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Gregory T. Papanikos
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5-10 July 2027, Athens, Greece

The [Architecture Unit](#) of Athens Institute, will hold its **16th Annual International Conference on Architecture, 6-10 July 2027, Athens, Greece** sponsored by the [Athens Journal of Architecture](#). The aim of the conference is to bring together academics and researchers from all areas of Architecture. You may participate as stream organizer, presenter of one paper, chair a session or observer. Please submit a proposal using the form available (<https://www.atiner.gr/2027/FORM-ARC.doc>).

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- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **7 June 2027**

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The Social Program Emphasizes the Educational Aspect of the Academic Meetings of Athens Institute.

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- Athens Sightseeing: Old and New-An Educational Urban Walk
- Social Dinner
- Mycenae Visit
- Exploration of the Aegean Islands
- Delphi Visit

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Athens Institute

A World Association of Academics and Researchers

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Ecology of *Hortus Conclusus*: The Idea of Self-sufficiency from the Greek Polis to the Fascist Housing to the Green Deal

*By Susanna Pisciglia**

From the end of the 17th century, with Cartesian thought and then the Second Industrial Revolution, cartographic representation changed and, consequently, so did the construction of the territory. Following the Second Industrial Revolution, the creation of the great energy network constitutes an important watershed, from material infrastructure it becomes a new cultural model. It marks the opening of a progressive distance between the individual and doing, between production and widespread skills. Dependence on large production systems, i.e., on the network, makes both the built heritage more vulnerable and individuals, rendered incapable of directly providing for their livelihood and thus more vulnerable. The process of progressive lengthening of production chains has been matched by a gradual human alienation from the environment as a habitat. The “strategic” model adopted by the European directives pursues the framework of remote, abstract enactment, inscribed within the present capitalistic models of growth, which is substantiated through a system of mandatory deadlines leading to the goal of “Transition”, a rapid and efficient response but not designed for long-term effectiveness, as the term itself witnesses. On the opposite side, Transformation would instead presuppose a radical and permanent change of the status quo, possible only through what Michel De Certeau calls ‘Tactics’, i.e., a capillary model that starts from the bottom. The article proposes to reopen the notion of sustainability by identifying a double ideological and methodological grid. On the one hand the transition scenario proposed by the Green Deal through the system of Strategies. On the other, an alternative scenario of active adaptation, aimed at a permanent Transformation, using the tool of Tactics.

Introduction

Before autarchy took on the national scale to which we have become accustomed through Fascism, Nazism, and, in part, Roosevelt's New Deal through protectionist policies, and all those countries that, like England and Australia, responded to the Great Depression by adopting agricultural autarchy policies, in short, before the subject took on a collective and then national value in the Enlightenment of the 18th century, autarky was an entirely individual practice, involving the construction of one's own *hortus conclusus*, and was projected onto the daily economy *-oikos nomos*, good domestic administration- producing housing solutions that optimized the reciprocity of the relationship between human and geographical singularity. In Italy, this particular relationship of connivance based on maximum agricultural exploitation coinciding with maximum care for

*Assistant Professor, University Iuav of Venice, Italy.

the land -cleaning of embankments, anti-erosion terracing in mountain agriculture, and, in general, widespread adaptation to local orographic and hydrographic specificities in order to maximize resources- has led to a highly anthropized and infrastructured landscape that is nevertheless among the richest in architectural diversity and landscape interest. A constructive *savoir faire* not based on pre-established architectural types or a priori abstractions, but on the need to minimize thermal exposure and dispersion, to encourage the channelling of cool winds or rather the deflection of cold ones,¹ the need to shelter livestock or dry fish, etc. The system of variables is so vast that, together with the specific building materials available in the area, the different sizes of families, and the unique productive and social needs, it generates dwellings that are as unique as the people who inhabit them. These are unique, unrepeatable constructions and, as such, conflict with the abstract idea of selecting a typical case to replicate, which is instead the basis of the self-sufficient rural villages built by the two regimes in the era of the network, which became the greatest common denominator of the entire landscape built since the Second Industrial Revolution and, above all, since the great post-war reconstruction.

The Fascist Idea of Autarky at the Scale of the Whole Nation

In the 1930s, Bernard Rudofsky exhibited a small selection of photographs from his collection *Architecture without Architects* at the *Bauausstellung* in Berlin, where it was met with great success. At that time, a regionalist movement was gaining ground in many European countries, studying the building and infrastructure traditions that had developed over centuries in their respective territories with a view to preserving them. In Germany and Italy in particular, under pressure from the fascist and Nazi regimes, national autarky policies aimed at productive and food self-sufficiency had been initiated since the early 1930s, leading to the recovery of as much agricultural land as possible through extensive land reclamation and the construction of new agricultural towns and villages to which farmers and unemployed people were transferred. The regimes isolated a preferred type of settlement, that of the garden city, and within it selected the types most characteristic of regional rurality. In Germany many villages, called *Siedlungen*, were built during these years in the form of garden cities consisting of single houses with green areas for vegetable gardens and special spaces for domestic livestock breeding for the economic self-sufficiency of families. The *Mustersiedlung Ramersdorf* in Munich was built next to and in contrast to *Neu-Ramersdorf*, which had been built a few years earlier in the rationalist style of the Weimar Republic. The houses in the *Ramersdorf* model settlement adhere to the *Heimatschutzstil*, the Nazi aesthetic that promoted the revival of traditional Germanic elements such as sloping roofs and the use of local materials such as wood and brick in order to comply with economic self-sufficiency directives. The same applies to the *Siedlung am Hart and Kaltherberge*, also in Munich, and many others scattered throughout the German

1. V. Pracchi, *Efficienza energetica e patrimonio costruito* (Rimini: Maggioli, 2013).

countryside to counteract progressive urbanization and encourage an increase in domestic agricultural production.

In Italy, too, the Fascist regime had begun building new rural settlements, combining stylistic elements and building traditions of an idealized Italian agricultural identity. Following on from the anti-malaria reclamation projects of the Giolitti era, extensive agricultural reclamation projects were launched in 1923 in the name of national agricultural and industrial self-sufficiency. Vast estates were confiscated in the south and put to more intensive and industrial production. The houses in the new villages, from Agro Pontino to Polesine, were designed to have their own vegetable gardens and small livestock farms for self-production and self-sufficiency. The names of the settlements were evocative, Littoria, Pontinia, Fertilia, Arborea, etc., for over a hundred new towns or villages.²

However, the process of selecting and synthesizing the minor rural architecture of a given territory in search of the ideal typology to be replicated within the Fascist garden cities ended up taking the form of a typification and abstraction that conflicts with the natural richness of the built historical heritage, and therefore with critical regionalism itself. At the 6th *Milan Triennial* in 1936, Giuseppe Pagano and Daniel Guarniero exhibited their photographic collection *Case rurali italiane*,³ a retrospective journey through the dialectic between environment and built heritage, or rather the cause-and-effect logic that led from the most prehistoric and nomadic forms of shelters and haystacks to the progressive petrification and stabilization of housing and work structures. The study investigates the ways in which, in response to functional needs that were unique in each case, linked to the particular crop, the materials of the land, the configuration of the territory, etc., forms were constructed that were always adapted to specific conditions, forms that were always different. The study, aimed at finding a methodology for rural housing in the 1930s, is a strong criticism of the fascist government's obstinacy in defining a single "perfect solution for farmhouses" with which to populate entire countryside and reclaimed areas (Figure 1). Pagano and Guarniero's research focuses on minor, residential architecture, precisely to avoid the more lofty themes. Rural houses offered a long historical perspective, dating back to prehistoric times, of refined adaptations to the territory and an intimate relationship with local production (Figure 2). The clear conclusion of this study is that the loss of authenticity and even specificity of rural houses, often converted into small villas, is a function of the loss of specificity and uniqueness of the crafts and skills of those who live there. The lengthening of the production chain and the progressive distancing of humans from the raw materials of different geographical areas is causing a contraction in living, in the sense of homogenization. The specific skills and tools of farmers, shepherds, dairy farmers, blacksmiths, etc. are moving outside the home, which is reduced to the lowest common denominator of the vital functions of protection and nutrition, opening the door to vast possibilities for the typification of a rurality of forms now emptied of meaning, to abstractions that no longer meet the realities of the places.

2. A. Pennacchi, *Fascio e martello. Viaggio per le città del Duce* (Roma: Laterza, 2020).

3. G. Pagano, and D. Guarniero, *Architettura rurale italiana* (Milano: Hoepli, 1936).



Figure 1. *Examples of Rural and Autarchic Foundation Cities in Fascist Italy, Carbonia 1937*

Source: Museo del carbone, Carbonia.

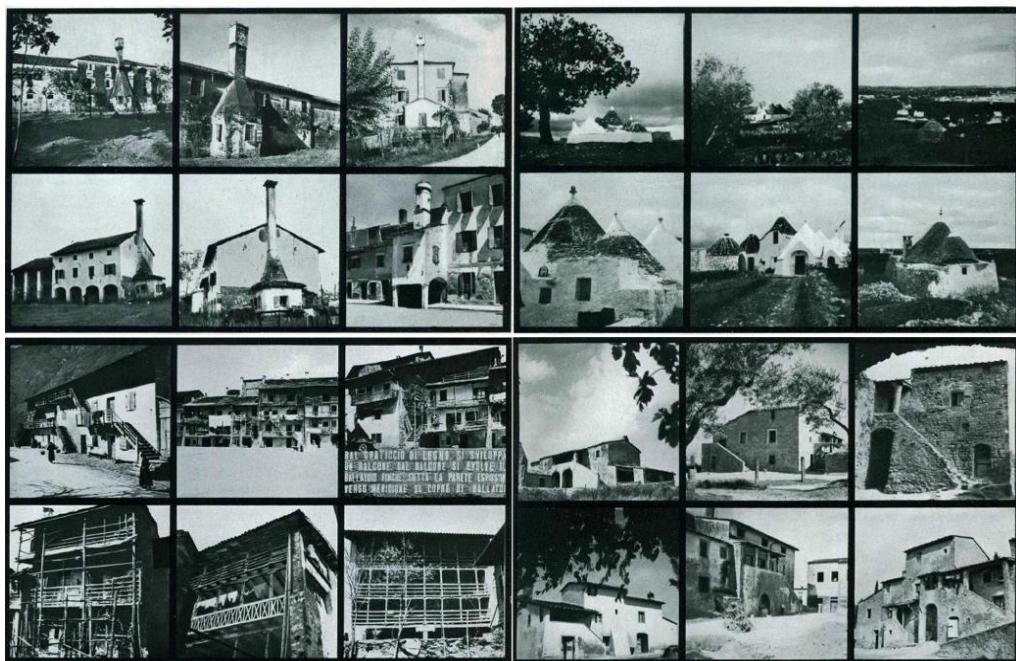


Figure 2. *Examples of Early 20th-Century Rural Housing in Italy, where Living and Production Coexist in Different Ways Depending on Environmental, Climatic, Energy, and Food-Related Factors*

Source: Pagano G, Guarniero, D (1936) *Architettura rurale italiana*, Milano: Hoepli.

The Greek Idea of Autarky at the Scale of Singularity

Autarky is one of the cornerstones of Western traditions of living. Social and architectural organization are a function of its dialectic.

Autarky, from the Greek *autós-arkéo*, means being self-sufficient. Within it, the term ark resonates, a closed structure serving as a shelter, in which to treasure what one has, so that it can mature to its fullness and multiply. A dual action resonates within it: on the one hand, an autonomy resistant to the social and urban context, such as the iconic image of Diogenes of Sinope, the founder of the idea of autarky, meek and patient in his cask, free from any desire for the possessions or power of others, striving for the greatest degree of connection with nature, for the growth and realization of one's own singularity. The same concept evoked by Aristotle in the *Politics* for every Athenian citizen, *polites*, who finds in the polis the most suitable habitat for their material and cultural fulfillment. The polis itself is autarchic as an independent and self-sufficient community,⁴ capable of self-government, as dictated by the further root that resonates in autarky, *archè*, which also gives meaning and direction to architecture, attributing to *techne* a role of reflex function. Whereas today, technology is instead the instrument and purpose of any activity, even architectural.

