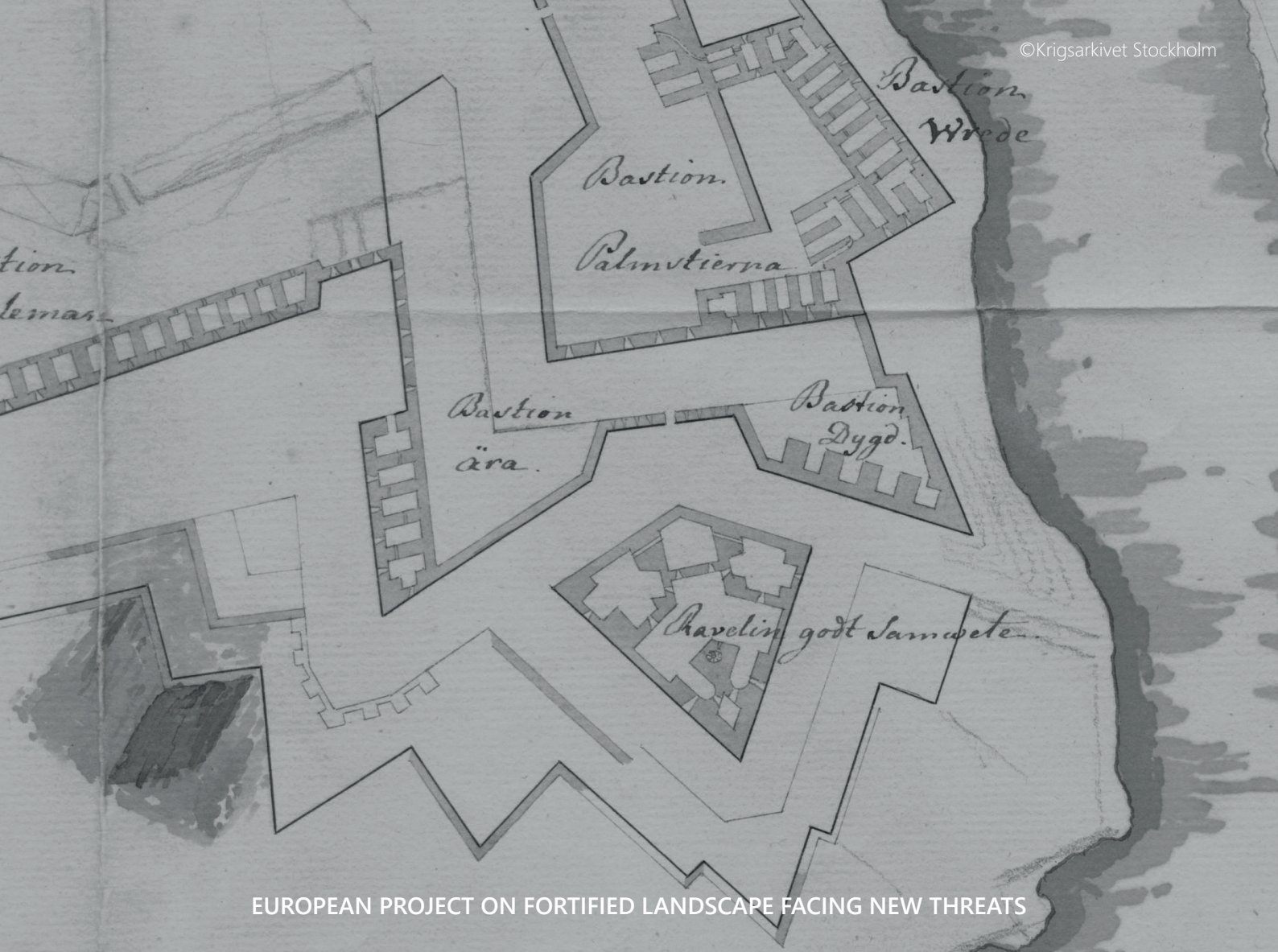

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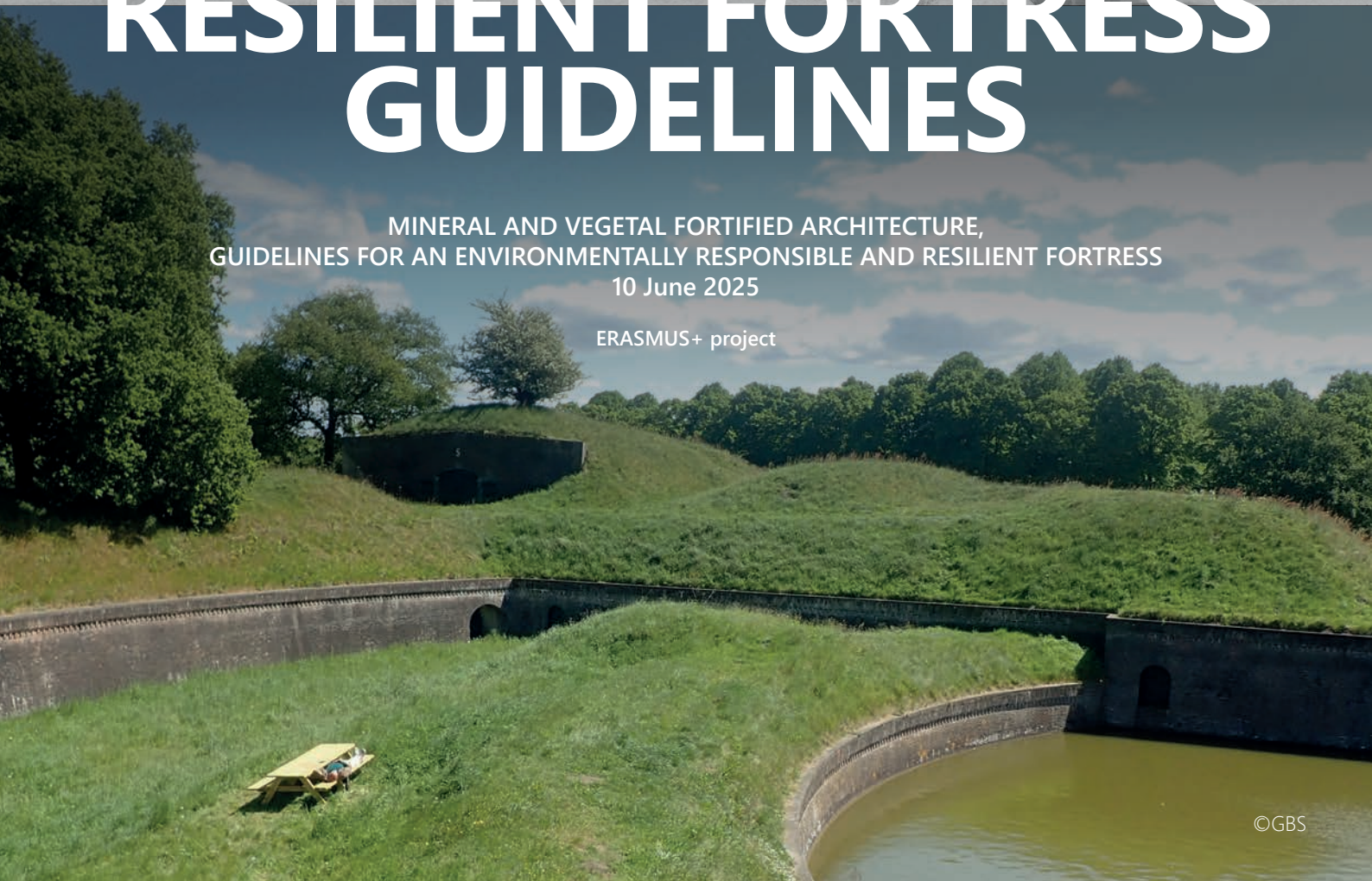
EUROPEAN PROJECT ON FORTIFIED LANDSCAPE FACING NEW THREATS

RESILIENT FORTRESS GUIDELINES

MINERAL AND VEGETAL FORTIFIED ARCHITECTURE,
GUIDELINES FOR AN ENVIRONMENTALLY RESPONSIBLE AND RESILIENT FORTRESS
10 June 2025

ERASMUS+ project



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Resilient Fortress, Erasmus+ project partners organizations.

