EUROPEAN PROJECT ON FORTIFIED LANDSCAPE FACING NEW THREATS

RESILIENT FORTRESS

SUOMENLINNA SUMMER SCHOOL REPORT

ERASMUS+ project
Governing Body of Suomenlinna (FI), Stichting Monumentenbezit (NL),
Centre des monuments nationaux (F), EFFORTS (EU),
Atelier d'Architecture Philippe Prost (F), Studio Architettura Meneghelli (IT)

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Resilient Fortress, Erasmus+ project partners organizations and case studies.

Location map

Preface

Philippe Prost, Atelier d'Architecture Philippe Prost

More than thirty years ago, together with my partner Catherine Seyler, we took a delegation from the Governing Body of Suomenlinna to visit the construction site of the Citadel of Belle-Île-en-Mer in France and, on that occasion, met Tuija Lind, architect working in Suomenlinna fortress. The questions raised at that time mainly concerned the restoration and reuse of the walls and buildings, as well as the enhancement of the entire site.

We then visited Suomenlinna ourselves to discover a magnificent ensemble, and especially different approaches regarding both the restoration and management of the site—approaches that were very inspiring for us French, at a time when the thinking of Viollet-le-Duc still prevailed in France. Since then, we have never ceased exchanging views on the specific issues of these fortresses, comparing our perspectives and visiting each other.

Once their obsolescence was acknowledged and their abandonment decided by the military, generally in the second half of the 20th century, these fortified structures immediately raised new heritage-related questions due to their extremely large size and the specificity of their architecture. Thus, the question of the reference state for a restoration cannot be approached as it would be for a simple building. The scale of the work needed for their mere conservation forces one to think in terms of a master plan, with a decade as the basic unit. As for the programs that should take place there to ensure their use and therefore their preservation, they must be adapted to very specific architectural and spatial typologies. Often resembling those of a city, their scale forces us to consider all questions in the long term, to confront the passage of time, and, in relation to the financial means required, to always think of the intervention in terms of economy of resources. The fact is that these are not just simple historical monuments, but true site-monuments, given their scale and the diversity of their constituent elements (walls and casemates, embankments and esplanades).

A quarter of a century later, while the questions have evolved, the fortresses continue to provide us a ground to the renewal of both research problems and approaches, forcing us to evolve our methods and techniques.

While the Venice Charter (1964) defined the principles of intervention on the historical monument as a permanence, the Florence Charter (1981) on historic gardens defined a different approach regarding the renewal of vegetation. Today, the environmental crisis raises the question of the preservation of living beings, both plant and animal, extending beyond the human species itself. Once again, the fortresses serve as true laboratories for thinking about development.

From the notion of site-monument, we move to that of an ecosystem. Restoration must now take into account the preservation of species and, therefore, their habitats. Thus, the concern for living organisms and the safeguarding of species calls into question both the restoration doctrines and the techniques implemented. Interdisciplinarity already in practice on such sites (with landscape, urban planning, as well as archaeology, anthropology, ...) is now opening to other fields (fauna, flora, ...). And in the 21st century, we shift from heritage to preserve and transmit to heritage as a source of inspiration and innovation. In the 21st century, the fortresses, as true ecosystems, help us think about a resilient future. Never again will restoration be approached as it was before, and the question of living organisms will now be part of defining restoration project.

The original text by Philippe Prost

Il y a plus de trente ans, nous faisions avec Catherine Seyler visiter le chantier de la citadelle de Belle-ile-en-Mer à une délégation du Governing Body of Suomenlinna et rencontrions à cette occasion Tuija Lind. Les questions posées relevaient alors essentiellement de la restauration et de la réutilisation des murailles et des bâtiments et de la mise en valeur du site tout entier.

Nous nous rendîmes ensuite à notre tour à Suomenlinna pour y découvrir un ensemble magnifique, et surtout des approches différentes concernant la restauration comme la gestion du site, approches très inspirantes pour nous Français, à une époque où la pensée de Viollet-le-Duc continuait encore de régner en France. Depuis nous n'avons jamais cessé d'échanger sur les enjeux propres à ces forteresses, de croiser nos points de vue et de nous rendre visite.

Une fois leur obsolescence constatée et leur abandon décidé par les militaires en général dans la seconde moitié du XX° siècle, ces ensembles fortifiés avaient d'emblée posé des questions nouvelles en terme patrimonial étant donné leur gigantisme et la spécificité de leur architecture. Ainsi la question de l'état de référence d'une restauration ne peut pas se poser comme sur un simple édifice, l'ampleur des travaux à y mener pour leur simple conservation oblige à penser en termes de schéma directeur avec la décennie comme unité de base, quant aux programmes devant y prendre place pour assurer leur usage et donc leur préservation, ils doivent être adaptés à des typologies d'espaces parfois très spécifiques. Souvent proche de celle d'une ville, leur échelle oblige à se poser toutes les questions dans la durée, d'affronter le temps long et en regard des moyens financiers à mobiliser à penser l'intervention toujours en termes d'économie de moyens. Le fait est qu'il s'agit non pas de simples monuments historiques mais de véritables sites-monuments étant donné leur échelle et la diversité de leurs éléments constitutifs (murs et casemates, talus et esplanades).

Un quart de siècle plus tard, si les questions ont évolué, les forteresses continuent à nous fournir un espace propice au renouvellement des problématiques comme des approches, à nous obliger à faire évoluer nos méthodes comme nos techniques.

Si la charte de Venise (1964) avait défini les principes de l'intervention sur le monument historique pensé comme une permanence, la charte de Florence (1981) sur les jardins historiques a défini une autre approche s'agissant du renouvellement du végétal. Aujourd'hui la crise environnementale pose la question de la préservation du vivant, végétal comme animal, et au-delà de l'espèce humaine elle-même. Une fois encore les forteresses sont de véritables laboratoires pour penser l'aménagement.

Et de la notion de site-monument, on passe celle d'écosystème. La restauration se doit de prendre en compte la préservation des espèces et donc de leurs habitats. Ainsi la préoccupation du vivant et de la sauvegarde des espèces interroge les doctrines de la restauration comme les techniques mises en œuvre.

L'interdisciplinarité déjà en vigueur sur de tels sites (avec le paysage, l'urbanisme mais aussi l'archéologie, l'anthropologie, ...) s'ouvre désormais à d'autres domaines (faune, flore, ...). Et au XXI° siècle, du patrimoine à conserver et transmettre, nous passons au patrimoine source d'inspiration et d'innovation. Et au XXI° siècle, les forteresses, constituant de véritables écosystèmes, nous aident à penser un avenir résilient. Jamais plus la restauration ne pourra être abordée comme elle l'était jusqu'alors et la question du vivant participera désormais à la définition du projet de restauration.

Philippe Prost

is a French architect and urban planner, professor at the Paris-Belleville School of Architecture and winner of the Grand Prix national d'architecture in 2022. He is a member of the Academie d'Architecture and president of the Fondation Le Corbusier. After dedicating ten years to research, Philippe Prost was called for help in 1991 on a 15-year long adventure at the citadel of Belle-Ile-en-Mer which started his career as private practitioner. Philippe Prost has written numerous articles on architecture and heritage as well as books on military architecture. "Vauban, le style de l'intelligence. Une oeuvre source pour l'architecture contemporaine" was awarded with the French Architecture Book Prize in 2008. "Par art par nature, architectures de guerre" 2019 underlines topography and natural resources being the starting point of war architecture design. The International Memorial of Notre-Dame-de-Lorette, inaugurated on November 11th in 2014 to commemorate the First World War Centenary, has won several important design awards, including the RIBA International Award for Excellence. The vide range of Philippe Prost's agency projects – public or private, big or small – are all considered equally important. Projects always start by listening to the place.

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1. Introduction to Resilient Fortress

Tuija Lind, Governing Body of Suomenlinna

Ancient and modern fortifications were designed by the best available military engineers and designers. They were places of technological and logistic innovation, planned to be autonomous in case of siege. These places of defence and attack can educate us on solid building techniques, on economic use of materials, as well as on water management. From the 16th to the 20th century, the architecture of war includes massive amounts of earthworks, spread to wide areas, which today are ecological reserves much needed in the preservation of biodiversity. More than any other category of cultural heritage, the widespread fortified heritage unites architecture with landscape.

Due to the structural strength of defensive constructions, many European fortifications once abandoned by the military have become protected monuments, places to live and to work and places to visit. They have a meaningful potential in European wellbeing, and they have an important role in teaching us our own history in its international context.

Originally built to resist artillery, fortified heritage today faces climate change as its major threat. The negative effects of climate change are clearly detectable, at least in Suomenlinna, where both masonry structures and cultural landscape have become fragile.

Specialists working with the fortified landscape at Suomenlinna have recently observed that the lifespan of maintenance and repair works is shorter than earlier. The preservation of the site is challenging, because when one wall is restored, the one next to it might already be collapsing, and when a rampart's erosion is repaired with care, a new path already appears beside it.

Unpredictable weather conditions and an increasing number of freeze-thaw cycles are disastrous for masonry structures. The dry summers and mild winters make the landscape extremely vulnerable both in the high and low seasons. There are also more and more visitors coming to Suomenlinna all year round. In addition to diminishing resources, these challenges linked to climate change urged the Governing Body of Suomenlinna to look for professional exchange with European colleagues who share the same problematics and who are willing to look for solutions together.

Erasmus + project named Resilient Fortress -application, presented by the Governing Body of Suomenlinna as lead partner with Stichting Monumentenbezit for the fortifications of Naarden (NL), Centre des monuments nationaux for the stronghold of Mont-Dauphin (F) and EFFORTS, European Federation of Fortified Sites (EU & B) with experts from France (Atelier d'Architecture Philippe Prost) and Italy (Studio Architettura Meneghelli) was chosen to be funded in June 2024.

Resilient Fortress -project is designed for upskilling professionals facing the challenges of climate change in the context of fortified heritage. The project goals and objectives are:

- Partners learn sustainable practices to cope with fortified heritage exposed to the effects of climate change and draft environmentally responsible guidelines.
- The project participants get an alert attitude towards climate change and are willing to transform old routines to green skills.
- The project results will motivate other fortified heritage sites to develop similar programs.

1.1) During the night of 30th April in 2016 some 50 m2 of retaining wall with tons of sandy rampart collapsed without warning. A probable cause is that the combination of heavy rains and a big number of mole tunnels enabled the earthwork to be saturated with water. It seems that in wintertime, the ice pressure broke the wall, and in spring when frozen land melted, the earth pressure pushed the three-meter high and two-meter-thick 19th century wall several meters from it's original position.

1.2) Fences erected for security reasons lead all walkers to the same path. A wet unfrozen soil is most vulnerable in wintertime. During dry summers the vegetation is also very sensitive.

1.3) Most common inhabitants and plants of Suomenlinna fortress in 1998 illustrated by Hannu Virtanen.

Tervapääsky, *Apus apus* (1), Kivitasku, *Oenanthe oenanthe* (2), Hemppo, *Linaria cannabina* (3), Varis, *Corvus corone* (4), Pulu, *Columba livia* (5), Loistokaapuyökkönen, *Cucullia argentea* (6), Kaaliperhonen, *Pieris brassicae* (7), Gammayökkönen, *Autographa gamma* (8), Pihlaja, *Sorbus aucuparia* (9), Haurasloikko, *Cystopteris fragilis* (10), Ketomaruna, *Artemisia campestris* (11), Kissankello, *Campanula rotundifolia* (12), Keltamo, *Chelidonium majus* (13), Valkomaksaruoho, *Sedum album* (14), Harmaakynsimö, *Draba incana* (15), Valkopeippi, *Lamium album* (16),

Pukinjuuri, *Pimpinella saxifraga* (17), Harmio, *Berteroa incana* (18), Ukonpalko, *Bunias orientalis* (19), Litutilli, *Descurainia sophia* (20), Hukanputki, *Aethusa cynapium* (21), Hullukaali, *Hyascyamus niger* (22), Lituruoho, *Arabidopsis thaliana* (23), Jauhosavikka, *Chenopodium album* (24), Ooppiumunikko, *Papaver somniferum* (25), Rautanokkonen, *Urtica urens* (26), Seittitakiainen, *Arctium tomentosum* (27), Pihasyreeni, *Syringa vulgaris* (28), Saarni, *Fraxinus excelsior* (29), Vaahtera, *Acer platanoides* (30).

The international context of Suomenlinna preservation and restoration

In the beginning of the 20th century, only the major original stone monuments were considered to be worth protection. This ideology was crystalized in the Athens Charter in 1931. The heritage and restoration principles used at Suomenlinna in the years after Finnish independence in 1918, followed the same rule. It was only the 18th-century fortification built by Sweden that was considered worth protection. The 19th-century ramparts and barracks built during the Russian period were not yet considered valuable.

After World War II, the Venice Charter (1964) gave value also to minor architecture and historical layers of different periods. This meant that larger urban or rural entities were considered important and worth preserving. In this field Suomenlinna was quite avant-garde, since the site was considered as an entity already in the 1960s and 1970s. Even "secondary" constructions, like the wooden houses and the industrial equipment and buildings on the dockyard were considered historically significant.

The first international convention on the protection of historic gardens came out in 1981. It preceded the European Landscape Convention (2000), which targeted wider cultural landscapes as well as raising awareness of the value of a living landscape. Also in this field Suomenlinna was up to date. Ten years of research on the cultural landscape starting in the 1970s led to an exceptional landscape renovation plan published in 1987. There were also some important restoration projects on the ramparts, funded by the national employment budget. At the end of the 1980s, there was a momentum for green architecture in the Suomenlinna fortifications. When the employment funding stopped, the landscape was however no longer considered as a priority. This is still so: priority is given to projects that can bring income.

The Council of Europe's Faro Convention (2011), ratified in Finland in 2017, considers cultural heritage as an economic and social resource offering cultural possibilities. As a result, the notion of shared heritage is taken into practice also in Finland. Today, the Governing Body of Suomenlinna gives voice to inhabitants, entrepreneurs, partners and visitors. They participate in drafting management plans and guidelines expressing their opinions. The problem is that only those who voice their interests are heard and are not necessarily a genuine representative selection.

Authentic fortress for future generations?

The mission of heritage professionals is to preserve an authentic heritage for future generation. Resilient Fortress -project is a good opportunity to reconsider what is an authentic heritage and who are the future generations.

One of the responsibilities of the Governing Body of Suomenlinna is to serve people, those who live or work in Suomenlinna, or those who come to visit it. The Governing Body is taking care of their wellbeing and safety. But are people really the only stakeholders? The drawing by Hannu Virtanen 1.3) Nature in the Fortification presents the most common flora and fauna at Suomenlinna. The drawing clearly shows that people are not the only inhabitants of Suomenlinna. Today, when the glaciers are melting and the loss of biodiversity is alarming, it is time to have the same respect to all species – at least when it is adapted to the protection of the cultural landscape. A World Heritage site should also give an example of how to consume less energy and building materials.

Heritage can be considered as a cumulation of values. When knowledge of the changing society and planet increases, new values and meanings are recognized. This does not mean that the earlier defined values become obsolete. Instead, people responsible for heritage need to take a wider range of viewpoints into consideration.

Protection against threats

Heritage professionals tend to react when historical buildings or cultural landscape are in danger. Athens and Venice charters and the European landscape convention were all born against threats. The starting point of Faro convention was quite opposite. In this convention heritage was seen as a resource. Today the climate change is a menace to our fortified heritage, but at the same time our sites can be considered as an exemplary test ground for slowing down the impacts of climate change and the loss of biodiversity. In planning a resilient fortress, the threats, and potentialities of the site – including the fundamental values of historic buildings, built, and planted landscape – must all be taken into consideration.

1.4) Collecting trash on the shoreline.

1.5) Suomenlinna skyline.

1.6) Suomenlinna bedrock and 20th-century quarry.

1.7) Bastion Lantingshausen test pit.

1.4-8) In the Unesco emblem designed by Belgian artist Michel Olyff in 1978 the central square symbolizes the results of human skill and inspiration and the circle celebrates the gifts of nature. It reminds us that the environmental conditions – geography, topography, soil, water, air – with built heritage, cultural landscape and underwater heritage form altogether the protected site.

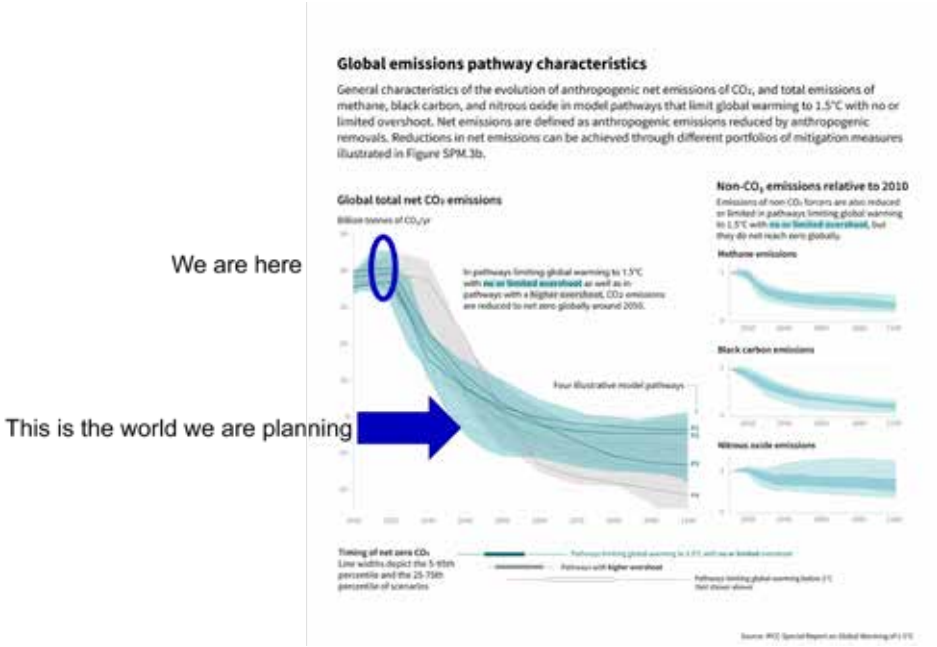
2. Climate Change in Urban Planning

Alpo Tani, City of Helsinki

This article is transcribed from video recording on a presentation held by Alpo Tani at Suomenlinna on 3 September 2024.

My focus is on climate change mitigation, though I shall open up a bit of the adaptation side as well. Probably the efforts to scope with climate change need concern on both aspects.

We are on the peak of climate emissions coming into the atmosphere. This chart from the IPCC report presents the emission reduction pathways on the level that will enable the living environment as we know it.



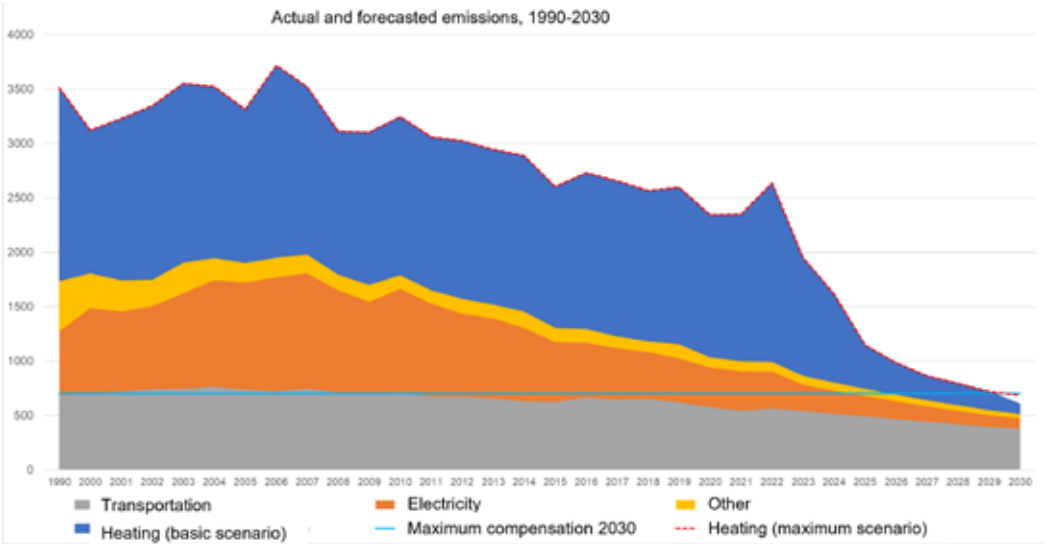
The disciplines, like urban planning, which has a future orientation, are planning the world that will go into zero carbon or even lower. There's only some twenty years timespan to make a fundamental turn to push all the emissions down. It's all about carbon neutral urbanization.