Autarky, Aristotle further specifies in the *Nichomachean Ethics*, is the happiness that comes from one's own fullness, from not having to depend in any way on anything else or anyone other than oneself. A state of inner imperturbability already explored by Socrates, then by Stoicism in the form of wisdom as *ataraxia*, detachment from earthly needs, which becomes an authentic rejection of the social structure with Cynicism. Epicurean joy that comes from frugality. Forms often at odds with the system of social interdependencies that structure the polis, almost unimaginable compared to the current model of total dependence on the internet.

European Green Deal and the Recycling of the Idea of Autarky

The *European Green Deal*, which today aims to restore levels of self-sufficiency across the entire built heritage by focusing on energy, actually risks becoming yet another major wave of neutralization of the built heritage, something that, in terms of geographical scale, emergency timelines and landscape impact, appears to be similar to post-war reconstruction, at least in Italy, where over 90% of the built heritage has very low energy performance values⁵ and where landscape restrictions apply to most of the territory. Once again, as in the days of the regimes, the idea of an ideal type of intervention prevails over reality, further reducing the already very low levels of diversity and complexity within the built landscape. The directives of the European Green Deal, specifically the EPBD (Energy Performance of Building Directive), favour the installation of photovoltaic panels,

4. Aristotle, *ibid*.

5. The calculation is based on buildings constructed before 2005, the year in which the EPBD I directive came into force in Italy, with a predominantly G energy class. The percentage is taken from the 2022 building stock provided by Cresme (Rome).

integral cladding with external insulation, and the replacement of windows and heating systems everywhere. The first two solutions are often incompatible with landscape regulations and historical constraints, but above all, they are incompatible with architectural and geographical common sense. Maps relating to solar radiation, for example, show how solar potential in many valley areas or areas particularly prone to fog, pollution or other types of shielding is less efficient than other local renewable sources that may have been more characteristic of the area over the centuries. A monocultural, standardizing culture that is in many ways contradictory to the very principles of ecology it purports to pursue – *oikos logos*, care for one's habitat – presides over the directives related to the Green Deal. A race to replace all devices currently in use in order not to change the consumption habits of European citizens, imposing deadlines that are so close and therefore so unachievable, but which in the meantime, from vehicles to buildings, massively increase the disposal of previous objects and the consumption of materials for the production of new ones, with extensive use of plastic materials, from cars to thermal envelopes to photovoltaic panels. This is an operation that is closer to satisfying the production markets than to ecology.

Autarchy, evoked today only in the most dramatic geopolitical circumstances, such as the sanctions of the twenty years of Fascism, the great energy crisis of the 1970s, the more recent crisis linked to the Russian-Ukrainian conflict, or, once again, the recent economic war of tariffs, always shows how autarchy has been distorted, moving from being a practice of conscious cultivation of one's own uniqueness to being a defence strategy; to being so on the national scale of an entire country. Whereas autarchy used to indicate the concentration of skills on the subject capable of achieving enough to be self-sufficient, today it indicates the subject's perfect dependence on a production chain external to him, the new subject of any autarchy. An ancient Chinese saying that goes, "Give a man a fish and you feed him for a day; teach him to fish and you feed him for a lifetime", sums up the policy now adopted by many missions to countries historically affected by severe food crises, which for decades had been resolved by simply distributing food. The progressive lengthening of production chains and the marginalization of individuals from skills and the ability to produce their own means of subsistence places contemporary individuals in the richest countries in a potentially similar condition of powerlessness in the event of a serious crisis, a potential condition that conflicts with the myth of resilience pursued.

The self-sufficiency that the research project *Autarky of Dwelling* aims for goes beyond the European directive, incorporating not only energy self-production but also water self-production, through rainwater collection and filtering devices, and food self-production, through the conversion of green areas belonging to the house into vegetable gardens. Not only because water is already beginning to represent a major emergency even in our part of the world and food, as a result, an emergency in the near future, but because it is precisely through self-production that important skills can be regained, without which no economic resilience, balance or social well-being is possible.

Bringing production back into the home, on the other hand, would in some ways characterize it, linking it to the specific characteristics of the territory in which it is located, making it not the end point on which the directives of the "ecological transition" rain down, but the starting point. We would move from the panoptic dimension of

European strategies, which must be adapted indiscriminately to different territories, to the dimension of specific tactics on a case-by-case basis, arising from individual territories and everyday practices.⁶ In this case, we could also stop talking in provisional terms of “transition” and, with much slower deadlines, start talking about “ecological” and social “transformation”.

Lining up and superimposing the autarchies of the 20th century is useful for highlighting the areas of research that the autarchy evoked today has lost even compared to its closest historical precedents. In fact, due to its temporal proximity to tradition, the autarchy of the 1920s is still characterized by some sensitivity to territoriality, even in the search for an ideal type that synthesizes the different landscape singularities. Furthermore, despite the panoptic coercion of the regime, it promoted collective inventiveness towards new materials and energies, and this period saw the first systematic studies on solar sources,⁷ biofuels and new low-cost building materials dictated by the need to make do with the little that was available. The value of this frugality is boosted and made attractive in various sectors by promoting fashion shows based on waste materials such as *lanital*, by promoting the myth of domestic food production, reuse and recycling, the long life and repairability of objects, etc. The communication of the Green Deal directives, the punitive language and the panoptic scale extended to the entire European continent are no less punitive, but communication, lacking in empathy and seduction, struggles to enter everyday life because it is as abstract as the distant production system on which we now depend. The self-sufficiency evoked after the 1973 energy crisis promoted a literature now disconnected from local architectural heritage but nevertheless closely connected to the environment thanks to the promotion of passive devices capable of maximizing the prevailing local thermophysical meteorological contribution. This literature is faced with the energy problem in a new built environment for the first time; villages have broken up and homes have lost the benefits of compact adjacency. The massive post-war reconstruction is characterized by isolated buildings, exposed on all sides, highly dispersive, indifferent to a whole series of measures - orientation, arrangement of openings, etc. - because they were built to serve a distribution network that would always guarantee a continuous flow of energy. The literature of these years attempts to correct the results of thirty years of unconscious design. The devices promoted in the 1970s were architectural features such as greenhouses, ventilation chimneys, green roofs, etc. However, this segment of research came to an end in the 1990s, giving way to new solutions that were less architectural and more technological and plant-based, in the clear belief that any design oversight could be easily compensated for with more powerful thermophysical systems and the use of new materials, regardless of latitude and altitude.

A process of progressive abstraction from the landscape and progressive alienation from the singularity of the subject leads to the neutral standardization that characterizes today's directives, essentially constructed in vitro, according to panoptic strategies unrelated to any specific territory.

6. M. De Certeau, *L'invenzione del quotidiano* (Milano: Feltrinelli, 2010).

7. G. Vinaccia, *Il corso del sole in urbanistica e edilizia* (Milano: Hoepli, 1939).

A Prototype for Venice Lagoon

The “autarchy of living” project attempts, particularly in North-Eastern Italy, to imagine reversing the process, starting from within the territory, from the deep agricultural tradition of the Po Valley, which was maintained and converted into sharecropping even when the countryside was abandoned. Recent experiences of thermal insulation and self-production of energy have reawakened in north-eastern Italy the pleasure of producing part of one's own means of subsistence autonomously, returning to making the home a small forge of productive activities, as was the model even for the smallest Venetian villas until the early 19th century. Along the waterways of the Brenta, Brentella, Sile and Piave rivers and their diversions, Villa Godi in Lonedo Vicentino, Villa Gradenigo Dolfin in Villarazzo di Castelfranco Veneto, Villa Feletto in Robegano di Noale, to name but a few, where water wheels, mills and cloth fulling mills were the normality,⁸ in a cultural context in which the home was a combination of *otium* and *negotium*, a clear and crystalline reflection of the singularities that inhabited it. In a context where Veneto itself up to mid XIX century was counting on more than 1800 active mills (Figure 3).



Figure 3. “Floating Mills on the Adige River Near Castelveccchio” Bellotto, 1745. Ashmolean Museum, Oxford, “View of the Mills at Dolo on the Brenta River” Canaletto, 1735

Source: Palladio Museum, Vicenza.

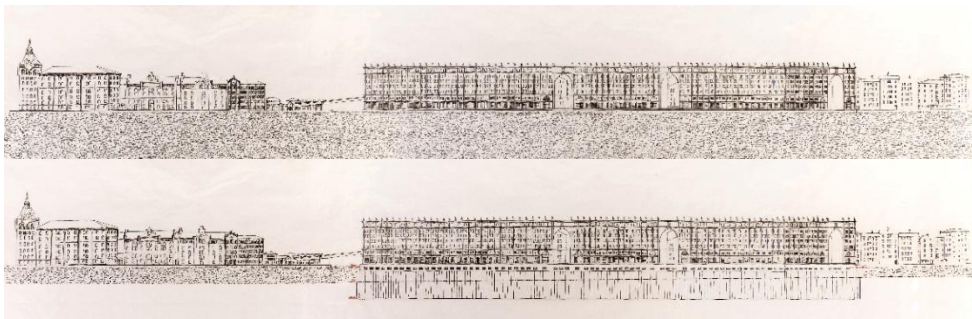
The project illustrated below, exhibited at the Italian Pavilion of the 19th Venice Architecture Biennale *Intelligens*, 2025, is an attempt to find ways to achieve ecological transformation in an urban environment that is already poorly connected to local resources and, moreover, one of the most delicate and restricted environments, namely Venice, the most fragile and precious town of north-eastern Italy. These ways of transformation can be offered as a tool for further enhancing the unique characteristics of its architectural and landscape heritage.

8. R. Vergani, *Villa e acqua in Villa veneta. Siti e contesti 1400-1600* (Villorba: Edizioni Fondazione Benetton Studi e Ricerche, 2006).

Venice has always been a delicate balance between innovation and conservation, between the real and the ideal. Built on an inhospitable marsh by the heroic efforts of a community, it has constructed its own nature through artifice. A dual, amphibious nature. Water is the lifeblood of Venice, but at the same time it is a real threat.

A city that is highly relevant today for having preserved its character by escaping the processes of urban decay that have affected all other cities, it is also highly relevant in anticipating many of the destructive processes triggered by climate change, which in the Mediterranean encounters a catalyst for various critical phenomena, in particular the progressive rise in sea level. The MOSE (Modulo Sperimentale Elettromeccanico) dam is a name with great symbolic power for a potential scourge of biblical proportions. Among other destructive processes is global mass tourism, which erodes the city from within, acting like termites to crumble entire historic building complexes. Behind façades bound by the superintendency and landscape laws, adjustments are being made rapidly to accommodate tourism, with significant and, above all, irreversible impacts. The equally irreversible consequence is depopulation, with more accommodation now being used for tourism than for residential purposes.

The project is a sketch for the new waterfront of the island of Giudecca and attempts to complete a scenography that has been interrupted since the early 20th century, in a city that makes representation the centre of meaning of its constructive approach (Figure 4). Representation, re-representation, bringing something that cannot be seen into presence, is the character of the city with which every project must contend, in the awareness that there is no representation without form, without a beginning and an end. And the Giudecca Canal condenses the city's maximum theatrical power. The Giudecca forms a concave lens that acts as a receptacle for the city, generating precise perspective viewpoints across the entire southern front, from Sant'Elena to Piazza San Marco, the Basilica della Salute and the former IUAV cotton mill. A powerful condenser of images, on which three large churches by Palladio have been built, mirroring each other: San Giorgio Maggiore, the Chiesa delle Zitelle, and the Redentore.



