RAISING STRUCTURAL ELEMENTS

HAZARD

RAINFALL AND FLOODS

COASTAL DYNAMICS

IMPLEMENTATION STEP

CONSTRUCTION

RENOVATION

AREA OF ACTION

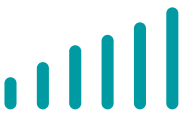
GROUND FLOOR

COST

€ € €

low medium **high**

LEVEL OF SKILL



high

In order to prevent or limit the penetration of water into the building in the event of floods or coastal flooding, you can raise the structural elements of the building. This involves placing the building and/or its openings beyond the reach of the water as part of the Avoid and Resist strategies to limit damage. These measures can be implemented at both building and neighbourhood levels.

IMPACTS

Raising the building and its openings **provides protection against severe damage caused by water and salt**, and **makes it easier to return to normal rapidly** in the event of floods or coastal flooding. This is an extremely effective preventive measure for new builds in high-risk areas.

Be aware that even if a property is not damaged by flooding, it is not necessarily usable or habitable. In reality, it can only be used if the networks serving it (roads, electricity, etc.) are still operational. The networks must therefore also be resilient.

INSTALLATION GUIDE

In the case of new buildings, there are several ways to raise the height of the building:

- **Raising on an embankment**: this solution only applies to buildings located at the extremities of flood zones.
- **Creation of a crawl space, basement or above-ground garage**: to raise the level of the first habitable floor.
- **Construction on stilts**: particularly suitable when a building is located in a coastal region or an area subject to frequent flooding.
- **Creating floating buildings**: an interesting option for properties located in areas affected by rising water levels or frequent flooding. These buildings are constructed on floats made of concrete, plastic, aluminium, etc. so that they can rise and fall with water levels.

In existing buildings, another option is to **completely raise door thresholds**, i.e. increase the height of entrances by several decimetres. This type of raising is generally considered during major renovation work, and is more likely to be carried out on older buildings, as it requires high ceilings.

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Muttersholz Nature Centre during flooding of the Ill river

Stilts installed to support the building during flood periods

WEAK POINTS AND STRONG POINTS

⊕ According to the European Centre for Flood Risk Prevention (*CEPRI*), **raising the height of a building is the most cost-effective strategy**, particularly for communal buildings at risk of flooding or coastal flooding, even if violent weather is exceptional.

⊖ However, bear in mind that the **financial benefits and costs of adapting a building to climate risks do not currently involve the same parties**: generally, the owner makes the investments while the insurance company reaps the benefits.

⊕ Raising buildings is an **alternative to removing people from areas affected** by rising water levels and flooding. In particularly exposed areas like Hamburg and Amsterdam, entire neighbourhoods have been constructed to remain out of water's reach.

MALADAPTATION

Maladaptation can result from the following:

Accessibility problems

Raising the height of a building can make access complicated, particularly for people with reduced mobility, the elderly and children. In addition, it can make it difficult to evacuate or shelter people rapidly in an emergency, compromising safety. It is essential to strike a balance between flood protection and accessibility for all, including in emergency situations.

Disruption to water flow

The widespread elevation of buildings can disrupt water flows, leading to ponding or local flooding with repercussions on other parts of the site or neighbouring unprotected buildings, which increases the risk of flooding. This transfer of vulnerability can also affect surrounding infrastructure, such as roads and sewerage systems, as well as neighbouring farmland, resulting in crop losses and damage to equipment. An integrated risk management approach, involving coordination with neighbouring landowners and local authorities, is essential to minimise this spatial vulnerability transfer and its effects on other systems.

Neglect of the uncertainties associated with climate change

The uncertainties associated with climate change must be considered when planning and designing the raising of buildings to minimise the risk of increasing future vulnerability. For example, if the elevation is designed based on a water level that turns out to be underestimated, the buildings could still be vulnerable to flooding despite the measures taken.

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MONITORING INDICATORS

ESSENTIAL RECOMMENDATIONS WORTH THINKING ABOUT

- RAISE ON AN EMBANKMENT FOR BUILDINGS LOCATED AT THE EXTREMITIES OF FLOOD ZONES
- CREATE A CRAWL SPACE, BASEMENT OR ABOVE-GROUND GARAGE
- BUILD ON STILTS (COASTAL REGIONS OR AREAS SUBJECT TO FREQUENT FLOODING)
- BUILD ON FLOATS (MADE OF CONCRETE, PLASTIC, ALUMINIUM, ETC.)

MONITOR MY ACTIONS FOR CLIMATE CHANGE ADAPTATION

+/- : Quantitative indicator ★ : Qualitative indicator

INDICATORS OF MEANS	INTERPRETATION
+/- Altitude of building floor (m)	Floor of the building above the highest known water level referred to in the local/coastal flood risk plan
+/- Percentage of entrances with raised height (%)	To be maximised when possible

INDICATORS OF RESULTS	INTERPRETATION
+/- Time needed to return the building to normal after a flood/ coastal flooding (hours)	To be minimised
+/- Severe financial, material and/ or human damage caused by water and/or salt	To be minimised

REGULATION / CRITERIA

● The **Flood Risk Prevention Plan (PPRI)** maps and regulates areas at risk of flooding according to the hazard and land use. It establishes specific building, urban planning and usage regulations, such as floor heights to be respected above the highest water level, no-build zones, and requirements for the storage of floating materials. The PPRi decree, codified in the French Environment Code, sets out the general rules for prohibiting and controlling construction in the event of overflowing rivers or coastal flooding (articles R. 562-11-1 et seq.) (French Ministries of Ecology, Energy and Territories, 2023).

FIND OUT MORE

CEPRI - Centre Européen de Prévention du Risque d'Inondation (2009), *Un logement " zéro dommage " face au risque inondation est-il possible ?*

CEPRI - Centre Européen de Prévention du Risque d'Inondation (2015), *Comment saisir les opérations de renouvellement urbain pour réduire la vulnérabilité des territoires inondables ?*

French Ministry of territorial and housing equality and French Ministry of Ecology, Sustainable Development and Energy (2012), *Référentiel de travaux de prévention du risque d'inondation dans l'habitat existant*.

New Brunswick Department of Public Safety (2019), *Floodproofing – Protecting your home and contents against flooding*

REAL-LIFE EXAMPLE

MUNICIPALITY OF MUTTERSHOLTZ

BUILDING : MAISON DE LA NATURE
SURFACE AREA: 1,600 M², 1 FLOOR
USE: PUBLIC
COST: €65,000 EXCLUDING VAT

Two-thirds of the Ried and Central Alsace Nature Centre is built on stilts. Located in Muttersholz in a flood-prone area, the centre regularly sees its grounds flooded by the overflow of the nearby River Ill, particularly in winter. The 15 water-repellent concrete stilts, anchored in 3m-deep shafts, support the rear part of the building, which remains accessible even in the event of flooding thanks to the elevation of access roads. The height of the sub-beam structure was calculated using the highest water levels indicated by the water authorities (167.44m in this case), with an additional 30cm of clearance to allow vegetation and other matter washed away during flooding to pass through. Stilt constructions involve creating the equivalent of a sixth facade exposed to outside temperature variations, so that particular attention needs to be paid to floor insulation. The cost of the structural work amounted to €65,000 (excluding VAT) (a single stilt costs around €170), and has ensured more permeable soil, with the result that both the building and the surrounding areas are now protected.

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