Technical Notebook
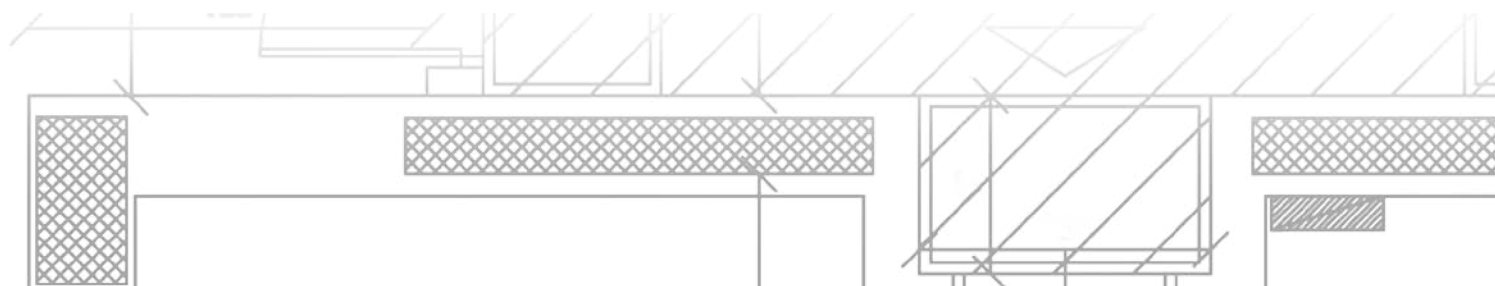
SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

1. INTRODUCTION

1.1 BASIC DEFINITIONS

Sound is a sensation perceived by the human ear and is generated by vibrations from an oscillating body. These oscillations are the movement of the particles of a specific object that transmits movement to adjacent particles, which in turn transmit this energy to the nearest particles and generate a sound wave. A wave will only be generated and then propagate if there is a liquid, solid or gaseous body (such as air).

Although the actual physical phenomenon is identical, we must make a distinction between the concepts of "sound" and "noise". In fact, while the first word recalls a generally positive sensation which is pleasant to hear, the second one undoubtedly identifies an irritating phenomenon and, in the worst cases, can be unbearable and often has a negative effect on the physical and psychological wellbeing of people.

Since sound is a wave, its physical size may be defined, as the amount of energy transported by the wave and which passes through a given surface perpendicular to the direction in which it propagates may be measured in a certain unit of time. This size is known as **sound intensity** and is measured in W/m^2. The range of sound intensity which may be perceived by the human ear is extremely wide (around 10^{12}) which, if compared with a scale measuring lengths or sizes, is comparable to the difference between the size of a human hair (around 2 thousandths of a mm) and the distance between the Earth and the Moon (around 300 thousand km). In fact, sound intensity ranges from a minimum value of 1×10^{-12} W/m^2 up to a maximum of around 1 W/m^2, above which sound is replaced by a sensation of pain. This immense range of values would make it extremely difficult to understand and control this phenomenon if it were measured by means of a simple linear scale. Similarly, it would also be complicated to express sound through **sound pressure**, which is defined as the difference of

pressure that our hearing apparatus is able to perceive compared with its value of equilibrium, represented by atmospheric pressure. This also has a wide range of variations, starting from 2×10^{-5} Pa (*hearing threshold*) up to around 60 Pa (*pain threshold*).

This is why, to compress the values within a much narrower range which is easier to read, sound (and noise) are measured using a logarithmic scale. In fact, this solution allows whole numbers up to a maximum of just three figures to be used.

The unit of measure most commonly adopted to express the level of sound intensity and pressure on a logarithmic scale is the **decibel** (dB), a non-dimensional unit which takes the lowest value perceived by the human ear as a reference to define a value of 0 dB.

The decibel, which may be used to measure both sound intensity and sound pressure, is defined as follows:

$$ dB = 10 \log_{10} \frac{I}{I_0} = 10 \log_{10} \frac{P^2}{P_0^2} $$

where **I** and **P** are the values of sound intensity and pressure measured, while **I$_0$** (1×10^{-12} W/m^2) and **P$_0$** (2×10^{-5} Pascal) are standard reference values which correspond to the minimum hearing level.

The decibel, therefore, is not a real unit of measure, it is rather a way of expressing a certain measurement through the relationship between sound intensity (or pressure) and the hearing threshold. It is worth noting that the square of acoustic pressure is proportional to the intensity of the sound band at the point where it is measured.

Apart from reducing the sheer number of values, a logarithmic scale is a much more efficient way of simulating the way the human ear reacts to sounds it is unable to perceive than with a linear scale: in practical terms, if the intensity of the stimulus is doubled, the sensation is never doubled. Also, we must add that the human hearing apparatus is a lot more sensitive

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to variations in pressure than the absolute value of the pressure itself. We just need to think that the pressure induced by even the loudest sound tolerated by the human ear (~ 60 Pa) is more than one thousand times smaller than the level of atmospheric pressure at sea level, equal to around 100000 Pa. Variations in sound pressure, therefore, must be considered simply as small "blips" compared with the value of atmospheric pressure.

Source	Sound level (dB)	Sound pressure (Pa)	Sound intensity (W/m²)	Sensation
Rocket being launched	170	6000	1×10^5	Unbearable
Aircraft taking off at 30 m	140	200	1×10^2	
Pain threshold	120	20	1	
Pneumatic hammer	110	6	1×10^{-1}	Very noisy
Discotheque	100	2	1×10^{-2}	
Underground railway	90	0.6	1×10^{-3}	
Intense traffic	80	0.2	1×10^{-4}	Noisy
Radio at high volume	70	0.06	1×10^{-5}	
Office noise	60	0.02	1×10^{-6}	
Normal conversation	50	0.006	1×10^{-7}	Quiet
Library	40	0.002	1×10^{-8}	
Quiet room	30	0.0006	1×10^{-9}	
Whispering	20	0.0002	1×10^{-10}	Very quiet
Leaves rustling	10	0.00006	1×10^{-11}	
Hearing threshold	0	0.00002	1×10^{-12}	

Note that, in the above table, for every increase of 20 dB, sound pressure increases by a factor of 10, while sound intensity increases by a factor of 100.

Similarly, using a simple calculation, you can show that:

– every doubling in sound level corresponds to an increase of 6 dB;

– every doubling in sound intensity (or sound pressure) corresponds to an increase of 3 dB (see diagrams below).

70 dB   **73 dB**   **76 dB**
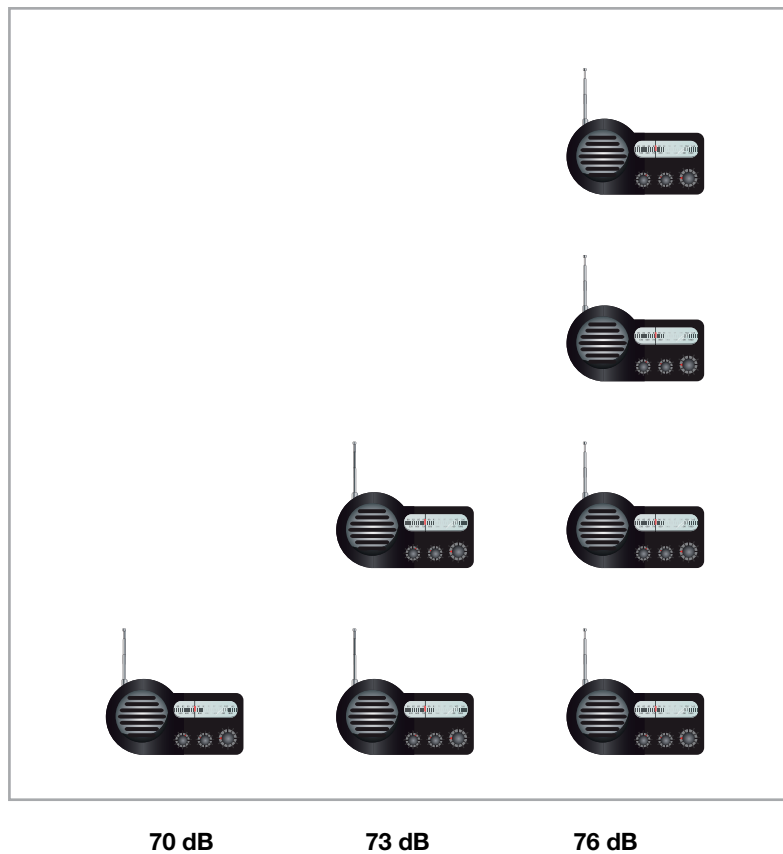
Finally, thanks to the properties of the logarithm, if there is a sound to which a second sound 10 dB lower than the first is added, the total sound perceived is almost the same (around +0.4 dB), which is why you may assume, for example, that 70 dB + 60 dB ≈ 70 dB. We may state, therefore, that if two sources with a difference of at least 10 dB are added together, the source which emits more decibels overcomes the sound of the source that emits fewer decibels.

Another parameter which has a significant effect on how noises are really perceived is sound **frequency**, which represents how many times the particles oscillate in a second, and is measured in hertz (Hz). The human

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ear, in fact, is able to perceive sounds ranging from 16 Hz to 20000 Hz, and is much more sensitive to the frequency of speech, whose range is 1000 Hz to 5000 Hz.

This difference in sensitivity to variations in the frequency at which sound is emitted means we perceive sounds differently, which doesn't correspond, therefore, to the real physical size of sound. Therefore, two sources with the same level of sound pressure may cause very different sensations.

An easy way of explaining this phenomenon is through the use of isophonic curves which offer a graphic representation of perceived sound compared with the number of dB for the various frequencies, and identify the geometric positions of the points at which the perceived intensity (and not the intensity actually emitted) is constant. Each isophonic curve is obtained experimentally by asking someone to listen to sounds emitted at different frequencies, and to regulate their volume in order to detect them with the same intensity.
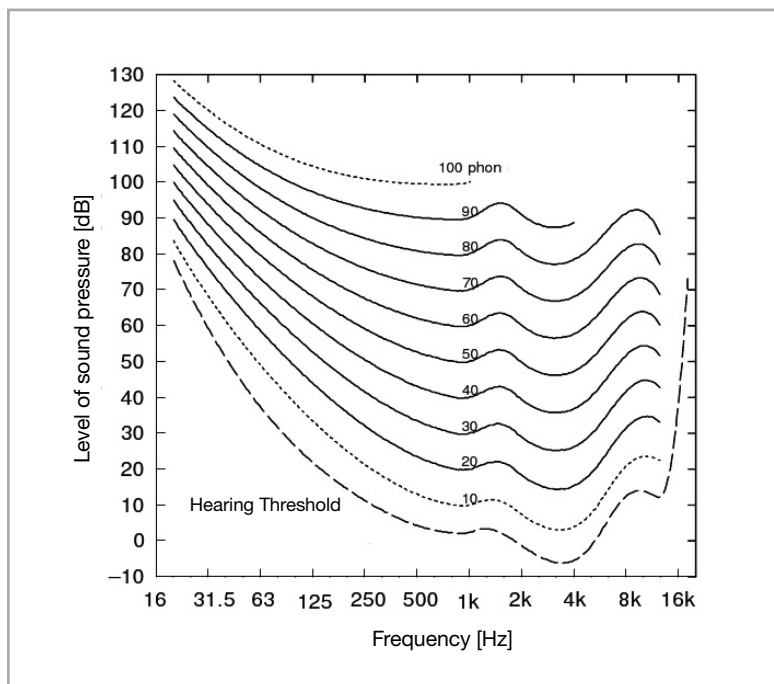
For a frequency of 1000 Hz, it is conventional practice to assign the same level for perceived intensity and sound intensity. Since these two values are measured with the same unit of measure (the decibel) but, as said previously, do not coincide when frequency varies, there was the idea of introducing a new unit of measure, the phon, which measures the perceived intensity only.

For example, as you can see in the graph, a sound emitted at a frequency of 1000 Hz with a physical level of 40 dB is perceived at 125 Hz with a sound level of 60 dB.

1.2 ACOUSTICS AND THE BUILDING INDUSTRY

Over the last few decades, the inarrestable rate of urban development and the increase of the population density of our cities have led to an inevitable increase in the number of sources of potentially disturbing noise perceived in buildings, with noise coming both from outside buildings, such as traffic and production activities, and from inside buildings, such as noise from neighbours, lifts, heating and air-conditioning systems and hydraulic systems. The steady increase in the quality of life, and the diffusion of the concept of living comfort, have undoubtedly increased the phenomenon, and in the most serious of cases is even perceived as social discomfort. In fact, exposure to noise causes a psychological discomfort and is an obstacle to a person's daily activities, making them less efficient (and less able to concentrate).

