of a self-supporting ventilated façade are summarised below:

1. Layout of the metal brackets.
2. Fixing the metal brackets (fixed point and sliding point).
3. Installation and fixing of the insulation.
4. Fixing the vertical profiles.
5. Fixing the starter profile.
6. Fixing the horizontal profiles.
7. Placing the finishing plates at the corners of the building.
8. Fixing the slabs supports.
9. Positioning of the slabs.
10. Screwed from the last row.
11. Termination of gaps (windows and doors).

Consortium members: Deutscher Naturwerkstein-Verband E.V (DNV), Asociatia Romania Green Building Council (RoGBC), Colegio Oficial de Arquitectos de la Región de Murcia (COAMU), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Klesarska Skola Pucisca (KLESARSKA)

6. REFERENCES

1. BIMstone project website. www.bimstoneproject.eu/bimstone-products

2. CUPAPIZARRAS website. www.cupapizarras.com

3. Tiles and Slabs from natural stone EURO-ROC. Environmental Product Declaration. IBU – Institut Bauen und Umwelt e.V. https://epd-online.com

4. Video “03. Natural stone ventilated façade” of BIMstone project. https://www.youtube.com/watch?v=dF2lPxRojLU