TECHNICAL DOSSIER

[IMPACT SOUND INSULATION: IMPACTODAN SYSTEM]

EN.09/2015

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IMPACT SOUND INSULATION: IMPACTODAN® SYSTEM

1. INTRODUCTION

Impact sound attenuation is the simplest acoustic system that can be applied to building works. A material is installed and acts as a barrier between the concrete compression layer and the mortar used as screed or for applying the coating. It is a solution that prevents an issue that is very difficult to resolve once the house is being lived in.

Impact sound is produced when construction elements are subjected to mechanical excitation, for example, dragging furniture across the floor, footsteps, etc. This is called structure-borne sound transmission.

This type of transmission can be prevented by attenuating the impact before it comes into contact with the building structure. Solutions that consist of installing a ceiling in the affected home below do not obtain the insulation required.

An attenuation solution must therefore be applied to all surfaces that are susceptible to impacts. The cost of this solution is minimal for new builds and it prevents a problem that is very difficult to resolve later on when renovating a property.

The IMPACTODAN® System offers the market just what it needs: reliability, affordability, security and satisfaction.

- The Impactodan® System offers the market reliability in achieving optimum in situ concrete acoustic insulation results, which are supported by the Spanish technical guidance document (DIT by its acronym in Spanish).
- Housing developers are able to provide quality sound insulation at minimum cost, achieving many benefits and preventing their clients from enduring the serious problems associated with renovation.
- Furthermore, the draughtsman can have peace of mind knowing that the construction unit is guaranteed to comply with acceptable sound levels in most current and future regulations.
- This results in complete user satisfaction, as the homeowner can enjoy undisturbed comfort in their own home.

2. SOUND TRANSMISSION

2.1 TYPES OF SOUND

Sound is a type of energy that is transmitted via elastic waves via air, liquid or solid medium.

An elastic wave is simply a movement or vibration that is associated with energy. In this context, all materials are capable of vibrating and therefore producing or transmitting sound.

We usually classify sounds in accordance with the place they are produced or depending on their transmission.

Noise emission is the sound produced in the source room, while noise reception is the sound heard in the receiver room. Then, lastly there is background noise, which is an underlying noise in the receiver room.

For example, if we hear our neighbour's television: the noise emission is the noise level produced in the neighbour's house, the noise reception is the television's level measured in my house and the background noise is the underlying noise that was in my house before it was disturbed by the neighbour's television, such as the refrigerator or a computer.

Depending on how the sound is transmitted, we will call it air-borne sound, structure-borne sound, impact sound and vibrations.

2.1.1. Air-borne sound

Air-borne sound is any sound that originates because of a disturbance in the air via which it is transmitted and is also perceived by a receiver via air.

The most common examples are those transmitted via an opening, for example, an open window.

Sound that produces direct transmission between rooms is also called air-borne sound, and its mechanism is as follows:

An emitted noise is spread through the air, coming into contact with the room's surfaces. At the border between the air and the wall, part of the incident energy (ei) is reflected, part is absorbed by the wall (ea) and part is transmitted (et). When it reaches the second border between the wall and the receiver room, the same phenomenon reoccurs, i.e. part of the energy (et) that comes into contact with this border is reflected (er'), part is absorbed (ea') and part goes back into the source room as sound waves (et'), and so on and so forth.

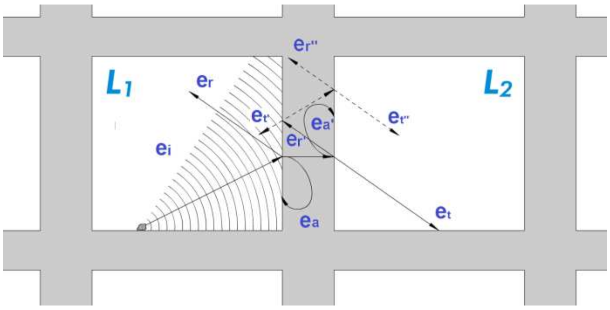


Figure 1: Air-borne sound transmission.

2.1.2. Structure-borne sound

When air-borne sound has enough energy, it will be capable of making the wall resonate. The total effect is that the whole wall is forced to vibrate due to the pressure fluctuations and the sound will then be transmitted through the solid material.

The noise level will therefore increase in the adjacent room as described above.

This is called structure-borne sound transmission or flanking transmission.

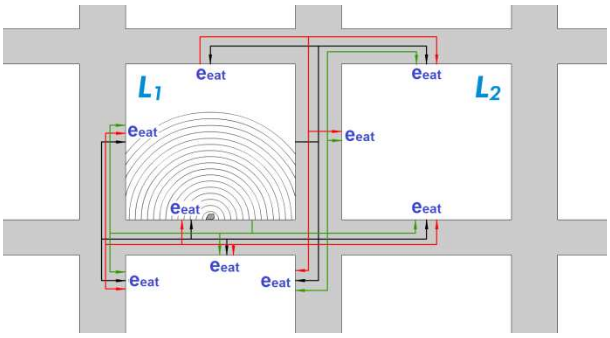


Figure 2: Structure-borne transmission.

2.1.1. Impact sound

Footsteps, dragging furniture across the floor, vibrations caused by machinery starting up (lifts, washing machines, etc.) and generally any noise caused by direct impact to a construction element generate a series of vibrations that are quickly spread throughout the structure with very little energy loss.

Sounds that are produced by mechanical excitation of construction elements are called impact sounds and are transmitted structurally.

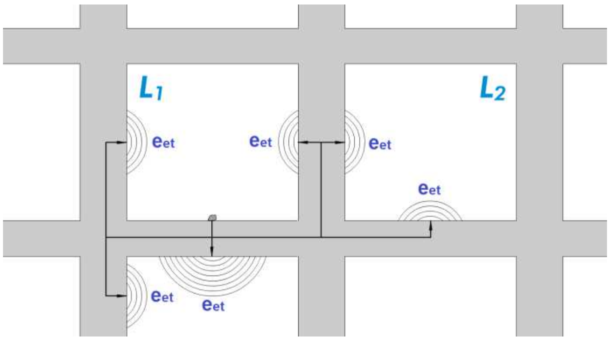


Figure 3: Impact sound or vibration transmission.

Figure 4 shows all of these effects together: direct sound Ed (black); flanking transmission Ff (flank-flank, blue), Df (direct-flank, green) and Fd (flank-direct, red); the transmission due to lack of airtightness Ee (orange); indirect transmission Ei (blue) and impact sound Ri (purple).

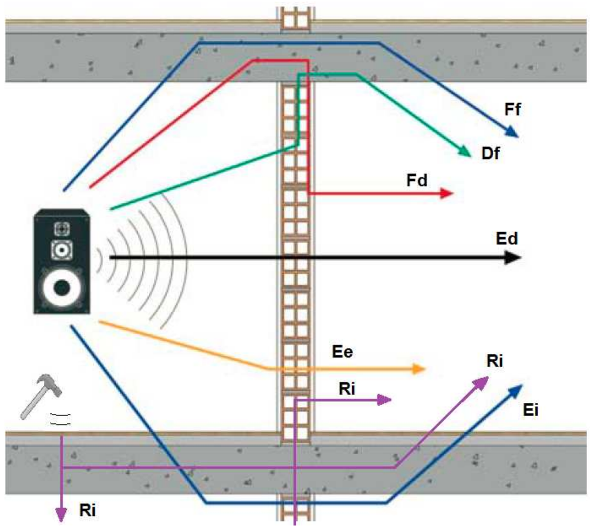


Figure 4: Sound transmission.

The study of sound transmission is called acoustic insulation. The sound isolation between rooms is defined as the difference in sound pressure levels between the source room L1 and the receiver room L2.

$$D = L1 - L2$$

2.2 NOISE PATHOLOGIES

We could deduce from the previous section that the sound insulation solution is a "floating room" within a "structural room", which therefore minimises the two types of sound.

Sound insulation solutions are considered for flooring to prevent air-borne sound and impact sound between concretes, partition walls and façades, which comes from the neighbouring property or outside, or for sound absorbers from suspended ceilings to attenuate structure-borne sound produced by premises with high noise levels, such as machine rooms, restaurants, concert venues, etc.

Pathologies will occur when this solution is not installed correctly (see Figure 5: "Floating room within structural room").

2.2.1. Air-borne transmissions

Air-borne transmission is produced when the sound is directly transmitted through the partition wall or via indirect pathways due to a lack of airtightness.

These are pathways Ed, Ee and Ei in Figure 4.

To prevent air-borne sound problems, you must first strengthen the separating element and ensure that the feedthrough elements are sealed correctly.

