HERITAGE AND SUSTAINABLE DEVELOPMENT

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INPA
Institut national pour le patrimoine architectural

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de la Culture

European Heritage Days
Journées européennes du patrimoine

klima agence

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Cultural heritage and sustainable development

The theme of the 2022 European Heritage Days is “Heritage and Sustainable Development”. It provides the opportunity to highlight an important and very timely issue, i.e., the preservation of elements of cultural heritage, notably, buildings which are intimately linked to sustainable development. In fact, we tend to see these elements “solely” as witnesses to our history and our values to be transmitted to future generations, or as a precious vector of social cohesion with a direct impact on our collective well-being (thus, “Heritage: All Inclusive”, the theme of the 2021 Heritage Days). However, the preservation of our cultural heritage also contributes to the rational use of resources and to European sustainable development objectives.

This year, the Heritage Days fit seamlessly with the adoption of the European Green Deal and the New European Bauhaus, which transcribes the objectives of the Green Deal from the creative fields (art, design, architecture). The Green Deal provides the strategy needed to implement the transition of the European Union to a sustainable economic model. With the goals of reducing carbon emissions and of achieving economic growth through a more inclusive approach by paying special attention to resource use.

It is precisely within the respectful use of resources that the preservation, renovation, repair and use of cultural heritage elements find their place. For example, preserving an old building which is part of our architectural heritage avoids creating additional construction waste. In addition, the renovation of a building can be carried out using modern technologies and techniques (e.g., the installation of a higher-performance boiler using renewable energies) and more traditional techniques (e.g., renovation with lime), allowing for energy renovation (and moderate resource use). In the end, renovating a building enables the preservation of witnesses to history for future generations and a contribution to sustainable development.

For all buildings which benefit from legal protection (via the PAGs (General Development Plans) of municipalities or via a ministerial decision) the Institut national pour le patrimoine architectural - INPA (formerly the Service des sites et monuments nationaux) can provide support for the works and provide subsidies.

In addition to the preservation of our architectural heritage, the energy renovation of buildings plays an important role in reducing operating energy (Betriebsenergie). Given the

current energy crisis and the constant increase in energy prices, energy renovation is becoming increasingly interesting with respect to helping users decrease their daily consumption and reduce costs. This decrease in energy use is concrete and tangible and it applies directly to consumers for the entire period the building is used.

"I'm convinced that the preservation of cultural heritage and sustainable development, as well as the respectful use of resources, go hand in hand. I wish you a pleasant and enriching reading of this brochure."

Sam Tanson,
Minister of Culture

This brochure is intended for a wide audience. Its purpose is to identify different practices and measures related to our cultural heritage and to explain how their preservation or renovation contributes to sustainable development. This brochure is not intended to be exhaustive, but to provide a clear presentation of the aspects of cultural heritage and highlight their connection with the respectful use of resources. It will be a precious source of information for citizens and for the professionals and non-professionals of the cultural heritage field.

Architectural heritage

The building sector has a major role to play with respect to the objective of the Green Deal, given that it consumes up to 40% of the total energy of the Union[1]. Architectural heritage can provide an example for the construction of new buildings since it is sustainable thanks to its building methods, its location, its longevity and the well-thought-out use of materials.

The preservation of an architectural heritage building is not contrary to its renovation or the improvement of its energy performance. On the contrary, preservation and renovation contribute to the rational use of resources.

It is important to take the grey energy of buildings into account within the framework of energy performance. Grey energy includes all of the energy consumed by a building (with the exception of energy consumption when in use) for its design, construction, demolition and the processing of the resulting waste. It is the sum of all energy used to build and demolish a building, including the extraction and the transport of raw materials and/or recycling after demolition.

One of the objectives of energy renovation is to ensure the sustainability of buildings which are part of our architectural heritage, and their continued use. The longevity of a building can be significantly extended via a combination of rational and suitable behaviour by the user.

"The conservation of monuments is always facilitated by making use of them for some socially useful purpose. Such use is therefore desirable but it must not change the layoutor decoration of the building. It is within these limits only that modifications demanded by a change of function should be envisaged and may be permitted." (Charter of Venice, 1964, Art. 5)

[1] *Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC*

"The conservation of monuments is always facilitated by making use of them for some socially useful purpose. Such use is therefore desirable but it must not change the layout or decoration of the building. It is within these limits only that modifications demanded by a change of function should be envisaged and may be permitted."