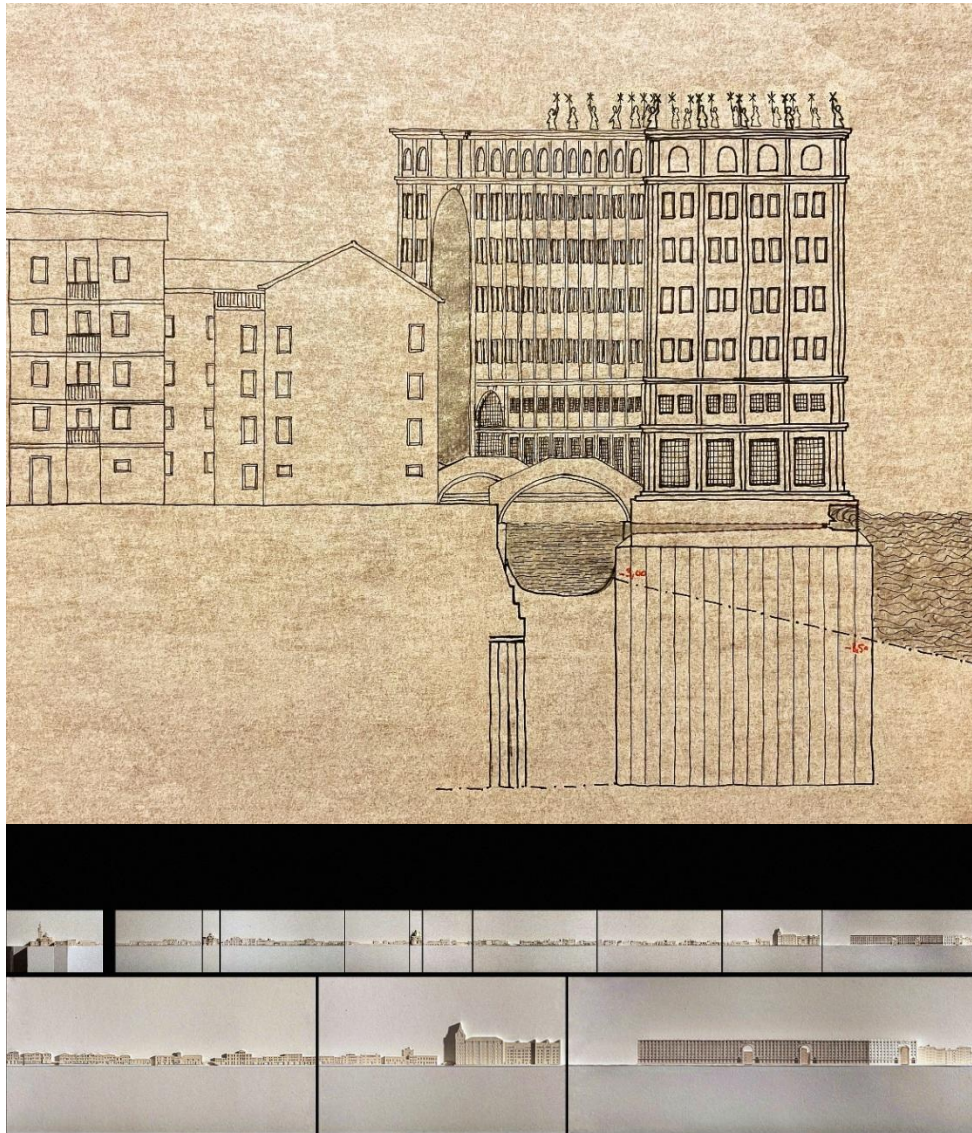


Figure 4. Proposal for a Residential Building in Venice along the Giudecca Canal to Complete the Landscape that was Interrupted at the Beginning of the 20th Century (The building exploits the kinetic energy of the small breaking waves of the lagoon along the Giudecca Canal, linking itself in a very specific way to the territory. The draft project is on display at the Italian Pavilion of the Intelligens Biennale, Venice, 2025)

Source: S. Pisciella. Collaborators: A. Mozzato, G. Antonioli, M. Renzi.

At the eastern end of Giudecca is the 16th-century complex of San Giorgio Maggiore, clad in Istrian stone, like every important Venetian building. while at the western end stands the imposing Mulino Stucky, built at the end of the 19th century in exposed brick with a Hanseatic façade, reminiscent of the great northern European ports of Hamburg or Gdansk, confirming the island's strong industrial vocation. In order to further expand the industrial area, in the mid-19th century, a *velma* - a shallow portion of the lagoon bed - was filled in, giving rise to the island of Sacca Fisola. Its industrial function lasted just over half a century, then, with the transfer of the industrial area from Giudecca to Marghera in the 1920s, Sacca Fisola

was designated as a working-class residential neighbourhood. The current buildings date back to the 1960s and contradict the continuous fabric of minor Venetian residential architecture that also characterises the entire front of Giudecca. In Sacca Fisola, the block buildings import the post-war typology of the suburbs.

The new building stands entirely in the water, taking advantage of the shallow isobaths in front of Sacca Fisola. Its purpose is manifold: to complete an interrupted landscape, but at the same time to pick up the threads of a discourse that began a century ago and was also interrupted, that of housing for residents. While at that time the aim was to provide healthy housing in an overcrowded city with poor sanitary conditions, today the aim is to provide housing for those who would otherwise be forced to leave due to a real estate market that is almost exclusively tourist-oriented. The new waterfront aims to address two further issues: the erosion of the banks and the ecological conversion of a city like Venice. In order: the building, slightly shorter than the Mulino Stucky, could house over 300 medium and large apartments for Venetian residents, in a central and strategic location in the city. The construction on the water, in addition to not requiring demolition and responding to a natural technique for the city, would involve the creation of a new canal between the building and the current *fondamenta*, useful not only for mooring near the Giudecca Canal, but also for protecting the current quay from erosion. Although Sacca Fisola, thanks to its higher elevation than the rest of Giudecca, does not yet suffer from the erosion phenomena affecting the banks of Zattere and Giudecca, which are increasingly flooded due to currents and intense nautical traffic in the canal, the layout can nevertheless be configured as a preventive measure with a dam function. The waves that currently break on the quay would be intercepted by the foot of the building and channelled into the internal canal in the form of calm water. As the waves pass through the pipes, a system of turbines would capture their kinetic energy, producing electricity for use in the building. The entire base of the building, just below the water's surface, would be equipped with movable sluice gates fitted with turbines, thus forming a small underwater hydroelectric reservoir to power the new urban backdrop. At the same time, at the top, where there is a large public terrace overlooking the city, rows of figures reminiscent of the crenellated facades of Ca D'Oro, Fondaco dei Turchi, Fondaco dei Tedeschi or the statues at the top of Palazzo Giustinian Faccanon could be actively involved in the project by the Accademia di Venezia, support micro-wind turbines that exploit the constant and continuous flow of wind. In a city where current photovoltaic systems are incompatible with the landscape unless they are built in the form of photovoltaic tiles, with the associated reduction in efficiency, the project seeks to enter into symbiosis with the energies that drive the daily tidal cycles of the lagoon, in the belief that only the specificity of places can provide the possible symbolic and technical answer to construction and ecological transformation.

Over the centuries, every Venetian project has been conducted on the dual track of technical effectiveness and symbolic power. A continuous dismantling, enlarging, rebuilding, and moving, to restore the original image each time. Like the lead domes of St. Mark's Basilica, a necessary addition to restore the view from the water basin after the construction of the Doge's Palace, which had ended

up hiding them. There is no work today that can escape comparison with that representation, an intimate image of the city, its invisible power.

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Integrated Refurbishment of Traditional Mediterranean Buildings for Sustainable Tourism: Insights from the Aeolian Island Summer School 2024

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Angelo Monteleone[•] & Vincenzo Sapienza[♦]*

The Aeolian Island Summer School 2024 (AISS|24), held in Zucco Grande on the island of Filicudi, brought together students, professionals, and academics to address the challenges of revitalizing fragile Mediterranean heritage contexts. Through field surveys, theoretical lessons, and collaborative workshops, participants developed sustainable design proposals integrating traditional Eolian architecture with contemporary technologies. Passive features—such as thick stone walls and shaded outdoor areas—were reinterpreted with renewable energy systems to achieve energy self-sufficiency while preserving architectural integrity. The program also tackled seismic retrofitting using local materials and advanced structural techniques, and proposed sustainable mobility solutions including floating docks and solar-powered inclined elevators to enhance accessibility. Design strategies emphasized architectural grafting, reversible interventions, and adaptive reuse to support tourism-related functions such as culinary spaces and scattered accommodations. Concluding its fourth edition, AISS|24 demonstrated the transformative potential of design-based, interdisciplinary education. It highlighted how heritage conservation, environmental sustainability, and community revitalization can be integrated into replicable models for marginal territories.

Introduction

In the face of accelerating climate change, resource depletion, and widespread socio-cultural fragmentation, the built environment has emerged as both a site of vulnerability and an arena for innovation.¹ In peripheral and fragile contexts, there is growing interest in the potential of traditional settlements to serve as models for sustainable regeneration.² These historical environments, shaped by centuries of adaptation to climatic, topographic, and socio-economic conditions, offer a repository

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1. Donagh Horgan, and Branka Dimitrijević, "Social Innovation in the Built Environment: The Challenges Presented by the Politics of Space," *Urban Science* 5, no. 1 (2020): 1.

2. Hai-fan Wang, and Shang-chia Chiou, "Study on the Sustainable Development of Human Settlement Space Environment in Traditional Village," *Sustainability* 11, no. 15 (2019): 4186.

of resilient spatial and material practices.³ At the same time, they are exposed to abandonment, degradation, and the pressures of undifferentiated development. This paradox has prompted scholars and practitioners to seek integrated approaches that reconcile the preservation of cultural heritage with the urgent demands of environmental sustainability, social cohesion, and territorial revitalization.

Traditional Mediterranean settlements represent a fertile ground for this inquiry. Characterized by compact morphology, passive design strategies, and construction systems rooted in locally available resources, they exemplify a form of architecture that is both context-responsive and culturally embedded.⁴ These settlements can be interpreted through the lens of critical regionalism, not as nostalgic remnants, but as dynamic systems capable of informing contemporary design agendas.⁵ Moreover, when understood as part of broader socio-ecological landscapes, they align with emerging paradigms in landscape urbanism and heritage-led regeneration, which emphasize the integration of ecological, cultural, and infrastructural dimensions across scales.⁶

Within this framework, the Aeolian Islands offer a paradigmatic case study. This UNESCO-designated archipelago off the northern coast of Sicily is marked by a convergence of natural beauty, vernacular architecture, and intangible cultural heritage.⁷ However, many of its historic settlements, especially those in remote or topographically challenging locations, have suffered from long-term depopulation, infrastructural obsolescence, and neglect. Their regeneration requires more than conventional conservation; it demands interdisciplinary, participatory, and experimental models that are able to address complex challenges such as energy autonomy, seismic safety, sustainable tourism, and inclusive mobility.⁸

The Aeolian Island Summer School (AISS), now in its fourth edition, emerges as a design-research initiative that responds to these challenges through an innovative pedagogical framework. Organized by the University of Catania in collaboration with the Order of Engineers of the Province of Catania, AISS combines architectural education, design experimentation, and community engagement within a real-world context. Each edition is framed around a specific site and thematic focus, enabling participants—students, academics, and professionals from multiple disciplines—to explore context-sensitive design solutions that bridge tradition and innovation. The 2024 edition (AISS|24) focused on the abandoned village of Zucco Grande, on the island of Filicudi.

3. Zihan Chen, Su Liu, Wei Liao, and Junxue Zhang, "Construction of Security Pattern for Historical Districts in Cultural Landscape Based on MCR Model: A Case Study of Chaozong Street, Changsha City," *Sustainability* 15, no. 13 (2023): 10619.

4. Maria Philokyprou, Aimilios Michael, Eleni Malaktou, and Andreas Savvides, "Environmentally Responsive Design in Eastern Mediterranean: The Case of Vernacular Architecture in the Coastal, Lowland and Mountainous Regions of Cyprus," *Building and Environment* 111 (2017): 91-109.

5. Keith L. Eggener, "Placing Resistance: A Critique of Critical Regionalism," *Journal of Architectural Education* 55, no. 4 (2002): 228-237.

6. Grete Swensen, Vebjørn Egner Stafseng, and Véronique K. Simon Nielsen, "Visionscapes: Combining Heritage and Urban Gardening to Enhance Areas Requiring Regeneration," *International Journal of Heritage Studies* 28, no. 4 (2022): 511-537.

7. Simona Calvagna, Antonio Gagliano, Sebastiano Greco, Gianluca Rodonò, and Vincenzo Sapienza, "Innovative Multidisciplinary Methodology for the Analysis of Traditional Marginal Architecture," *Sustainability* 12, no. 4 (2020): 1285.

8. Mehrdad Chahardowli, Hassan Sajadzadeh, Farshid Aram, and Amir Mosavi, "Survey of Sustainable Regeneration of Historic and Cultural Cores of Cities," *Energies* 13, no. 11 (2020): 2708.

This site, characterized by its architectural authenticity, ecological fragility, and socio-spatial isolation, provided an ideal setting for rethinking sustainable tourism and heritage recovery through collaborative design. This paper investigates how a learner-centered, design-based methodology can be employed in fragile, heritage-rich environments to develop sustainable, place-specific regeneration strategies. The AISS|24 program is presented not only as a case study, but as a replicable model for integrating environmental, structural, and cultural sustainability within architectural education and heritage practice.