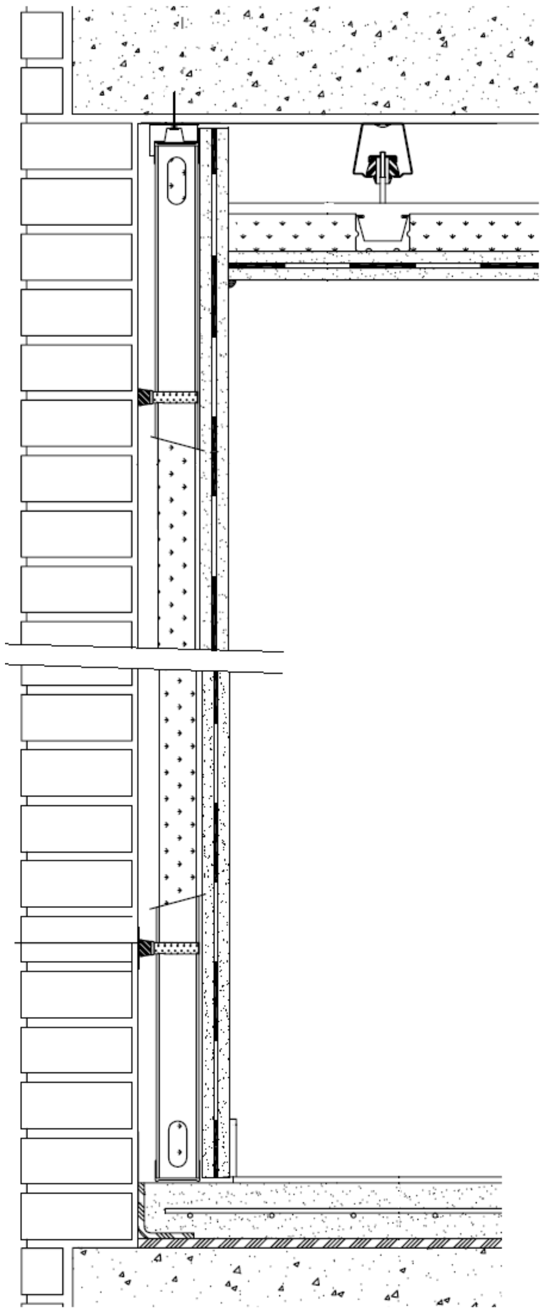


Figure 5: Floating room within structural room.

2.2.2. Structure-borne transmissions

Structure-borne transmission occurs when the sound's pathway is via solids, such as walls, pillars, concrete, etc., and which can become divided into:

- Structure-borne sound, given that the sound has enough energy to set the partition element into vibration (flanking transmission). They are marked as Fd, Df and Ff in Figure 4.

A "room within a room" solution must be used to prevent structure-borne sound problems.

- Impact sound, due to the mechanical excitation of a construction element. They are marked as Ri in Figure 4.

A floating floor solution must be employed to prevent impact sound.

- Vibrations, mechanical excitations from machines, embedded installations, etc., that produce continuous noise. In brief, vibrations are similar to impact sound and vice versa.

A sound attenuation system or an elasticity system must be applied to the machines to prevent vibrations or mechanical excitations.

3. IMPACTODAN® SYSTEM

3.1 FACTORS THAT AFFECT CONCRETE ACOUSTIC INSULATION

The impact sound system is a mass-spring-mass system, and will therefore be made up of concrete (mass), elastic material (spring) and screed (mass).

Other factors that can affect the system are:

- The surface or finish, which improves the insulation although it is usually left as a guarantee.
- Adjacent construction elements, responsible for indirect sound transmissions.
- Installations that cause sound bridges if not insulated.

These factors are essential, not only when designing the concrete acoustic insulation system, but especially when choosing the suitable materials.

3.2 CONCRETE ACOUSTIC INSULATION REQUIREMENTS

The initial concrete conditions for this system are:

- It must be resistant enough for the overload that is to be applied.
- In acoustic terms, it can be defined by its weight per metre squared, with > 250 kg/m^2 being a typical reference value.
- The system works for other types of concrete and wooden structures. In this case, we recommend you contact the technical department.

Elastic product conditions are:

- Compressive strength at 10% or 25% above 10 kPa or 20 kPa, respectively.
- Dynamic stiffness.
- Impact sound improvement.
- Air-borne sound improvement.

The screed's minimum conditions are that it must be resistant enough so that it does not crack.

Some of the success cases during more than 25 years of experience in applying different mortar types to the construction system are:

- Mortar made on-site from non-reinforced concrete with a ratio of 1:5 (300 kg of cement per m^3), minimum thickness 4-5 cm, for systems with partitions laid on this mortar.
- Mortar made on-site from non-reinforced concrete with a ratio of 1:6 for systems with partitions laid on concrete or on strips. In this case, a layer of sand can be used as fill first.
- "Poor" mortar or mortar made in situ, reinforced with chicken wire mesh or additivated with fibreglass (2 bags per concrete mixer), minimum thickness 4-5 cm.
- Dry mortars for terrazzo or marble must always be reinforced with a chicken wire mesh or 5-mm diameter electro-welded wire mesh, forming 40 x 40 cm grids.
- Self-levelling mortars must have the same mechanical specifications and additives must be used, which significantly slows down their curing.
- Mortars that are less than 3 cm thick must be specified in accordance with the project needs. Please consult our technical department.

3.3 IMPACTODAN® SYSTEM

The Impactodan® system helps improve how concretes behave towards impact sound and air-borne sound. It has been assessed by the Eduardo Torroja Institute of Construction Sciences, belonging to the UAEtc (Union Européenne pour l'Agrément Techniques dans la Construction) in accordance with the technical guidance document DIT No. 439 R/10.

The IMPACTODAN® System consists of completely decoupling the screed and flooring so that it is entirely independent from the building structure and installations.

The IMPACTODAN® System is made up of cross-linked polyethylene foam sheets and strips that seal the sheet and are used to decouple the sheet where it meets the walls, pillars, installations, etc. The sheet is protected by mortar before the flooring is installed.

Close ups of the system and their relationship to the partition system can be observed in Figures 6, 7 and 8. A brick partition wall or self-supporting panel walls (laminated gypsum board) can be employed.

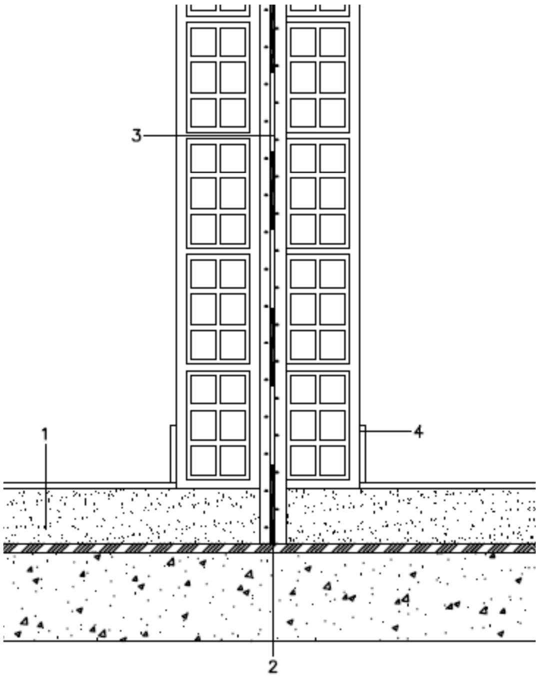


Figure 6: Masonry partition wall system on mortar. 1) IMPACTODAN® System; 2) Mortar separation; 3) Partition wall system; 4) Skirting board.

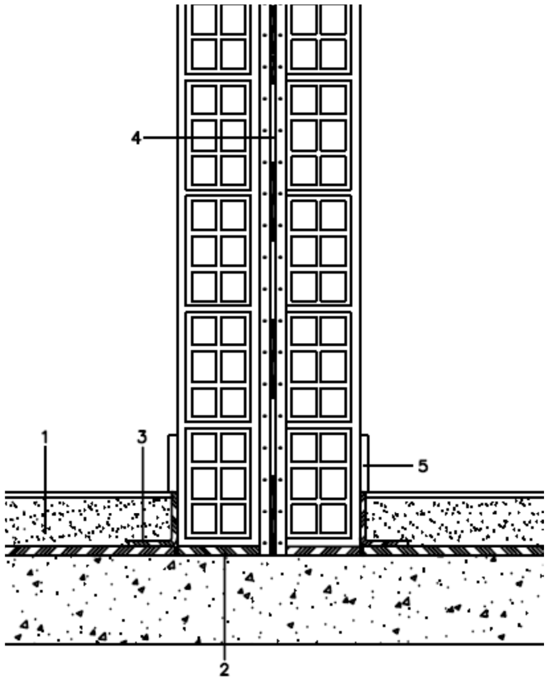


Figure 7: Masonry partition wall system on strips. 1) IMPACTODAN® System; 2) Wall decoupler; 3) Perimeter decoupler; 4) Partition wall system; 5) Skirting board.

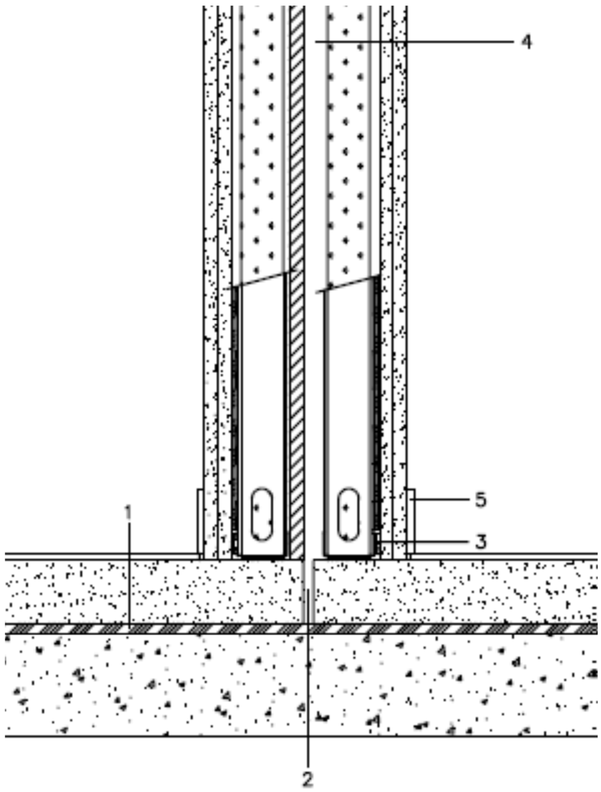


Figure 8: Laminated gypsum partition wall system on mortar. 1) IMPACTODAN® System; 2) Mortar separation; 3) Soundproofing material; 4) Laminated gypsum partition; 5) Skirting board.