The aim is to implement Paris climate accord. When it comes to cities, we need to understand that with the ongoing climate crisis there is another ongoing global megatrend, urbanization.

Cities are important in this context. According to the sustainable development goals cities are major contributors to global emissions and highly vulnerable to climate impact. At the same time climate crisis will be solved or lost in the cities or with the actions somehow linked to the cities. Cities must choose their stance towards climate actions. This has been discussed during last 15 years at least.

When it comes to targets, Helsinki nowadays is more on the climate leader side, at least. But it hasn't always been like this. The level of ambition has been rising since 5 to 10 years.

Helsinki city's goal is to be carbon neutral by year 2030. This is already quite near, just a couple of years away. After that Helsinki tries to find ways to be carbon negative. It's an uncharted territory how to make it, what sort of actions we'll have ahead of us. For sure these actions haven't been done before.

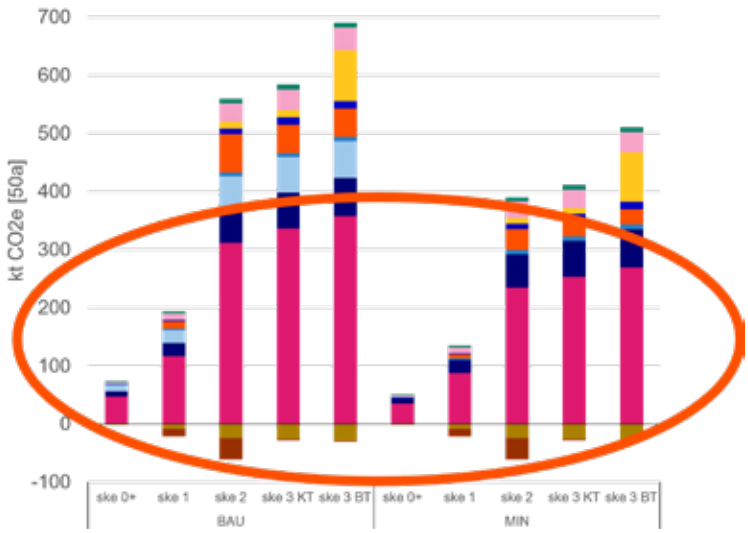


Heating (marked in blue) is a big contributor of emissions in case of Helsinki. How these emissions can be pushed down is a critical issue. The good thing is that Helsinki energy company is owned 100 % by the City of Helsinki. The figure above is based on company's statistics and plans and, according to the company, their emissions will be going quite rapidly down. Positive development is based basically on electrification, like everything is. The other thing is that we are continuing still to use biomass as a fuel. The city looks forward that the European Union won't be changing their standpoint about how to calculate emissions from using biomass that will enable this development.

You can notice that transportation isn't going that well or that rapidly down. There will be a lot of things to do. I personally feel as an expert that we have lots of uncertainties inside this sort of projection. I'm not hundred percent confident at all. There's lots of background discussions constantly going on focusing on climate targets and estimation measures.

Climate targets are not the only challenge that Helsinki has. Growth of population is an official target and there is a political will to grow. At the same time there are discussions if the city really should grow or is it something that we want to be prepared to. From climate viewpoint, it's easy to claim that the growth is not very sustainable. I personally think we should not grow any more, but I am saying this with a risk to be labelled as a difficult person. Further on, cities can't really decide are they growing or not. It is based on the ongoing urbanization. There are attractions in the cities, people want to move there and so on.

Lots of new apartments need to be built every year. We have been figuring out the carbon footprint of new construction areas, as well as urban planning challenges in general. These things are getting quite rapidly more and more challenging. For example, to find spots that are vacant for new houses. It's getting more and more difficult to think about soil and foundation; what sort of obstacles there are. If you are familiar with urban planning, you can see already from these scenario maps that we are dealing even with the corridors along the highways where there already are bridges nowadays. There are very narrow areas and in many ways challenging also not the least from the social acceptance.

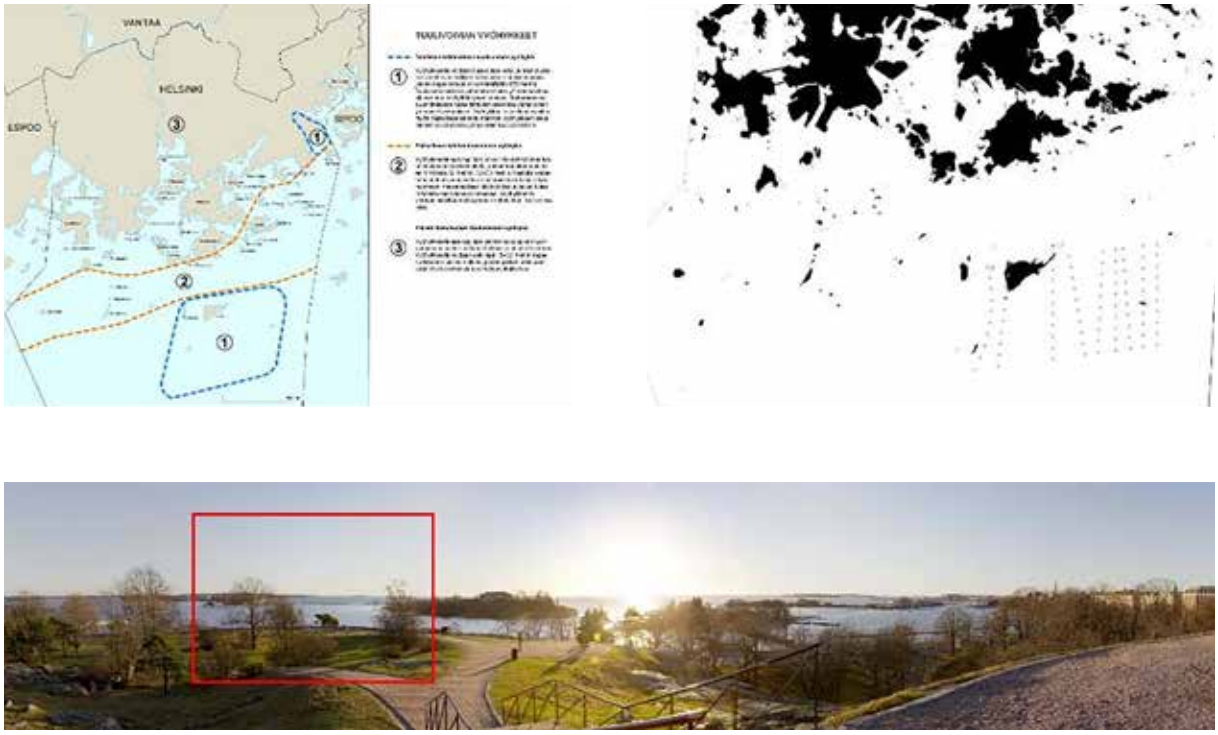


Biggest segment of emissions is released during construction, 60-80%. In developments that will be implemented on longer time frame emissions from transportation and energy are diminishing (estimations, sectoral targets). Building phase emissions remains dominant even if large scale timber construction and limit value for the lifecycle carbon footprint (16 kg/m2/a) is implemented.

In regarding the CO2 emissions, we've been studying it and there's basically two sets of scenarios. One is "business as usual" -scenario, and one is "minimized scenario", where basically all the fields that we have been studying where the emissions can be decreased, are considered, like wooden houses or renewable, local energy sources and stuff like that.

The thing is that the building phase itself seems to be dominant. If we are looking at life cycle emissions for 50 years, which is a typical life cycle, and timeframing it, emissions caused by construction itself can even be somewhere around 80 %. This is really essential fact for everyone who is dealing with urban environment. This is something that we need to understand and find ways how to kind of deal with this.

In Helsinki, energy production is nowadays combined with heat, energy, and cooling. It is a really energy efficient system but has been run quite dominantly by fossil fuels. This is a big problem. An updated vision image that you can find from the website of Helen Energy Company of Helsinki is already quite different. Energy production is more spread out and includes variable ways to produce energy. There are quite controversial ideas also, like small modular reactors, for example like small scale nuclear power plants. This is something that Helsinki energy company would like to see in the cities not in very distant future. However, I think that we don't even have a proper legislation for it nowadays.



2.1) Ullanlinna, Helsinki. Studies for the possibility wind energy in front of Helsinki.

So many things need to change. There's quite a big demand for ways to produce energy which is not based on burning some stuff. There we don't have endless possibilities. We have been studying the possibility for wind energy here inside the city of Helsinki since we have quite a big sea area and an archipelago. It has been studied in several phases. The challenges so far are great that it hasn't gone further, main obstacle being the military defence of Finland. It's been studied that wind turbines affect the radars and hinder the defence. The interesting thing is that now we are in the NATO and on the other side of the Gulf of Finland, on coast of Estonia, there are wind turbines. Estonia has been a NATO-member for a while. I'm not sure if this might change the Finnish defence premises.

2.2-3) Hot Heart, a series of islands with the dual function of storing thermal energy storage and serving as a hub for recreational activities. It has won the Helsinki Energy Challenge, which aims to decarbonize the heating system of the Finnish capital by 2030.

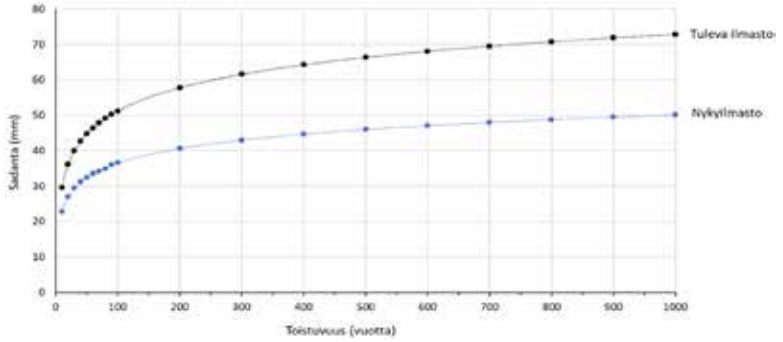
The potential location of these wind turbines would be behind the islands of Suomenlinna, somewhere around five kilometres from here to offshore. As marketing argument, it is said that wind turbines won't be visible from Suomenlinna because they would be located behind coastal islands, even though if there would be quite a substantial amount of wind turbines. It's studied that somewhere around 70 or even bigger amount of peak power would be comparable that with nuclear power plants that has been built in Finland recently.

In regarding the Helsinki archipelago there is an initiative called Helsinki Energy Challenge, which was presented a couple of years ago. It was an international competition in which the task was to design an energy system that won't be based on any sort of burning. In pictures 2.2-3) are example from the outcome to give you an idea. It's not science fiction. Or maybe it is a bit. These underwater silos are heat containers and futuristic islands. The landscape in Helsinki archipelago could be in the change in coming years. I like to underline to ponder if it is necessarily a change in the worse.

Preparing to climate change, and doing climate change mitigation operation, to plan for the carbon neutral future, or even to carbon negative future will affect the urban landscape for sure. But we are not at all ready with the climate actions, just developing ideas that will be affecting in the urban planning practices.

I will present a couple of ideas regarding climate adaptation to present a very general idea what is going on from city's point of view. I focus on areas, heavy rainfalls, and the fact that the floods are coming worse.

What needs to be done is to strengthen green structure. We need to prepare natural stormwater management systems and also prepare for heat, which is something not very typical for us living here in the North. The issue of rain is both interesting and maybe the most relevant regarding the resilience of fortress.



Toistuvuus (vuotta)	Nykyilmasto (mm)	Ilmastokerroin (-)	Tuleva ilmasto (mm)
10	22,8	1,30	29,6
20	27,0	1,34	36,1
30	29,4	1,36	39,9
40	31,2	1,37	42,6
50	32,4	1,38	44,7
60	33,6	1,38	46,4
70	34,2	1,40	47,9
80	34,8	1,41	49,1
90	36,0	1,40	50,2
100	36,6	1,40	51,2

Rains get heavier, and it will be worse in 20 years, even more in the future. You can read it from the chart on the previous page. I find the limit interesting. Basically, like in every 30 years, there could be a rain that in current climate isn't possible at all, something that has never happened before. It is possible that it will cause a lot of problems also with the erosion.

2.4) The Courtyard of the Future by SLA, Copenhagen.

2.5) The Climate Resilient Neighbourhood in Copenhagen.

These are the images from Copenhagen. I wish I could have used same kind of pictures from Helsinki. It's not yet the case, but I'm kind of happy to say that lots of our top management and political decision makers have been going to Copenhagen and checking this district as a good example. I've also been there. It was quite a funny event. I was there with a couple of architects, colleagues of mine, and they were saying that "Well, this should be a street", "This looks like a forest", "No, this is not right". But these images show what we need to learn more as urban planners.

Alpo Tani

has a planning geographer and urban planner background, currently working as a climate change mitigation specialist in the Helsinki urban environment department. He has been working with climate change related strategic urban planning questions for 15 years and his work has included wide variety of projects ranging from development of evaluation methods for climate impact assessments to planning of green transition needed both within transportation and energy systems.

3. Biodiversity in Brief

Lauri Erävuori, Sitowise

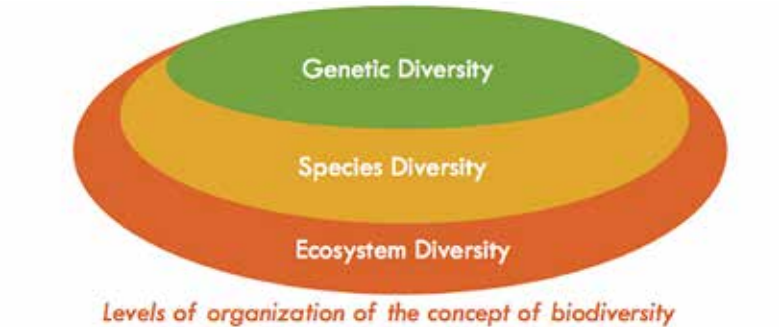
This article is transcribed from video recording on a presentation held by Lauri Erävuori at Suomenlinna on 3 September 2024.

Biodiversity is the shortened term of biological diversity, referring to variety of living species on Earth, including their interaction. Among the different kind of definitions for biodiversity, with some differences in use of terms, I prefer E. O. Wilson's definition of the biodiversity as "the very stuff of life".

The biodiversity consist of species, genetic, and ecosystem diversities. Usually, we refer to the species diversity. Species diversity refers to the number of different species and to the number on individuals inside any of those species. It takes more than one individual to make any species, since one individual is not able to reproduce their species.

The genetic diversity is related to the diversity of species. Genes determine the traits of individuals that form populations of a species. Mutations form new species or may adapt to environmental changes. Gene flow is necessary for diversity.

In addition to the living organisms like plants, animals, bacteria, and fungi, there are also so-called abiotic components, like weather, air, and soil. Abiotic components are related to the biodiversity, but not included in it. (1) Thus, bedrock is not part of biodiversity, those living things in bedrock are part of biodiversity. The ecosystem diversity includes abiotic factors in addition to the biodiversity including both species diversity and genetic diversity.



Levels of organization of the concept of biodiversity

(1) In biology and ecology, abiotic components or abiotic factors are non-living chemical and physical parts of the environment that affect living organisms and the functioning of ecosystems.

There are different kinds of ecosystems. The Finnish ecosystems are quite different than, let's say, in Tanzania, Africa. Some species can live in forest ecosystems in Finland, but not in Tanzanian forest ecosystems. Marine ecosystems differ from forest ecosystems having different abiotic factors. Land animals cannot live in marine ecosystems.

The ecosystem as a term includes several different kinds of habitats, which usually are smaller areas like forest or marine habitat. The habitat is a place where species adapted to the area can live and interact with other organisms and animals. For example, a forest ecosystem has many kinds of habitats. A mosaic of different kind of forests in one ecosystem has more biodiversity.

3.1) Iso Mustasaari, Suomenlinna.

Biodiversity can be measured but it is not simple. There are many ways to do that. Biodiversity is commonly measured in terms of taxonomic richness of a geographic area over a time interval. Biodiversity can also be measured by using habitat diversity and habitat quality. Some habitats have small species richness, nevertheless those are part on the biodiversity. All habitats are significant, but healthy habitats are richer. Connected habitats have more diversity. For example, all habitats, including pastures or meadows, which you have here in Suomenlinna, are rich in species and are important habitats. When trying to calculate Suomenlinna species diversity, birds and plants are easy to account, but insects, lichens or mosses are not.

For better biodiversity we need more species and different kind of habitats. Biodiversity supports everything in nature that we need to survive - food, clean water, medicine, and shelter. Every species and habitats are important. If we lose species, it is irreversible. If lots of species go extinct, humans cannot live on Earth.

When increasing the biodiversity or maintaining what you have in Suomenlinna, main target is to maintain the pastures. The plant biodiversity is important. Excessive visitor pressure has created a problem with erosion. It might be necessary to close some places and direct visitors elsewhere. In repairing erosion, use as much as possible native plants from these islands. If you can, use sheep here or other animals for maintenance. Their maintenance job is much better than human can do. Perhaps they had sheep here in 150-50 years ago, even other animals. That's one thing why these meadows are special and unique in whole Finland. Also, bees are good co-workers. I propose that in anything you plan or do, you should think all the ways where we can maintain or make greener. If you take green somewhere out, it is necessary to try to compensate in some other place.

Lauri Erävuori

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4. Restoring the Suomenlinna Fortifications: Principles in Practice and New Challenges

Tuija Lind, Governing Body of Suomenlinna

Suomenlinna (Sveaborg) is a bastioned trace fortification built in the 18th century as a Swedish naval base, transformed into a Russian garrison in the 19th century before becoming a Finnish military zone in the beginning of the 20th century. Since 1973 the seven fortified islands are developed according to a master plan that combines preservation with utility. The owner of the site, the Governing Body of Suomenlinna, is a public body under the Ministry of Education and Culture. Since the 1970s, the Governing Body's own gardeners are responsible for the maintenance of the fortified landscape, while inmates from the open prison work on most of the wall restorations.

The state-owned 80 HA area of Suomenlinna is situated inside the Helsinki council boundaries, near the city centre. A World Heritage site since 1991, the fortified landscape, parks, gardens, tree-lined alleys, 200 buildings, as well as the technical equipment of the dry dock, are protected by the Act on the Protection of Buildings, the highest rate of protection in Finland since 2022.

The case example of this article, the A13 shore work (see next page), is situated in the foreground of the aerial view of Suomenlinna.

In this article the methods developed at Suomenlinna since the 1990s for the restoration of the fortified structures are presented and analysed from the point of view of sustainability. Several general questions related to the fortified landscape in the future also arise: how to integrate environmental responsibility and heritage values in practise and how to continue restoration work in light of the ongoing climate change.

Before the 1990s the use of cement and concrete was common place in the restorations at Suomenlinna. Fortifications were made to look "original" from the outside, but from the inside they were structurally modernised. It was only some 25 years after the Venice Charter (1964) in the 1990s, that the authenticity and respect for historical layers became a criterion for restorations at Suomenlinna.

This change in the way of thinking had fundamental consequences, because thereafter fortification walls were no longer pulled down for being of the wrong kind. Even a 20th-century addition or repair is kept if it is structurally solid and functional. It is a well-known fact that the building industry is a major source of carbon dioxide emissions. Our 35-year-old principle of repairing only what is broken was and still is extremely sustainable. It is also a way to preserve a maximum of information concerning the original military object and its evolution as well as its restoration history.

4.1) Aerial view of Suomenlinna 2012.

4.2-3) In 1980s the restoration methods were often maximum interventions. In 1990s, in the case of A13 shore work, only the parts in bad structural condition were repaired.