The pedagogical structure of AISS|24 was rooted in active learning and research-by-design methodologies. Participants were engaged in a sequential process that combined theoretical instruction, fieldwork, interdisciplinary workshops, and digital prototyping.⁹ The approach reflects a broader trend in architectural education that emphasizes project-based inquiry, transversal competence-building, and context-embedded knowledge production. By situating learning within a real territorial context and involving local stakeholders, the Summer School fostered a reflexive, collaborative, and situated understanding of design as a socio-technical and cultural practice.

This paper presents the conceptual underpinnings, methodological articulation, and main outcomes of AISS|24. Its aim is twofold: first, to demonstrate how the integration of traditional know-how, sustainable technologies, and digital design tools can support innovative, low-impact interventions in fragile heritage contexts; and second, to reflect on how design-based educational models can contribute to the broader discourse on ecological transition, cultural continuity, and territorial resilience in Mediterranean settings. In doing so, the paper seeks to position AISS|24 as a replicable framework for action-oriented research and transdisciplinary learning, with relevance for similar marginal or depopulated areas undergoing socio-environmental transition.

The educational approach of AISS|24 also aligns with the objectives of the European Education Area and the UN's 2030 Agenda for Sustainable Development, particularly Target 4.7, which emphasizes the need to ensure that learners acquire the knowledge and skills necessary to promote sustainable development.¹⁰ Furthermore, the program reflects principles advocated by the New European Bauhaus, particularly in its emphasis on inclusive, place-based, and transdisciplinary learning.¹¹

Methodology

The AISS|24 was structured around a learner-centered and research-by-design methodological framework that emphasized active, situated, and interdisciplinary learning (Figure 1). Building upon the pedagogical foundations established in previous editions, AISS|24 reaffirmed the importance of shifting from passive

9. Christiane Reilly, and Thomas C. Reeves, "Refining Active Learning Design Principles through Design-Based Research," *Active Learning in Higher Education* 25 (2024): 81-100.

10. Kalterina Shulla, Walter L. Filho, Salim Lardjane, Jan H. Sommer, and Christian Borgemeister, "Sustainable Development Education in the Context of the 2030 Agenda for Sustainable Development," *International Journal of Sustainable Development & World Ecology* 27 (2020): 458-68.

11. María J. Rosado-García, Renata Kubus, Ramón Argüelles-Bustillo, and María J. García-García, "A New European Bauhaus for a Culture of Transversality and Sustainability," *Sustainability* 13, no. 21 (2021): 11844.

knowledge transmission to an experiential and participatory educational model. This approach foregrounds the co-production of knowledge through immersive design challenges, real-world engagement, and iterative collaboration among diverse actors.

Rooted in the principles of constructivist learning and informed by the literature on design-based research (DBR¹²) and project-based education, the methodology promoted the development of critical thinking, transversal skills, and context-specific design capacities. The educational strategy was structured to ensure the progressive acquisition of knowledge, moving from theoretical understanding to analytical practice and ultimately to creative synthesis. This pedagogical progression was articulated in four sequential and interconnected phases: (1) Theoretical instruction; (2) Practical and analytical sessions; (3) Immersive design workshops; and (4) Digital prototyping and presentation.

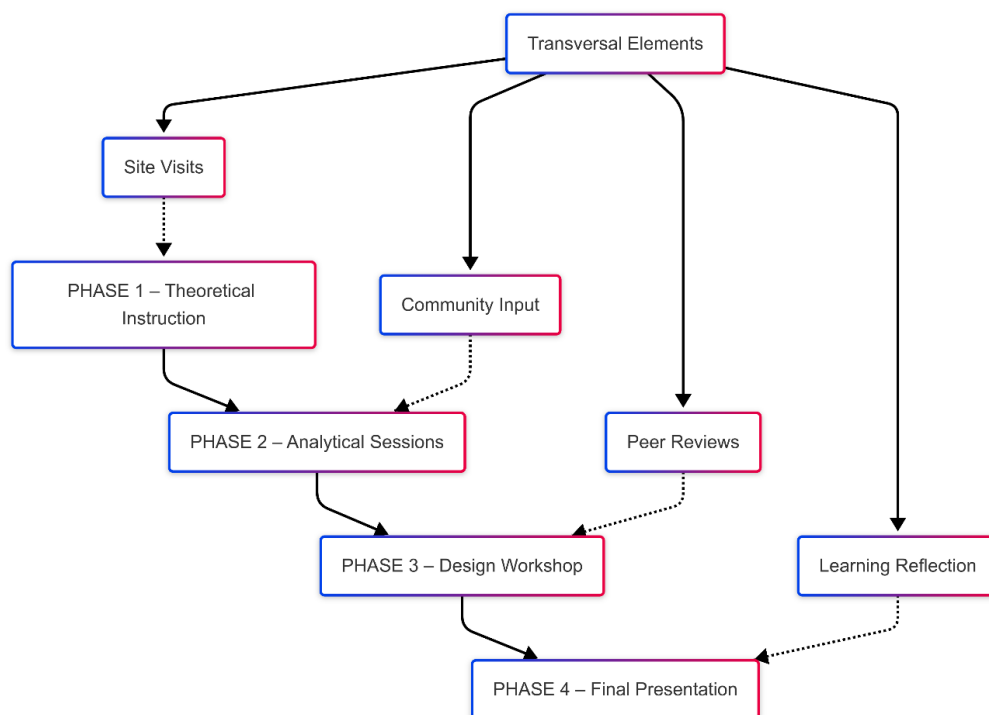


Figure 1. *AISS|24 Methodological Framework: A Design-Based, Learner-Centered Pedagogical Model for Sustainable Heritage Recovery*

Participants

Participants were recruited through a public call issued by the Order of Engineers of the Province of Catania and the Department of Civil Engineering and Architecture of the University of Catania. The Summer School was open to professional engineers registered with the Catania Order, master's students in the final years of civil/building engineering and related programmes, and recent

12. Güneş M. Avinç, "Design-Build Projects in Architecture Education and Experimental Structures as a Pedagogical Approach," *Journal of Engineering Science and Technology Review* 17, no. 4 (2024): 228-239.

graduates (within one year); if places remained, members of other professional Orders and students from other universities could also be admitted. The call required an application form and curriculum and invited candidates to indicate their first and second choice for the thematic area in which they must be involved (building reuse and new functions; structural diagnostics and seismic upgrading; energy retrofitting and renewables/energy communities; accessibility and green mobility; hydrogeological risk mitigation), which were later used to form balanced interdisciplinary groups. Applications were assessed by the Scientific Committee, primarily in chronological order and, for students and recent graduates, with priority to first-time participants. Thirty-one participants completed all activities and the final survey; the cohort comprised professional engineers, advanced students and recent graduates with previous experience in architectural/structural design and construction technology. Participation was voluntary, and all participants gave informed consent for the anonymised use of their data and project materials for research and dissemination purposes.

Theoretical Instruction

The first phase consisted of a curated series of lectures designed to provide participants with the cultural, environmental, and technical foundations necessary to engage with the case study. These lectures were interdisciplinary, covering a range of topics such as the historical evolution of Aeolian settlements, the morphological and ecological features of the Filicudi landscape, typological characteristics of vernacular architecture, principles of passive environmental design, and the seismic vulnerabilities of traditional construction. Technical instruction included the application of digital tools for environmental simulation and structural assessment, integrating BIM-based modeling, climate analysis, and energy performance evaluation.

Rather than operating in isolation, the lectures functioned as conceptual frameworks to be challenged, deepened, and operationalized during the subsequent phases. Emphasis was placed on positioning traditional knowledge systems in dialogue with contemporary sustainability and resilience paradigms, inviting critical reflection and reinterpretation.

Practical and Analytical Sessions

The second phase enabled participants to translate theoretical inputs into operational knowledge through hands-on exercises and analytical exploration. These sessions included on-site and desk-based activities such as morphological and typological surveys, site mapping, solar path and microclimate analysis, material behavior studies, and the use of parametric modeling tools. Conducted at the University of Catania and during the early stages of field engagement, these activities served to ground participants in the specificities of the site and to build a shared methodological toolkit.

Particular attention was given to the integration of digital technologies, facilitated by the involvement of ETALab (Enabling Technologies for Architecture Laboratory). Demonstrations and exercises in digital scanning and rapid prototyping tools provided a bridge between analog heritage systems and computational design approaches.

Experiential Learning Module: Field-based Design Studio in Zucco Grande

The third and central phase of the methodology was the immersive interdisciplinary design workshop conducted in the abandoned village of Zucco Grande on Filicudi Island. This site was chosen based on multiple selection criteria: its architectural and environmental value, its morphological complexity, and its capacity to stimulate design thinking around themes of isolation, decay, and resilience. The village's partial ruination and difficult access rendered it a setting for experiential learning and critical experimentation.

Participants were organized into seven interdisciplinary working groups, each assigned a thematic challenge related to the broader goal of sustainable heritage recovery. These themes included architectural adaptation and reuse, energy self-sufficiency, resource management, passive thermal comfort, sustainable mobility, seismic risk mitigation, and structural consolidation. Design challenges were framed within a shared master plan vision, which encouraged inter-group coordination, mutual feedback loops, and spatial coherence across different interventions.

Each group's workflow followed an iterative logic: site analysis, conceptual framing, design development, peer review, and prototype refinement. Tutors and mentors from architecture, engineering, and environmental disciplines provided ongoing supervision and critical dialogue, ensuring both technical feasibility and design sensitivity.

There are several design-build or heritage studios within global academic institutions including Rural Studio (Auburn University, USA), the worldwide European dbXchange Network, the CIRC-ARCH /Crafting Circularity (Antwerp University, BE) or Officina (IUAV University, IT). Specific applications of "learning by doing" in architectural topics are analyzed by Güneş¹³ where the pavilions produced by students in different Universities between 2010 and 2022 were researched and evaluated. The integration of design-build projects and experimental structures within the architectural education curriculum has been demonstrated to engender active student participation, foster the development of creative thinking skills, and facilitate the exploration of significant issues such as sustainability, recycling, innovative and advanced construction techniques.¹⁴

This approach has been adopted in AISS|24 with, in addition, the integration of parametric design, rapid prototyping, and active heritage learning in a context of seismic and climatic vulnerability. Unlike traditional preservation-focused models, AISS|24 positions students not as observers but as co-producers of resilient solutions with real territorial and pedagogical impact.

13. Sardar S. Shareef, Hozan L. Rauf, and Ejeng B. Ukabi, "Reconsidering Teaching Construction in Architectural Education," *Journal of Philology and Educational Sciences* 3, no. 1 (2024): 43-57.

14. David A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development* (New Jersey: FT Press, 2014).

Digital Prototyping and Final Presentation

The fourth phase focused on the material and communicative translation of the design proposals. Using a range of analog and digital tools, including physical modeling, parametric scripting, and rendering techniques, participants refined their proposals into project narratives suitable for public dissemination. Special attention was paid to the integration of sustainability indicators—such as energy performance, material circularity, and environmental impact—as evaluative criteria for the proposals.

This phase culminated in a final public event at the University of Catania, during which each team presented their design to a multidisciplinary audience. The event was conceived not only as a conclusion, but as a platform for collective learning and trans-scalar reflection, reinforcing the participatory and transformative goals of the program.

Assessment of Design Proposals

The seven design proposals developed by the interdisciplinary groups were evaluated during the final public review by a panel consisting of the School's teaching staff and invited external experts from academia and professional practice. To ensure comparability across projects, a set of shared assessment criteria aligned with the intended learning outcomes and the objectives of the AISS|24 was adopted: (1) understanding and interpretation of the local context (heritage values, landscape and environmental constraints); (2) integration of sustainability dimensions (energy performance, seismic safety, accessibility and social use) in a coherent design concept; (3) feasibility and reversibility of the proposed interventions with respect to the fragile setting; (4) quality of interdisciplinary collaboration (e.g., explicit contribution of different disciplines to the proposal); and (5) clarity of representation and communication (drawings, models, diagrams, and oral presentation). Each proposal was discussed and assessed against these criteria; feedback was then used as a basis for revising and refining the projects and for the critical reflection activities reported in the Results and Discussion section.