3.3.1. Products

- IMPACTODAN® SHEET

IMPACTODAN® cross-linked polyethylene foam sheets, (5-mm and 10-mm thick), and are available in the following formats:

Product	Thickness	Format
IMPACTODAN® 5	5 ± 0.3 mm	Rolls of 50 x 2 m
		Rolls of 15 x 1 m
IMPACTODAN® 10	10 ± 0.3 mm	Rolls of 25 x 2 m

Table 1: Impactodan® sheet format.

IMPACTODAN® sheets have the following minimum specifications:

Specifications	IMPACTODAN® 5	IMPACTODAN® 10
Thickness (EN ISO 845), mm	5 ± 0.3	10 ± 0.3
Nominal density, kg/m^3	27 ± 2	25 ± 2
Dynamic stiffness, MN/m^3	< 95	< 65
Young's modulus, kPa	> 5	> 5
Air flow resistivity, kPa s/m^3	> 100	> 100
Water vapour transmission rate (mg/m h Pa) (UNE 12086)	> 0.00030	
Water vapour diffusion resistance factor, (For 1 000 hPa) (UNE 12086)	> 2000	
Tensile strength, kPa	> 180	> 130
Compression set (EN ISO 1856), 24 h, 50% compression, 23°C	< 32%	< 30%
Compression (EN ISO 3386-1) at 25%, kPa	23 ± 2	23 ± 2
Hysteresis load, Nm	> 1.6	> 2.1
Impact resistance, (UNE-EN 12691) Smooth metal surface.	Positive (10 mm punch)	
	Positive (20 mm punch)	
	Positive (30 mm punch)	
	Positive (40 mm punch)	

Table 2: Impactodan® sheet minimum technical specifications.

- AUXILIARY IMPACTODAN® STRIPS

Auxiliary strips are recommended for IMPACTODAN® 5 and required for IMPACTODAN®10. They include:

DESOLIDARIZADOR DE MUROS: It's a wall decoupling strip of 10 ± 0.6 mm thick and 150 ± 10 mm wide cross-linked polyethylene foam. These strips are used to leave brick partitions floating.

CINTA DE SOLAPE: It´s a joining tape of 3 ± 0.3 mm thick and 70 ± 10 mm wide self-adhesive cross-linked polyethylene foam. This tape is used to seal sheet joins or lag installations.

DESOLIDARIZADOR PERIMETRAL: It's a perimeter decoupling strip of 3 ± 0.3 mm thick and 200 ± 10 mm wide self-adhesive cross-linked polyethylene foam. These strips are used when the sheet overlaps vertically with the partition wall.

AUXILIARY IMPACTODAN® Sheet Strips have the following minimum specifications:

Specifications	Joining tape	Perimeter decoupling strip	Wall decoupling strip
Thickness (mm) (UNE EN ISO 845)	3 ± 0.3	3 ± 0.3	10 ± 0.6
Width (mm)	70 ± 10	200 ± 10	150 ± 10
Nominal density, kg/m^3	30 ± 10%		
Dynamic stiffness, MN/m3	< 100		
Young's modulus, kPa	> 5		
Tensile strength, kPa	> 140		
Compression set (UNE-EN ISO 1856), 24 h, 50% compression, 23°C	< 35%		
Compression (UNE-EN ISO 3386-1) at 25%, kPa	> 20		
Hysteresis load, Nm	> 1.9		
Impact resistance, (UNE-EN 12691) Smooth metal surface.	Positive (10 mm punch)		
	Positive (20 mm punch)		
	Positive (30 mm punch)		
	Positive (40 mm punch)		

Table 3: Auxiliary strips' minimum technical specifications.

3.3.2. System

The system leaves the subfloor completely separated and floating (decoupled) from the building structure and its installations, both from the floor and the perimeters. See Figure 9.

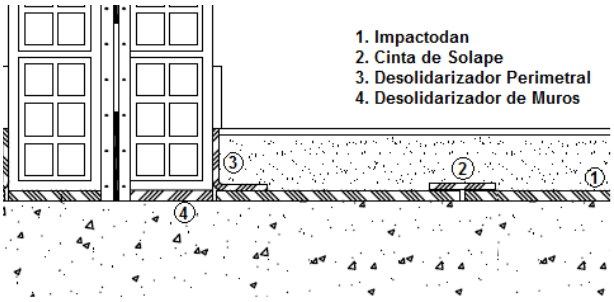


Figure 9: IMPACTODAN® System. 1) IMPACTODAN® System; 2) Joining tape; 3) Perimeter decoupler; 4) Wall decoupler.

The theoretical acoustic specifications, proven by laboratory tests, can be observed in Appendix 4 "IMPACTODAN® System insulation values", where different results were obtained for air-borne and impact sound by changing the screed weight (subfloor), product thickness and concrete weight.

3.3.3. Installation

Pre-installation operations:

a. **Materials:** Before starting, ensure that you have all the materials needed to carry out the works.

b. **Laying out:** The installations that are going to run through the floor must be laid out and/or pre-installed before positioning the IMPACTODAN® sheet.

b.1. Partition wall system on elastic strips: If you choose to make the vertical separations before installing the IMPACTODAN® System, they will be laid on wall decoupling strips (see section 2 and Figure 7).

b.2. Partition wall system on mortar: If you choose to install the IMPACTODAN® System before making the vertical separations, the finish flooring installation will not be continuous on the sheet because a batten or similar must be placed, which will later be removed (an elastic filler with a dynamic stiffness of < 100 MN/m^3 may be left). See Figures 6 and 8.

c. **Fixing:** 3-mm thick self-adhesive cross-linked polyethylene sealant strips will be used, which fix the different sections of sheeting to one another and 3-mm thick self-adhesive cross-linked polyethylene perimeter strips, which decouple the mortar and flooring from concretes, pillars, installations or other structural elements. See Figures 9 and 11.

Support conditions

Before installing IMPACTODAN®, make sure the support is clean, dry and free from sharp objects.

System installation

1. Spreading out the product on the floor:

Spread out the IMPACTODAN® sheet over the concrete, paying special attention to the installations. Seal sheet overlap with joining tape. See Figure 10.

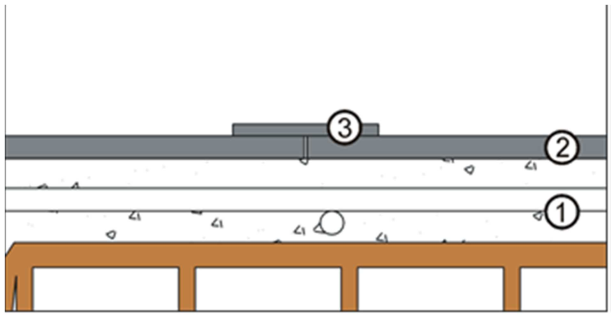


Figure 10: IMPACTODAN® spread out.
1) Concrete; 2) IMPACTODAN®; 3) Sealant tape.

If you are using IMPACTODAN® 5, you can assemble the sheets on top of one another, ensuring an overlap of 8-10 cm. Seal the overlap with adhesive tape. See Figure 11.

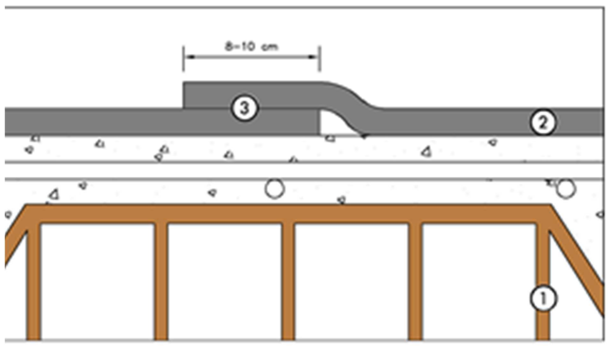


Figure 11: Seal between IMPACTODAN® sheets with 8-10 cm overlap.
1) Concrete; 2) IMPACTODAN®; 3) 8-10 cm overlap.

2. Façades and pillars:

Lay the IMPACTODAN® sheet head on to the vertical surface (façade enclosure and pillars). Then, apply the perimeter strip, fixing the IMPACTODAN® sheet to said vertical surface. Make sure that the perimeter strip is high enough to ensure that the mortar screed and flooring do not touch the vertical element. You can then pour the mortar and lay down the flooring. See Figure 12.