Nowadays, protecting ourselves from noise must be seen as a primary requirement.

To reach this objective, it is fundamentally important that all those people and companies that operate in this sector are even more committed to increasing the acoustic efficiency of buildings, also due to the increasing awareness of the final user of a building.

As previously discussed, noise may only be generated and propagated if there is an elastic element with a certain mass, be it solid, liquid or gas. In the specific case of the propagation of noise in buildings, it is typically

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spread by the actual elements which make up the building (walls and floors). The transmission of sound occurs according to one of two distinct propagation mechanisms: airborne transmission and transmission through the structure of the building. Inside buildings, walls are generally subject to airborne noise only (voices, televisions, etc.), unlike floors which, apart from airborne noise, are also and mainly subject to impact noise (footsteps, falling objects, moving furniture about, etc.).

Figure 1.1

2. REFERENCE LEGISLATION

2.1 PASSIVE ACOUSTIC REQUIREMENTS OF BUILDINGS

Each country has specific domestic standars regarding to building acoustic requirements, with different limitations. Unfortunately, the comparison of these requirements is not simple because of the different terms of descriptors used and the frequency range applied.

For example in Europe, for airborne and impact sound insulation requirements, nine and five different descriptors are applied, respectively, not counting minor variants and additional recommendations (Tab. 2.1).

| EUROPEAN ACOUSTIC REQUIREMENTS FOR RESIDENTIAL BUILDINGS					
Country	**Basic descriptor airborne sound insulation**	**Airborne sound insulation**	**Basic descriptor impact sound insulation**	**Impact sound insulation**	**National standard**
Italy	R'_w	50	L'_{nw}	63	DPCM 5/12/97
Denmark	R'_w	55	L'_{nw}	53	DS 490
Finland	R'_w	55	L'_{nw}	53	SFS 5907
Norway	R'_w	55	L'_{nw}	53	NS 8175
Germany	R'_w	57-53	L'_{nw}	48-53	VDI 4100
Sweden	$R'_w + C_{50-3150}$	53	$L'_{nw} + C_{I\,50-2500}$	53	SS 25267
Austria	D_{nTw}	60-55	L'_{nTw}	43-48	–
UK	$D_{nTw} + C_{tr}$	45	L'_{nTw}	62	–
France	$D_{nTw} + C_{tr}$	53	L'_{nTw}	58	Qualitel
Switzerland	$D_{nTw} + C_{tr}$	55-52	L'_{nTw}	50-53	–
Spain	$D_{nTw} + C_{100-5000}$	50	L'_{nTw}	65	–

Tab. 2.1
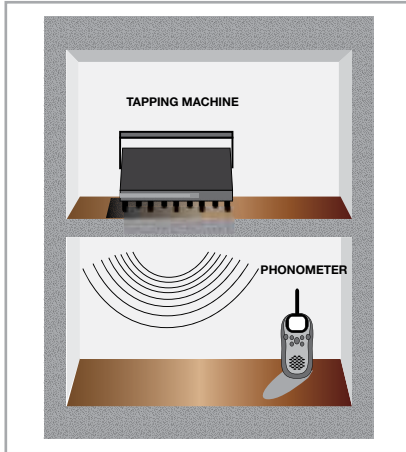
Figure 2.1
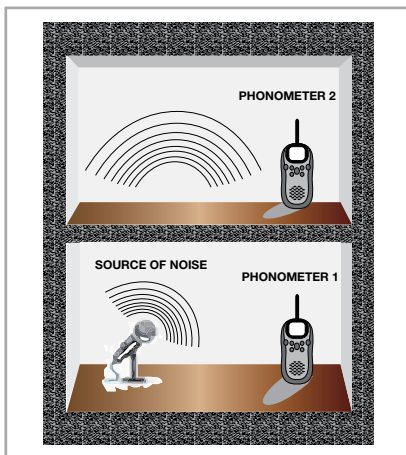
Figure 2.2

The soundproofing in a building, therefore, must take into account both types of noise propagation: airborne nose (e.g. voices) and impact noise (e.g. footsteps).

The latter type, which depends entirely on the acoustic properties of the dividing floors between separate housing units, is usually the most irritating and, therefore, the most common cause of arguments.

Insulation against noise caused by footsteps is defined by the parameter $L'_{n,w}$. This parameter characterises the capacity of a floor installed in a building to reduce impact noise. The lower the index, the higher the soundproofing performance of a slab.

The value of $L'_{n,w}$ is measured by using a tapping machine which simulates footsteps on the floor under analysis, and then measuring the level of noise perceived in the room below with a phonometer (*Fig 2.1*).

The floor must also guarantee good soundproofing from airborne noise, which is determined using the parameter R'_w which corresponds to the apparent soundproofing capacity index of separation elements between different housing units. The higher the value of R'_w, the better its performance in terms of insulation from airborne noise.

This parameter is measured in a building by positioning a source of noise in one of the rooms and measuring the noise levels in both the room where the sound is emitted and in the room where the noise is heard (*Fig 2.2*).

The procedures to carry out these measurements may be found in the Technical Standard EN ISO 717-2:2007.

Each noise measurement and their evaluation with respect to the local legal requirements must be carried out by qualified Environmental Acoustics Technicians. Following this analysis, the authorised Technician drafts a report for the applicant, who must then deliver a copy to the local Town Hall.

3. SOUNDPROOFING SYSTEMS FOR FLOORS

3.1 NEW BUILDINGS - FLOATING SCREEDS

It is possible to obtain sufficient insulation against impact noises between different living units by interposing an element with the capacity of dampening vibrations between the source of the noise and the adjacent structures. As circumstances or conditions change, this element may be applied in various points: between the load-bearing structure and the screed, or between the screed and the flooring, as well as directly underneath the floor by creating a false ceiling. The latter solution, which is often employed for interventions in existing buildings or inside rooms disturbed by noise, is often not particularly efficient because it is not possible to prevent lateral transmission of noise, which then propagates through the walls (*Figure 3.1*).

This is why the most widely adopted solution is a "*floating screed*", made by interposing elastic material between the load-bearing structure or the levelling layer and the screed (*Figure 3.2*). This solution is usually adopted in new buildings and generally where a self-supporting screed at least 4 cm thick has to be installed. A floating screed is generally considered the best solution to improve acoustic comfort and to meet the acoustic requirements of current legislation.

The installation of a floating screed basically consists in creating a kind of closed container where the screed and the flooring are inserted so that they are completely isolated from the surrounding structure.
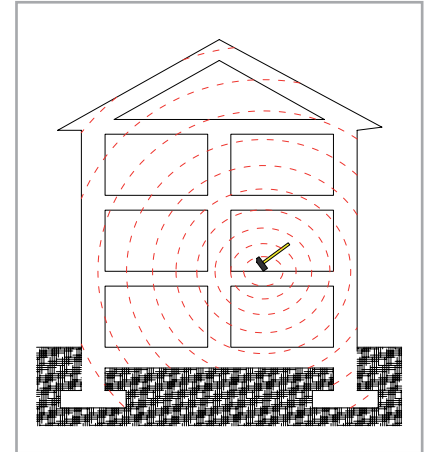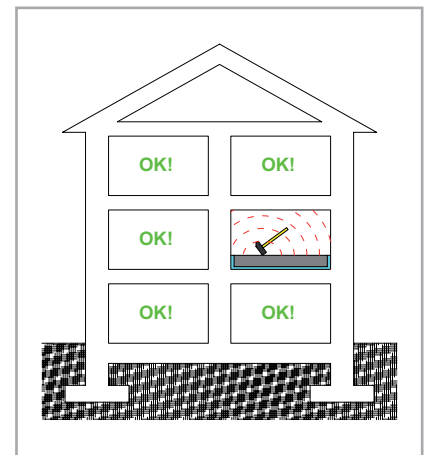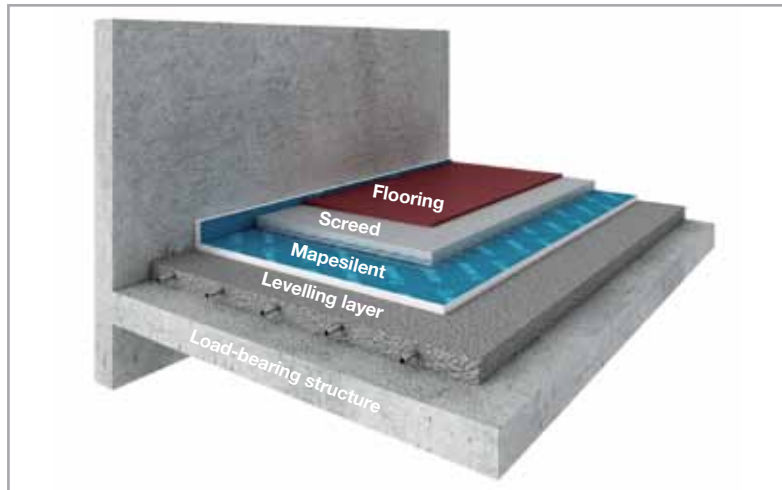

Figure 3.1

Figure 3.2

The elastic material, if correctly applied, acts as a spring which dampens the vibrations generated by footsteps on the screed and floor. It is vitally important, therefore, that the following installation guidelines are followed. The minimum thickness of a floating screed is calculated by considering the intrinsic characteristics of the material used to make the screed and the mechanical stresses to which it will be subjected under normal conditions of use.

Traditional cementitious-based substrates must be at least 4 cm thick, and the thickness must be increased accordingly if the loads are high. Electro-welded reinforcement mesh should always be inserted at the mid-point of the screed to spread loads and prevent depressions.

When a floating screed is installed, products from the **MAPESILENT** range may be used to soundproof against the noise of footsteps.

3.2 EXISTING BUILDINGS

In renovation and rebuilding work, specific solutions to improve the acoustic properties of floors are often required. Unfortunately, because of the limited amount of space available and to avoid overloading the original load-bearing structure, it is often impossible to install a floating screed. Therefore, if it is impossible or too expensive to demolish the existing flooring and install a new soundproof floating screed, or in buildings where design or installation mistake have been made and the thickness available is not sufficient to install a soundproofed floating screed, it is still possible to apply a soundproofing system directly under the new flooring. In these cases, underfloor soundproofing may be installed using the **MAPESONIC CR** system.

New flooring

Mapesonic CR

Existing flooring

Screed

Levelling layer

Load-bearing structure
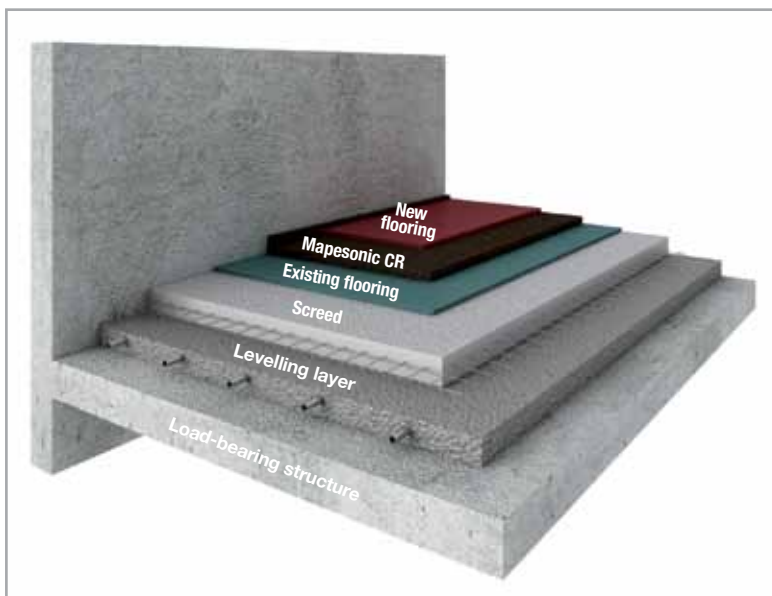
4. MAPESILENT SYSTEM