(Charter of Venice, 1964, Art. 5)

In order to ensure the rational use of resources and, particularly, of non-renewable resources, several measures for the conservation and renovation of existing architectural heritage buildings (encompassing construction measures and techniques and everyday behaviour to be used) are introduced below.

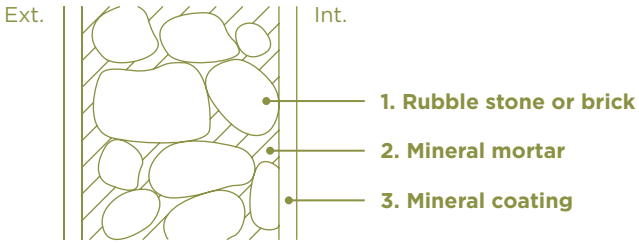
1. Construction measures

Buildings which are part of our architectural heritage contain precious information about construction techniques and the materials used.

| 1.1. WALLS (MASONRY)

› Function and Definition

Exterior masonry walls contain information about the building method, the know-how of the period, the materials used and the evolution of buildings. They consist of:



1. The primary component of the wall, which is either a single wall, or dual-wall hollow masonry which has a high heat retention capacity.
2. Element joining stone/bricks. There are also masonry walls with no mortar.
3. Protective layer ensuring long wall life.

The most common damage is the result of the deterioration of the coating and/or mortar exposed to bad weather. The stone and brick are thick and strong and rarely have to be replaced.

› Preservation measures

Measures which preserve the historical substance:

- **ventilate the building** to remove any dampness;
- **clean** the façades;
- **remove** rain water, **maintain** the pipes and gutters;
- **repair the coating** to ensure that the masonry is protected;
- **point the stonework** to manage dampness;
- **install drainage**, if there are water problems around the base;
- **replace the coating and/or the mortar** with similar products (mineral).

› Energy renovation measures

The following measures optimise energy performance:

- **use "box in the box" solutions**;
- **insulate the walls** from the inside rather than the outside of the façade;
- **watch for thermal bridges**.

Inside insulation combined with the preservation of outside walls improves the thermal envelope without impacting the outside appearance. It's important to carry out the work in accordance with the state of the art to prevent thermal bridges and dampness.

| 1.2. ROOFS (SLOPED)

› Function and Definition

The roof is the top level covering the building to protect it from weather. It consists of:

1. Solid wood structural element.
2. Secondary wood structure.
3. Natural slate or tiles fastened directly to the laths to provide ventilation underneath the roofing.

The most common damage is the result of the deterioration of the roofing exposed to bad weather. The large area of the roof and its impact on the energy performance of the entire building is significant. Renovating is often a matter of meeting challenges, including improved watertightness and air-tightness, increased lighting in the space and better protection against fire.

› Preservation measures

Several measures enable the preservation of the historical substance of a building:

- **reinforce or partially replace** the frame;
- **replace any broken slate or tiles**;
- **clean the roof**;
- **remove** rain water, maintain the downspouts and gutters;
- **inspect and repair** connecting areas;
- **maintain and repair** all metalwork;
- **provide temporary protection** (in the event of an accident);
- **inspect and repair laths and rafters** to ensure stability;
- **light the attic** with skylights or windows;
- **replace the roofing** with the same material, e.g. slate or tiles.

› Energy renovation measures

The following measures optimise energy performance

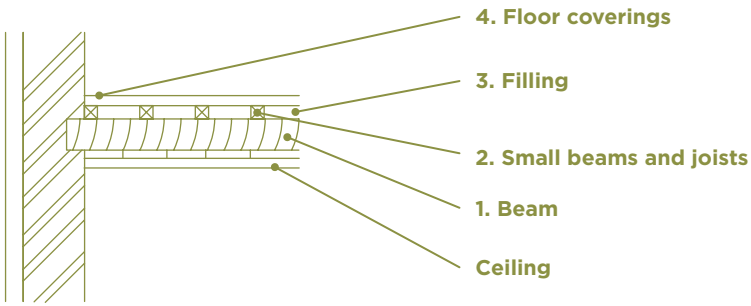
- **insulate the roof from the inside** ensuring good ventilation of the insulated roof and carry out a static study of the frame that will carry the insulation material;
- **use "box in the box" solutions**.



| 1.3. FLAGSTONES AND FLOORS

› Function and Definition

Floors are the horizontal separation between floors. They are usually made of wood, which makes them particularly sensitive to moisture. They consist of:



1. Solid wood load-bearing framework.
2. Secondary wood structure.
3. Cob, gravel, slag, etc.
4. Parquet, tiling, terrazzo, stone slab, clay tiles, etc.

