IMPROVING THE INSULATION AND INERTIA OF OPAQUE BUILDING ELEMENTS

HAZARD

HEAT

IMPLEMENTATION STEP

CONSTRUCTION

RENOVATION

AREA OF ACTION

ENVELOPE

COST

€ € €

low **medium** high

LEVEL OF SKILL

high

To effectively protect a building from heat, it's essential to ensure that opaque walls are well insulated in order to limit heat loss in winter and heat penetration in summer. High thermal inertia stabilises the temperature inside the building by slowing down temperature variations. Improving insulation and inertia requires considering both the technique used to install insulation in buildings and the materials used for insulation and cladding.

IMPACTS

As temperatures rise and heat waves intensify and multiply, improving the insulation and inertia of a building's opaque surfaces (walls and roof) helps to **limit the penetration of heat into the building** during the summer months, thereby maintaining occupants' thermal comfort. As the interior spaces are cooler, the **energy required to cool the building is lower**, and the building's energy bill and environmental impact are reduced.

INSTALLATION GUIDE

A number of actions can be taken to improve the insulation and thermal inertia of the building:

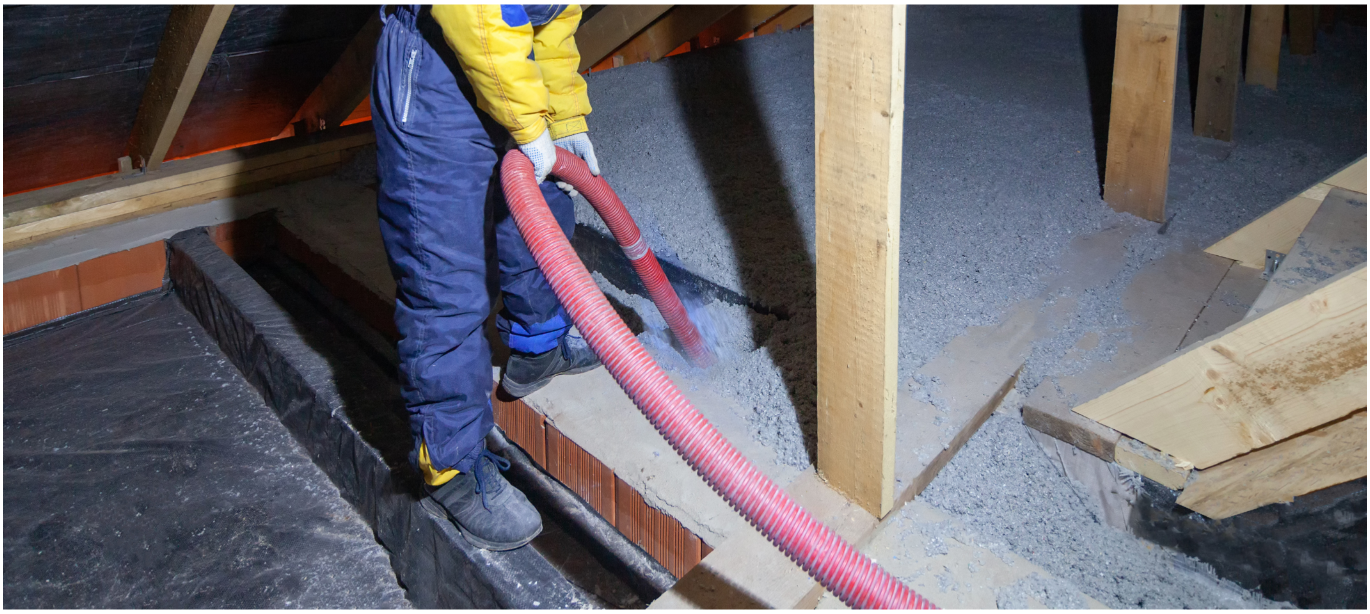
- Carry out a thermal analysis to ensure that the building has satisfactory summer and winter insulation and is **free from thermal bridges**, i.e. insulation defects often located at the junctions between the floor and other structural elements.

- Favour external wall insulation, which is highly effective in eliminating thermal bridges and reinforces the building's inertia.

- Select high-performance insulation for the building envelope to limit heat exchange between hot and cold environments. Generally speaking, the most effective insulation has **low thermal conductivity** (the amount of heat transferred through the material) and therefore **high thermal resistance** (ability to withstand cold and heat). To combat heat penetration, the best solution is insulating materials with **low diffusivity** (the ability to delay heat release) and a **long phase shift** (heat penetration time of at least 10 hours)**,** such as plant-based materials.

- Use materials with high thermal effusivity (high heat absorption without surface heating) for the building's interior spaces, such as marble or stone.