About the guidelines

These guidelines are the outcome of a small-scale partnership Erasmus+ project named Resilient Fortress. The project was designed for upskilling professionals facing the challenges of climate change and the increasing need of environmental responsibility in the context of fortified heritage.

The guidelines provide a comprehensive framework for the sustainable preservation of fortified monuments and their landscapes. By integrating mineral (stone, mortar) and vegetal (living plants, earthworks) materials and systems, they address the need to safeguard of fortified cultural heritage while ensuring ecological balance and mitigating the effects climate change.

Suomenlinna, Finland. ©GBS

Bomarsund, Åland.
(illustration before destruction) ©Henrik Juslin

Naarden, Netherlands. ©Monumentenbezit

Forte Tesoro, Italy. ©Angelo Dapor

Mont-Dauphin, France. ©CMN

Port Vauban, France. ©AAPP

The guidelines are based on nine months exchange between project partners: institutions and private actors with a long experience on fortified architecture preservation. The institutions responsible for fortified sites have in common a long-term or indefinite ownership of the monuments and a long-term commitment to the preservation of the sites. We wish these pages will also motivate other colleagues to gain an alert attitude towards climate change and an open mind to transform old routines to green skills.

What about after Erasmus? -chapter in the end of these guidelines is a list of topics us partners have in common. Most of them require site or location specific solutions, but all of them are better developed in cooperation with colleagues and by exchanging know-how in situ.

Mineral and Vegetal Fortified Architecture,
Guidelines for an Environmentally Responsible and Resilient Fortress

General

Besides legislation, all interventions in planning, preservation works, and maintenance must be based on knowledge on fortified architecture and the history of its development, hydraulic network, structures, building materials, vegetation, living species, soil and water, as well as understanding the relationship between architectural form and uses. The chosen restoration-conservation and maintenance methods and techniques should help the fortified landscape to adapt to the effects of climate change and should not increase its progress.

Historical knowledge must integrate architecture and landscape, considering their historical structure and morphological characteristics. Only through this unified perspective is it possible to fully understand the contemporary context, by recognizing the historical traces that have shaped its evolution. Fortified monuments and sites are often complex requiring an overall view. A priority should be given to the development of masterplans.

The site as a historic military system and an ecosystem

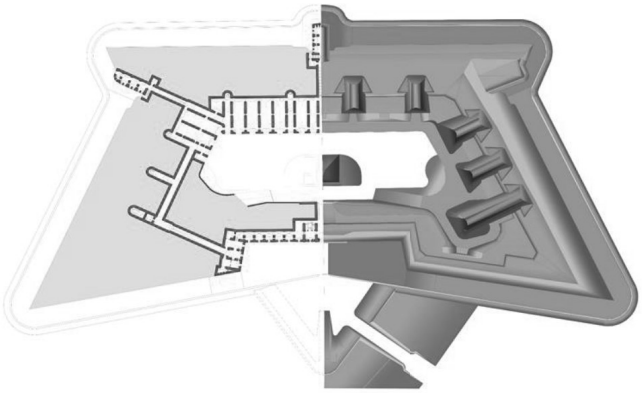
Military architecture is an inseparable "organism" of masonry and earthworks historically integrated for strategic purposes in the environmental context. Missing or altering one or the other part comprises the architectural organism and its protection and preservation over time.

From 16th to 19th century, most of the fortifications consist of stones, bricks, mortar, earthworks and vegetation. We state that the vegetal part of fortification is an integral part of military architecture, as valuable as the mineral one. They should be considered as a whole, as a coherent system:

- On the cultural-historical level – mineral and vegetal parts form the fortress together.
- On the maintenance level – mineral and vegetal parts influence each other's behaviour.
- On the ecological level – mineral and vegetal parts hold plants and animals. They form an essential part in the preservation.
- Biodiversity of vegetation enhances the coherence of the earthworks and influences the water circulation positively.
- The hydraulic network is an important part of their articulation.