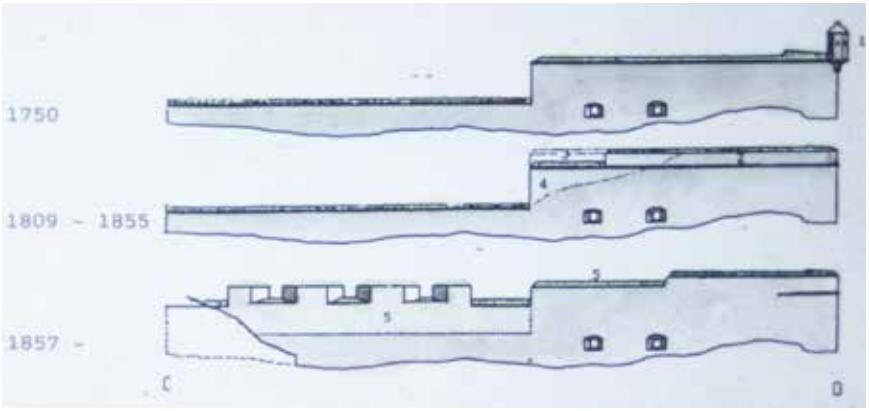
Minimum intervention

The first restoration project at Suomenlinna, where the principle of minimum intervention was implemented, was the A13 shore work (1992–1997). Built in 1750, the A13 shore work is situated at the southern part of the fortress to protect one of the two straits giving access to the anchorage bay at the back of the islands. From its casemates the guns would fire on the ship's sides and from its terreplein the masts. As artillery firepower developed in the 19th century, the enemy fleet did no longer have to approach the target in order to cause damage. During the Crimean War in 1855, the British-French fleet bombarded Suomenlinna-Sveaborg from a three-kilometre distance. As an answer to the new treat, the A13 shore work was gradually strengthened during the 19th century and partly covered by earthworks, which formed the modern line of coastal defence in front of Suomenlinna and Helsinki.

In the restoration project of the A13 shore work it was decided to preserve all historical layers. Adaptation of this principle meant that restoration was equal to repair of the existing architectural state. Other principles adapted were the use of traditional materials as much as possible, the search for solutions that are easy to repair in the near or far future, and the respect of existing soil. Since the traditional building materials were not available anymore, and many old techniques had been lost, this specific restoration project became a major learning process for all project participants, a learning-by-mistakes school.

In the damage survey, areas that needed repair were detected and the reason for their bad condition was studied. It was quite clear that main cause of structural deterioration was water entering the structures and not finding its way out. With the wind from open sea nearby, the rainwater reaches both the horizontal and vertical parts of the A13 shore work. When the mortar gets wet too often and the freeze-thaw cycles are frequent, the masonry structure is deteriorated. Over time the pinning stones fall and leave place for even more water to enter between the stones. Within some years, the decay is accelerated.

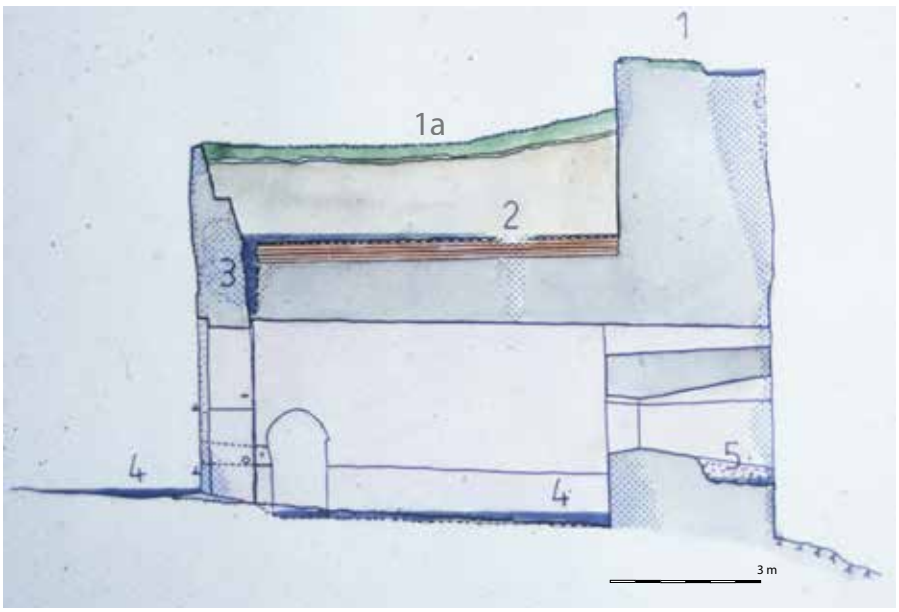
The erosion of soil is comparable with the erosion of masonry structures. If the green surface of a rampart or a parapet has a dense growth and there is a sufficient slope, the vegetation acts like waterproofing. Rainwater wets it only from the surface. But if the vegetation is worn out and eroded, the water wets also the soil. Fortifications have masses of earth and sand to protect them from gunfire. If this volume is loaded with water, it doubles in weight. When the wet soil freezes, the pressure of ice is tremendous and causes dangerous collapses.



4.4) 18th-century admirers regretted the dismantled watch towers. They used to be many at Suomenlinna, but none of them was left. Had one wanted to rebuild one on the southernmost point of A13 shore work, it would have caused destruction.

4.5) Kustaanmiekka-Gustafsvärd and A13 shore work-Strandvärk in year 1756 and the location of a 1989 test trench.

4.6) Test trench 1989.



4.7) Damage survey: 1. Erosion of the parapet, 1a. Terreplein with no inclination 2. Lack of clay 3. Frost damages and lack of drain, 4. Rainwater stagnation 5. Eroded masonry.

Reinventing traditional methods

When describing a monument, it is a habit to start from the foundations to explain its architecture in the order it was built. But when it is a question of monument preservation, it is necessary to analyse the situation starting from the roof, because weatherproofing is vital for any construction, including fortifications.

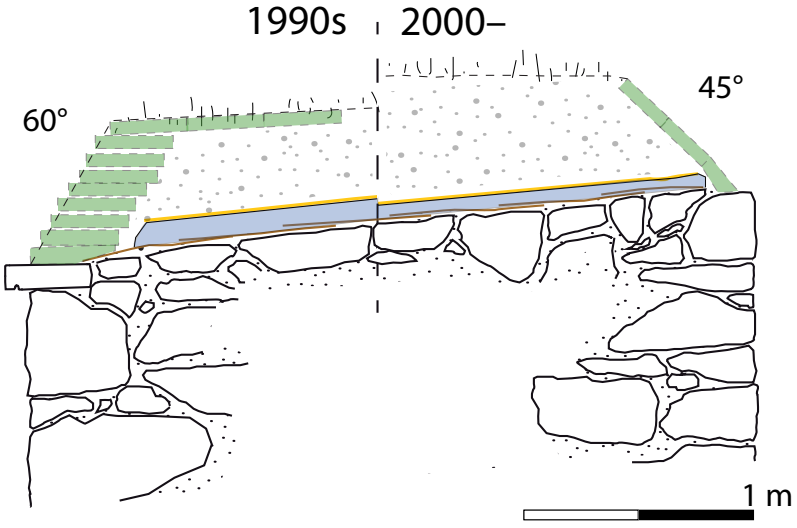
There was also a very practical reason behind the principle of using as much traditional materials as possible. We had noticed in Suomenlinna that it was difficult to repair modern waterproofing materials used since the 1950s in the fortification restorations. When, for example, a concrete slab from earlier restorations was leaking, it was not possible to find where the water got in, without breaking everything. There was a need to find waterproofing solution that could be repaired only where the problem was.

In Finland, birch bark and clay are traditional materials, which were still used for waterproofing in the beginning of the 20th century. These materials were re-adopted in A13 shore work restoration project. Due to lack of knowledge, it took several years to learn how to handle these materials. For example, birch bark must be stored so that the extracted pieces are under pressure but in a dry and ventilated environment. To maintain its waterproofing qualities clay must stay elastic. It must neither be too wet nor too dry. The maximum thickness of clay is 5 cm, otherwise it cracks too much during the dry season and is not waterproof when it rains. This kind of waterproofing needs at least 30 cm of soil above it, preferably even more.

The square "grass tiles" extracted from meadows have always been used for shaping the parapets and shooting sectors. This tradition was revived at Suomenlinna in the 1980s and has been developed ever since with many practical lessons learned. Grass tiles can be stored only for few days, and it is good to sink them into water before use. It was also noticed that building a grass surface to a parapet requires the same precision as the work of a bricklayer. The grass elements should all be of same size and thickness for a good result. One mistake was to build too steep profiles for the parapets. In time the earth pressure makes them even steeper, and it is difficult to get vegetation to grow on almost vertical surfaces. A 45° angle is ideal.

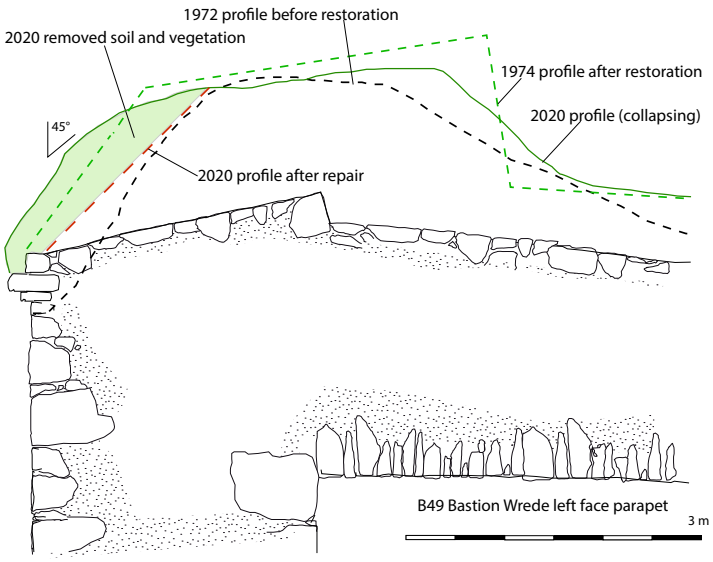
4.8) Coming from a Pelso prison in the Oulu region, the birch bark was harvested from trees that were going to be cut at the end of June or beginning of July. The clay was found near Helsinki from an old brick factory's land.

4.9) Extracting 300 x 300 x 80 "grass tiles" from Suomenlinna meadow.



4.10) Piling up several grass tiles did not give better results than using only one layer one the parapet. Parapet structure 1990s: humus soil min. 300 mm, fine sand 10 mm, clay 70-100 mm, birch bark, masonry. Parapet structure after 2000: sandy soil min. 500 mm, fine sand 10 mm, clay max. 50 mm, birch bark, masonry.

4.11) Construction site of Bastion Wrede in summer 2020.



4.12) The example of B49 Bastion Wrede provides evidence on the natural transformation of a steep parapet caused by earth pressure.

4.13-14) Rebuilding partly collapsing parapets in Bastion Wrede summer 2020.

4.15) The first stage of wall repair is loosening pinning stones and extracting eroded mortar.

Repairing only what is broken

The idea behind repairing only what is broken and doing as little as possible is the preservation of authenticity – both material and immaterial. Authenticity is also the reason for choosing traditional materials. A masonry wall consists of mainly two materials, stone and mortar. If the one of them is substituted, it has a major impact in the ageing process of the monument.

In Finland there is no natural hydraulic lime in the bedrock, which is why cement had replaced traditional lime-based mortars also in the field of architectural preservation. The A13 shore work was the first project where natural hydraulic lime was used in large quantities in Finland, apart from the Åland Islands, where hydraulic lime was used already in the 1980s. Suomenlinna's hydraulic lime was first imported from Switzerland (Jura lime) and later from France (St. Astier NHL5).

4.16) Grouting is a common method used in Suomenlinna wall repair.

4.17) After grouting the mortar settles some hours before the wall is washed.

4.18-19) Earlier all earth was removed before restoration work. In A13 shore work restoration project only the soil hindering repair works was removed.

The uncoursed stone walls of Suomenlinna with the width of one to three metres are built as shell walls, with a core filled with large stones and mortar. This kind of wall is structurally strong if it contains no gaps. In the repair works – after having removed only the loose material like growth, deteriorated mortar and pinning stones – grouting is a good and a conservative way to repair only what is needed. The aim is to have a wall 100 % filled with mortar and stones, leaving no space for rainwater to enter and make damage during winter.

The minimum intervention was also applied to existing soil. Earlier, the soil was totally removed from terrepleins and parapets before a restoration project started. In the A13 shore work project the soil was respected as much as possible for its archaeological potential. The digging was minimalised and done manually with a spade. The respect of the seed bank was not yet an issue, but with a minimum intervention, it was preserved as well.

4.20-26) In the A13 shore work restoration project the principal objective besides wall repair was to prevent water getting into the structures, and if it did get in, to provide an exit for it. During the restoration project, the 18th-century drains and gutters were remade or repaired. Instead of using plastic drains with a short lifespan, the drains were built with stones and concrete pipes cut into two. Instead of using geotextile, the drains were covered gradually with cobble stones, uncrushed gravel, and sand. The gradually diminishing gravel is replacing the geotextile. This kind of infrastructure can easily be repaired in the future.

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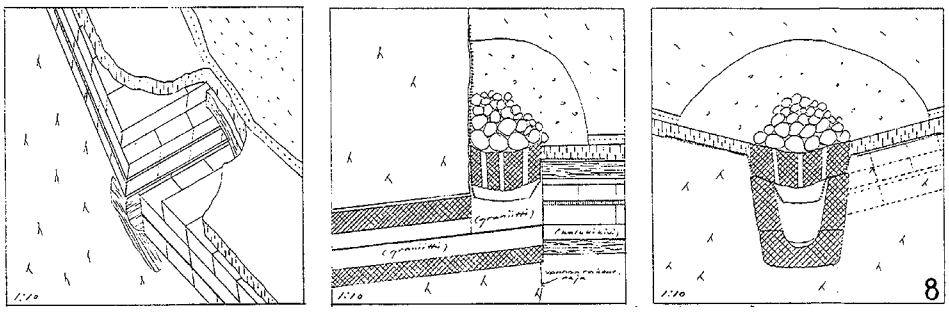

4.26)

Working around the year

The extent of fortification walls needing urgent repair in the 1990s was huge. The Suomenlinna prison, with its 70 men, needed year-round working places that the Governing Body had difficulties to organise. Putting these two needs together, it was decided to repair walls also in winter. In the beginning, the winter working conditions were not adequate, and the tents difficult to heat.

Within time the scaffoldings were covered with transparent cover sheets letting the day light in. They were also better isolated, and the loss of energy diminished. A hydraulic lime mortar requires at least two weeks of +10°C temperature not to be damaged. The tents were and still are heated with light fuel oil. This kind of heating seems to be good for the carbonation of mortar, but heating tents in wintertime in Finland requires a lot of energy. It would be interesting to find an ecological solution for this kind of winter work.

Another negative aspect of year-round work is the time it takes to build up winterproof scaffoldings. Earlier it was possible to "waste" human resources, since the Suomenlinna prison could provide a large number of men to work on the fortifications, but in future the diminishing amounts of both work force and money will probably put an end to winter work on wall restoration projects.

60 000 m2 of walls to be maintained in a changing climate

Based on a damage survey the first long-term plan for the Suomenlinna fortification restoration was made in 2000. The idea was to place several building sites near each other in order to achieve logistical synergies. Despite of a decade of extensive repair with some tree to four ongoing building sites, it was noticed that the long-term plan was too optimistic. Some 25 years are not enough to go around all the walls in Suomenlinna.

In 2021 a new damage survey was made this time with an estimation on time and money needed for a minimum intervention in each fortification wall. It was counted that a sum of 9,2 million euros is needed to get the walls in a good shape.

During this survey was also noticed that the expected lifespan of the Suomenlinna fortification restorations is not half a century as expected earlier, but sometimes only a quarter, especially on the walls facing south-west, south and south-east. There is some 10 to 15% more rainfall in the Helsinki region today than in the 1990s. When everything is extremely wet, the water pressure makes water move upwards also. In these situations, the traditional materials are not waterproof anymore. In some cases, the birch bark and clay have been replaced by modern rubber membrane even though it is not in line with earlier restoration principles.

This survey was also an occasion to gather lessons learnt during 30 years of working on fortification building sites. The knowledge was crystallised into a technical specification on how to repair different kinds of walls. The document consists of seven specifications. Three of them are dedicated to stone-wall repair and grouting, one for dry-stone walls, one for brick structures, one for ruins and one for waterproofing and green roofs of fortifications. As soon as the know-how was gathered to an easy-access format, we noticed that it already needs updating.

As from the 2020s, the Governing Body's budget is targeted mainly to projects that bring income. At the same time the prison has seen its budget cut. In 2024 the Governing Body faced a situation, where there is a need to take a new step in updating restoration practices into a more responsible, climate resistant and effective direction. The A13 shore work restoration project (1992–1997) proves that if all stakeholders of the project believe in something and consider it valuable enough, it is possible to change working methods. It is a question of knowledge, values and will.

4.27) B48 Bastion Virtue (Hyve) under restoration 2010.

4.28-29) The two faces of the salient of A5 bastion Gyllenborg were restored in 2005 and 2006 with hydraulic lime morter. In the photos taken in 2021 it is clearly visible that the left face of the bastion already needs repair. It is orientated to southwest (open sea) receiving wind, rain and sun. The increasing number of freeze-thaw cycles shortens the restoration life cycle of Suomenlinna fortifications.

4.30) Suomenlinna walls.

Lessons learned

During the years that followed the A13 shore work project some twenty major wall restoration projects were completed. These projects taught us:

- A better use of the mortar and techniques of grouting and understanding that the use of traditional mortar requires more knowledge than the so-called normal cement-lime mortar.
- By involving gardeners and landscape planners to wall restoration projects, it was understood what the suitable vegetation and soil for the parapets and ramparts really is.
- After having spoilt some projects by opening them too early to public, it was understood that the vegetation needs several years to heal, and its maintenance must be planned.
- As a result from a birdwatcher's observation, planning cavities for birds nesting became part of the wall repair projects, but not in a systematic way.

There is also an unlearned lesson:

- Even with 30 years of experience, the protection of surrounding landscape before starting a building site is inadequate. The engines used for everything are getting bigger, and if the drivers don't value green areas, they take short-cuts on vegetation instead of waiting some minutes. Sometimes the damage is irreplaceable, and it always requires a lot of work for gardeners.

Tuija Lind

architect, D. Sc (tech.) trained at the Department of Architecture at Aalto University (Helsinki), has developed three different approaches to heritage through the practice of restoration, conservation theory and archeology. Her field of expression is Suomenlinna (GBS), where she is responsible for fortified structures and historical dockyard. Her theoretical knowledge is developed through writings on the reuse of Suomenlinna and on ruin restauration. As a member of French archaeological mission in Pompeii (porta Nocera) she observes year after year traces left by human activity and the degradation of masonry structures. She is a member of Finnish ICOMOS and ICOFORT, a board member of EFFORTS and the coordinator of Resilient Fortress Erasmus + project.

5. Preserving Landscape in Suomenlinna

Pia Kurki, Governing Body of Suomenlinna

5.1) Suomenlinna fortified landscape seen from the south.

The erosion of grasslands and meadows

In Suomenlinna, the fortress is a combination of stone walls and various kinds of structures with green surfaces on them: ramparts, glacis, moats and grassroofs. The green parts of the fortress are often covered with meadows and grass. This vegetation is the most vulnerable to erosion. Already the current impacts of climate change increase this erosion in many ways and make it more difficult to successfully carry out repairs.

Several different factors cause the erosion of grasslands and meadows of the fortress. They are comfortable to walk or drive on, sometimes easier than in the uneven stone pavements. People understand the value of bushes and trees, but they don't pay the same attention to ground cover plants. On construction sites these areas are rarely protected with fences in the same way as trees. It is surprisingly common to be unaware that grassy fields and meadows cannot withstand intensive driving and walking. Grass is also a favourite food for geese. In some places, geese eat the grass so low that it will no longer be able to recover and grow again.

Due to the impacts of climate change, there is no longer snow every winter in Suomenlinna. Thereby grass and meadows are wet and bare. When snow forms a protective layer on frozen ground, the water that replaces snow has no protective features. In winters the low and wet grass vegetation is even more vulnerable for permanent damages when people are walking or driving on them.

The main factors causing erosion at Suomenlinna, however, are the excessive number of visitors and the traffic caused by large construction sites and the storage areas they require. In addition the increasing maintenance traffic accelerates the erosion. In general transport trucks have become huge, but a positive exception to this has been made in the waste management of Suomenlinna, as the maximum size of the waste trucks was specified in the service procurement.

Narrow paths and driveways are not wide enough for increased traffic and increasingly larger vehicles. Due to the increasing traffic and visitors to Suomenlinna, in many places the roadside areas are also used as walkways and lanes, even though their grass or meadow vegetation cannot withstand such use. The historic landscape is being damaged as green areas are transforming into sandy fields and narrow paths are widening into driveways.

