REPORT 1.2.4

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

FLOATING OR TECHNICAL FLOOR INSTALLATION PROCESS

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1. INTRODUCTION

1.1. 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 technical or floating floor 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 and sustainable result.

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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.

Some manufacturers of this high technical flooring system have registered some different Environmental Product Declarations. In the following links the different EPD's, developed by Environdec and IBU - Institut Bauen und Umwelt e.V. and owned by some different manufacturers, leading companies in the manufacture of these floors, of some technical flooring systems can be consulted where it has been assessed from module A1 to A3, that is, from the cradle to the door of the factory.

FDEB1 Europed Raised Access Flooring System

Targa Raised Access Flooring Systems

Raised Floor System, Type LIGNA

Raised Floor System, Type NORTEC

The EPD of marble and limestone slabs has been carried out according to the LCA methodology with quantified environmental information of its entire life cycle. That is to say, the EPD of these materials is of the "cradle to door" type, as can be seen in the following table, which includes the life cycle stages considered.

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 BOUNDARIES
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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	MND

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

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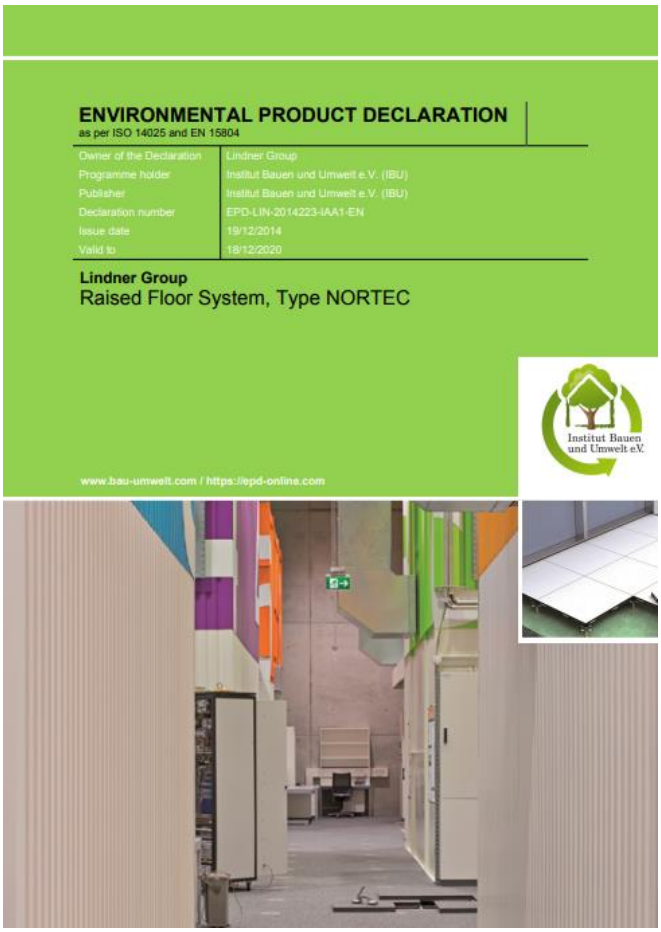
Below is one of the examples of EPD mentioned:



RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1m² NORTEC raised floor system

Parameter	Unit	A1-A3
Global warming potential	[kg CO_2-Eq.]	13.01
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	7.09E-9
Acidification potential of land and water	[kg SO_2-Eq.]	4.19E-2
Eutrophication potential	[kg $(PO_4)^{3-}$ Eq.]	7.18E-3
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	3.76E-3
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	9.49E-4
Abiotic depletion potential for fossil resources	[MJ]	310.10

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

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3. CONSTRUCTIVE CONSIDERATIONS

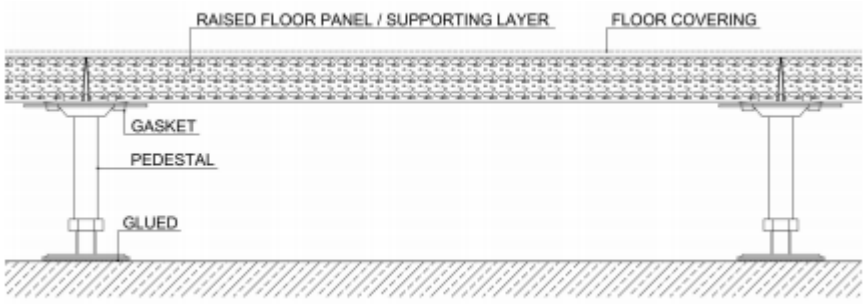
3.1. Description of technical or floating floor

The technical or floating floor consists of an elevated load-bearing structure on which the slabs will be installed, leaving a free space between the support and the passable slabs. In this space, all the electrical cables, telephone cables, alarms and the rest of the wiring and pipes are normally placed all installations. It means, the modular components form an installation for accommodating all installations as well as supply and disposal lines and providing unhindered access at each point and at all times to this hollow space.