› Preservation measures

Several measures preserve their historical substance:

- **clean and treat floors** to avoid dirt build-up in the gaps;
- **repair the floor coating as necessary**;
- **treat the exposed surface** of tiles, i.e., ceilings and arches.

› Energy renovation measures

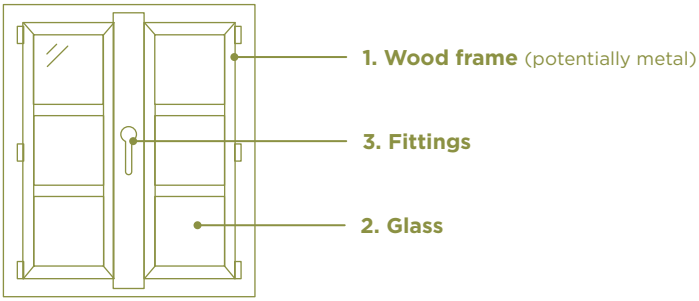
Insulating the upper (attic) and lower (basement/ground) floors can have a significant impact on the energy consumption of buildings because, among other things, they can separate the heated and unheated areas:

- **insulate the attic floor and/or the basement floor** to reduce the heated area;
- **insulate the floor in contact with the ground** to avoid moisture problems;
- **insulate the floors between stories** for acoustic and thermal purposes.

| 1.4. WINDOWS

› Function and Definition

The layout, shapes, materials and divisions of windows structure façades. Windows provide lighting for rooms, protect against bad weather, provide acoustic and thermal insulation and ventilation for the rooms. They consist of:



1. They are usually made of wood and sometimes metal. They have a thin profile, are proportionally balanced and are sometimes decorated with moulding, sculpted or decorated
2. They can be blown, cast, coloured, structured, etc.
3. They are often very decorative, made by skilled craftsmen.

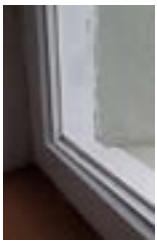
The most common damage is caused by the deterioration of wood exposed to weather (notably, horizontal elements such as transoms and drainage). Considering the small area of the window frame, it's clear that the most significant losses are of glass surfaces. Work at this level will, therefore, be particularly effective from and energy renovation standpoint.



› Preservation measures

Several measures to preserve the historical substance:

- **open and clean the windows** (glass + frames), unclog the air vents, ensure that the hinges don't rust, oil the hinges;
- **repair the putty** to ensure watertightness;
- **paint or varnish the window frames to protect the wood** (or the metal) against exposure to weather. Don't paint the hinges and don't plug the air vents with paint or varnish. If necessary, sand or strip the frames before applying a new coat. Window frames can be repaired with new wood or metal, the locking system can be adjusted, the seals can be replaced and/or repaired, etc. Removal of the fixed portion of the window (frame) nearly always results in the loss of part of the original substance;
- **repair the seals:** Connection between window and wall (mineral insulation, careful not to impede the natural ventilationl Connection between the frame-opening (wood slat and/or adjustment of the window catches) l Connection between the frame-glass (putty);
- **treat with an anti-rust product** (metal windows);
- **repair the fittings and hinges.**




› Energy renovation measures

The restoration and renovation of existing windows ensures that the full benefit of their thermal and insulating capacities can be enjoyed.

- **adapt the glass**, e.g., by adding a second pane;
- **replace the glass**, e.g., by installing insulating glass;
- **install dual-pane windows temporarily or permanently**, i.e., a second window with a frame, installed inside or outside in the opening of the existing window (useful from an acoustic standpoint);
- **install double glazing temporarily or permanently**, i.e., a second window with a frame, inside or outside of the existing frame (useful to protect precious glass and stained glass);
- **replace the windows** retaining the materials, proportions and divisions of the frame.