Thus, architecture and earthworks represent an environmental asset within the urbanized context. Conceived in this way, fortified heritage can offer citizens a valuable source of biodiversity and accessible public spaces. But it is important not to forget, that besides the vegetal and mineral architecture, the ecosystem of fortified landscape consists of all living species, us humans being only one of them.

Fort Carré and Port Vauban. ©GBS

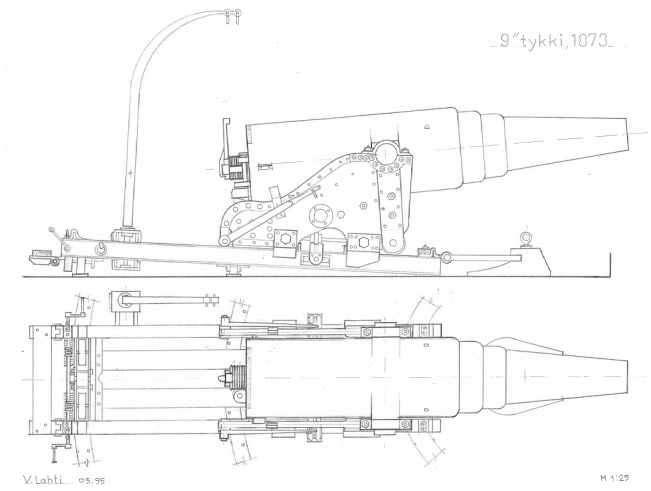


Fort Aurelia. ©Meneghelli

Gunpowder magazine. ©GBS

Suomenlinna. ©GBS

Warty hemidactyle. ©Gregory Deso



9″ coastal gun, 1873. ©Viktor Lahti

Preservation strategy and maintenance

We state that preservation is an ongoing process, and it is an illusion to think that a monument can be brought to a permanent "finished" state of conservation. So, a restoration should always be accompanied by a maintenance plan. If this is done well, the maintenance will be the main action in the future, thereby scaling down the restoration part.

The climate change is increasing the need for maintenance. Fortified heritage sites face increasing threats from extreme weather events – such as torrential rains, prolonged droughts, and intense heat waves. These conditions demand a shift in our approach: rather than seeing the "mineral" (stone, masonry, built structure) and the "vegetal" (plants, earthworks, ecosystems) as opposing forces, they should be maintained in harmony. One should not be dominant over the other.

Nature's tempo, a time difference

Different from human society, where time is money and everything needs to be done immediately, nature takes its time. Therefore, this time needs to be taken into consideration when looking at landscape preservation plans. Instead of thinking in weeks, we should be thinking in years.

In practice this can mean that a plan needs to be prepared over a period of years, or a site needs to be closed for several seasons to give nature the chance to recover on its own. Nature's tempo usually differs from decision making and budgeting periods. Commitment is required.

Mont-Dauphin. ©CMN

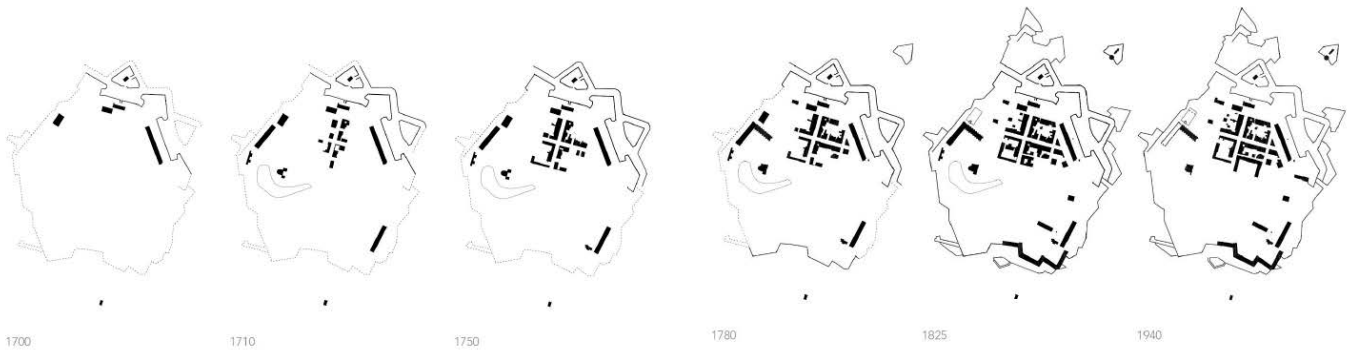
Timeline and context of military architecture