5.2) Approximately one million people are visiting Suomenlinna each year.

5.3) The driveways are getting wider because people are walking beside them. Sometimes it is easier to walk on the grass than on the stone pavement or more pleasant on the shadow rather than under the sunshine. This changes radically the appearance of the historical landscape.

Historical fortifications will be destroyed or even disappear if erosion damages cannot be repaired. The loss of vegetation weakens biodiversity. In addition, as the surface layers of the soil wear off possible archaeological remains can be exposed and destroyed. Erosion also causes roots of the trees to suffer.

Erosion and its consequences are a concern at every historical site, and the issue of erosion has been present even before the current change of climatic conditions. But now, when the weather conditions are changing, the recovery of vegetation after repair work takes longer than before. Before vegetation grew back in about a year, now recovery takes two or three years. Long dry periods in summer are one reason for this slower recovery of vegetation.

Should we water more or sow new seeds? When regrowth is delayed, birds, strong winds and rains after a dry season carry away seeds and the soil is left bare and worn off again.

5.4) Picture has been taken in the 1970's when the ramparts were badly eroded. In some places we are going towards the same situation when the green surface of the ramparts is vanishing and the structure of sea sand layer is revealed.

5.5) This is a moat where there has been a driveway for building site. Meadow of the moat has been repaired three years ago and still the vegetation has not been recovered.

Also other factors affect the repair of erosion damages at Suomenlinna. The principle of landscape restoration work has been to reuse the soil excavated from Suomenlinna as extensively as possible but almost all the soil at Suomenlinna is contaminated. Since Suomenlinna does not have much clean soil of its own, new soil must be transported to Suomenlinna, which increases traffic. This weakens our efforts to reduce emissions as part of climate change actions. The soil, which is sufficiently clean, is often very sandy and does not form a good seedbed, especially when there are long dry periods in the summer. Especially on deep slopes, grass tiles from Suomenlinna's meadows are used for repair work, but now the removal areas of these tiles must be limited because the sites recover so slowly.

5.6) To have vegetation on the deep slopes it is easier with the grass tiles, Suomenlinna own transfer grass. Nowadays it is more difficult to find places where to get them because the places are recovering so slowly.

As a result of all this, new soil will be brought from the mainland and irrigation of the repair areas will likely be increased. Thus, we are increasing climate change by repairing the landscape eroded by climate change.

5.7) With light fences we try to prevent the visitors from walking on the slope which is badly eroded.

5.8) On the ramparts of Kustaanmiekka there has been build new path with modern structure and fences to avoid erosion.

The management should urgently draw up instructions for construction sites on how to protect grassland and meadow areas during repair work. The use of cars in Suomenlinna must be effectively restricted, especially the use of large cars. The best way to save resources is to minimize the causes of erosion and thus the need for repairs. We are already informing visitors about the values of Suomenlinna's landscape and guiding them. In practice, the fences are the most effective way to keep visitors on the paths designated for them. We have already had to build fences due to increased safety requirements. Unfortunately fences change the historical landscape. They send a signal that this is a tourist destination, not an authentic fortress. Will we now have to build more fences in the cultural landscape due to climate change?

Preserving authenticity and biodiversity in the historic fortress of Suomenlinna

Historic landscapes, parks, gardens and fortresses have obviously a lot of historical values but also a big amount of biodiversity. Old trees provide shelter for a variety of species like insects, fungi, birds, bats and other animals. Trees bind carbon dioxide, and biodiversity helps plants and animals, the entire biotope of the area, to withstand the effects of climate change.

Biodiversity and historical authenticity are not automatically opposing objectives, although it is not always easy to find the right balance between them. When trying to preserve both the authenticity of the cultural landscape and the diversity of nature, landscape values must be considered more comprehensively than before. I will illustrate this problem with two examples:

1. Fortress seen from the sea in the past and today

The historical landscape of Suomenlinna includes rocky cliffs and boulders on the shores opening out to the sea, with a stone wall rising behind them. For example, the eastern front of Iso Mustasaari was originally an open landscape, but today the bushes and trees growing on the shore block the view from the sea.

Trees and bushes are important for biodiversity, but on the other hand, we want to show the fortress: how it used to be visible from the sea and how important it was to see the enemy from the walls. This leads to key questions of principle and practice. When is it too many trees and bushes growing in front of the historical fortress? What does it mean to biodiversity if we cut most of the trees? Can the area have rich biodiversity if there is not a lot of trees but only meadow with rich flora and fauna?

5.9) This picture from the eastern shore of the island Iso Mustasaari has no exact timing. The rock and the shore between the sea and the stone walls is quite open.

5.10) Picture is taken in summer of 2024 from the eastern shore of the island Iso Mustasaari. In front of the stone walls thera are a lot of trees and bushes. From the sea you cannot see the fortress and if you want to see to the sea which has been the purpose in times of war, it is almost impossible.

2. Values of an individual old tree and historical value of the tree alley as a whole

The tree alley of Kultaranta is located in Susisaari island. During the Swedish and early Russian periods, there was a harbour at north end of the alley, which served as one of the main entrances to the fortress. This tree alley has a lot of historical and garden artistic values and is now protected by law.

5.11) Old plan from year 1844. On the western shore there is an old harbour and from there begins the tree alley of Kultaranta heading to east. North side of the alley is marked by two rows of trees.

5.12) The tree alley 2019. Red, orange and yellow are marking the condition of the tree and the different kinds of trees and the species of the trees.

This tree alley has two special characteristics: one is that on the other side there has been trees in two rows. The other is that the trees are not all same species. We don't know if this was the case originally. In 2019, some of the trees were in poor condition and some had to be felled by the Governing Body of Suomenlinna.

When one or two trees fall from an alley, it is not possible to plant a new tree between two old ones, because there is not enough space and light for the new tree to grow healthily. An unfortunate restoration has been made in Kultaranta: new trees have been planted between the old ones, and they have apparently had no chance of surviving in such a cramped space. In some historical areas, decisions have previously been made to cut down all the trees in the alley and plant an entire new tree alley. This is not the case anymore, today we now know very well the value of old trees.

When we consider the renewal of a tree alley, there are many things to think about: when do too many old trees disappear from an alley, and it ceases to be an alley? We cannot lose this tree alley, but how and when is it time to renew it? Is it when more than half of the trees are dying? These solutions must be considered separately in every alley and in every site.

5.13) The tree alley of Kultaranta in the 1970s.

5.14) The tree alley in the summer 2024. The small trees where planted long time ago between the old trees and they have no chance to develop into big trees.

Is restoration of the landscape and historical parks more difficult than before? Or is it more interesting now when we consider and integrate also the values of biodiversity? We cannot weaken the historical values. We need reasoned views on the relationship between the authenticity of a historic fortress and the enhancement or protection of biodiversity. We also need more knowledge and good practices on how to balance the historical and the biological values of historic parks and gardens. In Suomenlinna, perhaps we need a biodiversity master plan to take these values into account.

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6. About Soil and Vegetation

Iina Johansson, Governing Body of Suomenlinna

Some thoughts on contaminated soil of Suomenlinna

During its history, Suomenlinna has been involved in several wars, the effect of which can be seen in the site's soil. The operation of the historic dry dock, undeveloped waste management of the closed island community and traditional heating methods have also left their mark on Suomenlinna's soil, which today is known to widely contain harmful substances. Harmful substances are mainly metals, such as antimony, arsenic, mercury, chromium, copper, lead, nickel, and zinc, but petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), oils and organotin compounds are also present in some places, specifically on dock areas. For this reason, whenever earthworks are carried out in Suomenlinna area, it must be taken into consideration that the excavated soil is contaminated.

The remediation of soil containing harmful substances is governed by environmental and waste legislation. On the basis of perennial investigations, certain background values for metals have been defined for Suomenlinna. Therefore, soils containing metals over threshold and/or guideline values (as given on the Government Decree on the Assessment of Soil Contamination and Remediation Needs 214/2007) can be reused on site under certain conditions, e.g. based on a risk assessment.

6.1) Typically, Suomenlinna's excavations are related to repair and restoration of buildings and landscape as well as infrastructure repair work.

6.2) Beneficial re-use of soil is mainly limited by the small size of the long-term storage area and also by the geotechnical suitability of typical Suomenlinna soil containing a lot of construction waste, such as pieces of bricks. Too often it is noticed that the quality of Suomenlinna soil is not suitable for present requirements.

Suomenlinna in its entirety is protected by the Antiquities Act. During the years 2013-2023, on the protected soil of Suomenlinna, the number of projects carried out in different types and sizes that included excavations was nearly 130. The implemented investigations of soil during that period consist of nearly 700 individual samples and for the sake of remediation 25 537,68 tons of soil has been transported to waste sites in the mainland.

One can't help but wonder if at least some of these excavations, carried out for the sake of modernization, safety, energy efficiency or even sustainable development, have really been all necessary. As long as the soil remains untouched, its content of metals and seed bank is also a key part of Suomenlinna's cultural history and world heritage. Could there be an alternative to the excavations in the future? Is digging always necessary? Would it be possible to develop fresh solutions instead of the most obvious ones: excavate, remove, transport, buy, renew.

6.3)

In order to be able to operate more sustainably and promote circular economy, e.g. in composting the garden waste on the premises, executing more efficient utilization of soil containing metals and reusing local materials, the number and size of technical areas should be increased. How can this be accomplished in a place where each area has its own historical past, identity, and value? Could a single part of the historical fortress be sacrificed for reuse in the name of sustainability?

In the course of history, a diverse flora has formed in the Suomenlinna area. The seeds of valuable cultural plant species are buried in different parts of the ground. The valuable seed bank should also be considered during excavation work, especially if soil is being taken away from Suomenlinna. Also, when bringing backfill soil from elsewhere, the possible presence of invasive, alien or introduced species must be considered, because species that come along with soil materials destabilize the balance of plant biotopes typical of Suomenlinna.

6.4-6) Highly poisonous Henbane (*Hyoscyamus niger*) often grows around old fortifications. Its seeds can remain viable in the soil for more than hundred years. Therefore, the species is often found in Suomenlinna in places where soil has recently been excavated. In the first year Henbane develops a large rosette of leaves which at first glance may resemble cabbage. It blooms in its second – and final – year and after the flowering is over, tens of thousands of seeds ripen in its vase-like capsules.

Some thoughts on historical vegetation of Suomenlinna

Suomenlinna combines the natural and cultural landscape in a unique way in Finland. As in buildings and fortifications, the layers of Suomenlinna's eras can also be read in its vegetation. Ancient introduced species and species that arrived at the fortress during Swedish rule, as well as introduced species from the Russian period and the period after Finland gained independence in 1917, have all been integrated with the original species of the islands over the centuries.

There have been three extensive inventories of Suomenlinna's vegetation in the 20th century, the first in 1918–20, the second in the 1950s, and the third in 1977–80. The city of Helsinki has inventoried Suomenlinna's valuable vegetation sites since 1998, and the cultural plant sites were surveyed in 2015. The latest vegetation and plant biotope surveys of Suomenlinna were carried out in 2021–23.

6.7) One of the earliest introduced species to have arrived on Suomenlinna is the Field Garlic (*Allium oleraceum*). Used to prevent scurvy, it arrived on the shores of Finland with the Vikings.

6.8) It is worth noting that the Russian introduced species, such as Asiatic Dock (*Rumex confertus*), form the most internationally known historical layer of Suomenlinna's herbaceous plants, which Western European botanists and plant enthusiasts in particular definitely want to get to know during their visits to Finland.

Based on all surveys carried out, we now know that both native herbaceous plants and especially the introduced species that settled in Suomenlinna before Finland gained independence, and the biotopes formed by them must be protected by means of expert maintenance, and their habitats must be protected from overuse.

It is important to note that Suomenlinna is not a nature reserve, but a cultural heritage site whose – nowadays – indigenous vegetation in its entirety is a vital part of the history of the fortress and therefore worth to be retained.

6.9) Warty Cabbage (*Bunias orientalis*), one of the most recognizable plants on Suomenlinna is a Russian-era arrival.

Caring for the most important species naturally requires identifying them in the terrain and knowing their requirements. Knowledge of the exact locations of the cultural species' habitats and the need for treatment or even lack of treatment is also key. Monitoring of the status of vegetation and the effects of maintenance must be continuous. One could talk about a so-called observational maintenance of vegetation.

In these matters, there is a need for familiarization of the landscape maintenance personnel, and also for more cooperation between botanists, biologists, researchers, and maintenance implementers than at present. And, of course, continuous funding is a requirement for the success of all maintenance, protection and conservation work related to Suomenlinna's landscape in general.

If biodiversity in the context of Suomenlinna consists to a great extent by the variety of plant species originating from the eras of the fortress, wouldn't a key part in preventing biodiversity loss then naturally be in retaining the several times surveyed historical herbaceous plants. If so, the most important part of landscape maintenance would then be thorough identification as well as identified maintenance of cultural vegetation of Suomenlinna.

Curled Thistle
(Carduus crispus)

Canada Goldenrot
(Solidago canadensis)

Canadian Fleabane
(Erigeron canadensis)

6.10-12) One substantive part of preserving the authenticity of Suomenlinna's plant world is the eradication of weeds, invasive, and harmful alien species, or preventing their spread if they threaten the vegetation intended to be preserved. If "all flowers are allowed to bloom" in the name of biodiversity, there is a true danger to lose a key part of the history of Suomenlinna's vegetation.

Economic perspectives bring their own challenges to Suomenlinna's landscape and vegetation maintenance. In accordance with the cost-sharing agreement made between the State of Finland and the City of Helsinki in 1976, the city is responsible for the repair, renovation, and maintenance of certain areas of Suomenlinna. The city of Helsinki buys the maintenance of these areas from the Governing Body of Suomenlinna (GBS). There are also some other areas in Suomenlinna for the maintenance of which the GBS receives payments. However, the majority of areas that are habitats of the valuable cultural plants are those that do not generate income for the GBS.

In today's society, where the value of everything, even heritage, is increasingly defined in terms of money, it is even more difficult to justify the need to maintain such "unproductive" areas. Is there a danger that the ever-decreasing landscape maintenance resources of Suomenlinna will in the future be to an increasing extent directed only to areas whose maintenance generates income? How long will the preservation of cultural landscape by means of maintenance be considered a significant value in itself?

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7. Naarden: Knowledge and Research-Based Preservation

Jeroen van der Werf, Stichting Monumentenbezit

Introduction of Naarden and Monumentenbezit

This article describes the work of Monumentenbezit on the fortifications of Naarden. After talking about the way Monumentenbezit came to be and what the organization's preservation policy is, several practical examples show how this works out in the case of Naarden, as far as the masonry is concerned. The article ends with a short look at the green maintenance and a general afterthought.

Monumentenbezit is a non-profit organization, stationed in the Netherlands. The work of this NGO (a foundation) revolves around the preservation of a portfolio of monuments spread throughout the Netherlands. The core of this portfolio is formed by twenty-nine monuments that were transferred to Monumentenbezit, as one package, by the Dutch government in January 2016. That was also the moment the organization became operational. So, Monumentenbezit has done her work for eight years now. With the transfer, the responsibility for the preservation was passed from the Dutch state to Monumentenbezit as well.

The portfolio of the foundation is very diverse. Monumentenbezit is, amongst others, the owner of churches, palaces, castles, ruins, statues, houses and city gates. Monumentenbezit is the owner of these monuments forever and is not allowed to sell any of them. To ensure a financial stable base for this indefinite preservation task, the Dutch government installed a fund. This fund is housed in a separate foundation, independent from Monumentenbezit, and pays out annual returns. These returns can be used by Monumentenbezit for the restoration of the monuments. Besides that, the foundation can supplement its income by renting out the monuments and applying for subsidies for restoration projects and the development of it's portfolio.

Monumentenbezit is fully committed to maintaining the heritage entrusted to it. The monuments and their cultural-historical values come first. That is why Monumentenbezit draws up a separate conservation plan for each object in its portfolio, fully tailored to the needs of that specific structure. The largest complex in the portfolio of Monumentenbezit are the fortifications of Naarden, one of the best-preserved fortified complexes in Europe. Before looking at how the preservation policy of Monumentenbezit worked-out in Naarden, it is good to have a short look at the history of the fortifications and give them a cultural-historical context.

Naarden, as we know it today, was founded in 1350. The city was built on a very strategic spot, protecting the northern main access road into Holland, coming from the east. Throughout the centuries Holland turned into the economic heart of the Netherlands. So, having a strong fortress in Naarden was vital to the protection of the region. Especially when, during the 17th century, more and more of the riches of the overseas trade started to accumulate in Amsterdam. During the French invasion of the Dutch Republic in 1672, the land west of Naarden was inundated in an improvised way. It turned out to be a masterstroke.

7.1) The commemorative obelisk in Rijswijk. One of the monuments that were transferred to Monumentenbezit by the Dutch State in 2016.

7.2) The ruins of Teylingen, another example of a monument that was transferred by the Dutch State.

The French army was stopped and a year later this invading force started to retreat. It led to the decision of the Estates of Holland to turn these large inundations into a coherent, well-functioning defence system. Today we know this defence system as the Dutch Waterline. It became the backbone of the Dutch national defence and kept this role until the beginning of the Second World War. All this time, Naarden was a vital part of it. In general, one might say that ever since its foundation, Naarden has played a vital role in the defence of the Netherlands and has been closely related to the main military events that took place in the country since that time.

Looking at the fortifications themselves, one can distinguish three different construction phases. The bastioned trace, consisting of a wall with six large bastions, a wide inner ditch with six ravelins and a covered way that envelopes the whole fortress. This complex was built between 1673 and 1685. It coincides with the start of the construction of the Dutch Waterline. This bastioned trace exists virtually unchanged today. The casemates in the walls and the bastions deserve a special mention. They are unique. Of the fortifications predating this bastioned trace nothing remains, except for several parts of the medieval walls preserved in the underground.

7.3) Aerial view of the fortifications of Naarden.

7.4) Fragment of a map of the Dutch Waterline. Naarden is situated on the edge of the blue field on the right. It is clearly visible that the town is an important intersection of roads leading to the west. To the left, Amsterdam is visible.

The bastioned fortifications remained as they were for two hundred years, but in 1873 warfare and weapon technology had changed so much that a modernization was needed. The main issue that needed to be addressed was protection against rifled artillery. This was realized by constructing a new fortress within the perimeter of the existing 17th century fortifications. Two things were done:

1. The earthworks of the walls, ravelins and bastions were completely remodelled, broadened and heightened.
2. In these new earthworks a complex of about thirty bombproof buildings was constructed. These buildings consisted of a masonry construction, covered in a thick layer of earth. Only the façade that was least exposed to enemy fire remained visible.

This modernization of the fortifications took place between 1873 and 1880. It forms the second building stage. It has survived complete, except for two buildings. They were demolished in the 1950's. Not long after this modernization, the introduction of the high-explosive grenade had already made it redundant. From the 1890's onward only the covered way of the fortress played an active role in the defence of the town. It led to the construction of twelve small, plain-concrete shelters along the covered way. They were built between 1895 until 1906. The shelters form the third and final layer of the fortifications. All twelve shelters still exist today. Not long after the First World War, in 1926, the fortifications officially lost their military function. By that time, they had already been classified as a monument for five years.

7.5) Picture of the 17th century fortifications, showing the embrasures of the five casemates in one of bastions. From here the ditch around the ravelins (on the foreground) could be defended.

7.6) The flank of one of the bastions in Naarden.

7.7) Aerial view of one of the ravelins in Naarden. The masonry of the ravelin dates from the 17th century. The earthworks of the ravelin were completely remodelled in the 19th century. At that same time (1875) the two bombproof guardhouses were constructed. They consist of a thick masonry construction, covered in an even thicker layer of earth.

To sum up: In 2016 Monumentenbezit became the owner of a fortified complex that has played a vital role in Dutch military history for almost six hundred years. That fortified complex consists of three very well preserved and well distinguishable historical layers dating from the 17th, 19th and early 20th centuries. Some of the features of the fortifications are unique, also on a European scale. The cultural-historical importance of the complex was underlined when it became UNESCO world heritage in 2021, as part of the Dutch Waterlines.

To be in charge of such a valuable complex is of course a great honour and very exciting, but it is also a great responsibility. The property of Monumentenbezit in Naarden encompasses sixty individual buildings, holding about 25.000m2 of masonry, including that of the fortress walls. Monumentenbezit is a small organization with limited means. In 2016, the foundation had four employees. Over the years this has grown to eight. Two of them share the responsibility for the work in Naarden and this forms a big challenge. So, a very important first question, in 2016, was how to best handle the preservation of this large complex.