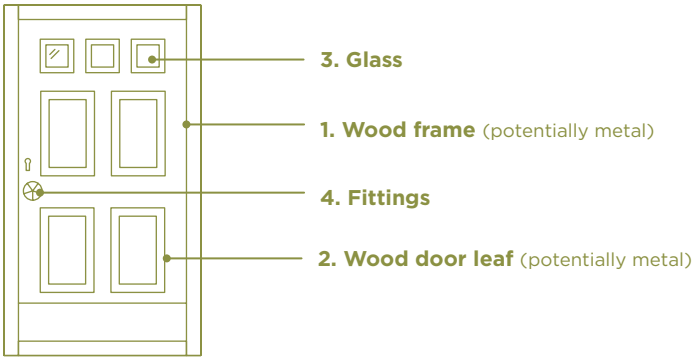
Windows are the “coldest point” of the façade and restoring them prevents heat loss. Installing more airtight and thermally insulated windows increases the surface temperature of the glass. As a result, the openings become cooler and may experience condensation. Special care must be taken when working on this element. Good ventilation must also be maintained to prevent condensation.

You can also install an identical copy of the original, taking into account the details, proportions, materials, etc.

| 1.5. DOORS

› Function and Definition

Doors are often a “business card” and witnesses to the know-how of a period. They consist of:



1. They are usually made of wood, have a thin profile, are proportionally balanced and sometimes decorated with moulding, sculpted or decorated.
2. The wood is usually highly decorative and the woodworking of great quality.
3. Part of the door may be glass, either in the door leaf or as a transom. The glass can be blown, cast, coloured, structured, etc. It may have a grill.
4. They are often very decorative, made by skilled craftsmen

The most common damage is the result of the deterioration of wood exposed to weather (notably, horizontal elements such as transoms and drainage holes). Given the relatively small surface area of doors (< 2 m^2), their impact on the overall energy performance of the building is small.

However, renovating them for energy purposes can have a big impact on the comfort of residents by eliminating draughts.

They provide access to the building, from the unheated area to the heated area, protection against bad weather and acoustic and thermal insulation. Doors were traditionally made of solid wood and, later, of metal also.

› Preservation measures

Several measures preserve their historical substance:

- **open and clean the door**;
- **clean the door frame and leaf** (inside & out), open all of the doors on a regular basis to ensure that the hinges don't rust, oil the hinges;
- **paint or varnish the doors**;
- **protect the wood and metal against exposure to bad weather** (especially the lower section, which is more exposed), be careful not to paint the hinges, sand or strip the frame before applying a new coat;
- **repair the fittings and hinges:** replace if necessary, take care with the appearance of new elements (potentially plan measures to increase security, e.g. by installing a cylinder lock).

› Energy renovation measures

- **improve watertightness:** Either around the frame, or at the bottom of the door (brush seal or strip);
- **plug all cracks and gaps** to eliminate most of the losses caused by draughts;
- **build a vestibule:** If the layout of the space allows, an additional layer with a second door can be added inside the building;
- **if appropriate, a copy identical to the original can be installed,** taking into account the details, proportions, materials, etc.;
- **insulate the letterbox:** Install an inside box with a peripheral seal around the opening to prevent cold air from entering;
- **adapt or replace the glass:** Preserve the current frame, install dual-pane glass, coated or insulating glass;
- **install a double door:** Double the door leaf to the inside. The new part will be static. The inner side of the door is, unfortunately, often sacrificed;
- **replace the door** maintaining the original division, profiles and materials.

The preservation of buildings, as an alternative to their demolition, and the various energy renovation measures contribute to sustainable development in several respects:

1

By avoiding the mining of precious and limited resources

2

By reducing energy consumption (Betriebsenergie)

3

By reducing the use of grey energy for demolition and reconstruction

4

By avoiding an increase in construction waste

5

By enabling continuous use and longer building life (increased life cycle)

