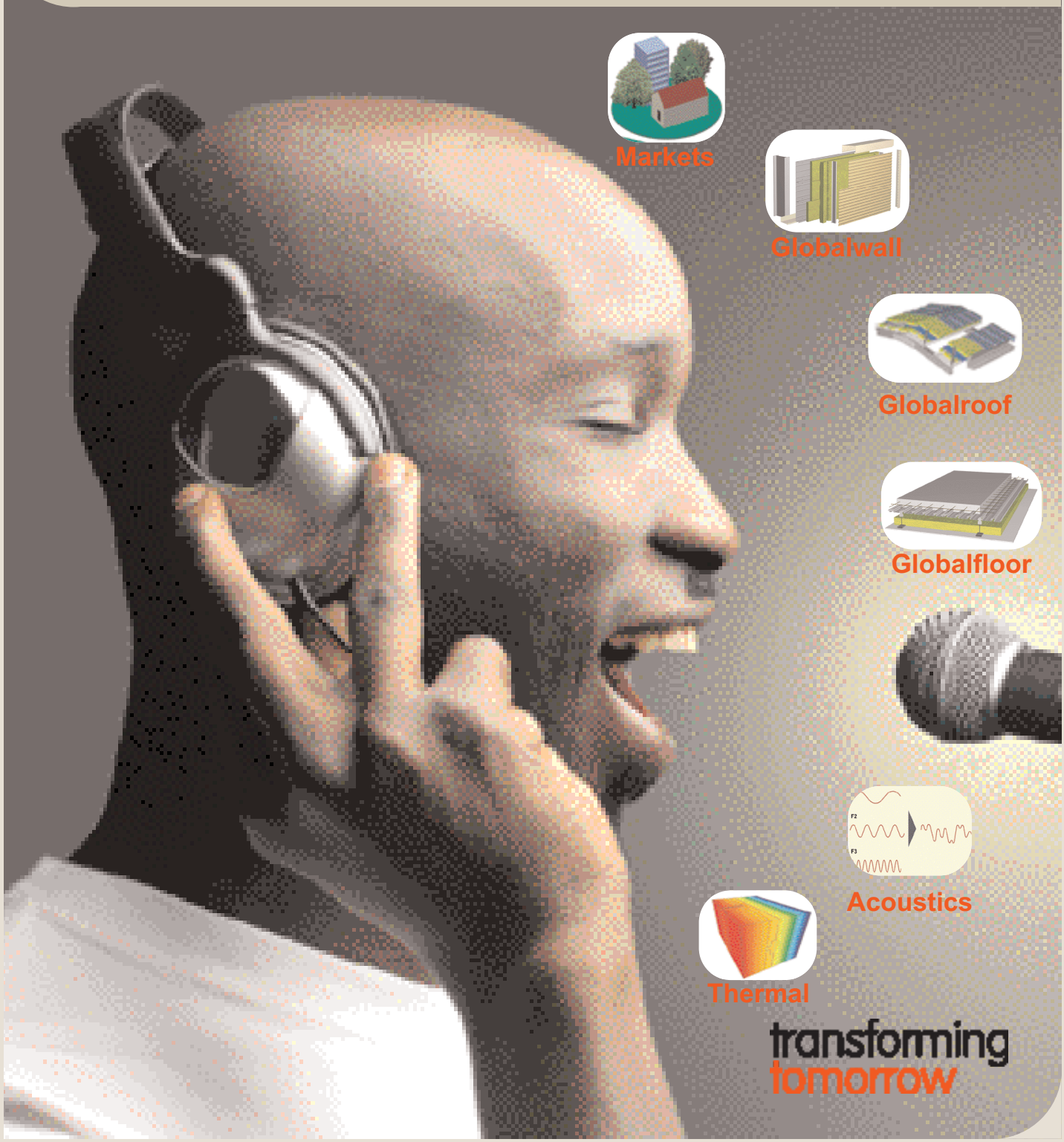
ArcelorMittal

Arval
by ArcelorMittal

# Acoustic and thermal guide

## A guide for energy saving and noise comfort in buildings



# Table of contents



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# Introduction

Saving energy while enhancing thermal and acoustic comfort are objectives you cannot miss out on today.

Arval people have built up this product offer to tally with your current needs and also with future challenges. Their experience and expertise have enabled the development of the most exhaustive range of solutions, integrating highly efficient and innovative constructive systems.

The Building sector accounts for 25% of $CO_2$ emissions and in accordance with the Kyoto Protocol, which, above all, aims at cutting down greenhouse $CO_2$ gases, our goal is to offer the building market systems, which will enable you to achieve lower energy consumption and even generate energy.

All the systems fit thermal regulations and are concerned with equalling out the cost/performance ratio.

They present efficient solutions for acoustic comfort in our buildings, which is also one of our priorities. These acoustic systems are all laboratory tested and certified.

Our systems are environmentally safe because all the components are recyclable and, let us not forget that steel is indefinitely recyclable and recycled.

Our experience has enabled us to acquire a few hundred references in different countries for buildings of all kinds, new or refurbished . Arval technical assistance will give you all the help you need to choose the best system for your building project and, if you do have specific requirements, they will even design a special system for you.

Arval is here to bring you particularized solutions which will build up a sustainable future.

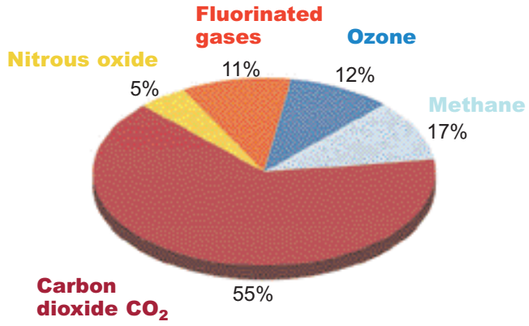
# Context
# Climate change

## Increase in the greenhouse effect

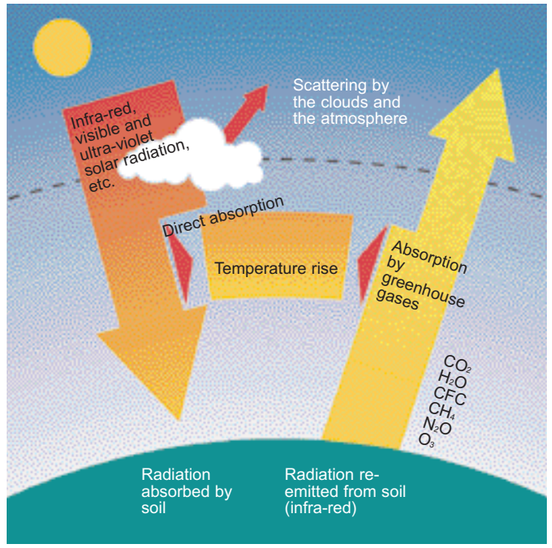
The energy landscape is undergoing a radical change in response to the change in climate challenge resulting from the increase in greenhouse gases and also in order to face up to the shortage of fossil matter (oil, natural gas...).

**Carbon dioxide is the main factor instrumental to the greenhouse effect.**

90% of this carbon dioxide comes from fossil energy combustion (petroleum products, coals, natural gas) and is directly associated with energy consumption.




## Implication for countries




The countries, who have signed up to the Kyoto Protocol, are legally bound to reduce their emissions of greenhouse gases by 5 % by the period 2008/2012 below their 1990 levels ; for countries in the European Union, this means an 8% reduction in emissions.

Additionally, during the European Council in March 2007, the European Union unilaterally promised to reduce their emissions of $CO_2$ by 20% by the year 2020 and invited developed countries to ratify an international pact whereby an overall reduction of 30% below their 1990 levels would be the objective by 2020.

Within this context, it is important to remember that in Europe:

- **energy consumed by services related to buildings accounts for 40% of final overall energy consumption**
- **residential and non-residential building sectors generate 25%(1) of $CO_2$ emissions.**

(1) The indicatory value varies from one country to another.

DX - Fotolia.com

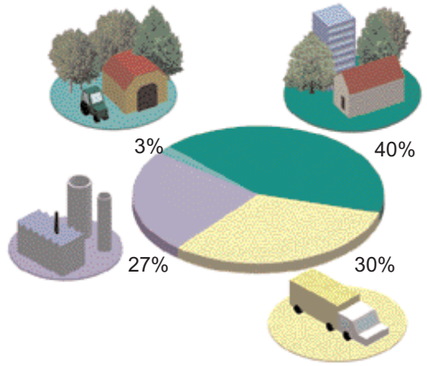


## Energy consumption in the building industry

If it is true that building generates about 25% (1) of greenhouse gases, it is equally true that it is the biggest consumer of energy with a percentage of about 40% (1) of final overall energy consumed including sectors such as transport, industry...

**Heating and air conditioning account for almost two thirds of building energy consumption and for the majority of $CO_2$ emissions.**

Other energy consuming sectors vary to different degrees according to the type of building: household hot water 10%, household appliances and multimedia equipment (15% and 20% in the service sector), air conditioning 5% in the service sector.




**Energy consumption**

Potential savings in energy consumption in the building sector are, therefore, substantial and they will be even more so as overall energy consumption in the building sector is continuing its upward trend.

This is due to the rise in the standard of living, the emergence of new needs such as summer comfort, which generate considerable consumption in terms of air conditioning, and is also due to the increase in the housing stock.

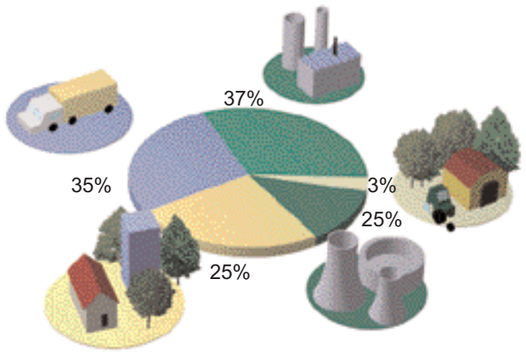
Thus, we can see that energy consumption has steadily increased by 1% per year over the past 30 years in the building sector.

## $CO_2$ emissions in building

Building's $CO_2$ emissions have been steadily increasing since 1990 (they have risen by +15%) and increase the relative weight of the building.

**The role of all those involved in building has, therefore, become a priority in order to meet the sustainable development challenge.**

Progressively, world states have started adopting a progress perspective in building and building refurbishment through new regulations.




**$CO_2$ emissions in the air in Europe (1)**

(1) The indicatory value varies from one country to another.

# Context
# High energy performance building

## European Energy Performance of Buildings Directive


**Since January 2006, the new European Directive "Directive 2002 / 91 /E C European Energy performance of buildings Directive EPBD" seeks to ensure that the new building regulations aim at diminishing energy consumption in buildings.**

Member states are required to do the following:

- Make out an analysis method for energy consumption in buildings in order to work out the energy performance value of the building,
- Determine minimal energy performances for new or renovated buildings,
- Promote the issuing of energy consumption certificates for buildings,
- Draw up requirements in terms of monitoring heating and air conditioning systems.

Moreover, for buildings in excess of 100 $m^2$, it will be mandatory to look into alternative heating or energy generating solutions, which can be incorporated into the building's design.

The traditional method was based on lessening U-values of different components without taking any other factors into account but this is no longer sufficient.

New ways of assessing the energy performance of a building should prove that the new rules have been observed, such that the whole building is taken into account, including its energy efficiency, i.e. its lighting, heating, ventilation, thermal bridging, energy generation, heat recovery, the building's direction...

**Furthermore, analyses should be made of life cycles of systems when designing a building, so that account is taken of the amount of energy required to build and demolish it, as well as the recyclability of materials used and their nontoxicity.**



## Construction " with low energy consumption"

The existing housing stock is at about 400 kWh/$m^2$ per year. Let us not forget that for many years we constructed buildings without even thinking about energy consumption, all you had to do is switch on the air-conditioning or heating to get the right temperature for the season, but all this was at the price of energy consumption and $CO_2$ emissions, which are quite incompatible with a sustainable future.

Our consumption is such that we need to be very ambitious about our energy saving objectives with all the new buildings and existing buildings that need rehabilitating. The horizon is an average of 50 kWh/$m^2$ per year for new and existing buildings. The challenge is sizable.

- In this perspective new regulations are being introduced concerning energy consumption in the building sector.
- In the case of new buildings, the "low consumption building" will relate to primary energy consumption, below 50 kWh/$m^2$ per year and on an average. Even positive energy buildings are a possibility.
- As far as existing buildings are concerned, retrofit should aim at more or less a 40% reduction in energy consumption.

**The primary goal of low energy or "passive" buildings is to cut down energy costs as much as possible by acting upon several parameters, one of which is the long neglected bioclimatic architecture.**

When the building is designed:

- The constructive elements will restrict heat loss and minimise thermal bridging
- Rooms occupied by people will be south facing and IT space, storage locations or any other premises will be north facing
- The right exposure and size of apertures, optimized by sunbreakers, will provide the ability to make the most of winter sun light and heat everywhere whilst providing protection in summer.
- The installation of thermal solar collectors or photovoltaic panels will contribute to establishing an energy balance
- Ventilation will be controlled or even used to heat in winter or cool in summer.

From these ideas arose building labels such as:

| Label examples | Country |
|---|---|
| ***Passivhaus*** | Germany |
| ***Minergie*** | Switzerland |
| ***Effinergie*** | France |
| ***Total quality*** | Austria |
| ***BREEAM*** | UK |
| ***LEED*** | USA |
| ***Green star*** | Australia |
| ***Green Star SA*** | South Africa |

## Modern and summer comfort architecture

**By incorporating thermal summer comfort requirements, thermal regulations have highlighted the advantages of sunbreakers and “honeycomb shell” roofing solutions.**

They are designed to afford protection from solar radiation whilst giving an equal share of thermal comfort and natural lighting without forgetting the view outside.

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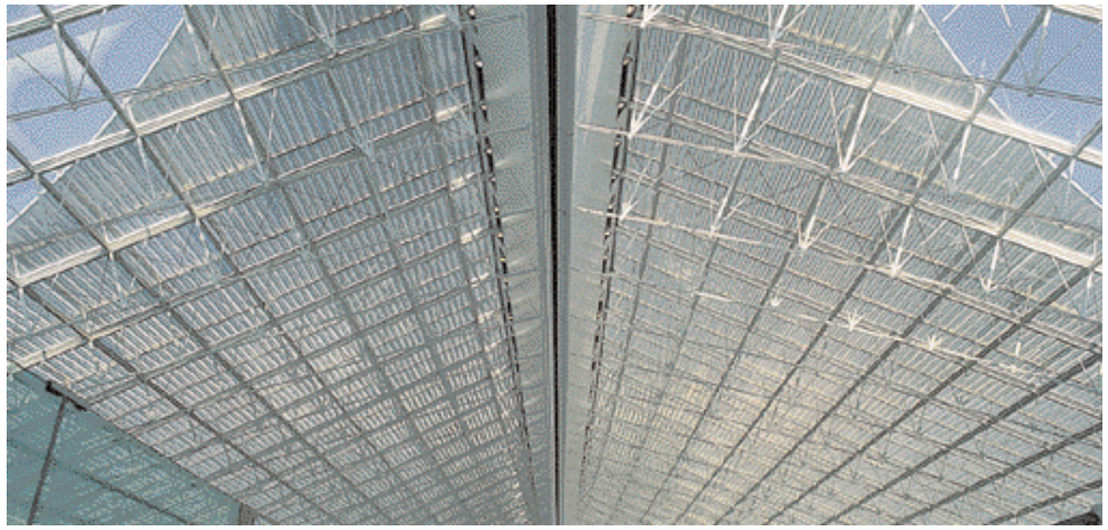
- Despite their highly functional quality, **Sunstyl** sunscreens can give architects a new expressive medium with which to work via their vertical, horizontal or boxed in slats, in a fixed position or multi-directional, in which case they can be hand or motor operated.

Your façades can be light and transparent thanks to steel’s high strength. Used with a concept adapted to summer comfort, picture windows also privilege natural lighting, cut down on the use of artificial light and thus contribute to achieving energy efficient buildings.

- Sunbreakers are very much in demand and have become a must for optimal management of solar contribution.
- Our technical know-how in metalwork enables the achievement of elegant overhead roofing and aesthetic façade solutions.

**The product array we have to offer is vast and fits the requirements of aesthetic sun screening. See our *Sunstyl brochure*.**



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## Thermal comfort of vegetated roofs

**Vegetated roofs provide an answer to the priority of sustainable development. They afford a higher level of hygrothermal, visual and olfactory comfort as well as lessening non-renewable primary energy consumption by contributing to summer and winter comfort.**

S. Chalmeau

**Building: Historial de Vendée**
**Architect: Plan 01 - Mr Tran**

- Hacierco vegetated rooftop solutions contribute to thermal comfort as well as favourably acting upon urban temperatures and water management issues. This is the reason why vegetated roofs are surging in popularity, very much with the support of local authorities.
- Urban areas are, indeed, typically warmer. The main reason for this is the absence of trees and vegetation, which contribute to a natural cooling down of the air through water evaporation from the soil and leaves. Additionally, high rise buildings and narrow streets in towns warm the air and restrict air movement. Vegetated roofs provide solutions for high temperature containment in urban areas during the summer.
- Green roofs can also have a positive impact upon water management in towns and villages by substantially cutting down (up to 50%) the yearly rainwater runoff into drainage systems. Compared to traditional roofing, the green rooftop cover, also, ensures the absorption of high amounts of runoff in the event of showers.
- The green roof offers undeniable advantages for thermal comfort, not only in winter but also in summer. Thermal inertia and protection provided by vegetation keep the temperature of the roof support constant all year round. Nevertheless, appropriate insulation remains essential.
- Vegetated roofing fits in with diverse design solutions: harmonious contemporary lines, setbacks and other plays on volumes, as well as the environmental priority.
- Moreover, Hacierco dry construction methods typically minimise construction site nuisance.

**We can offer steel solutions with a good mechanical performance compatible with this application.**

## Integrated photovoltaic roofing

If regulations become more and more stringent, imposing increasingly more demanding thermal performance thresholds in new and refurbished buildings, the measures will not suffice to fulfil the community's targets for dividing $CO_2$ emissions by four by 2050.

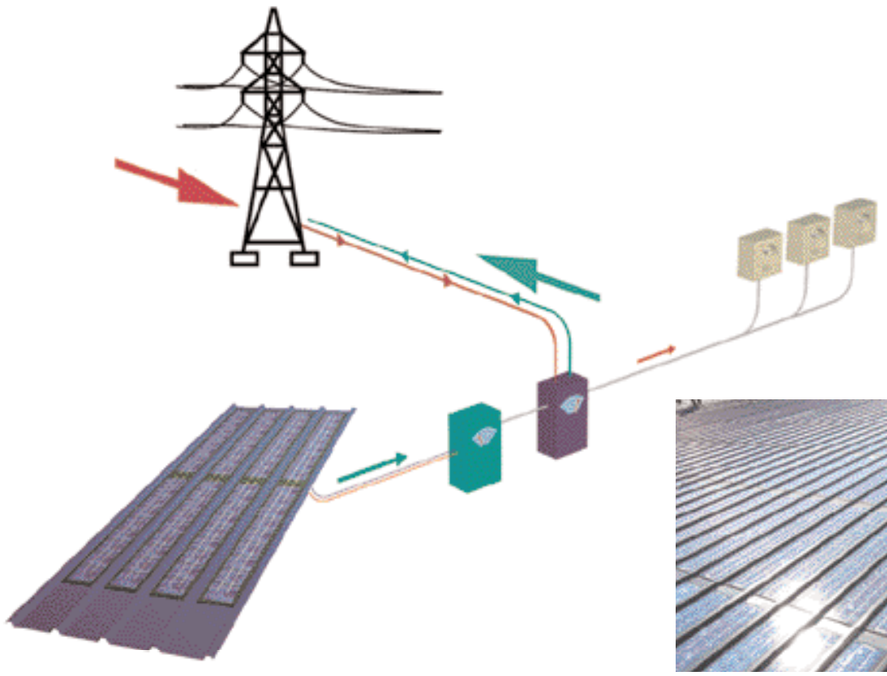
A new way is, therefore, paved for positive energy buildings.

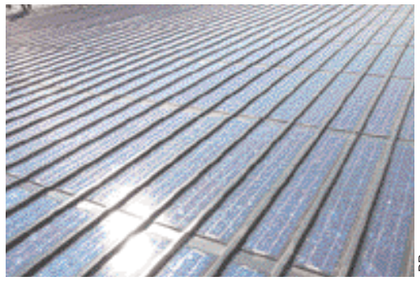
**Thus, tomorrow's energy-generating buildings will take the place of yesterday's energy-consuming buildings.**

The idea that buildings may become energy self-sufficient is no longer considered as exceptional. In the long run, not only will buildings no longer consume energy (due to work carried out on the envelope, ventilation and thermal insulation systems), but they may also generate energy with solar collectors and/or photovoltaic panels.

The pressure of regulations and fiscal incentives vary from one country to another but are, nevertheless, there to meet energy requirements of the future.

**Whether solar applications are thermal or photovoltaic, they will be increasingly integrated into the envelope of the building.**





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**The Arsolar solutions from Arval are particularly appropriate because they combine the energy generating function with that of architectural techniques.**



# Context
# Steel for responsible building

## Steel is perfectly adapted to the sustainable development challenge

In a context where the reduction of greenhouse gases, the environment, health and economy are increasingly linked up, steel presents many advantages.

**Arval construction envelope or internal cladding constructive systems provide a great many thermal and acoustic insulating solutions.**

Comfort, aesthetics, safety, economy, resource preservation: these are qualities that steel construction systems possess, these are their advantages.

davorr - Fotolia.com

Steel has incomparable magnetic properties thus enabling it to be separated and recovered from any other waste constituents. It is, therefore, indefinitely recyclable and recycled.

**Steel can be indefinitely 100% recycled without any change to its inherent properties.**

In the world, the percentage of steel manufactured from recycled ferrous scrap has reached the 40% level. A lot of ore is thus preserved (even though iron ore is one of the most plentiful elements in the earth's crust), with positive consequences upon energy consumption and greenhouse gas emissions.

- Steel is not only a recyclable, recycled, perennial and highly efficient material but it is also neutral as regards health and gives us daily proof of its ability to go along with the most inventive and effective architectural approaches, adapting to the most demanding installation conditions, especially concerning construction site nuisance.

Axel Teichmann - Fotolia.com

**This potential makes steel the unshakeable ally of an environmental approach.**

## Building techniques and systems are chosen to fit in with the environment

Steel constructive elements are prefabricated in the factory thus cutting down on construction site nuisance. Arval systems have found an excellent compromise between weight and resistance, thus offering very vast architectural possibilities and permitting the use of lightweight solutions, which leave space for light and blend harmoniously in with the environment.

The most tangible contribution of steel is most probably to environmental building measures.

**Steel systems take part in this resource saving logic whilst holding on to their architectural functions, generating energy and consuming as little raw materials as possible.**

Furthermore the ductibility of steel is a major asset in the event of an earthquake. Damage to buildings is cut down to a minimum during a tremor. The risk of buildings collapsing is cancelled out.

## Evolutivity

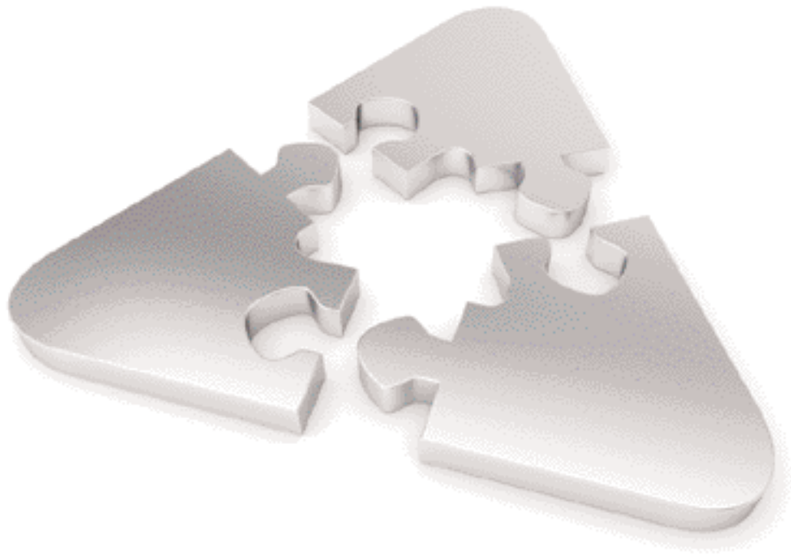
Sustainable development is concerned with the needs of future generations.

With steel solutions, it is easy to reshape spaces in order to adapt to changing applications and different building purposes and, at the same time, minimise environmental impact (waste, energy consumption, etc.).

These solutions make it easy to add on extensions and raise the height of buildings when renovating, refurbishing or carrying out standard compliance work (bracing, adding on a stairway, etc.).

rvvelde - Fotolia.com

**Our solutions are also solutions which can be "reused".**



Qubist - Fotolia.com

## A perennial material

**Thanks to the many protection systems based on metallic and organic coatings, steel does not lose any of its properties throughout the lifetime of the building and ensures its durability.**



# Context
# Acoustic comfort

The pursuit of thermal comfort should not reduce that of acoustic comfort especially for certain uses: classrooms, auditoriums, swimming pools, offices, in which echoes, impact and transmission noises must be banned.

The final solution adopted must accommodate many requirements including the building's finish as well as its built-in aesthetic quality.

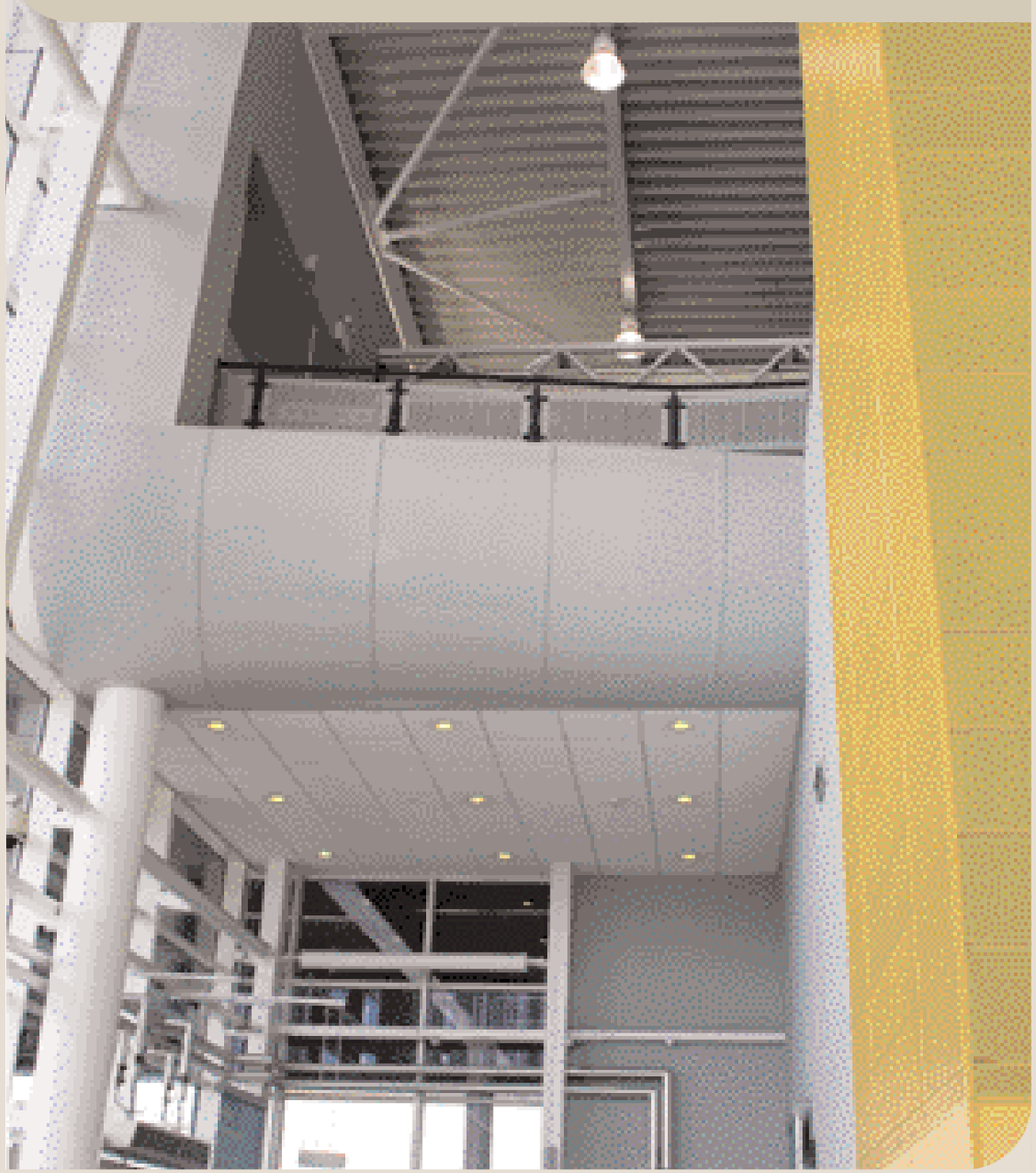
**This guide allows for a better selection to be made through a very wide, classical and also innovative complete systems range.**

- The complete solutions we can offer are **qualified and certified**, providing the ability to fit requirements and regulations :
  - sound insulation,
  - sound absorption.

endostock - Fotolia.com

olly - Fotolia.com

# Application markets



Robert Hackett - Fotolia.com



# Application markets
# Commercial buildings

## Shopping centres

Kirill Zdorov - Fotolia.com

**The leisure centre application of commercial buildings is gradually taking precedence over that of a shopping centre.**

This explains why requirements for these types of buildings are changing in order to enhance the comfort of the building.

These premises need to be comfortable and have a good sustainable aesthetic appearance.

**Arval has a vast range of products that are used to achieve performances laid down by regulations and the customer.**

- **Thermal features:**
  The building must have good thermal protection so as to maintain the right temperature inside the building, regardless of the temperature outside. Thus, people can remain seated in restaurants for long periods or walk around and shop.

- **Acoustics:**
  Acoustic comfort needs to be carefully looked into, also, because there are a wide variety of activities in each part of the centre, such as cinemas, restaurants, shops, etc. We can offer the right system for each part of the centre.

Roman Milert - Fotolia.com

# Application markets
# Sports buildings

## Arenas

**In the design of these types of buildings, it is very important to look into what requirements are essential in order to achieve optimal performances when using the building.**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- **Thermal features:**
The building needs to have good thermal insulation because it can be used for different activities and it is, therefore, important for the right temperature to be maintained inside the building.
Low inertia can be an advantage because the building is only in use for a few hours.


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- **Acoustics:**
The building must be designed to house thousands of noisy people. It is very important to have good sound absorption in order to achieve a good level of comfort, even if people shout.
Most of these buildings are multipurpose and may be used as concert halls, sports facilities and, also, meeting rooms. Reverberation time needs to be adjusted in order to achieve a good level of comfort.
Good sound insulation is required to avoid any propagated sound impact on neighbours.

**We can offer several systems, which will give you performances compliant with the regulations or able to meet specific requirements for your building, whilst providing you with the possibility of designing an aesthetically pleasing building.**

## Gymnasium

**When several people are in a gymnasium, the noise inside is loud. Arval can propose systems capable of adjusting reverberation time and improving acoustic comfort.**

Arval is able to propose the right system for every kind of Gymnasium so that the sound reflected inside the building is adjusted, even if the number of people inside has increased.

At the same time, we are able to achieve thermal performances, which ensure a good level of indoor comfort without heavy energy consumption.


Filipe varela - Fotolia.com



## Swimming pools – water parks

Indoor swimming pools and water parks are among the most popular buildings for children and people.

**The swimming pool environment is rather particular and very aggressive. Arval is able to come to terms with the combination of humidity, chlorine, and warm temperatures. Arval has developed systems that have worked well for over 10 years.**

- **Humidity:**
The percentage of humidity in the building can reach 100%. This means that if we do not avoid water absorption, the insulation will deteriorate. Using the right insulation integrated in the global system is the key to using the building correctly. Moreover, the risk of damp occurring is increased by chlorine particles dissolved in the environment.


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**Building: Centre nautique de Tarare**
**Architect: Sylvie Lebreton**

- **Thermal features:**
Swimming pools are warm during the summer and during the winter too. This means that the risk of condensation must be avoided at all times; even if there is 100% of humidity indoors.