Evaluation of Learning Outcomes

To evaluate the educational impact of AISS|24, an anonymous post-programme questionnaire was designed and administered online during the final day of activities. The survey comprised three sections: (i) background information (study programme, year, previous experience with heritage and sustainable design), (ii) eighteen closed-ended items on perceived learning outcomes and quality of the educational experience, and (iii) three open-ended questions inviting critical reflection on strengths, weaknesses and suggestions for improvement. Closed-ended items were formulated as statements (e.g., "The Summer School improved my ability to integrate sustainability considerations into heritage projects") and rated on a 5-points Likert scale from 1 ("strongly disagree") to 5 ("strongly agree").

Responses to closed-ended items were analysed using descriptive statistics such as frequencies and percentages, focusing on indicators related to interdisciplinarity, integration of sustainability and heritage, effectiveness of the four-phase structure and

perceived usefulness of digital tools. Open-ended responses were examined through an inductive thematic analysis: two authors independently coded the comments, grouped them into recurring themes (e.g., perceived added value of on-site immersion, workload and timing, suggestions on logistics), and resolved discrepancies through discussion until consensus was reached.

Educational Foundations of the AISS|24 Pedagogical Model

The pedagogical model adopted by AISS|24 is grounded in constructivist and experiential learning theories, emphasizing the role of learners as active participants in the co-construction of knowledge. It draws inspiration from Kolb's experiential learning cycle,¹⁵ in which concrete experience, reflective observation, abstract conceptualization, and active experimentation form a cyclical and integrated process. Furthermore, the collaborative and situated dimension of the program aligns with Wenger's theory of communities of practice, where learning emerges through social interaction within a shared domain of interest. The real-world complexity of the design challenges presented in AISS|24 reflects Schön's concept of the "reflective practitioner",¹⁶ fostering the development of professional judgment through action and critical reflection. The structure of AISS|24 echoes the principles of design-based research (DBR,¹⁷) in which pedagogical innovation is tested, refined, and assessed in iterative cycles within authentic contexts. In this scenario, we stimulate the students to be able to move from siloed disciplinary thinking to actively navigating "wicked problems" in interdisciplinary teams within transdisciplinary learning environments, according to similar experiences like Anchor framework,¹⁸ which conceptualises universities as civic anchors that co-create solutions with local communities through project-based, real-world challenges.

Aeolian Islands and Aeolian Houses

The Aeolian Islands are a very suitable case study for several reasons. The most important of these is the remoteness of the location, which is offset by the strong relationship between architecture and landscape. Secondly, there is the presence of cultural and natural excellences, which are of interest to tourists.

The Aeolian Archipelago is located off the northern coast of Sicily, at a distance of just over 12 nautical miles from the Cape of Milazzo. It comprises seven large inhabited islands and numerous rocky outcrops. The largest of the "Seven Sisters" (as the locals call them) is Lipari, which has played the role of the archipelago's capital since time immemorial, despite Salina Island's larger

15. Donald A. Schön, *The Reflective Practitioner: How Professionals Think in Action* (Londra: Routledge, 2017).

16. Sasha Barab, and Kurt Squire, "Design-Based Research: Putting a Stake in the Ground," *Journal of the Learning Sciences* 13, no. 1 (2004): 1-14.

17. Avinç, "Design-Build Projects in Architecture Education and Experimental Structures as a Pedagogical Approach," 2024, 228-239.

18. Calayde Davey, "The ANCHOR Framework," in *Proceedings from the International Research Symposium on Problem-Based Learning (IRSPBL)* (2025).

economic presence (Figure 2). The islands have a documented history dating back to prehistoric times. They have experienced both prosperous and depressed periods throughout history, such as the free kingdom of the Eolian people in the 6th century BC, the surrender to the Roman fleet of Consul Aurelio Cotta during the Punic Wars (252 B.C.), and the colonization by Lord Ruggero D'Altavilla the Norman, as well as the sack by the Saracen pirate Ariadeno, known as Barbarossa, in 1544,¹⁹ The Aeolian Islands were recently rediscovered by the public thanks to the famous 1949 film *Stromboli*, starring Ingrid Bergman and directed by Roberto Rossellini. The archipelago's value has also been recognised by UNESCO, which added the islands to its World Heritage List in 2000.

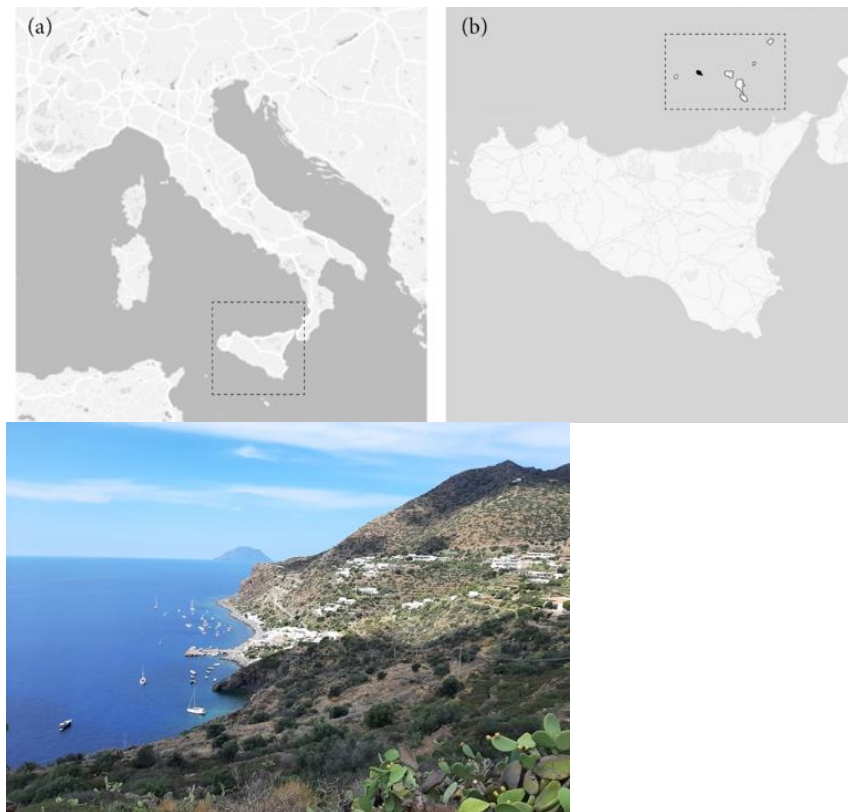


Figure 2. *The Aeolian Archipelago and its Built Environment: (a) Location at the National Scale; (b) Location at the Regional Scale; (c) Typical Example of Aeolian Vernacular Architecture*

Filicudi lies in the western arm of the Aeolian Islands. Although Stromboli is closer to the Sicilian coast, Filicudi and nearby Alicudi are more isolated because they lie far off the Milazzo-Lipari-Naples route, which was once frequented by merchant ships and is now popular with tourists. Nevertheless, Filicudi boasts the

19. Moses I. Finley, Denis Mack Smith, Christopher Duggan, and G. Codignola, *Breve storia della Sicilia* (Bari: Laterza, 1992).

longest history: a prosperous community that traded obsidian lived on the small hill of Cape Graziano from the Neolithic to the Bronze Age²⁰ (Figure 3).



Figure 3. *The Archeological Site of Cape Graziano: A Village of Bronze Age (from 2300 B.C. to 1300 B.C.)*

The relationship between the inhabitants and the natural environment has created a stunning landscape, the result of hard work on the land. Thanks to its isolation, Filicudi Island has managed to preserve its rural landscape more effectively. It has now become a popular destination for naturalists from all over the world, having been declared a protected nature reserve in 1997.

Filicudi is "the Island of Ferns", or perhaps "of the Phoenicians". It is certainly a suggestive island of the Aeolian Archipelago with six eruptive centres: the Fili di Sgiacca, the Zucco Grande, the Fossa delle Felci, the Monte Torrione, the Montagnola and the Capo Graziano. The coast is dotted with numerous caves and lava cavities, the best known of which is the Grotta del Bue Marino, once a breeding of reproduction of the Monk Seal, now extinct. Today, the island of Filicudi, about 9.5 km² and with a maximum elevation of 774 m a.s.l., is characterized by a series of scattered districts that have formed along the winding axes of the mule trails created to serve the terracing system, very peculiarity of the island.

One of the centres worth visiting is Zucco Grande, a village in the north-east of Filicudi. Zucco Grande is an abandoned village. To reach it, you must walk two kilometres along a footpath, leaving the inhabited part of the island behind.

The village was once home to 300 people, and their houses, now in ruins, are surrounded by vegetation. The site is indicated on 19th century cadastral maps

20. M. C. Martinelli, *Aeolian Islands Filicudi in the Bronze Age* (Palermo: Sicily Department of Cultural Heritage and Sicilian Identity, 2015).

(Figure 4). The streets, now covered in ferns and volcanic lava, are evidence of Filicudi's geological history and recall the antiquity of this place, which emerged from the volcanic archipelago almost 600,000 years ago. It is said that the most beautiful women on the island lived in this village. The elders remember musical processions by groups of men who wanted to impress the renowned Zucco Grande maidens. Nearby is Filicudi's only water source: Vallone Fontana. Today, it has dwindled to a single stream, yet the area's vegetation remains among the lushest on the island.

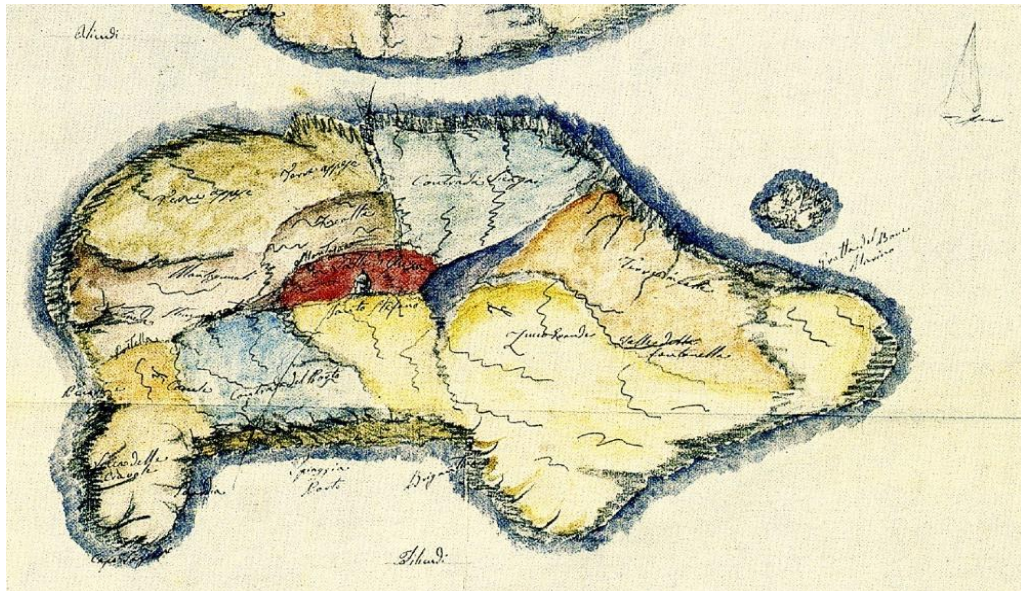


Figure 4. *The Island of Filicudi in a 19th Map: Underlined in Red the “Zucco Grande” Village*

Aeolian Islands Summer School

The Aeolian Islands Summer School forms part of a program of ongoing training activities organised in collaboration between the Catania Engineering Council and the University of Catania. It consists of an intensive, innovative teaching course, usually held in September. Each year, a specific focus is chosen and developed by mixed working groups under the supervision of a multidisciplinary teaching staff. The school's goal is to develop knowledge, skills and competences in the field of innovation.

The Summer School aims to develop skills and competencies that are useful in everyday professional life. The course provides a comprehensive experience, covering everything from concept sketching to defining executive details. The organization began in 2019 with the first edition held in the city of Catania. Since 2022, the school has been hosted on the island of Filicudi, focusing on the promotion of Aeolian architecture. From that date onwards, it has been known as the "Aeolian Islands Summer School".

The 2022 edition of the Summer School was entitled "Sismo-energy requalification of historical buildings". It focused on the design features of refurbishment works for

traditional buildings, with the aim of improving energy efficiency and seismic resilience through an integrated design approach. The Aeolian houses were a perfect case study for this purpose because they can be considered ante-litteram sustainable buildings and have withstood several earthquakes over the years.²¹ Taking into account the specific requirements of the area, the refurbishment design incorporated innovative solutions for tourist accommodation, such as short-term rentals, holiday homes, and home restaurants.