The system is made up of **MAPESILENT ROLL**, **MAPESILENT PANEL**, **MAPESILENT BAND R**, **MAPESILENT TAPE** and **MAPESILENT UNDERWALL**, and is a simple, efficient way to create a floating screed which is perfectly isolated from the structure, and on which it is possible to install any type of flooring (ceramic, stone, parquet, PVC, linoleum, etc.).
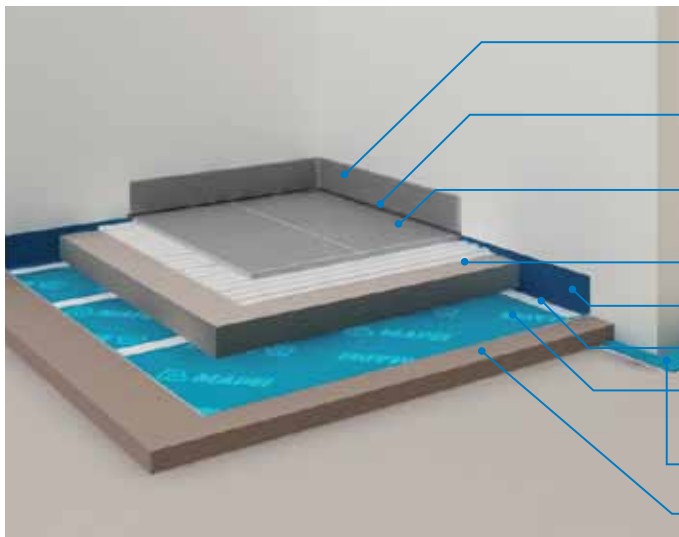
Perimeter skirting boards

Sealant:
MAPESIL AC

Floor laid with adhesive from Mapei range according to EN 12004 standards

Screed:
MAPECEM PRONTO or **TOPCEM PRONTO**

MAPESILENT BAND R

MAPESILENT TAPE

MAPESILENT ROLL

Wall-break:
MAPESILENT UNDERWALL

Lightweight concrete / Slab

Perimeter skirting boards

Sealant:
MAPESIL AC

Floor laid with adhesive from Mapei range according to EN 12004 standards
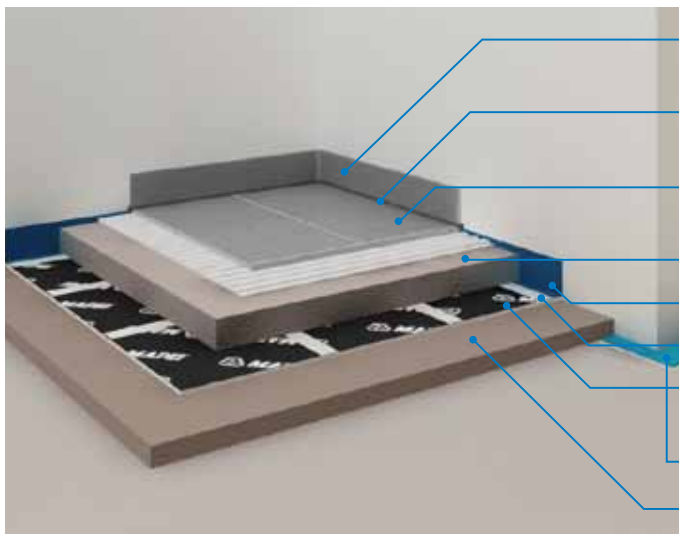
Screed:
MAPECEM PRONTO or **TOPCEM PRONTO**

MAPESILENT BAND R

MAPESILENT TAPE

MAPESILENT PANEL

Wall-break:
MAPESILENT UNDERWALL

Lightweight concrete / Slab

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

This specific products which make up the system allow to meet the requirements of current legislation regarding both soundproofing and thermal insulation.

4.1 COMPONENTS OF THE SYSTEM

• MAPESILENT ROLL

Elasto-plastomeric polymer bitumen membrane sandwiched together with blue-coloured, non-woven fabric and a polyester fibre backing, available in 10 m by 1 m rolls with 5 cm wide borders, total nominal thickness 8.0 mm.

Figure 4.1

• MAPESILENT PANEL

Elasto-plastomeric polymer bitumen membrane sandwiched together with a non-woven fabric backing, available in handy 1x1 m squares, total nominal thickness 13.0 mm.

• MAPESILENT BAND R

Closed-cell, expanded polyethylene adhesive membrane applied to perimeter walls and around the edges of through-elements in screeds to prevent the formation of acoustic bridges. The product is available in handy 50 m long rolls in widths of 100 mm and 160 mm. The 160 mm version is mainly used for heated floors.

Figure 4.2

• MAPESILENT TAPE

Closed-cell polystyrene adhesive sealing tape used to seal overlaps between different pieces of **MAPESILENT BAND R**, to cover and join overlaps between **MAPESILENT BAND R** and **MAPESILENT PANEL** or **MAPESILENT ROLL** and for joints between panels of **MAPESILENT PANEL** and overlaps between rolls of **MAPESILENT ROLL**.

Figure 4.3

Photo 4.4

Photo 4.5

• MAPESILENT UNDERWALL

Polymer bitumen soundproofing strip sandwiched together with blue-coloured, non-woven fabric and a polyester fibre backing positioned under dividing walls to block the transmission of vibrations and impacts, available in 10 metre long rolls in widths of 14 and 33 cm.

4.2 ADVANTAGES

High performance systems

Its excellent performance is illustrated in the readings taken on an installed system, with reductions in the noise of footsteps (ΔL_w) of more than 30 dB.

Flexibility

The two types of membrane available allow 5 different system configurations to be formed, according to the thermal-acoustic performance required from the system.

Easy installation

Allows for quick and extremely simple installation of a continuous soundproofing layer with no acoustic bridges. Its special conformation allows for easy checking of the correct position of the panels and sheets so that a continuous soundproofing layer may be formed.

Resistant to foot traffic and impact

During the phase before laying the screed, the product's high resistance prevents foot traffic and/or accidental impact due to dropped tools from damaging the continuous layer and, therefore, its soundproofing capacity.

Certified system

MAPESILENT is certified according to current international standards EN ISO 10140-3:2010 (formerly EN ISO 140-8:1999), EN ISO 717-2:2007, EN 29052-1:1993 and EN 29053:1993.

Easy to design system

MAPEI comes with **DATA MAPESILENT**, a versatile, easy-to-use software programme to verify the thermal and acoustic performance of floors.

4.3 LABORATORY TESTS

The main physical property to take into consideration when choosing soundproofing for floating screeds is its *dynamic stiffness*, a parameter intrinsic of a resilient material which defines its capacity to deform elastically when subjected to a dynamic load within a mass-spring-mass system. It is defined as the relationship between dynamic force and dynamic movement.

The standard which describes the test method is EN 29052-1:1993, and its main aim is to supply a test method which compares production samples of similar materials with defined, known properties.

Dynamic stiffness (**S'**) is determined by calculating the apparent dynamic stiffness per unit of surface area of the sample (**S'$_t$**) with the following equation:

$$\mathbf{S'_t} = 4\pi^2 \; m' \; f_R{}^2 \qquad \textit{[MN/m}^3\textit{]}$$

where: m'   = *surface mass of the oscillating test plate*

            f_R = *measured resonance frequency of the material*

According to the resistance to air flow (**r**) of the soundproofing material or, if multi-layered, of one of the layers which forms the system, its dynamic stiffness (**S'**) is calculated as follows:

for   **r** ≥ 100 kPa s/m^2 ⇒ S' = S'$_t$

               10 ≤ **r** ≤ 100 kPa s/m^2 ⇒ S' = S'$_t$ + S'$_a$

               r < 10 kPa s/m^2 ⇒ S' = S'$_t$ (only if S'$_a$ is negligible)

where: S'_a $= \dfrac{111}{d}$ *dynamic stiffness of the gas contained only within the layer with the lowest resistance to air flow;*

d $= $ *thickness in mm of the layer with the lowest resistance to air flow under a load of 200 kg/m².*

This means that any soundproofing mattress made up of one or more layers with a resistance to air flow of between 10 and 100 kPa s/m² (typical value for fibre materials) requires that S'_a is also calculated. In such cases, for all multi-layered soundproofing materials with at least one layer in fibre, dynamic stiffness S' must be calculated by adding S'_t and S'_a to prevent over-estimating the performance levels that the material is really able to achieve when installed.

Another parameter often used to compare and choose the most suitable soundproofing material is the *reduction of noise caused by footsteps* (ΔL_w), which identifies by how many dB the material is able to reduce noise.

Since the reduction in noise offered by a soundproofing system is highly influenced by the characteristics of the entire floor and flooring, when comparing different resilient materials, you must also consider the stratigraphic layout of the package where the material has been tested.

To help with this there is a European standard EN ISO 10140 (formerly EN ISO 140) "*Acoustics - Laboratory measurements of the soundproofing of buildings and elements of buildings*", which contains a standard test method that may be used to compare the performance of different soundproofing materials under the same conditions.

This standard method, which all manufacturers should follow, requires testing to be carried out in a reinforced concrete acoustic chamber made from two chambers, one on top of the other, separated by a 14 cm thick floor, also in reinforced concrete, with a surface area of at least 10 m². The difference in the amount noise is reduced, measured both with and without a floating screed, determines the value of noise reduction ΔL_w.

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Pay particular attention to the values declared on technical data sheets because, very often, the levels of noise reduction declared have not been obtained using the test method described above, but rather by using a simplified test which is unrepeatable and deceptive, using a simple plate 1 m² with no soundproofed chambers above and below one another.

To avoid making mistakes, we suggest checking that the laboratory test has been carried out according to the standardised method mentioned above.

4.4 TESTING INSTALLED SYSTEMS

As mentioned previously, because of the different ways materials are certified, it is often impossible to carry out an objective comparison of products for soundproofing floors by just reading the information on their data sheets. However, even if laboratory tests are carried out by strictly following the current reference norms, they are extremely useful to carry out an initial comparison between different systems, but are often insufficient in determining their real performance when installed, in that laboratory testing is carried out in completely different conditions to those encountered on site.

Therefore, to make choosing the most suitable soundproofing system more simple and to avoid complications, we always recommend also taking into consideration the certificates for testing carried out on installed systems by qualified, third party experts.

In fact an acoustic test, carried out by positioning a tapping machine on the floor to simulate footsteps (*Photo 4.5*) and then measuring the noise in the room below with a phonometer (*Photo 4.6*), is the only way of measuring the real performance of a soundproofing system and to certify whether it really meets legal soundproofing requirements.

The excellent performance of the **MAPESILENT** system has been demonstrated by the readings taken on an installed system by qualified Environmental Acoustics technicians, who have registered reductions in the noise of footsteps (ΔL_W) of more than 30 dB.

Photo 4.6

Photo 4.7

4.4.1 Onsite measurements on brick-cement slab

Naked slab

Isolamento dal rumore di calpestio secondo la UNI EN ISO 140-7 (Dicembre 2000)
"Misurazione in opera dell'isolamento dal rumore di calpestio di solai"

Misurazioni effettuate da:
TEP S.r.l.
Via Matteo Civitali, 77 - 20148 Milano
Tel: 02-40070208

Cliente:
MAPEI spa
VIA CAFIERO 22
20158 MILANO (MI)

Data della prova:
09/02/2009

Descrizione solaio esaminato:
Edificio a Busto Arsizio (VA) - Macchina da calpestio poggiata sul solaio portante tra i piani P2/P1
Solaio laterocemento 20+5 intonacato sul lato inferiore

Volume ambiente ricevente: 39.1 mc

Frequenza f Hz	L'n Terzo di ottava dB
50	
63	
80	
100	60.8
125	63.7
160	65.2
200	64.9
250	66.4
315	67.4
400	68.3
500	68.3
630	68.5
800	70.8
1000	72.0
1250	74.2
1600	74.9
2000	77.4
2500	81.6
3150	81.1
4000	
5000	

curva di riferimento — misura in opera

Note:

Valutazione secondo ISO 717 - 2:
$L'_{n,w}$ = **85.0** dB C_I = **-13** dB
Valutazione basata su risultati di misurazioni in opera

Data: 18/11/2008   Firma: Ing. Matteo Borghi

Slab soundproofed with MAPESILENT ROLL

Isolamento dal rumore di calpestio secondo la UNI EN ISO 140-7 (Dicembre 2000)
"Misurazione in opera dell'isolamento dal rumore di calpestio di solai"

Misurazioni effettuate da:
TEP S.r.l.
Via Matteo Civitali, 77 - 20148 Milano
Tel: 02-40070208

Cliente:
MAPEI spa
VIA CAFIERO 22
20158 MILANO (MI)

Data della prova:
26/03/2009

Descrizione solaio esaminato:
Edificio a Busto Arsizio (VA) - Macchina da calpestio poggiata sul solaio tra i piani P2/P1
Solaio laterocemento 20+5 intonacato sul lato inferiore, massetto alleggerito sp. 6 cm, MAPESILENT ROLL,
massetto TOPCEM PRONTO sp. 4,5 cm, piastrelle

Volume ambiente ricevente: 38.1 mc

Frequenza f Hz	L'n Terzo di ottava dB
50	
63	
80	
100	55.0
125	60.0
160	57.2
200	53.5
250	51.9
315	55.9
400	56.5
500	52.4
630	52.1
800	53.0
1000	51.3
1250	51.3
1600	48.6
2000	46.8
2500	47.9
3150	45.3
4000	
5000	

curva di riferimento — misura in opera

Note:

Valutazione secondo ISO 717 - 2:
$L'_{n,w}$ = **55.0** dB C_I = **-4** dB
Valutazione basata su risultati di misurazioni in opera

Data: 26/03/2009   Firma: Ing. Matteo Borghi

Reduction of noise caused by footsteps ΔL_w: 30 dB
Impact sound pressure level $L'_{n,w}$: 55 dB

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

Naked slab

Isolamento dal rumore di calpestio secondo la UNI EN ISO 140-7 (Dicembre 2000)
"Misurazione in opera dell'isolamento dal rumore di calpestio di solai"

Misurazioni effettuate da:
TEP S.r.l.
Via Matteo Civitali, 77 - 20148 Milano
Tel: 02-40070208

Descrizione solaio esaminato:
Cantiere a Treviso - Via dei Comin
Solaio divisorio tra piano interrato e piano terra
Stratigrafia: Solaio in laterocemento 24+5, .
Note: Pignatte non intonacate, pareti laterali in laterizi forati non intonacate.