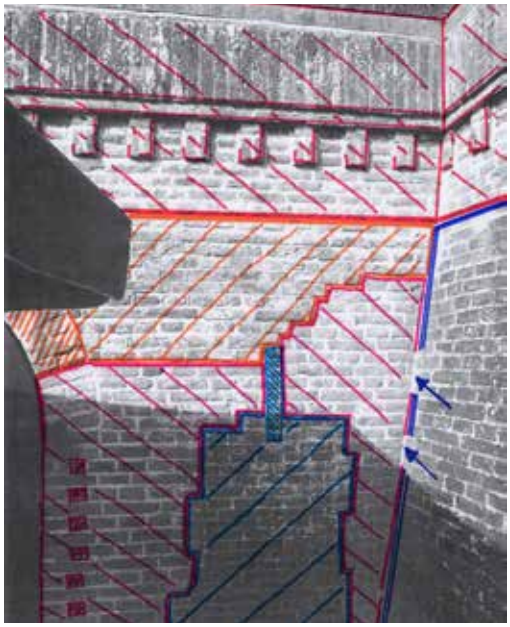
Looking at the preservation work in Naarden, there are two major tasks: "the green maintenance" (earthworks, trees and grass) and "the red maintenance" (brick, concrete and natural stone). They both represent an almost endless amount of work. From the start it was clear to Monumentenbezit that the best way to handle these tasks was by working on them with steady partners with whom the organization would close long-term contracts of five or six years, with the explicit intention to prolong the cooperation after that. It was expected of the contractors to be an active partner in this cooperation, critical on the conventional ways of working and open to new methods. Testing, monitoring and research would be the key factors. By working together, Monumentenbezit and its partners would build up knowledge together, profiting from each other's specialisms. It should lead to a project organization that revolves more around teamwork, knowledge and quality and less around contracts, time and money. In such a work environment, flexibility and dedication to the work are of great importance. During the preparation of a project the necessary time must be taken to do research and tests. If needed the work can be stopped during its execution to do extra tests and monitor them. This could mean the contractor is left with a gap in his planning, forcing him to focus on other work and to resume the work on the fortifications after the tests yield satisfactory results.

How did Monumentenbezit select these dedicated partners? In the case of the masonry, this started with writing a vision on the preservation of the fortress walls and the bombproof buildings. This vision considered both the desired aesthetic result and the desired technical result of the preservation work. On the aesthetic side, the vision stated that the harmonic whole the walls form, should be preserved. A patchwork of reparations and the loss of patina should be prevented. Lichen, an important part of that patina, should not be removed while cleaning the masonry. On the technical side, the vision foresaw the use of materials compatible with the existing materials like custom made bricks and lime-based mortars. Reused material should be used as much as possible and unnecessary reparations needed to be prevented. The vision document was accompanied by a technical specification. Here the envisaged cooperation, based on knowledge, research, testing and evaluation, was described. The contractor had to guarantee a steady team of masons doing the work. Furthermore, the specifications described the various damage patterns visible in the masonry and how to deal with them. Lastly, a fictional amount of work was described, spread all over the fortress, showing all the different damage patterns described.

These documents were sent to various contractors, with several questions. They were asked to react to the described vision. What were strong points? What were weak points? What would they change? Besides that, a logistical plan for the work was asked. How would the contractor approach the practical side of the work and the organization of the construction site? The last question concerned a price for the prescribed amount of work and a timetable for the execution of it. From the reactions, two parties were invited for interviews and to do a half day of test restorations to show techniques and to explain their overall work approach. Why did they do certain things and why not? After this, one party was selected and given a five-year contract. Parallel to this, Monumentenbezit also selected a steady research partner to do the needed research on the bricks and mortars. Upfront, while making the restoration plans, but also afterwards to evaluate and check the quality of the work if needed. This team has been working on the masonry since 2018. Recently the contracts have been extended until 2028.

Over the past six years, the work in Naarden has shown to be very diverse. Nothing is what it looks like. Every situation must be judged on its own. There are hardly any standard solutions. This is not surprising if one takes into account that the walls and buildings not only show three distinct construction phases (17th century, 19th century and early 20th century), they show the result of almost 350 years of reparations and restorations as well. They all have left traces in the walls, and they all come with their specific problems, quirks and needs.

7.8) One of the things stated in the vision on the masonry was the preservation of lichen. On the right side, the wall with black algae and lichen. Damages and other irregularities are not visible without cleaning. On the left the wall after cautiously cleaning it with water at low pressure. The algae are removed, and the lichen stay.



7.9) These pictures show the many reparations that took place in just a small part of the wall over the centuries. In pink the original 17th century work. In light blue a ventilation shaft that has been closed and a part of the wall that was demolished to create a new ventilation shaft in the 19th century. In orange reparations that took place between the 17th and 20th centuries. In red a restoration of the 1970's. The irregularities in the joints that are marked with the dark blue arrows, show that these stretches of wall were not built at the same time.

Cavities in the walls

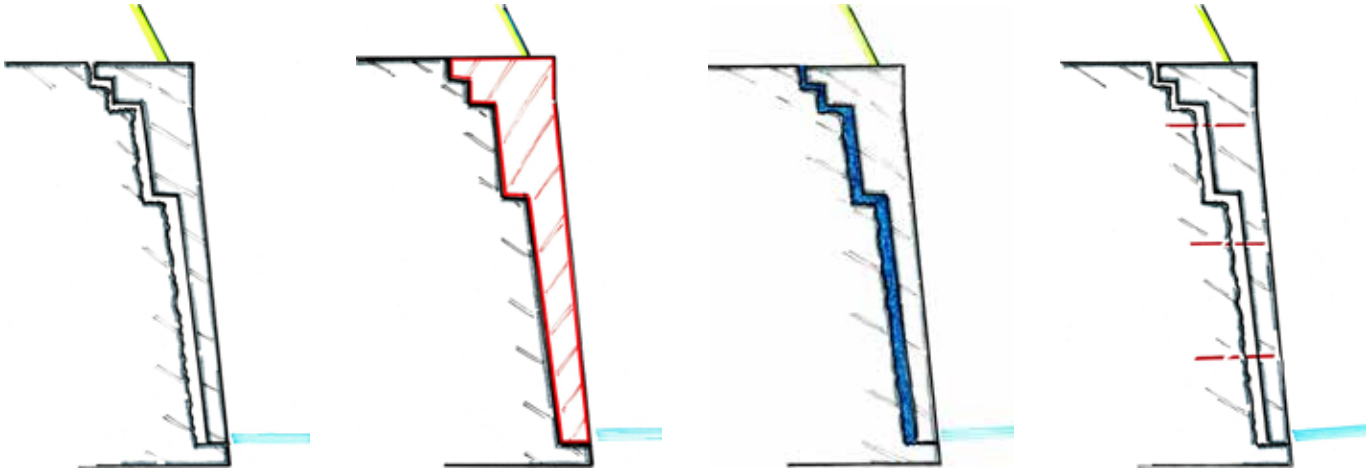
During an inspection for the preparation of the work in 2018, it became clear that parts of the walls of one of the bastions showed cavities. They extended to a height of about two to three meters along the entire length of the wall and were 4 to 25 centimetres wide. The wall therefore largely consisted of two parts: a solid core with an outer shell in front of it. The outer shell was one and a half stone thick. The cavities lay between the two parts. It raised the question of how to deal with it.

7.10) The cavity in the wall. On the left the core of the wall, dating from the 17th century. On the right the shell that wat placed in front of it as a reparation in the 19th century. Between them the cavity of about 8 centimetres.

The option of replacing the outer shell entirely with new masonry that was properly bonded to the core was quickly rejected. Too much historical material would be lost and too many traces in the masonry would be erased. The other options were filling the cavity with mortar or connecting the outer shell and core using stainless steel anchors. However, this would result in a new, stiffer construction, of which it was unclear how it would behave in the future.

Was it wise to intervene? Were the cavities actually a problem?

Destructive research and an inspection of the wall showed that the outer shell was stable and caused no consequential damage. The shell was placed in front of the existing wall as a reparation (probably in the 19th century) and stood stably. It led to the decision not to do anything with the cavities. The top of the wall was repaired to prevent water infiltration, and the cavities were left as they were. Now that it is clear that the cavities are there, they can be monitored.



7.11) Schematic drawing of the different restoration scenarios of the cavities. From left to right:

1. The cavity as it was found in-situ.
2. The whole outer shell is replaced by new masonry, well bonded with the 17th century core. This was rejected right away.
3. Filling the cavity with mortar. This alternative was rejected as well.
4. Connecting the shell and the core with stainless steel anchors. This alternative was rejected as well.

After research in-situ the choice was made to leave the cavities as they were.

7.12) The restoration of a damaged part of the wall. From left to right:

1. The situation before restoration.
2. A part of the masonry removed.
3. All of the masonry removed, the cavity clearly shows.
4. The situation after restoration.

Efflorescence of lime in new masonry

During the first restoration project in 2018 (the walls of the Oud Molen bastion) work was stopped during the winter, to pick it up again in the spring of the following year. During a short inspection in February 2019, there was a white efflorescence and a clear leaching of lime visible on the edge between the restored work and the existing masonry. Unbound lime from the new mortar of the restored wall found its way out via water transport through the masonry and deposited on the outside surface after evaporation of the water.

Although this phenomenon could be prevented in the execution of the masonry, it raised the question whether it would be better to use a mortar with more hydraulic components. After all, there is almost continuous water movement in the walls. Even in summer the walls are wet at a depth of about ten centimetres. The risk of the formation of free lime could perhaps be reduced by using a different mortar.

7.13) The efflorescence of lime that was visible on the wall in February 2019.

Based on this idea, four test samples were set up in April 2019. One with the mortar that had been used so far, one with the same mortar but with a higher cement content. A third was carried out with a prefab trass-lime mortar and a fourth surface with a trass-lime mortar according to a self-prepared recipe. The mortars were tested in April 2022. How had they stood the test of time?

From a technical point of view all mortars gave good results. They had hardened well, there was no lime or salt efflorescence detected, and the cohesion between stone and mortar was strong. However, one thing immediately stood out when inspecting the test samples in-situ: the two surfaces with the trass-lime mortar stood out very much. They looked much lighter than the surrounding masonry, which was not desirable from an aesthetic point of view. The other two samples blended very nicely into their surroundings.

In addition to the aesthetic side, the fact that these two samples remained so much lighter, also raised the question whether they disturbed the overall water management of the masonry. The later sample analysis showed that the masonry at greater depths in these two samples was wetter than in the test samples without trass. In other words, the water transport is indeed disturbed. Could this have negative consequences for the longer term? The analysis of the samples provided no evidence for this. However, a trass-lime mortar was also used on the nearby Katten bastion during the restoration of 2009.

7.14)
The four test samples that were made in April 2019:

A: The mortar that had already been used: 60L sand, 25L lime, 1L cement.

B: The same mortar with slightly more cement: 60L sand, 25L lime, 5L cement.

C: A prefabricated trass-lime mortar.

D: A trass-lime mortar according to a recipe mixed on-site: 60L sand, 20L lime, 10L trass, 5L cement.

In April 2022 the test samples C and D colored very light in comparison to their surroundings. The samples A and B blended in very well with the existing masonry. In the end it was decided to hang on to recipe A, holding the smallest amount of cement.

The renewed masonry surfaces with light appearence hardly show any weathering and, given the strong moss and algae growth in the surrounding work, there appears to be a higher water load in the surrounding masonry. Although there is no direct damage, it does seem to have an adverse effect. This led to the decision not to use trass-lime mortar and to stick to the original mortar and to respond better to the weather conditions and to pay more attention to the execution of the work. The experiences of 2019 and 2020 had already shown that this would lead to good results.

7.15) The masonry of the adjacent bastion (Katten), that was restored in 2009, still stands out very much in comparison to the older masonry. Besides that, this older masonry shows much more growth of moss and algae.

Efflorescence of salt in the façade of the Promers barracks

The Promers barracks is the building with the most prominent, richly decorated façade of the fortifications. The parade ground for the soldiers used to be in front of it. It holds a key position in the ensemble of military buildings in Naarden. Besides being such a prominent building it also shows one of the most difficult damage patterns: a very destructive efflorescence of salt. It makes bricks crack and splinter in a very dramatic way. When looking at old photographs of the building, it becomes clear that this efflorescence has always been visible in the façade. About twenty years ago, the façade underwent a big restoration, where a lot of the damage was repaired, but it started to occur again shortly afterwards. In 2025 a new restoration of the façade is needed. In preparation of that, Monumentenbezit has done extensive research.

7.16) The façade of the Promers barracks, showing the salt efflorescence in 2019.

7.17) The damage caused by the salt in 2019.
7.18) Detail of a splinter of brick about to come off in 2019. This is due to the salt crystallization in the masonry.

It looks like reparations and restorations of the past have worsened the problem: the use of cement, the use of bricks that were too hard, and the fact that big reparations were done without bonding the new masonry with the existing masonry. These factors disturb the movement of humidity through the facade. It led to the decision to remove all the cement joints, all the way up to the healthy lime mortar. They will be replaced by a lime-mortar of a recipe based on the original mortar in the façade. All the reparations of twenty years ago will be taken out and replaced by new reparations that are well-bonded with the surrounding work, using stones of a similar

quality as the original ones. These bricks will be custom made by a specialized factory in the Netherlands. This work will take place in two steps: in October 2024 the cement joints will be removed and two large test samples will be made with the new stones and the new mortar. These samples will be left in for about six months and will be tested again. If this gives the desired result, the restoration work will take place in September and October of 2025.

7.19) Picture showing the efflorescence in 2024. Next to it the same part of the wall with the proposed intervention marked on it. In blue the part where the cement joints need to be removed. In orange the part where the reparations of the previous restoration (in 2000) need to be taken out and replaced. As a test, part of this reparation will be taken out in October 2024 and replaced with new masonry. It will be tested in August 2025.

7.20) Aerial view of the Turfpoort bastion.

Green maintenance

These examples give an idea of the work Monumentenbezit has been doing on the masonry so far. Now it is good to have a look at the first years of the green maintenance. Here, a similar tender process was applied. When the fortifications were transferred to Monumentenbezit, all existing maintenance contracts were cancelled by the Dutch State. This included the contract for the green maintenance. Luckily the Dutch State had already made specifications and a vision for the tender of a new contract, and they could be used by Monumentenbezit.

These documents were sent to different gardening companies. With the question to give a price and a critical response to the vision documents. Besides that, the contractors were asked to explain their work method, to explain how communication would take place (also with the local population) and what machinery they would use for the work. After receiving the answers and prices, two parties were invited for interviews. It led to the decision to give the contract to a relatively small gardening company, completely specialized in green heritage. Because Monumentenbezit would give them a five-year contract, they were able to invest in machines and personnel. One of the machines they were able to buy was a remote-controlled mowing machine specifically designed to mow steep slopes. It greatly enhanced the safety of the work. The green maintenance started in May 2016 and still continues today to everybody's satisfaction. There are at least two gardeners working for Monumentenbezit in Naarden for several days a week throughout the whole year.

Conclusion

While all this took place, Monumentenbezit was confronted with external factors beyond it's control: the COVID-pandemic, increasing tourism and climate change. They all affect the regular maintenance work in Naarden. When looking at the masonry, the impact of these factors is relatively low. Paradoxically enough the only risk is formed by the fact that winters become milder. This often leads to the decision to work well into the winter months, and although there doesn't seem to be much harm in doing so, recent experience has shown that the more variable weather conditions in these months (rain and damp, combined with frost at night) still form a high risk that masonry starts to show early signs of weathering and efflorescence of lime. It led to the decision of Monumentenbezit not to work on the masonry from November to March. The real influence of these external factors, however, shows in the green maintenance. The next article will deal with the details of that. Looking back at the work in Naarden of the past years, it is interesting to conclude by addressing another, more general, aspect of the work. Namely that it demonstrates the relativity of the present. In the hustle and bustle of the moment, decisions made during a restoration seem permanent, eternal and unchangeable. However, viewed from a distance, things become very different. Like no other monument, the fortifications of Naarden show that the preservation of old buildings should be seen as a long line, a continuous and endless process. A process that started long before the present and will continue long afterward. The work being done now is part of it, nourished by the past, nourishing the future, but relative, a point on the line, a snapshot. What we take for granted now has never been so in the past and will not remain so in the future. It is therefore important to properly record the work so that those who come after us understand what we have done in the present and why. It puts the work in perspective. This is not a license to do whatever we want, not at all. It makes it all the more important to carefully consider why things are done, to show what choices have been made and why they have been done that way. This way, the next part of that line will be better connected to our work. The judgment on our work lies in the future and conscious, well-substantiated choices will resonate the longest there.

Jeroen van der Werf

is an engineer and a construction historian. He currently works for the Stichting Monumentenbezit where he is in charge of the restoration and preservation work of the fortifications of Naarden. He studies the history of the fortifications and the technical specifics of the materials used there. He is a member of several European organizations involved in fortifications and castles and is the secretary general of the International Fortress Council.

8. Naarden: Towards a New Green Maintenance

Federica Marulo, University of Groningen

Research background

This paper summarizes the contents of the presentation for the Suomenlinna Summer School (Suomenlinna, 3 September 2024) in the frame of the ERASMUS+ project "Resilient Fortress". It discusses the revision of green maintenance strategies for the fortifications of Naarden, Netherlands. This initiative stems from a collaboration between Monumentenbezit and the author, where research on preservation strategies has been conducted. (1) The focus is on implementing environmentally sustainable practices to address the ongoing challenges posed by climate change and increased recreational pressure on this significant site and its green heritage.

8.1) Naarden's fortifications, the mechanical maintenance of grass cover at bastion Oranje.

As a "military garden" designed for strategic defence purposes, the green heritage of Naarden's fortifications includes both earthworks and vegetation, which interact closely with the built structures. This creates a complex relationship between the natural and architectural elements, demanding integrated preservation strategies.

(1) The author completed a PhD on "Preservation Strategies of Historic Military Systems. A Comparison between Italy and the Netherlands". In the last stage of the PhD process, a traineeship was undertaken at Stichting Monumentenbezit (2022–2023), which led to the present collaboration.




8.2-5) The green cover of Naarden's fortification before the summer drought.

After a short overview on the impacts of climate change in the Netherlands, the paper discusses its specific effects on Naarden's fortifications. It then examines the revision of green maintenance strategies, focusing on the challenges posed by recreational pressure and drought, and the shared responsibilities for maintaining the fortifications. A brief historical overview of green preservation practices at Naarden provides context for current strategies. Subsequently, the paper assesses the damage to the fort's green heritage and proposes solutions, addressing issues like vegetation loss and informal paths. It discusses specific areas such as Bastion Oranje and Bastion Katten, and explores the relationship between green maintenance and masonry preservation. The conclusion emphasizes the need for an integrated approach to preserving both the natural and architectural elements of the fortifications in the face of climate change.

Impacts of climate change in the Netherlands

The Netherlands faces significant challenges related to climate change due to its delta geography, characterized by low-lying land and proximity to water bodies. These challenges include rising sea levels, more frequent extreme weather events such as torrential rainfall, and prolonged periods of intense heat and drought.

In response to these challenges, the Dutch government published the National Climate Adaptation Implementation Programme in November 2023. (2) This programme is based on climate scenarios from the national meteorological service (3), projecting conditions for the year 2050, including:

(2) Ministerie van Infrastructuur en Waterstaat, Nationaal Uitvoeringsprogramma Klimaatadaptatie: Slimmer, intensiever, voor en door iedereen (November 2023).
(3) Koninjlijk Nederlands Metereologisch Instituut, KNMI'23 klimaatscenario's voor Nederland (October 2023).

- An increase in tropical climate days and higher average summer temperatures.
- A rise in the number of extremely dry days along with increased heavy rainfall events.
- A significant rise in sea level.

The government is increasingly aware of the adverse effects of climate change on the built heritage of the Netherlands. Short-term consequences include damage due to heat, drought, and storms, which can impact foundations and green spaces, including fortifications. Long-term consequences are more difficult to predict but equally concerning.

The Climate Adaptation Implementation Programme includes actions aimed at protecting cultural heritage. These actions consist of constructing, raising, or widening dikes, enhancing water storage capacity, greening urban areas, and modifying agricultural practices. Furthermore, the programme emphasizes leveraging historical knowledge and heritage to inform climate adaptation strategies.