The careful analysis of the characteristics of Aeolian architecture, even in its ruined state, guided the workshop participants, who were divided into six working groups. Many of the solutions presented by the working groups were based on Aeolian building practices and the distributional specificities of traditional architecture. The revival of the traditional bagghiu, complete with pergola and wooden features, was a recurring theme in all the proposals (Figure 5). The working groups tried to reconcile compliance with conservation rules, improvement of the buildings' seismic response, current comfort standards and the need to reduce energy and water consumption within the strict regulatory framework of the area in question,²² with varied outcomes and not without some difficulty.



Figure 5. *A Typical Aeolian House: We Can See the Bagghiu and its Pergola in Reed Mat*

The Summer School 2023, titled "Building Digital Technologies for Sustainable Architectural Units", focuses on innovative technologies most suitable for temporary micro-architecture in fragile contexts. The following considerations led to its creation.

21. Alessandro Lo Faro, Angelo Monteleone, Gianluca Rodonò, and Vincenzo Sapienza, "The Seismic-Energetic Refurbishment of Vernacular Architecture: An Application to Aeolian Island (Italy)," in *10th Euro-American Congress on Construction Pathology, Rehabilitation Technology and Heritage Management (Rehabend 2024)*, a cura di Círculo Rojo, 1501-1508 (2024).

22. Ibid.

The enhancement of building heritage is an important opportunity for territorial development. Although it is mandatory to imagine new ways to create more space, adapt existing buildings to new uses and standards, or provide new functions and facilities in the area, it is also important to consider new ways to achieve this. To this end, it is crucial to develop expertise in advanced design methodologies for innovative, lightweight building components formed from recycled and recyclable materials assembled using dry technologies. These methodologies allow for new types of intervention involving reversible and removable additions to existing buildings. Furthermore, the scope has been broadened from architecture to landscape, taking into account innovative solutions for new constructions.

The island of Filicudi has two tourist ports, two archaeological sites and several ruined buildings. There are therefore many places where actions to valorize the local cultural heritage or improve the tourist reception can be planned, using mobile, temporary and new architectural units.²³ To this end, lightweight, sustainable and reversible building technologies are essential, as they help to keep the building site clear and reduce invasiveness.

Participants were asked to design two pavilions for tourist reception in port areas, two pavilions for showcasing prehistoric finds at archaeological sites, and two traditional Aeolian house extensions to serve as information points. The designs were created using corrugated cardboard and wood. The high performance possible with these materials, even in the AEC sector, was demonstrated in a recently completed research project²⁴ and an ongoing one.²⁵ The University of Catania has played a central role in both projects. Using less invasive building technologies may help to meet the need for respect and preservation of the local architecture thanks to their reversibility.

The Summer School 2023 will focus on the following goals:

- Design approach for small-scale architecture.
- Checking that the landscape is suitable.
- Using digital tools for architecture.
- Using parametric models.
- Use of the rapid prototyping tools.

The working groups had been addressed towards the use of some innovative building technologies, such as:

- ACHICART: it is based on alveolar precast panels that are made by corrugated cardboard; these panels are used for the building's outer walls and also for the structure that holds up the building; this technology has already been tested for use in a small experimental building called Test-Box.²⁶

23. Next Generation UE, *PNRR Isole verdi* (Ministero dell'Ambiente e della Sicurezza Energetica).

24. Early Warning System for Cultural Heritage, *EWAS Project*.

25. Archicart, *Archicart Lifehouse Project*.

26. Dario L. Distefano, Gianluca Rodonò, and Vincenzo Sapienza, "Le nuove frontiere dell'architettura di cartone," *Il progetto sostenibile* 38 (2016): 112-119.

- ICARO: it is the acronym of Innovative Cardboard ARchitectual Object and it is based on a precast mixed panel that combines wood and corrugated cardboard. These two materials work well together thanks to a sort of pre-stress. Icaro technology has already been tested by building a small experimental pavilion in a Sicilian archaeological area.²⁷
- LAYERS: the fundamental premise of this technology is the decomposition of the architectural object into a series of layers, which may be either vertical or horizontal. These layers can be constructed from wood and assembled with either a mutual gap or in direct contact. This technology is primarily concerned with the fabrication of objects with organic shapes.

In the development of the design activities, a digital workflow was assumed in the various phases of the process: from the survey of the areas to the rapid prototyping of physical models. This phase was facilitated by the collaboration of the ETALab, a facility of the University of Catania.²⁸ The proposed methodology was found to be highly suitable for the building technologies that had been adopted, and it was also found to be in line with the digital transition to which the AEC sector was moving towards.²⁹

The Aeolian Island Summer School 2024 (AISS|24)

Educational Framework for Sustainable Heritage Design

The AISS|24 was conceived as an interdisciplinary educational initiative aimed at exploring innovative strategies for the integrated recovery of traditional buildings in Mediterranean contexts, with a particular emphasis on fostering sustainable tourism hospitality. Bringing together academics, professionals, and students from diverse fields such as architecture, civil engineering, transportation, and environmental sustainability, the program promoted a collaborative learning environment where theoretical knowledge and practical experience converged.

Organized by the University of Catania in collaboration with the Order of Engineers of the Province of Catania and supported by local authorities, the Summer School focused on the historic village of Zucco Grande, located on the island of Filicudi, as its primary case study. This site, rich in cultural heritage yet marked by abandonment and decline, offered a setting in which to explore the challenges and opportunities associated with the revitalization of traditional Mediterranean architecture.

The pedagogical approach adopted by AISS|24 was structured to blend academic instruction with immersive fieldwork, enabling participants to develop

27. Vincenzo Sapienza, Gianluca Rodonò, Angelo Monteleone, and Simona Calvagna, "ICARO—Innovative Cardboard Architecture Object: Sustainable Building Technology for Multipurpose Micro-Architecture," *Sustainability* 14, no. 23 (2022): 16099.

28. Enabling Technologies for Architecture Laboratory (ETALab).

29. Vittoria Bonini, Paolo Galelli, and Alessio Minetto, *Tomorrow is Reloading: Il ruolo del digitale nel progetto della città contemporanea*. (Genova: Genova University Press, 2022); Microsoft, and RIBA. *Digital Transformation in Architecture*.

context-sensitive design solutions grounded in direct observation and experiential learning. The program followed a blended learning model integrating lectures, site surveys, workshops, and collaborative project development.

The educational goals of the initiative included fostering interdisciplinary cooperation in the resolution of complex architectural and environmental problems; advancing the application of passive design principles and renewable energy technologies to enhance the sustainability of historic buildings; investigating new solutions for improving accessibility and mobility in geographically isolated but culturally significant areas; and formulating design methodologies for the structural consolidation of vernacular buildings, with specific attention to seismic safety and the conservation of original materials.

Program and Activities

Running from September 13 to October 12, 2024, the Summer School was designed to provide participants with a comprehensive understanding of sustainable strategies for the integrated recovery of traditional Mediterranean buildings, using the abandoned village of Zucco Grande on the island of Filicudi as a real-world case study.

The program officially began on September 13 with the Inaugural Day hosted at the headquarters of the Order of Engineers of the Province of Catania. This opening session introduced participants to the objectives, methodologies, and thematic priorities of AISS|24, highlighting the central focus on sustainability, cultural heritage preservation, and community-centered design. A series of lectures followed, addressing key topics such as traditional Mediterranean architecture, sustainable tourism development, passive design techniques, energy efficiency, and the seismic vulnerabilities of historic buildings. At the end of the session, participants were divided into seven interdisciplinary working groups, each tasked with developing a design proposal tailored to specific challenges and opportunities identified within the Zucco Grande site.

On September 18, participants attended a Keynote Lecture held at the Ex Chiesa di Santa Caterina d'Alessandria in Lipari. The event featured renowned experts in architecture and environmental sustainability who presented on a variety of subjects, including bioclimatic design, strategies for regenerating abandoned villages, the potential of renewable energy communities in remote territories, and the historical evolution of coastal settlements in the Mediterranean.

From September 19 to 22, participants traveled to Filicudi to carry out an intensive fieldwork phase on site at Zucco Grande (Figure 6). This immersive segment of the program enabled students to gain a direct understanding of the architectural, environmental, and socio-cultural dimensions of the location. During this phase, they conducted architectural surveys to document existing structures and evaluate building techniques and material conditions; carried out environmental assessments to analyze microclimatic behavior, resource availability, and landscape constraints; examined accessibility challenges imposed by the island's rugged topography; and engaged with local stakeholders to collect oral histories and perspectives on the significance and future potential of the village. These activities served as the foundation for the subsequent development of design solutions grounded in real-world conditions.

After returning to Catania on September 23, participants entered the final stage of the project development phase, which lasted until October 4. During this period, the working groups refined their concepts and advanced their proposals into more comprehensive and integrated design solutions, incorporating feedback from academic mentors. The resulting projects addressed several interconnected themes. These included reconciling the conservation of traditional forms with modern sustainability objectives through the use of passive strategies and local materials; incorporating renewable energy technologies such as photovoltaic systems and rainwater harvesting combined with passive cooling techniques to reduce energy dependence; developing innovative strategies to improve accessibility while minimizing environmental impact through the design of pedestrian paths and sustainable transport solutions; proposing structural reinforcement and seismic retrofitting techniques that respected the conservation requirements of historic architecture; and envisioning community-centered public spaces that could strengthen local identity, enhance the tourism offering, and support economic revitalization.

The Summer School culminated on October 12 with the Final Presentation and Exhibition held at the University of Catania. This concluding event offered a formal opportunity for each group to present their work to an audience of academics, professionals, local stakeholders, and public administrators. Through drawings, models, and multimedia presentations, participants articulated the challenges they encountered and the design solutions they developed over the course of the program. Beyond celebrating the achievements of the working groups, the event fostered valuable dialogue among different stakeholders, encouraging wider reflection on sustainable heritage recovery and underscoring the importance of interdisciplinary collaboration in addressing the multifaceted challenges of fragile contexts.



Figure 6. *Participants in Zucco Grande, Filicudi*

Results and Discussion

Design and Prototyping

Working in seven interdisciplinary groups, participants tackled a range of issues including energy optimization, structural reinforcement, sustainable mobility solutions, and heritage conservation strategies. Each group developed a detailed proposal that not only addressed the specific challenges of Zucco Grande but also explored the broader implications of sustainable development in Mediterranean contexts.

The following sections of this paper outline the structure of the Summer School, describe the key activities and workshops conducted, and present the outcomes of the group projects, which collectively demonstrate a range of innovative approaches to sustainable heritage recovery.

It must be clarified that all sustainability metrics presented in the following sections, such as energy savings or emission reductions, are predicted indicators

derived from simulations and design calculations, not empirical measurements of built interventions.

Taking into account the complexity of the project, the various groups were involved in addressing the different issues in an integrated multidisciplinary design process starting from an initial master plan (Figure 7), in which the work of each group was directly linked to the emerging requirements and the results obtained in the development phase of the other groups, aimed at identifying potential problems and conflicts throughout the design phase. It is important to highlight that the design process was iterative. Several proposals underwent significant revisions based on feasibility critiques and inter-group feedback. For instance, initial mobility plans were deemed overly invasive, requiring a shift to lighter, modular infrastructure. Similarly, early concepts for the "Albergo Diffuso" required simplification to meet the constraints of the existing ruins and resource availability, highlighting a common challenge in balancing ambitious revitalization with practical conservation.



Figure 7. *Zucco Grande Project Master Plan*

The first two groups worked on the project of recovery and functional revitalization of the existing through design proposals aimed at transforming the old buildings and the traces of the ruins into spaces dedicated to tourist reception. The third and fourth groups, taking inspiration from the previous design proposals and the renewed needs in terms of comfort and energy demand, worked on the energy requalification project of the old buildings and on the study of strategies for the production of sustainable energy, but also the management of resources in Zucco Grande. The fifth group was engaged in the accessibility project to the site chosen as a case study, with the aim of also renewing the mobility system of the island. The last two groups finally addressed the issue of seismic risk mitigation and structural consolidation.

Group Volcano – "L'innesto"

The Vulcano team explored the concept of architectural grafting (the graft) as a strategy to merge contemporary interventions with the existing historical fabric of Zucco Grande. The primary objective was to create a dialogue between past and present, promoting architectural continuity while introducing new functions that could revitalize the abandoned settlement. This approach was selected as an alternative to conservative restoration or demolition with reconstruction, allowing the valorization of the urban context through a new identity linked between past and future (Figure 8).