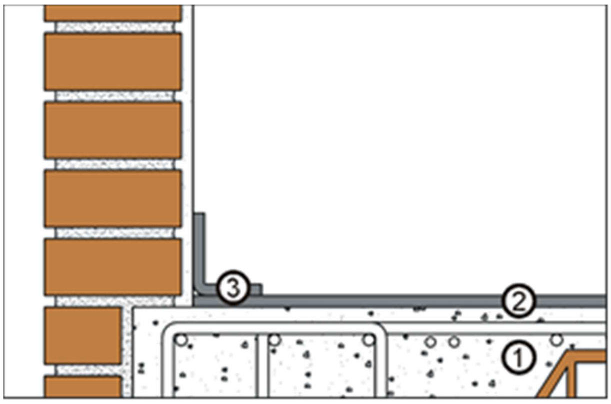


Figure 12: Point of contact with the façade or mixed party wall with perimeter strip.
1) Concrete; 2) IMPACTODAN®; 3) Perimeter decoupling strip.

If you are using IMPACTODAN® 5, you can raise the product higher up the vertical surface without having to fix it to the wall with any type of mechanical element such as nails, etc. See Figure 13.

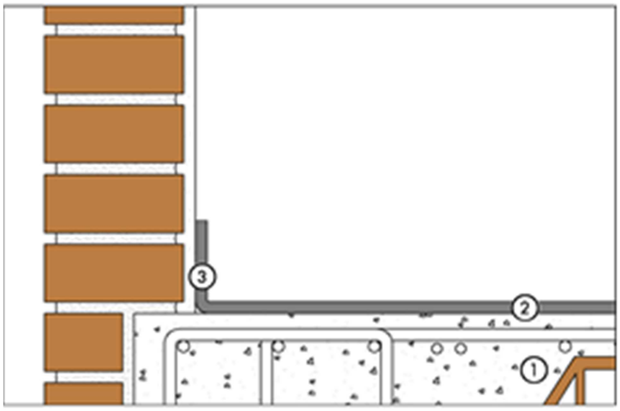


Figure 13: Point of contact with the façade or mixed party wall by vertical overlap.
1) Concrete. 2) IMPACTODAN®; 3) Enough vertical overlap.

Make sure that the vertical overlap is high enough to ensure that the mortar screed and flooring do not touch the vertical element. You will later fold it down to support the skirting board and any excess material will be cut. See Figure 14.

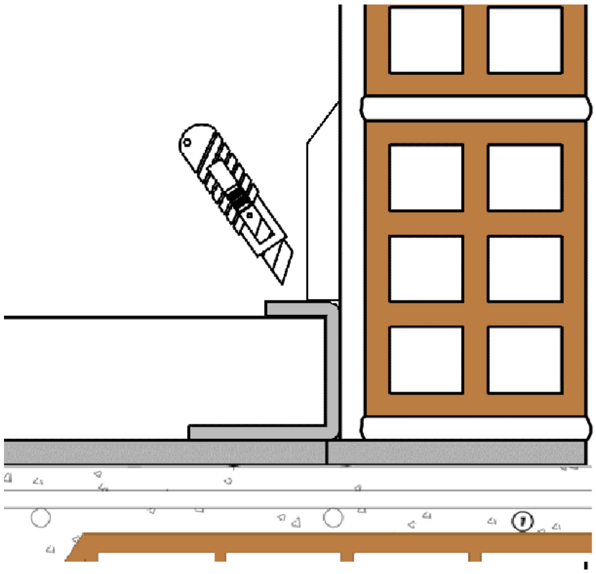


Figure 14: Cutting of excess material.

3. Vertical elements:

Vertical separations on decoupling strips:

You can lay the IMPACTODAN® sheet once you have erected the vertical separation on the wall decoupling strips. Then, apply the perimeter decoupling strip, fixing the IMPACTODAN® sheet to the vertical separations. Make sure the perimeter decoupling strip is high enough to separate the wall from the mortar plus the flooring. See Figure 15.

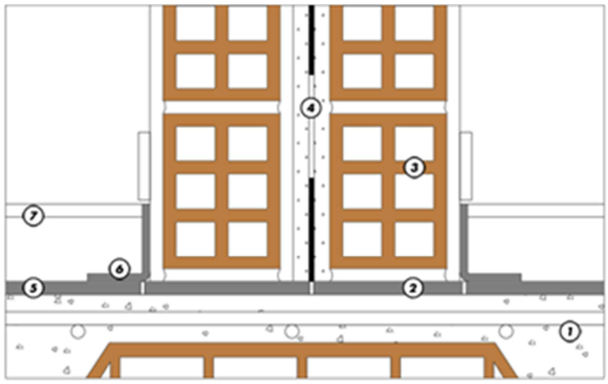


Figure 15: Masonry partition wall or laminated gypsum partition on decoupling strip.
1) Concrete; 2) Wall decoupler; 3) Partition wall; 4) Insulation material; 5) IMPACTODAN®; 6) Perimeter decoupler; 7) Mortar and finish.

Vertical separations on floating mortar:

Once you have spread out the IMPACTODAN® sheet and applied the perimeter strips where it meets the vertical surfaces and the installations, place a separator, which will act as formwork (metal ruler, wooden board, etc.).

When the mortar has set, remove the separator leaving a joint in the middle (an elastic filler with a dynamic stiffness of < 100 MN/m^3 may be left).

Build the separating walls on both sides of this joint. See Figure 16.

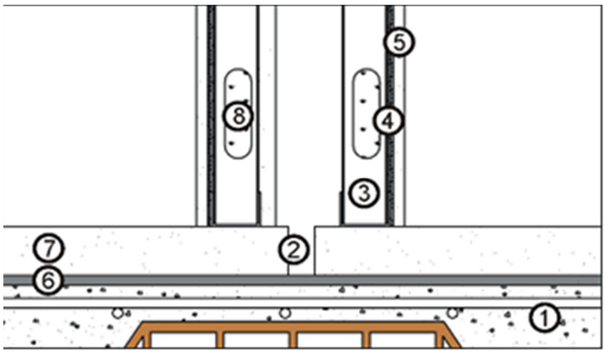


Figure 16: Masonry partition wall or laminated gypsum partition on floating mortar.
1) Concrete; 2) Mortar separation joint; 3) structure; 4) Soundproofing material; 5) Laminated gypsum board; 6) IMPACTODAN® sheet; 7) Mortar and finish; 8) Absorbent material.

Mixed vertical separations:

Once the traditional wall has been built (masonry, concrete, etc.) you can install the IMPACTODAN® sheet, as shown in Figure 17.

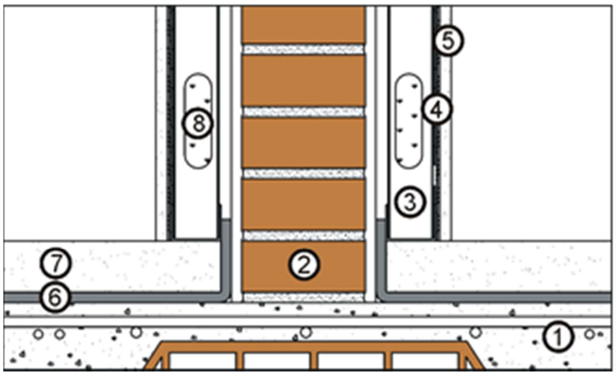


Figure 17: Mixed partition wall system.
1) Concrete; 2) Masonry partition; 3) Structure; 4) Soundproofing material; 5) Laminated gypsum board; 6) IMPACTODAN® 5; 7) Mortar and finish; 8) Absorbent material.

Interior partitions:

The interior partitions will be erected on elastic strips.

Make sure the mortar is completely separate from these partitions. As such, create a vertical overlap with the perimeter decoupling strips or by raising the IMPACTODAN® 5 sheet high enough to cover the mortar and the surface. See Figures 18 and 19.

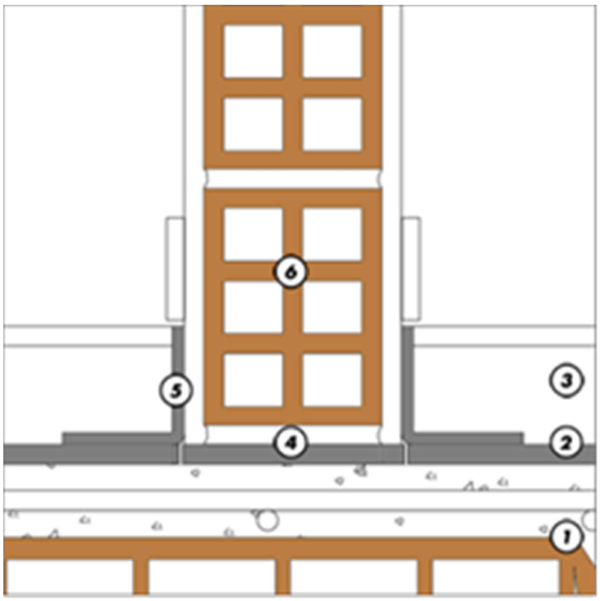


Figure 18: Covering the mortar enough with perimeter strip.
1) Concrete; 2) IMPACTODAN®; 3) Mortar and finish; 4) Wall decoupler; 5) Perimeter decoupler; 6) Partition wall.