In line with this, the Cultural Heritage Agency of the Netherlands (RCE) has established a specific programme focusing on Heritage, Water, and Climate, with the goal of preserving cultural heritage in the face of climate change. (4) The RCE is responsible for implementing several actions outlined in the National Implementation Programme, including:

- Mapping climate change risks to cultural heritage and conducting research on the principal risks.
- Establishing operational goals and measures for cultural heritage protection.
- Raising awareness among heritage professionals and governmental bodies regarding the effects of climate change.
- Learning from cultural heritage by reusing traditional solutions for water management and reinstating historical landscape elements to enhance biodiversity.

When looking at the map of climate change risk made by the RCE for the whole national territory, significant risks for Naarden can be observed, particularly concerning drought, wildfire, and heat stress. This underscores the critical role of the fortifications, especially in relation to green heritage.

Revising green management strategies for Naarden's fortifications

1. Starting conditions and challenges

Since acquiring the fortifications in 2016, Monumentenbezit has closely monitored the site and documented extensive damage to the vegetation and green cover. An ecological assessment was conducted alongside a study by environmental psychologists to understand usage trends of the fortifications. (5) Preliminary findings indicate that the damage to Naarden's green heritage can be attributed to two main factors:

1. Recreational Pressure: The inhabitants of Naarden utilize the fortifications as a city park, attracting both local and international tourism, especially after the UNESCO nomination. The use and walking on the fortifications by both human and non-human visitors intensified during the COVID-19 pandemic (summer 2020–2022).
2. Drought: The combination of increased recreational pressure and unprecedented drought periods, starting in the summer of 2019, has hindered natural recovery processes. Thus, the interplay between these two factors has negatively impacted the preservation of Naarden's green heritage.

Following these preliminary studies, the focus shifted towards revising the existing green maintenance regime. In 2022, during the author's traineeship at Monumentenbezit, a detailed examination of the current green maintenance practices was conducted in collaboration with Jeroen van der Werf. This effort aimed to develop a revision that would address the identified issues, referred to as the New Green Plan.

(4) Rijksdienst voor het Cultureel Erfgoed, Klimaatrisico's voor het Nederlandse erfgoed.
(5) C. Zoon (Zoon Ecologie). Groenbeheer Naarden Vesting: deskundigen veldbezoek (9 June 2020); K. Ruitenburg & A. Tavaille (Novi Mores onderzoeks- en adviesbureau). Voorkomen van recreatieschade door gedraksaanpak vesting Naarden (8 July 2021).

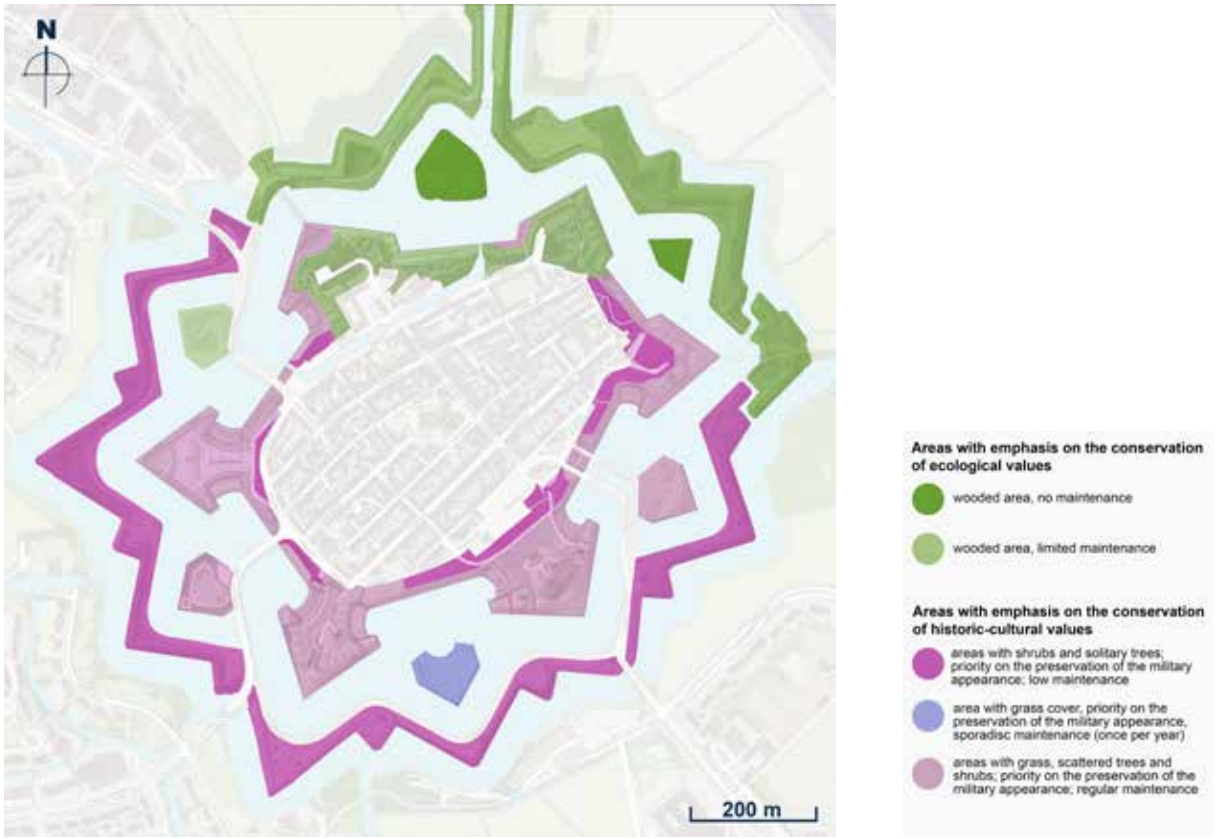
2. Management responsibilities and phased implementation

At first, the division of tasks for restoration and maintenance works has been mapped. The responsibilities for restoration and maintenance of the fortifications are shared among several parties, including Monumentenbezit, the municipality of Gooise Meeren (responsible for restorations on the covered way), and the Museum of the Fortifications, which has overseen the green maintenance within bastion Turfpoort since the 1950s. Additionally, a local farmer tenants Fort Ronduit, and a scouting group operates at Ravelin 3.

Given this distribution of responsibilities, the initial phase of the green management plan was limited to the inner fortifications and ravelins—areas for which Monumentenbezit is responsible for both restoration and maintenance. The maintenance of the covered way was deferred to a second phase pending agreements with the municipality, which is currently developing a plan for the necessary restorations.

3. Historical overview of green preservation practices

An examination of the previous management regime revealed two main approaches to vegetation maintenance:



8.6) Map of the existing green maintenance regime. The existing maintenance approach distinguishes between two main vegetation types: open areas with grass, solitary trees, and bushes where the preservation of historic-cultural values is prioritized (e.g., Bastion Oranje to Bastion Nieuw Molen) and densely wooded areas, such as Bastion Katten and parts of Bastion Oud Molen with an emphasis on the preservation of ecological values.

1. Areas with a vegetal cover of grass, solitary trees, and bushes, where the historic military appearance is preserved. This is exemplified by the stretch from Bastion Oranje to Bastion Nieuw Molen.
2. Areas characterized by a dense cover of trees, such as in Bastion Katten and parts of Bastion Oud Molen.

The history of green preservation and management in Naarden can be traced back to its demilitarization in 1926. Following this transition, Naarden municipality sought new uses for the fortifications as recreational spaces for the local community. In the late 1940s, plans were made to convert the fortifications into a city park by prominent Dutch garden architects Dirk Friederik Tersteg and his son Tom. However, the recognition of the fortifications as a national monument significantly influenced this process, resulting in only a partial implementation of these plans.

Subsequent green heritage plans were proposed in the 1960s alongside the initiation of extensive restorations of walls and masonry components, but the green plans were not implemented. In the 1980s, a new plan commissioned by the State Forestry Service began to incorporate a broader set of values, including cultural, historical, recreational, and ecological considerations.

This brief overview reflects the author's ongoing research into the history of green heritage preservation, an area that remains understudied compared to the more well-documented history of Naarden's fortifications. Understanding this historical context is crucial for informing the development of the new green maintenance plan and addressing contemporary challenges.

Assessment of damage to green heritage and proposed solutions

1. Common issues affecting vegetation

An analysis of the differences in vegetal cover (between grass and sparse tree areas and more forest-like regions) led to an investigation of potential relationships between these conditions and observed damages. Key recurring issues include:

8.7) Stairs along the main path are highly vulnerable to vegetation erosion, leading to damage over time.

- Vulnerable Stairs and Paths: Stairs along paths are particularly susceptible to damage from vegetation erosion. Provisional fences have been employed to protect these areas and encourage natural recovery, with initial experiments yielding positive results. However, a permanent solution is needed once the provisional fences are removed.
- Informal Paths: The proliferation of informal walking routes outside designated paths contributes to the loss of vegetal cover, which can expose earthworks to deterioration and potentially harm historical structures.

The new green plan involves a comprehensive analysis of observed damages documented throughout the year (2022–23). This analysis culminated in a map illustrating damage intensity across various areas, ranging from severe to light.

8.8) This map visualizes damage levels recorded throughout 2022-23, ranging from light to severe. It serves as a key tool for assessing impact and guiding the redesign of circulation paths within the fortifications.

This mapping exercise was essential for quantifying the issues at hand and providing a foundation for planning the revised circulation paths within the fortifications.

2. Specific challenges at Bastion Oranje and the Utrecht's gate

One area of concern includes the Utrecht Gate and Bastion Oranje, where damages exacerbated by recreational pressure were further intensified by drought during summer months. Provisional measures, such as fencing off the area, facilitated natural recovery of the vegetal cover in the fall. Although the grass cover at the shoulder of Bastion Oranje was restored in 2021, intense frequentation of this highly panoramic spot quickly undermined this intervention. While some natural recovery was observed during fall, the quality of new vegetation raised concerns regarding its sustainability over time.

8.9) The Utrecht's gate before and after recovery from the summer drought .

8.10) The shoulder of bastion Oranje before and after recovery from the summer drought.

To address these issues at Bastion Oranje, two complementary measures are proposed: closing the outer path along the water side to alleviate recreational pressure, and planting bushes along traverses to clearly delineate the main visitor route along the inner path. This latter intervention not only increases vegetal cover but also requires careful design to minimize visual disruption from both within the fortifications and the covered way.

3. Specific challenges at Bastion Katten

Bastion Katten presents a unique situation due to its dense tree cover, which mitigates exposure to drought but can hinder the growth of lower-level vegetation. This tree canopy poses challenges, particularly when combined with recreational pressure.

8.11) The dense tree cover at bastion Katten helps against drought but limits lower vegetation growth.

To achieve a better ecological balance at Bastion Katten, the new green plan includes measures aimed at fostering the growth of lower vegetation while maintaining the forest-like character of the area. This involves careful selection and pruning of tree branches to promote lower-level growth. Furthermore, removed branches can be repurposed to block off secondary paths, aiding in the preservation of the site.

4. Interrelationship between green management and masonry preservation

The management of green spaces at Bastion Katten has also raised important questions regarding the relationship between green maintenance and the preservation of masonry structures. Inspections of the masonry walls along the water side revealed that areas lacking tree cover experienced greater moisture-related damage. Conversely, certain sections where trees were present appeared to benefit from improved drainage due to their root systems.

Conclusions

In conclusion, several critical questions arise regarding the integrated management of green spaces and masonry preservation. It is essential to consider how green management can effectively support the preservation of masonry structures and how the preservation of these structures can, in turn, enhance green management efforts. Furthermore, strategies must be developed to cultivate an integrated preservation approach for both green and masonry components that effectively responds to the impacts of climate change on fortified heritage.

These questions highlight the need for a holistic understanding of the interrelationship between natural and built environments, particularly in the context of climate adaptation. The revised green management plan for Naarden's fortifications has raised awareness on the importance of not only to mitigate immediate challenges but also to create long-term resilience in both green and masonry elements. Addressing these inquiries in the upcoming phases of the "Resilient Fortress" project will be crucial, as the outcomes are expected to inform a comprehensive response to the pressing challenges faced by fortified heritage, ensuring the sustainability and preservation of these significant cultural heritage sites for future generations.

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9. The Fortress of Mont-Dauphin and its Conservation Issues

Isabelle Fouilloy-Jullien & Laurent Alberti, Centre des monuments nationaux

The stronghold of Mont-Dauphin is a fortress in the heart of the French Alps at an altitude of 1050 m. The fortress is located in the Ecrins massif (altitude of Dôme des Ecrins 4015 m).

History of the stronghold

When, in July 1692, the Duke of Savoy came out of the Vars Pass towards Guillestre, Catinat had noticed the Millaures plateau, located at the junction of the Guil and Durance rivers, during his manoeuvres. He informed Vauban of this easily defensible site.

When Vauban visited the site, he enthused in the introduction to his project:

> *"Description of a steep mountain [...] very suitable for building a fortress".*

9.1) View of Catinat and the Guil valley.

9.2) Aerial view of the fortress of Mont-Dauphin.

His plan, dated 25 September 1692, involved blocking off the only accessible side of the plateau, opposite the village of Eygliers to the east, with two regular bastioned fronts. In fact, these formed a "crowned wall", roughly based on the military ridge at the top of the plateau, 460 meters long, and resting on the right and left against the cliffs that fell 120 meters over the Guil gorges and the Durance plain. Around the rest of the perimeter, the enclosure, protected by the peaks, was limited to a simple wall.

Vauban named the stronghold "Mont-Dauphin" in honor of the king's son and works began in spring 1693. The main bastioned front, to the north, began at the same time as the first essential buildings: powder magazine, barracks, engineer's house, etc. Inside the enclosure, Vauban planned a village with a church for three thousand people. He wanted the soldiers to enjoy a social life in a remote area with a hostile winter climate. The bastioned structure he had planned on the Guillestre plateau to prevent a cannon attack over the Guil was never built because it was too expensive.

9.3) The Briançon gate, fortress of Mont-Dauphin.

Morphogenesis and inventory

The network of the Centre des monuments nationaux (CMN) includes monuments as varied as ancient archaeological sites, medieval monasteries and castles, Renaissance and Classical ensembles, 19th-century commemorative monuments and villas from the modern movement. This diversity implies a multitude of architectural configurations, which in turn leads to a wide range of conservation issues. To deal with these issues, the CMN works by combining the problems associated with the monument's context with those intrinsic to the monument itself.

The contextual causes may concern the geomorphological or urban dimensions, the ecosystems in which the monuments are located, as well as the anthropological dimension which may refer to the economic and social context of the monument, the uses made of it... The causes of pathologies intrinsic to the monument relate to the history of its constitution, the reality of its material and constructive constitution, but also the quality of its upkeep and its suitability for the use to which it is put. As far as Mont-Dauphin is concerned, we can begin by recalling the evolution of the construction periods of the stronghold, with its morphogenesis.

Morphogenesis

The stronghold was built in a relatively short space of time, less than 80 years, if we exclude the Rochambeau barracks. We can also see that the Front des Eygliers was the first phase in the development of the stronghold, thanks to the natural protection of the relief on the west, north and south sides. The south side was developed from the mid-18th century onwards. Vauban and his successors were concerned about the presence of a small platform to the south, which weakened the defences there. It was therefore decided to strengthen the defences at this precise point. Throughout the 18th century, other defences were added or improved: the lunette d'Arçon on the Eygliers glacis, and the powder magazine, which was buried in the 19th century to protect it from bombs. Finally, it is worth noting the discrepancy between the rate of development of the town's defensive and urban zones. The stronghold once housed a thousand soldiers and up to 400 civilians. But the town never reached the 2,000 inhabitants that Vauban had hoped for.

Context and geomorphology

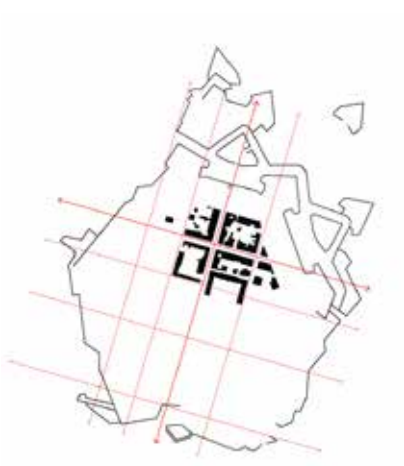
Vauban chose the desolate plateau of Les Millaures (a thousand winds), at a strategic crossroads of valleys giving access to the Dauphiné and Provence, where building materials and supplies were close at hand and plentiful. Vauban's first memoir is a perfect illustration of the link between site and stronghold:

> *"This is the place on the mountain where there is the most sun and cultivated land; there are even vineyards on its territory, woods, dressed stone, tuff excellent for vaults and archetypal stone, good plaster, very good lime, slate and charcoal in the vicinity of this place, and all this within a league and a half at the most [...]."*

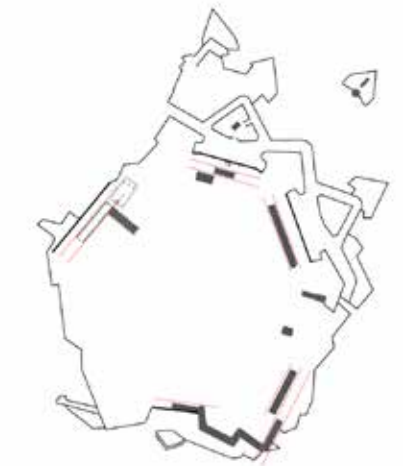
The natural plateau at the confluence of the Guil and Durance rivers rises to an altitude of 150 meters and dominates the two valleys leading to the Agnel, Montgenèvre and Vars passes. The Vauban development, created ex nihilo, is part of an area where history has long since found its place. The defensive town offers a unique view of the ancient Roman road Via Domitia, which led from Italy (via the Montgenèvre pass) to the Iberian peninsula, via Embrun, Gap, Nîmes, Montpellier, Narbonne and more.

Composition and formal logic

The civil part of the stronghold follows a grid system that concentrates the buildings around the arteries, freeing up the centre of the blocks for courtyards and gardens. At the centre of the grid is the parade ground and the church. The defensive system is based on a radial system: the main or advanced defensive works, i.e. the ramparts and bastions, are designed to radiate out from the geometric centre of the stronghold. The military buildings (arsenal, powder magazine, barracks, etc.) are located along the geometry of the ramparts of the stronghold.



The civil part of the stronghold



The defensive system

The barracks

Inventory of buildings: Barracks

In the 1680s, Vauban set about standardising military buildings. Powder magazines, arsenals, barracks and guardhouses were designed according to pre-established plans. The standardisation of military architecture meant that projects and investments could be planned remotely and deadlines could be reduced, avoiding misappropriation of funds and poor workmanship. In keeping with the spirit of the Enlightenment, this reasoned approach, in which each building was part of a logical classification, was reflected in the organisation of the town, with facilities divided into 3 main categories : barracks, defensive works and the buildings that served them, generally isolated behind the defensive front. The barracks take the form of three main buildings. The Campana barracks and the Binot barracks, with their large, elongated buildings, are typical of the royal barracks of the modern era. They are set between two bastions, parallel to the ramparts that link them.

The Rochambeau barracks

The later Rochambeau barracks were designed in 1766. Corresponding to the typology of casemated barracks, it backs onto the ramparts of the Embrun front of the stronghold of Mont-Dauphin, and corresponds to the superposition of two independent programmes: a group of casemates built at the end of the 18th century on the reverse side of the curtain wall, and an attic at each end of the building, which has the particularity of being covered by a Philibert Delorme-style roof structure, built between 1819 and 1823.

What is the organisation of the Rochambeau barracks? Designed to defend against a possible assault from the small southern plateau, it takes the form of a bar, the layout of which corresponds to the logic of a rampart. At the rear, a courtyard was laid out, the level of which corresponds to that of the lowest of the barracks, which distribute two levels of rooms via straight staircases. Regardless of the layout, the last level, the attic, is accessible from the ends, while the other levels vary in height according to the level of the surrounding ground.

The attic of today's Rochambeau barracks has been through a number of ups and downs, from the origin of the project to its construction, including the threat of its disappearance and its preservation. The reasons for building a roof to cover the terraces are clearly identified: to make the barracks and ovens watertight, to create a multi-purpose area and to store armour in the event of a siege. The choice of a "Philibert Delorme" roof structure was justified by the desire to free the space from any obstacles to manoeuvring and traffic.