Figure 8. *Rendered View and Main Elevation of the Work of the Vulcano Group*

Key interventions included the use of platform frame structures made of sustainable materials such as heat-treated wood and locally sourced stone, ensuring minimal environmental impact and strong contextual integration. These modular and lightweight structures were designed to be reversible and adaptable, allowing for future modifications without compromising the integrity of the original architecture. The project emphasized the creation of common spaces that could serve both residents and visitors, promoting social interaction and community involvement. Courtyards, shaded terraces and outdoor gathering areas have been strategically incorporated to enhance usability and enhance the spatial experience, while respecting the environmental sensitivity of the site.

Group Filicudi – "Albergo diffuso"

The Filicudi team focused on the adaptive reuse of existing buildings and traces to develop a model of "Albergo Diffuso" that supports sustainable tourism while preserving the cultural identity of Zucco Grande. The project involved the reconstruction of the old collapsed volumes and the transformation of the scattered historical structures into interconnected hospitality spaces that could attract visitors and at the same time promote local economic growth. Starting from the refurbishment of the old oven, a new kitchen was designed in compliance with current regulatory standards. Since the south-west part of the buildings has two elevations above ground, the ground floor was dedicated to tourist-receptive activities, while the rooms on the first floor were reserved for the exclusive use of the host. All the new functions were integrated into the traditional layout of the village. For the reconstruction of the old volumes on the ground floor, traditional materials and techniques were re-proposed, while for the total reconstruction of the area adjacent to the oven area, the second floor of the host's residence, the room that will serve as a guest room and the independent block containing the toilets and the administrative office, Steko wooden blocks were used, subsequently covered in wooden boards treated with the Shou Sugi Ban technique, a solution that aesthetically dialogues with the pre-existing structure and at the same time improves the weather resistance of the covering itself (Figure 9).



Figure 9. Section and Construction Detail of the Work of the Filicudi Group

Particular attention was paid to the enhancement of the existing water management systems, including the restoration of the rainwater collection tanks, reflecting the Aeolian architectural tradition of resource-conscious design. The project also promoted local gastronomy and cultural heritage by incorporating spaces for cooking classes, local produce markets and community events. By revitalizing abandoned buildings and activating common spaces, the project aimed to create a model of sustainable tourism rooted in the local culture and traditions of Filicudi.

The project preserved and reactivated existing rainwater cisterns. Design projections estimated 18,000-liter seasonal capacity, which simulations indicated could meet 60–70% of domestic non-potable water use during high tourist season, potentially reducing dependency on imported water by an estimated 40%.

Group Lipari – "Continuum"

The Lipari team developed a proposal for a visitor hub and first contact tourist center that would serve as an entry point to Zucco Grande, enhancing the experience of both residents and tourists. The project aimed to create a seamless transition between the historic village and the surrounding natural landscape, while promoting environmentally responsible tourism. The project included a reception area, an information center, and local craft shops, all arranged around an open plaza that could serve as a gathering space for visitors and the local community. In order to obtain spaces dedicated to the new functions starting from the restoration of the pre-existing volumes, the reconstruction of the collapsed parts on the first floor was planned with new masonry covers, whose finish allows to differentiate the new blocks from the pre-existing parts (Figure 10).



Figure 10. *Main View of the Work of the Lipari Group*

The architectural approach emphasized passive design strategies, such as natural ventilation, solar shading, and the use of green roofs, to improve energy efficiency and reduce the ecological footprint. A network of pedestrian paths has also been introduced to improve connectivity within the site, encouraging slow mobility and fostering deeper engagement with the local landscape. By integrating tourism services with community spaces, the project has reinforced the idea of a continuum between cultural heritage, nature and contemporary life.

Group Salina – "Zucco Green"

The Salina team pursued the challenge of energy self-sufficiency by proposing strategies for sustainable energy production and resource management within Zucco Grande. In this case, the group was directed to design strategies and interventions aimed at energy efficiency of buildings and sustainability. The primary objective was to create a model for an energy resilient village that could operate independently, minimizing its environmental impact (Figure 11).

Simulations indicated that the project incorporated expanded cork panels for thermal insulation, reducing the U-value of external walls by approximately 60% compared to the existing stone masonry. The photovoltaic system was dimensioned to meet at least 85% of the expected energy demand based on simulated annual solar gain. These interventions aim to lower operational energy consumption below 40 kWh/m²·year, consistent with NZEB criteria in Mediterranean zones.

The integration of photovoltaic panels and multi-split heat pumps enabled renewable energy generation and efficient climate control, while passive cooling strategies – such as shading devices and cross-ventilation – further reduced energy consumption. Water management was also a focus, with the implementation of rainwater collection systems and greywater recycling to promote the circular use of resources. A community energy hub was proposed as a central hub for monitoring energy flows, encouraging the creation of a renewable energy cooperative that could support local residents and future visitors.



Figure 11. Integration of Photovoltaic Panels in Buildings and Energy Results of the Work of the Salina Group

Group Stromboli – "Mobilità Sostenibile & Accessibilità"

The Stromboli team addressed the critical issue of mobility and accessibility, aiming to improve transportation options within Zucco Grande while preserving the ecological integrity of the island. The project aimed to improve connectivity for both residents and tourists, particularly in areas that are currently difficult to access due to the rugged terrain. One of the group's key proposals was the development of an electric sea-bus network, designed to provide zero-emission transportation between Zucco Grande and other parts of Filicudi. Modular floating pontoons constructed from recycled materials were introduced to create three seasonal landing places, to facilitate safe and flexible mooring points. A solar-powered inclined panoramic elevator was proposed to connect the coastal area with the village at a higher altitude, offering an accessible and environmentally friendly alternative to traditional routes. An intermodal connection system based on a rack monorail was designed to connect the village to the internal vehicular routes of the island, as well as facilitate the transport of tourists and luggage (Figure 12).

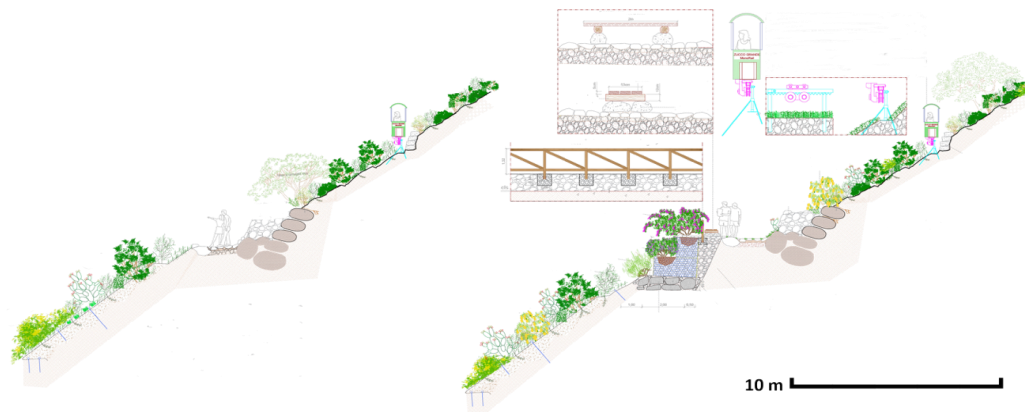


Figure 12. *Pedestrian Link Design Sections and Monorail Scheme. Work of the Stromboli Group*

The project has also integrated on-demand micro-mobility options both on land and inshore, including car sharing of electric vehicles and e-bikes, but also hydrofoil e-bikes and surf scooters, enabling flexible last-mile transport solutions tailored to the needs of both residents and tourists, also aimed at an immersive experience. The proposed electric sea-bus and inclined elevator were projected to reduce CO₂ emissions by over 90% compared to current diesel-based access modes. The use of solar energy for mobility infrastructure further enhances the site's transition to zero-emissions mobility.

Group Alicudi – "Recupero Strutturale"

The Alicudi team focused on the structural consolidation of the existing buildings of Zucco Grande, with a focus on seismic risk mitigation, while maintaining their historical authenticity (Figure 13). Recognizing the vulnerability of traditional masonry

structures in seismic areas, the team explored minimally invasive techniques compatible with heritage conservation standards.

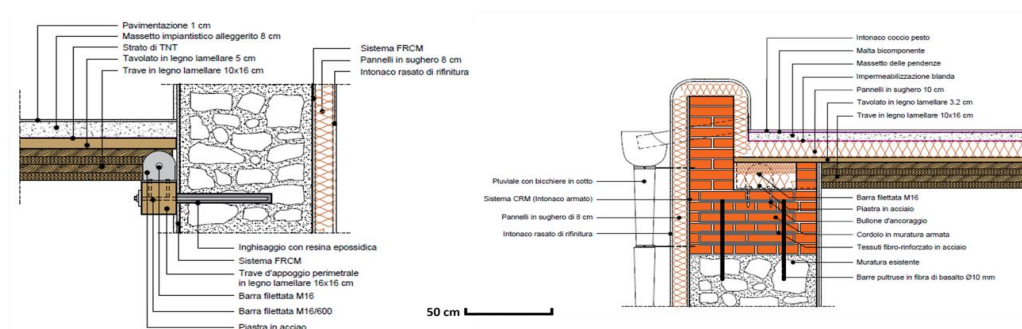


Figure 13. *Improvement Interventions: Floor-Wall Connection and Roof-Wall Connection. Work of the Alicudi Group*

The project adopted the "Where It Was – How It Was" approach, using original materials found on site to reconstruct collapsed portions and repair damaged elements. Structural reinforcements instead included the consolidation of the masonry with injections of binding mixtures and using the FRCM system, the construction of reinforced masonry curbs on top of the load-bearing facings, and the reconstruction of the old floors according to the checks required by current regulations. To ensure long-term safety, the team proposed the installation of a seismic monitoring system capable of tracking the structural health of the buildings over time. This approach not only improved the structural integrity of Zucco Grande, but also respected the cultural and historical value inherent in its architectural heritage.

Group Panarea – "Adeguamento Sismico & Conservazione"

The Panarea team focused on achieving seismic retrofitting while preserving the architectural character of the traditional buildings of Zucco Grande (Figure 14). The project aimed to balance the need for structural safety with the principles of reversibility and minimal intervention, ensuring that the proposed techniques could be adapted or removed in the future without damaging the original fabric. Key interventions included the application of Reinforced Composite Mortar (CRM) to improve the strength and ductility of the masonry, reinforcement by hooping of the masonry openings to prevent collapse during seismic events and the strategic use of steel tie rods to improve overall stability. For the horizontal structures, the team proposed the reconstruction of the floors using traditional techniques, combined with modern reinforcement strategies to improve load distribution and prevent deformation. A key focus of the project was the use of highly sustainable materials and low-impact construction methods, in line with the wider objectives of environmental sustainability and heritage conservation. By prioritizing safety without compromising aesthetic and historical integrity, the project has provided a replicable model for seismic retrofitting in contexts of historical interest.