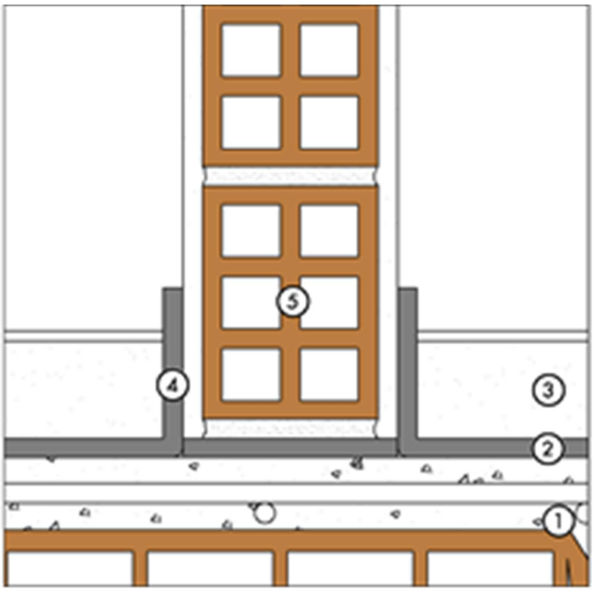


Figure 19: Covering the mortar enough using the vertical overlap.
1) Concrete; 2) IMPACTODAN® 5; 3) Mortar and finish; 4) Vertical overlap; 5) Partition wall on decoupling strip.

If you choose to use partitions on a floating floor, these partitions will be installed directly on the floating floor. In this case, please check section 5 of this document, "CONCRETE ACOUSTIC INSULATION REQUIREMENTS".

Heating installations

You must install underfloor heating systems after spreading out the IMPACTODAN® sheet, following the usual procedure for these systems as shown in Figure 20.

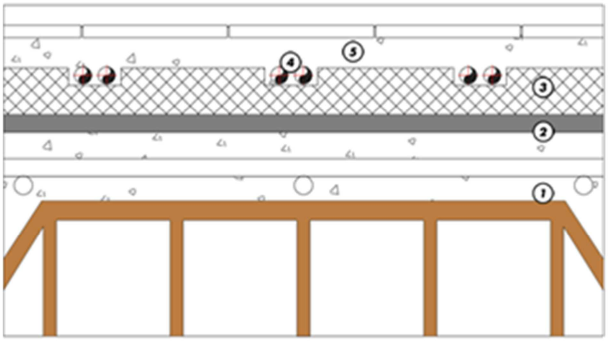


Figure 20: *Adapting the IMPACTODAN® System to underfloor heating.*
1) Concrete; 2) IMPACTODAN®; 3) Thermal underfloor heating insulation; 4) Underfloor heating piping; 5) Mortar and finish.

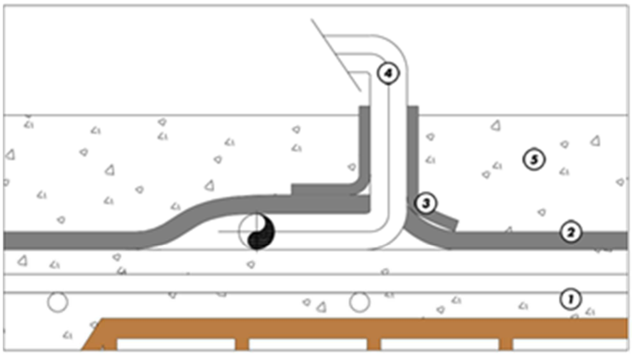


Figure 21: *Adapting the IMPACTODAN® System to traditional heating. Pipe insulation.*
1) Concrete; 2) IMPACTODAN®; 3) Sealant tape; 4) Piping; 5) Mortar.

You must never fix the radiator to the floating floor.

You can install the heating pipes on top of the IMPACTODAN® sheet if non-centralised heating systems are used. In this case, once the pipes are installed, you will lay the sheet under them following the sealing and vertical overlap procedure described in the system. Then pour the mortar. Figure 21

Installation ducts

Vertical ducts for installations will be separated from the structure using perimeter decoupling strips or joining tape. If an installation were to be in the middle of where the IMPACTODAN® sheet is to be laid, seal it accordingly, in accordance with Figure 22.

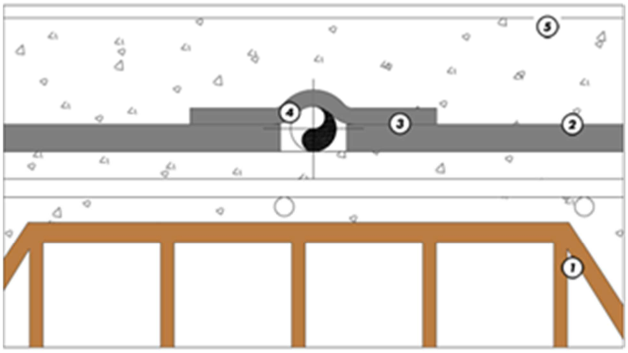
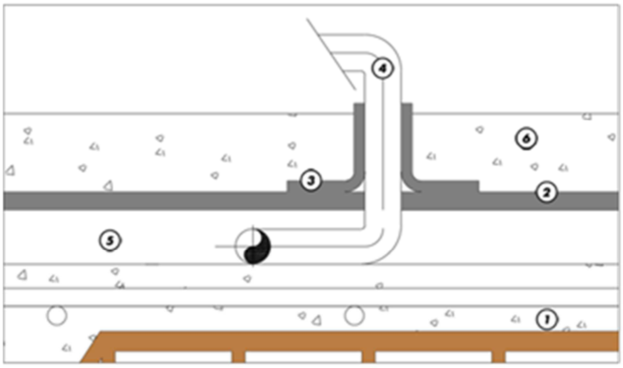


Figure 22: *System compatibility with piping.*
1) Concrete; 2) IMPACTODAN®; 3) Sealant tape; 4) Piping; 5) Mortar.

When a sand screed(1) or light mortar is employed to protect the installations, install IMPACTODAN® over it. See Figure 23.



(1). If there are no installations, the IMPACTODAN® sheet can go under the sand screed and then the mortar can be poured on top of it.

Figure 23: *Adapting the IMPACTODAN® System to traditional heating with fill. Pipe insulation.*
1) Concrete; 2) IMPACTODAN®; 3) Sealant tape; 4) Piping; 5) Mortar filler; 6) Mortar.

The woodwork pre-frame and frame must not pierce the floating mortar. See Figure 24.

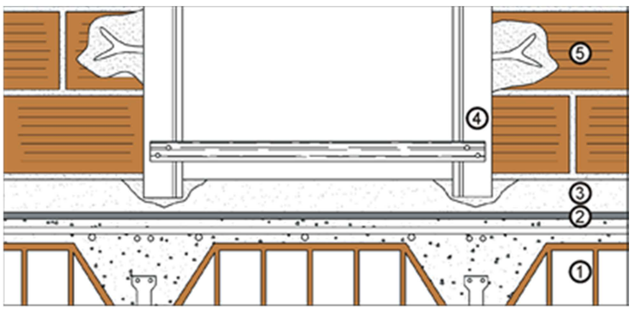


Figure 24: *System compatibility with woodwork. Doors.*
1) Concrete; 2) IMPACTODAN®; 3) Mortar; 4) Frame; 5) Partition wall.

4. MAINTENANCE AND CONSERVATION

The IMPACTODAN® System does not require any special maintenance. If the IMPACTODAN® system needs repairing, ensure that you replace the material and lag the piping, leaving it in the same conditions as before the repair.

APPENDIX 1: TERMINOLOGY

Apparent sound reduction index, R': Sound insulation, in dB, of a construction element (field measurement) including indirect transmissions. It is a function of frequency.

It is expressed as:

$$R' = L_1 - L_2 + 10 \cdot \lg \frac{S}{A} \quad \text{[dB]}$$

Where
L_1 = average sound pressure level in the source room, [dB];
L_2 = average sound pressure level in the receiver room, [dB];
S = construction element area, [m²];
A = equivalent sound absorption area of the receiving room, [m²].

A-weighted apparent sound reduction index of a construction element, R'$_A$: An overall assessment, in dBA, of the apparent sound reduction index, R', for an incidental, normalized. A-weighted pink noise.

It is expressed as:

$$R'_A = -10 \cdot \lg \sum_{i=1}^{n} 10^{(L_{Ar,i} - R'_i)/10} \quad \text{[dBA]}$$

Where
R'_i = apparent sound reduction index in the frequency band i, [dB];
$L_{Ar,i}$ = normalized A-weighted pink noise spectrum value in the frequency band i, [dBA];
i = covers all third-octave frequency bands from 100 Hz to 5 kHz.

A-weighted equivalent continuous sound pressure level, L_{eqA}: It is defined in dBA by the L_{eqA} value.
It is used for noises that vary over time, expressed as:

$$L_{eqA} = 10 \cdot \lg \frac{1}{T} \int_0^T 10^{L(t)_{pA}/10} dt \quad \text{[dBA]}$$

Where
$L(t)_{pA}$ = A-weighted sound pressure level for the instant t, [dBA];
T = time interval considered in s.

A-weighted sound pressure level, L_{pA}: Level that estimates a complex sound by means of a unique value employing the A-weighting.

It is used for a known sound spectrum, in third-octave or octave bands, and is expressed as follows:

$$L_{pA} = 10 \cdot \lg \sum_i 10^{(L_i + A_i)/10} \quad \text{[dBA]}$$

Where
L_i = sound pressure level in the frequency band i, [dB];
A_i = A-weighted value in the frequency band i, [dBA];

A-weighted sound reduction index for dominant outside traffic noise, R_{Atr}: An overall assessment, in dBA, of the sound reduction index, R, for outside traffic noise. It is expressed as:

$$R_{Atr} = -10 \cdot \lg \sum_{i=1}^{n} 10^{(L_{Atr,i} - R_i)/10} \quad \text{[dBA]}$$

Where
R_i = sound reduction index value in the frequency band i, [dB];
$L_{Atr,i}$ = normalized A-weighted traffic spectrum value in the frequency band i, [dBA];
i = covers all third-octave frequency bands from 100 Hz to 5 kHz.