Note well : This action of creating a roof in response to the problem of rainwater infiltration, i.e. finding not just a technical but also an architectural solution to a health conservation problem, brings us back to the question raised about the action to be taken to combat the increase in rainfall that affects the upper parts of certain defence structures.

Inventory of buildings: isolated service buildings

These buildings correspond to those required for the operation of the defensive complex: arsenal, guardhouse, powder magazine, etc.

Isolated structures

Ramparts, gates and advanced defensive system

The powder magazine

Within this family of buildings, the powder magazine is of particular interest because of the alterations it has undergone, which have led to the appearance of certain pathologies in recent years. The interior of this powder magazine is highly representative of the many buildings of this type constructed between 1667 and 1815. It appears to be the only authentic Vauban storehouse to have been brought up to the standards required for protection against rifled artillery after 1874. The powder magazine for the stronghold of Mont-Dauphin was included in Vauban's initial design of 1692 and was one of the first buildings to be constructed. Completed in 1694, it is a rectangular rubble masonry building with a bomb-proof vault, supported on each side by four thick buttresses cushioned on an inclined plane. The powder magazine is divided into two levels by a floor. The upper level houses the powder room, protected by walls over 3 m thick and featuring a broken barrel vault made of cut tufa rubble. The cross-beamed floor rests on oak beams supported by a central row of wooden posts set on ashlar blocks. The upper level is the entrance from the courtyard. It is accessed via a covered walkway launched from a perron. Two diverging flights of stairs leading down from this perron provide access to the lower level.

In 1882, to protect the powder magazine from rifled artillery, the building was brought up to standard, in accordance with the ministerial instruction of 22 August 1874. On each side, a ramped-arch vessel was built, which also served as a drainage gallery and storage area in wartime. The whole structure was covered by a protective mass of earth, with an entrance to the south-east, set into the slope and supported laterally by two walls. Today, the powder magazine is open to the public for tours, exhibitions and events.

9.4) The powder magazine.

9.5) High room of the magazine.

Ramparts, gates and advanced defensive structures

The 18-hectare intramural site is protected by defensive systems typical of Vauban citadels and their bastioned fortifications. Clearing glacis, ravelins, bastions and ramparts are organised to accommodate defensive manoeuvres and their associated spaces: walkways, curtain walls, escarpments and counterscarps. At Mont-Dauphin, this took the form of three bastions with two ravelins and a sentry walk on the Eygliers side (i.e. to the north), while a basic enclosure protected the rest of the square's perimeter, which was already isolated by the relief.

Here we can see two of the many defensive works, the Briançon gate and the lunette d'Arçon, only two of which distribute the stronghold: the Briançon gate and the Embrun gate:

9.6) The Briançon gate.

9.7) The Embrun gate.

The first is representative of the royal works of the classical period, whose role was to display the prestige of royal works in the architecture of the royal absolutism of the reign of Louis XIV. The lunette d'Arçon built later (between 1728 and 1731) on the glacis of the square, this ravelin is one of three commissioned thirty years earlier by Vauban to watch over a blind spot on the Eygliers front. The other two, which were to frame it, were never built. In 1791, General d'Arçon ordered its conversion into a lunette with reduced security and casemates with inverted fire, quickly nicknamed the "Lunette d'Arçon".

To address the conservation problems encountered by the CMN in its use of the site, it should be remembered that only part of the stronghold is managed by the CMN. This excludes not only the village and its church, but also the first two barracks in the square (the oldest) and certain batteries. The conservation difficulties we are encountering therefore exclude those relating to domestic architecture.

Conservation issues

In order to programme conservation or restoration work, the CMN has drawn up a guide document, the purpose of which is to report on the state of health of structures: the health assessment. The assessment of the state of health of protected properties is defined by the European standard on the assessment and reporting of the state of the built environment, which can be defined according to four categorical criteria (CC).

CC 0 No symptoms corresponding to the "good condition" criterion in the survey.
CC 1 Minor symptom corresponding to the "fair" criterion in the survey.
CC 2 Fairly strong symptoms corresponding in the survey to the "faulty" criterion
CC 3 Major symptoms corresponding to the "poor" and "peril" criteria in the survey.

This assessment is based primarily on a visual examination of the structures. The first condition report was carried out by the chief architect of historic monuments in 2005, and the most recent was carried out in 2014 by our predecessor, the State urban planning architect, who is the site curator. These condition reports show that the monument's masonry is in various states of disrepair. Among the causes of the pathologies affecting the masonry are the loss of waterproofing at the top of the structures, the use of external materials during subsequent repairs, and the very nature of the soil on the Millaures plateau, which is made up of a "pudding" that lacks cohesion.

To illustrate these conservation issues, 3 recent operations can be presented. Only operations related to masonry disorders are presented here, given that these make up the majority of pre-contemporary monuments, and therefore to the problems of reinforced concrete structures, which call for other pathologies and other types of conservation measures.

Restoration of the escarpment on either side of the Briançon gate

The first example concerns the escarpment on either side of the Porte de Briançon on the northern front. The 2005 condition report noted several defects affecting the facing of this structure:

- Detachment of the facing from the inner blocking as a result of the mortar being washed away by run-off and seepage.
- Misalignment of courses due to vegetation.
- Locally deformed facing.
- Poor condition of the string course and the first three upper courses, due to particularly intense rainwater run-off at the top of the curtain wall.

Looking at the location of these defects, it can be seen that the parts with washed-out joints are located at the top of the structure, suggesting a break in the waterproofing of the curtain wall. Similarly, the deformed parts are accompanied by the presence of parasitic vegetation and faded joints, suggesting localised infiltration of the masonry rendering.

Faced with these problems, the CMN commissioned the chief architect of historic monuments to restore the structure. He chose the following repair options:

- Reconstruction of the waterproofing of the upper sections.
- Allowing water to drain away.
  This part of the project will be implemented through the following works.
- Dismantling/reassembling deformed stone facings, including pinning.
- Creating decompression wells.
- Replacing ashlar in search of new stone (particularly in cords, first courses and base courses).
- Recasting and repointing.
- Lime grout injection.
- Installation of a reinforced tarpaulin at the top of the embankment, reprofiling and planting of vegetation.

9.8) Embankment of the Briançon gate.

9.9) Vegetation on the Briançon gate wall.

It should be noted that for the deformed sections, in addition to using a barbican, the architect chose not to lay whole blocks, but to use stone plugs combined with dowels. With a view to integration, the work also included the application of a patina that makes the whole look homogeneous without masking the intervention. This shows the opening of the barbican, the design of which corresponds to a widening of the joints.

In order to restore the watertightness of the crown of the structure, the blocks forming the upper cordon of the escarpment had to be repositioned by stripping and replacing the existing fill. It was restored to its original profile, with its precise angle, enabling the defending infantry to point their rifles at the right angle.

Repair of Bastion no. 63

The following example concerns the repair of a section of wall in bastion no. 63, again on the northern front. There are two problems:

- A fairly large breach of around 20 m2 of the wall.
- Destructuring of a group of blocks with systematic washing of their joints.

9.10) In winter 2018-2019, part of the wall of bastion 63 collapsed.

9.11) The crowning was reconstructed.

Two observations can be made to explain these two disorders. The first concerns the nature of the soil throughout the stronghold of Mont-Dauphin. Vauban was struck by the appearance of the rock of the plateau on which the stronghold was built (poudingue/pudding* in geological terms). He thought that this conglomerate was so solid that the walls of the ditches to be built could do without a masonry facing, which would be a great source of savings. Unfortunately, this was not the case.

A site report from 1693 informed him of the following: "you have been informed that no rock has been found in the excavations, as had been thought, but only stones and pebbles covered in sand and earth, which obliges you to multiply the masonry well beyond what had been planned". Rolled pebbles from glacial and torrential alluvial deposits were used for the core of the masonry and were not bonded to the binder. Entire sections of certain escarpments were detached. Although Vauban had been informed of this as early as 1693, he had ordered from a distance that the pebbles be broken to ensure better bonding, which was not carried out until 1697. To sum up, the faces of the bastion are flanked by simple masonry facings, rather than masonry of the "weight wall" type.

In addition, the soil behind the bastion is heterogeneous and the measures planned by Vauban to make it more resistant were not taken. A quick examination of the collapsed structures also reveals late repairs to the facings where cement was used for the joints. This cement mortar jointing created an obstacle to moisture exchange. The addition of the original wall configuration to the cement mortar joint first explains the appearance of the belly, then the collapse.

The blocks were inventoried and numbered, then reassembled and the inner core of the wall rebuilt. The pointing was reconstituted with lime. The crown was rebuilt, ensuring that the wall was watertight. Swollen or disjointed pockets were cleaned of cement joints and then completely rebuilt.

Diagnosis of the powder magazine

The last case study concerns the powder magazine, with an operation that is in its early stages, and more specifically the first part of the study phases, the diagnosis. This operation was launched in response to problems of slope subsidence resulting from the modification of the powder magazine's protections, which date back to 1882.

In addition to these subsidence problems, seepage and other traces of dampness were observed in many places. In order to draw up an intervention plan and understand the phenomena behind these two disorders, several test pits were drilled to understand the composition of the slope complex. The latter consisted of an earth blanket, under which a layer of lime mortar-bound aggregate was laid on the reverse side of the masonry.

9.12-13) Infiltrations in the powder magazine.

In order to explain both the subsidence and infiltration problems, it would appear that the backfill, which is now more uniformly subsided in places, has undergone deformation and settlement, mainly as a result of rainwater run-off. This erosion caused water to be retained, facilitating infiltration. It also seems that the ventilation shafts and the masonry structure surrounding the access door contribute to this phenomenon: water stagnates against the masonry and then seeps in. Finally, the erosion of the backfill and the lack of a proper waterproofing layer encourage internal infiltration.

In his proposal, the architect initially envisaged reconstructing the entire embankment, removing all the earth. The scale of the work, but above all the need to remove the authentic waterproofing, led the CMN to ask for a more economical approach that would be less destructive of the original features. A second version of the project is therefore currently being studied, involving less intrusive surface stripping of the embankment, the installation of a flexible and suitable waterproofing element, and the restoration of the embankment's original profile. Finally, the installation of a perimeter drain is also envisaged as a measure to improve the overall drainage of the site, while respecting the historic substance of the 19th-century intervention.

Isabelle Fouilloy-Jullien

has graduated from École de Louvre. She is an art historian and a chief curator for heritage. She has been the director of heritage department of Briançon for 26 years. Since 2016 she has been working for the Centre de monuments nationaux and is the administrator for the stronghold of Mont-Dauphin and Fort Saint-André.

Laurent Alberti

a state architect, has graduated from the Centre des Hautes Etudes de Chaillot. After working in the private sector, he has worked as the head of the Deparment of Architectural History and Archaeology of Paris. Today he works as a curator for the Centre des monuments nationaux (CMN), and is in charge of 20 monuments, including the fortified city of Carcassonne, the forts of Salses-le-Château, and Villeneuve-lés-Avignon, as well as the fortress of Mont Dauphin. He also teaches at École Nationale Supérieure d'Architecture de Paris Belleville.

10. Restoration and Preservation of Fortified Heritage and its Landscape: The Case Study of Forte Tesoro and Forte Aurelia

Fiorenzo Meneghelli & Andrea Meneghelli, Studio Architettura Meneghell

This paper focuses on the recovery and valorisation of the fortified heritage, examining in particular the case of Fort Monte Tesoro, located in the Lessini Mountains, and Fort Aurelia Antica, set in an urban context in Rome.

Forte Tesoro

Forte Monte Tesoro, built in 1911, is part of the defence system of the Kingdom of Italy against the Austro-Hungarian Empire. During the First World War, the fort lost its defensive functionality due to the shift of the front line beyond the Lessini mountains. The restoration project has received significant recognition: it obtained awards at the "Landscape as Cultural Habitat" conference promoted by ICOMOS in 2014 and for the best restoration in 2021 by the Order of Architects of Verona, highlighting the initiative "Forte Monte Tesoro: from military garrison to landscape garrison".

The enhancement project was developed through three main themes: the recovery of the powder magazine and barracks, the promotion of accommodation and leisure activities and the conservation of biodiversity in the Lessinia Woods.

The fort is located at the top of the mountain, in an area surrounded by barbed wire nets. It was the site of a NATO military base until the 1990s. For a long time it remained a closed and secret place. After the area was handed over to the municipality of Sant'Anna in 2013, a redevelopment project was launched, involving the local community for the economic and social recovery of the mountain area.

The area, covering 154,640 square metres, has a morphology that offers significant views of Verona and Lake Garda, making the fort a landmark of considerable environmental and cultural interest.

The new architecture was carefully designed to maintain historical features using traditional and modern materials. The architectural renovation was carried out with a minimalist approach. For example the illumination was done using low-intensity LED lighting to maintain the original atmosphere. Environmental integration studies ensured that each structure blends harmoniously into mountain context.

The renovation phases ran from 2012 to 2022, including restoration of the original architecture and structural consolidation. Traditional materials such as stone were used alongside modern elements such as concrete and Corten steel, creating a contrast that enhances the fort's history. Particular attention was paid to accessibility, with paths connecting the fort with the surrounding landscape. The roof was restored, allowing visitors to enjoy a panoramic view of the Alps and Lake Garda. The new Corten steel domes, designed to harmonise their surroundings, offer observation points.

10.1) Aerial view of the Forte Tesoro and barracks after the restoration project.

10.2) Aerial view of the fortress in the environmental context of the Lessini mountains.

The escape route was interpreted as a transition from the darkness of the underground fortress to the light of the natural environment. A breach was opened in the historic wall, highlighting the materiality of the concrete. From there, an optical telescope made up of modular Corten steel elements juxtaposed with each other starts, with a mountain as its focal point. The contrast between the massive concrete structure of the fort and the steel modules makes this transition a highly significant experience. The modular steel elements, placed between stone blocks, are laid dry, making the intervention reversible. Natural barriers made of intertwined beech branches have been created to allow visitors to visit safely overhanging paths over the moat, preserving the naturalness of the site. The interior has retained its rough surface, the walls and vaults have simply been cleaned. This allows the visitor to perceive these interiors as a discovery of a place that preserves its authenticity. The static consolidation work, although camouflaged in the texture of the exposed stone wall, was an important intervention.

On the ground floor there is a forced ventilation system with metal ducting that interprets the technological solutions historically found in Italian armoured forts. For the electrical distribution, open conduits were adopted not to affect the wall and to allow flexibility for future implementation of the network.

The fort structure is separated from the mountain by a perimeter cavity that allows the ventilation of the rooms and collecting rainwater, which is then channelled into tanks inside and outside the fort, for the garrison's water supply. In the *cavedium*, visitors can be in contact with the naturalness of the excavated rock wall and understand its function in contrast to the fort's artificial geometry.

10.3) 360 degree view of landscape surrounding the fortress.

10.4) Gola Front.

10.5) Interior view at the level of the armoured batteries.

The rehabilitation project transformed an abandoned site into a cultural meeting place, promoting cultural and leisure activities. This intervention emphasised the historical elements, improving the understanding of the relationship between the fort and the natural environment. The fort, while maintaining its historical characteristics, has become a flexible space for various types of events, such as theatre, music and food and wine events, promoting conviviality and the local area. A recurring theme of the renovation is the fusion of history and contemporaneity, allowing the local community to recognise itself in the place.

The promotion of cultural and leisure activities have made the fortress a place of aggregation and promotion of the territory. Historical elements have been emphasised, enhancing the understanding of the relationship between the fort and the natural environment. This has allowed the site to maintain its historical-architectural character while hosting the most diverse initiatives, none of which must become a permanent fixture or use.

The fort is an open and flexible venue for events: theatre or music, stargazing, food and wine events, etc. It is place, therefore, to promote the territory and conviviality being it a living place open to the community.

The restoration of Fort Monte Tesoro, therefore, is not just a restoration project, but an emblematic example of how fortified heritage can be interpreted and valorised, becoming a vital resource for contemporary communities and promoting a meaningful link with the landscape and local history. This project invites reflection on the importance of safeguarding and enhancing cultural heritage in the contemporary context.

Forte Aurelia

The restoration of Fort Aurelia, located in the urban area of Rome, marks a significant step towards the broader redevelopment of the capital's Campo Trincerato fortifications. Forte Aurelia was built between 1877 and 1881, with a polygonal layout on a Prussian model. This structure acts as a meeting point between the urbanised suburbs of Rome and the Parco Regionale dei Casali, emphasising its dual role in both military history and the current urban layout.

10.6) View of the Gola Front and Rivellino at Fort Aurelia.

Historically, the Campo Trincerato, established between 1877 and 1891, consists of a series of fortifications (15 forts and 4 batteries) surrounding Rome, which became the capital of the Kingdom of Italy in 1871. Fort Aurelia is mainly underground and has internal areas (shelters) facing a central parade ground. However, over the years numerous invasive interventions had overshadowed the fort's original identity, necessitating a comprehensive restoration project aimed at restoring its historical relevance.

The restoration project is guided by a Masterplan that includes the removal of incongruous recent constructions placed on the historic site and relocating them outside the fort. This also allowed the excavation of the moat almost completely buried, revealing the fort's original masonry profiles. The key objectives of the restoration include:

- A careful conservative restoration of the historical part and punctual integration works for some compromised parts.
- The construction of a multifunctional underground hall for institutional purposes and cultural activities.

Started between 2017 and 2018, the restoration work began with the cleaning and restoring of the earthworks, followed by work divided into phases to adapt to the complexity of the site. In order to restore the image of the fort, the Rivellino, demolished in the 1950s, with new buildings added, was reconstructed according the historical geometry. This intervention, with the creation of a triangular courtyard, gave new visibility to the monumental entrance front of the fort.

The new Rivellino includes various services for visitors, such as technical rooms, toilets and exhibition spaces. Inside, a documentation centre illustrates the history of the fort and the ongoing restoration processes through models and information panels. The powder magazine, located under the Rivellino, has undergone minimal intervention, preserving its atmosphere and allowing visitors to explore the environment in semi-darkness.

10.7) Interior of the central caponier.

A critical issue in the restoration was the management of the embankments, which cover the rooms of the shelters. The project involved restoring the historical geometry of the embankments while ensuring effective stormwater management and low-maintenance green surfaces. Some of the trees that had caused water infiltration were removed in the Gola Front, while other vegetation that had developed over time was preserved on the other sides of the Fort's polygon. The entrance bridge was carefully restored, the brick vaults supporting the walking surface were reconstructed, along with the cast-iron parapets modelled on historical designs.

The restoration of the royal coat of arms of the House of Savoy, placed on the facade of the fortress, required extensive cleaning and consolidation addressed to the surface degradation. After treating the marble, missing parts were reconstructed using special resins, ensuring that the additions were visually consistent with the original.

Inside the surfaces were slightly cleaned; the resulting polychromy makes it possible to read the texture of the brick and tufa masonry, but also the stratification of the paintwork carried out over the decades when this place had become a hospital, a refuge for evacuees from the Second World War, then barracks, etc..

The museum display of a minimalist nature used steel totems to display the history and ongoing work of the fort on panels. A detailed analysis of the cocciopesto floors allowed the restorers to recover the colours of the historical surfaces. Lighting plays a fundamental role enhancing the fort's architectural features. The exterior and interior lighting was calibrated to highlight the structures with moderate and punctual light while also leaving areas in semi-darkness.The restoration solved the problems of water infiltration in the shelters below the artillery emplacements.

The intervention was diversified according to the state of the sites, with excavations of varying depths for waterproofing with bentonite sheets, covered either with turf or with draining paving. The artillery emplacements were restored to house 1:1 scale models of the cannons made of metal based on historical drawings.

10.8) Interior view of the caponier with exhibition on Italian fortifications.

In conclusion, the qualifying elements of the Fort's restoration are:

- The recovery of the fort as a historical memory that continues to "live on" in the contemporary world within a military complex.
- The experimentation of a dual-use of a military area, which preserves its institutional functionality and at the same time becomes a space open to citizenship.
- The creation of a multicultural pole: a museum, a temporary exhibition space, a multi-purpose hall, a large green area, etc.

Through this integration of history and modernity, Fort Aurelia is destined to become an important cultural attraction, serving both the local community and the entire city.