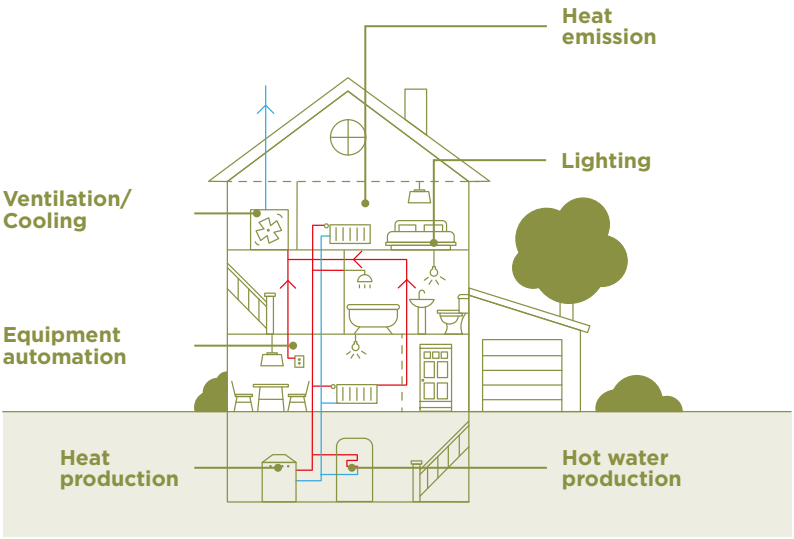
6

By using natural, local and recyclable materials

2. Non-construction measures and techniques

The mechanical measures implemented for buildings include the boiler, the ventilation and the installation of solar panels.

The boiler and ventilation generally have little visual or substantial impact on the building. The upgrading of technical equipment like the boiler can provide a financial savings for both owners and users. The installation of solar panels contributes to energy savings, but there is a visual impact on buildings. This is why each case must be considered individually to know if this type of system can be installed.



| HEAT PRODUCTION

A new condensing boiler can **reduce energy consumption by 30%**. Regardless of the system selected, preference should always be given to renewable energy sources including solar energy, heat pumps, heating with wood or district heating.

| HEAT EMISSION

Lowering the ambient temperature by 1°C can **save up to 6% on energy**[2] . For example: Ovens & fireplaces, radiators, heating of construction elements, setting the temperature of construction elements.

| VENTILATION AND COOLING

During winter, the ventilation system's heat exchanger heats the cool air drawn in, which is naturally drier, assisted by the heat of the stale air which is exhausted from the rooms. In summer, the cool air has a naturally higher humidity level and is the same temperature as the outside air. However, the cool air can be further cooled with **additional equipment** to provide lower temperatures inside the house.

[2] *Kantonale Denkmalpflege Bern und Kantonale Denkmalpflege Zürich, Energie und Baudenkmal, Band III Haustechnik, V1 2014*

| EQUIPMENT AUTOMATION

Setting the equipment according to use **can reduce energy needs.** Setting depending on the day (week day/weekend), the time of day (day/night) and the use of the rooms can be very cost-effective.
The Environment Agency has implemented an energy evaluation system for home heating equipment called **“Heizungscheck”**. A complete review of the boiler is done during this single mandatory inspection carried out by a professional and recommendations are given to increase the energy efficiency of the heating system.

| HOT WATER PRODUCTION

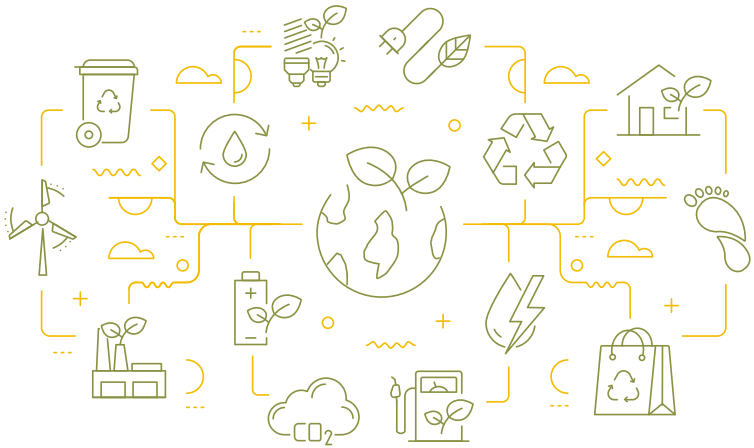
A third of all water consumption in buildings is hot water, which is heated by a system which consumes more or less energy. The impact on the environment of a litre of hot water is equivalent to 30 to 150 litres of cold water[3]. Insulating water pipes, the use of tanks, heating at night and tankless water heaters can improve system performance and make hot water production more efficient.

| LIGHTING

About 2.5% of all electricity used in homes is for lighting[4]. In addition to being energy saving, **LED bulbs** don’t emit any ultraviolet light, which is a major benefit for the preservation of sensitive surfaces, given that ultraviolet light accelerates the ageing of materials.
The installation of **motion detectors, timers**, **twilight sensors** and **automation** can improve system performance.