A-weighted sound reduction index improvement of a coating, *R*$_A$: An increase in the weighted sound reduction index of a construction element by adding a treatment or coating to a base construction element. It is calculated by the difference between the global A-weighted sound reduction index values of a reference construction element with the improvement coating and the base reference construction element itself.

A-weighted sound reduction index of a construction element, R_A: An overall assessment, in dBA, of the sound reduction index, R', for an incidental, normalized, A-weighted pink noise.

Sound reduction indices will be measured using laboratory tests. However, when there are no tests available, the sound reduction index provided by a construction element consisting of a single skin of homogeneous materials plastered on both sides, is almost exclusively based on its mass. They are expressed as below (mass law), where the insulation R_A, is in accordance with the mass per surface unit, m, expressed in kg/m².

$$m \leq 150 kg/m^2 \qquad R_A = 16.6 \cdot \lg m + 5 \quad \text{[dBA]}$$

$$m \geq 150 kg/m^2 \qquad R_A = 36.5 \cdot \lg m - 38.5 \quad \text{[dBA]}$$

It is based on the sound reduction index values, R, obtained by means of laboratory testing; this index is expressed as:

$$R_A = -10 \cdot \lg \sum_{i=1}^{n} 10^{(L_{Ar,i}-R_i)/10} \quad [dBA]$$

Where
R_i = sound reduction index value in the frequency band i, [dB];
$L_{Ar,i}$, = normalized spectrum value for pink noise in the frequency band i, [dBA];
i = covers all third-octave frequency bands from 100 Hz to 5 kHz.

A-weighted spectrum: An approximation with minus sign of the equal-loudness contour with a loudness level equal to 40 phons. The A-weighted curved is defined by the following values for the frequency margin applicable to this dB:

Table A.6 A-weighted curve values

Frequency Hz	100	125	160	200	250	315	400	500	630
dBA weighting curve	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2	-1.9

Frequency Hz	800	1000	1250	1600	2000	2500	3150	4000	5000
dBA weighting curve	-0.8	0	0.6	1.0	1.2	1.3	1.2	1.0	0.5

The A-weighted spectrum is used to compensate the human ear's sensitivity differences for different frequencies within the auditory field.

A-weighted standardized level difference between interior rooms, $D_{nT,A}$: An overall assessment, in dBA, of the standardized level difference between interior rooms, D_{nT}, for pink noise.

It is expressed as:

$$D_{nT,A} = -10 \cdot \lg \sum_{i=1}^{n} 10^{(L_{Ar,i}-D_{nT,i})/10} \quad [dBA]$$

Where
$D_{nT,i}$ = standardized level difference in the frequency band i, [dB];
$L_{Ar,i}$ = normalized A-weighted pink noise spectrum value in the frequency band i, [dBA];
i = covers all third-octave frequency bands from 100 Hz to 5 kHz.

A-weighted standardized level difference for façades, roofs and floors in contact with the outside air for traffic noise, $D_{2m,nT,Atr}$: An overall assessment, in dB, of the standardized level difference of a façade, roof or floor in contact with the outside air, $D_{2m,nT}$ for traffic noise.

It is expressed as:

$$D_{2m,nT,Atr} = -10 \cdot \lg \sum_{i=1}^{n} 10^{(L_{Atr,i}-D_{2m,nT,i})/10} \quad [dBA]$$

Where
$D_{2m,nT,i}$ = standardized level difference in the frequency band i, [dB];
LAtr,i = normalized A-weighted traffic spectrum value in the frequency band i, [dBA];;
i = covers all third-octave frequency bands from 100 Hz to 5 kHz.

If the dominant outside noise is from aeroplanes, this index will be used for the overall assessment, but using the normalized A-weighted aeroplane spectrum values.

Brick partition wall: A partition wall made up of wet-assembled building blocks, such as hollow bricks, perforated bricks, concrete blocks, light clay blocks, solid plaster partition walls, etc.

Cladding: An element added to the vertical construction element. The following are types of cladding:

a) one or several plasterboards fixed to a panel wall;
b) a panel consisting of a plasterboard and a layer of insulation material fixed to the base element;
c) an element consisting of a single skin with perimeter elastic strips and a chamber filled with an absorbent, porous and elastic material.

Coating: A layer laid over a base or support construction element. Coatings include claddings applied to vertical construction elements, floating floors, carpets and suspended ceilings on horizontal construction elements.

Critical frequency, f_c: Frequency limit below that which starts to give rise to the coincidence phenomenon, in which the sound energy is transmitted through the construction element in the shape of bending waves, coupled to the air's sound waves, consequently reducing the sound insulation.

It is defined based on the elastic constants of the construction element, and is expressed as:

$$f_c = \frac{6.4 \cdot 10^4}{d} \sqrt{\frac{\rho \cdot (1-\sigma^2)}{E}} \quad Hz$$

Where
d = wall's thickness, [m];
ρ = density, [kg/m³];
E = Young's modulus, [N/m²];
σ = Poisson's ratio.

Direct sound transmission: Sound transmission to the receiver room exclusively via the separation element, either via the solid part or via air-borne transmission, through cracks, openings or ducts, etc. if there were any.

lastic strip: Band of elastic material, at least 10-mm thick, used to interrupt the transmission of vibrations where the wall meets the floor, ceiling and other walls. These strips must be made from materials with a dynamic stiffness, s', below 100 MN/m³ such as elasticized polystyrene, polyethylene foam and other materials with similar features.

Enclosure or room: A space in the building restricted by exterior walls, partitions or any other separating element.

Enclosure or room where an activity takes place: An enclosure where an activity is carried out, which is different to those in the rest of the building where it is found, for example, business, administrative, educational, industrial, garage and parking (excluding those located in spaces outside the building area although the spaces are covered), etc., in housing, hotels, hospitals, etc., provided that the standardized A-weighted average sound pressure level of the enclosure is above 70 dBA and is not a noisy enclosure.

Façade: A building's perimeter enclosure, which may be vertical or have a gradient of no more than 60° over the horizontal line, and which separates it from the exterior. It includes the façade wall and openings (exterior doors and windows).

Flanking element: A construction element adjacent to a separating element, through which indirect structure-borne sound transmission or flanking is produced.

Floating floor: A construction element on the concrete, which consists of the flooring with its support layer and elastic element.

Frequency, f: Number of sinusoidal sound wave pulses produced in a second.

Frequency spectrum: Representation of the distribution of energy of a sound according to the component frequencies. It is usually expressed using pressure or power levels in third-octave bands or octave bands.

Heavy-weight prefabricated board: An element made from concrete or gypsum boards, or any other material with similar specifications.

Homogeneous construction element: An element with one skin, made from solid, concrete products, etc. Homogeneous concretes are concrete slabs and concretes with light ceramic aggregates.

Indirect sound transmission: Sound transmission to the receiver room via transmission pathways that are different to direct transmission. This may be via air-borne or structure-borne transmission; it is also called flanking transmission.

Inhabitable enclosure or room: An interior enclosure designed to be used by people, whose density of occupation and stay duration require compliance with sound, heat and health conditions. Inhabitable enclosures include the following:

a) Rooms (bedrooms, dining rooms, libraries, living rooms, etc.) in residential buildings;
b) Class rooms, libraries, offices, in education centres.
c) Surgeries, patient rooms, waiting rooms, in health sector buildings;
d) Offices, studies, meeting rooms, in administrative buildings;
e) Kitchens, bathrooms, toilets, corridors in buildings for any use;
f) Any other type of building with a similar use to those mentioned above.

Installations enclosure or room: An enclosure that contains the building's installation equipment (whether individual or a set), understood as being any equipment or installation susceptible to alter the environmental conditions of said enclosure.

Level difference between rooms, D: Difference, in dB, between the average sound pressure levels produced in two rooms due to the action of one or several noise sources being emitted in one of them, which is understood to be the source room. In general, it is a function of frequency.

Light-weight façade: Continuous façade, anchored to an auxiliary structure, whose mass per surface unit is less than 200 kg/m².

Light-weight roof: A roof whose permanent load does not exceed 100 kg/m^2.

Mixed construction element: An element consisting of two or more parts of different amounts of insulation, some of which are assembled as an extension of others until the entire surface is covered. Examples: wall made up of a dwarf wall on which a window is assembled, façade wall with windows, partition wall with a door, etc.

Noisy enclosure or room: An enclosure with general industrial use, whose activities produce a standardized A-weighted average sound pressure level above 80 dBA.

Normalized A-weighted pink noise spectrum: Representation in numerical form of the A-weighted sound pressure values, corresponding to pink noise in third-octave and octave frequency bands.

Table A.5. Normalized A-weighted pink noise spectrum values.

f_i Hz	$L_{Ar,i}$ dBA	f_i Hz	$L_{Ar,i}$ dBA
100	-30.1	800	-11.8
125	-27.1	1000	-11.0
160	-24.4	1250	-10.4
200	-21.9	1600	-10.0
250	-19.6	2000	-9.8
315	-17.6	2500	-9.7
400	-15.8	3150	-9.8
500	-14.2	4000	-10
630	-12.9	5000	-10.5

Normalized A-weighted traffic noise spectrum: Representation, in numerical form, of the A-weighted sound pressure values, corresponding to traffic noise in third-octave and octave frequency bands.