- **Acoustics:**
Swimming pool areas or water parks are typically quite extensive, thus sound reverberation demands that particular design attention be paid to absorbing sound reflecting off hard surfaces.
Pools are very reflective to sound due to their tiled walls and floor surfaces. One of the largest sound reflective areas in the swimming pool is the water itself which reflects 99% of the sound which hits it.
There are many young people in this type of building and acoustic correction is essential if we wish to understand each other and maintain a harmonious atmosphere.

**Hairaquatic is a unique system that is able to solve all these problems at the same time.**


.shock - Fotolia.com

# Application markets
# Public buildings

## Hospitals

Hospitals are one of the most complex types of buildings. Each hospital comprises a wide range of services and functional units.
Flexibility and expandability are also important since medical needs and modes of treatment will continue to evolve.

**Hospitals must be easy to clean and maintain and this is facilitated by appropriate, durable materials and finishes.**

Philippe Geenen - Fotolia.com

- **Thermal features:**
  Hospitals are large public buildings that have a significant impact on the environment and economy of the surrounding community. They are heavy users of energy.

  Because hospitals place such high demands on community resources they are natural candidates for sustainable design and high thermal-efficient solutions to avoid excessive heat build-up in summer and heat escape in winter.

- **Acoustics:**
  Every effort should be made to make the hospital remain as unthreatening, comfortable, and stress-free as possible. We can propose several systems for hospitals with very good thermal and noise insulation so that a quiet room is available at any time.

## Retirement

Have you worked all your life long?
Where would you like to live once you have retired?

**Arval thinks that indoor comfort is essential to our lives and this is even truer when we retire.**

Therefore, we have put different systems on the market to improve thermal and acoustic comfort.

James Steidl - Fotolia.com

- **Thermal features:**
  Improving thermal insulation provides the ability to keep the indoor temperature at the right level at a low cost.

- **Acoustics:**
  This is an important issue because we want to spend our time in a comfortable place with as little noise as possible coming from outside and no sound reverberating.

**Arval gives you the answer to all your requirements.**



## Education

Monika Adamczyk - Fotolia.com

Education serves several purposes in societies, the most important of which being its role as a means for social development and democratic empowerment.

**Schools need a healthy and invigorating indoor environment where every child has the best opportunity to learn - and the teacher the best opportunity to impart knowledge and interact with the pupils.**

What affects the operational efficiency and comfort of a school?

- **Visual comfort:**
  You can choose if you wish to allow light to enter via the roof or via the façade and we can offer you the right system for optimum results.

- **Acoustics and degree of noise annoyance:**
  Research has confirmed that noise in the class room, even when it is significantly below harmful levels, can be detrimental to mental and physical health. Students who are subjected to noise show increased incidence of nervous complaints, nausea, headaches and other problems, such as mood changes and potentially increased incidence of conflict.

These factors are particularly relevant in schools since schools present a more concentrated set of acoustic problems.

Good acoustics for learning support easy verbal communication, which requires low noise levels and very little reverberation. Sources of noise hampering students' concentration include:

- outside the school (vehicular traffic and aircraft flyover)
- the hallways (foot traffic and conversation)
- other classrooms (amplified sound systems and inadequate partition sound transmission loss)
- inside the classroom itself (reverberation).

picsfive - Fotolia.com

- **Thermal comfort:**
  Thermal comfort means that teachers, students and administrators should neither be hot or cold as they teach and learn.
  The aim is to create a working environment in which the air is fresh and maintained at a comfortable temperature for the purpose.
  A high performance school is also energy efficient. Energy efficient schools save money while conserving non-renewable energy resources and reducing atmospheric emissions.

# Application markets
# Community buildings

## Auditoriums

Sound performance is the target of these buildings. Any noise is to be ruled out as it can disturb listening to music.

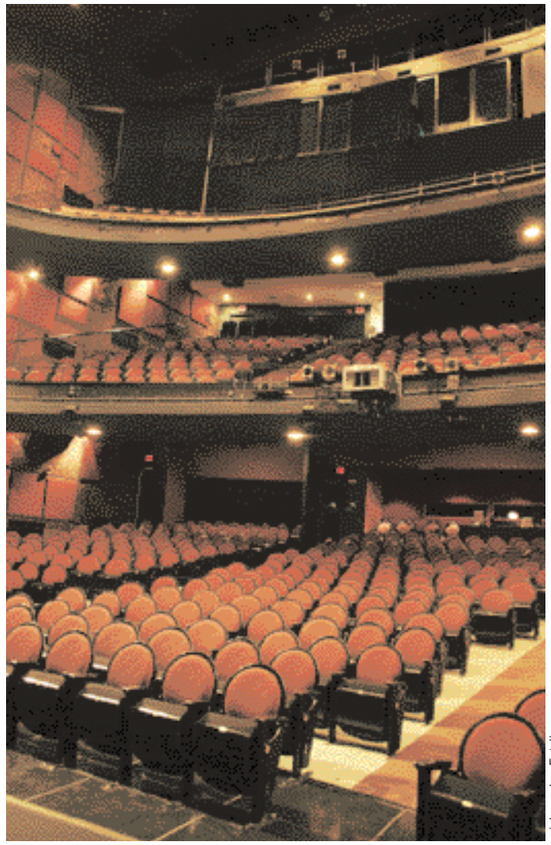
**All systems must be studied, designed and properly installed because if some aspect is not correctly accomplished, the system will not work and the building will forever have bad acoustics.**

The performances we need to take into consideration are:

- **Thermal features:**
  People go to the Auditorium or the cinema to comfortably listen to music, watch a play or film.
  We need to install a cost-effective system with thermal insulation so as to maintain a constant temperature.

- **Acoustic insulation:**
  Acoustic insulation is critical in these buildings. Outside noise must be kept out of the building.

- **Acoustic correction:**
  Avoiding outside noise is insufficient. Reverberation time is critical and should be corrected at any frequency. The system must absorb noise at any frequency. The system would be considered ineffective if it just absorbs low frequencies and not high frequencies, or vice versa.



pink candy - Fotolia.com

Ivan Hafizov - Fotolia.com

**Arval can propose several systems for these buildings in compliance with the regulations or in accordance with a customer's specific requirements, whilst being very appropriate for high-end façades.**



## Offices

pat fauve - Fotolia.com

Offices are the image of a company. Every company wants to give the best aesthetical image.

**Arval has several systems, which can combine aesthetics with performances required by the regulations or by a customer's specifications.**

As people working in these buildings spend 1/3 of their day in the building, the building must be designed to keep indoor comfort as high as possible in order to improve staff efficiency.

With our system, the right balance can be found between aesthetics and requirements.

This building must have good performances in:

- **Thermal features:**
  The building must have good thermal insulation to keep the internal temperature at an energy efficient cost.
  It has been proved that if the temperature is not controlled, people's efficiency diminishes fast.

- **Acoustics:**
  Office work requires that people concentrate during phone conferences, meetings and open discussions, etc.
  This means that we need to have good acoustic insulation to avoid external noise annoyance and also acoustic absorption to keep the reverberation time at the right level.

Ludovic LAN - Fotolia.com

# Application markets
# Community buildings

## Hotels

**A hotel is designed to be attractive to people who are seeking accommodation. However, nothing is achieved if the internal comfort is not appropriate for the building.**


Stephen Coburn - Fotolia.com

The performances we need to take into consideration are:

- **Thermal features:**
  The building is occupied by people all year round, which means it should be thermally insulated so that the indoor temperature remains at the appropriate level all year, in summer and in winter. If the thermal insulation is not efficient the energy cost will be high and the people will not go back to the hotel.

- **Acoustics:**
  The acoustic insulation must be in accordance with the regulations or even higher. People accommodated in the hotel want to spend their time resting. If there is too much noise, they will choose a different hotel next time.

**Arval can propose several systems for these buildings in compliance with the regulations or in accordance with a customer's specific requirements, whilst being very appropriate for high-end façades.**

## Apartments

arkna - Fotolia.com

Our home is where we rest at the end of a day's work, talk to the family about the latest news: it is the place where we lead our private lives, etc.

**The systems Arval proposes have registered very good performances regarding thermal and acoustic insulation.**

- **Thermal features:**
  The building must have sufficient thermal insulation to maintain the indoor temperature at a good energy efficient cost.

- **Acoustics:**
  People want and need to rest at home.
  Good acoustic insulation is required to keep the noise out.

ChantalS - Fotolia.com



## Airports

**Airport terminal buildings are for current architecture the equivalent of cathedrals for the Middle Ages.**

Architects use a tremendous amount of imagination to design the latest Terminal Buildings in order to accomplish the most beautiful buildings.

However, they need to obtain optimum performances without changing their designs and Arval is able to offer them this capability.

Our systems allow for creativity whilst affording the best thermal performances for indoor comfort.

Acoustic performances are also very important.

Can you imagine hearing the noise of planes while you are waiting for your flight?

Can you imagine missing your flight because you are unable to make out what they are saying on the PA system?

**Arval knows all about this and has developed optimum systems to accommodate these issues.**


Thor Jorgen Udvang - Fotolia.com

## Railway stations

**High speed trains are one of the latest developments, which are changing our habits in middle-distance travelling.**

Some passengers, who used to travel by plane, are now travelling by train. This means new railway stations.

ukilledthecat

New stations require new performances.

- **Thermal insulation:**
  There are more passengers waiting for more trains. This means they need to be able to wait comfortably for the train to arrive.

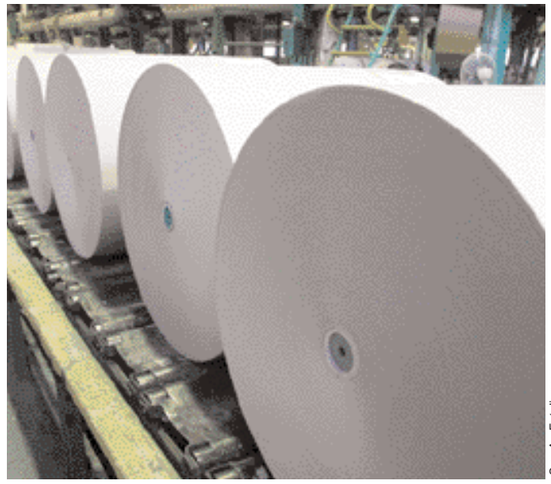
- **Acoustic insulation:**
  Trains are not noisy. However, several trains plus waiting passengers produce noise, which means that the reverberating time needs to be corrected. Arval can provide solutions for constructive systems that require correction such as roofs, ceilings and façades.

# Application markets
# Industrial buildings

## Paper industry

The internal environment of these types of buildings is very aggressive because of high humidity, chemical particles suspended in the air, internal noise and the temperature inside.

**Arval has been working for years on developing systems, which are able to find the right balance between all these performances.**



SemA - Fotolia.com

- **Humidity:**
The percentage of humidity in the building can reach 95%. Therefore, it is necessary to attend to the vapour permeability and vapour absorption of the insulator. You must use insulation with no vapour absorption otherwise it will be degraded by changes in outside temperatures.

- **Thermal features:**
Since the inside temperature is above 28ºC in some parts of the building, you need to calculate the thermal insulation required in order to avoid condensation in wintertime. High humidity in these buildings makes the issue even more important.

- **Acoustics:**
When the machinery is working, noise inside is louder than 90 dB. We need to correct the reverberation time in order to enhance noise comfort within the building. Noise absorption can be achieved, but when we combine this requirement with high humidity and chemical components suspended in the air, we need to select a system dedicated to this, such as Hairaquatic and Wallaquatic.

- **Chemical corrosion:**
We can offer you coatings designed to protect metallic sheets from chemical corrosion, even when the steel sheet is perforated.

SemA - Fotolia.com

**Our Hairaquatic system is the solution you need for these buildings because the thickness of the thermal insulator provides the ability to achieve the appropriate thermal insulation.
This thermal insulation does not absorb water.**



## Recycling, water and waste treatment plants

Phils - Fotolia.com

The evolution of regulations in terms of waste management and treatment has led to the building of facilities such as compost plants, waste sorting plants, waste incinerators and sewage treatment plants.

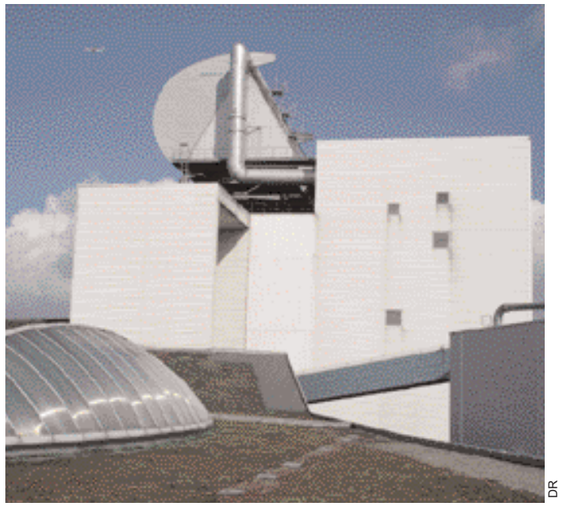
**These new facilities are getting bigger and bigger and, when built near towns, undergo more and more controls.**

The public authorities may encourage measures to optimize environmental integration via vegetated roofing so that these buildings fold perfectly into the landscape.

- **Sound proofing and absorption:**
People living in the vicinity do not want to have to put up with sound annoyance or the inconvenience of unpleasant smells. Building closed facilities, in this case, means getting rid of these inconveniences, namely via sound proofing.
In recycling plants, noise can be so loud that it proves to be necessary to address the sound absorption issue.

- **Thermal features:**
As for compost plants, buildings with thermal insulation are required so that temperature controls can be carried out to manage the industrial process.

sylbohec - Fotolia.com



DR

**Monthyon waste treatment plant (77)
Architect S'PACE**

# Application markets
# Storage buildings

## Agri-foodstuffs

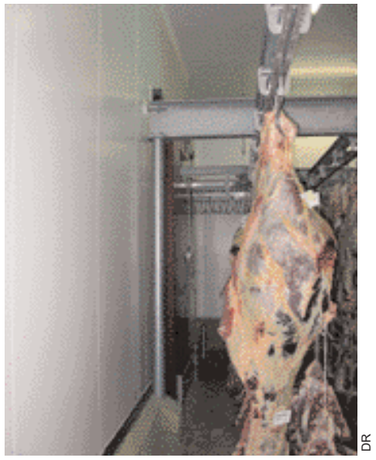
**The agri-foodstuffs market has got bigger and, therefore, performances are different according to the use made of the building.**

This market must have buildings, which can store products at any temperature, from 20ºC to - 40ºC.

This means, a very wide range of products with appropriate performances is required to deal with all situations.

- **Thermal insulation:**
  Thermal insulation is the most important point to be taken into consideration whatever the case may be. It is always necessary to think about thermal bridging but, in this particular case, it is even more important to do so because the difference in temperature between inside and outside is considerable.

  Arval offers polyurethane panels with U values from 0,35 to 0,11 W/m² ºK.



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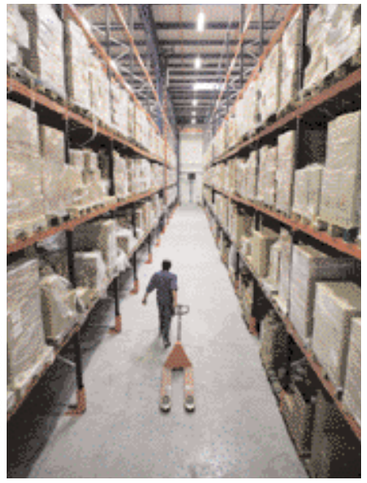
**Arval has other systems to offer in case different performances are required in addition to thermal performances.**

## Logistics

**Globalization means that the product can be manufactured in any part of the world and sold elsewhere.**

That is why we need to carry and store different products, materials or animals. In this respect, buildings have to be designed with thermal and acoustic performances because over time we may change what we store.



REMY GROS - Fotolia.com

Depending on the products we store, the facilities may require a heating or a cooling system.

If we store fruit, a constant temperature of 4 to 6ºC is required.

However, when the stored goods are not perishable, the temperature should be right for the people working inside.

Rocha - Fotolia.com



# Application markets
# Agricultural buildings

## Farms

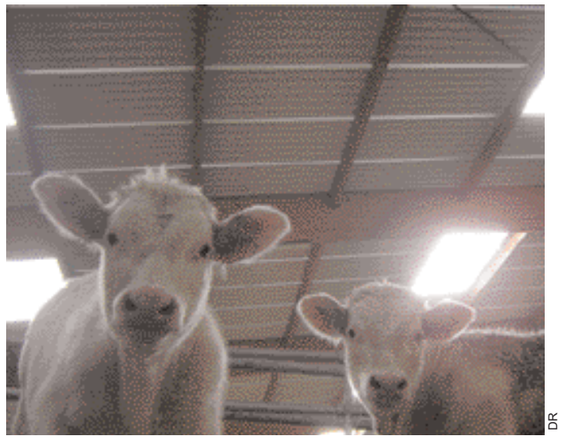
**The production of a farm is in direct relation with the animals' comfort. If the temperature in the building is too high or too low, the animals die.**

geewhiz - Fotolia.com

When designing these buildings, we have to bear in mind the following performances:

- **Thermal features:**
  It is important to have the right thermal insulation so that a small amount of energy is used to keep the building warm and stop it from getting cold.
  The animals help to maintain a warm atmosphere with low energy consumption.

- **Ventilation:**
  With the right ventilation and thermal insulation, we can keep the temperature under control in the summer time, keep the heat out during the day with the insulation and cool down the building during the night with the ventilation.



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**This system will allow you to reduce energy consumption all the time.**

# Globalwall
## Solutions for high energy efficiency

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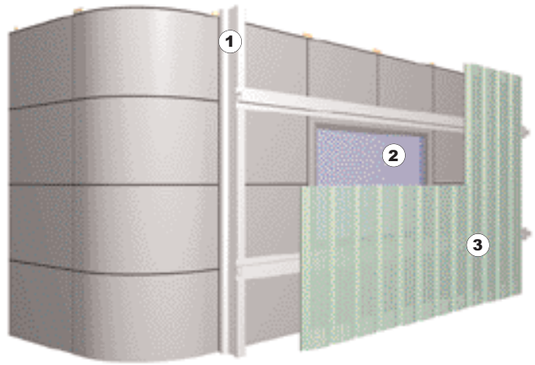
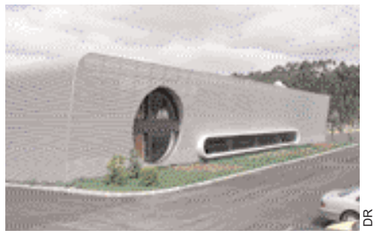
# Globalwall
# Sunstyl

## Transparent Sunstyl

**The Sunstyl product provides the ability to cut down on the impact of the sun on glazed parts of a building.**



DR

**System description**
1. Secondary Frame
2. Windows ; Glass wall, etc.
3. Sun screen

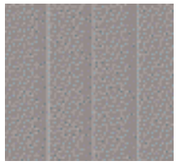
It enables a cut in energy consumption for air-conditioning due to a better control of hot sun rays admitted.

Mascaret

Perforation ratio:
13 to 27%

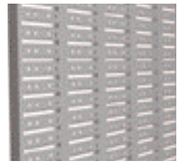
Trapeza

Perforation ratio:
15%



Hairplan deco

Perforation ratio:
25%



Lumiere

Perforation ratio:
17%

Frequence screen

Perforation ratio:
15%

**Advantages**

These solutions enable the aesthetically pleasing appearance of the façade to be maintained via the installation of a product which admits sunlight into the building during the day and lets artificial light out at nightfall, the light being filtered by the Sunstyl sun breaker.

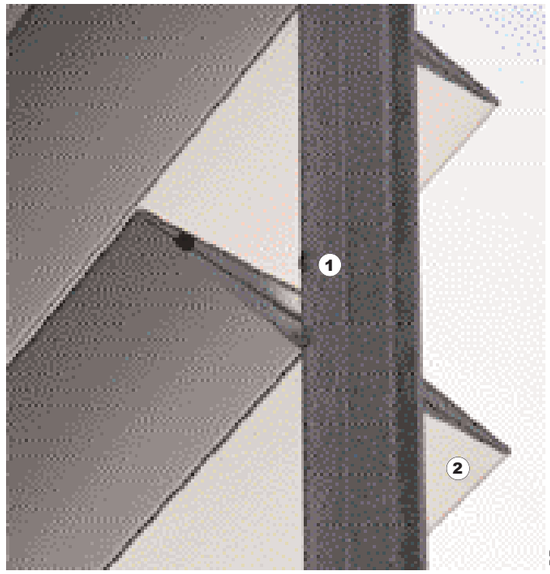
# Globalwall
# Sunstyl

## Ecume

**Ecume allows for an increase in the building's summer and winter comfort via a sunray entry control system.**

This can be a motor driven system which ensures an optimal input of sunrays in winter and a decrease in direct sunlight in summer.

Ecume can be motor driven or not.



DR

**System description**
1. Secondary frame
2. Sunstyl


DR

### Advantages

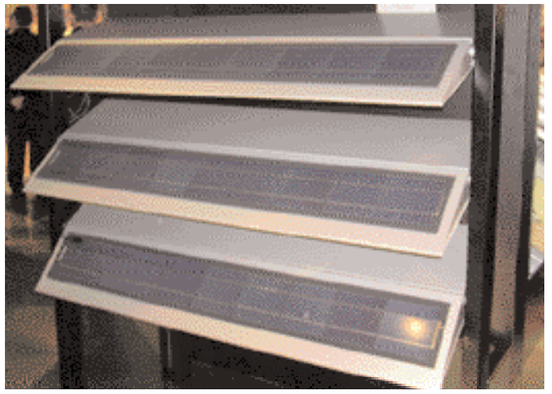
This aesthetically pleasing product can be steered to face in the right direction so that the building acquires luminosity and, at the same time, reduces solar radiation.
You can achieve a saving in energy consumption for air-conditioning in the summer time.

### Special points

The singularity of this system is that it can be motor driven to face the right way every time.



## Solar Ecume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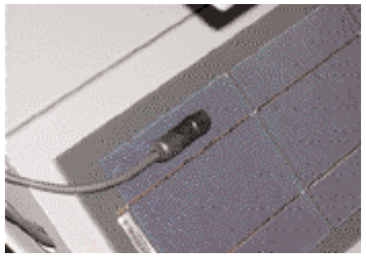
**Arval has developed Solar Ecume with a view to offering façades a Sunstyl solution.**

This product has been architecturally and technically designed to generate electrical power.

This solution is particularly appropriate for service sector buildings where priority has been given to cutting down $CO_2$ emissions, thus playing a part in sustainable development.

This solution integrates crystalline silicon cells into a steel product.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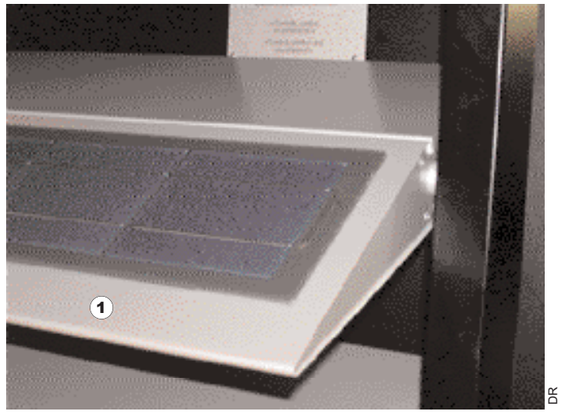

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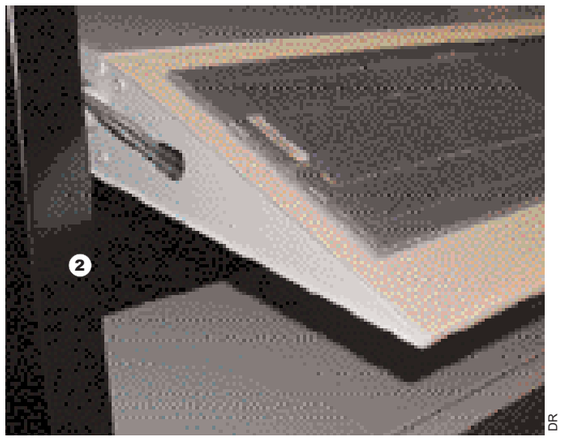
**System description**
1. Photovoltaic Ecume
2. Secondary frame



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**These products allow for a connection to be established with the electricity production network.**

Note: See photovoltaic roofs for more information.

# Globalwall
# Sunstyl

## Slats

Other Sunstyl systems are at your disposal to screen windows from the sun.

**Arval can offer you Sunstyl with a lighter secondary structure than many other systems you can find.**

These systems can be made to fit over windows smaller than 4 m (consult us for longer elements).

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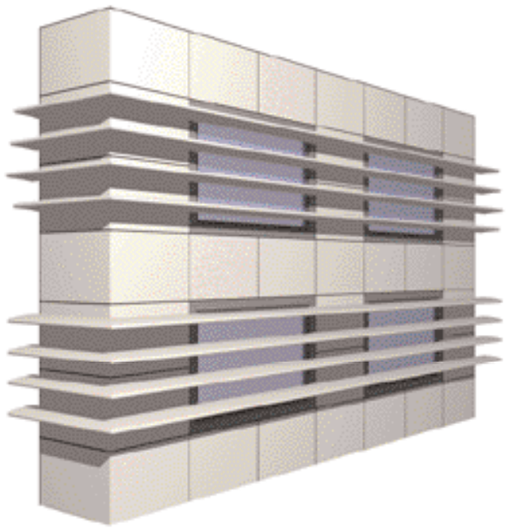
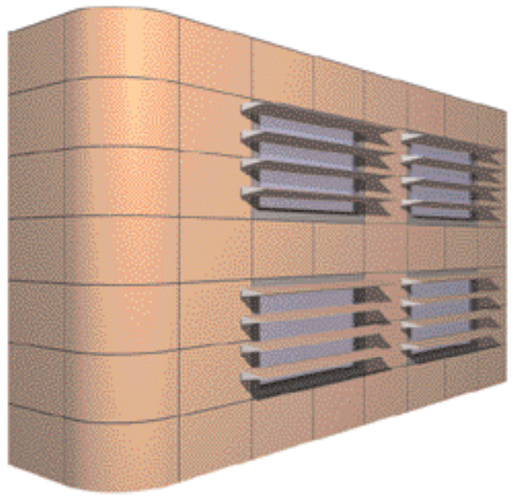
Examples of our slat Sunstyl systems:

- Enva
- Morgio
- Mistra
- Lubero
- Sterel







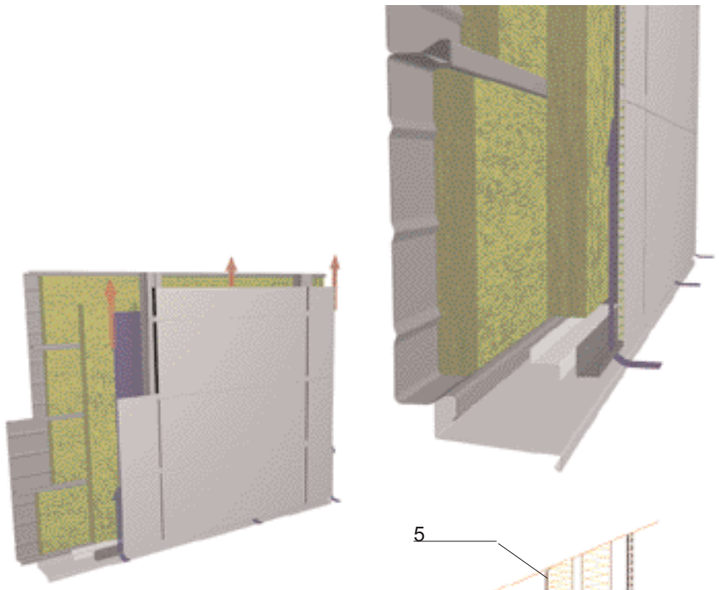
# Globalwall
# Ventilated Facade

**Arval has developed its own ventilated façade systems with a plethora of external sheets.**

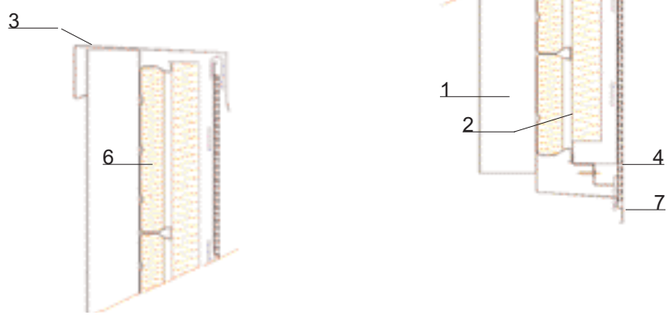
We can offer you a wide range of shapes and colours, which will enable you to design the building you have dreamed of. Our systems are energy saving and, you can save this energy because you are reducing solar radiation on the wall.

We have several systems and products to offer, which are all suitable for use on this kind of façade.

- Hairplan
- Marine
- Isofran
- Gascogne



**System description**
1. Framework
2. Secondary structure
3. Parapet cap flashing
4. Cladding strip
5. Trays
6. Insulation
7. Drip flashing




**Advantages**

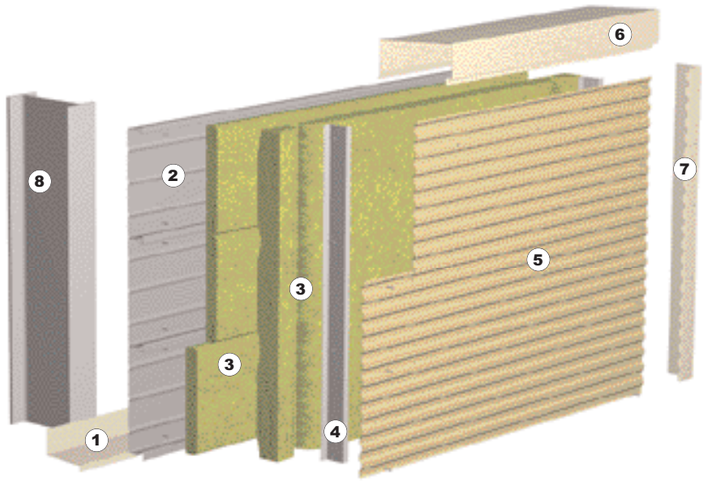
An aesthetically-pleasing, energy saving system with no extra insulation required due to natural ventilation between the skins.

# Globallwall
# Insulated double skin facade
# Principles

**The insulated double façade systems developed by Arval render top performances and provide the answer to regulations in force or specific requirements.**

- Technical performances for thermal Globalwall
- Technical performances for acoustic and thermal Globalwall

Their design not only incorporates a compromise between the price and a reduction in energy losses, but also deals with the risk of condensation.




**System description**
1. Drip flashing
2. Trays
3. Insulation of one layer or more
4. Spacer
5. External skin (horizontal, vertical, …)
6. Parapet cap flashing
7. External corner
8. Structure

Arval technical assistance will size the structure of thin PDF elements suited to your project (see the questionnaire at the end of the guide).



# Globallwall
# Insulated double skin facade
# The systems

**Various Globalwall systems have been designed in order to meet market requirements.**

There are two subsystems according to whether they are:

- for energy saving walls,
- for acoustic comfort and energy saving walls.

Acoustic performances are laboratory established and set forth in certificates.

## Insulated double skin cladding

### Thermal Gobalwall

| System | | Thermal transmittance U W/(m².K) |
|---|---|---|
| DS | DS 43 | 0,43 |
| DSS | DSS 44 | 0,44 |
| | DSS 43 | 0,43 |
| | DSS 38 | 0,38 |
| | DSS 35 | 0,35 |
| | DSS 39 | 0,39 |
| | DSS 36 | 0,36 |

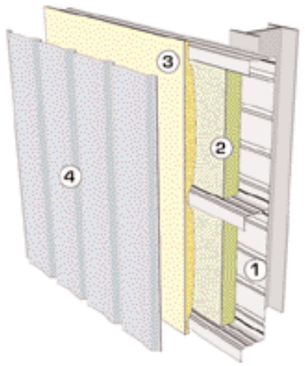
### Acoustic and thermal Gobalwall

| System | | Acoustic attenuation Rw (C ; Ctr) dB | Acoustic absorption αw | Thermal transmittance U W/(m².K) |
|---|---|---|---|---|
| IN | IN 227 | 54 (-2 ; -7) | - | 0,30 |
| | IN 226 | 50 (-2 ; -7) | - | 0,43 |
| | IN 220 | 42 (-4 ; -11) | - | 0,63 |
| | IN Isofran | 41 (-1 ; -6) | 0,75 | 0,41 |
| CIN | CIN 338B | 48 (-2 ; -8) | 0,75 | 0,39 |
| | CIN 323 L | 44 (-1 ; -7) | 0,90 | 0,34 |
| | CIN 327 | 40 (-2 ; -7) | 0,90 | 0,34 |
| CN | CN 125 | 36 (-2 ; -7) | 0,75 | 0,67 |
| | CN 120 | 30 (-2 ; -7) | 0,75 | 0,81 |
| Eccorisol | Eccorisol | 39 | 0,80 | 0,37 |
| UK | UK 10 | 30 (-1 ; -2) | - | 0,40 |
| Wallaquatic | Wallaquatic | 37 (-2 ; -7) | - | 0,83 |
| Habilis | Habilis | 58 (-1 ; -6) | 0,85 | 0,318 |

Acoustic insulation or attenuation, acoustic absorption and heat transmission are described in detail in the chapter dealing with "Basic Concepts".