Volume ambiente ricevente: 78,6 mc

Frequenza f Hz	L'n Terzo di ottava dB
50	
63	
80	
100	66,0
125	65,4
160	66,9
200	69,3
250	69,7
315	68,3
400	68,5
500	75,0
630	76,6
800	76,2
1000	76,4
1250	76,1
1600	82,0
2000	83,9
2500	88,8
3150	85,0
4000	
5000	

curva di riferimento — misura in opera

Valutazione secondo ISO 717 - 2:
$L'_{n,w}$ = **91,0** dB C_i = **-14** dB
Valutazione basata su risultati di misurazioni in opera

Firma: Ing. Matteo Borghi

Slab soundproofed with MAPESILENT ROLL

Isolamento dal rumore di calpestio secondo la UNI EN ISO 140-7 (Dicembre 2000)
"Misurazione in opera dell'isolamento dal rumore di calpestio di solai"

Misurazioni effettuate da:
TEP S.r.l.
Via Matteo Civitali, 77 - 20148 Milano
Tel: 02-40070208

Descrizione solaio esaminato:
Cantiere a Treviso - Via dei Comin
Solaio divisorio tra piano interrato e piano terra
Stratigrafia: Solaio in laterocemento 24+5, MAPESILENT ROLL singolo strato, massetto sabbia e cemento sp. 5cm
Note: Pignatte non intonacate, pareti laterali in laterizi forati non intonacate.

Volume ambiente ricevente: 77.8 mc

Frequenza f Hz	L'n Terzo di ottava dB
50	
63	
80	
100	60.5
125	59.4
160	58.3
200	56.4
250	55.7
315	52.1
400	48.5
500	47.5
630	47.8
800	45.9
1000	44.3
1250	40.5
1600	44.6
2000	46.5
2500	46.0
3150	42.3
4000	
5000	

curva di riferimento — misura in opera

Note:

Valutazione secondo ISO 717 - 2:
$L'_{n,w}$ = **54.0** dB C_i = **-3** dB
Valutazione basata su risultati di misurazioni in opera

Firma: Ing. Matteo Borghi

Reduction of noise caused by footsteps ΔL_w: 37 dB
Impact sound pressure level $L'_{n,w}$: 54 dB

Naked slab

Isolamento dal rumore di calpestio secondo la UNI EN ISO 140-7 (Dicembre 2000)
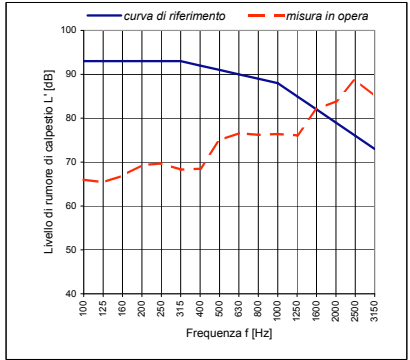**"Misurazione in opera dell'isolamento dal rumore di calpestio di solai"**

Misurazioni effettuate da:
TEP S.r.l.
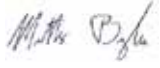**Via Matteo Civitali, 77 - 20148 Milano**
Tel: 02-40070208

Descrizione solaio esaminato:
Cantiere a Treviso - Via dei Comin
Solaio divisorio tra piano terra e piano primo
Stratigrafia: Solaio in laterocemento 24+5, .
Note: Pignatte non intonacate, pareti laterali in laterizi forati non intonacate.

Volume ambiente ricevente: 57,8 mc

Frequenza f Hz	L'n Terzo di ottava dB
50	
63	
80	
100	61,1
125	63,7
160	65,3
200	67,3
250	69,5
315	70,4
400	70,5
500	73,6
630	78,5
800	76,0
1000	76,8
1250	78,6
1600	82,2
2000	86,4
2500	91,2
3150	87,2
4000	
5000	

curva di riferimento — — *misura in opera*
Livello di rumore di calpestio L' [dB] / Frequenza f [Hz]
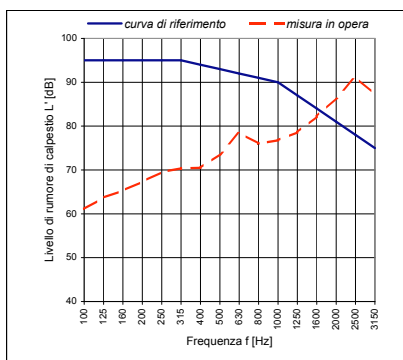
Valutazione secondo ISO 717 - 2:
L'$_{n,w}$ = **93,0** dB   C$_i$ = **-14** dB
Valutazione basata su risultati di misurazioni in opera

Firma: Ing. Matteo Borghi

Slab soundproofed with MAPESILENT PANEL

Isolamento dal rumore di calpestio secondo la UNI EN ISO 140-7 (Dicembre 2000)
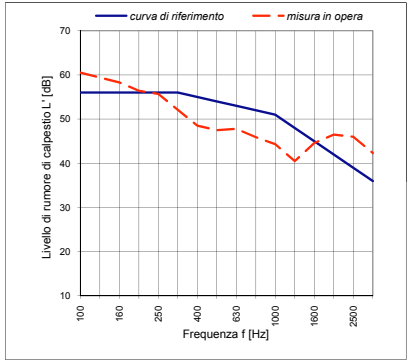**"Misurazione in opera dell'isolamento dal rumore di calpestio di solai"**

Misurazioni effettuate da:
TEP S.r.l.
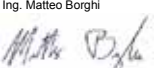**Via Matteo Civitali, 77 - 20148 Milano**
Tel: 02-40070208

Descrizione solaio esaminato:
Cantiere a Treviso - Via dei Comin
Solaio divisorio tra piano terra e piano primo
Stratigrafia: Solaio in laterocemento 24+5, MAPESILENT PANEL, massetto in sabbia e cemento sp. 5cm
Note: Pignatte non intonacate, pareti laterali in laterizi forati non intonacate.

Volume ambiente ricevente: 56.4 mc

Frequenza f Hz	L'n Terzo di ottava dB
50	
63	
80	
100	56.0
125	54.9
160	50.8
200	49.4
250	49.0
315	48.5
400	44.7
500	44.2
630	45.4
800	42.4
1000	42.9
1250	39.9
1600	39.7
2000	42.4
2500	46.7
3150	46.0
4000	
5000	

curva di riferimento — — *misura in opera*
Livello di rumore di calpestio L' [dB] / Frequenza f [Hz]
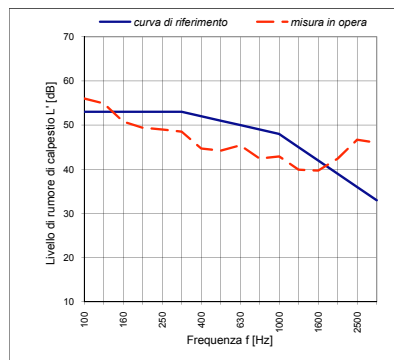
Note:

Valutazione secondo ISO 717 - 2:
L'$_{n,w}$ = **51.0** dB   C$_i$ = **-5** dB
Valutazione basata su risultati di misurazioni in opera

Firma: Ing. Matteo Borghi

Reduction of noise caused by footsteps ΔL$_w$: 42 dB
Impact sound pressure level L'$_{n,w}$: 51 dB

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

4.4.2 Onsite measurements on concrete slab

Concrete slab soundproofed with MAPESILENT ROLL
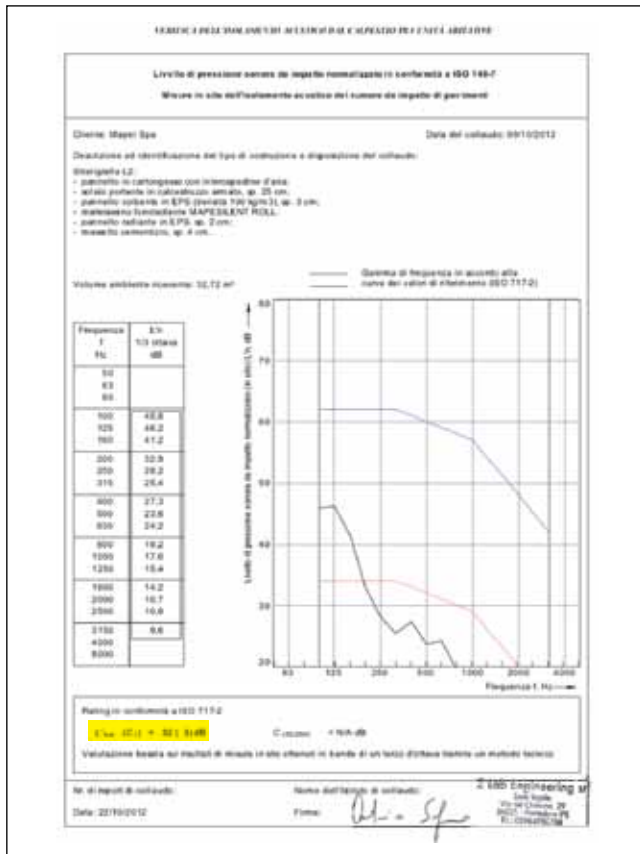
Impact sound pressure level L'ₙ,ᵥ: 32 dB

Layers:
– Plasterborad
– Concrete slab, 25 cm
– EPS (high density), 3 cm
– MAPESILENT ROLL
– EPS (heating system), 2 cm
– Concrete screed, 4 cm

Concrete slab soundproofed with MAPESILENT ROLL
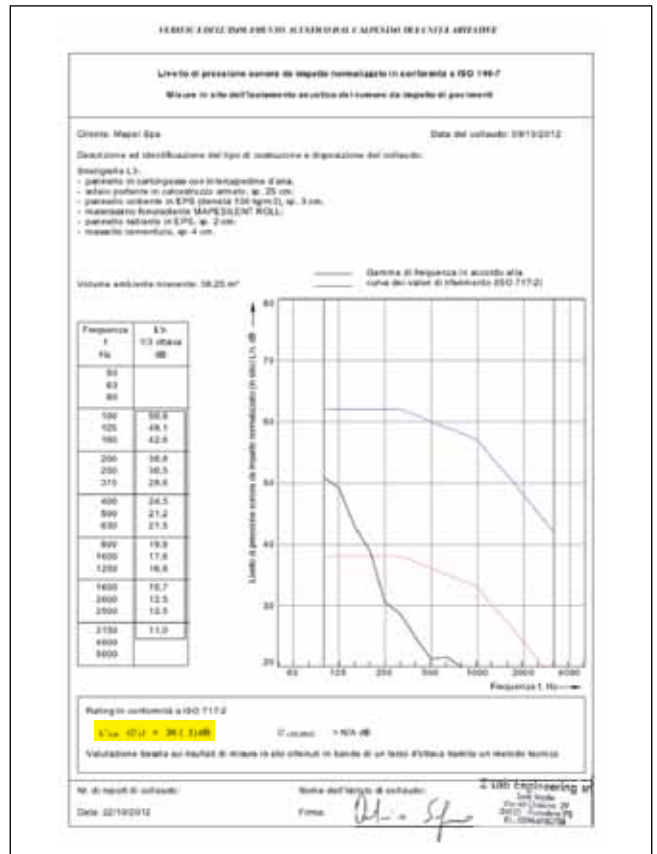
Impact sound pressure level L'ₙ,ᵥ: 36 dB

Layers:
– Plasterborad
– Concrete slab, 25 cm
– EPS (high density), 3 cm
– MAPESILENT ROLL
– EPS (heating system), 2 cm
– Concrete screed, 4 cm

4.5 PREDICTED ACOUSTIC PERFORMANCE

For design purposes, it is possible to use the method described in EN 12354 standards: "*Building acoustics - Estimating acoustic performance in buildings from the performance of products*".