3. The right reflexes

Energy-efficient behaviour by users can decrease energy consumption by about a third[5].



Many actions can be taken: installing (and using/closing) curtains and shutters, wearing an extra layer of clothes, closing doors to prevent draughts, turning down the heat in rooms that aren't in use, turning off lights, using hot water carefully, avoiding putting furniture in front of heating surfaces, ensuring that rooms are well ventilated, putting down carpets... In addition to reducing energy consumption, these actions/reflexes require little or no financial investment.

[3] *Kantonale Denkmalpflege Bern und Kantonale Denkmalpflege Zürich, Energie und Baudenkmal, Band III Haustechnik, V1 2014*

[4] *Kantonale Denkmalpflege Bern und Kantonale Denkmalpflege Zürich, Energie und Baudenkmal, Band III Haustechnik, V1 2014*

[5] *Merzkirch Alexander, Hoos Thorsten, Maas Stefan, Scholzen Frank, Waldmann Danièle, Wie genau sind unsere Energiepässe? Vergleich zwischen berechneter und gemessener Endenergie in 230 Wohngebäuden in Luxemburg, Bauphysik 02/2014. Study carried out by the University of Luxembourg three years after the implementation of the energy passport, with 125 single-family homes and 105 multi-family homes.*

4. Subsidies from the Institut national pour le patrimoine architectural - INPA

| SUBSIDIES

Subsidies are available to municipalities, municipal associations, non-profits and all other natural persons and legal entities for the restoration and the enhancement of buildings of cultural interest which have preserved their typical or historical character and which are protected under a national or municipal measure.

Works eligible for a subsidy are those which **contribute to the preservation or restoration of the original aspect of a building.**

› The following works are eligible for a subsidy:

1. Façade, roof, metalwork, shell, lock and window installation work.

2. The restoration or renewal of doors and various works intended to protect the historical substance of the building.

3. Scientific analyses as well as architectural and engineering work for the preservation or restoration.

› Eligible works can be subsidised:

Up to **25%**	of the costs incurred for buildings listed by the municipality or included in a protected area of national interest.
Up to **50%**	of the costs incurred for buildings listed as national cultural heritage
Above **50%**	of the costs incurred for buildings listed as national cultural heritage and given an opinion of the Cultural Heritage Commission.

The request for subsidies must be filed with the Institut national pour le patrimoine architectural (INPA) by the applicant before work starts. The application is made via a standard form.

https://inpa.public.lu/fr/formulaires.html

The subsidy amount is set by the ministry after the completion of the restoration work based on the opinion of the Institut national pour le patrimoine architectural and after the filing by the requester of a form and paid invoices for the works.

› Contact INPA

INSTITUT NATIONAL POUR LE PATRIMOINE ARCHITECTURAL
26, rue Münster L-2160 Luxembourg
Tel.: 247-86650/86652 • Email: info@inpa.etat.lu • inpa.public.lu

5. “Klimabonus” assistance

The “Klimabonus” is a state assistance scheme which promotes sustainability, the rational use of energy and renewable energies in housing.

The purpose of the “Klimabonus” is to promote energy renovation and sustainable construction in housing, to promote heating systems which encourage the use of renewable energies, to incentivise investment in photovoltaic technology and promote the purchase of electric vehicles and the installation of charging stations.

Luxembourg’s municipalities and energy suppliers also support users’ projects.

Users can simulate the amount of subsidies they can receive for their energy renovation project and, therefore, contribute to protecting the climate.

› For more information and to access the subsidy simulator, go to: **www.klima-agence.lu**

6. How to improve the footprint of a home?

Users can do work on a building to improve the thermal and acoustic comfort of their home and decrease their heating costs. As explained in this brochure, the measures taken must be implemented with an eye to the heritage value, which must be analysed case-by-case based on the historical substance.