Fiorenzo Meneghelli

is an architect working on the heritage field: restoration of historic buildings, and the recovery of military architecture and enhancement of territorial defensive systems. He coordinates network of fortifiel sites, he is the vice president of the Instituto Italiano dei Castelli and president of its Veneto section, also a member of ICOMOS/ICOFORT and head of the Study Centre of Forte Marghera as well as EFFORTS Member. He has set up exhibitions, promoted conferences and published essays on the recovery of fortified works in Italy and Europe.

Andrea Meneghelli

is an architect-engineer who has taken part in several international conferences and in a European project on fortified cultural heritage as co-lecturer. He works as a project leader and a BIM coordinator at Mario Cucinella Architects and collaborates with the Studio Architettura Meneghelli for restoration of historic buildings.

11. Bastion St Jaume's Preservation Works in a Global Transformation Project: Preserving the Living, Another Way of Restoring

Germaine de Bazelaire & Baptiste Grandais, Atelier d'Architecture Philippe Prost

"Relating the work to its place, connecting architecture to the site and the site to the living beings."

- André Chastel

These words of André Chastel summarise the work that has been done in Antibes. In this presentation we will see how the project of restoration in Antibes has given us an opportunity to deeply connect the site to its living beings, thus opening up new ways in restoring our heritage.

The Port Vauban project

The Port Vauban in Antibes is located in the South of France, between Nice and Marseille. It is a site occupied since the Antiquity, and in the XVI century it was a strategic defensive position at the boarder of the French Kingdom and the Savoy Duchy. The bastion St Jaume was added to the fortifications around 1650. The World War II bombs affected strongly the courtine but the bastion was luckily preserved from heavy damages.

Today the harbour faces new challenges. The project in Antibes, led by the Atelier d'Architecture Philippe Prost together with Vauban 21 in charge of the public service delegation of the harbour, consists in renovating the existing harbour. The aim is to transform it into a XXI th century marina, modern but also sustainable. The restoration of the ramparts is part of this project and contributes to an ecologically responsible attitude. It aims at preserving the existing fortifications, its stones and its living beings, as well as giving back the "chemin de ronde" to the public and making the fortification system accessible to all.

The monument and its protected species

The ramparts are protected as a registered monument since 1930. Besides that, two species of reptiles were identified as possibly living in the ramparts and requiring protection: the tarentula mauritanica, and the warty hemidactyle, of which the latter is a threatened species.

Under the initiative of our client, holder of the certificate of Clean Harbour ("Ports Propres actifs en biodiversité"), an ecologist was contracted already in the diagnosis phase. He aimed at supervising the restoration process, so as to make sure that the works would respect the living species. The call for tender for the restoration of the masonry included the report of the ecologist. The contractor was thus informed that the restoration process should obey to precise environmental specifications.

11.1) Aerial view of the Bastion St Jaume in Antibes.

The rampart's brick parapet was in bad condition. Some faces were heavily eroded. The top of the brickwork was dismantled by vegetations' roots. The rubble scarp needed repointing and the tip of the bastion had lacking stones in its quoin.

11.2) The *Tarentula mauritanica*.

11.3) The warty hemidactyle, a threatened wild species.

Preserving the rampart, its stones and its wildlife

As the restoration started and the scaffoldings were erected, a herpetologist started inspecting the cracks of the masonry with an endoscope, in search of geckos. The presence of excrements was a first indicator of their presence. A nest with eggs was eventually found and several reptiles were encountered on site.

The contractor could not start repointing or replacing the stones and brickwork before the herpetologist inspected the wall. However, some actions like vegetation removal could be carried out simultaneously. Zone by zone the workers followed the herpetologist's progress.

During his inspections, the herpetologist used handkerchiefs to mark the anfractuosities that were already hosting geckos or that ought to remain open so as to become a habitat for geckos. Once the amount of anfractuosities and their position was known, the restoration process was confirmed during an onsite meeting at which all the stakeholders were present : the ecologist, the architect, the client, the construction firm and the "Architecte des Bâtiments de France" (State architect). As the workers would progress with their work, it was decided that they would take away the handkerchiefs and insert a Provencal cane to prevent filling in the wall with mortar.

11.4) Scaffoldings for the first phase of works.

11.5) Marking suitable anfractuosities with handkerchiefs.

11.6) Finding the right size of provencal cane.

The masonry cleaning, initially planned to be made using biocides (although 99% biodegradable...), was replaced by simple water projection so as to be more respectful of the living species and the environment, while still giving a satisfying result.

As no protected flora was mentioned on the site, we could proceed with the removal of the chasmophytes, whose roots strongly affected the brickwork. To maintain a certain balance in the existing ecosystem, this vegetation removal was compensated by newly planted vegetation near the courtine.

Reiterating the experience

This first experience in Antibes of a new way of restoring was for us a sort of "prototype". A similar process was implemented at the Citadelle of St Tropez, where also protected geckos were found. This time, it is at the architect's suggestion that the client added an ecologist to the team. This is how the first phase of restoration of the scarp included the creation of gecko habitats in the cracks of the masonry.

11.7-8) Creating habitats for the geckos.

11.9) The restored brickwork in Antibes' rampart.

11.10) Reiterating the experience in the Citadelle of St Tropez.

Another project where we hope a similar process will be put into action, is the Fort Carré and its peninsula. The preliminary study that was led, included landscape and botanical analysis among other. Beside of protected wildlife species, the botanist study revealed the presence of several interesting flora elements like a unique olive grove forest, anemomorphosis (wind deformation) of the trees facing the sea, meadow with protected species, multiple chasmophytes. Etc. We believe that it is possible to adapt the process of restoration to preserve both built and living heritage, and that this adds value to our actions.

11.11) The restored brickwall of Port Vauban in Antibes.

Towards a new way of restoring

During all the restoration process of the bastion, we aimed at preserving not only the constructed heritage but also the living species. We hope that the restored rampart will continue to offer a suitable anthropogenic habitat for the geckos. We believe that taking into account the living species present on site and in the built heritage will lead to a new way of restoring, more respectful of the environment and more suitable for humans.

To conclude, the experience at the bastion St Jaume stressed out the following aspects as essential to a new way of restoring:

- The importance of sensitizing the stakeholders (client, workers, architects ..) to build awareness. It is the transformation of our way of looking at things that will lead to changing our actions and habits of intervention.
- The importance of early stage diagnosis made by a cross-disciplinary team, so as to combine the prescriptions of diverse fields and integrate them in the call for tender.
- The importance of a strong on site presence of the different stakeholders, so as to find the best action oriented solutions in a joint effort.
- The necessary coordination of the specialist's on site visits with the pace and phases of the restoration works.
- The importance of the involvement of the workers and contractor.
- The importance of the simplicity of means and low tech solutions, so as to successfully implement the protocol on a building site.

Germaine de Bazelaire

is a french-polish architect who graduated from the EPFL in Lausanne in 2011. Subsequently she trained in preservation and restoration of architectural heritage at the Ecole de Chaillot in Paris. After having worked for several years in Geneva, she moved to Paris and is currently enjoying her architectural practice as a project manager at the Atelier d'Architecture Philippe Prost. Her current projects include the Port Vauban restoration in Antibes, the renovation of Port Gallice in Juan-les-Pins and the preservation of the Columbarium at the Parisian Père Lachaise cemetery.

Baptiste Grandais

is an HMONP architect from Normandy. He trained at the Ecole Nationale Supérieure d'Architecture de Paris Malaquais and spent a year in Rome at the Universita degli studi Roma Tre. After graduating in 2017, he spent four years working for the Parisian architecture firm Bruther. In 2021, he joined the Atelier d'Architecture Philippe Prost. In particular, he is working on the redevelopment of the Vauban marina in Antibes, the preliminary study for the Fort Carré in Antibes and the restoration work on the Citadelle of Saint-Tropez.

12. EFFORTS Europe Sustainable Heritage Projects

Rafaël Deroo, European Federation of Fortified Sites (EFFORTS)

EFFORTS Europe is a European network organisation established in 2017 to share, via European projects for its members, knowledge and practical innovation on the reuse of military built heritage, such as walled towns, fortresses and defense lines. EFFORTS emphasizes the awareness of the great environmental cultural, educational, research, social, and economic assets of European fortified heritage. The basis for EFFORTS was laid during the final conference of the At Fort Interreg IVC project in Suomenlinna, Helsinki (Finland 2014) and international conferences on military heritage in 's-Hertogenbosch (Netherlands 2016) and Berlin-Spandau Zitadelle (Germany 2017). On 9 November 2018 in Venice (Forte Marghera), EFFORTS has adopted its founding Declaration of purpose. Today EFFORTS unites more than 150 European fortified sites and networks and is growing. EFFORTS is the European professional representation of fortified sites. It is member of the Europa Nostra managed European Heritage Alliance 3.3. and the Climate Heritage Network.

Realising that the conceptual attitudes towards cultural heritage at European level is undergoing a fundamental transformation, from an approach focused on conservation to a focus on the value and reuse of fortified heritage. In order to do this, EFFORTS members strive to prepare their sites for today's risks, as there is climate change. There are many fields in which EFFORTS members are active.

12.1) EFFORTS annual congress 2019 in Antwerp.

Most fortifications had enormous influence on the development of towns and landscapes. Historic defensive walls and forts need to be interpreted as intrinsic components of the historic urban and rural landscapes they were meant to defend and protect. The open, deserted, fortified areas of cities and regions need to be turned into opportunities for today's climate and development needs. Remedying to the empty fortification sites and defence lines of today, offers the connection that is most important for the revival and transformation of cities and regions.
Fortified sites can be transformed into cultural hubs, parks or event spaces, in a way that respects its surrounding environment while adapting to climate change issues. These sites offer the green spaces that connect different parts of cities and regions and built bridges for economic and social development.

Valuable lessons that can be learned from properties constructed and operating during an era before electrical power and central heating. Combined with today's technology these places challenge us to find new solutions for low energy performance, with respect to the place and its environment. Monumental buildings are challenged in energy performance. They are not easily adaptable to today's energy performance standards.

This revival of fortified heritage makes a positive contribution to the United Nations Sustainable Development Goal 'Climate Action'. This is not only by improving their energy performance, but also because the sites' thick walls and roof constructions are ideal to retain heat and cold. The original living quarters and barracks are easily reusable for housing with high occupancy rate. Gunpowder magazines, arsenals, strongholds are transformable for new public or private purposes. The sites can be used for different climate-related functions, such as water storage, flood protection, generation and storage of sustainable energy.

For these purposes, and due to the similarities of fortifications across Europe, adaptive re-use of European fortifications, fortresses and defense lines need a Europe-wide research and innovation practice agenda.

EFFORTS members have also based its work on sustainable reuse of fortified heritage. In 2022, the 'EFFORTS Goes Green' Creative Europe Network project (EGG) bases itself on the EU Green Deal: building capacity for military heritage sites to adopt environmentally sustainable and socially inclusive practices, on ensuring adaptive measures that make heritage and heritage professions more accessible to all, disregarding background, beliefs, or (potential) disabilities. The EGG project also focuses on making fortified sites partners for the implementation of the European Green Deal and Europe as an inclusive society, incl. the New European Bauhaus Initiative, building forth on the extensive and representative network of EFFORTS.

12.2-3) Erasmus+ project ‘"Resilient Fortress" in Suomenlinna, summer 2024.

In the wake of the EGG, EFFORTS decided to establish with its members to found an annual Summer Academy system, focusing on capacity building meetings for professionals in sustainable fortress management. The 2024 first Summer Academy was also the first meeting of the Erasmus+ project ‘Resilient Fortress’, initiated by EFFORTS Europe with Suomenlinna, its member and the project leader. This project, with EFFORTS itself, another EFFORTS member and an EFFORTS expert as partners, focuses on the fight against global warming by offering experts the opportunity to gain information about climate action and sustainability through peer support and supplementary learning, increasing green competence of professionals through peer support between organisations. It strengthens the organisations’ green policy and competences in environmental responsibility. In addition, the project identifies continuing education in sustainable cultural environment.

EFFORTS
GOES GREEN

Rafaël Deroo

is the secretary general of the European Federation of Fortified Sites, representing 200 sites from 23 countries. EFFORTS focuses on the growth of a network platform for its members in order for them to increase their European project capacity, especially in green adaptive reuse for fortified heritage.

13. Suomenlinna Summer School

Tuija Lind, Governing Body of Suomenlinna, Marianne Lehtimäki

Suomenlinna Summer school took place at Suomenlinna in the beginning of September 2024. It was the first of the four Erasmus + projects activities. The event gathered architects, gardeners, curators, landscape architects, archaeologists, structural engineers, foremen and heritage specialists, a biologist and a climate change expert at Suomenlinna fortified archipelago. The Governing Body of Suomenlinna (GBS) also organized an educational side event for Suomenlinna prison inmates and foremen, who work with the fortified landscape and wall restoration. The site visits led by Suomenlinna practitioners and planners, active discussions, a conference day with ten presentations and a workshop produced an adequate source material for figuring out what is a resilient fortress, what are the values to be defended in the future and what are the challenges.

13.1) Summer School group visiting Länsi-Mustasaari, Suomenlinna.

Summary of the outcome of the Suomenlinna Summer School

Fortifications have as a characteristic a wide presence of green areas. Thereby fortifications can become a pioneer and a stronghold for the protection of biodiversity of the historic landscape. Unlike transformations of post-industrial areas, where new functions have often disrupted historical memory, the fortresses still embody their multidimensional context tied to their location. Despite the similarities on fortified structures and same kind of challenges faced in their repair and restoration, masonry structures are site and local climate related and require site-specific solutions.

13.2) Site visit to B31 Bastion Hårleman.

Target I

The integration of environmental responsibility and biodiversity as part of heritage values in the restoration, maintenance, and repair of fortified heritage:

- Describe the concrete effects of climate change impacts.
- Study expertise-based ways to achieve balance and good enough compromises between preventing nature loss and the preservation of historic landscape with its built heritage.
- Examine the restoration process in more detail to identify where a specific biological expertise and coordination of activities is needed.
- Explore, if it is better to proceed the project in stages to estimate how the planned solutions work.
- Present concrete examples of areas/elements that require the combined preservation of heritage and of biodiversity as a cross disciplinary approach (biologist, herpetologist, botanist, heritage and landscape architects etc.).
- Good practices in diagnosing problems at an early stage.
- Enhancing strong presence of the different stakeholders on the construction site. Involvement of workers and construction firms to succeed in the implementation of the specification of works.

- Raising awareness among stakeholders (clients, employees, architects, etc.) about the integrated protection of the natural and cultural heritage of the landscape.
- Joint efforts to find the most adapted and action-oriented solutions.
- Favouring low tech solutions, easily reproductible on varied sites and projects.
- Cross-sector discussions on design solutions for fences and stairs in a wide nature-heritage-use context.
- After the restoration project to reflect on the process; what went well and what could have been done better? What kind of gaps do we have in our knowledge and need to learn?
- Document the work and process and communicate the experiences to others as lessons learned.
- Promote research and co-operation with experts to explore good examples for combining biodiversity and building physics of structures to understand the consequence of the selected measures.

13.3-5) Workshop at Myllysali, Suomenlinna.

Target II

Guidance dealing with shared problems:

- On preventing erosion.
- On maintenance of green surfaces on the fortress.
- How to protect green surfaces in construction phases.
- Principles for guiding the visitors and educate the users (residents, tourists, visitors) to be more aware of the heritage/environmental significance of the sites.
- Guidelines for calculating carbon footprint to change actions and minimizing carbon oxide and adapting comparable principles for calculations on different sites.
- Promotion of recycling by guidelines to waste management for building sites exploring latest research for advanced composting.

13.6-8) Lecture day at Tenalji von Fersen, Suomenlinna.

Target III

Issues to ponder further together (for guidelines):

- Which professionals should we involve for identifying crucial questions to elaborate common solutions?
- Related to habitats and habitants at working sites, currently there is no processes for pre-survey the working sites, comparing archaeological or harmful material survey.
- Balancing between different values in heritage sites: when the circumstances are forcing us to decide between sacrificing either the authentic structures or immaterial values of the site as in the case of Bomarsund (Åland / Finland) where a protecting roof is built above the ruin spoiling the view but protecting the structure.
- The economic sustainability of the interventions on masonry and green components. Erosion and deterioration processes accelerate as the climate changes. This will require additional funding and/or identifying critical works and assessing what really needs to be prioritized and what needs to be done differently than before.
- Rethinking the requirement of effectivity. Do things need to be "done" immediately or is it better to extend the project timeline? Vegetation may need longer time to recover for best results. It is important to communicate this to visitors.
- A good inventory of the site before starting the restoration work helps in restoring the environment. Keeping the negative environmental impact as small as possible as the vegetation recovery time will be longer. For example, by using smaller machines and handwork as well as protective measures (steel or plastic sheets) to minimize footmarks on green areas. Erosion caused by visitors will further extend the recovery time. Areas may need to be closed for longer to allow the area to recover.
- Involving contractors in the design process could lead to better solutions and contractor accountability.
- Keeping the builders informed about why things are being done helps them to commit.
- Can we consider using vegetation as a tool against rain, wind, sun? Could a moss or lichen be harm or benefit for stone construction when continuous moisture is expected? How about the roots?
- Ways to acquire up-to-date information that will help find workable solutions to the problems. Although the structures may be very different in different parts of Europe in fortifications, we have a lot to learn from each other, such as site management, logistics, organization of things, work specifications, etc. The sites also have similar problems with visitors taking liberties to walk in places where they should not.

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is an architect involved in the development of several studies and initiatives on cultural heritage and the environment and has worked as a project manager in national and EU-funded projects aimed at integrating cultural heritage protection into broader development processes. She has acted as an independent expert in cultural heritage tasks, for example, commissioned by the Secretariat of the Cultural Routes of the Council of Europe, the Council of the Baltic Sea States and the Ministry of Education and Culture. She has coordinated the cooperation of national cultural heritage agencies in the Baltic Sea region for almost twenty years and has written and delivered several reports. After working as a senior advisor on the Suomenlinna Board of Directors in the Cultural Heritage and Climate Change project (Structural Funds), she works in private practice. She is the President of ICOMOS Finland.

13.9) Group photo of evening session participants the 3 September 2024.

14. Lessons Learned from Suomenlinna Summer School

Daniel Andersson & Jani Johnsson, Landskapets fastighetsverket

Comments and notes on gained insight regarding:

Mortar use in fortification constructions

In maintenance, conservation and restoration, mortar and plaster form a central part in preservation of stone constructions. In our case, the majority of discussions have been held on a theoretical level regarding the composition of the mortar. Unfortunately, this knowledge has not been passed on to the executors, which has resulted in numerous different solutions over the years. Being able to see and experience how Suomenlinna consciously works with mortar compositions for the repair of stone structures passing on at the same time the knowledge to the craftsmen at the construction site with good results, has been inspiring and instructive.

Compensatory properties of the vegetation

The insights we gained about the ability of the vegetation to counteract decay and weathering as well as moisture load on masonry constructions, was new and instructive information for us. We have generally regarded the vegetation in our ruins as harmful: through the roots the vegetation is assumed to penetrate the constructions and bind moisture and lead to an increased moisture load. Hearing how elsewhere the increased rainfall – in the wake of climate change – was counteracted by actively using vegetation in a conscious way to counteract erosion and weathering of masonry was an eye opener for us.

Biodiversity, a challenge in the restoration profession

Biodiversity can in some cases stand on the way of ongoing maintenance of historical sites. The goal of biodiversity can even overshadow and hinder the restoration profession.

Erosion in historical fortress

Due to hiking trails and how we relate to different ways of letting visitors wander freely versus a designated excellent hiking trail. These two different solutions generate different challenges and opportunities regarding vegetation.

Restoration traditions

Insights into how different restoration philosophies affect the moment where in some parts of Europe one works with the minimum possible interventions while elsewhere one is more permissive to reconstructions, additions and the creation of new activities, uses and safety in historical building with contemporary architectural tools.

14.1) Illustration of Bomarsund fortress reconstruction.

14.2) Remains of Bomarsund fortress destroyed in 1854 during the Battle of Bomarsund, part of Crimean War.

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2 – 4 September 2024

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Lorena Zambelli (IT)

8 October 2024

Twenty prisonners from Suomenlinna Prison (Prison and Probation Service of Finland)
Amille Aromaa / Suomenlinna Prison (FI)
Juhana Haikonen / Suomenlinna Prison (FI)
Iina Johansson / Governing Body of Suomenlinna (FI)
Jari Kallio / Suomenlinna Prison (FI)
Pia Kurki / Governing Body of Suomenlinna (FI)
Tuija Lind / Governing Body of Suomenlinna (FI)

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