In this way, the slabs are easy to remove in order to carry out any revision or modification in the installations, without the need to demolish them.

For this reason, technical, raised or floating floors are mainly used in renovation or new construction works, which require great design flexibility, constant performance in wiring systems or periodic inspection of cables and pipes.

The technical floor system consists of a load-bearing structure made up of adjustable metal supports and crosspieces and the panels or tiles that are installed on the structure without the need for masonry work or the use of mortars or glues.



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

Source: Canal Construcción.

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The **structure** is made of galvanised steel and has an anti-movement fixing system for the head to avoid possible variations in levelling that may occur due to vibrations or movements of the slabs once the installation has been completed.

The **pedestals or supports** are in charge of providing the floor with the necessary height for the project to be carried out. These elements incorporate anti-noise plastic joints with four positioning pins. Among its qualities it is possible to emphasize the facility to regulate the height thanks to the threaded bolt.

Source: Butech.

The **crosspieces** are used to give the pavement greater stability and resistance. In its upper part, like the pedestals, it incorporates anti-noise plastic strips along the entire surface. These rails are screwed to the head of the pedestal.

Source: Butech.

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In terms of performance, the structure for technical flooring is highly resistant to bending under vertical and/or eccentric load, thanks to a M16 section threaded bolt, a 22 mm diameter tube 2 mm thick, internally calibrated to obtain a coupling with tighter tolerances and, consequently, less play and a direct coupling between the threaded bolt and the base disc and the tube, without the need for deformable plastic elements.

The free space between the support and the slabs can vary according to the needs of installation and overhaul, commercially the structures that are easier to obtain allow spaces of between 3.5 and 100 cm, since at greater heights the air conditioning ducts could also be installed.

The advantages of the technical floor in natural stone slabs are:

- Aesthetic improvement of the space thanks to the concealment of the installations under the pavement.
- Easy inspection of the floor.
- Simple maintenance of all networks.
- Acoustic and thermal insulation, due to the space between the floor and the modules or floating slabs.
- Freedom of reforms when necessary for the ease of change, without works, both piping and wiring.
- Easy replacement of damaged or worn parts, even the total change of the structure is quick and without works, with what this entails (dirt, work hours, economic cost, etc.).
- Low maintenance cost.
- Great variety of textures and colours.
- High resistance and easy cleaning.
- Different formats.

3.2. Applicable regulation

In Europe, the standard EN 12825:2001 "Raised access floors" specifies the characteristics and performance requirements of registrable raised floorings whose main use is their installation inside buildings in order to offer full access to the services located in the plenum. This standard does not apply to requirements related to hazardous substances that may be subject to regulations.

This standard applies to factory-made modular flooring elements including panels and pedestals and defines test and measurement methods. It also defines the elements for product conformity assessment. This standard can be consulted at the following link: https://www.une.org/encuentra-tu-norma/busca-tu-norma/norma/?c=N0026213

Also, the standard EN 13213:2001 “Hollow floors” specifies performance requirements and describes test methods for hollow floors for the use in interior parts of buildings. It contains information for the evaluation of conformity of the product to this European Standard.

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In addition, the Basic Requirements must be met for each requirement of the Technical Building Code (CTE).

In terms of design and installation of registrable raised floors, the provisions of the following sections of the Technical Code shall be complied with:

- Structural safety. DB SE.
- Fire Safety. DB SI.
- Healthiness. DB HS.
- Protection against noise. DB HR.
- Energy saving. DB HE.

4. CONSTRUCTION PROCESS

4.1. Layout of the first slab

In order to proceed with the process of installing the raised technical floor, the necessary measures will be taken for the staking out of the first slab.

Source: BIMstone Project website.

The process will begin by measuring the height that the floor must have in order to cover the existing installations.

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Source: BIMstone Project website.

Subsequently, the necessary markings shall be made on the horizontal plane where the two supports furthest from the wall which has been considered as the reference point shall be placed.

Source: BIMstone Project website.