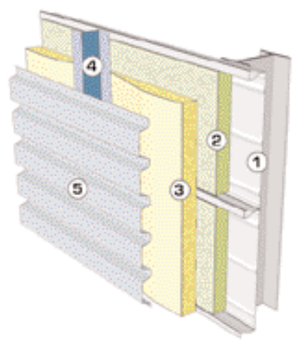
# Globallwall
# Insulated double skin facade
# Thermal solutions

## DS 43



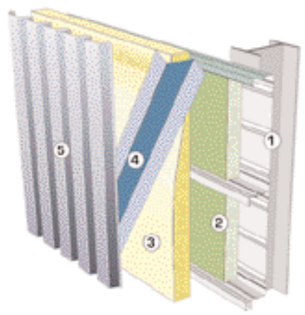

**System description**
1. Hacierba profile
2. Tray bottom insulation
3. Roll insulation
4. Profile Frequence, Oceane or Trapeza

## DSS 44




**System description**
1. Hacierba profile
2. Tray bottom insulation
3. Roll insulation
4. Spacer
5. Profile Frequence, Oceane or Trapeza

## DSS 43




**System description**
1. Hacierba profile
2. Tray bottom insulation
3. Roll insulation
4. Spacer
5. Profile Frequence, Oceane or Trapeza

| System | Thermal transmittance U W/(m².K) | Cubic size cm |
|---|---|---|
| DS 43 | 0,43 | 18 |
| DSS 44 | 0,44 | 18 |
| DSS 43 | 0,43 | 17 |

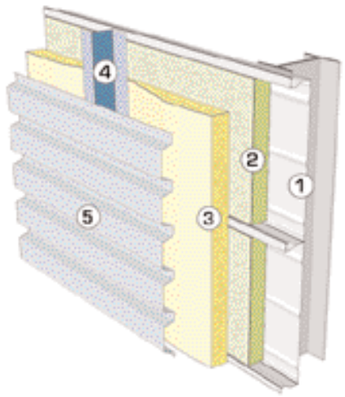
U for 2 m distance between spacers, parallel to the trays

**Advantages**

- Aesthetic
- Good thermal performances
- Economical systems
- Buildings with no acoustic requirements



## DSS 38 and DSS 35




**System description**
1. Hacierba profile
2. Tray bottom insulation
3. Roll insulation
4. Spacer
5. Profile from the Frequence, Oceane or Trapeza product ranges

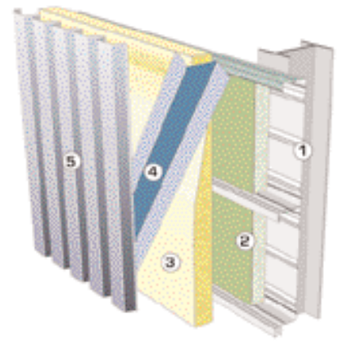
| System | Thermal transmittance U W/(m².K) | Cubic size cm |
|---|---|---|
| DSS 38 | 0,38 | 20 |
| DSS 35 | 0,35 | 20 |

Estimated value where the distance between the spacer = 2 m parallel to the trays

**Advantages**

- Aesthetic
- Good thermal performances
- No-linear thermal bridges
- Cost-effective systems
- Buildings with no acoustic requirements

## DSS 39 and DSS 36




**System description**
1. Hacierba profile
2. Tray bottom insulation
3. Roll insulation
4. Spacer
5. Profile from the Frequence, Oceane or Trapeza product ranges

| System | Thermal transmittance U W/(m².K) | Cubic size cm |
|---|---|---|
| DSS 39 | 0,39 | 18 |
| DSS 36 | 0,36 | 18 |

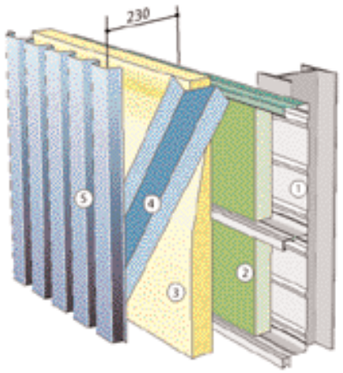
Estimated value where the distance between the spacer = 2 m parallel to the trays

**Advantages**

- Aesthetic
- Good thermal performances
- No-linear thermal bridges
- Cost-effective systems
- Buildings with no acoustic requirements

# Globallwall
# Insulated double skin facade
# Acoustic and thermal solutions

## IN 226




**System description**
1. Hacierba profile
2. Tray bottom insulation
3. Roll insulation
4. Spacer
5. Profile from the Frequence, Oceane or Trapeza product ranges

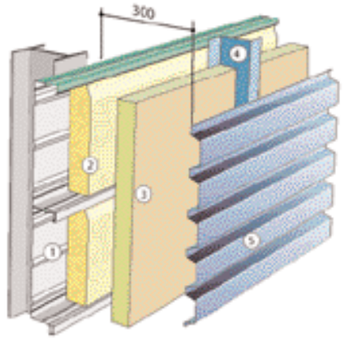
| Acoustic attenuation | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|
| Rw (C ; Ctr) dB | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 50 (-2 ; -7) | 0,43 | 0,94 | 33 | 23 |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 29 | 40 | 49 | 52 | 57 | 62 |

**Advantages**

- Aesthetic
- Low thermal bridges
- High acoustic performances
- Concert halls, Noisy factories, etc.

## IN 227




**System description**
1. Hacierba profile
2. Tray bottom insulation
3. Roll insulation
4. Spacer
5. Profile from the Frequence, Oceane or Trapeza product ranges

| Acoustic attenuation | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|
| Rw (C ; Ctr) dB | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 54 (-2 ; -7) | 0,30 | 0,94 | 49 | 23 |

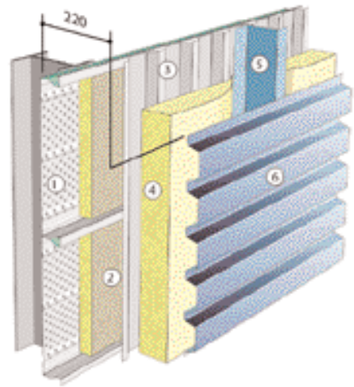
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 33 | 46 | 52 | 56 | 57 | 60 |

**Advantages**

- Aesthetic flat underside with secret-fixing
- Available in curved shapes
- Very high acoustic absorption performances
- For unheated buildings if not see 125RT



## CIN 338 B




**System description**
1. Perforated Hacierba tray
2. Tray bottom insulation
3. Hacierba profile
4. Roll insulation
5. Spacer
6. Profile from the Frequence, Oceane or Trapeza product ranges

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 48 (-2 ; -7) | 0,85 | 0,36 | 0,80 | 28 | 26 |

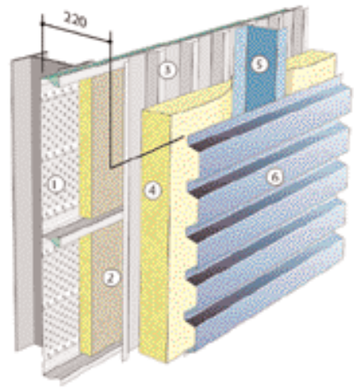
U value calculated with a spacer centre distance of 2 m.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 27 | 36 | 46 | 57 | 63 | 64 |
| α | 0,25 | 0,59 | 0,97 | 0,91 | 0,80 | 0,88 |

**Advantages**

- Aesthetic
- Low thermal bridges
- High acoustic performances
- Concert halls, noisy factories, etc.

## CIN 323 L




**System description**
1. Perforated Hacierba tray
2. Tray bottom insulation
3. Roll insulation
4. Spacer
5. Profile from the Frequence, Oceane or Trapeza product ranges

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 44 (-1 ; -7) | Type P 0,90<br>Type C 0,35 | 0,34 | 0,80 | 25 | 22 |

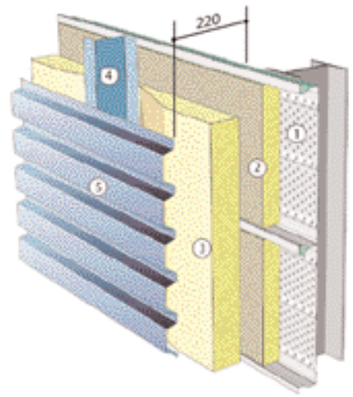
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 24 | 33 | 41 | 52 | 58 | 67 |
| Type P α | 0,92 | 1 | 0,99 | 0,90 | 0,83 | 0,79 |
| Type C α | 0,73 | 1 | 0,88 | 0,67 | 0,42 | 0,17 |

**Advantages**

- Aesthetic
- Low thermal bridges
- High acoustic performances
- Concert halls, noisy factories, etc.

# Globallwall
# Insulated double skin facade
# Acoustic and thermal solutions

## CIN 327




**System description**
1. Perforated Hacierba tray
2. Tray bottom insulation
3. Roll insulation
4. Intermediate spacer
5. Profile from the Frequence, Oceane or Trapeza product ranges

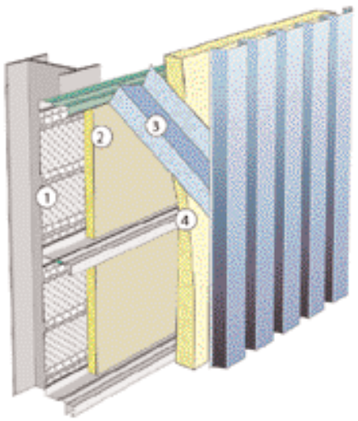
| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 40 (-2 ; -7) | Type P 0,90 Type C 0,35 | 0,34 | 0,80 | 25 | 22 |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 20 | 28 | 38 | 46 | 54 | 65 |
| Type P α | 0,92 | 1 | 0,99 | 0,90 | 0,83 | 0,79 |
| Type C α | 0,73 | 1 | 0,88 | 0,67 | 0,42 | 0,17 |

**Advantages**

- Aesthetic
- Low thermal bridges
- High acoustic performances, including noise correction
- Factories, multi purpose halls and any places requiring acoustical correction

## CN 125 RT




**System description**
1. Perforated Hacierba tray
2. Tray bottom insulation
3. Intermediate spacer
4. Insulation with aluminium vapour barrier
5. Profile from the Frequence, Oceane or Trapeza product ranges

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 36 (-2 ; -7) | Type P 0,75 Type C 0,35 | 0,67 | 0,79 | 18 | 14 |

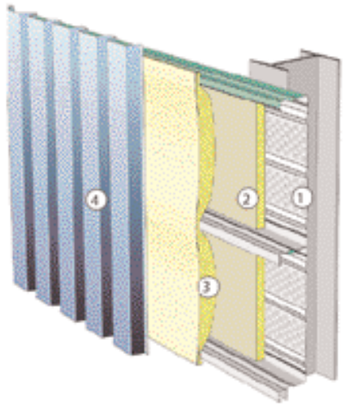
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 16 | 25 | 33 | 41 | 43 | 48 |
| Type P α | 0,41 | 0,56 | 0,70 | 0,80 | 0,80 | 0,70 |
| Type C α | 0,73 | 1 | 0,88 | 0,67 | 0,42 | 0,17 |

**Advantages**

- Aesthetic
- Low thermal bridges
- High acoustic performances, including noise correction
- Factories, multi purpose halls and any places requiring acoustical correction



## CN 120




**System description**
1. Perforated Hacierba tray
2. Tray bottom insulation
3. Roll insulation
4. Profile from the Frequence, Oceane or Trapeza product ranges

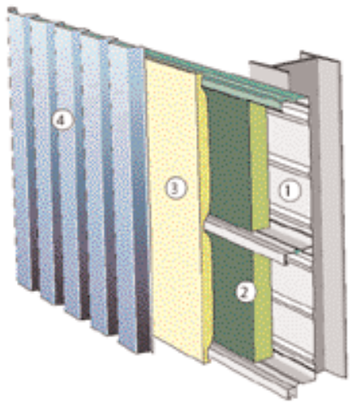
| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 30 (-2 ; -7) | Type P 0,75 Type C 0,35 | 0,81 | 0,76 | 17 | 12 |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 10 | 18 | 27 | 36 | 37 | 41 |
| Type P α | 0,41 | 0,56 | 0,70 | 0,80 | 0,80 | 0,70 |
| Type C α | 0,73 | 1 | 0,88 | 0,67 | 0,42 | 0,17 |

**Advantages**

- Aesthetic
- High acoustic performances

## IN 220




**System description**
1. Hacierba tray
2. Tray bottom insulation
3. Roll insulation
4. Profile from the Frequence, Oceane or Trapeza product ranges

| Acoustic attenuation | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|
| Rw (C ; Ctr) dB | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 42 (-4 ; -11) | 0,63 | 0,80 | 17 | 12 |

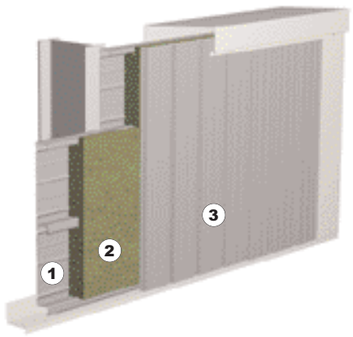
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 16 | 32 | 41 | 47 | 46 | 47 |

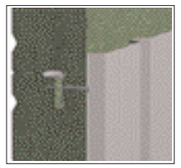
**Advantages**

- Aesthetic
- High acoustic performances

# Globallwall
# Insulated double skin facade
# Acoustic and thermal solutions

## Eccorisol



**System description**
1. Hacierba tray
2. Insulating block
3. Profile from the Frequence, Oceane or Trapeza product ranges

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Cubic size |
|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | cm |
| 44 | 0,80 | 0,31 | 17 |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| ECCORISOL | 22 | 36 | 49 | 58 | 59 | 62 |

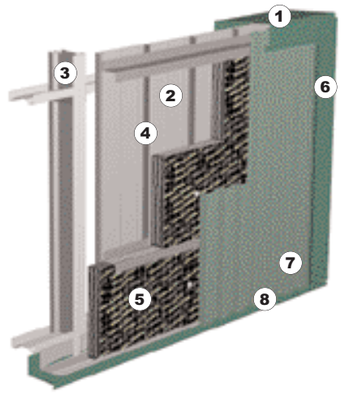
**Advantages**

- Aesthetic
- No thermal bridges
- Ease of installation
- High acoustic and thermal performances (noise insulation and acoustic correction)

DR



## Wallaquatic




System developed for high-humidity buildings in which water should not be absorbed by the insulating core.

**System description**
1. Parapet cap flashing
2. Trays
3. Framework
4. Spacer
5. Foamglass panel
6. External corner
7. External skin
8. Drip flashing

| Acoustic attenuation | Thermal transmittance | Weight | Cubic size |
|---|---|---|---|
| Rw (C ; Ctr) dB | U W/(m².K) | Kg/m² | cm |
| 37 (-2 ; -7) | 0,83 | 25 | 12 |

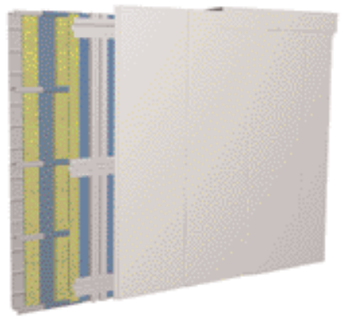
**Advantages**

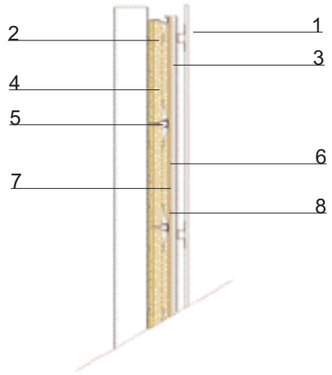
- Aesthetic
- Acoustic performances
- No water absorbed by the insulating core
- For swimming pools and factories with high internal humidity

# Globallwall
# Insulated double skin facade
# Acoustic and thermal solutions

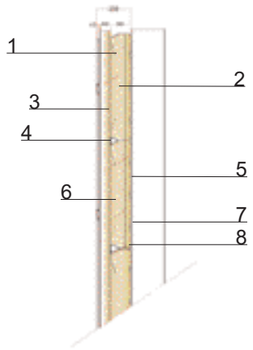
## IN Isofran

Any of our systems can be used for high-end building applications. Arval can offer Isofran as a vertically or horizontally installed external skin.

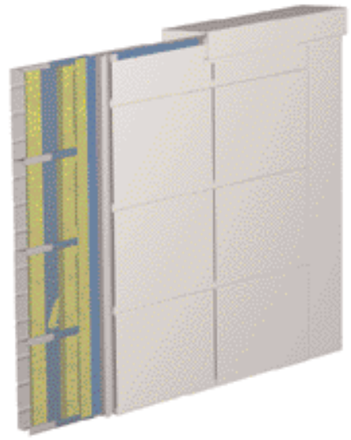





**System description**
1. Isofran
2. Hacierba tray
3. Adjustable spacer
4. Insulation
5. Vapour barrier
6. Rain screen
7. Insulation
8. Insulation




**System description**
1. Hacierba tray
2. Insulating block
3. Vapour barrier
4. Insulation
5. Insulation
6. Rain screen
7. ISOFRAN



Here we have one example of one system and its performances.

| Acoustic attenuation | Acoustic absorption | Thermal transmittance |
|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) |
| 36 (-2 ; -7) | 0,75 | 0,41 |
| 41 (-1 ; -6) | - | 0,41 |

Approximate value where λ = 0,040 W/(m·K) – Value to be checked with CE and ACERMI references

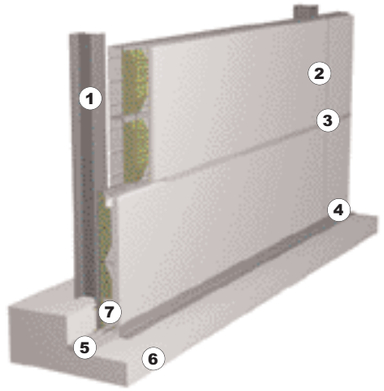


# Globallwall
# Composite wall
# Acoustic and thermal solutions

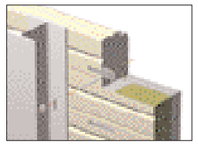
## Habilis

**Arval has developed a system which will achieve high performances in fire resistance, noise insulation, thermal insulation and anti-intrusion properties.**

The system is factory made and delivered on-site ready to install.




**System description**
1. Framework
2. Habilis panel
3. Horizontal joint
4. Starter corner
5. Jointing mortar
6. Slab
7. Habifix



| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Cubic size |
|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | cm |
| 58 (-1, -6) (76 dB on request) | 0,85 | 0,318 | 200 |

Approximate value where λ = 0,040 W/(m·K) – Value to be checked with CE and ACERMI references.

### Advantages

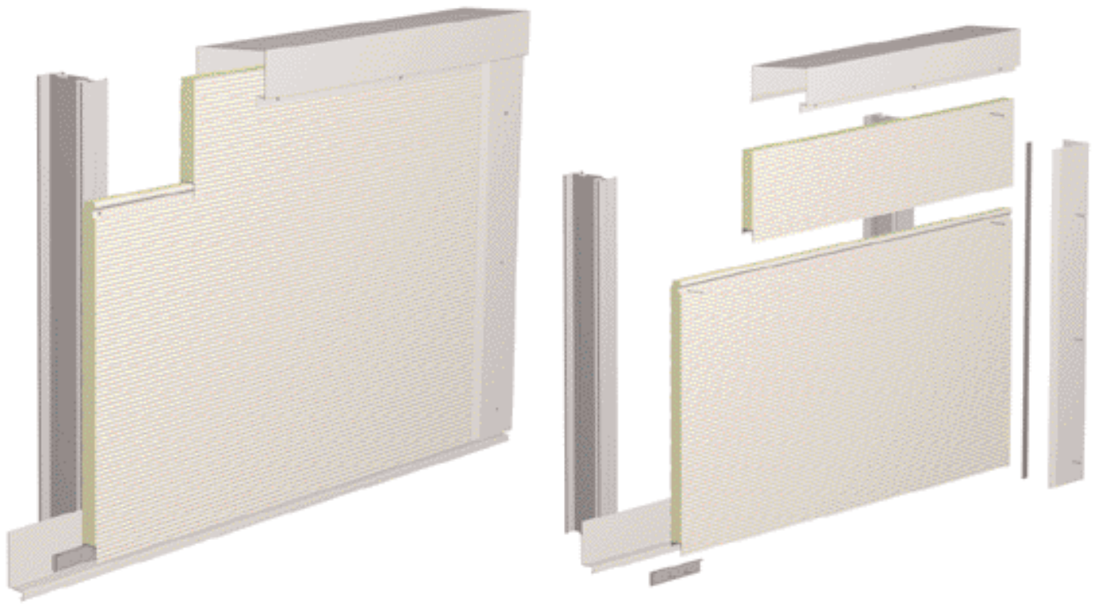
- Aesthetic
- Anti-intrusion
- High thermal performances
- Excellent acoustic performances

# Globallwall
# Insulated Panels

The Ondatherm and Ondafibre composite façade panels you can choose from have diversified thermal and acoustic features in order to satisfy the market requirements.

## Façade panel

| System | | Acoustic attenuation Rw (C ; Ctr) dB | Acoustic absorption αw | Thermal transmittance U W/(m².K) |
|---|---|---|---|---|
| Ondatherm | Ondatherm 1040 B | 25 (-1 ; -3) | - | 0,76 to 0,24 |
| Promisol | Promisol 1003 B or HB | 25 (-1 ; -3) | - | 0,82 to 0,25 |
| | Promisol 1003 BA or HBA | 25 (-1 ; -3) | 0,5 | 0,50 to 0,28 |
| | Promisol 2003 Bi or HBi | 25 (-1 ; -3) | - | 0,59 to 0,25 |
| Promline | Promline 2000 B or HB | 25 (-1 ; -3) | - | 0,59 to 0,25 |
| Hainaut | Hainaut Linea 204 B or HB | 25 (-1 ; -3) | - | 0,59 to 0,25 |
| | Hainaut Liss 2010 B or HB | 25 (-1 ; -3) | - | 0,59 to 0,25 |
| Frequencisol | Frenquencisol 2025 B or HB | 25 (-1 ; -3) | - | 0,54 and 0,38 |
| Ondafibre | Ondafibre 3003 B or HB | Up to 31 (-3 ; -4) | 0,95 | 0,62 to 0,27 |
| | Ondafibre 3506 B or HB | Up to 31 (-3 ; -4) | - | 0,49 to 0,29 |



Acoustic performances are laboratory established and set forth in certificates.



# Globallwall
# Insulated panels
# Acoustic and thermal solutions

## Ondatherm 1040B


**System description**
1. Thermal insulation: PU foam without HCFC

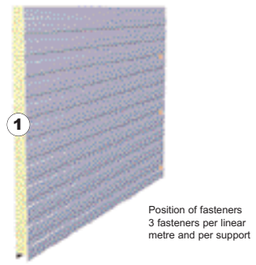
| Panel properties | | Nominal thickness of foam core (mm) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30 | 40 | 50 | 60 | 80 | 100 |
| Weight (kg/m²) | Example, both faces 0.63mm thick | 12,5 | 12,9 | 13,3 | 13,7 | 14,5 | 15,3 |
| Acoustics | Insulation: Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw (C ; Ctr) : 25 (-1 ; -3) dB | | | | | |
| Thermal features (where λ = 0,025 W/m.K) | Thermal transmittance U (W/m².K) | 0,76 | 0,58 | 0,47 | 0,40 | 0,30 | 0,24 |
| | Linear heat loss ψ (W/m.K) | 0,11 | 0,06 | 0,04 | 0,03 | 0,02 | 0,01 |

**Advantages**

- Good thermal insulation for building with low or medium humidity
- Ease and speed of installation

# Globallwall
# Insulated panels
# Acoustic and thermal solutions

## Promisol 1003 B or HB




Position of fasteners
3 fasteners per linear metre and per support

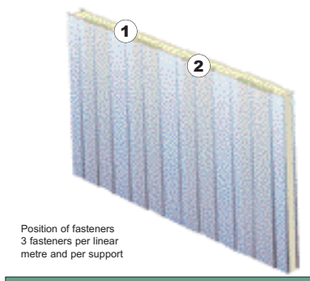
**System description**
1. Thermal insulation: PU foam without HCFC

**Advantages**

- Good thermal insulation for indoor partitions or façades where visible fixings are not of any consequence
- Ease and speed of installation

| Panel properties | | Nominal thickness of foam core (mm) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30 | 40 | 50 | 60 | 80 | 100 |
| Weight (kg/m²) | Example, both faces 0.63 mm thick | 11,8 | 12,2 | 12,6 | 13 | 13,8 | 14,7 |
| Acoustics | Insulation: Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw (C ; Ctr) : 25 (-1 ; -3) dB | | | | | |
| Thermal features (where λ = 0,025 W/m.K) | Thermal transmittance U (W/m².K) | 0,82 | 0,62 | 0,50 | 0,41 | 0,31 | 0,25 |
| | Linear heat loss ψ (W/m.K) | 0,27 | 0,11 | 0,07 | 0,05 | 0,03 | 0,03 |

## Promisol 1003 BA or HBA




Position of fasteners
3 fasteners per linear metre and per support

**System description**
1. Thermal insulation: PU foam without HCFC
2. Acoustic insulation: Glass wool

| Panel properties | | Nominal thickness of foam core (mm) | | |
|---|---|---|---|---|
| | | 60 | 80 | 100 |
| Weight (kg/m²) | Example, both faces 0.63 mm thick | 13,6 | 14,4 | 15,2 |
| Acoustics | Insulation: Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw (C ; Ctr) : 25 (-1 ; -3) dB | | |
| | Absorption | α = 0,50 | | |
| Thermal features (where λ = 0,025 W/m.K) | Thermal transmittance (W/m².K) | 0,50 | 0,36 | 0,28 |
| | Linear heat loss ψ (W/m.K) | 0,05 | 0,03 | 0,03 |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 20 | 18 | 23 | 25 | 34 | 42 |
| α | 0,06 | 0,22 | 0,59 | 0,87 | 0,70 | 0,51 |

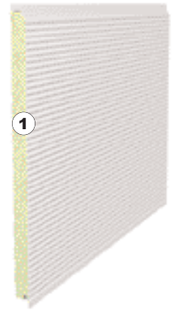
**Advantages**

- Good noise insulation for buildings in which it is necessary to correct the reverberation time
- Ease and speed of installation

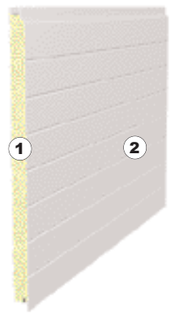


## Promisol 2003 Bi or HBi

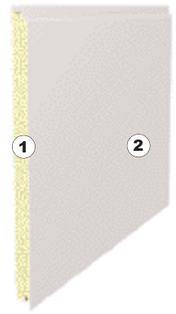

## Promline 2000B or HB




## Hainaut Linéa 2034 B or HB




## Hainaut Liss 2010B or HB




**System description**
1. Thermal insulation: PU foam without HCFC
2. These panels are manufactured with a 0,75 mm thick external skin.
Available in 60mm and 80mm, consult us for other thicknesses

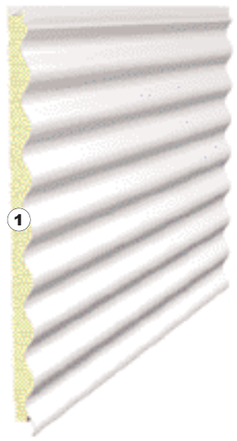
| Panel properties | | Nominal thickness of foam core (mm) | | | | |
|---|---|---|---|---|---|---|
| | | 40 | 50 | 60 | 80 | 100 |
| Weight (kg/m²) | Both faces 0,63 mm thick | 12,6 | 13 | 13,4 | 14,2 | 15 |
| | In thicknesses of 0,75 and 0,63 mm | 13,7 | 14,1 | 14,5 | 15,3 | 16,1 |
| Acoustics | Insulation: Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw (C ; Ctr) : 25 (-1 ; -3) dB | | | | |
| Thermal features (where λ = 0,025 W/m.K) | Thermal transmittance U (W/m².K) | 0,59 | 0,48 | 0,40 | 0,31 | 0,25 |
| | Linear heat loss ψ (W/m.K) | 0,19 | 0,09 | 0,06 | 0,06 | 0,03 |

**Advantages**

- Good thermal insulation for buildings where a good finishing is required
- Non visible fixing

# Globallwall
# Insulated panels
# Acoustic and thermal solutions

## Frequencisol 2025 B or HB




**System description**
1. Thermal insulation: PU foam without HCFC

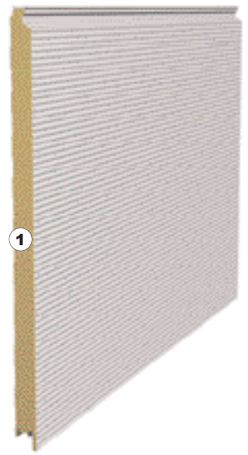
| Panel properties | | Nominal thickness of foam core (mm) | |
|---|---|---|---|
| | | 60 | 80 |
| Weight (kg/m²) | Example in thicknesses of 0,63 and 0,53 mm | 12,2 | 13 |
| Acoustics | Insulation : Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw (C ; Ctr) : 25 (-1 ; -3) dB | |
| Thermal features (where λ = 0,025 W/m.K) | Thermal transmittance U (W/m².K) | 0,54 | 0,38 |
| | Linear heat loss ψ (W/m.K) | 0,06 | 0,03 |

**Advantages**

- Good thermal insulation for buildings where a good finishing is required
- Special aesthetic shape



## Ondafibre 3506 Bi or HBi




**System description**
1. Thermal insulation: mineral wool

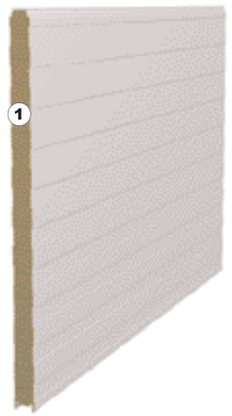
| Panel properties | | Nominal thickness of foam core (mm) | | | | |
|---|---|---|---|---|---|---|
| | | 60 | 80 | 100 | 120 | 150 |
| Weight (kg/m²) | Both faces 0,63 mm thick | 16,6 | 18,8 | 20,3 | 22,3 | 25,4 |
| Acoustics | Insulation : Attenuation index | Rw (C ; Ctr) : 30 (-2 ; -2) dB | - | - | - | Rw (C ; Ctr) : 31 (-3 ; -4) dB |
| Thermal features (where λ = 0,044 W/m.K) | Thermal transmittance U (W/m².K) | 0,66 | 0,49 | 0,43 | 0,35 | 0,29 |
| | Linear heat loss ψ (W/m.K) | 0,03 | 0,02 | 0,01 | 0,01 | - |

**Advantages**

- Good thermal insulation for buildings where a good finishing is required
- Acoustic performances possible
- Ease of installation
- Fire behaviour

# Globallwall
# Insulated panels
# Acoustic and thermal solutions

## Ondafibre 3003 B or HB




**System description**
1. Thermal insulation : mineral wool

| Panel properties | | Nominal thickness of foam core (mm) | | | | |
|---|---|---|---|---|---|---|
| | | 60 | 80 | 100 | 120 | 150 |
| Weight (kg/m²) | Both faces 0,63 mm thick | 16,6 | 18,8 | 20,3 | 22,3 | 25,4 |
| Acoustics | Insulation : Attenuation index | Rw (C ; Ctr) : 30 (-1 ; -2) dB | | | | Rw (C ; Ctr) : 31 (-3 ; -4) dB |
| | Absorption | $\alpha$ = 0,95 | | | | |
| Thermal features (where $\lambda$ = 0,041 W/m.K) | Thermal transmittance U (W/m².K) | 0,62 | 0,46 | 0,40 | 0,33 | 0,27 |
| | Linear heat loss $\psi$ (W/m.K) | 0,01 | 0,01 | - | - | - |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| $\alpha$ | 0,34 | 0,87 | 0,96 | 0,89 | 0,88 | 0,95 |

**Advantages**

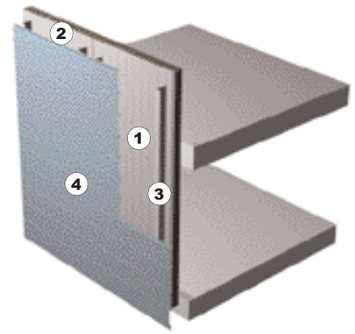
- Good thermal insulation for buildings where visible fixings are not of any consequence
- Acoustic performances possible
- Ease of installation



# Globallwall
# Acoustic and thermal solutions

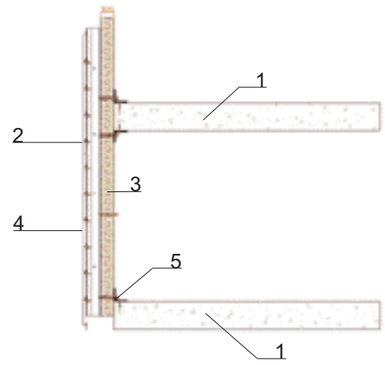
## UK 10

This system is a combination of siding and insulated panels placed together on a ventilated façade, in order to achieve a high performance, high-end façade product.