When the noise from footsteps is transmitted, the calculation method proposed by the standard may only be applied to environments where the rooms are above and below one another and which have a similar base structure. The acoustic performance of the floor is expressed with an impact sound pressure level (**$L'_{n,w}$**) which is obtained from the formula:

$$L'_{n,w} = L_{nw,eq} - \Delta L_w + K$$

where:

$L_{nw,eq}$ = level of sound pressure caused by footsteps of the slab

ΔL_w = reduction index of the sound pressure level caused by footsteps according to EN 12354-2

K = correction factor for the transmission of lateral noise

The value of **$L'_{nw,eq}$** which identifies the acoustic performance of just the load-bearing structure of the floor, is obtained according to the following relationship, valid for 100 kg/m² < m' < 600 kg/m²:

$$L_{nw,eq} = 164 - 35 \log (m'/m'_o)$$

where:

m'_{floor} = mass per unit of surface area of the load-bearing floor

m'_o = mass per unit of reference surface area, equal to 1 kg/m²

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS
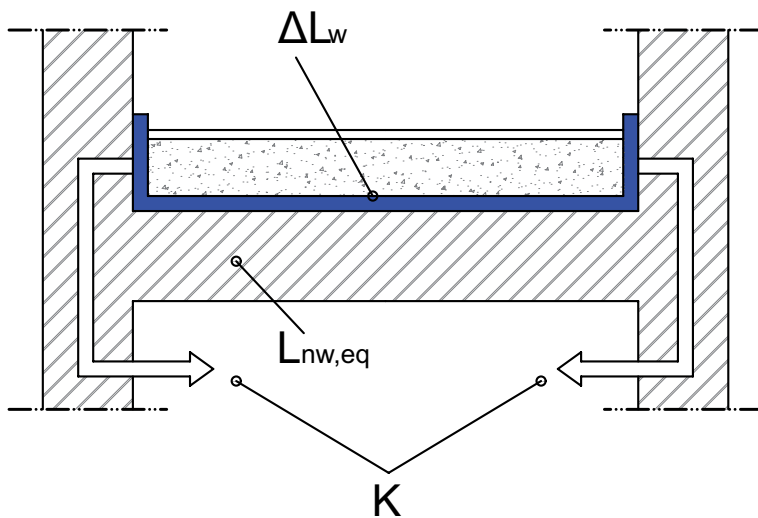
The previous equations show how much the areic mass of the load-bearing structure influences the impact sound pressure level ($L'_{n,w}$). Therefore, for particularly light floors such as wooden floors, the lack of mass must be compensated for by applying a soundproofing system with higher performance.

In order to satisfy any thermo-acoustic performance requirement according to the characteristics of the floor and the final use of the building, the system may be installed in 5 different configurations. The following table illustrates the soundproofing performance obtainable by varying the configuration of the system.

N°	MAPESILENT configuration	m'_{floor} [kg/m²]	$L_{n,w,eq}$ [dB]	m'_{screed} [kg/m²]	S' [MN/m³]	f_0 [Hz]	ΔL_w [dB]	K [dB]	$L'_{n,w}$ [dB]
1	**MAPESILENT ROLL** single layer				47	109.7	22.8		56.5
2	**MAPESILENT ROLL** double layer				23.5	77.6	27.3		52.0
3	**MAPESILENT PANEL** single layer	300	77.30	100	21	73.3	28.0	2	51.3
4	**MAPESILENT ROLL** + **MAPESILENT PANEL**				14.5	60.9	30.4		48.9
5	**MAPESILENT PANEL** double layer				10.5	51.8	32.5		46.8

where:

m'_{screed} = mass per unit of surface area of a 5 cm thick screed

S' = dynamic stiffness for calculation purposes (Σ S' sandwiched materials according to EN 12354-2:2002)

f_0 = resonance frequency of the system according to EN 12354-2 $[f_o=160\sqrt{s'/m'_{screed}}]$

The mass of the floor (**m'_{floor}**) was calculated on the following stratigraphic layout:

Lime-cement render (1 cm), brick-cement structure (20 + 4 cm), lightweight screed (600 kg/m³ - 7 cm) and floating screed in **TOPCEM PRONTO** (5.0 cm).

As a further support for designers to help select the most suitable soundproofing system according to the type of structure and the final use of the structure or building, MAPEI also offers **DATA MAPESILENT**, a versatile, easy-to-use software programme to verify the acoustic performance of floors.

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

With **DATA MAPESILENT** it is possible to analyse:

• Impact sound pressure level (L'$_{n,w}$).

• Compliance with acoustic requirements.

• The soundproofing capacity of floors (R$_w$).

• Compliance with thermal requirements.

DATA MAPESILENT also has a large database with around 400 items, with performance figures from reports published by the most important research institutes. Users may also continuously increase the size of the database by inserting the characteristics of new materials.

Misurazioni effettuate da:

TEP S.r.l.
Via Matteo Civitali, 77 - 20148 Milano
Tel: 02-40070208

Cliente:

MAPEI spa
VIA CAFIERO 22
20158 MILANO (MI)

Data della prova:
26/03/2009

Descrizione solaio esaminato:
Edificio a Busto Arsizio (VA) - Macchina da calpestio poggiata sul solaio tra i piani P2/P1
Solaio laterocemento 20+5 intonacato sul lato inferiore, massetto alleggerito sp. 6 cm, MAPESILENT ROLL,
massetto TOPCEM PRONTO sp. 4,5 cm, piastrelle

Volume ambiente ricevente: 38.1 mc

Frequenza f Hz	L'n Terzo di ottava dB
50	
63	
80	
100	55.0
125	60.0
160	57.2
200	53.5
250	51.9
315	55.9
400	56.5
500	52.4
630	52.1
800	53.0
1000	51.3
1250	51.3
1600	48.6
2000	46.8
2500	47.9
3150	45.3
4000	
5000	

Note:

Valutazione secondo ISO 717 - 2:
$L'_{n,w}$ =   **55.0**   dB C_I =   **-4**   dB
Valutazione basata su risultati di misurazioni in opera

Data: 26/03/2009   Firma: Ing. Matteo Borghi

The characteristics of the calculation software and the dynamic stiffness (**S'**) of the 5 possible configurations of **MAPESILENT** system, all perfectly compliant with the test method proposed by EN 29052-1:1993 and inserted in the database, allow a realistic estimate of the performance obtainable from an installed system to be carried out.

For example, if all the elements which make up the system are installed correctly, the acoustic results calculated by the software ($L'_{n,w}$ = 54.4 dB) are very close to the results measured on an installed system during specific testing carried out by qualified Environmental Acoustics technicians ($L'_{n,w}$ = 55 dB).

4.6 INSTALLATION

Installation of the MAPESILENT system

Correct installation and careful attention to the recommended procedures are essential to obtain good results from thermal insulation and soundproofing systems.

The way a "floating screed" system works follows a very simple concept. A flexible material with the capacity of absorbing vibrations is laid between the screed and the load-bearing floor, and between the screed and the side walls. To get the best out of the soundproofing properties of the entire system, special care must be taken during installation. In particular, the screed must never come into contact with the lateral structure or any other elements in the room (pillars, drains, etc.), which would interrupt its continuity, to avoid the formation of "acoustic bridges".

The **MAPESILENT** system has been carefully developed to reduce problems to a minimum during installation. MAPEI's experience in waterproofing products has led to the development of a range of products which are easy to install, and which are resistant to tearing during normal site activities.

The sequence of operations to install the **MAPESILENT** system is as follows.

Checking the substrate

A) Check that the substrate is flat and that there are no rough areas. Channels for cables or piping must be levelled off. If a lightweight screed is used to cover cable or pipe channels, make sure that it is installed evenly. Concentrations of material could cause cracks or fractures which would completely ruin soundproofing against the noise of footsteps.

NOT CORRECT CHANNELS FOR CABLES OR PIPING

CORRECT CHANNELS FOR CABLES OR PIPING
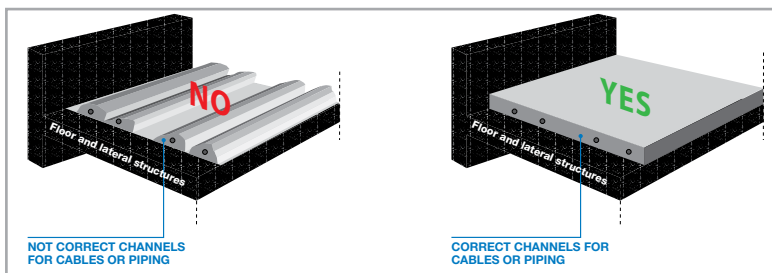
B) Any excess material which makes the surface uneven must be removed.

C) Any rubble must be removed before installing the material.

• MAPESILENT PANEL

A) On a perfectly flat, well-cured, strong substrate, lay the **MAPESILENT PANEL** tiles side by side with the fibre part (the lighter side) facing downwards.

If off-cuts of panels are used, trim approximately 5 mm from the bitumen membrane to prevent it coming into contact with the perimeter wall and creating acoustic bridges.

B) Once the alignment of the **MAPESILENT PANEL** tiles has been checked, carefully seal all the joints with **MAPESILENT TAPE**.
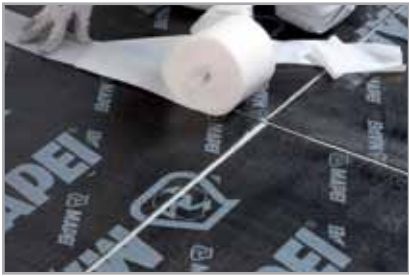
C) To guarantee that the **MAPESILENT TAPE** bonds perfectly, we recommend passing over the surface of the tape with a rigid or semi-rigid roller.

D) Around the corners of the room, trim the lower part of the side strip to form a 90° angle.

Around the perimeter walls of the room and any elements which pass through the screed, lay the roll of **MAPESILENT BAND R** by removing the protective film on the back to expose the adhesive part.

E) Position the angle of **MAPESILENT BAND R** to check that the two sides of the cut match perfectly.

F) When laying the various elements side by side make sure there are no gaps, otherwise acoustic bridges will be formed.

G) Cut and apply **MAPESILENT TAPE** in the corners and on the fillet joints between the pieces of **MAPESILENT BAND R** to guarantee perfect continuity in the layer of soundproofing.

H) Also apply tape on the overlaps between the **MAPESILENT PANEL** and **MAPESILENT BAND R**.

I) Once work has been completed, the **MAPESILENT TAPE** must be visible on all the overlaps and joints between **MAPESILENT PANEL** and **MAPESILENT BAND R** and there must be absolutely no points of contact with the substrate to prevent the formation of acoustic bridges.
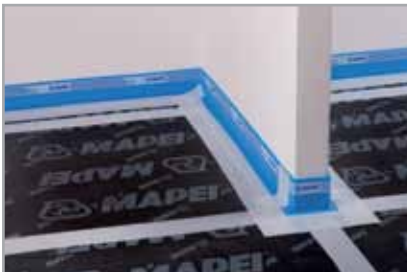
• MAPESILENT ROLL

A) The sheets of **MAPESILENT ROLL** must be laid on a well-cured, flat and sufficiently strong substrate, starting at the foot of the walls with the fibre part (the lighter side) facing downwards, and following the same direction as the longest wall.

B) Lay the next sheets by positioning them at the foot of the wall, making sure that the lateral border overlaps the adjacent one, to guarantee that the fibre backing on the back face forms a continuous layer.

After laying the sheet, remove the protective film from the back of the lateral border of the overlap.

C) After checking that the sheets of **MAPESILENT ROLL** overlap perfectly, seal all overlaps using **MAPESILENT TAPE**.

D) To guarantee that the **MAPESILENT TAPE** bonds perfectly, we recommend passing over the surface of the tape with a rigid or semi-rigid roller.

E) Around the perimeter walls of the room and any elements which pass through the screed, apply **MAPESILENT BAND R**.

F) Cut the lower part of the perimeter strip to form a 90° angle and check that the two parts match perfectly.