As is the case with every type of heritage, context is essential in preservation of military heritage.

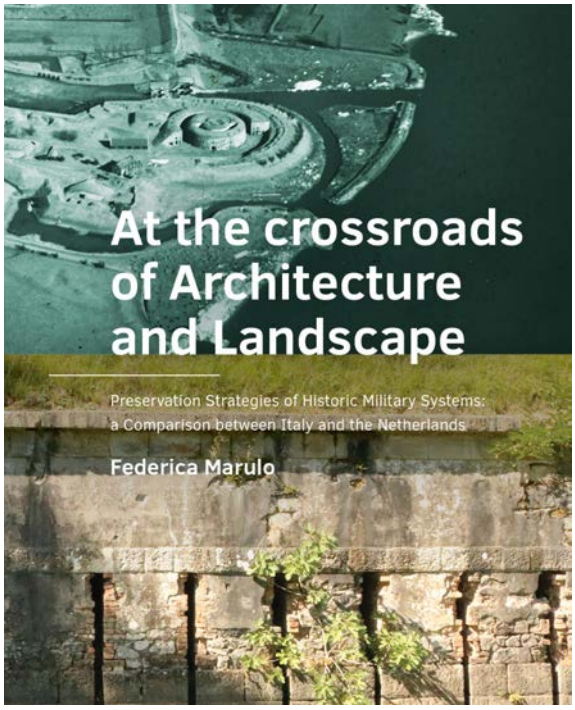
The context of a fortress consists of :

- The political situation (the tension between nations) that led to its construction and later adjustments.
- The geography of the site. Topography and landscape are determining for the shape of the fortress (a mountain fort is different from one in a flat, wet land) and what is being protected by it (a harbour, a mountain pass, a crossroads of trade routes, a river, a town/city etc.).
- The development of weapon technique and war tactics. A fortress stops an invading enemy. The weapons and tactics of the attacker are essential for the shape the fortress takes. Rifled artillery from the 1870's asks for a different type of military architecture than smooth bore guns from the 1670's.
- The visibility on the surrounding landscape not to leave blind spots for the enemy.

All these factors determine the shape the fortress has today. They form the context of the fortress, the basis of the preservation policy and the validation of the building. It is essential to know this context and how the different parts of the fortress fit into it.



ENSA PB, Studio "mémoire, contexte & création". ©Students of Philippe Prost & Antoine Pénin



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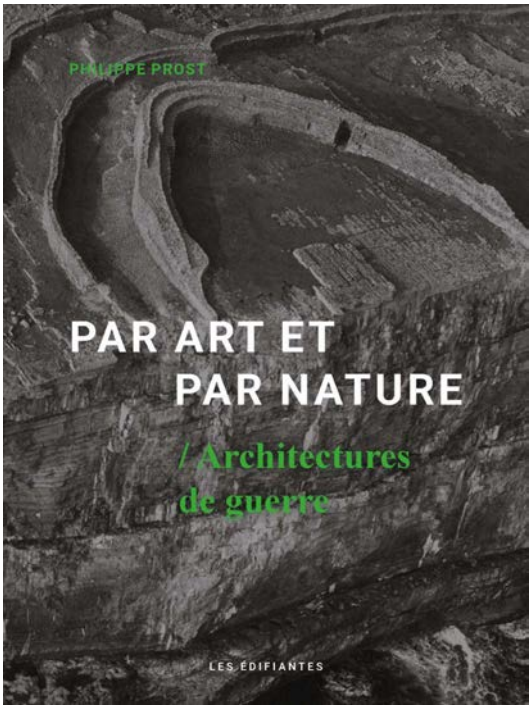