**System description**
1. Fixing system
2. Mineral wool panel
3. Spacers
4. Siding

**System description**
1. Concrete slab
2. Adjustable spacer
3. Promfire
4. Sauternes ST E800
5. Fixing angle-iron




**Advantages**

- Good thermal and acoustic performances
- Excellent system for ventilated façades
- Easy to install
- Aesthetically pleasing

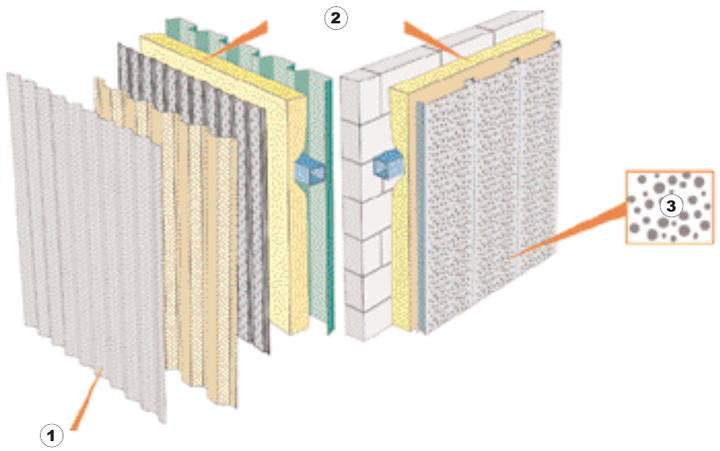
Note: Thermal and acoustic performances depend on the thickness of the Mineral wool panels used as a support. Please refer to Mineral wool panels.

# Globalscreen
# Acoustic screen
# Acoustic solutions

## Globalscreen

**Arval has developed some products in order to improve the internal comfort of your building.**

When our products are used for internal panelling, we obtain the best acoustic correction and thermal insulation within the building.




**System description**
1. Frequence, Oceane or Trapeza Profile - Total perforation ($\alpha$ = 0,85)
2. Perforations - Void 25%

**Arval has noise barriers to offer for use along roads or to correct acoustic performances when there is too much noise outside a building, which disturbs the neighbourhood.**

### Acoustic screens

| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance |
|---|---|---|---|
| | Rw (C ; Ctr) dB | $\alpha$w | U W/(m².K) |
| CR111 | - | 0,85 | Contact us |
| Hairplan déco | - | 0,80 | Contact us |

**Advantages**

- Good acoustic correction for renovation of the internal part of buildings



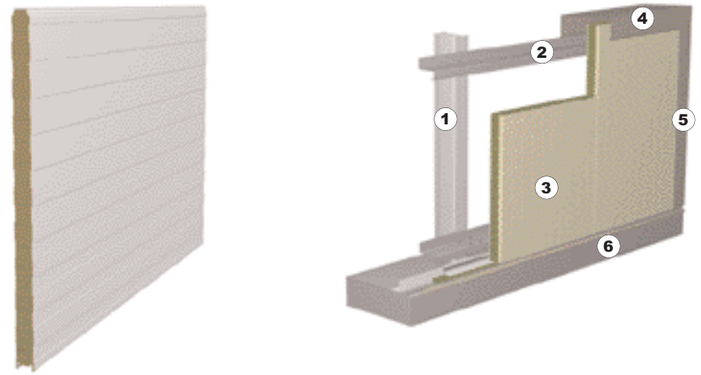
# Globalpartition
# Acoustic partition
# Acoustic and thermal solutions

## Ondafibre 3003

**Arval can offer several systems for partitions.**

When designing these systems it is necessary to provide for every requirement the partitions may need in terms of fire and acoustic performances.

Arval has developed two main concepts of partitions, a panel made of steel and mineral wool, with acoustic and fire performances and a system made of steel, plaster board and glass wool with fire performances.



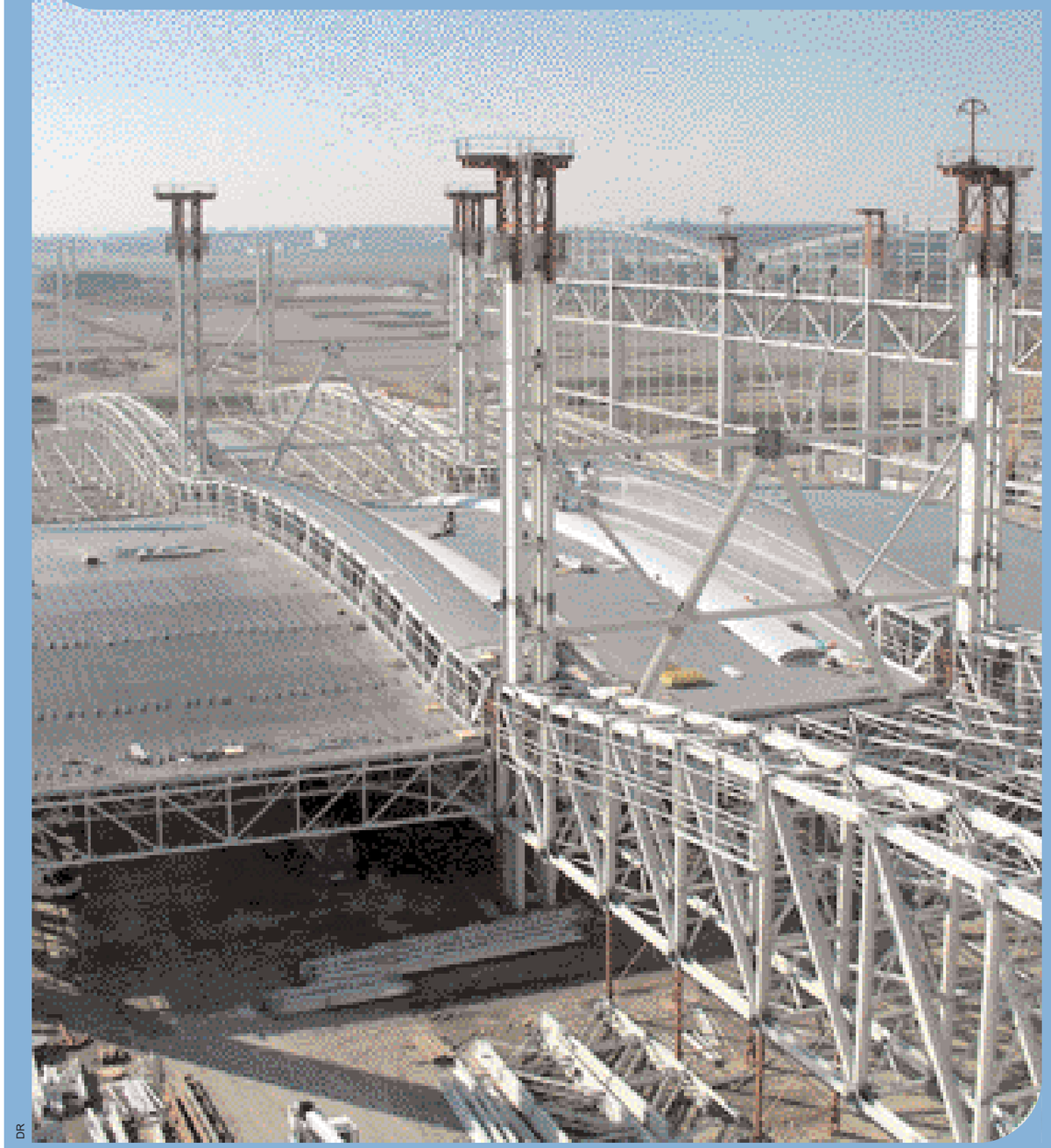

**Panel system description**
1. Framework
2. Secondary structure
3. Mineral wool sandwich panel
4. Parapet cap flashing
5. External corner
6. Drip flashing

| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Fire resistance |
|---|---|---|---|---|
| | Rw (C ; Ctr) dB | $\alpha$w | U W/(m².K) | |
| Panel (60 mm unperforated) | 30 (-1 ; -2) | - | 0,62 | EI 60 |
| Panel (150 mm unperforated) | 31 (-3 ; -4) | 0,95 (perforated) | 0,27 | EI 120 |

**Advantages**

- Thermal and acoustic performances
- Fire behaviour
- Easy to install

# Globalroof
# Solutions for high energy efficiency



DR



# Globalroof
# Sunbreaker roofing

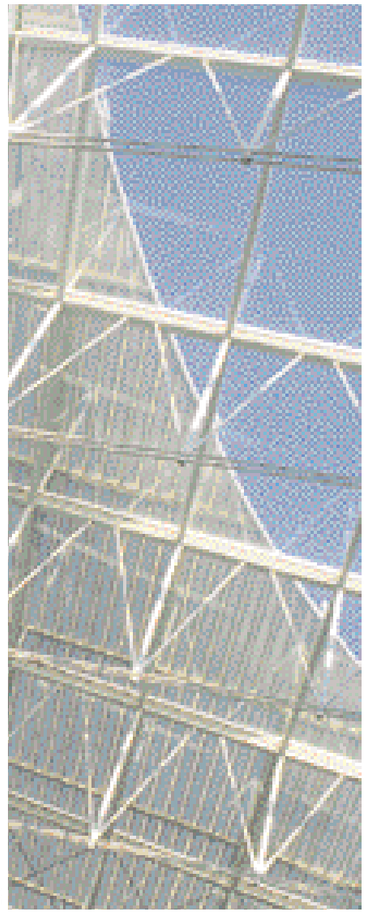
## Sunstyl

At present, there are all kinds of buildings with glass roofs, simply because they provide natural lighting.

**However, glazed surfaces need sunbreakers not only with glare control to ensure visual comfort but also with overheating control to ensure thermal comfort.**

Arval has developed numerous overroofing solutions which:

- minimise glare, overheating and summertime consumption for air-conditioning
- allow for an input of sunrays in winter enabling a cut in the energy consumed for heating.



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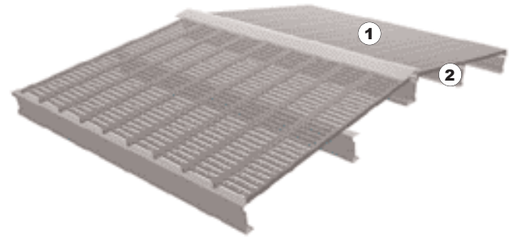
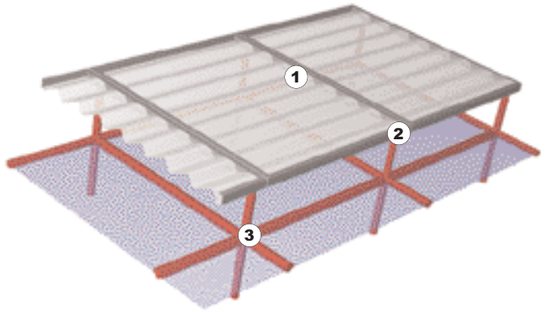
**Overroof on the 2 F terminal in Roissy-Charles-de Gaulle**

### Lumière C



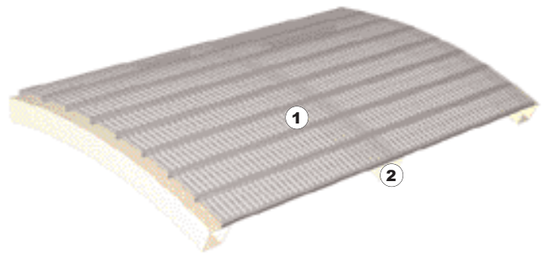

1. Lumière C
2. Support

### Mascaret




1. Mascaret
2. Frame
3. Support

### Lumière C

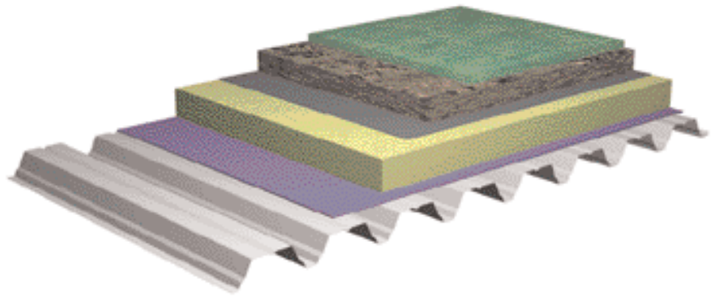



1. Lumière C
2. Support

See also the possibilities presented in the Globalwall solutions which can be adapted to roof applications (Façade “sunbreaker” chapter). .

# Globalroof
# Green roofs

## Hacierco system



## The advantages of green roofs, Globalroof with Hacierco

### For towns

**- Landscape expressivity**

A green area enables us to hand over to landscaping and agricultural expressivity.

**- Better atmosphere**

A green roof decreases atmospheric pollution (chemical elements and dust) and helps air oxygenation and humidification.

**- Water management**

A green surface has positive consequences upon water management issues by cutting down on the percentage of rainwater runoff into drainage systems and wastewater treatment plants.

It slows down water runoff, which is essential in climatic areas where torrential rain downpour is produced by violent storms.

### For buildings

**- Increase in thermal performance efficiency**

Plant roofs minimise heat transfer towards the under-surface caused by evaporation of the water retained. We typically record a 10°C difference in the temperature of the under-surface by the effect of vegetation.

Moreover, when used with the appropriate insulation, the system fits regulatory requirements in terms of heat loss. The gain in thermal comfort in wintertime correlates with lower heat convection, as the plants effectively reduce the speed of the wind.

**- Increase in acoustic comfort**

This system diminishes impact noise by about 8dB and enhances sound insulation by about 5dB.

### During construction

**- Minimises construction site nuisance**

Hacierco is a dry steel system, which minimises construction site nuisance and cuts down on worksite duration.



## Special features

**Systems for extensive or semi-intensive green roofs are interesting to install as they are lightweight, not very bulky and require minimal upkeep.**

Compared to a typical flat roof, the system must, nevertheless, accommodate the most rigorous requirements above all in terms of weatherproofing, root and heavy loading resistance.

Hacierco decking is particularly suited to these requirements. Using Hacierco as a bearer profile decking means the implementation of a " steel decking " building system, which is an offsite solution, minimising construction site nuisance, and giving quick installation gains. The system is suitable for curved roofs.

It is installed in compliance with the regulations in force.

B. Lemloine

# Globalroof
# Photovoltaic roofing
# Energy-generating systems

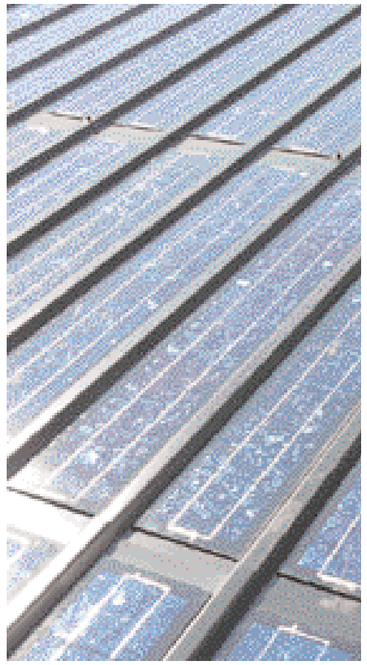
## Arsolar solutions

Arsolar and Arsolar plus systems are mixed roofing solutions since they provide the technical function of generating electricity along with the architectural function of weatherproofing and at the same time ensure the mechanical performance essential to the building.

**Arsolar is based on photovoltaic technology which converts the energy from sunlight into electrical current via crystalline silicon, a semi-conducting material.**

Two installation possibilities:

- The facility is isolated, not near any electric network : batteries are required
- The facility is wired up to the electric network : energy is injected into the network.



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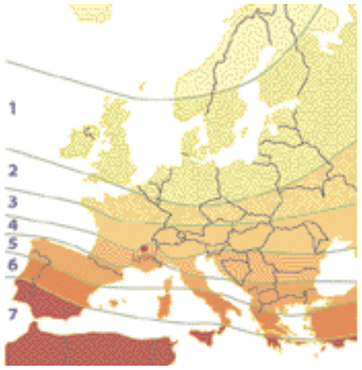
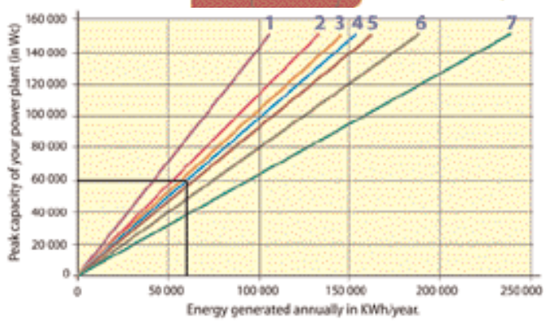
**The amount of energy generated by the Arsolar roof depends mainly on the sun area and the capacity installed.**

**Example of the output of an Arsolar installation:**
In Lyon (zone 4), the power of an Arsolar roof is 60 000 Wc (about 1000 m²) therefore, generating about 65 000 kWh/year.



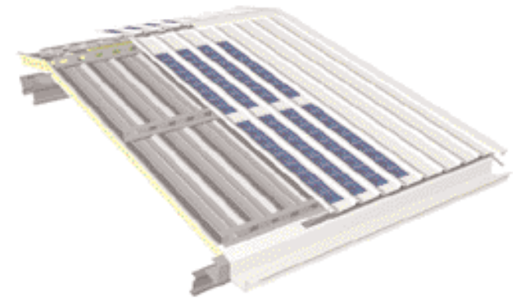

| Electrical Properties | Solution | |
|---|---|---|
| | Single | Double |
| Nominal power | 130 Wc | 260 Wc |
| Nominal power per m² of Arsolar | 75 Wc | 75 Wc |
| Number of Arsolar modules for two inverters of 3300 W | 56 modules i.e. about 100 m² | 28 modules i.e. about 100 m² |
| Tolerance | +/-2.5 Wc | |
| **Installation characteristics** | | |
| Minimum gradient | > 10% ou 6° | |
| Optimum angle of slope | Depends on the latitude | |
| Type of ventilation spacer | Perforated Arsolar spacer Top-hat sections | |
| Weight (Kg/m²) | 20 | |

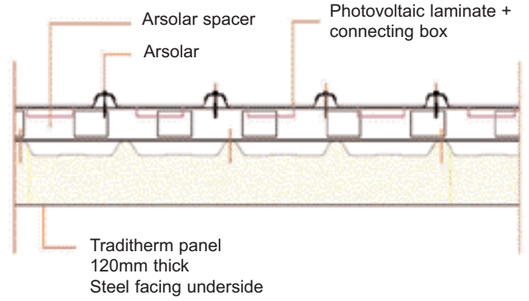


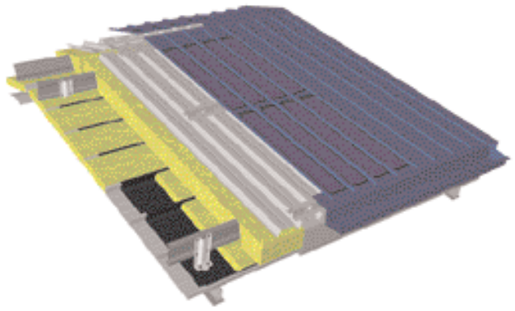
**The Arsolar roofing systems are made up of photovoltaic laminates mounted onto special pre-painted steel roofing profiles or panels.**
**Arsolar roofing elements are pre-wired for on-site connection.**

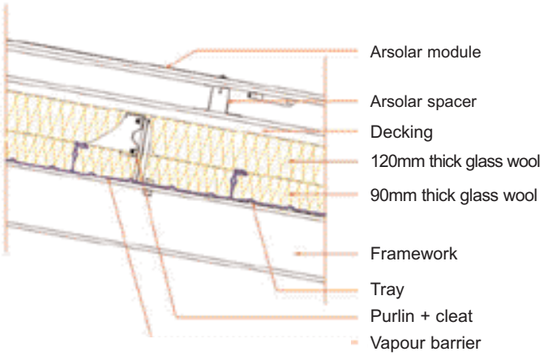
## Integrated Arsolar system

Insulated roofing systems made up of Arsolar profiles.



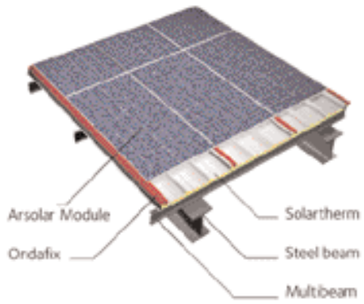


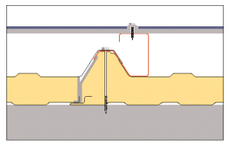






## Arsolar Plus

Insulated roofing system made up of sandwich panels and photovoltaic modules.



| Arsolar Plus features | |
|---|---|
| Nominal power | 135-142 Wp/m² |
| Thickness panel (mm) | 40 to 100 |
| U values (W/m²k) | 0,24 to 0,56 |
| Weight (kg/m²) | 27 to 30 |
| Length (m) | 18 |
| Width (mm) | 1000 m |

# Globalroof
# Insulated double skin roof
# Principles

**The double skin roofing systems developed by Arval render top performances and provide the answer to the regulations in force or specific requirements.**

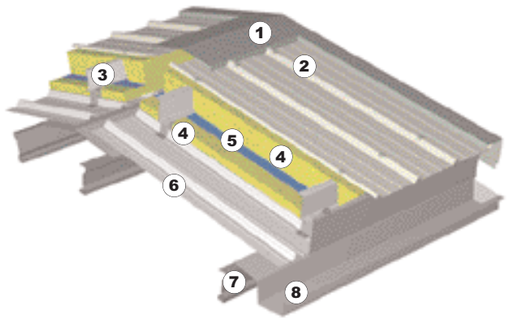
The wide range of twin-skin roofing systems you can choose from are characterized by their:

- technical performances for thermal Globalroof
- technical performances for acoustic and thermal Globalroof

Their design not only incorporates a reduction in energy losses but also deals with the risk of condensation.

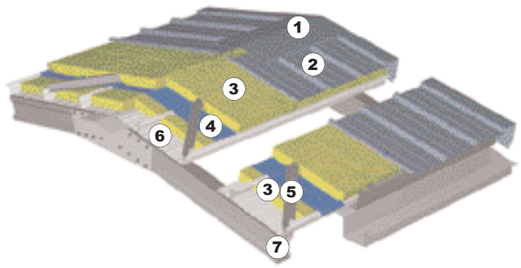
Arval technical assistance will size the structure of thin PDF elements suited to your project (see the questionnaire at the end of the guide).

## « Parallel » double skin roofing




**System description**
1. Ridge - flashings
2. Trapeza, Oceane or Frequence
3. Spacer system
4. Insulation
5. Vapour barrier
6. Hacierco
7. Structure
8. Gutter

## «Perpendicular» double skin roofing




**System description**
1. Ridge - flashings
2. Trapeza, Oceane or Frequence
3. Insulation
4. Vapour barrier
5. Purlin
6. Hacierco tray
7. Structure



## Globalroof systems also adapt well to curved roofs

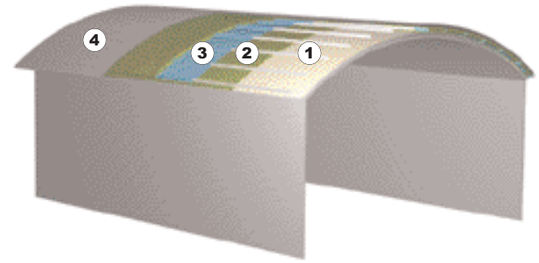
- Examples of parallel fix twin-skin arched roofs with DSP, CN 127 systems:

  1. On the innerside, Trapeza profiles are mounted perpendicular to the roof drain, either factory curved or curved on-site.

  2. The spacer system is installed perpendicular to the Trapeza profile on the underside, i.e. parallel to the roof drain.

  3.The insulation and vapour barrier are laid.

  4. Trapeza, Océane or Frequence profiles are installed.




- Example of twin-skin curved roofing made up of Hacierco C trays, with parallel fixing systems : DST, IN 220, IN220RT, CN125, CN125RT, IN 226, IN 227, CIN 323J, CIN 327T, CIN 338T.

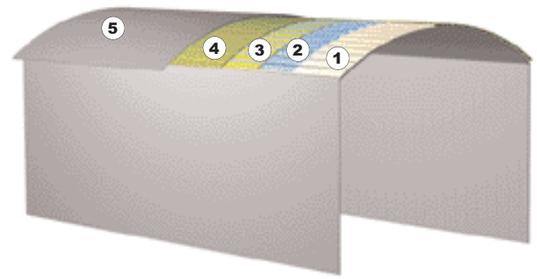
  1. On the underside, Hacierco trays are mounted frame to frame, parallel to the roof drain with a minimum support width of 100mm.

  2. Insulation is laid in the trays.

  3. Spacer systems can be mounted parallel to the trays.

  4. The insulation and vapour barrier are laid.

  5. Trapeza, Océane or Fréquence profiles are erected.




According to the radius and the dimensions, the profiles can be curved on-site, in the factory with smooth curving for small radii, and notch curving for very small radii.

# Globalroof
# Insulated double skin roof
# The systems

**Double skin Globalroof systems have diversified features in order to satisfy special market requirements.**

There are two subsets which are as follows :
- for energy saving roofs,
- acoustic comfort and energy saving roofs.

Acoustic performances are laboratory established and set forth in certificates.

## Thermal Globalroof

| Systems | | Thermal transmittance U W/(m²K) |
|---|---|---|
| DSP | DSP 17 | 0,17 |
| | DSP 22 | 0,22 |
| | DSP 26 | 0,26 |
| | DSP 28 | 0,28 |
| | DSP 30 | 0,30 |
| DSP Direkt | DSP Direkt 14 | 0,14 |
| | DSP Direkt 15 | 0,15 |
| | DSP Direkt 17 | 0,17 |
| | DSP Direkt 20 | 0,20 |
| | DSP Direkt 24 | 0,24 |
| DST (double skin tray) | DST 20 | 0,20 |
| | DST 27 | 0,27 |
| | DST 34 | 0,34 |
| | DST 41 | 0,41 |
| DST (double skin - tray support) | DST 30 | 0,30 |
| | DST 33 | 0,33 |

## Acoustic and thermal Globalroof

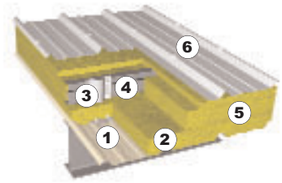
| Systems | | Acoustic attenuation RW (C ; Ctr) dB | Acoustic absorption αw | Thermal transmittance U W/(m².K) |
|---|---|---|---|---|
| CIN | CIN 323 J | 47 (-2 ; -8) | 0,90 | 0,25 |
| | CIN 327 T | 43 (-3 ; -8) | 0,90 | 0,23 |
| | CIN 338 T | 48 (-2 ; -8) | 0,75 | 0,40 |
| IN | IN 227 | 54 (-2 ; -7) | - | 0,30 |
| | IN 226 | 50 (-2 ; -7) | - | 0,41 |
| | IN 220 RT | 42 (-4 : -11) | - | 0,41 |
| | IN 220 | 42 (-4 ; -11) | - | 0,85 |
| CN | CN 125 RT 1 P | 36 (-2 ; -7) | 0,95 | 0,27 |
| | CN 125 RT P | 36 (-2 ; -7) | 0,85 | 0,41 |
| | CN 127 | 36 (-2 ; -7) | 0,70 | 0,37 |
| | CN 125 P ou C | 36 (-2 ; -7) | 0,75 | 0,87 |

The U values of thermal transmittance are given for 5 fasteners per m² through the thermal insulation and for a given purlin framing as described in different systems presented below.
Acoustic insulation or attenuation, acoustic absorption and heat or thermal transmission are described in detail in the chapter dealing with "Basic concepts".



# Globalroof
# Insulated double skin roof
# Thermal systems

## DSP




**System description**
1. Trapeza roofing profile
2. Insulation gripped under the cleat
3. PDF cleat (see the sizing questionnaire)
4. PDF purlin
5. Insulation
6. Frequence, Oceane or Trapeza profile

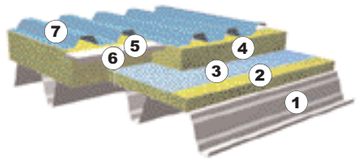
| System | Thermal transmittance U W/(m².K) | Temperature factor on inner surface $f_{Rsi}$ | Cubic size mm | Cleats Height mm |
|---|---|---|---|---|
| DSP 17 | 0,17 | 0,72 | 325 | 279 |
| DSP 22 | 0,22 | 0,70 | 265 | 219 |
| DSP 26 | 0,26 | 0,69 | 235 | 189 |
| DSP 28 | 0,28 | 0,69 | 220 | 174 |
| DSP 30 | 0,30 | 0,69 | 210 | 164 |

U value calculated with a purlin spacing of 2,4 m and a cleat spacing of 1,35m.

### Advantages

- Rapid assembly with reduced labour requirements
- Very high thermal performances

## DSP Direkt « Energy Saving »




**System description**
1. Hacierco decking profile
2. Insulation
3. Vapour barrier
4. Insulation
5. Pre-perforated purlin
6. Telescope fixing
7. Frequence, Oceane or Trapeza profile

| System | Thermal transmittance U W/(m².K) | Temperature factor on inner surface $f_{Rsi}$ | Cubic size mm |
|---|---|---|---|
| Direct Taket 14 | 0,14 | 0,96 | 439 |
| Direct Taket 15 | 0,15 | 0,96 | 419 |
| Direct Taket 17 | 0,17 | 0,96 | 399 |
| Direct Taket 20 | 0,20 | 0,95 | 369 |
| Direct Taket 24 | 0,44 | 0,95 | 339 |

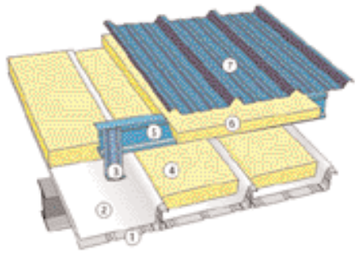
U value calculated with a spacing of > 0,5 m.

### Advantages

- Very high thermal performances
- Rapid assembly with reduced labour requirements

# Globalroof
# Insulated double skin roof
# Thermal systems

## DST



**System description**
1. Non-load-bearing Hacierco tray
2. Vapour barrier
3. PDF cleats (see sizing questionnaire)
4. Insulation
5. PDF spacer bar
5. Insulation
7. Frequence, Oceane or Trapeza profile

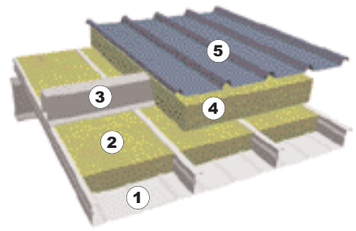
| System | Thermal transmittance | Temperature factor on inner surface | Cubic size |
|---|---|---|---|
| | U W/(m².K) | $f_{Rsi}$ | mm |
| DST 20 | 0,20 | 0,83 | 330 |
| DST 27 | 0,27 | 0,83 | 210 |
| DST 34 | 0,34 | 0,83 | 170 |
| DST 41 | 0,41 | 0,83 | 150 |

U value calculated with a purlin spacing of 2m and a cleat spacing of 1,20m.