G) Remove the protective film from the back of the **MAPESILENT BAND R** to expose the adhesive part.

H) Carefully align the various pieces of **MAPESILENT BAND R** to prevent gaps which would then form acoustic bridges.

Complete installation by pressing the horizontal and vertical faces of every piece to guarantee solid, direct contact with the substrate.

I) In correspondence with any openings, apply **MAPESILENT BAND R** by cutting it to shape according to the thickness of the partition wall. Recreate the continuous surface of the horizontal part by integrating it with trimmed pieces of **MAPESILENT BAND R**.
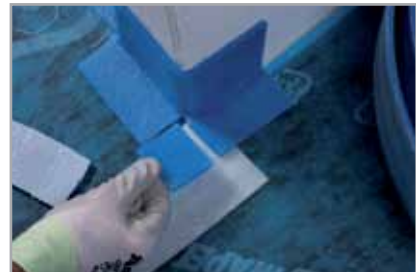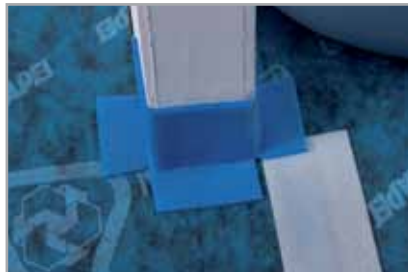
J) Cut and apply **MAPESILENT TAPE** in the corners and on the fillet joints between the pieces of **MAPESILENT BAND R** to guarantee perfect continuity in the layer of soundproofing.

K) Also apply **MAPESILENT TAPE** on the overlaps between the **MAPESILENT ROLL** and **MAPESILENT BAND R**.

L) Once installation is complete, **MAPESILENT TAPE** must be visible on all the overlaps and joints between **MAPESILENT ROLL** and **MAPESILENT BAND R**. There must be absolutely no points of contact with the substrate to prevent the formation of acoustic bridges.

Installing the screed

After completing installation of the **MAPESILENT** soundproofing system, whether **MAPESILENT ROLL** or **MAPESILENT PANEL** have been used, the screed on which the floor covering will be applied may be installed immediately.

To make the screed, use a special binder or pre-blended mortar from the Mapei range:

- **TOPCEM**

  Special normal-setting, quick-drying (4 days), controlled-shrinkage hydraulic binder for screeds.

- **TOPCEM PRONTO**

  Ready-to-use, quick-drying (4 days), normal-setting, controlled-shrinkage mortar, class CT-C30-F6-A1fl according to EN 13813 and EC1R Plus – very low emission of volatile organic compounds.

- **MAPECEM**

  Special quick-setting and drying (24 hours), controlled-shrinkage hydraulic binder for screeds.

- **MAPECEM PRONTO**

  Pre-blended, ready-to-use, quick-setting and drying (24 hours), controlled-shrinkage mortar, class CT-C60-F10-A1fl according to EN 13813.

  The thickness of the screed and the type of reinforcement used must be chosen according to the type of traffic to which the surface will be subject when in service.

  After waiting the prescribed curing time for the screed, which depends on the type of binder used and the type of flooring to be applied, the floor may be installed (ceramic tiles, stone, resilient and textile flooring, wood, etc.).

Finishing off skirting boards

A) Once the screed has been cured, install and grout the flooring using suitable products selected according to the shape and size of the flooring material.

B) Once the adhesive and grout have dried, trim off all the excess pieces of **MAPESILENT BAND R**.

C) Apply the skirting boards around the perimeter of the room so that there is a small gap of a few millimetres between the skirting board and flooring.

D) Seal the spaces between the skirting boards and the floor with a suitable flexible sealant such as **MAPESIL AC** after applying **PRIMER FD**.

Fig. 4.8

Fig. 4.9

Fig. 4.10
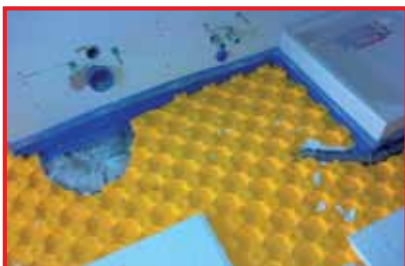
Fig. 4.11

Fig. 4.12

4.7 INSTALLATION ERRORS AND SOLUTIONS

Careful design of the soundproofing package and the right choice of soundproofing material are, without a doubt, indispensable to obtain good overall soundproofing results. However, since compliance with legal passive acoustic requirements (and attribution of acoustic class) must be checked by means of an acoustics test carried out once work has been completed, it is fundamentally important that, as well as designing the stratigraphic layout correctly, all the elements which make up the system are applied and installed carefully and correctly.

Errors made during application and installation of the system could have such an influence on the performance of the soundproofing system that, in many cases, it will not comply with the acoustic limits.

The following is a list of the some of the most common problems found on site.

SUBSTRATE NOT LEVELLED OFF CORRECTLY

Problem

Even though technological developments applied to the construction sector have supported year after year the development of integrated building design, the fact that a building must have certain soundproofing characteristics is all too often overlooked, even today.

In fact, if the acoustic requirements of a building are not designed correctly, a series of problems could be generated that could penalise or completely ruin any intervention carried out with the aim of reducing the transmission of sounds within the building.

The first condition to guarantee that a soundproofing system is installed and functions correctly is, without a doubt, the way the substrate is levelled off, and all too often the thickness of the levelling layer is insufficient. Spreading a resilient layer on a particularly uneven surface

does not allow the material to adhere correctly to the substrate (Figs. 4.8, 4.9 and 4.10).

We must add that not only does poor flatness of the substrate compromise the performance of the soundproofing system, but also conditions how the successive layers are installed, such as heating panels (Fig. 4.11) or the screed (Fig. 4.12) which, in correspondence with channels, would not be thick enough to withstand the stresses to which it is subjected under normal conditions of use.

Solution

Since it well established that the layer must be thick enough for plant systems (piping and cables), if the channels are only partially contained within the lightweight layer, it is possible to intervene by improving the flatness of the surface with normal cementitious mortar (Fig. 4.13).

BREAK IN THE CONTINUITY OF THE SYSTEM

Problem

It is fundamentally important to guarantee the perfect continuity of the soundproofing system to prevent points of contact between the floating screed and the side structure. The biggest problems usually occur when the elastic strip around the perimeter is not applied accurately, especially at the corners, if the strip does not adhere perfectly to the substrate, and in breaks in continuity, such as the manifolds for an underfloor heating system (Fig. 4.14) or pipe-work which passes vertically through the screed (Fig. 4.15).

Fig. 4.13

Fig. 4.14
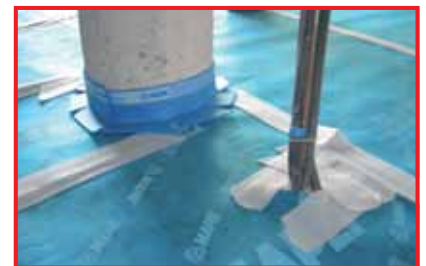
Fig. 4.15

Fig. 4.16
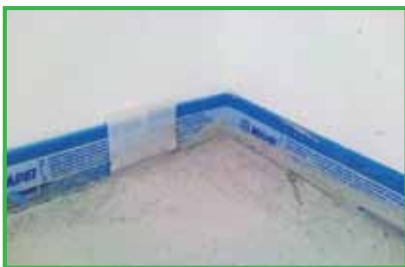
Fig. 4.17

Fig. 4.18

Fig. 4.19

Fig. 4.20

Solution

The perimeter strip must adhere to the manifold (Fig. 4.16) to prevent the element which interrupts the continuity being moved or damaged when the elements for the heating system are being installed. The strip must also adhere completely to the substrate at the corners (Fig. 4.17) to prevent it being damaged when the screed and flooring are installed. Any element which passes through or breaks the continuity of the screed must be bound with the same strip used for the perimeter or with elastic sealing tape (Fig. 4.18).

INSUFFICIENT THICKNESS OF THE FLOATING SCREED

Problem

During renovation work where design is limited by existing heights and distances, and also in new buildings, there is often not enough space available to install a sufficient levelling layer to cover the plant equipment and install a floating screed. In such circumstances, there is a risk of the thickness being insufficient (Fig. 4.19), or that it is irregular and not strong enough, and that it will then crack and also damage the flooring. Sometimes, to avoid having to make a "double screed", the plant equipment is installed in the floating screed (Fig. 4.20). In such cases, this would create numerous points of contact between the screed and side structure which would then make the soundproofing system inefficient.

Solution

The thickness of the floating screed must be constant and at least 4 cm thick, with electro-welded reinforcement mesh positioned at the mid-point (Fig. 4.21).

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

RIGID CONTACT POINTS IN THE FLOORING

Problem

In many circumstances, the performance of the soundproofing is reduced or ruined due to crucial mistakes being committed during installation of the flooring.

The absence of an expansion joint between the internal flooring and the step at the entrance door (or French window) will generate an acoustic bridge which represents up to 5-7 dB (Fig. 4.22).

A partial interruption in the elastic perimeter strip (50 cm is enough) can have quite an impact on the performance of the soundproofing system. This could have an effect of up to 10 dB (Fig. 4.23).

Skirting boards (or coverings) joined rigidly to the flooring, or contact between the flooring and the side walls, would compromise the efficiency of the entire soundproofing system which, depending on the characteristics of the surfaces in contact, could reach or be even higher than 15 dB (Figs. 4.24 and 4.25).

Where there is a wooden skirting board in perfect contact with the floor, no significant loss in performance of the soundproofing system has been recorded.

Solution

It is fundamentally important to check the perfect continuity of the elastic side strip, which must only be trimmed once the flooring has been installed and grouted. A gap must be left between the skirting board and the flooring, and this gap must then be sealed with an elastic sealing product (Fig. 4.26).

Useful information

During the design phase, it is a good idea to evaluate how many channels for plant equipment (especially in bathrooms) will have to be made above the load-bearing structure of the floor so that, when the lightweight

Fig. 4.21

+ 5÷7dB

Fig. 4.22

+ 10 dB

Fig. 4.23

+ 15 dB

Fig. 4.24

+ 15 dB

Fig. 4.25

Fig. 4.26

Fig. 4.27

Fig. 4.28

Fig. 4.29

substrate is applied to cover the plant equipment, they do not show up on the surface, otherwise installation of the soundproofing system would be particularly difficult and the system would be less efficient.

• If a double layer of soundproofing material is required, the first layer of **MAPESILENT ROLL** or **MAPESILENT PANEL** must be applied with the fibre side (the light-coloured side) facing upwards. Position the second layer with the fibre part facing downwards so that the fibre side of the two layers are against each other. To prevent the formation of acoustic bridges, it is good practice to stagger the elements of the first and second layers by installing them in the same direction (Figs. 4.27 and 4.28).

• When applying **MAPESILENT BAND R**, avoid forming joints between adjacent rolls near to the corners of the room. Apply each roll by pressing firmly all the surface (horizontal and vertical) so that the adhesive transfers onto the substrate and the roll does not lift (Fig. 4.39).

• Before pouring the screed material, make sure the **MAPESILENT TAPE** has been applied correctly over all the overlaps and all the joints between the various pieces of **MAPESILENT BAND R**, and between the **MAPESILENT BAND R** and the **MAPESILENT ROLL** or **MAPESILENT PANEL** (Fig. 4.30).

• Make sure the **MAPESILENT BAND R** is only trimmed once the flooring has been bonded and grouted (Fig. 4.31).

• Install skirting boards with a thin, pre-cut strip of PVC or similar material around 3 mm thick placed against the perimeter wall before they are bonded in place. Apart from creating an even gap between the skirting board and flooring, this will speed up the operation and, at the same

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

time, prevent the adhesive applied on the back of the skirting board dripping and forming a rigid contact point with the flooring under the skirting board (Fig. 4.32).

4.8 TECHNICAL SPECIFICATIONS

4.8.1 Single-layer sheet system

Supply and installation of a soundproofing system to reduce noise caused by footsteps on floors, using a polymer-based elasto-plastomeric bitumen membrane sandwiched together with non-woven fabric and a layer of polyester fibre (such as **MAPESILENT ROLL** produced by MAPEI S.p.A.), inclusive of all required special pieces: shaped perimeter profiles in closed-cell, expanded polyethylene (such as **MAPESILENT BAND R** produced by MAPEI S.p.A.) and closed-cell, expanded polyethylene sealing tape (such as **MAPESILENT TAPE** produced by MAPEI S.p.A.) required to complete the system, certified according to current norms and standards (EN ISO 717-2:2007, EN ISO 140-8 and EN 29052-1:1993).