©Philippe Prost

Context and knowledge on vegetation – in history, in present and in future

The necessity to know the context of the vegetation isn't reserved only to the mineral part of fortifications. As in fortified architecture, the layers of eras can also be read in vegetation. The historical aspect of vegetation and earthworks needs to be studied. After military use some areas grew wildly, and some were transformed to public parcs or private gardens, for pleasure or for utility gardens.

Besides the context, vegetation forms an essential part of the preservation of earthworks and masonry structures. From the natural waterproofing provided by lichen or densely growing grass on earthen architecture to the creation of favourable conditions for water infiltration and retention, vegetation plays an important role on every level.

Monitoring of the status of vegetation and the effects of maintenance must be continuous. One could talk about a so-called observational maintenance. Also, by continuous monitoring the methods of maintenance can be adjusted to the effects caused by climate change.

In these matters, there is a need for familiarization of the landscape maintenance personnel, and for more cooperation between botanists, biologists, researchers, and maintenance implementers.

Naarden. ©GBS

Warty Cabbage (*Bunias orientalis*). ©Anja Pitkänen

Knowledge on restoration techniques and material

The knowledge of restoration techniques of the past and the behaviour of construction materials becomes more and more important in today's preservation policies. Research in archives and the critical study of past restorations in-situ is essential in today's practice. Besides that, it is important to note that, in general, up until WWII preservation was done with traditional materials like stone, mortar and earth. Sometimes turned into artificial stones as brick and concrete. But mostly organic, nonetheless.

After WWII more unnatural products started to be introduced, such as bitumen, plastic crates and waterproofing agents. They cause their own damage patterns and raise the question for us how to deal with them. If possible – we will have to make a shift toward the organic again.

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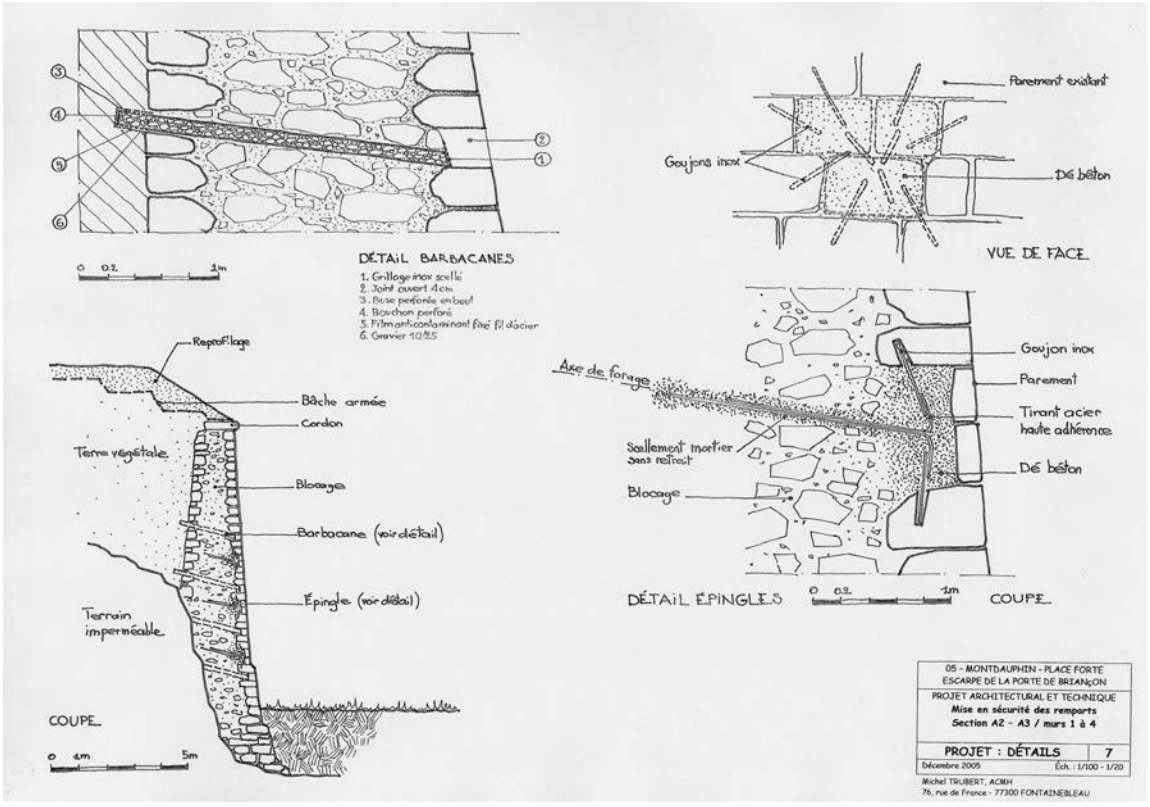