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- Perpendicular fix curved shapes are available

## DSTS




**System description**
1. Load bearing Hacierco tray
2. Insulation
3. Spacer bar SiO3
4. Insulation
5. Frequence, Oceane or Trapeza profile

| System | Thermal transmittance | Temperature factor in inner surface | Cubic size |
|---|---|---|---|
| | U W/(m².K) | $f_{Rsi}$ | mm |
| DSTS 33 | 0,33 | 0,78 | 27 |
| DSTS 30 | 0,30 | 0,78 | 29 |

U value calculated with a purlin spacing of 2m.

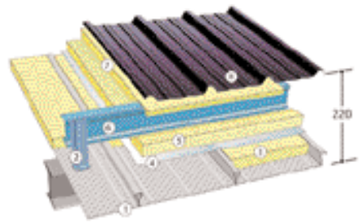
**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface



# Globalroof
# Insulated double skin roof
# Acoustic and thermal systems

## CIN 323J or CIN 327T




**System description**
1. Perforated non-load-bearing Hacierco tray
2. PDF cleats (questionnaire)
3. Tray bottom insulation
4. Vapour barrier
5. Roll insulation
6. PDF purlin (questionnaire)
7. Roll insulation
8. Frequence,Oceane or Trapeza profile

| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| CIN 323J | 47 (-2 ; -8) | 0,90 | 0,25 | 0,86 | 31 | 26 |
| CIN 327 T | 43 (-3 ; -8) | 0,90 | 0,23 | 0,86 | 21 | 26 |

Value calculated with a purlin spacing of 2m and a cleat spacing of 1,35m. .

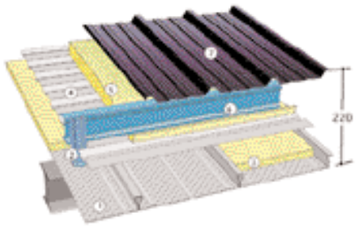
| | | Performance per octave | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| CIN 323J | R dB | 26 | 34 | 47 | 63 | 72 | 78 |
| | α | 0,82 | 1 | 1 | 1 | 0,87 | 0,78 |
| CIN 327 T | R dB | 21 | 30 | 45 | 45 | 63 | 66 |
| | α | 0,92 | 1 | 0,99 | 0,90 | 0,83 | 0,78 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- Perpendicular fix curved shapes are available
- High thermal performances
- For multi purpose halls, concert halls with high insulating and sound absorption performance requirements

# Globalroof
# Insulated double skin roof
# Acoustic and thermal systems

## CIN 338T




**System description**
1. Perforated non-load-bearing Hacierco tray
2. PDF cleats (see questionnaire)
3. Tray bottom insulation
4. Profil Trapeza
5. Roll insulation
6. PDF purlin (see questionnaire)
7. Frequence, Oceane or Trapeza profile

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 48 (-2, -8) | 0,75 | 0,40 | 0,82 | 35 | 41 |

U value calculated with a purlin centre distance of 2m and a cleats centre distance of 1,35m.

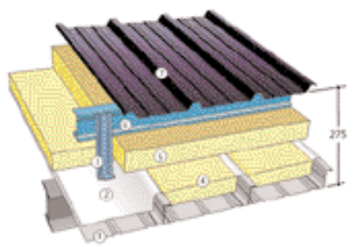
| | Performance par octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 27 | 36 | 46 | 57 | 63 | 64 |
| α | 0,41 | 0,56 | 0,70 | 0,80 | 0,80 | 0,70 |

### Advantages

- Aesthetically pleasing smooth secret-fix under-surface
- Available in curved shapes
- For multi purpose halls, concert halls and heated buildings with high performance requirements in insulation and sound absorption.



## IN227




**System description**
1. Non-load-bearing Hacierco tray
2. Vapour barrier
3. PDF cleat (see questionnaire)
4. Tray bottom insulation
5. PDF purlin (see questionnaire)
6. Roll insulation
7. Frequence, Oceane or Trapeza profile

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 54 (-2 ; -7) | - | 0,30 | 0,67 | 49 | 32 |

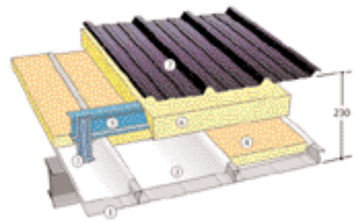
U value calculated with a purlin spacing of 2m and a cleat spacing of 1,20m.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 33 | 46 | 52 | 56 | 57 | 60 |

### Advantages of IN227

- Aesthetically pleasing smooth secret-fix under-surface
- Available in curved shapes for perpendicular fixing
- High sound insulation performances
- Good thermal insulation

## IN 226




**System description**
1. Non-load-bearing Hacierco tray
2. Vapour barrier
3. PDF spacer cleat (see questionnaire)
4. Tray bottom insulation
5. PDF purlin (see questionnaire)
6. Roll-formed insulation
7. Frequence, Oceane or Trapeza profile

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 50 (-2 ; -7) | - | 0,41 | 0,83 | 33 | 27 |

U value calculated with a purlin spacing of 2m and a brace cleat spacing of 1,20m.

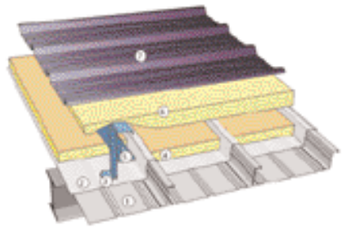
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 29 | 40 | 49 | 52 | 57 | 62 |

### Advantages of IN226

- Aesthetically pleasing smooth secret-fix under-surface
- Available in curved shapes for perpendicular fixing
- High sound insulation performances

# Globalroof
# Insulated double skin roof
# Acoustic and thermal systems

## IN 220 RT



**System description**
1. Non-load-bearing Hacierco tray
2. Vapour barrier
3. PDF cleat (see sizing questionnaire)
4. Rail in tray insulation
5. PDF purlin (see sizing questionnaire)
6. Roll insulation
7. Frequence, Oceane or Trapeza profile

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 42 (-4 ; -11) | - | 0,41 | 0,79 | 25 | 21 |

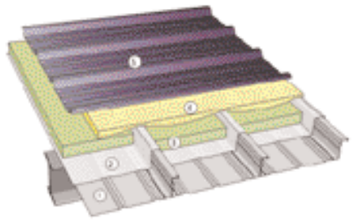
U value calculated with a purlin spacing of 2m and a cleat spacing of 1,20m.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 16 | 32 | 41 | 47 | 46 | 47 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- Available in curved shapes

## IN 220



**System description**
1. Hacierco tray
2. Vapour barrier
3. Rail in tray insulation
4. Roll insulation
5. Frequence, Oceane or Trapeza profile

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 42 (-4 ; -11) | - | 0,85 | 0,79 | 25 | 12 |

U value calculated with a purlin spacing of 2m and a bracket spacing of 1,20m.

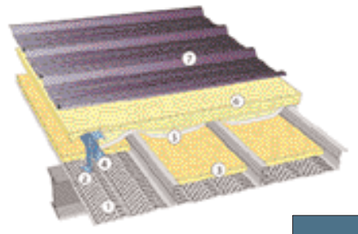
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 16 | 32 | 41 | 47 | 46 | 47 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- Curved shapes are available
- For unheated buildings, otherwise IN220RT



## CN 125 RT P and CN 125 RT 1 P



**System description**
1. Perforated (P)
2. PDF cleat (see questionnaire)
3. Tray bottom insulation
4. PDF purlin (see questionnaire)
5. Insulation + Vapour barrier
6. Insulation
7. Frequence, Oceane or Trapeza profile

| Système | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| CN 125 RT P | 36 (-2 ; -7) | 0,85 | 0,41 | 0,79 | 20 | 13 |
| CN 125 RT 1 P | 36 (-2 ; -7) | 0,95 | 0,27 | 0,79 | 21 | 25 |

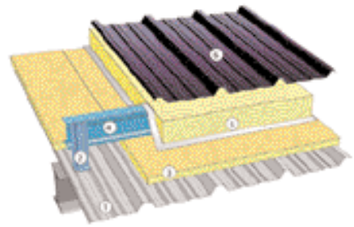
U value calculated with a purlin spacing of 2m and a cleat spacing of 1,20m.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 16 | 32 | 41 | 47 | 46 | 47 |
| α (P) | 0,25 | 0,59 | 0,97 | 0,91 | 0,80 | 0,88 |
| α (1 P) | 0,29 | 0,72 | 1 | 0,97 | 0,90 | 0,96 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- The perforated version gives very good sound absorption
- Available in curved shapes

## CN 127



**System description**
1. Perforated Trapeza profile
2. PDF cleat (see questionnaire)
3. Roll insulation
4. PDF purlin (see questionnaire)
5. Insulation + Vapour barrier
6. Frequence, Oceane or Trapeza profile

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 36 (-2 ; -7) | 0,70 | 0,37 | 0,83 | 18 | 14 |

U value calculated with a purlin spacing of 2m and a cleat spacing of 1,30m.

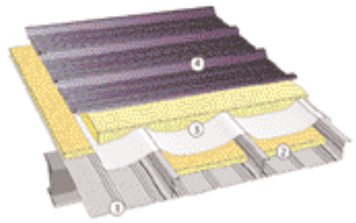
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 16 | 25 | 33 | 41 | 43 | 49 |
| α | 0,85 | 1 | 0,98 | 0,79 | 0,59 | 0,62 |

**Advantages**

- Simple and cost-effective system
- Available in curved shapes

# Globalroof
# Insulated double skin roof
# Acoustic and thermal systems

## CN 125 C or P



**System description**
1. Perforated (P) or notched (N) Hacierco tray
2. Tray bottom insulation
3. Insulation + Vapour barrier
4. Frequence, Oceane or Trapeza profile

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 36 (-2 ; -7) | 0,75 (P) 0,35 (C) | 0,87 | 0,79 | 18 | 14 |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 16 | 25 | 33 | 41 | 43 | 48 |
| Type P α | 0,41 | 0,56 | 0,70 | 0,80 | 0,80 | 0,70 |
| Type C α | 0,73 | 1 | 0,88 | 0,67 | 0,42 | 0,17 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- Available in curved shapes
- Very good sound absorption performance
- For unheated buildings otherwise see CN 125 RT



# Globalroof
# Waterproof membrane roof
# Principles

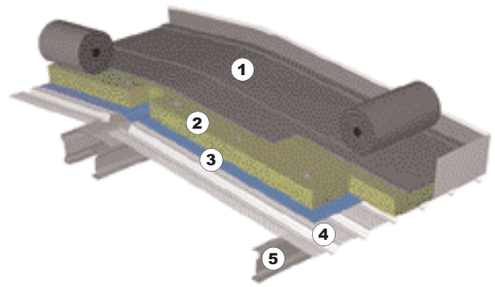
Roof systems with waterproof membrane developed by Arval achieve high performances and provide the solutions to regulations in force or specific requirements.

The wide range of waterproof roofing systems you can choose from are characterized by their:

- technical performances for thermal Globalroof
- technical performances for acoustic and thermalGlobalroof

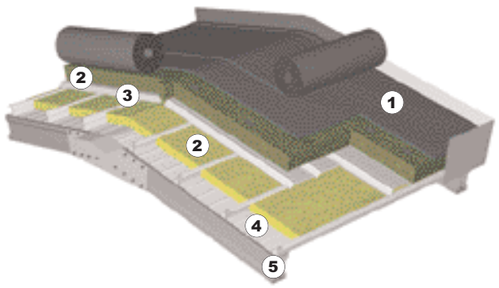
Their design not only incorporates a reduction in energy losses but also addresses the risk of condensation.

## Waterproof Globalroof on Hacierco profiles




**System description**
1. Waterproofing membrane
2. Insulation
3. Vapour barrier
4. Hacierco
5. Purlins

## Waterproof Globalroof on Hacierco trays




**System description**
1. Waterproof membrane
2. Insulation
3. Hacierco decking
4. Hacierco tray
5. Structure

Arval technical assistance will size the structure of thin PDF elements suited to your project (see the questionnaire at the end of the guide) for systems requiring bracing or purlins as is the case for the CIN 325P system or the IN228 system.

# Globalroof
# Waterproof membrane roof Principles

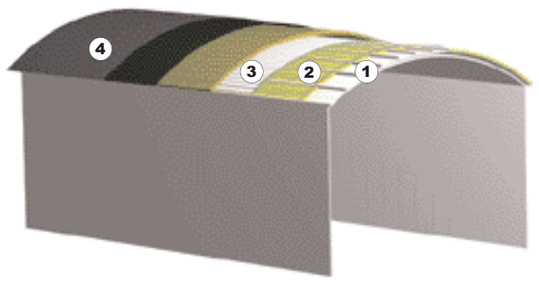
**Thermal and acoustic roofing with membrane adapts well to curved shapes.**

## Waterproof Globalroof on Hacierco profiles

When addressing single skin sealed roofing, the radius can be obtained by natural on-site curving of the Hacierco profile.

Examples of parallel fix sealed roofing: IN 228, CIN 322 and CIN 325 systems

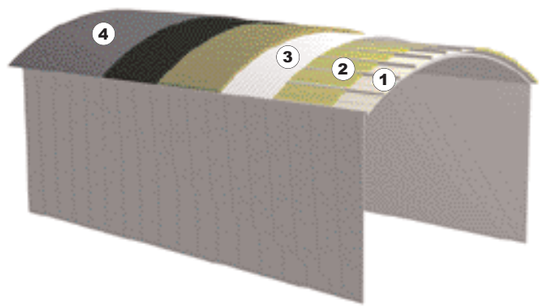
1. Hacierco trays mounted frame to frame, parallel to the roof drain with a minimum support width of 100mm.
2. Secondary structure mounted perpendicular to the roof drain.
3. Hacierco decking mounted parallel to the roof drain.
4. Insulating and membrane components are laid.




## Waterproof Globalroof on Hacierco trays

Examples of perpendicular fix arched roofing with sealant : CIN 321, IN 228, CIN 322, CIN 325

1. Hacierco trays mounted frame to frame, parallel to the roof drain with a minimum support width of 100mm.
2. Secondary structure is mounted
3. Perpendicular fix Hacierco decking is mounted and curved on-site (with appropriate radius)
4. Insulating and membrane components are laid.






**The Globalroof membrane systems you can choose from have diversified features in order to satisfy special market requirements.**

There are two subsets which are as follows :

- for energy saving roofs,
- acoustic comfort and energy saving roofs.

Acoustic performances are laboratory established and set forth in certificates.

### Thermal waterproof Globalroof

| System | | Thermal transmittance |
|---|---|---|
| DP | DP 33 | 0,33 |
| | DP 27 | 0,27 |
| | DP 20 | 0,20 |
| | DP 15 | 0,15 |

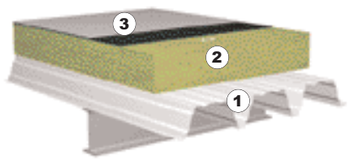
### Acoustic and thermal waterproof Globalroof

| Systems | | Acoustic attenuation | Acoustic absorption | Thermal transmittance |
|---|---|---|---|---|
| | | Rw (C ; Ctr) dB | αw | U W/(m².K) |
| CIN | CIN 325 | 55 (-2 ; -6) | 0,90 | 0,20 |
| | CIN 322 | 49 (-3 ; -10) | 0,31 | 0,32 |
| | CIN 321 AP | 40 (-2 ; -7) | 0,85 | 0,22 |
| IN | IN 228 | 56 (-1 ; -5) | 0,19 | 0,19 |
| | IN 210 F | 46 | - | 0,26 |
| | IN 210 E | 43 | - | 0,36 |
| | IN 210 A | 40 | - | 0,64 |
| | IN 211 A | 36 | - | 0,62 |
| IR | IR 221 | 47 (-2 ; -9) | 0,33 | 0,23 |
| CN | CN 100 Fi A or B | | 0,80 - 0,65 | 0,33 |
| | CN 1114 i | 36 (-2 ; -8) | 0,95 | 0,33 |
| | CN 1114 R | | 0,85 | 0,64 |
| | CN 118 | 39 | 0,60 | 0,33 or 0,62 |
| | CN 114 A | | 0,70 | 0,50 |
| | CN 116 B | | 0,65 | 0,46 |
| | CN 116 Pi | | 0,60 | 0,64 |
| | CN 116 PR | | 0,60 | 0,64 |
| | CN 112 | | 0,30 | 0,64 |
| | CN 1115 R1 | | 0,80 | 0,64 |
| | CN 1115i | 32 | 0,80 | 0,64 |
| | CN 115 R2 | | 0,95 | 0,64 |

The U values of thermal transmittance are given for 5 fasteners per m² through the thermal insulation except for the CN 118 system, which has no through fixing, and also the CN 100Fi, which has secret fixing.

# Globalroof
# Waterproof membrane roofing Thermal systems

## DP 15 to 33




**System description**
1- Hacierco profile
2- Insulation
3- Multilayer bituminous sealant

| System | Thermal transmittance | Temperature factor on inner surface | Cubic size |
|---|---|---|---|
| | U W/(m².K) | $f_{Rsi}$ | cm |
| DP 33 | 0,33 | 0,83 | 130 |
| DP 27 | 0,27 | 0,83 | 160 |
| DP 20 | 0,20 | 0,83 | 220 |
| DP 15 | 0,15 | 0,83 | 320 |

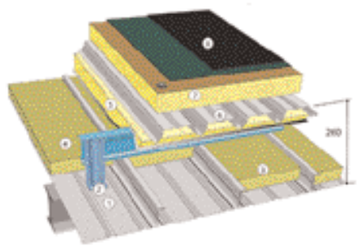
**Advantages**

- Flat under-surface if Hacierco has secret fixing
- Available in curved shapes
- Cost-effective system
- Very high thermal performances



# Globalroof
# Waterproof membrane roof Acoustic and thermal systems

## CIN 325 P or C




**System description**
1. Non-load-bearing perforated P or notched N Hacierco tray
2. PDF cleat (see questionnaire)
3. Insulation
4. PDF purlin (see questionnaire)
5. Roll insulation
6. Hacierco or Trapeza decking
7. Insulation
8. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C : Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 55 (-2 ; -8) | 0,90 (P)<br>0,35 (C) | 0,20 | 0,92 | 55 | 37 |

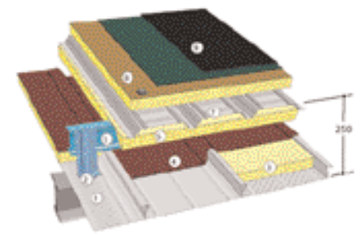
U value calculated with a purlin spacing of 2 m and a cleat spacing of 1,20m.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 33 | 45 | 54 | 67 | 74 | 81 |
| Type P α | 0,92 | 1 | 0,90 | 0,90 | 0,83 | 0,79 |
| Type C α | 0,73 | 1 | 0,88 | 0,67 | 0,42 | 0,17 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- Excellent sound absorption when perforated
- Excellent thermal performances
- For multi purpose halls, concert halls
- Perpendicular fix curved shapes can be achieved

## CIN 322




**System description**
1. Non-load-bearing Hacierco tray (perforated, notched, plain)
2. PDF cleat (see questionnaire)
3. Insulation
4. PDF purlin (see questionnaire)
5. Roll insulation
6. Hacierco decking
7. Insulation
8. Multilayer bituminous sealant

| Acoustic attenuation | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|
| Rw (C : Ctr) dB | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 49 (-3 ; -10) | 0,31 | 0,92 | 41 | 32 |

U value calculated with a purlin spacing of 2m and a cleat spacing of 1,20m.

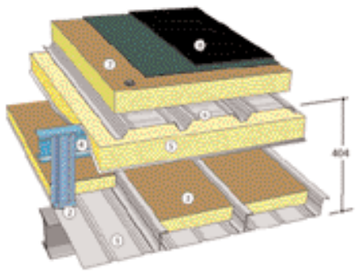
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 25 | 38 | 49 | 61 | 73 | 79 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- Perpendicular fix curved roofing is possible
- Excellent thermal and sound insulation performances

# Globalroof
# Waterproof membrane roof
# Acoustic and thermal systems

## IN 228



**System description**
1. Hacierco tray
2. PDF cleat (see sizing questionnaire)
3. Insulation
4. PDF purlin (see sizing questionnaire)
5. Roll insulation
6. Hacierco decking
7. Insulation
8. Multilayer bituminous sealant

| Acoustic attenuation | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|
| Rw (C ; Ctr) dB | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 56 (-1 ; -5) | 0,19 | 0,99 | 50 | 51 |

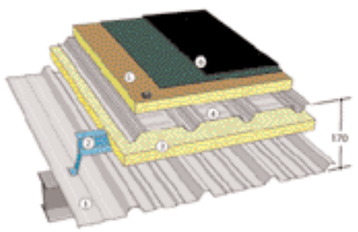
U value calculated with a purlin spacing of 3m and a cleat spacing of 1,60m.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 41 | 46 | 49 | 60 | 72 | 84 |

**Advantages**

- Aesthetically pleasing, smooth secret-fix under-surface
- No fixing on under-surface
- Excellent sound and thermal insulation
- Perpendicular fix curved roofing is possible

## IR 221



**System description**
1. Trapeza profile
2. Universal Hairenov zed spacer
3. Insulation
4. Hacierco decking
5. Insulation
6. Multilayer bituminous sealant

| Acoustic attenuation | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|
| Rw (C, Ctr) dB | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 47 (-2 ; -9) | 0,33 | 0,99 | 31 | 23 |

U value calculated with a 2 m spacing of the hairenov zed spacers

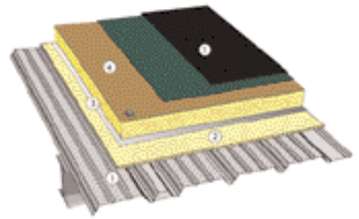
| | Performance par octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 24 | 37 | 45 | 51 | 60 | 71 |

**Advantages**

- Special Hairenov zed spacer reduces installation time
- System adapted to the renovation of buildings and their compliance with new thermal regulations
- No fixing on under-surface



## CN 100 Fi A or B



**System description**
1. Perforated Hacierco profile
2. Acoustic and insulation
3. Insulation
4. Multilayer bituminous sealant

| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| A | - | 0.80 | 0,33 | 0,94 | 35 | 18 |
| B | - | 0,65 | 0,33 | 0,94 | 35 | 18 |

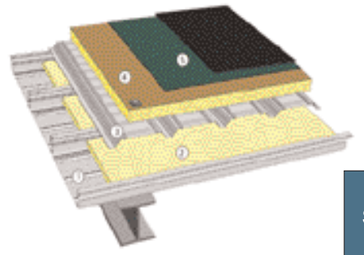
U value calculated according to the thickness of the insulation (see also system DP)

| | | Performance per octave | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| A | α | 0,56 | 0,83 | 0,79 | 0,75 | 0,75 | 0,69 |
| B | α | 0,55 | 0,78 | 0,76 | 0,60 | 0,60 | 0,63 |

**Advantages**

- Secret fixing on under-surface of profile
- Compact
- Good acoustic absorption performances
- On-site curving

## CIN 321 P or C



**System description**
1. Perforated (P) or notched (C) Hacierco tray
2. Insulation
3. Hacierco decking
4. Insulation
5. Multilayer bituminous sealant

| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 321 P or C | 40 (-2 ; -7) | 0,75 (P)<br>0,35 (C) | 0,49 | 0,89 | 34 | 20 |
| 321 AP | 40 (-2 ; -7) | 0,85 (P) | 0,30<br>0,22 | 0,93<br>0,94 | 40<br>47 | 22<br>27 |

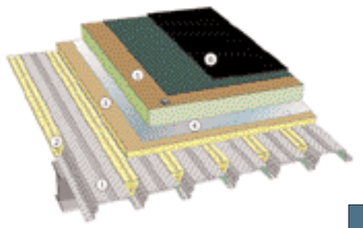
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| Type P α | 0,41 | 0,56 | 0,70 | 0,80 | 0,80 | 0,70 |
| Type C α | 0,73 | 1 | 0,88 | 0,67 | 0,42 | 0,17 |
| Type AP | 0,25 | 0,59 | 0,97 | 0,91 | 0,80 | 0,80 |

**Advantages**

- Aesthetically pleasing, smooth under-surface and no fixing on under-surface either
- Perforated or notched tray depending on the level of absorption required
- Available in curved shapes
- For multi purpose halls, concert halls
- Other thermal performances can be achieved according to the thickness of the insulation

# Globalroof
# Waterproof membrane roof
# Acoustic and thermal systems

## CN 1114i bitume or PVC



**System description**
1. Perforated Hacierco decking
2. Insulating batts
3. Insulation
4. Vapour barrier
5. Insulation
6. Multilayer bituminous sealant

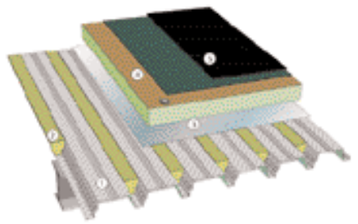
| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| bitume (b) | 36 (-1 ; -6) | 0,95 | 0,33 | 0,97 | 36 | 21 |
| PVC (P) | 36 (-2 ; -8) | 0,95 | 0,33 | 0,97 | 30 | 21 |

| | | Performance per octave | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| bitume | R dB | 17 | 24 | 32 | 47 | 61 | 80 |
| PVC | RdB | 15 | 24 | 33 | 42 | 58 | 75 |
| | α bitume/PVC | 0,61 | 0,92 | 0,94 | 0,95 | 0,97 | 0,84 |

### Advantages

- Excellent sound absorption
- Good thermal performances
- On site curving
- For multi purpose halls such as sports halls

## CN 1114R



**System description**
1. Perforated Hacierco decking
2. Insulating batts
3. Insulation
4. Vapour barrier
5. Insulation
6. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| - | 0.85 | 0,64 | 0,97 | 26 | 14 |

U value calculated according to the thickness and conductivity of the insulation, consult us to calculate your project.

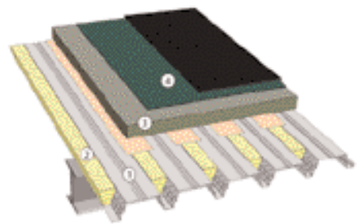
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| α | 0,60 | 0,80 | 0,83 | 0,86 | 0,84 | 0,79 |

### Advantages

- Excellent sound absorption
- On site curving
- For multi purpose halls such as sports rooms, which require very good acoustic absorption.



## Hairaquatic CN 118



**System description**
1. Perforated Hacierco decking with special coating
2. Insulating batts
3. Foam glass insulation
4. Multilayer bituminous sealant
5. Kraft paper or bridging strips

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 39 (-1 ; -4) | 0,60 | 0,62 | 0,94 | 25 | 15 |
| 39 (-1 ; -4) | 0,60 | 0,33 | 0,94 | 32 | 21 |

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 24 | 32 | 33 | 40 | 48 | 49 |
| α | 0,11 | 0,33 | 0,71 | 0,82 | 0,65 | 0,46 |

### Advantages

- Hairaquatic CN 118 has been specially designed to control the condensation and acoustics of buildings with high or very high humidity, such as swimming pools, paper mills, sports centres... over 10 years of experience!
- On site curving

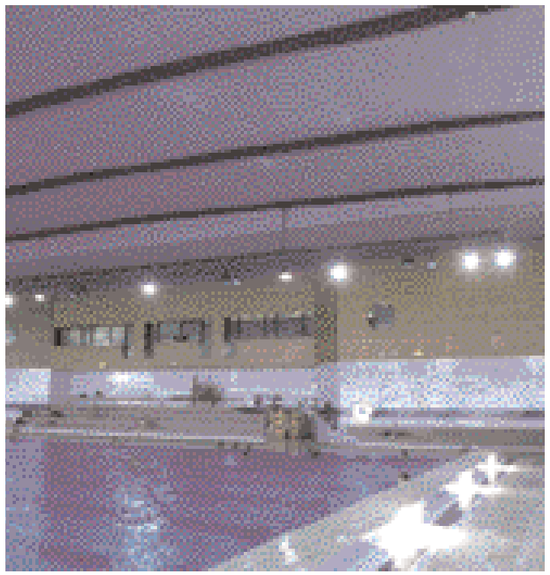
In the Hairaquatic system, the roof is supported by decking with perforated ribbing filled with rock wool slats and covered with bridging strips thus avoiding bituminous run-out. The advantage of this system is that foam glass insulation is bitumen-bonded to the roof, and this foamed glass is highly efficient since it remains inert in a damp environment.

The system does not require through-fixing, which reduces the risk of corrosion.

The whole installation is covered by a single or double layered sealing system.

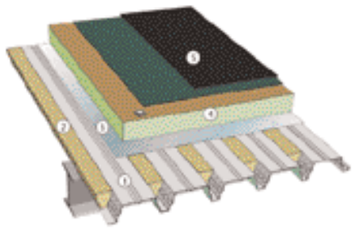
Partial perforation of the ribbing affords the system excellent acoustic performances.

Special coating is applied to the Hacierco prepainted steel profile to guarantee the good behaviour of the system (consult us).



# Globalroof
# Waterproof membrane roof
# Acoustic and thermal systems

## CN 114 B



**System description**
1. Perforated Hacierco decking
2. Insulating batts
3. Vapour barrier
4. Insulation
5. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| - | 0,70 | 0,50 | 0,95 | 30 | 17 |

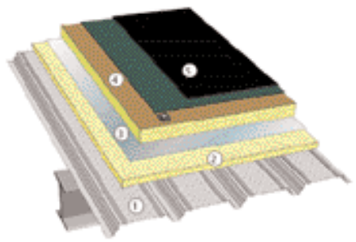
U value depending on the thickness and conductivity of the insulation, consult us to calculate your project.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| α | 0,67 | 0,96 | 1 | 0,83 | 0,63 | 0,54 |

**Advantages**

.
- For buildings with medium span roofing.
- High thermal performances can be achieved if you increase the thickness of the insulation (consult us)
- On site curving
- Good sound absorption performances

## CN 116 B



**System description**
1. Perforated Hacierco decking
2. Acoustic insulation
3. Vapour barrier
4. Insulation
5. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| - | 0.65 | 0,46 | 0,95 | 30 | 15 |

U value depending on the thickness and conductivity of the insulation, consult us to calculate your project.

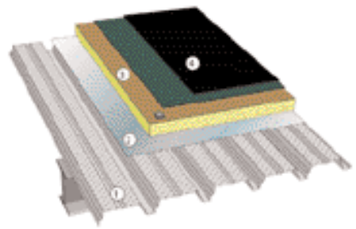
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| α | 0,67 | 0,96 | 1 | 0,83 | 0,63 | 0,54 |

**Advantages**

- Cost-effective system
- Higher thermal performances can be achieved if you increase the thickness of the insulation (consult us)
- Suited to the roofing of buildings with no or little heating such as technical premises, storage sheds
- On site curving



## CN 116 Pi



**System description**
1. Perforated Hacierco
2. Acoustic vapour barrier
3. Insulation
4. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| - | 0,60 | 0,64 | 0,94 | 25 | 12 |

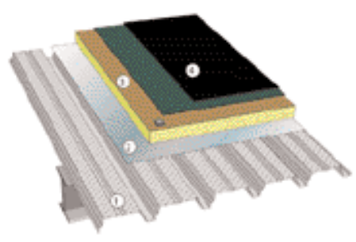
U value depending on the thickness and conductivity of the insulation, consult us to calculate your project.

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| α | 0,37 | 0,82 | 0,89 | 0,70 | 0,56 | 0,45 |

**Advantages**

- Cost-effective systems with good sound absorption performances in low frequencies
- Higher thermal performances can be achieved if you increase the thickness of the insulation (consult us)
- Suited to the roofing of technical premises, storage sheds, lobbies…
- On site curving

## CN 116 PR



**System description**
1. Perforated Hacierco decking
2. Acoustic vapour barrier
3. Insulation
4. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| - | 0,60 | 0,64 | 0,94 | 25 | 12 |

U value depending on the thickness and conductivity of the insulation, consult us to calculate your project.