Table A.3. Normalized A-weighted traffic noise spectrum values.

f_i Hz	$L_{Atr,i}$ dBA	f_i Hz	$L_{Atr,i}$ dBA
100	-20	800	-9
125	-20	1000	-8
160	-18	1250	-9
200	-16	1600	-10
250	-15	2000	-11
315	-14	2500	-13
400	-13	3150	-15
500	-12	4000	-16
630	-11	5000	-18

Normalized impact sound pressure level of a horizontal construction element, L_n: Average sound pressure level in the receiver room referring to absorption of 10 m^2, with the horizontal construction element assembled to separate it from the room above. Said element is set into vibration by the tapping machine under laboratory test conditions (lack of indirect transmissions). It is a function of frequency.

It is expressed as:

$$L_n = L + 10 \cdot \lg \frac{A}{10} \quad [dB]$$

Where
L = average impact sound pressure level in the receiver room, [dB];
A = equivalent sound absorption area of the receiver room, [m^2].

Normalized impact sound pressure level, field measurement, L'_n:
It is the average sound pressure level in the normalized receiver room at sound absorption of 10 m^2, when the construction element that separates it from the source room is set into vibration by the tapping machine. It is a function of frequency. It is expressed as:

$$L'_n = L + 10 \cdot \lg \frac{A}{10} \quad [dB]$$

Where
L = average sound pressure level in the receiver room, [dB];
A = equivalent sound absorption area of the receiver room, [m^2].

Normalized weighted impact sound pressure level of a horizontal construction element, $L_{n,w}$: Value at 50 Hz of the reference curve adjusted to test values of normalized impact sound pressure level, Ln. If test levels are given for octave bands, the value at 500 Hz must be reduced by 5 dB.

Normalized weighted impact sound pressure, field measurement, $L'_{n,w}$:
It is the value at 500 Hz of the reference curve adjusted to normalized impact sound pressure level test values, L'_n. If the test levels are given for octave bands, the value at 500 Hz is reduced by 5 dB.

Octave band: Frequency interval where the highest frequency is twice the lowest frequency.

Party wall: A partition that adjoins with other buildings that are already built or could legally be built, on all of its surface or part of its surface.

Porous material: An absorbent material with an alveolar, granular, fibrous structure, etc., that reduces mechanical energy into heat, when air comes into contact with the material's surfaces.

Reduction in the impact sound pressure level (or impact sound insulation improvement) of a floating floor or suspended ceiling, ΔL: Difference between the normalized reference sound pressure level of a normalized reference concrete and the floating floor or the suspended ceiling and the reference concrete itself. It is a function of frequency.

Reverberation time, T: Time, in s, needed for the sound pressure level to decay 60 dB after the source stops. In general, it is a function of frequency. The values of the requirements established as limits are understood to be obtained from the weighted sound absorption coefficients, $_w$.

The reverberation time values are specified and used in the calculations rounded to one decimal place. (For example: 1.25 → 1.3).

Roof: Upper enclosure of a building, which may be horizontal or have a gradient of no more than 60° over the horizontal line. It includes the resistant element (concrete) plus the finish on its lower part (ceiling) plus the coating or covering on the upper part. Both the blind part of the roof and the skylights must be considered.

Self-supporting panel element: An element consisting of one or more laminated gypsum boards, fixed to a self-supporting skeleton frame with a chamber filled with porous, elastic and acoustically absorbent material.

Sound absorption coefficient, α: Relationship between sound energy absorbed by a (usually) flat object, and the incidental sound energy on the object, which is referred to as the surface unit.
It is a function of frequency.
The sound absorption coefficient values and the equivalent sound absorption area will be specified and used in the calculations rounded to two decimal places. (For example: 0.355 → 0.36).

Sound absorption, A: Amount of sound energy, in m^2, absorbed by an object in the acoustic field. It is a function of frequency.

It can be calculated, for absorbent planes, for each frequency band f, and is expressed as:

$$A_f = \alpha_f \cdot S \qquad [m^2]$$

Where
A_f = sound absorption for the frequency band f, $[m^2]$;
α_f = sound absorption coefficient of the material for the frequency band f;
S = material area, $[m^2]$.

The values of the requirements established as a limit shall be considered as obtained using the weighted sound absorption coefficients, $_w$.

Sound power level, L_W: It is expressed as:

$$L_W = 10 \cdot \lg \frac{W}{W_0} \qquad [dB]$$

Where

W = considered sound power [w];
W_0 = reference sound power, value 10^{-12} [w].

Sound pressure level, L_p: It is expressed as:

$$L_p = 10 \cdot \lg \left(\frac{p}{p_0} \right)^2 = 20 \cdot \lg \frac{p}{p_0} \qquad [dB]$$

Where

p = sound pressure considered, [Pa]; (root mean square)
p_0 = reference sound pressure, of value $2 \cdot 10^{-5}$ Pa.

Sound reduction index improvement of a coating, *R*: An increase in the sound reduction index of a construction element by adding a treatment or coating to the base construction element. It is calculated by the difference between the sound reduction index of a reference construction element with the improvement coating and the base construction element itself. It is a function of frequency.

Sound reduction index of a construction element, R: Sound insulation, in dB, of a construction element (laboratory measured). It is a function of frequency.

It is expressed as:

$$R = L_1 - L_2 + 10 \cdot \lg \frac{S}{A} \qquad [dB]$$

Where

L1 = average sound pressure level in the source room, [dB];
L2 = average sound pressure level in the receiver room, [dB];
S = construction element area, $[m^2]$;
A = equivalent sound absorption area of the receiver room, [m2].

Spectrum adaptation term, C, C_{tr}: A value, in decibels, which is added to the value of a weighted magnitude obtained by the ISO 717-1 reference curve method (R_w, for example) to take into account a given sound spectrum's specifications. Each A-weighted index is integrated with the spectrum adaptation term belonging to the associated weighted index, derived from the reference curve method.
When the incidental sound is pink noise or railway noise or from a railway station, the C symbol is used, and when the noise is due to traffic or aeroplanes, the Ctr symbol is used.

Standardized impact sound pressure level, L'_{nT}: Average sound pressure level, in dB, in the normalized receiver room at a reverberation time of 0.5 s, when the construction element that separates it from the source room is set into vibration by the tapping machine. It is a function of frequency.

It is expressed as:

$$L'_{nT} = L - 10 \cdot \lg \frac{T}{T_0} \quad \text{[dB]}$$

Where
L = average sound pressure level in the receiver room, [dB];
T = reverberation time in the receiver room, [s];
T_0 = reference reverberation time; its value is T_0=0.5 s.

Standardized level difference between interior rooms, D_{nT}: Difference between average sound pressure levels in two rooms due to one or several noise sources being emitted in one of them; it is normalized to the value 0.5 s of the reverberation time. In general, it is a function of frequency.

It is expressed as:

$$D_{nT} = L_1 - L_2 + 10 \cdot \lg \frac{T}{T_0} \quad \text{[dB]}$$

Where
L1 = average sound pressure level in the source room, [dB];
L2 = average sound pressure level in the receiver room, [dB].
T = reverberation time in the receiver room, [s];
T_0 = reference reverberation time; its value is T_0=0.5 s.

Standardized level difference for façades, roofs and floors in contact with the outside air $D_{2m,nT}$: Air-borne sound insulation of a façade, roof or floor in contact with outside air, measured in dB, when the outside noise level, $L_{1,2m}$, is produced 2 metres in front of the façade or roof.

It is expressed as:

$$D_{2m,nT} = L_{1,2m} - L_2 + 10 \cdot \lg \frac{T}{T_0} \quad \text{[dB]}$$

Where

$L_{1,2m}$ = average sound pressure level measured 2 metres in front of the façade or roof, [dB];
L_2 = average sound pressure level in the receiver room, [dB];
T = reverberation time in the receiver room, [s];
T_0 = reference reverberation time; its value is T_o=0.5 s.

Standardized weighted impact sound pressure level, $L'_{nT,w}$: An overall assessment of the standardized impact sound pressure level, L'_{nT}.

Third-octave band: Frequency interval understood between a determined frequency f_1 and a frequency f_2 related by $(f_2/f_1)^3 = 2$.

Weighted apparent sound reduction index, R'_w: A value in decibels of the reference curve, at 500 Hz, adjusted to the test values of the apparent sound reduction index, R'.

Weighted reduction in impact sound pressure level (or impact sound insulation improvement) of a floating floor or suspended ceiling, ΔL_w: Difference between the normalized weighted impact sound pressure level of the normalized reference concrete and that calculated for this reference concrete with the floating floor or suspended ceiling.

Weighted sound reduction index improvement of a coating, ΔR_w: An increase in the weighted sound reduction index of a construction element by adding a treatment or coating to a base construction element. It is calculated by the difference between the weighted sound reduction index values of a reference construction element with the improvement coating and the base construction element itself.

Weighted sound reduction index, R_w: Value, in decibels, of the reference curve, at 500 Hz, adjusted to the test values of the sound reduction index, R. As an approximation, $R_w + C = R_A$ and $R_w + C_{tr} = R_{Atr}$ are considered.