It is important to ensure that heat cannot escape through the walls, roof, windows, floors, ceilings (the walls adjacent to the garage, for example), when the latter are poorly insulated or when there is air leakage from inside the home toward the outdoors.

Heat loss and heating needs can be reduced by implementing a range of energy renovation measures.

7. Building surroundings

› Definition

Around buildings, private and public areas such as gardens and green spaces and the special layout of the roadway can contribute to sustainable development.



› Protection measures

When designing an outdoor space, several measures can be used to preserve the historical substance of the building and make the outdoor area sustainable and resilient;

- **the permeability and revegetation of the soil,** which enables rainwater to penetrate the soil instead of remaining on the surface, which considerably reduces the ground temperature and surface heating (especially important in the city);
- **the re-establishment of farming activities** (e.g., the use of flocks of sheep to replace petrol-powered equipment);
- **the layout of air flows and insulation**, and increasing pedestrian areas;
- **respect for, and the use of, indigenous flora** which contributes to maintaining the authenticity and integrity of sites and protects biodiversity;
- **the use of local and natural materials**, including sandstone, paving stones, earth, etc.

› Contribution to sustainable development

The design of areas around buildings can provide a non-negligible contribution to sustainable development.

By encouraging the cultivation of local flora, private and public gardens promote the protection of local wildlife. They become biodiversity reserves which contribute to the well-being of people and all living things. These green spaces facilitate the natural regeneration of trees and enable water savings, as well as its storage and channelling when it results from torrential rains.

Ensuring that the ground in public spaces isn't sealed, and replanting it, prevents water run-off (i.e., the run-off of surface water). Rainwater can seep into the ground and reach the water table, reproducing the natural

management and transit cycle of water. The permeable surfacing of streets prevents flooding caused by the extreme natural weather phenomena which are increasingly frequent as a result of climate change.

8. “Dréchemauerbauen”: Traditional dry stone construction know-how

› Definition

The art of building using the dry stone technique reflects the know-how associated with the construction of stone structures by piling the stones on top of each other with no other materials except, occasionally, dry earth. Dry stone structures exist in most rural areas - primarily on uneven terrain - both inside and outside of inhabited spaces. They also exist in urban areas. The stability of the structures is guaranteed by the careful selection and placing of stones.

› Protection measures

The preservation of traditional dry stone building know-how (“D’Konscht vum Dréchemauerbauen”) is guaranteed by its inclusion, since 28 November 2018 in the inventory of the national intangible cultural heritage of the Grand Duchy of Luxembourg.

The “Art of dry stone walling, knowledge and techniques” was added to UNESCO's Intangible Cultural Heritage of Humanity list in 2018. (Croatia, Cyprus, France, Greece, Italy, Slovenia, Spain, Switzerland, Ireland, Austria and Luxembourg will request that they be added to the list also).

An Interreg Grande Région project under way since 2016 is intended to re-anchor and strengthen dry stone know-how in Luxembourg via a series of actions. Luxembourg has a wide range of examples of dry stone construction.

Both private and professional audiences can find out about and get an introduction to dry stone building from a number of public sources: the showroom at the Centre nature et forêt Biodiversum Camille Gira in Remerschen and at Natur- & Geopark Mëllerdall (workshops, internships and a book for children (Wiichtel Wumm) explaining the dry stone walls of Mullerthal).

› Contribution to sustainable development

Dry stone structures have shaped many very different landscapes. They enable the development of a range of habitats, types of agriculture and animal husbandry and are witness to the methods and practices used by people since prehistory.

The stone structures play an essential part in preventing landslides, flooding and avalanches. They fight erosion and land desertification, improve biodiversity and create microclimate conditions suitable for farming.

Dry stone structures have always been built in complete harmony with the environment and the technique is representative of a harmonious relationship between humans and nature.

› Links:

- https://environnement.public.lu/fr/natur-erliewen/centres-d_accueil/biodiversum.html
- https://www.naturpark-mellerdall.lu/fr/projets/projet-interreg-va-murs-en-pierre-seche-dans-la-grande-region/
- https://ich.unesco.org/fr/RL/l-art-de-la-construction-en-pierre-sche-savoir-faire-et-techniques-01393
- https://iki.lu/post/show_cat/7

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