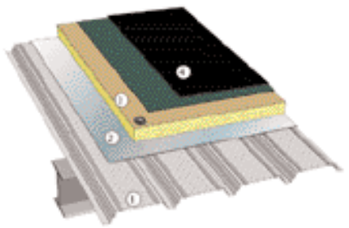
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| α | 0,33 | 0,68 | 0,81 | 0,75 | 0,56 | 0,45 |

**Advantages**

- Cost-effective systems with good sound absorption performances in medium frequencies
- Higher thermal performances can be achieved if you increase the thickness of the insulation (consult us)
- Suited to the roofing of technical premises, storage sheds, lobbies…
- On site curving

# Globalroof
# Waterproof membrane roof
# Acoustic and thermal systems

## CN 112



**System description**
1. Notched perforated Hacierco decking
2. Acoustic vapour barrier
3. Insulation
4. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| - | 0,30 | 0,64 | 0,94 | 24 | 10 |

U value depending on the thickness and conductivity of the insulation, consult us to calculate your project.

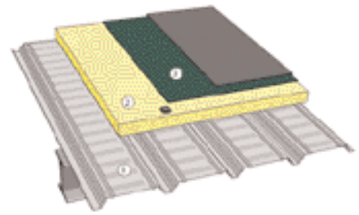
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| α | 0,46 | 0,96 | 0,78 | 0,48 | 0,25 | 0,20 |

**Advantages**

- Compact
- Good thermal performances can be achieved by increasing the thickness of the insulation (consult us)
- On site curving



## IN 210 F, 210 E and 210 A



**System description**
1. Hacierco decking
2. Insulation
3. Multilayer bituminous sealant

| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| IN 210 F | 46 (-1 ; 6) | - | 0,26 | 0,97 | 47 | 24 |
| IN 210 E | 43 (-2 ; -7) | - | 0,36 | 0,96 | 38 | 18 |
| IN 210 A | 40 (-2 ; -7) | - | 0,64 | 0,94 | 24 | 12 |

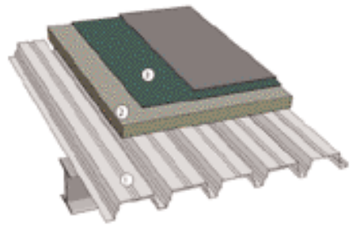
| System | | Performance per octave | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| IN 210 F | R dB | 27 | 35 | 43 | 50 | 58 | 64 |
| IN 210 E | R dB | 26 | 31 | 37 | 46 | 52 | 59 |
| IN 210 A | R dB | 20 | 28 | 36 | 46 | 55 | 63 |

**Advantages**

- Cost-saving
- Good sound insulation performances
- On site curving
- U values as high as 0,15 W/m².K can be achieved – see DS systems

# Globalroof
# Waterproof membrane roof
# Acoustic and thermal systems

## IN 211 A



**System description**
1. Hacierco decking
2. Foam glass insulation
3. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| 36 (-1 ; -6) | - | 0,62 | 0,94 | 24 | 10 |

U value depending on the thickness and conductivity of the insulation, consult us to calculate your project.

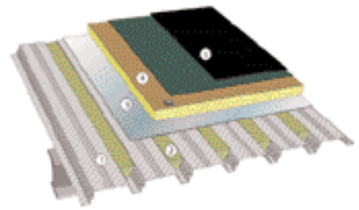
| | Performance par octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 23 | 28 | 29 | 38 | 43 | 45 |

### Advantages

- Aesthetically pleasing: with concealed fasteners
- Compact
- On site curving
- Consult us if you wish the thermal insulation to be optimized, U values as high as 0,15 W/m².K can be achieved



## CN 1115 R2



**System description**
1. Perforated Hacierco decking
2. Acoustic vapour barrier
3. Insulation
4. Multilayer bituminous sealant

| Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|
| Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| - | 0,95 | 0,64 | 0,94 | 25 | 12 |

U value depending on the thickness and conductivity of the insulation, consult us to calculate your project.

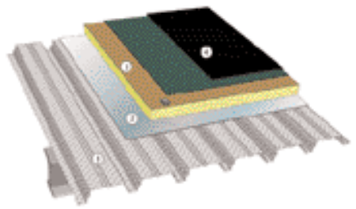
| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| α | 0,33 | 0,72 | 0,94 | 1,00 | 0,96 | 0,82 |

### Advantages

- Cost-effective system with high sound absorption performances
- Excellent thermal performances can be achieved by increasing the thickness of the insulation.
- For multi purpose halls such as sports rooms and industrial premises, which require very good acoustic absorption.
- On site curving

# Globalroof
# Waterproof membrane roof Acoustic and thermal systems

## CN 1115 R1, CN 1115i bitume, CN 1115i PVC



**System description**
1. Perforated Hacierco decking
2. Acoustic vapour barrier
3. Insulation
4. Multilayer bituminous sealant

| System | Acoustic attenuation | Acoustic absorption | Thermal transmittance | Temperature factor on inner surface | Weight | Cubic size |
|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | αw | U W/(m².K) | $f_{Rsi}$ | Kg/m² | cm |
| CN 1115 R1 | 32 (-1 ; -4) | 0,80 | 0,64 | 0,94 | 24 | 12 |
| CN 1115i bitume | 32 (-1 ; -4) | 0,75 | 0,46 | 0,94 | 28 | 15 |
| CN 1115i PVC | 29 (0 ; -3) | | | | 22 | 15 |

U value depending on the thickness and conductivity of the insulation, consult us for the calculation of your project.

| System | | Performance per octave | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| CN 1115 R1 | α | 0,28 | 0,62 | 0,80 | 0,93 | 0,79 | 0,64 |
| CN 1115i | α | 0,37 | 0,83 | 0,93 | 0,87 | 0,76 | 0,65 |
| CN 1115i bitume | RdB | 20 | 21 | 26 | 36 | 52 | 66 |
| CN 1115i PVC | RdB | 18 | 20 | 24 | 29 | 47 | 63 |

### Advantages

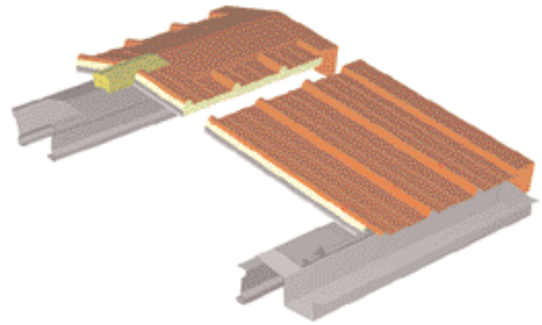
- For multi purpose halls such as sports rooms and industrial buildings
- On site curving
- Higher thermal performances can be achieved by using insulation as thick as U 0,15 W/m².K, consult us for your project.



# Globalroof
# Insulated roof panels Systems

**The Ondatherm or Ondafibre composite roofing panels you can choose from diversify thermal and acoustic features in order to satisfy special market requirements.**

Acoustic performances are laboratory established and set forth in certificates.

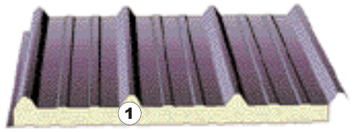


### Ondatherm and Ondafibre

| Systems | Acoustic attenuation | Acoustic absorption | Thermal transmittance |
|---|---|---|---|
| | Rw (C ; Ctr) | $\alpha_w$ | U (W/m²K) |
| Panel with polyurethane foam | | | |
| Ondatherm 1040 TS | 25 dB (-1 ; -3) | - | 0,24 to 0,76 |
| Ondatherm 1040 TSA | 27 dB (-1 ; -3) | 0,50 | 0,28 to 0,50 |
| Ondatherm 900-35C and 1000-35C | 30 dB (-1 ; -3) | - | 0,23 to 0,68 |
| Panel with rock wool | | | |
| Ondafibre 3005 T | 30 dB (-1 ; -2) | 0,50 | 0,26 to 0,61 |

# Globalroof
# Insulated roof panels

## Ondatherm 1040 TS




**System description**
1.Thermal insulation: PU foam with no HCFC

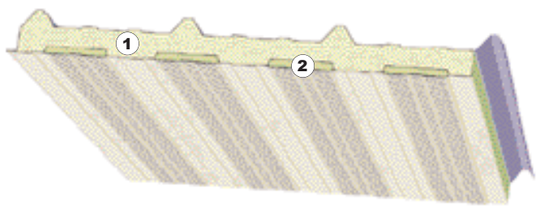
| Panel properties | | Nominal thickness of foam core (mm) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 30 | 40 | 50 | 60 | 80 | 100 | 120 |
| Weight (kg/m²) | Example 0,63 and 0,63 mm thick | 12,5 | 12,9 | 13,3 | 13,7 | 14,5 | 15,3 | 16,1 |
| Acoustics | Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw (C ; Ctr) : 25dB (-1 ; -3) | | | | | | |
| Thermal features (with λ = 0,025 W/m.K) | Thermal transmittance U (W/m.K) | 0,76 | 0,58 | 0,47 | 0,40 | 0,30 | 0,24 | 0,20 |
| | Linear heat loss ψ (W/m².K) | 0,11 | 0,06 | 0,04 | 0,03 | 0,02 | 0,01 | 0,01 |

**Advantages**

- Ease of installation - Reduced assembly time
- Good sound proofing
- Curved shapes are available

- Roofing for premises with low or medium humidity Based on the Technical Report in force
- For premises with high and very high humidity: consult us

## Ondatherm 1040TSA




**System description**
1. Thermal insulation: PU foam with no HCFC
2. Acoustic insulation : Glass wool

| | Performance per octave | | | | | |
|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 |
| R dB | 20 | 18 | 23 | 25 | 34 | 42 |
| α | 0,06 | 0,22 | 0,59 | 0,87 | 0,70 | 0,51 |

| Panel properties | | Nominal thickness of foam core (mm) | | |
|---|---|---|---|---|
| | | 60 | 80 | 100 |
| Weight (kg/m²) | Example 0,63 and 0,63 mm thick | 13,9 | 14,7 | 15,5 |
| Acoustics | Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw (C ; Ctr) : 27 dB (-1 ; -3) | | |
| | Absorption | $\alpha_w$ = 0,50 | | |
| Thermal features (with λ = 0,025 W/m.K) | Thermal transmittance U (W/m.K) | 0,50 | 0,36 | 0,28 |
| | Linear heat loss ψ (W/m².K) | 0,03 | 0,02 | 0,01 |

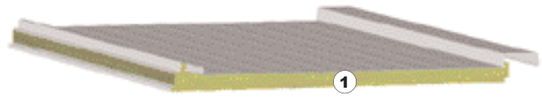
**Advantages**

- Ease of installation - Reduced assembly time
- Very good sound absorption

- Roofing for premises with low or medium humidity As per specialised Survey.



## Ondatherm 900-35C or 1000-35C




**System description**
1. Thermal insulation : PU foam with no HCFC

| Panel properties | | Nominal core thicknesses (mm) | | | | |
|---|---|---|---|---|---|---|
| | | 30 | 40 | 50 | 80 | 100 |
| Weight (kg/m²) | Example 0,50 and 0,50 mm thick | 11 | 11,4 | 11,8 | 13 | 13,8 |
| Acoustics | Attenuation index (test for 60mm, value valid for any thickness of facing or insulation) | Rw 30 dB | | | | |
| Thermal features (with λ = 0,041 W/m.K) | Thermal transmittance U (W/m².K) | 0,68 | 0,53 | 0,43 | 0,27 | 0,23 |

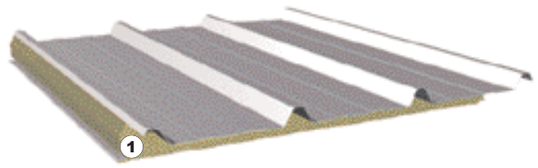
Thicker panels are possible, consult us.

**Advantages**

- Aesthetically pleasing - Concealed fixing
- Reduced assembly time
- High thermal performances
- Roofing for premises with low or medium humidity For premises with high and very high humidity: consult us.

# Globalroof
# Insulated roof panels

## Ondafibre 3005 T




**System description**
1. Thermal insulation : Rock wool

| Panel properties | | Nominal thickness of foam core (mm) | | | | |
|---|---|---|---|---|---|---|
| | | 60 | 80 | 100 | 10 | 150 |
| Weight (kg/m²) | Example 0,63 and 0,63 mm thick | 17,7 | 19,9 | 21,4 | 23,4 | 26,5 |
| Acoustics | Insulation : Attenuation index (60mm) | Rw (C ; Ctr) 30 dB (-1 ; -2) | - | - | - | Rw (C ; Ctr) 31 dB (-3 ; -4) |
| Thermal features (with λ = 0,041 W/m.K) | Thermal transmittance U (W/m².K) | 0,61 | 0,46 | 0,39 | 0,33 | 0,26 |
| | Linear heat loss ψ (W/m.K) | 0,02 | 0,01 | 0,01 | - | - |

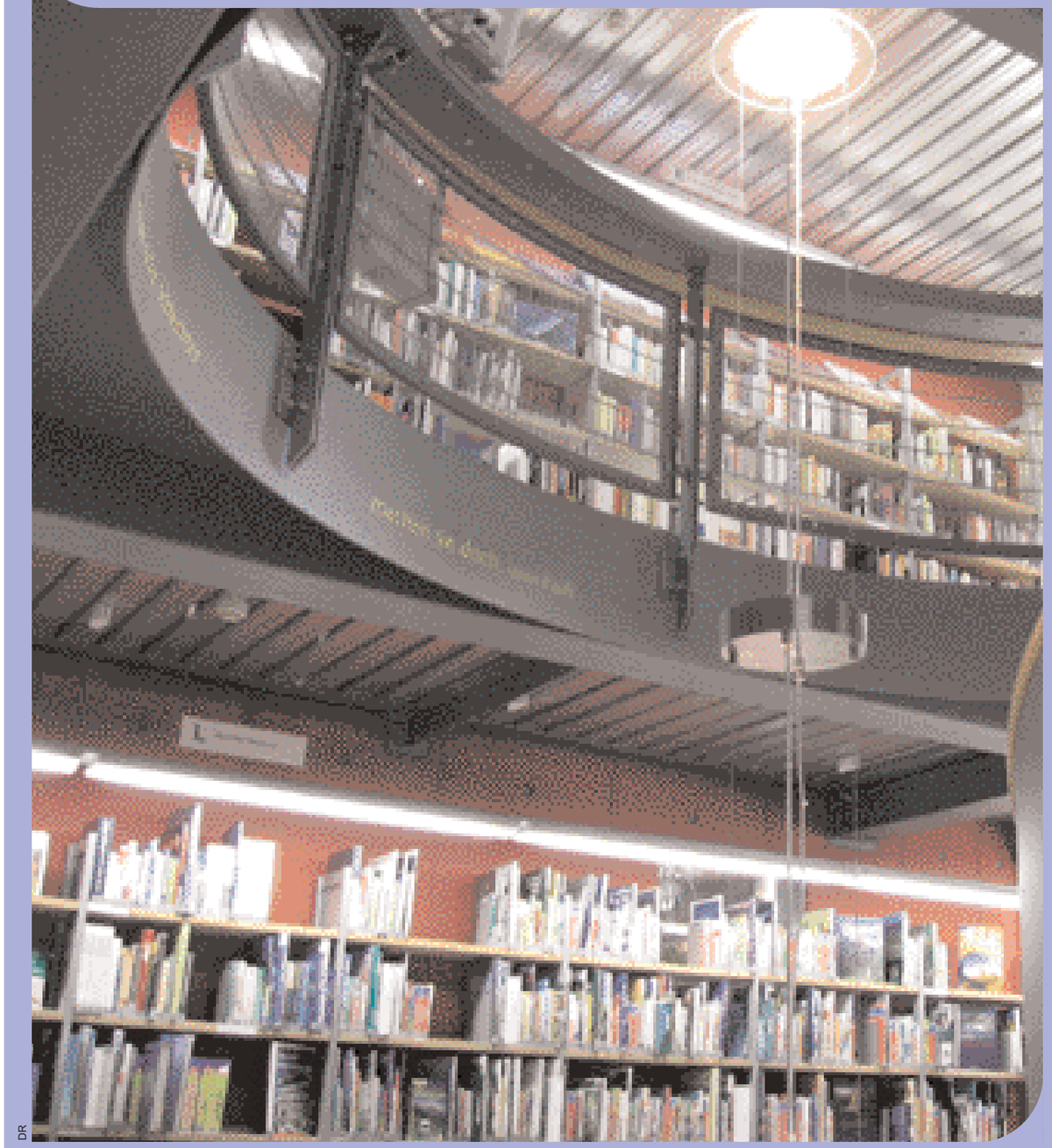
**Advantages**

- Good thermal insulation
- Fire reaction Euroclass A2 - S1 d0
- Roofing for premises with low or medium humidity
  Based on the Technical Report in force



# Globalroof
# Notes

# Globalfloor
# Thermal and acoustic solutions



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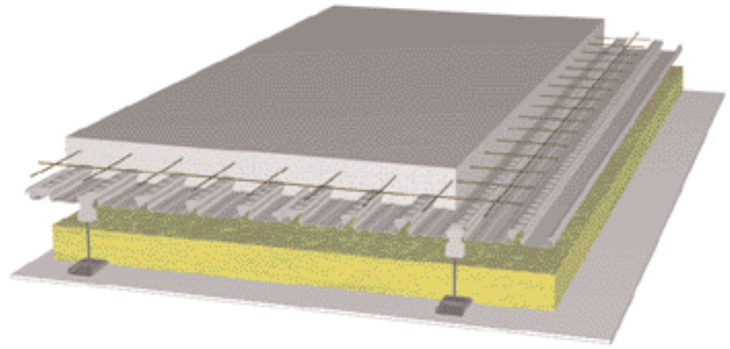
# Globalfloor
# Thermal and acoustic solutions



**Arval flooring is much appreciated in the service sector of the market because it can give all the performances required by thermal and acoustic regulations together with easy-to-use versatility.**

Arval can offer you various technical solutions based on the principle of double-walling, damping, in order to address sound insulation issues in flooring and comply with the current regulations of each particular country:

- by inserting insulation under the floating screed in the upper part of the floor slab : a solution well suited to all Arval flooring systems,
- by inserting insulation in the plenum under a suspended ceiling such as Cofrastra Decibel,
- with insulation fitted into precast flooring : Cofradal 200 and Cofradal 200 Decibel.

This technology gives leeway to new perspectives in sound and heat comfort. The presence of thermal acoustic insulation gives, above all, thermal independence from level to level and enables users to manage their energy expenditure in a truly independent fashion.

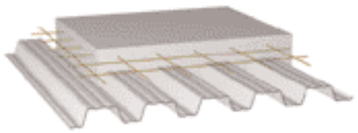
**The acoustic solutions we can offer have all been validated by laboratory testing. Prime examples of their use and numerous successful projects have substantiated these laboratory results.**

Implementing factory-produced industrial systems using expert technology and an acknowledged speed of laying brings substantial savings in terms of construction costs compared to a reinforced concrete floor.

Ultimately, the main contractor and designer are once again able to choose the thickness of the load-bearing floor slab.

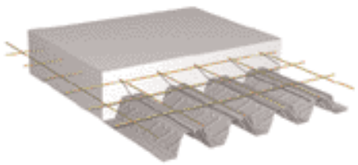
# Globalfloor
# Thermal and acoustic solutions

## Cofraplus 60



| Slap depth | Acoustic attenuation | Weight |
|---|---|---|
| cm | Rw (C;Ctr) dB | daN/m² |
| 10 | 45 (-1, -3) | 164 |
| 12 | 47 (-1, -4) | 212 |
| 14 | 49 (-1, -5) | 260 |
| 16 | 50 (-1, -5) | 308 |
| 18 | 52 (-2, -6) | 356 |
| 20 | 53 (-1, -6) | 404 |
| 22 | 54 (-1, -6) | 452 |
| 24 | 55 (-1, -7) | 500 |

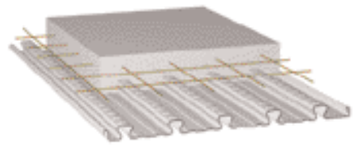
## Cofraplus 77



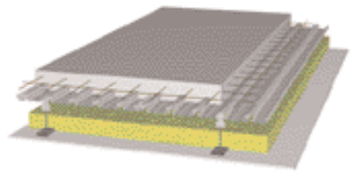
| Slap depth | Acoustic attenuation | Weight |
|---|---|---|
| cm | Rw (C;Ctr) dB | daN/m² |
| 12 | 45(+0, -3) | 192 |
| 14 | 47(+0, -4) | 240 |
| 16 | 49(-1, -5) | 288 |
| 17 | 50(-1, -5) | 312 |
| 20 | 52(-1, -6) | 384 |
| 24 | 54(-1, -6) | 480 |



## Cofrastra 40

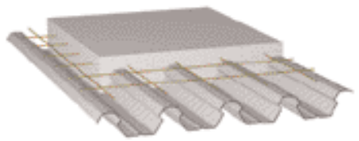


## Cofrastra 40 Decibel



| Reference | Acoustic attenuation | Impact sound level | R (dB) per octave (Hertz) (test conversion into 1/3 of an octave) | | | | | | Weight daN/m² | Thickness in cm |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | Ln, w in dB | 125 | 250 | 500 | 1000 | 2000 | 4000 | | |
| COFRASTRA 40<br>14 cm thick slab | 51 (-3 ; -7) | 79 | 33 | 37 | 48 | 56 | 66 | 70 | 330 | 14 |
| COFRASTRA 40 decibel<br>14 cm thick slab<br>+ plenum<br>+ BA 13 ceiling | 56 (-6 ; -11) | 66 | 32 | 42 | 62 | 72 | 81 | 84 | 343 | 23 |
| COFRASTRA 40 decibel<br>14 cm thick slab<br>+ insulation 60 mm<br>+ BA 13 ceiling | 65 (-4 ; -10) | 61 | 41 | 53 | 64 | 73 | 81 | 84 | 345 | 23 |

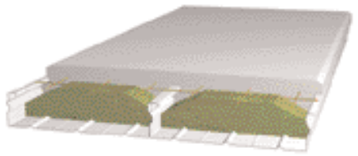
## Cofrastra 70



| Reference | Acoustic attenuation | Impact sound level | R (dB) per octave (Hertz) (test conversion into 1/3 of an octave) | | | | | | Weight daN/m² | Thickness in cm |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rw (C ; Ctr) dB | Ln, w in dB | 125 | 250 | 500 | 1000 | 2000 | 4000 | | |
| COFRASTRA 70<br>13 cm thick slab | 49 (-1 ; -5) | 86 | 33 | 37 | 44 | 57 | 58 | 66 | 236 | 13 |

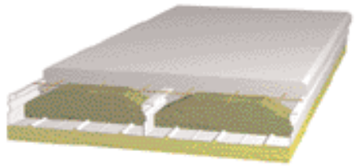
# Globalfloor
# Thermal and acoustic solutions

## Cofradal 200



| System | Acoustic attenuation Rw (C ; Ctr) in dB | Impact sound level Ln, w in dB | Transmission coefficient U (W/m².K) |
|---|---|---|---|
| Cofradal 200<br>Single, without false ceiling | 58 (-1 ; -6) | 78 | 0,78 |
| Cofradal 200<br>With false ceiling<br>(Glass wool + BA 13) | 64 (-2 ; -7) | 66 | - |
| Cofradal 200<br>With floating floor layer<br>(Rocksol 501,20 cm<br>+ reinforced floor layer<br>50 mm precast) | 72 (-6 ; -14) | 49 | - |

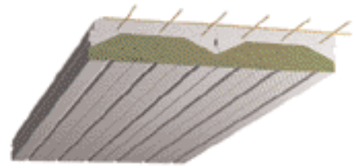
## Insulated Cofradal 200



| Polyurethane thickness in mm | U-value (W/m².K) mid-span (not including supports) with polyurethane thermal conductivity λ =0,029 W/m.K |
|---|---|
| 40 | 0,37 |
| 60 | 0,29 |
| 80 | 0,24 |
| 100 | 0,20 |



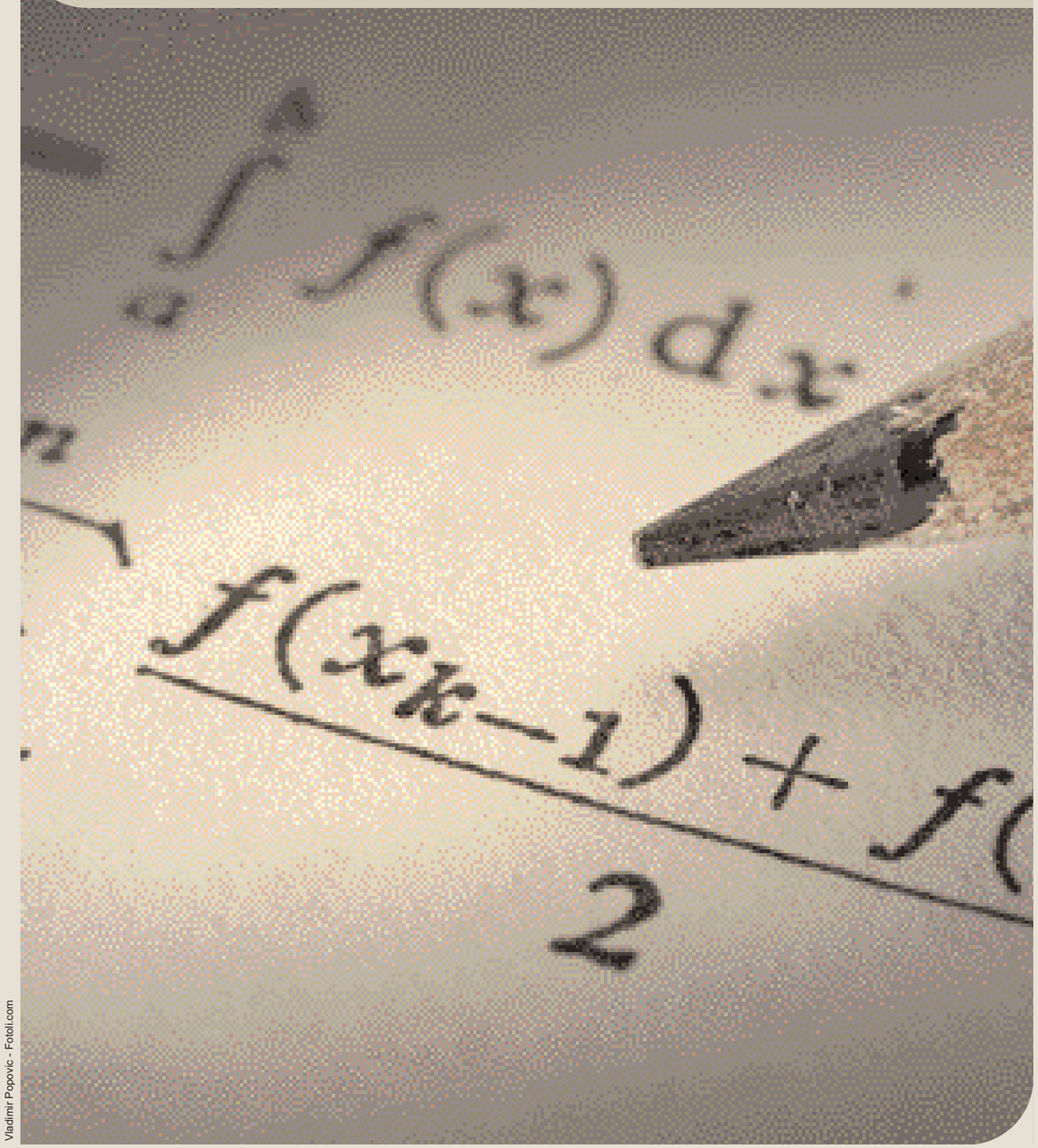
## Cofradal 200 Decibel



| System | Acoustic attenuation Rw (C ; Ctr) in dB | Impact noise level Ln, w in dB | Acoustic absorption $\alpha_w$ |
|---|---|---|---|
| Single, without false ceiling | 58 (-2 ; -8) | 78 | 0,85 |

Heng Kong Chen -

# Basic concepts



Vladimir Popovic - Fotoli.com



# Thermal issues
## Principles

**The purpose of a building is to protect man from outside aggression and bad weather, which is the reason why their design mainly aims at restricting draughts and maintaining a pleasant temperature inside.**

One of the consequences of the first oil shock in 1973 was that thermal regulations were specifically established for the first time in order to cut down on the energy required to heat a building.

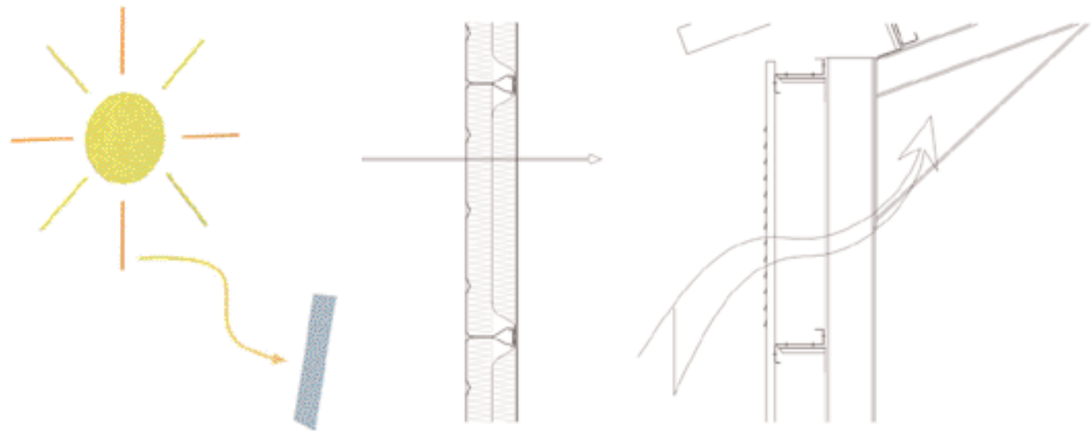
To this end, it was necessary to look into how heat is transmitted in buildings.

### Heat transmittance

There are three types of heat transmittance:

- **Radiation** is mainly characterized by infra-red waves spreading out from a heat source. This type of transfer occurs, for instance, in “glass” walling.
- **Conduction**, which is the direct transmittance of heat from one material to another, is the main transfer phenomenon occurring in opaque walls, twin-skin cladding, weatherproofing, double skin sandwich panel roofing, composite flooring and so on.
- **Convection** transfers heat per air movement. It can be ventilation or air leakage…

The purpose of insulating a building is to minimise each kind of transfer, whence requirements in terms of thermal transmission for glass walling (radiation), opaque walling (conduction) and also airtightness requirements for buildings (convection).



**Radiation** **Conduction** **Convection**

# Thermal issues
# Principles

**Arval systems are mainly suited to opaque walling, where conduction is the mode of transmittance.**

Conduction, as defined by Fourrier's law, determines thermal conductivity as the main property of the material. For building products, we use thermal conductivity at 10°C.

## Thermal conductivity

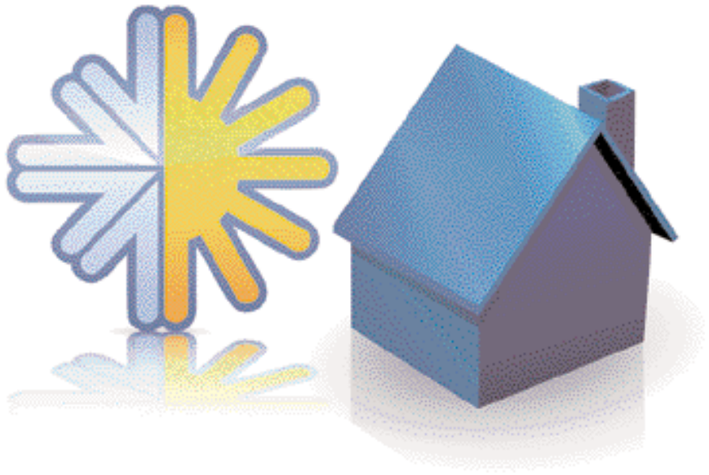
Thermal conductivity λ in W/(m.K) is a material's ability to let heat pass through. This varies according to whether the material is more or less insulating. The weaker the thermal conductivity value, the more insulating the material.

**Examples of material (as per STANDARD EN 12524)**

| Material | Thermal conductivity |
|---|---|
| Copper | 380 W/(m.K) |
| Aluminium | 230 W/(m.K) |
| Steel | 50 W/(m.K) |
| Concrete | 2,30 W/(m.K) |
| Glass | 1 W/(m.K) |
| EPDM | 0,25 W/(m.K) |
| Butyl | 0,24 W/(m.K) |
| Plaster (600 kg/m$^3$) | 0,18 W/(m.K) |
| PVC | 0,17 W/(m.K) |

**Examples of material**

| Material | Thermal conductivity |
|---|---|
| Polystyrene | 0,031 to 0,058 W/(m.K) |
| Cellular glass | 0,035 to 0,048 W/(m.K) |
| Mineral wool | 0,031 to 0,065 W/(m.K) |
| Polyurethane foam | 0,025 to 0,050 W/(m.K) |



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You can work out the heat flow per square metre of the surface area, from the thermal conductivity of the material, for a given temperature difference. However, a wall is made up of several types of material, which can be more or less insulating. The definition of a material's thermal resistance enables us to compare each material used, with regard to its thickness.