CLICK HERE TO CONSULT THE GUIDE TO ACTION FOR CLIMATE CHANGE ADAPTATION



Attic insulation using cellulose wadding

WEAK POINTS AND STRONG POINTS

⊕ Since the roof is the building surface most exposed to the sun's rays, low diffusivity materials are the best insulation option. However, if temperatures don't drop sufficiently during the night, the heat contained in the materials can't escape and quickly penetrates the building the following day. **Green roofs** can also be an interesting insulation solution.

⊖ While biobased materials help mitigate climate change and have less impact, they can be more expensive.

⊕ A number of grants are available at national level in France to help finance insulation work (MaPrimeRénov', Prime coup de pouce isolation, etc.) and locally (municipalities and regions).

⊕ Combined with passive cooling methods using **ventilation**, **cooling from the ground**, or **adiabatic systems**, high-inertia materials are highly effective and economical (financial and energy savings).

MALADAPTATION

Maladaptation can result from the following:

Impaired indoor air quality

Better thermal insulation of walls can reduce the exchange between indoor and outdoor air, increasing the risk of condensation and humidity without adequate ventilation. Moisture build-up can encourage mould, adversely affecting indoor air quality and the health of occupants. Over-insulation that doesn't consider climate and usage requirements can make the building excessively airtight, resulting in an accumulation of pollutants and a sensation of confinement. It's therefore essential to install appropriate ventilation to maintain a balance between insulation and air circulation.

Overheating in the building

Excessive internal heat build-up can occur when electrical appliances, lighting systems and occupants generate a significant amount of heat inside the building. To avoid overheating and a "thermos" effect, it's important to reduce internal heat emissions by using, for example, **equipment that emits low heat.**

Increased thermal discomfort at night

A significant phase shift, which moves the penetration of heat stored during the day to the night, can create a cooler environment during the day. However, during heatwaves, night-time temperatures remain high, which can disrupt occupants' thermoregulation while they sleep, leading to wellbeing and health issues. Although phase shifting can reduce heat during the day, other cooling measures are needed to ensure occupant comfort day and night during extreme heatwaves.

MONITORING INDICATORS

ESSENTIAL RECOMMENDATIONS WORTH THINKING ABOUT

- CARRY OUT A THERMAL ANALYSIS

MONITOR MY ACTIONS FOR CLIMATE CHANGE ADAPTATION

+/- : Quantitative indicator ★ : Qualitative indicator

INDICATORS OF MEANS		INTERPRETATION
+/-	Number of thermal bridges	To be minimised
+/-	Thermal resistance of building envelope insulation for a fixed thickness (m^2.K/W)	To be maximised
+/-	Thermal conductivity of building envelope insulation for a fixed thickness (W/m.K)	To be minimised
+/-	Thermal diffusivity of building envelope insulation for a fixed thickness (m^2/s)	To be minimised
+/-	Thermal phase shift of building envelope insulation for a fixed thickness (hours)	To be maximised
+/-	Percentage of interior building materials with high effusivity (%)	To be maximised

INDICATORS OF RESULTS		INTERPRETATION
+/-	Comparison between the temperature of the situation in which the adaptation action was implemented and that of a control situation* (°C)	Improved thermal comfort
+/-	Comparison between energy consumption for heating the building with the adaptation action in place and that of a control situation* (kWh)	Energy consumption for heating with improved insulation and inertia of opaque walls < control situation*.
+/-	Comparison between energy consumption for cooling the building with the adaptation action in place and that of a control situation* (kWh)	Energy consumption for cooling with improved insulation and inertia of opaque walls < control situation*.

**The control situation is defined by the parameters set to isolate the influence of the adaptive action (similar conditions: weather, time of measurement, space, etc.).*

TOOL

- Cerema has designed the *RITE* tool (***Risque d'Inconfort Thermique d'Été* - Risk of Thermal Discomfort in Summer**) to rapidly evaluate the indoor summer comfort of new buildings and renovations in response to climate change. Easy to use by all actors in the building sector, *RITE* has so far only been developed for residential housing.

REGULATION / CRITERIA

- According to the French decree on the thermal characteristics and energy performance of existing buildings, modified by the decree of 22 March 2017 - art. 2.Chapiter 1: Building envelopes and opaque elements (articles 2 to 7), any work to install or replace thermal insulation on a surface must be carried out so that the insulated wall has a total thermal resistance **greater than or equal to the minimum value depending on the type of wall concerned** (see annex II of the decree).

FIND OUT MORE

ADEME (2011), *Chaud dehors, frais dedans – Garder son logement frais en été*

Cerema (2023), *Evaluation du Risque d'Inconfort Thermique d'été face au changement climatique. Présentation et notice d'utilisation*

Observatoire de l'Immobilier Durable (OID) (2020), *Les matériaux durables pour le bâtiment - Etat des lieux du biosourcé et du réemploi en métropole parisienne*

PassivAct (2019), *Comprendre l'inertie thermique, la diffusivité, l'effusivité et leurs incidences sur le confort*