APPENDIX 2: DESCRIPTION OF THE WORK UNITS

Quantity	Unit	Units
	m^2	**Impact sound insulation: IMPACTODAN® 10 system - Partition walls on concrete.**
		Sound insulation on concrete, consisting of: 10-mm thick cross-linked polyethylene closed-cell foam sound sheet, spread over the concrete ensuring that there are no air pockets, with a compressive strength at 25% over 20 kPa and dynamic stiffness below 65 Mn/m3, IMPACTODAN 10. Overlapped over one another with 3-mm thick and 70-mm wide self-adhesive cross-linked polyethylene strip, with a dynamic stiffness of < 100 Mn/m3, Joining Tape. Separated from vertical elements via a 3-mm thick and 150-mm wide cross-linked polyethylene strip, with a dynamic stiffness below 100 Mn/m3, Perimeter decoupling strip in accordance with DIT No. 439 R/10.
0,15	h	Certified builder
0,15	h	Assistant
1,01	m^2	IMPACTODAN® 10
0,50	ml	IMPACTODAN® JOINING TAPE
1,50	ml	IMPACTODAN® PERIMETER DECOUPLING STRIP
0,01	%	Auxiliary methods
0,03	%	Indirect costs

Quantity	Unit	Units
	m^2	**Impact sound insulation: IMPACTODAN® 5 system with strips- Partition walls on concrete.**
		Sound insulation on concrete, consisting of: 5-mm thick cross-linked polyethylene closed-cell sound foam, spread over the concrete ensuring that there are no air pockets, with a compressive strength at 25% over 20 kPa and dynamic stiffness below 95 Mn/m3, IMPACTODAN 5. Overlapped over one another with 3-mm thick and 70-mm wide self-adhesive cross-linked polyethylene strip, with a dynamic stiffness of < 100 Mn/m3, Joining Tape. Separated from vertical elements via a 3-mm thick and 150-mm wide cross-linked polyethylene strip, with a dynamic stiffness below 100 Mn/m3, Perimeter decoupling strip in accordance with DIT No. 439 R/10.
0,15	h	Certified builder
0,15	h	Assistant
1,01	m^2	IMPACTODAN® 5
0,50	ml	IMPACTODAN® JOINING TAPE
1,50	ml	IMPACTODAN® PERIMETER DECOUPLING STRIP
0,01	%	Auxiliary methods
0,03	%	Indirect costs

Quantity	Unit	Units
		Impact sound insulation: IMPACTODAN® 5 system without strips- Partition walls on concrete.
		Sound insulation on concrete, consisting of: 5-mm thick cross-linked polyethylene closed-cell sound foam, spread over the concrete ensuring that there are no air pockets, with a compressive strength at 25% over 20 kPa and dynamic stiffness below 95 Mn/m3, IMPACTODAN 5. Assembled over one another with a 8-10 cm overlap. Including proportional overlap to separate the vertical elements, according to DIT No. 439 R/10.
0,15	h	Certified builder
0,15	h	Assistant
1,01	m^2	IMPACTODAN® 5
0,01	%	Auxiliary methods
0,03	%	Indirect costs

Quantity	Unit	Units
	m^2	**Impact sound insulation: IMPACTODAN® 10 system - Partition walls on concrete.**
		Sound insulation on concrete, consisting of: 10-mm thick cross-linked polyethylene closed-cell foam sound sheet, spread over the concrete ensuring that there are no air pockets, with a compressive strength at 25% over 20 kPa and dynamic stiffness below 65 Mn/m3, IMPACTODAN 10. Overlapped over one another with 3-mm thick and 70-mm wide self-adhesive cross-linked polyethylene strip, with a dynamic stiffness of < 100 Mn/m3, Joining Tape. Separated from vertical elements via a 3-mm thick and 150-mm wide cross-linked polyethylene strip, with a dynamic stiffness below 100 Mn/m3, Perimeter decoupling strip in accordance with DIT No. 439 R/10.
0,15	h	Certified builder
0,15	h	Assistant
1,01	m^2	IMPACTODAN® 10
0,50	ml	IMPACTODAN® JOINING TAPE
1,50	ml	IMPACTODAN® PERIMETER DECOUPLING STRIP
0,01	%	Auxiliary methods
0,03	%	Indirect costs

Quantity	Unit	Units
	m^2	**Impact sound insulation: IMPACTODAN® 5 system with strips- Partition walls on concrete.**
		Sound insulation on concrete, consisting of: 5-mm thick cross-linked polyethylene closed-cell sound foam, spread over the concrete ensuring that there are no air pockets, with a compressive strength at 25% over 20 kPa and dynamic stiffness below 95 Mn/m3, IMPACTODAN 5. Overlapped over one another with 3-mm thick and 70-mm wide self-adhesive cross-linked polyethylene strip, with a dynamic stiffness of < 100 Mn/m3, Joining Tape. Separated from vertical elements via a 3-mm thick and 150-mm wide cross-linked polyethylene strip, with a dynamic stiffness below 100 Mn/m3, Perimeter decoupling strip in accordance with DIT No. 439 R/10.
0,15	h	Certified builder
0,15	h	Assistant
1,01	m^2	IMPACTODAN® 5
0,50	ml	IMPACTODAN® JOINING TAPE
1,50	ml	IMPACTODAN® PERIMETER DECOUPLING STRIP
0,01	%	Auxiliary methods
0,03	%	Indirect costs

Quantity	Unit	Units
		Impact sound insulation: IMPACTODAN® 5 system without strips- Partition walls on concrete.
		Sound insulation on concrete, consisting of: 5-mm thick cross-linked polyethylene closed-cell sound foam, spread over the concrete ensuring that there are no air pockets, with a compressive strength at 25% over 20 kPa and dynamic stiffness below 95 Mn/m3, IMPACTODAN 5. Assembled over one another with a 8-10 cm overlap. Including proportional overlap to separate the vertical elements, according to DIT No. 439 R/10.
0,15	h	Certified builder
0,15	h	Assistant
1,01	m^2	IMPACTODAN® 5
0,01	%	Auxiliary methods
0,03	%	Indirect costs

APPENDIX 3: ENVIRONMENTAL DATA SHEET

PRODUCT ENVIRONMENTAL PROFILE

PRODUCT	
Trade name:	IMPACTODAN®
MANUFACTURING MATERIALS	
Materials:	Cross-linked polyethylene foam
Volatile organic compound (VOC) content	< 10%
RECYCLED CONTENT	
Recycled prime material content:	5%
Post-consumer recycled content (by weight):	0%
Pre-consumer recycled content (by weight):	100%
(Recycled content is defined in accordance with the document ISO 14021).	
SOLAR REFLECTANCE INDEX	
Solar reflectance index:	N/A
(Value calculated according to ASTM E 1980 methodology)	
MANUFACTURING	
Location:	Polígono Industrial Sector 9, 19290 Fontanar, Guadalajara, SPAIN
Certifications:	Company ISO 9001 certified since 1998
INSTALLATION IMPACTS	
Material losses:	> 1%
Waste:	Plastic packaging to protect the product, to be sent to landfill
Auxiliary products:	Joining tapes, wall and perimeter decoupling strips made from 3-mm thick cross-linke foam
CONTRIBUTION TO BUILDINGS' GREEN CERTIFICATES	
LEED® (United States)	Potential direct and indirect contribution in the following categories and credits: Sustainable sites Credit 7.2: Roofed heat island effect Materials and resources Credit 4: Recycled content Credit 5: Regional materials
ADDITIONAL OBSERVATIONS:	

It can be mechanically separated in water treatment plants.
Given the product's consistency, it does not disperse into the environment, meaning that it does not generate negative environmental impacts.

APPENDIX 4: IMPACTODAN® SYSTEM INSULATION VALUES

Concrete weight (kg/m²)	Subfloor weight (kg/m²)	IMPACTODAN® 5 SYSTEM				IMPACTODAN® 10 SYSTEM			
		L	R	Ln	Rw	L	R	Ln	Rw
250	100	21	5.0	63	54.0	22	5.5	62	54.5
	120	22	5.6	62	54.6	23	6.1	61	55.1
	140	23	5.8	61	54.8	24	6.3	60	55.3
	160	24	6.4	60	55.4	25	6.9	59	55.9
300	100	20	4.0	61	56.0	21	4.5	60	56.5
	120	21	4.6	60	56.6	22	5.1	59	57.1
	140	22	5.2	59	57.2	23	5.7	58	57.7
	160	23	5.8	58	57.8	24	6.3	57	58.3
350	100	19	3.5	59	58.5	20	4.0	58	59.0
	120	20	4.1	58	59.1	21	4.6	57	59.6
	140	21	4.7	57	59.7	22	5.2	56	60.2
	160	22	5.3	56	60.3	23	5.8	55	60.8
400	100	18	3.5	58	60.5	19	3.5	57	60.5
	120	19	4.1	57	61.1	20	4.1	56	61.1
	140	20	4.7	56	61.7	21	4.7	55	61.7
	160	21	5.3	55	62.3	22	5.3	54	62.3
450	100	17	3.2	57	62.2	18	3.2	56	62.2
	120	18	3.8	56	62.8	19	3.8	55	62.8
	140	19	4.3	55	63.3	20	4.3	54	63.3
	160	20	4.9	54	63.3	21	4.9	53	63.9
500	100	16	2.9	56	63.9	17	2.9	55	74.9
	120	17	3.4	55	64.4	18	3.4	54	75.4
	140	18	3.9	54	64.9	19	3.9	53	75.9
	160	19	4.4	53	65.4	20	4.4	52	76.4

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