## Thermal resistance

A material's thermal resistance, R, in m$^2$.K/W represents its ability to permit heat transmittance. Contrary to thermal conductivity, the higher the thermal resistance, the more efficient the insulation.

A standard material's thermal resistance is calculated as follows:

$$R = \frac{t}{\lambda}$$

t = thickness in m
λ = thermal conductivity in W/m.K

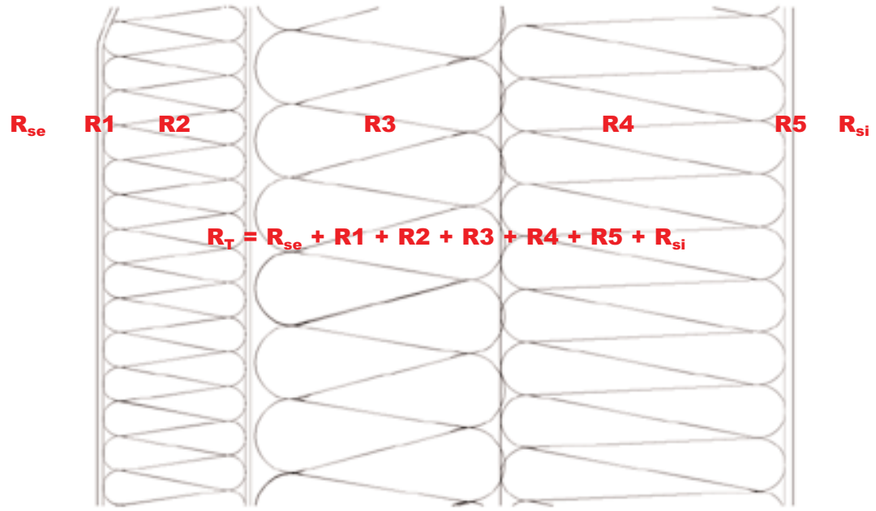
Examples :

| | Thickness in mm | R in m$^2$.K/W |
|---|---|---|
| Polyurethane λ=0.025W/(m.K) | 50 | 2 |
| | 100 | 4 |
| Mineral wool λ=0.040W/(m.K) | 80 | 2 |
| | 160 | 4 |

**A wall is generally made up of several different types of material. In order to be able to give the characteristics of the wall, it is necessary to give the resistance of the whole wall.**

## Resistance, $R_T$, of a system made up of different types of material

The total thermal resistance $R_T$ (in m$^2$.K/W) of a wall is made up of several different types of homogeneous material and is obtained by adding up their thermal resistance.



# Thermal issues
## Principles

**A wall will behave differently according to what it is used for and the direction in which the heat flows.**

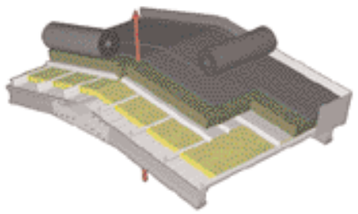
So that the surface heat exchange is taken into account (radiation and convection), a layer (without thickness) is added to each side of the wall. The thermal surface resistance corresponds to this layer.

## Thermal surface resistance

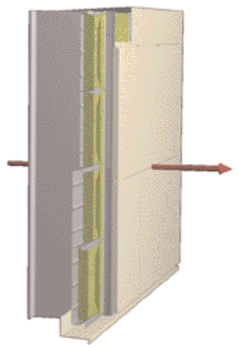
It varies according to the direction of the flow and with regard to whether the surface in question is outside or inside the building. We call:

- $R_{si}$ (m².K)/W, the internal thermal surface resistance.
- $R_{se}$ (m².K)/W the external thermal surface resistance.

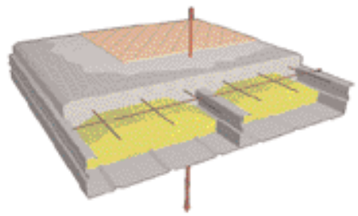
| Use | Direction of heat flow | | |
|---|---|---|---|
| | Upward | Horizontal | Downward |
| | Roofing | Cladding | Flooring |
| $R_{si}$ [W/(m².K)] | 0,10 | 0,13 | 0,17 |
| $R_{se}$ [W/(m².K)] | 0,04 | 0,04 | 0,04 |



Upward flow



Horizontal flow



Downward flow



**All walls have discontinuous aspects.**
**These aspects generally bring about changes in the thermal properties of the wall.**

This discontinuity can originate from the design of the building (e.g. expansion joints) or from the installation of certain products (tray or sandwich panel interlocking joints, lateral joins on supports…).

A thermal transmittance coefficient has been determined so that this discontinuity is taken into account.

## Thermal transmittance coefficient

The thermal transmittance coefficient, $U_p$, is the rate of heat transfer through one square metre of a wall divided by the Kelvin difference in temperature between the two sides of the wall. It shall be determined according to the following formula:

$$U_p = U_c + \Delta U$$

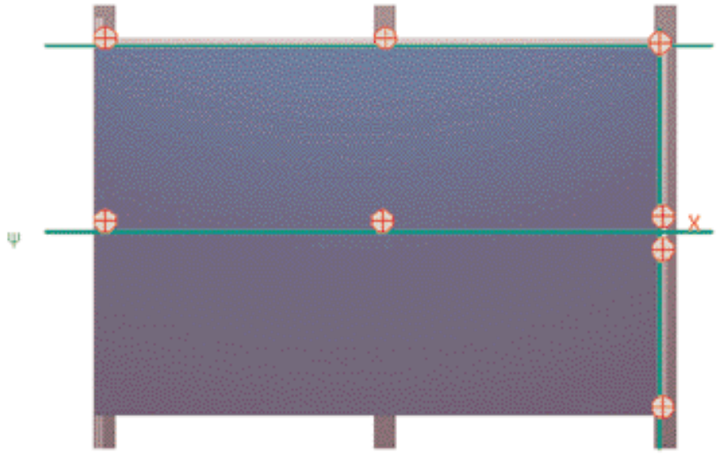
Where $U_c$ represents the transmittance coefficient in the centre part of the wall, without thermal bridging:

$$U_c = \frac{1}{R_T}$$

And ΔU represents the transmittance brought about by all the thermal bridging in the wall:

$$\Delta U = \frac{\sum \Psi \cdot l + \sum \chi}{A}$$

Where:
ψ : The linear thermal transmittance coefficient [W/(m.K)]
L : The length of the linear thermal bridging [m]
χ : The point thermal transmittance coefficient [W/K]
N : The number of point thermal bridges
A : Area (m²)



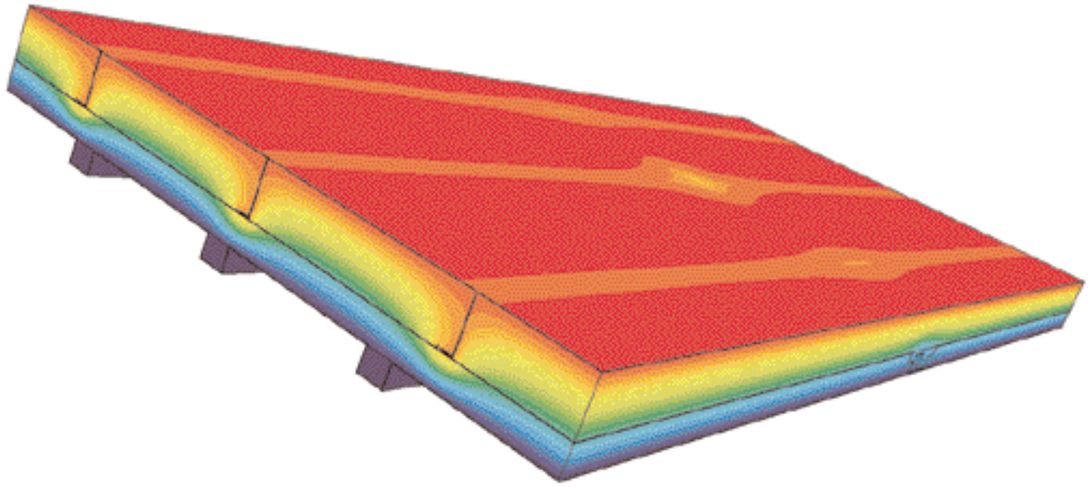

Example of thermal bridges

# Thermal issues
# Principles

## Example of thermal bridges

Point $\chi$: fixing, through a beam…
Linear $\psi$: panel interlocking, compression of insulation by a structural element or a tray edge…

**The thermal bridges situated between two walls are generally addressed separately by the regulations (façade/roof connection, corner of building, floor/façade connection…).**



**Thermal bridge on a double skin system**



## Definition of the thermal transmittance of a single wall sandwich panel Ondatherm 1040 TS

**Arval technical documents provide all the elements required to calculate single wall heat loss.**

i.e. an Ondatherm 1040TS panel, 1m cover width, placed on 3 supports, with a 5 m span and overlapping along the transverse joint, all the ribs being fixed.

We have 6 fasteners per panel (those along the transverse and longitudinal overlaps are considered as half fixing, because they fix 2 panels), i.e. 6 fasteners for 10 $m^2$ of panels (number of spans x span length x cover width = 2x5x1), i.e. 0,6 fasteners per $m^2$.

For a surface area A = 1 $m^2$ and a thickness of 100 mm

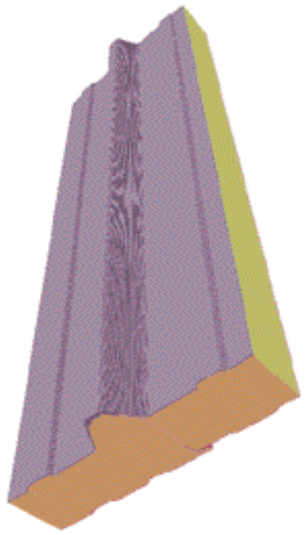
According to the Technical Assessment, we have:
$U_c$ = 0,24 W/($m^2$.K)
$\psi$ = 0,01 W/(m.K)
$\chi$ = 0,01 W/K

$$U_p = U_c + \frac{\Psi \cdot l + \chi \cdot N}{A}$$

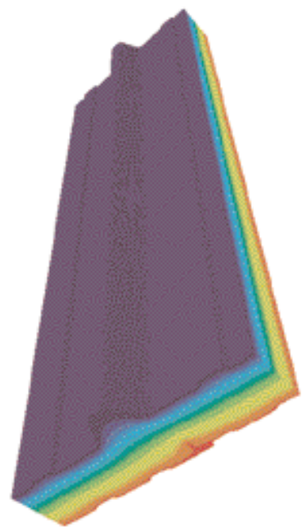
For the above instance, L = 1m due to the interlocking joint (in fact 1$m^2$ divided by the cover width of the panel) and N = 0,6 fasteners /$m^2$ for the above instance.

$U_{wall\ 100mm}$ = 0,24 + 0,01x1 + 0,01x0,6

$U_{wall\ 100mm}$ = 0,256 W/($m^2$.K)



**Panel junction**



**Example of linear brdge at panel junction**

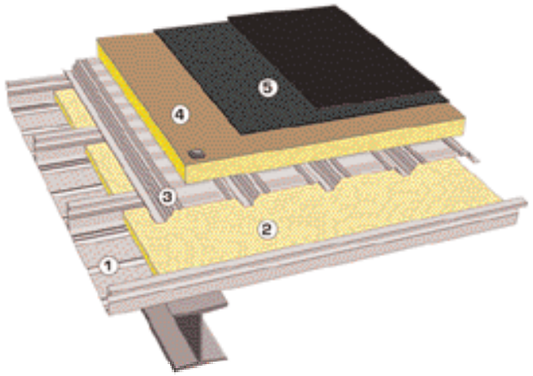
# Thermal issues
# Principles

## Thermal transmittance of a complex system

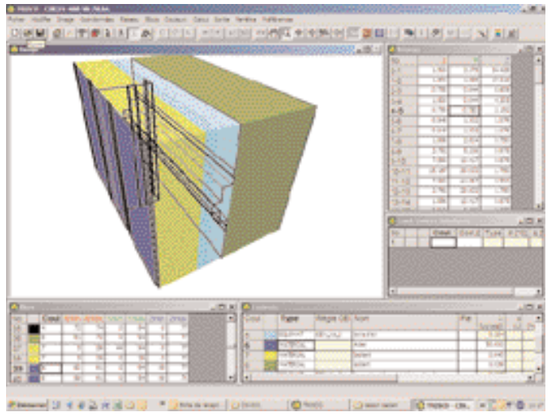
**Arval technical assistance is able to calculate the Up value of a wall using a special software modelling technique.**

### Example of modelling a complex system

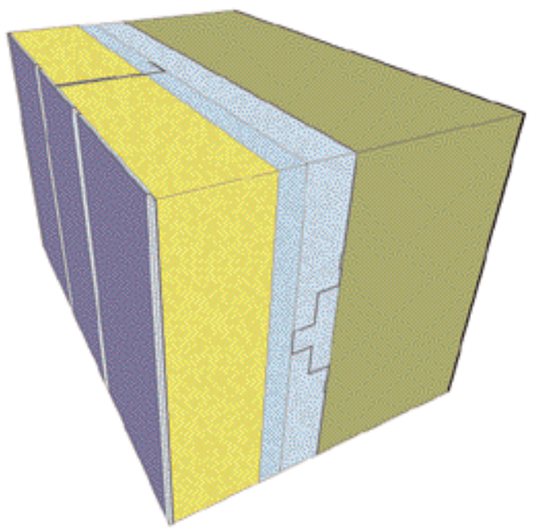
Arval is able to model thermal transfer occurring on these systems. For example, for a Globalroof system, modelling has provided the ability to calculate thermal transfer and the influence of various thermal bridges (tray edge and spacer).



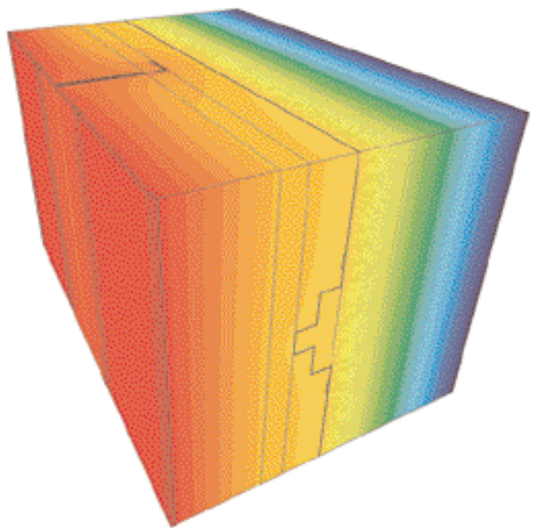

**CIN 321 system**



**Thermal modelling software**



**Modelling**

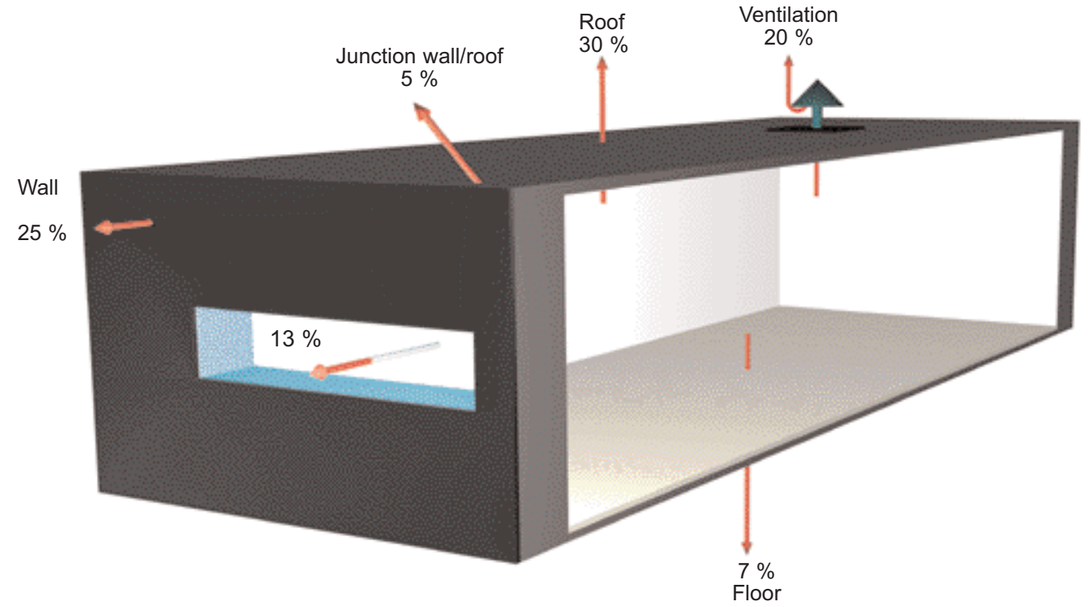


**Modelling result**



## Heat loss

Heat loss distribution, in relation to overall heat loss, is determined in the following fashion:

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# Thermal issues
# Regulations

## Context

**Further to the signature of the Kyoto protocol, it has become necessary to cut down $CO_2$ emissions in order to diminish the greenhouse effect.**

Just for information, the residential building sector as well as the service sector account for over 40% of the overall energy consumption in the European Union.

The objective is to cut down on $CO_2$ emissions in order to:

- Limit global warming,
- Secure the supply of fossil resources,
- Curb the impact of increases in the price of energy.


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### Energy performance of buildings: European Union directive n°2002/91/CE of 16/12/2002

This directive is the direct consequence of the Kyoto agreements. It is based on five requirements:

- A methodology for calculating the integrated energy performance of buildings.
- The application of minimum requirements on the energy performance of new buildings.
- The application of minimum requirements on the energy performance of large existing buildings that are subject to major renovation.
- An energy performance certificate for buildings (new, existing and public buildings)..
- A regular inspection of boilers and air-conditioning systems in buildings as well as an evaluation of heating systems if the boilers are over 15 years old.


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The European directive also requires these regulations to be applied to buildings with a total surface area of over 1000 m² and subject to renovation.

### The directive transposed into national law

Each country in the European Union has transposed the directive into national law. They have, thus, established minimum levels according to their respective climates (winter heat and summer heat, air permeability, energy consumption…).

**This generally results in a minimum value per wall and per structural thermal bridge, a minimum value for the whole building and a heat loss calculation for the building, which takes into account indoor heat gain (heating, light…).**



## Properties of the walls

The coefficients determined are:

$$U_p = U_c + \frac{\sum \psi \times L}{A} + \frac{\sum \chi \times n}{A}$$

$U_p$ for each outdoor wall or unheated premises,
$\psi$ for wall/ground, wall/floor and wall/roof junctions.

Threshold values are given in the following figure in W/(m².K).

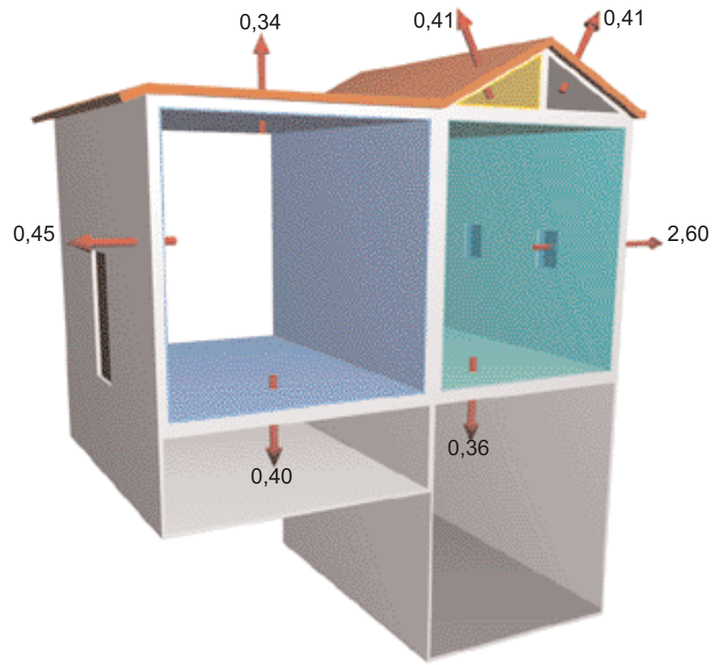
### How to calculate the overall heat transfer coefficient U of the building :

We can determine the global heat transfer coefficient $U_g$ of the building from coefficients $U_p$ and $\psi$, weighting coefficients of the area in which the building is located:

$$U_g = \frac{\sum_i U_i \cdot A_i + \sum_j \Psi_j \cdot l_j + \sum_k \chi_k}{\sum_i A_i}$$

Where $U_i$ is the coefficient of a given wall, $A_i$ is the wall surface area, $\psi_j$ is the linear thermal bridge (wall/slab, wall/intermediate floor, wall/roof), $l_j$ is the length of the linear thermal bridge and $\chi_k$ is the point thermal bridge.

This coefficient must be lower than the threshold value given in the regulations.




**Threshold value example**

# Acoustics
# Principles

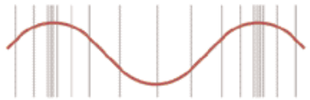
Noise, which enables us to communicate with our voices, can also prove to be a source of stress in our civilisation. Indeed, we come across it everywhere, be it from lanes of traffic or house fittings.

The evolution of society means that we are forever subjected to noise, especially in built-up areas of housing and office accommodation.

**In order to curb sound disturbance, Arval can offer you a range of technical solutions providing the ability to improve the acoustic bonification and / or sound insulation of buildings.**

## What is a noise ?

Sound is a " pressure " wave, which propagates through gases, liquids and solids.

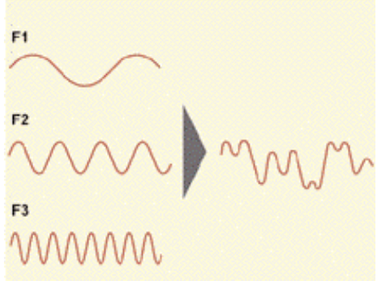


This wave is created by the rapid vibration of materials.

A pure tone is characterised by its frequency, f , measured in Hz (Hertz) and its pressure level in dB (decibels).

- The higher the frequency, the higher the pitch.
- The lower the frequency, the lower the pitch.
- The stronger the pressure, the louder the sound.

We call noise a set of sounds.




**Noise made of three sounds**

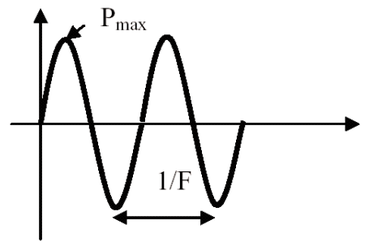
Yuri Arcurs - Fotolia.com



## Frequency

Audible frequencies, F, are between 20 Hz and 20000 Hz. We speak about:

- infrasounds below 20 Hz,
- low pitched sounds from 20 to 350 Hz,
- medium pitched sounds from 350 to 1500 Hz,
- high pitched sounds from 1500 to 20000Hz.




Measurements in building acoustics are made over a frequency range, which goes from 100 to 5000 Hz.

## Sound pressure level

The sound pressure level (in decibels: dB) quantifies the amplitude of a sound. The human ear detects sounds of varying amplitude from $2^{10\text{-}5}$ Pa to 20 Pa. The pressure level is measured on a logarithmic scale according to the following formula:

$$L_p = 20.\log\frac{P_{eff}}{P_0}$$

Where $P_{eff}$ is the effective sound pressure and $P_0 = 2.10^{-5}$ Pa.
Adding pressure levels in dB is not the same as a classical addition.

Adding identical levels


Lp total = Lp + 10 log (number of sound sources) = 95 + 10 log2 = 98dB

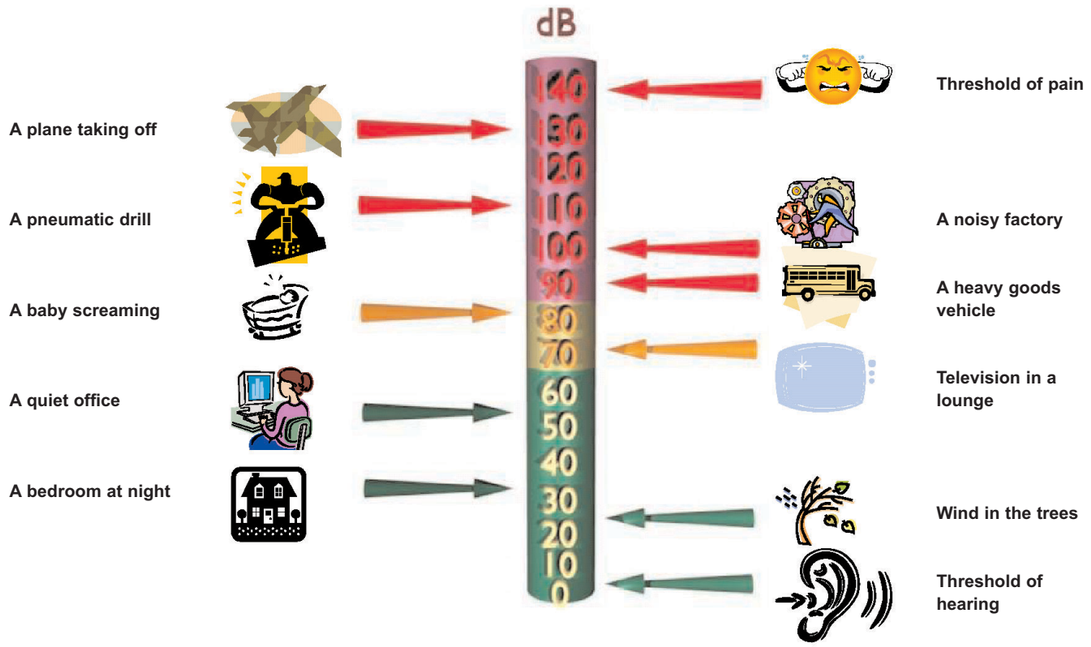
Adding different levels


Total Lp = 10 log ($\Sigma$ $10^{Lpi/10}$) = 10 log ($10^{90/10}$ + $10^{95/10}$) = 95dB

**With these examples, we can see that one noise can cover another. This also explains that noise perception depends on the general sound level and why we perceive noises at night that were inaudible during the day, once daytime sounds have ceased.**

# Acoustics
# Principles

## Sound level scale

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## The human ear

The human ear is made up of three different parts:

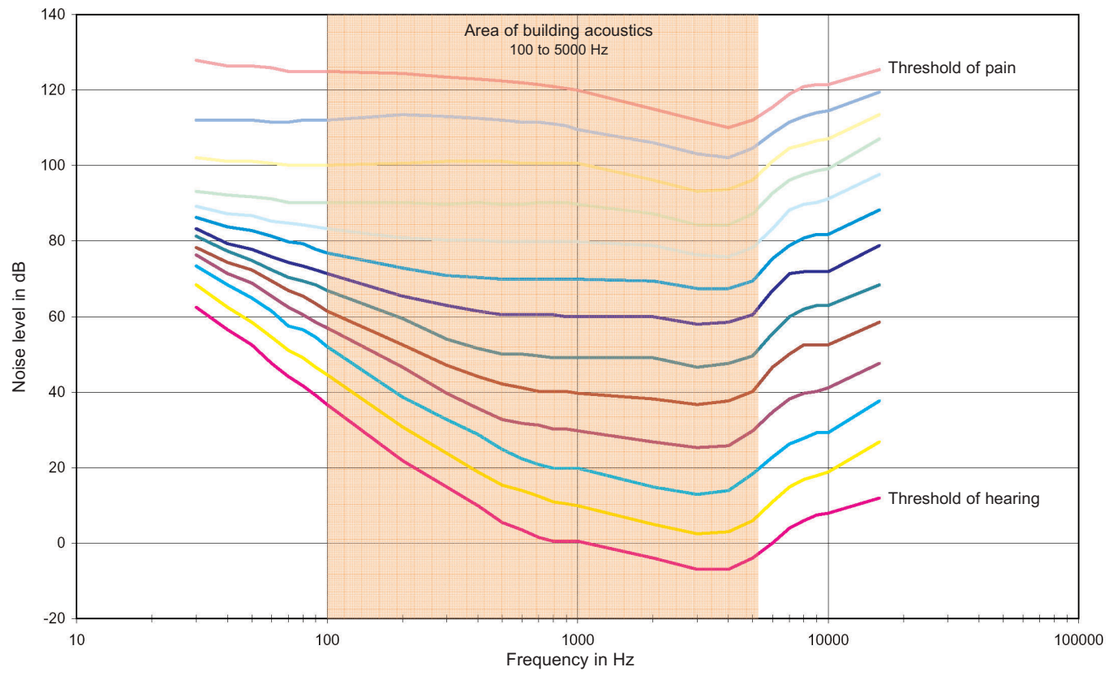
- The outer ear (the auricle and auditory meatus) which collects and amplifies sound vibrations.
- The middle ear (the eardrum, ossicles and eustachian tube) which transforms sound energy into mechanical energy and amplifies it.
- The inner ear (the vestibule and cochlea) which transforms the mechanical energy of sound into electrical energy and transmits it to the auditory nerve.

**The human ear perceives varying sound frequencies from 20 Hz (low pitch) to 20000 Hz (high pitch). Sound is perceived differently according to the frequency.**

The diagram below gives the same sound intensity perceived by the ear according to the frequency. Thresholds of hearing and of pain also vary according to the frequency (See the Flechter-Munson curve below, as well as the area concerned by building acoustics).

So as to bear in mind what man can hear, we correct noise with a weighting factor (called type A weighting).

**Human ear perceptions - 20 à 20 000 Hz**



# Acoustics
# Principles

## Building acoustics

**Building acoustics are concerned with sound absorption and transmittance.**

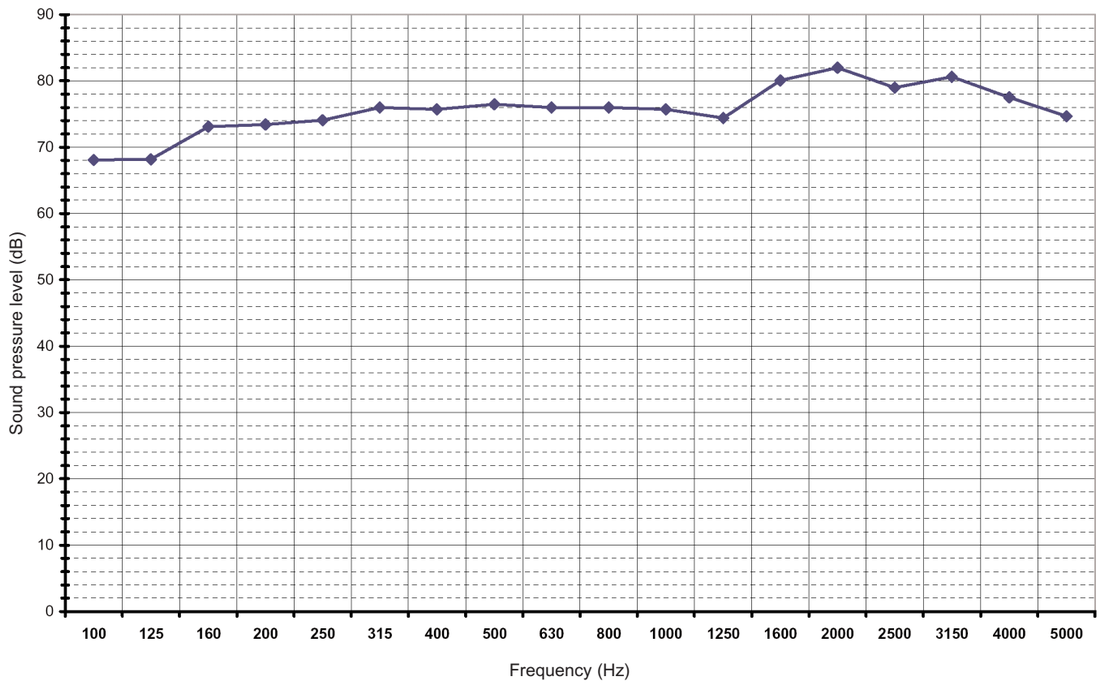
In order to be able to differentiate between different material and walling, it has been decided to work per frequency band: per octave band or per one third octave band.