The system must have the following technical and performance characteristics:

nominal thickness d = 8.0 mm

reduction of noise caused by footsteps on an
installed system ΔL_w = 37 dB

reduction of noise caused by footsteps under
laboratory conditions $\Delta L_w^{(*)}$ = 21 dB

real dynamic stiffness S' = 47 MN/m³

apparent dynamic stiffness S'_t = 15 MN/m³

thermal resistance R = 0.145 m²K/W

(*) measured in an independent laboratory on a 14 cm thick normalised reinforced concrete floor with a surface area of 10 m² and an upper acoustic chamber (according to EN ISO 140-8).

All other operations included and calculated in the price for work completed according to specification

………(€/m²)

Fig. 4.30

Fig. 4.31

Fig. 4.32

4.8.2 Double-layer sheet system

Supply and installation of a soundproofing system to reduce noise caused by footsteps on floors, using a double layer of polymer-based elasto-plastomeric bitumen membrane sandwiched together with non-woven fabric and a layer of polyester fibre (such as **MAPESILENT ROLL** produced by MAPEI S.p.A.), inclusive of all required special pieces: shaped perimeter profiles in closed-cell, expanded polyethylene (such as **MAPESILENT BAND R** produced by MAPEI S.p.A.) and closed-cell, expanded polyethylene sealing tape (such as **MAPESILENT TAPE** produced by MAPEI S.p.A.) required to complete the system, certified according to current norms and standards (EN ISO 717-2:2007, EN ISO 140-8 and EN 29052-1:1993).

The system must have the following technical and performance characteristics:

nominal thickness d =	8.0+8.0 mm
reduction of noise caused by footsteps on an installed system $\Delta L_w >$	37 dB
real dynamic stiffnes S' =	23.5 MN/m^3
thermal resistance R =	0.290 m^{2}K/W

All other operations included and calculated in the price for work completed according to specification

.........(€/m²)

4.8.3 Single-layer panel system

Supply and installation of a soundproofing system to reduce noise caused by footsteps on floors, using a layer of polymer-based elasto-plastomeric bitumen membrane sandwiched together with a layer of polyester fibre (such as **MAPESILENT PANEL** produced by MAPEI S.p.A.), inclusive of all required special pieces: shaped perimeter profiles in closed-cell, expanded polyethylene (such as **MAPESILENT BAND R** produced by MAPEI S.p.A.) and closed-cell, expanded polyethylene sealing tape (such as **MAPESILENT TAPE** produced by MAPEI S.p.A.) required to complete

the system, certified according to current norms and standards (EN ISO 717-2:2007, EN ISO 140-8 and EN 29052-1:1993).

The system must have the following technical and performance characteristics:

nominal thickness d =	13.0 mm
reduction of noise caused by footsteps on an installed system ΔL_w =	42 dB
reduction of noise caused by footsteps under laboratory conditions $\Delta L_w{}^{(*)}$ =	24 dB
real dynamic stiffness S' =	21 MN/m^3
apparent dynamic stiffness S'_t =	10 MN/m^3
thermal resistance R =	0.313 m^{2}K/W

(*) measured in an independent laboratory on a 14 cm thick normalised reinforced concrete floor with a surface area of 10 m^2 and an upper acoustic chamber (according to EN ISO 140-8).

All other operations included and calculated in the price for work completed according to specification

……..(€/m^2)

4.8.4 Combined sheet-panel system

Supply and installation of a soundproofing system to reduce noise caused by footsteps on floors, by combining a layer of sheets of polymer-based elasto-plastomeric bitumen membrane with a polyester fibre backing (such as **MAPESILENT ROLL** produced by MAPEI S.p.A.) with a layer of panels of polymer-based elasto-plastomeric bitumen membrane with a polyester fibre backing (such as **MAPESILENT PANEL** produced by MAPEI S.p.A.), inclusive of all required special pieces: shaped perimeter profiles in closed-cell, expanded polyethylene (such as **MAPESILENT BAND R** produced by MAPEI S.p.A.) and closed-cell, expanded polyethylene sealing tape (such as **MAPESILENT TAPE** produced by MAPEI S.p.A.) required to complete the system, certified according to current norms and standards (EN ISO 717-2:2007, EN ISO 140-8 and EN 29052-1:1993).

The system must have the following technical and performance characteristics:

nominal thickness d =	8.0+13.0 mm
reduction of noise caused by footsteps on an installed system $\Delta L_w >$	42 dB
real dynamic stiffness S' =	14.5 MN/m^3
thermal resistance R =	0.458 m^{2}K/W

All other operations included and calculated in the price for work completed according to specification

……..(€/m^2)

4.8.5 Double-layer panel system

Supply and installation of a soundproofing system to reduce noise caused by footsteps on floors, using a double layer of polymer-based elasto-plastomeric bitumen membrane sandwiched together with a layer of polyester fibre (such as **MAPESILENT PANEL** produced by MAPEI S.p.A.), inclusive of all required special pieces: shaped perimeter profiles in closed-cell, expanded polyethylene (such as **MAPESILENT BAND R** produced by MAPEI S.p.A.) and closed-cell, expanded polyethylene sealing tape (such as **MAPESILENT TAPE** produced by MAPEI S.p.A.) required to complete the system, certified according to current norms and standards (EN ISO 717-2:2007, EN ISO 140-8 and EN 29052-1:1993).

The system must have the following technical and performance characteristics:

nominal thickness d =	13.0+13.0 mm
reduction of noise caused by footsteps on an installed system $\Delta L_w >$	42 dB
real dynamic stiffness S' =	10.5 MN/m^3
thermal resistance R =	0.626 m^{2}K/W

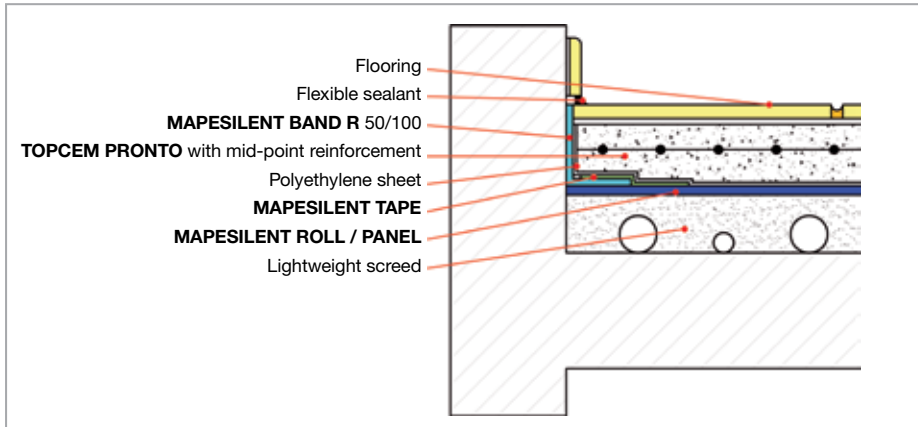*All other operations included and calculated in the price for work completed according to specification*

……..(€/m^2)

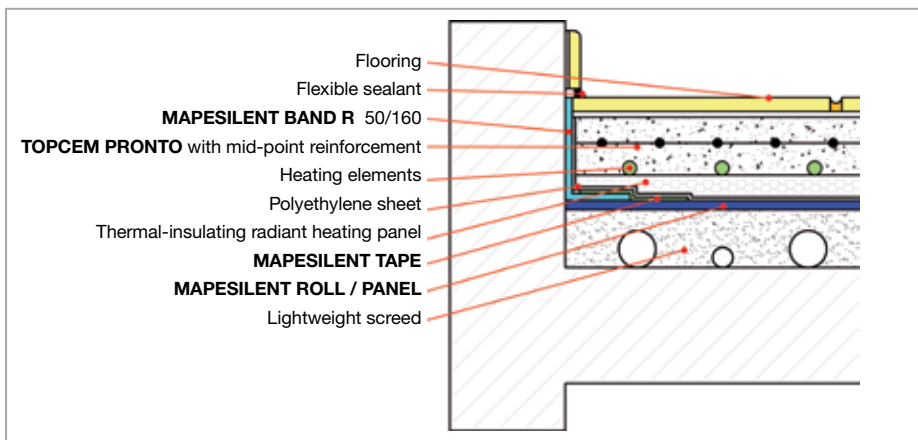# SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

4.9 TECHNICAL DRAWINGS

Solution 1 - Intermediate floor

Flooring
Flexible sealant
MAPESILENT BAND R 50/100
TOPCEM PRONTO with mid-point reinforcement
Polyethylene sheet
MAPESILENT TAPE
MAPESILENT ROLL / PANEL
Lightweight screed

Solution 2 - Intermediate floor with a heated screed

Flooring
Flexible sealant
MAPESILENT BAND R 50/160
TOPCEM PRONTO with mid-point reinforcement
Heating elements
Polyethylene sheet
Thermal-insulating radiant heating panel
MAPESILENT TAPE
MAPESILENT ROLL / PANEL
Lightweight screed

Solution 3 - Flat roof

MAPELASTIC
Flooring
Flexible sealant
Compressible layer
MAPEBAND
MAPESILENT BAND R 50/100
TOPCEM PRONTO with mid-point reinforcement
Polyethylene sheet
MAPESILENT TAPE
MAPESILENT ROLL / PANEL
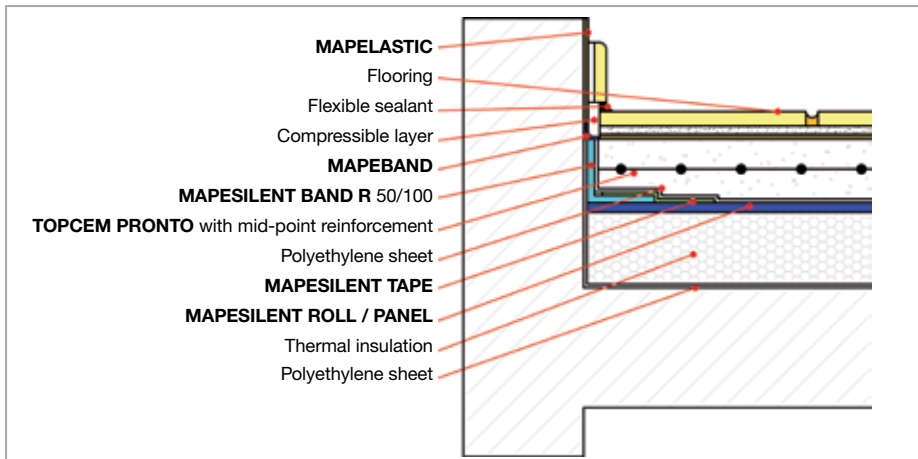Thermal insulation
Polyethylene sheet

Fig. 5.1 - Levelling of the substrate

5. MAPESONIC CR

MAPESONIC CR is an innovative, high-performance soundproofing system in sheets used in renovation work on existing floors where good soundproofing is required against the noise of footsteps without having to remove the existing flooring, or where a second soundproofing system is to be installed directly in contact with a new floor with the aim of correcting or eliminating defects or limitations in the first system.

Mapesonic CR may be applied on top of old cement-based substrates and old ceramic and natural stone flooring before installing ceramic, stone, multi-layer parquet and resilient floor coverings. It is particularly suitable, therefore, for all buildings requiring renovation work, such as residential units, offices, hotels, care-homes, schools, etc.
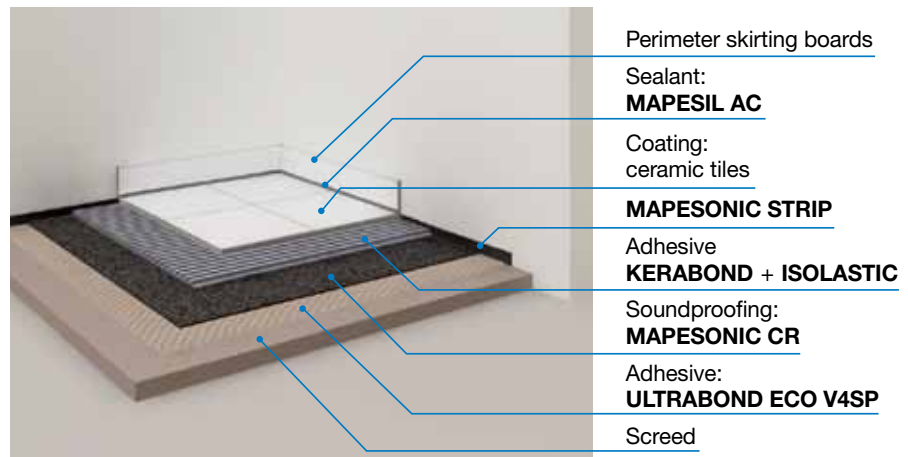

Perimeter skirting boards

Sealant:
MAPESIL AC

Coating:
ceramic tiles

MAPESONIC STRIP

Adhesive
KERABOND + **ISOLASTIC**

Soundproofing:
MAPESONIC CR

Adhesive:
ULTRABOND ECO V4SP

Screed

5.1 COMPONENTS OF THE SYSTEM

• MAPESONIC CR

Soundproofing membrane in cork and recycled rubber to combat the noise of footsteps, used in renovation work of flooring to upgrade the acoustic properties of buildings, available in 2 and 4 mm thick.