4.2. Application of the fixation

To ensure the correct adhesion of the structure of the raised technical floor, an adhesive shall be applied to the base of each of the four supports.

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Source: BIMstone Project website.

4.3. Installation of the vertical supports

With the adhesive still soft, the four supports of the elevated structure will be placed exerting pressure on its base and checking that they are perfectly placed and fixed.

Source: BIMstone Project website.

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4.4. Installation of the crossbars

Next, the crosspieces on which the slab is to be placed are laid. The crosspieces are supported directly on the supports and, to fix them, they are screwed with two screws at both ends. In this way, the structure is completely assembled and immovable.



Source: BIMstone Project website.

4.5. Laying the stone slabs

Since both the supports and the crosspieces are normally bonded with plastic parts that act as a noise protection system, the next step is to lay the slab on top of the structure that has already been assembled.

For correct tile installation, a suction cup will be used. With this suction cup, the slab can be placed in its exact position without leaving gaps between it and the walls.

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Source: BIMstone Project website.

4.6. Levelling of the slabs

Once the suction cup has been removed, the correct leveling of the slabs is checked, as well as any possible defects in planimetry that may exist between the tiles by tightening the screws of the vertical supports. For this purpose, a spirit level shall be used.

Source: BIMstone Project website.

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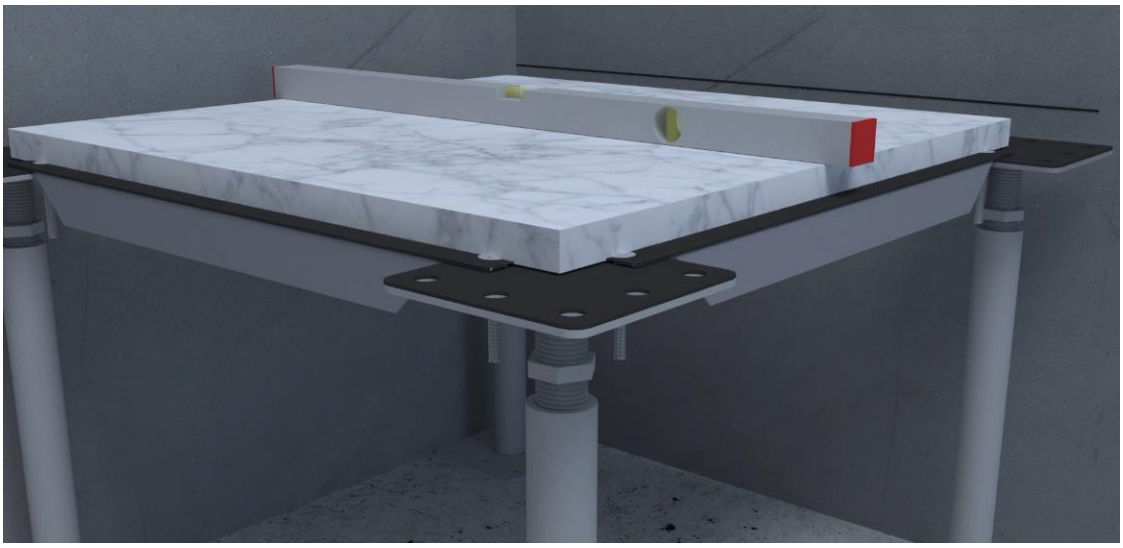

Source: BIMstone Project website.

4.7. Completion of the installation

In the same way that the first four supports have been placed, the installation of the rest of the supports and crosspieces that make up the framework of the structure to cover the entire surface of the room will be carried out.

Source: BIMstone Project website.

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At the same time as the supporting structure is installed, the stone slabs will be placed on top, covering the entire surface with natural stone slabs.

4.8. Placement of the plastic joints

To finish the process of laying the raised floor and protect both the walls and the natural stone slabs, plastic joints will be placed in the gap created between the two.

Source: BIMstone Project website.

In this way, a floor is installed that provides easy access to the registers and installations located under it.

Source: BIMstone Project website.

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5. SUMMARY OF STEPS TO BE FOLLOWED IN THE CONSTRUCTION PROCESS

The construction processes of a technical or floating floor are summarised below:

1. Layout of the first slab.
2. Application of the fixation.
3. Installation of the vertical supports.
4. Installation of the crossbars.
5. Laying the stone slabs.
6. Levelling of the slabs.
7. Completion of the installation.
8. Placement of the plastic joints.

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