The standards only deal with frequencies between 100 Hz and 5000 Hz.

- An octave band is an interval between 2 frequencies f1 and f2, such as f2 = 2 x f1.
- An octave band level is the overall level of a portion of sound located between f1 and f2.
- A one-third octave band is an octave band split into three parts in a logarithmical fashion. These bands are finer and provide the ability to make a better analysis of an effect.

| Frequencies | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Octave band | 125 | | | 250 | | | 500 | | | 1000 | | | 2000 | | | 4000 | | |
| 1/3 octave band | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | 5000 |

**Example of a sound spectrum**

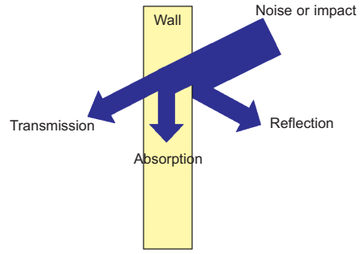





## Sound propagation

Sound propagates in the air at a speed of 340m/s. It always originates from a vibrating surface. In a free space, sound propagates in all directions. It attenuates as you move away from the source.

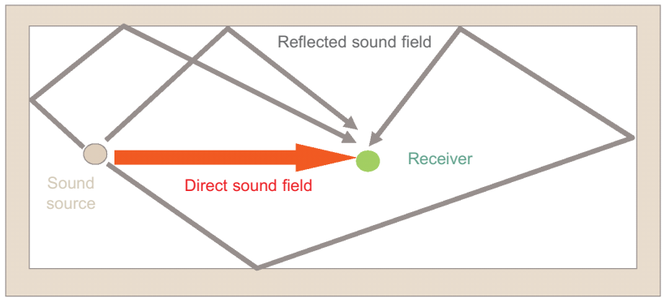
When a sound is emitted in a closed space, it propagates until it is confronted with a wall, in which case some of it will be reflected towards the inside of the room, some of it will be absorbed by the wall and some of it transmitted to the other side of the wall.




## Acoustic bonification

**When noise is emitted in a closed space, our ear partly receives the sound directly and partly indirectly (when it is reflected off the walls of a room).**

When sound is reflected, it tends to increase the noise level within the room. In order to treat room acoustics, we endeavour to partly diminish reflected sound, thus increasing the absorption properties of the wall.

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# Acoustics
# Principles

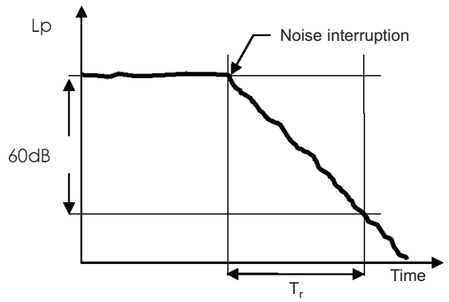
## Acoustic absorption

Acoustic absorption, $a_w$ is related to the reverberation time required to decrease the sound level by 60dB.
We have:

$$T_r = \frac{0.16 \cdot V}{\sum_i S_i \cdot \alpha_{Si}}$$

Where:
$T_r$ is the reverberation time,
V is the volume of the room,
$S_i$ is the surface area of a wall i,
$\alpha_{si}$ is the absorption coefficient of the wall i.

The absorption coefficient is situated between 0 and 1; 0 being for a sound-reverberating surface ; 1 for a sound-absorbing surface.




The absorption coefficient $\alpha_S$, is measured in a reverberation room as per the EN ISO 20354 standard and the results are calculated in a 1/3 octave band. We then calculate the specific coefficient $\alpha_w$ from the $\alpha_s$ coefficients specified in the EN ISO 11654 standard.

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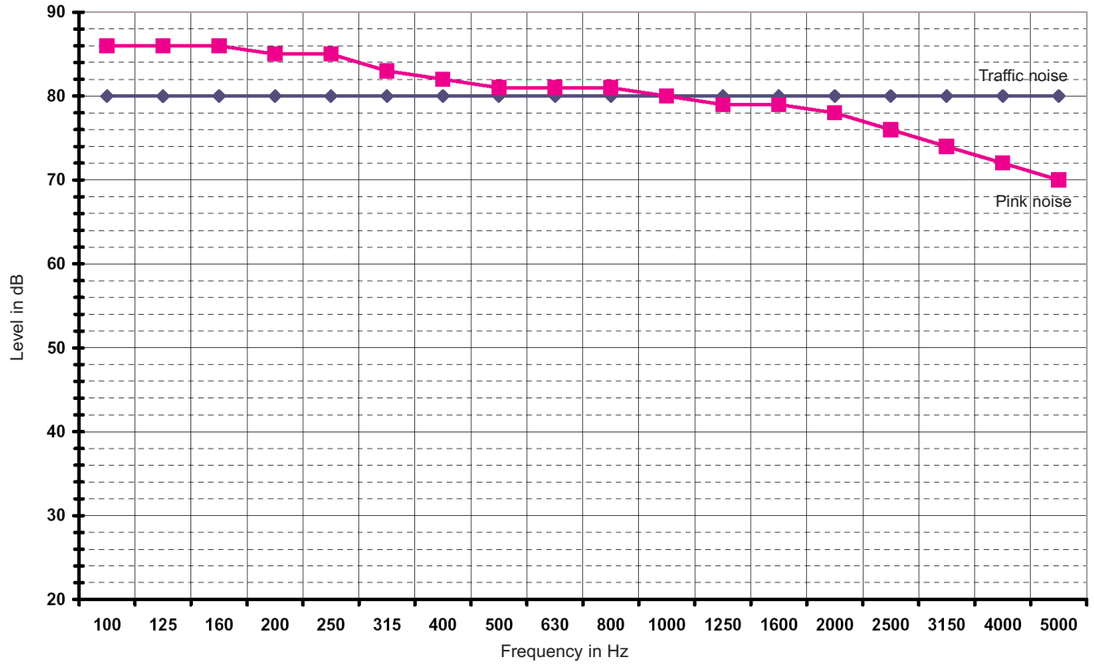
## Noise source in a building

The second feature we address when treating acoustics is the insulation of the premises. This relates to the building's capacity to prevent outdoor noise from entering the premises. For this to be effective, it is necessary to first determine what kinds of noises we have to deal with.

There are four main noises in a building:

- Outdoor airborne sound, generated by road, rail or air traffic
- Indoor airborne sound, generated by conversations, television, a hi-fi unit…
- Impact sound (on flooring), generated by people walking, moving furniture or dropping an object…
- Building equipment noise generated by the plumbing system, mechanical ventilation, the heating installation, air conditioning…

**Three sounds have been standardized so as to account for the above noises: pink noise (with uniform amplitude whatever the frequency), traffic noise and the noise of an impact machine.**




**Standardized noises**

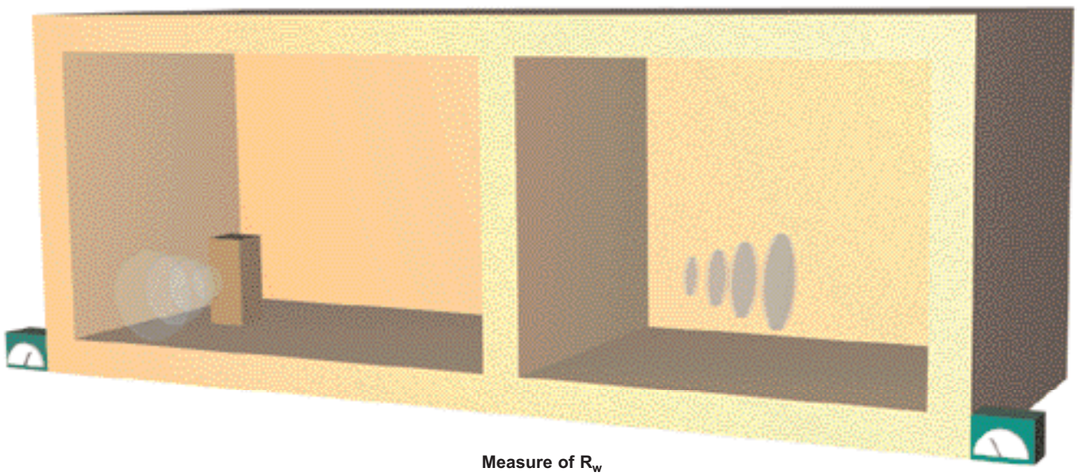
**It is necessary to differentiate between the performances of the building and those of each individual component. As far as Arval products are concerned, we are interested in the components.**

# Acoustics
# Principles

## Airborne sound insulation

This performance is expressed by an insulation coefficient per frequency range, R.

It is measured as per the specifications in the EN ISO 140-3 standard for outdoor walling systems and partitions. The system to be defined is situated between an emission room and a receiving room.



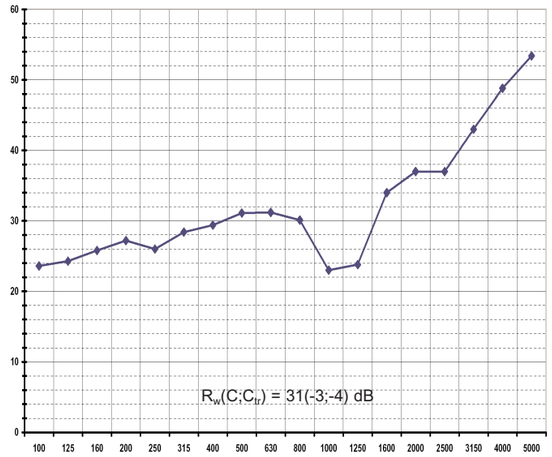
**Measure of $R_w$**

With the value we have measured, we can recalculate the acoustic attenuation index, $R_w(C;C_{tr})$ as called for in the EN ISO 717-1 standard.

The acoustic attenuation index $R_w+C$ is used for indoor airborne sound and the index $R_w+C_{tr}$ for outdoor airborne sound (tr stands for traffic), bearing in mind the fact that the standardized noises in question are different: pink noise or traffic noise (see previous page).

### $R_w$ examples for different material:

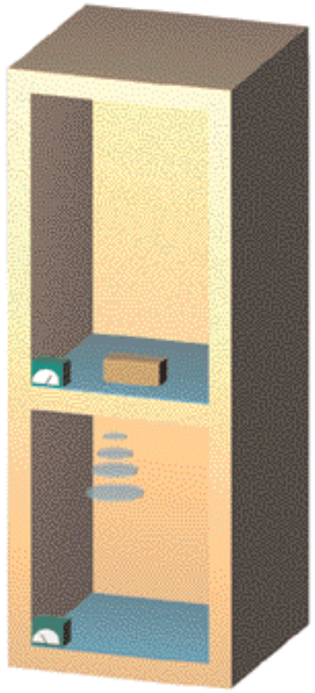
| Partition | $R_w$ |
|---|---|
| IN227, 49 kg/m² | 54 |
| CIN323L, 25 kg/m² | 44 |
| Concrete 16 cm thick, 390 kg/m² | 56 |
| Concrete 8 cm thick, 390 kg/m² | 45 |
| Solid brick, 2 cm, 480 kg/m² | 57 |
| Hollow breeze block 16 cm thick, 230 kg/m² | 48 |
| Earthenware tile, 56 kg/m² | 16 |




**Example of measurement**



## Impact noise insulation

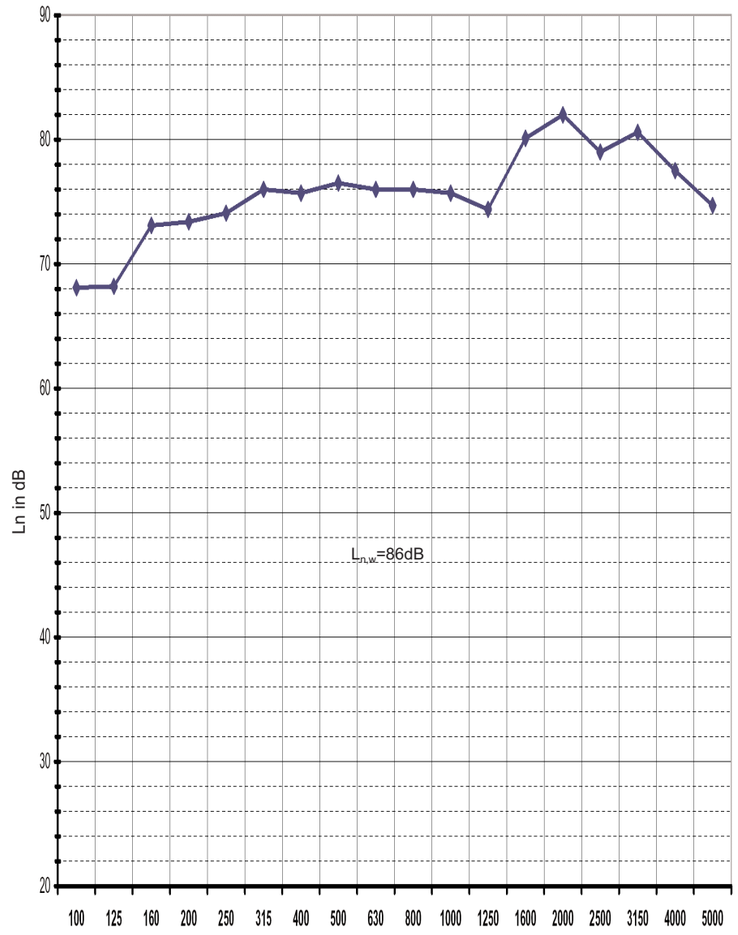


**Measure of $L_n$**

This performance is expressed by a measured sound level, $L_n$.

It is measured as per the specifications in the EN ISO 140-6 standard for flooring systems. The system to be defined is situated between an emission room and a receiving room. The sound is generated by a standardized impact machine.

With the value we have measured, we can recalculate the sound level $L_{n,w}$ as called for in the EN ISO 717-2 standard.




**Example**
**$L_n$ measurement**

# Acoustics Regulations

## Workshops, factories,...

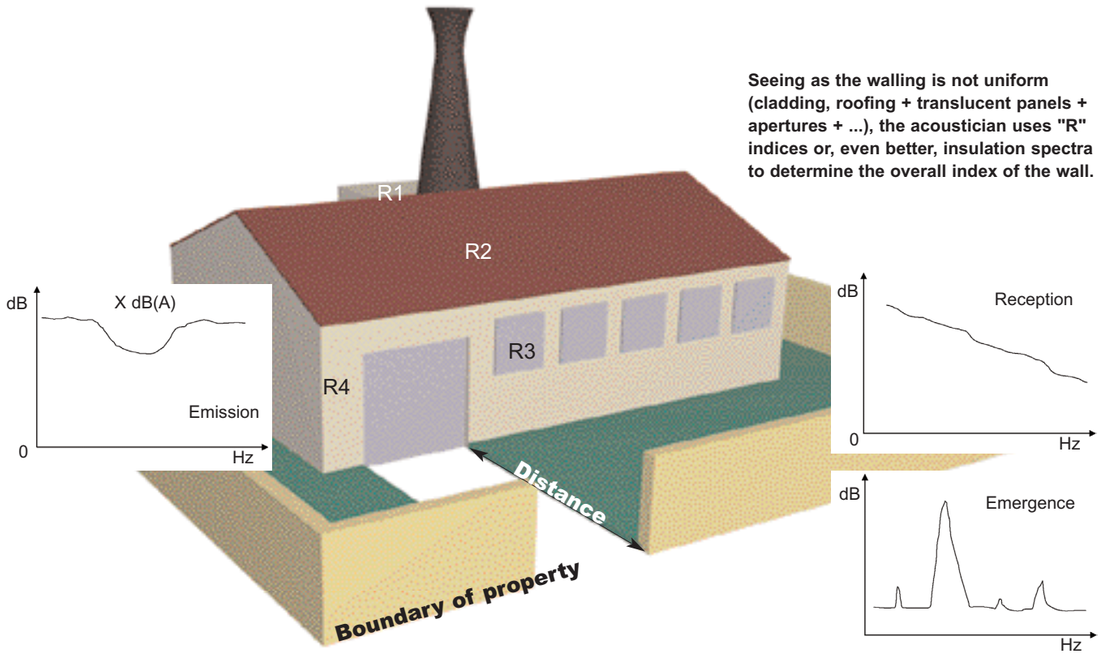
The labour code (article 235.2.11-Law of 30.08.1990) stipulates that, if the sound level is higher than 85 dB, the indoor walls should have sufficiently high acoustic absorption in order to be able to diminish the noise level by doubling the distance from the noise source (DL).

The regulations: The law of 20.08.1985, the decree of 05.05.1988, the law of 01.03.1993 and the decree of 19.04.1995, require that the neighbourhood should be respected, regarding the noise level at the boundary of a property and the emergence of residual noise This leads to the planning of façades and roofs, which will ensure acoustic insulation according to the type of noise inside the building and the distance from the boundary of a property.

According to:

- the indoor noise spectrum
- the sound level to be respected at the boundary of a property
- a calculation taking the distance into account (wall-boundary)
- the notion of emergence (intermittent noise).

It is, therefore, possible to determine which sound insulation spectrum the wall should have.




**Seeing as the walling is not uniform (cladding, roofing + translucent panels + apertures + ...), the acoustician uses "R" indices or, even better, insulation spectra to determine the overall index of the wall.**

**The overall insulation "$R_g$" is very much influenced by the weaker insulation "R" of the components.**



## Sports room

The NF P 90.207 standard regarding acoustics in sports premises requires the envelope to be efficient from an acoustic point of view:

- Sound proofing to prevent the internal noise from getting out $D_{nT,A,tr} \geq 30$ dB.
- Average reverberation time Tr ≤ 0,14xV1/3

With: $T_r = \frac{T_{r-125\,Hz} + T_{r-250\,Hz} + T_{r-500\,Hz} + T_{r-1000\,Hz} + T_{r-2000\,Hz} + T_{r-4000\,Hz}}{6}$

Some gymnasiums are occasionally used for activities other than sports : it is necessary to take this into account when deciding upon which acoustic insulation would be suitable for the building envelope so as to avoid disturbance in the neighbourhood (see multi-purpose halls).

## Swimming pools

In a swimming pool, the reverberation time needs to be controlled in the pool area.

The roof may help control the reverberation time under certain conditions of humidity, with heat insulators and the appropriate paint.

## Multipurpose halls

Depending on whether the building is located in a town environment and/or in an area where there is noisy activity late at night, it is necessary to use a building envelope, which will ensure good sound proofing so as to avoid causing a nuisance to premises in the vicinity. (see the regulations for workshops, factories…).

For premises diffusing amplified music, see decree no. 98.1143 of 15.12.1998.

## School buildings, hotels, health care institutions

The regulations (law of 25.04.2003) specify the acoustic characteristics of various different premises (classrooms, restaurants, covered playgrounds, trafficking …) so that sound proofing can be provided between the premises and noise prevented from getting out as well as reverberation times dealt with.

## Housing

The regulations concerning the acoustics of blocks of flats and private individual houses are very important: the law of 28.10.1994 (NRA) amended on 01.01.2000.

Above all, it is necessary to choose the insulation specifically suited to façades and roofs: depending on the environment location (P.L.U), as well as regulatory insulation between the dwellings: wall, divider, partition, floor, floor connection, façade partition walling.

# Hygrothermal issue
# Principles

## Introduction

Humidity transfer is a very complex process as it depends on the thermal properties and permeability of the elements it passes through.

The principles established from hygrometric observations, enable us to take every precaution required to avoid condensation or the loss of thermal performances.

## Composition of air

Air comprises several gases, of which nitrogen and oxygen are the most widely known. It also contains a certain quantity of water vapour. As a general rule, ambient air contains between 0 and 4% of water vapour (4% in tropical areas and close to 0% in the Antarctic).

## Hygrometry of an atmosphere

The relative humidity RH of an atmosphere defines the quantity of water vapour present in the atmosphere.

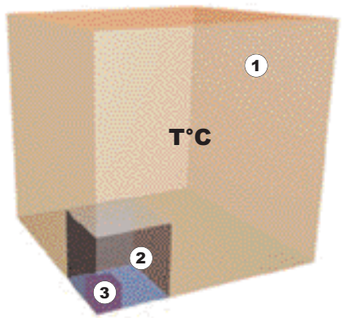
Ambient air contains a certain quantity of water vapour, $m_v$.

If the quantity of water vapour exceeds the quantity of saturated vapour, $m_{vs}$, or if the temperature reaches dew point temperature, then there is condensation.

The air is said to be saturated.

$$HR = 100 \times \frac{m_v}{m_{vs}}$$

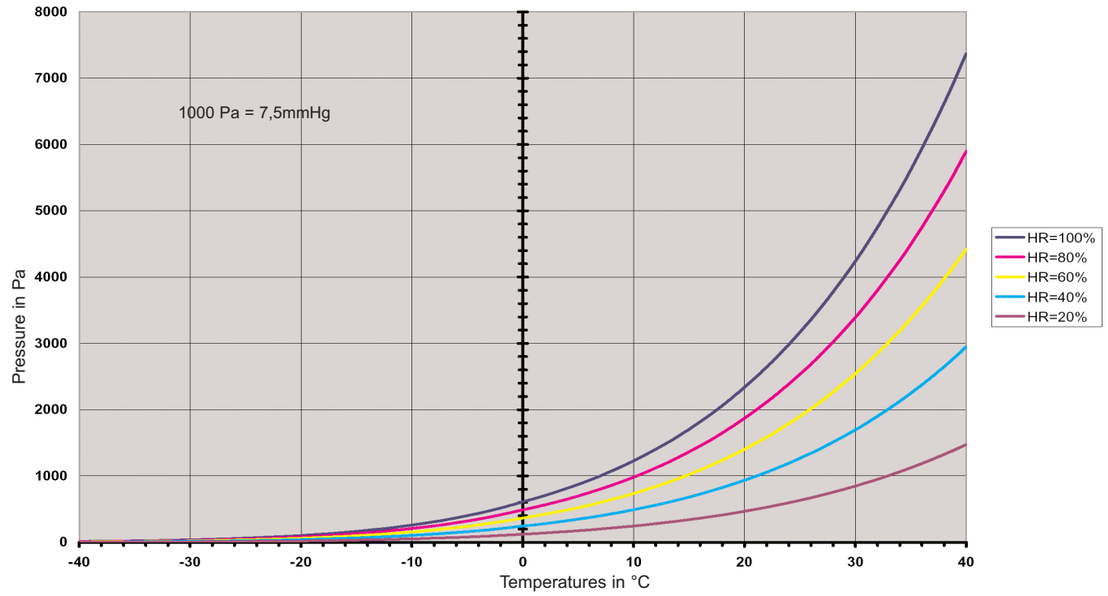
1. Volume of air
2. Maximum quantity of water vapour
3. Actual quantity of water vapour prior to condensation (RH = 100%)




If the temperature of a volume of air decreases, the maximum quantity of water vapour it contains also diminishes. When the ambient temperature reaches dew point temperature, Td, water condenses on the walls.



Air can only absorb a certain amount of water vapour. This quantity corresponds to the pressure of saturated water vapour. If you try to add water vapour to the air, even though the pressure of saturated water vapour has been reached, condensation will occur.
The Mollier diagram enables you to determine the pressure of saturated water vapour according to the temperature. The diagram below gives the pressure of water vapour according to the temperature and relative humidity.




**Pressure of the water vapour in the air**

Let us take the example of air with 80% of relative humidity (RH) at 20°C, if you cool it down, then condensation will begin to occur at a temperature of 16,4°C. This temperature is called dew point temperature.
Dew point temperature corresponds to the temperature at which the water vapour contained in the air starts to condensate, for a given quantity of water vapour.

## Water vapour permeability of material

The permeability of materials to water vapour (kg/m.s.Pa), refers to the mass of water vapour transmitted through one metre of material, in one second for a difference of 1 Pa in the pressure of the water vapour.
The more permeable the material, the greater the permeability.

## The water vapour resistance factor

We refer to μ as the material's water vapour resistance factor, which represents the ratio between the permeability of the air and the permeability of the material. The greater the μ factor, the less permeable the material.
The EN 12524 standard gives water vapour resistance factors for main building materials.

# Hygrothermal issue
# Principles

## Superficial condensation

Superficial condensation occurs when the surface temperature of a wall is lower than or equal to the dew point temperature.

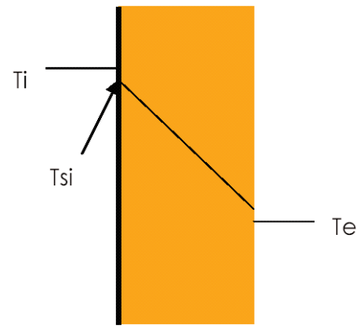
In order to avoid superficial condensation on a wall, the indoor surface temperature $T_{si}$, must be higher than the dew point temperature $T_d$.

$$T_{si} = f_{Rsi} \times (T_i - T_e) + T_e$$

When $f_{Rsi}$ is the temperature factor on the indoor surface, $T_i$ is the indoor temperature and $T_e$ the outdoor temperature.

With the $f_{Rsi}$ coefficient it is possible to evaluate the surface temperature $T_{si}$ and, therefore, the risk is of having condensation appear on the surface.

The higher the $f_{Rsi}$ the lower the risk of condensation.




**Countries may have thermal regulations which specify a minimum $f_{Rsi}$.**

### Example of calculations

For a roof made with IN 210A system, $f_{Rsi}$ is 0,94.
The inside conditions are $T_i$ = 20°C ; 70% RH.
The external condition is $T_e$ = -10°C.
The dew point of air at 20°C and 70% RH is 14,4°C.
The superficial internal temperature $T_{si}$ on IN 210A is : $T_{si} = f_{Rsi}(T_i-T_e)+T_e$ = 0,94(20-10)-10.
$T_{si}$ = 18,20°C.
$T_{si}$ is above the dew point temperature (14,4°C). There will be no surface condensation.



## Condensation within the construction

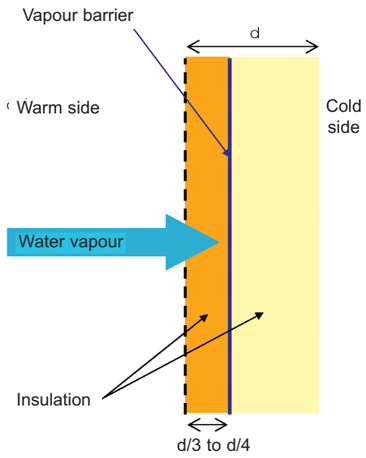
When the internal skin of a complex does not serve as a vapour barrier (for example when there are perforations), there is a risk of condensation forming in the construction.

It is generally recommended to provide for this when using cladding, and when using roofing it becomes compulsory to lay a vapour barrier on the warm side of the roof inside (after applying the acoustic insulation) when the warm side of the skin is perforated.

The risk is that condensation may occur in the walling, which may compromise the sustainability of the products.

In order to determine the condensation risk, it is necessary to determine the temperature within the elements according to the thermal conductivity as well as the water vapour pressure within the wall from the water vapour resistance factor and check at each point that the dew point temperature has not been reached. The EN 13788 standard enables us to make these calculations. Nevertheless, it would seem appropriate to determine the state of certain limits, which need to be taken into account (the temperature and water vapour pressure on either side of the wall).

For normal-use buildings, we consider that if a vapour barrier is placed on the inside, between a third and a quarter of the thickness of the insulation, there will be no problem of condensation occurring.




Fabio Barni - Fotolia.com

# Global solution
## Notes



# Globalsolution
## Questionnaire
## for PDF quotation and sizing

Questionnaire to be photocopied, completed and sent to our commercial department.

**Company:**..... Contact:..... Date:.....
Address:..... Phone:..... Fax:.....
..... E-mail:.....

Building reference:..... Location of building:..... Delivery:.....

**Detailed sketch to be added**

Building length:.....m in.....bay(s) of.....m Height to eaves:.....m
in.....bay(s) of.....m Height to ridge:.....m
width in.....hall(s) of.....m Slope:.....% or.....°

### Climatic loads

Snow loads:.....kN/m² Snow drift: yes - no Long-side permeability:.....%
Wind loads:.....kN/m² Category of ground:..... Gable permeability:.....%

### Roof purlins system

Global roof solution:..... Weight:.....kN/m²
Insulation type - under roof:..... Weight:.....kN/m²
Service overloads:..... Overloads:.....kN/m²
Distance between purlins:..... Deflection limit: 1/.....

### Wall rails system

Globalwall solution:..... Weight:.....kN/m²

Long-side wall: distance between columns:.....m Distance between rails:.....m Rails: inside - outside columns
Gable: distance between columns:.....m Distance between rails:.....m Rails: inside - outside columns

### Additional items

Cleader angle:.....lm Other:.....
.....
.....

# Global solution
# Notes



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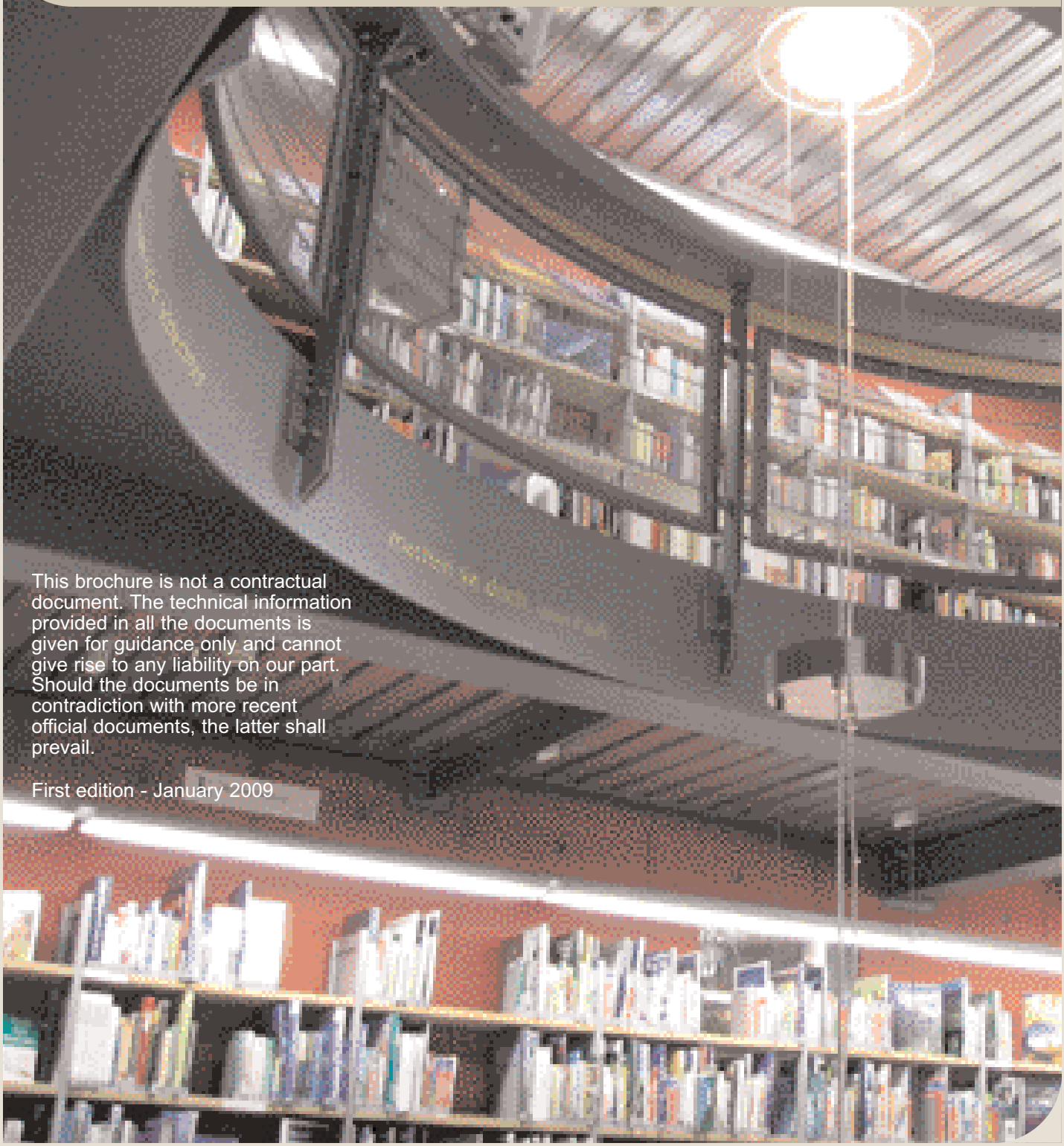
Arval
by ArcelorMittal

# Acoustic and thermal guide

## A guide for energy saving and noise comfort in buildings



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