Fig. 5.2 - Apply MAPESONIC STRIP around the perimeter

SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

• MAPESONIC STRIP

Self-adhesive tape applied along perimeter walls and around through elements in flooring (pillars, etc.) to prevent the formation of acoustic bridges.

5.2 ADVANTAGES

Efficient reduction of noise from footsteps

Mapesonic CR considerably reduces the transmission of impact noise to upgrade the acoustic performance of buildings.

May be overlaid on old flooring

The characteristics of the materials which make up the system and its reduced thickness allow an efficient soundproofing barrier to be created without removing the old flooring.

Easy installation

Allows for quick installation of an underfloor soundproofing system with no acoustic bridges.

May be installed on heated floors

The low thermal resistance offered by the product makes it an ideal choice where there are underfloor heating systems.

Certified system

MAPESONIC CR is certified according to current international standards (EN 10140-3 and EN ISO 717-2:2007).

Very low emission of volatile organic compounds

Classified EC1 Plus according to GEV-EMICODE.

5.3 LABORATORY TESTS

Acoustic tests have been carried out in the laboratory according to the standard test contained in the international standard EN ISO 10140 (formerly EN ISO 140) "*Acoustics - Laboratory measurements of the soundproofing of buildings and elements of buildings*".
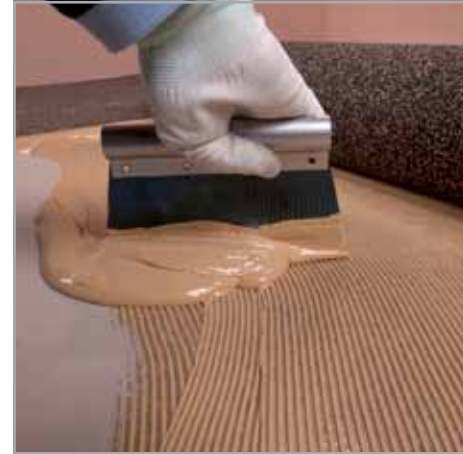

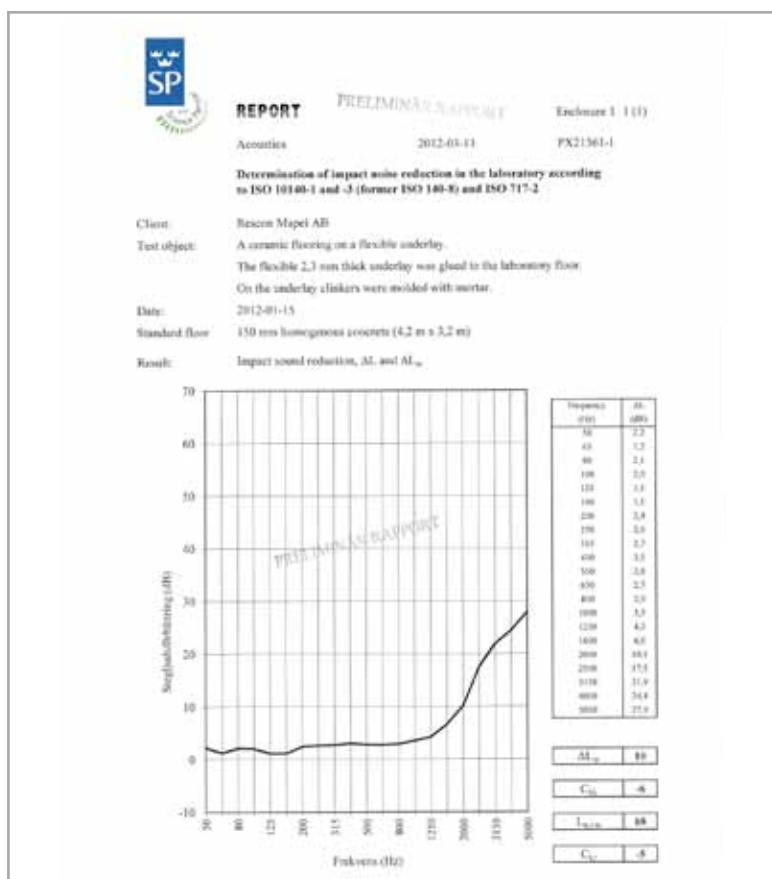Fig. 5.4 - Unroll the sheets of MAPESONIC CR

Fig. 5.3 - Spread on the adhesive to bond
MAPESONIC CR

Fig. 5.5 - Massage the surface of MAPESONIC CR

Fig. 5.6 - Spread the adhesive to bond ceramic tiles

5.4 INSTALLATION

Correct installation of **MAPESONIC CR** requires a flat, cured substrate with no cracks with adequate mechanical characteristics. If the soundproofing mat is overlaid on old flooring, check that the flooring is well bonded to the substrate beforehand.

Uneven surfaces and areas where plant fittings (such as electric cables and pipe work) pass through the substrate must be evened out before applying **MAPESONIC CR** (Fig. 5.1).

Before installing the rolls of soundproofing material, and after removing the protective plastic film, apply **MAPESONIC STRIP** adhesive tape around the edge of the room and around pillars and any other elements which pass through the flooring (Fig. 5.2). The material must be applied so that it

forms a continuous layer, taking particular care in the corners of the walls and the junction points of the elements.

On a clean, dry surface unroll the sheets of **MAPESONIC CR** in the direction of the longest side of the room. Leave them loosely placed for a day to acclimatise before cutting them according to the length to be covered. Roll up the sheets for half their length with the other half resting on the substrate, and spread the adhesive on the first half of the substrate. Choose an adhesive according to the characteristics of the substrate (Fig. 5.3). On absorbent substrates, such as screeds and skim layers, use **ULTRABOND ECO V4 SP**. On non-absorbent substrates, such as ceramic, and on multi-layered parquet, use **ULTRABOND ECO S955 1K**. Once installation of the sheets has been completed, massage the surface with a rigid roller or a flat trowel, starting from the centre and working towards the edges (Fig. 5.5). Then repeat the procedure for the second part of the roll.

24-48 hours after applying the sheets, the new floor covering may be bonded. Use neat **KERABOND + ISOLASTIC** (Fig. 5.6) or **ELASTORAPID** to install ceramic, porcelain and stone on **MAPESONIC CR**. Install parquet flooring (multi-layered type only) with **ULTRABOND ECO S955 1K** (Fig. 5.7).

When laying resilient floor coverings, we recommend applying a cementitious skimming layer of **NIVORAPID** (or **PLANIPATCH**) + **LATEX PLUS** reinforced with **MAPENET 150** to distribute concentrated loads.

After installing and grouting the new flooring, cut the excess portions of **MAPESONIC STRIP** perimeter strip applied around the edge (Fig. 5.8).

Apply the skirting boards around the edge so that they are not in direct contact with the flooring, then seal the gap between the skirting boards and the flooring with a suitable silicone sealant (Fig. 5.9).

Fig. 5.7 - Spread the adhesive to bond parquet

Fig. 5.8 - Grout the surface and trim
the excess of MAPESONIC STRIP

Fig. 5.9 - Apply the skirting board and seal
with a suitable elastic sealant

5.5 TECHNICAL SPECIFICATIONS

Thin underfloor sheet system

Supply and application of a thin underfloor soundproofing system with the capacity of reducing noise caused by footsteps (such as **MAPESONIC CR** produced by MAPEI S.p.A.), after positioning suitable insulating strip around the perimeter of the room (such as **MAPESONIC STRIP** produced by MAPEI S.p.A.). Apply the membrane directly on the substrate, after thoroughly cleaning and preparing the substrate, using acrylic adhesive in water dispersion (such as **ULTRABOND ECO V4 SP** produced by MAPEI S.p.A.) for absorbent substrates, or one-component, sililated polymer-based adhesive (such as **ULTRABOND ECO S955 1K** produced by MAPEI S.p.A.) for non-absorbent substrates.

The soundproofing mat must have the following characteristics:

thickness:	2 or 4 mm (according to the level of soundproofing required)
material:	recomposed cork and rubber with polyurethane binder
elongation at failure (%):	20
tensile strength (N/mm²):	0.6
EMICODE:	EC1 Plus

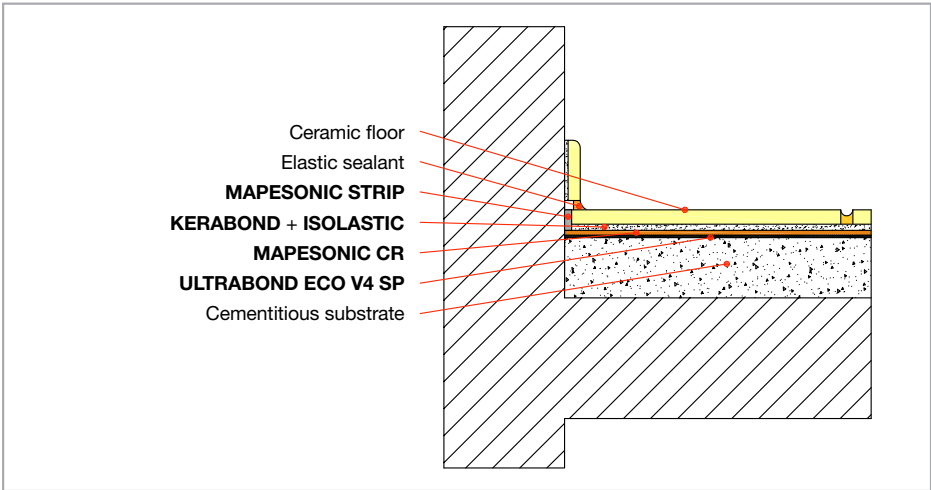*All other operations included and calculated in the price for work completed according to specification*

……..(€/m²)

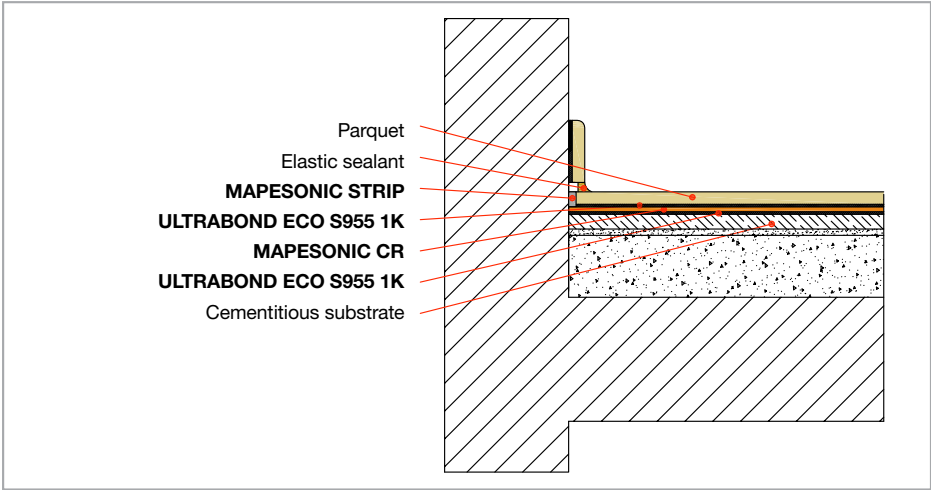# SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

5.6 TECHNICAL DRAWINGS

Ceramic flooring

Ceramic floor
Elastic sealant
MAPESONIC STRIP
KERABOND + **ISOLASTIC**
MAPESONIC CR
ULTRABOND ECO V4 SP
Cementitious substrate

Wooden flooring

Parquet
Elastic sealant
MAPESONIC STRIP
ULTRABOND ECO S955 1K
MAPESONIC CR
ULTRABOND ECO S955 1K
Cementitious substrate

Technical Notebook
SOUNDPROOFING SYSTEMS TO REDUCE NOISE TRANSMITTED BY FOOTSTEPS IN BUILDINGS

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