Mont-Dauphin.

©Michel Trubert

The long-term maintenance planning includes documented testing and monitoring

Problems cannot be solved at once. There must be a possibility of adjusting the preservation and maintenance policies and steering the process. In long-term planning time is an important asset.
In general, the restorations, the materials and techniques used as well as the decisions made during the process, need to be recorded for future preservationists. That way, the knowledge gathered during the process doesn't get lost but can be used as the basis for future work.

There are no standard solutions. There are site specific solutions, but within a site, there are location specific solutions as well. Every piece of work should be considered as an individual little project. There is little room for routine.

The restored brickwall of Port Vauban in Antibes. ©AAPP

What about after ERASMUS?

During the exchange sessions (September 2024 – May 2025) it became clear that every site has its own site-specific challenges. Presenting these challenges to European colleagues, exchanging, learning from other experiences helped to understand the value of the work we do with fortified heritage.

We also noticed that we are lucky, because most of us can do testing and monitoring, and have the possibility to analyze our own doings. which is a necessity if we want to approve. We also have the chance to work with a continuity – understanding that time is an essential element in heritage maintenance. Resilient Fortress -ideology means preserving simultaneously the fortified monument-landscape and its ecosystem.

Besides the differences, the basic issues we deal with are the same:

- evacuation of water: melting snow, rainwater and flooding,
- protecting masonry from water and frost,
- Finding the suitable mortar, not only for the specifics of the stone, but also suitable to the climate at hand (heavy frost, sea salt etc.),
- erosion issues in general, caused by visitors, climate conditions and fleet, separately or simultaneously,
- working by phases due to winter conditions and harsh weather for example on the seashore.

For all of us, a responsible approach to a resilient fortress requires knowledge on:

- legislation,
- construction history and building materials,
- vegetation,
- living species on both mineral architecture and vegetal architecture including soil and water,
- documentation of works is of major importance for both correcting unsuccessful interventions, and for repeating successful interventions.

We also learned the importance of a to-do-list before intervening:

- identifying stakeholders that are involved and needed to defend the ideology of Resilient Fortress,
- making an inventory of vegetation and other living species,
- defining the ethics and aims of the project (the balance between different values) and sharing this knowledge in meetings with all project participants,
- defining what are the areas that need to be protected (and how) during building works,
- defining the limits of working site and fence them (to protect herbaceous and woody plants properly,)
- what are the materials that can be used: should the use of geotextile and plastic be abolish and what about rubber,
- planning fencing,
- planning waste management and recycling,
- preventing the import of invasive species to our sites,
- planning maintenance.

We also understood that a knowledge-based communication could have a major role in transmitting the message, the meanings and the values of the fortified cultural landscape we defend.

We continue.

Erasmus + project

Funded by the European Union

Resilient Fortress Project Partners


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