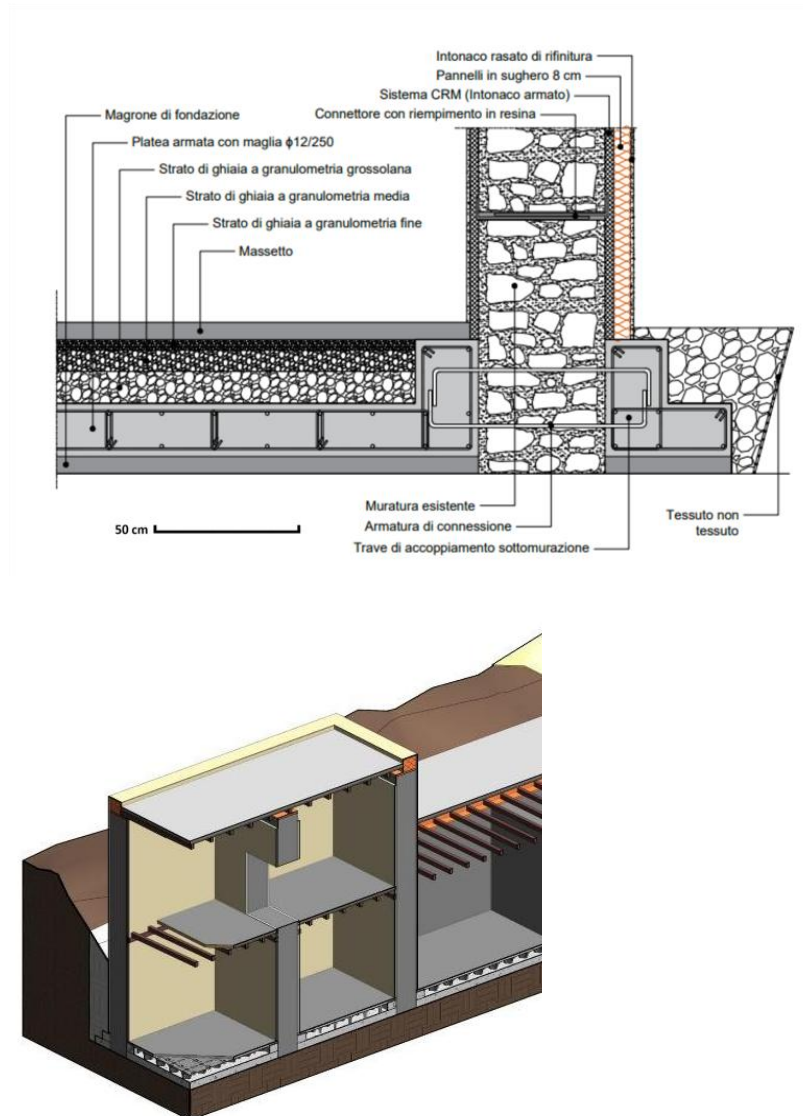


Figure 14. *Improvement Interventions on Foundations. Work of the Panarea Group*

Comparative Analysis of Design Approaches

Table 1 summarizes the design focus, strategies, technologies, and sustainability contributions of the seven interdisciplinary groups involved in AISS|24. While Table 1 summarizes the distinct outcomes, a comparative analysis reveals shared challenges and divergent strategies.

This is most evident in the two groups addressed to the structural reinforcement. Group Alicudi adopted a stringent "Where It Was, How It Was" philosophy, prioritizing material authenticity and minimal intervention using FRCM systems (Figure 13). In contrast, Group Panarea focused more on reversibility and compatibility, utilizing CRM systems and steel tie rods (Figure 14), which offer robust seismic retrofitting while being philosophically distinct from Alicudi's strict conservation approach.

Table 1. Comparative Summary of the Design Proposals Developed During the AISS|24 Summer School

Group	Design Theme	Main Objectives	Technologies and Materials	Heritage Conservation Approach	Sustainability Contributions
Vulcano	Architectural Grafting	Merge new functions with historical ruins through reversible additions	Platform-frame, local stone, heat-treated wood	Reversible modular structures; contextual integration	Low-impact reuse; passive comfort; social activation
Filicudi	Albergo Diffuso	Adaptive reuse for scattered hospitality model	Steko blocks, wooden boards (Shou Sugi Ban), traditional masonry	Recovery of collapsed volumes; architectural typology reuse	Rainwater collection; circular resource use; socio-economic regeneration
Lipari	Visitor Hub and Cultural Continuum	Create a tourism and community hub as a threshold between heritage and nature	Green roofs, natural ventilation, shading systems	Visual/functional continuity with original settlement	Passive cooling; slow mobility; multifunctional public space
Salina	Energy Self-Sufficiency	Retrofit buildings for energy efficiency and resilience	Expanded cork insulation, PV panels, multi-split systems, water recycling	Hidden integration of systems in existing fabric	Energy autonomy; circular water use; creation of energy hub
Stromboli	Sustainable Mobility and Accessibility	Improve inclusive access and intermodal transport to the village	Electric sea-bus, floating pontoons, inclined solar elevator, monorail	Infrastructure inserted without disturbing existing layout	Zero-emissions transport; access for all; flexible seasonal infrastructure
Alicudi	Structural Consolidation	Seismic retrofitting and material repair using low-impact methods	FRCM systems, grout injections, reinforced masonry curbs	“Where it was, how it was”; use of local materials	Enhanced safety; monitoring systems; authenticity preservation
Panarea	Seismic Retrofitting and Material Preservation	Minimize visual and structural invasiveness during seismic adaptation	CRM systems, steel tie rods, traditional floor reconstructions	Reversibility; minimal intervention philosophy	Resilience; use of low-impact and traditional-compatible techniques

A similar comparison emerges among the architectural reuse proposals. Group Vulcano ("L'innesto") proposed a high-contrast "grafting" of modern, reversible platform-frames onto the ruins (Figure 8). Group Filicudi ("Albergo Diffuso") opted for a hybrid approach, blending traditional reconstruction (re-proposing old techniques) with modern systems like Steko blocks for new additions (Figure 9). Group Lipari ("Continuum"), however, prioritized passive design and landscape integration (Figure 10), using the existing volumes as a basis for a visitor hub rather than a residential model.

Learning Impact: Survey Results and Reflections

According to the post-program survey (n = 31), 91% of participants agreed or strongly agreed that they had improved their ability to integrate sustainability in heritage design. 85% reported that the collaborative environment helped develop new interdisciplinary skills. The use of digital tools, such as parametric modeling and energy simulation, was rated as "very effective" by 78% of respondents.

"Designing in Zucco Grande taught me how to balance technological innovation with cultural sensitivity. It was not just a studio—it was a real-world challenge. " – Participant, Building Engineering and Architecture master student.

Challenges and Limitations

The AISS|24 experience highlighted several tensions and constraints that qualify the results presented above. A recurrent issue concerned the relationship between conservation and energy retrofitting: in many proposals, participants had to balance the desire to improve thermal performance and reduce operational energy use with the need to preserve the material authenticity and visual integrity of masonry envelopes and roofs. Prioritising reversible and minimally invasive interventions often meant accepting lower theoretical energy savings than more intrusive alternatives, illustrating the trade-offs that practitioners face in protected heritage contexts.

Feasibility also emerged as a significant limitation. While the projects were grounded in regulatory frameworks and informed by preliminary sizing and simulations, economic and governance aspects could only be explored at a preliminary level within the limited timeframe of the Summer School. Some of the more ambitious mobility and infrastructural solutions (e.g., funicular systems, rack monorails, extensive floating pontoons), as well as the proposed energy community and water management schemes, would require detailed cost-benefit analyses, environmental impact assessments and management models before implementation. The proposals should therefore be read as advanced, research-informed scenarios intended to stimulate dialogue with institutions and communities, rather than as implementable masterplans.

At the process level, inter-group coordination and the balance between competing objectives proved challenging. Aligning assumptions on service levels and phasing across seven groups progressing at different speeds led to overlapping or conflicting interventions that had to be renegotiated and adjusted in the final stages. Participants also reported difficulties in reconciling energy performance, seismic safety, accessibility, landscape integration and social use under time pressure and with heterogeneous familiarity with simulation tools and regulations. These tensions, while limiting the degree of optimisation achieved in each proposal, formed a central part of the intended learning experience.

Compared with the 2022 and 2023 editions, which operated at the scale of individual buildings or small micro-architectures, the 2024 programme adopted a settlement-scale perspective. This broadened the educational value in terms of cross-scalar and interdisciplinary reasoning but also intensified logistical complexity and cognitive load for participants. The present study therefore captures a single intensive

cycle of design-based experimentation in a complex setting and should be complemented in future research by longitudinal follow-up across multiple editions and by more detailed feasibility studies on selected pilot interventions.

Beyond Zucco Grande: Towards a Transferable Model

The design and pedagogical framework developed during AISS|24 can serve as a prototype for other fragile, depopulated or climate-sensitive contexts across the Mediterranean and beyond. When compared to similar international workshops, such as the UNESCO "Living Heritage" initiatives or design-build studios in rural Japan (e.g., Kengo Kuma's workshops), the AISS|24 model places a unique emphasis on integrated technological systems rather than focusing solely on vernacular construction or craft. While many international programs prioritize traditional materials, the Zucco Grande projects demonstrate a hybrid model that weds high-tech simulation (NZEB, CO₂ reduction) with heritage conservation. Its replicability stems from its modular educational structure, the use of scalable technologies (e.g., Steko blocks, CRM/FRCM reinforcement), and a transdisciplinary process that bridges research, practice, and community engagement.

Future applications may include island communities in the Cyclades, North African coastal settlements, or post-disaster rural heritage sites where integrated sustainability and cultural resilience are urgently needed.

Conclusion

The AISS|24 reaffirmed the value of interdisciplinary, design-based educational programs as instruments for addressing the ecological, socio-cultural, and spatial challenges facing heritage landscapes in marginal territories. Grounded in a learner-centered methodology that integrated theoretical instruction, field investigation, and collaborative design, the program provided a dynamic framework for testing innovative approaches to sustainable heritage recovery. The abandoned village of Zucco Grande on Filicudi Island served not only as a case study but as an immersive laboratory where participants were invited to reinterpret vernacular architecture as a living, adaptable system.

The outcomes of AISS|24 demonstrated that traditional Mediterranean settlements can be reimagined through contemporary design strategies that prioritize sustainability, resilience, and cultural continuity. The proposals developed by the seven interdisciplinary working groups articulated a coherent and multilayered vision for the village's revitalization. These ranged from passive and active strategies for energy autonomy, to lightweight and reversible architectural grafts, to inclusive mobility infrastructures and hospitality models rooted in the identity of place—such as the reinterpretation of the *albergo diffuso*. The integration of advanced technologies, including photovoltaic arrays, CRM and FRCM reinforcement systems, Steko blocks, and parametric prototyping, was balanced with a respectful engagement with local materials, construction traditions, and landscape character.

The integration of measurable sustainability indicators within the design proposals—ranging from operational energy use to embodied material impact and mobility emissions—demonstrates the feasibility of aligning heritage preservation with technical standards for ecological transition, as defined by CAM, EPBD, and the New European Bauhaus principles.

AISS|24 transcended the boundaries between academic training, applied research, and territorial engagement, positioning design as both a method of inquiry and a tool for regeneration. The program fostered a temporary but intense learning community, where students, researchers, and professionals could explore the intersections of technical innovation, cultural heritage, and environmental ethics. The active learning model proved effective not only in building technical and analytical capacities, but also in cultivating critical reflection, intercultural exchange, and community-oriented design thinking.

In conclusion, the AISS|24 program serves as a replicable and scalable model for sustainable regeneration in fragile contexts. By framing heritage not as a static asset but as a living system open to adaptation, the initiative contributes to the evolving discourse on architectural education as a catalyst for ecological transition. It aligns with the objectives of the New European Bauhaus and UNESCO's Historic Urban Landscape approach, underscoring the potential of education rooted in place, driven by research, and guided by sustainability.

To strengthen its impact, future editions of AISS will pursue the development of pilot implementation strategies in collaboration with municipalities, cultural heritage institutions, and funding agencies. Selected design proposals may be refined through research grants or tested through temporary installations, opening a pathway from conceptual design to built experimentation. The program will incorporate longitudinal assessment tools—such as alumni tracking, competency mapping, and post-occupancy evaluations—to monitor both professional development and real-world outcomes. Moreover, future sessions will explore enhanced integration of digital twins, open-source design repositories, and participatory planning methodologies to foster broader community engagement. These developments aim to position the AISS model as a reference framework for academic institutions and regional planning bodies engaged in the ecological transition of vulnerable heritage territories.

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Heavy Lightness: A Comparative Study between Álvaro Siza's Portugal Pavilion and Oscar Niemeyer's Casa das Canoas

*By Salvatore Rugino**

This contribution examines the concept of “heavy lightness” in architecture through a comparative analysis of Álvaro Siza's Portugal Pavilion (1998) and Oscar Niemeyer's Casa das Canoas (1953). While focusing on these two paradigmatic reinforced concrete works, the study situates the phenomenon within a broader historical trajectory extending from classical antiquity to contemporary practice. The research employs a comparative and multidisciplinary approach, integrating technical-constructional analysis, morphological survey, and phenomenological assessment of spatial experiences. The analysis reveals how distinct design strategies— Siza's structural subtraction and Niemeyer's morphological transformation—achieve phenomenologically convergent effects of perceived lightness. Particular attention is devoted to the technical specificities of each work, including the cable-suspended concrete roof of Siza's pavilion and the continuous curved surfaces of Niemeyer's residence. The conclusion positions “heavy lightness” as a critical category for understanding twentieth-century and contemporary architecture, capable of reconciling technical innovation, poetic sensibility, and sustainability.

Introduction

The concept of “heavy lightness” constitutes one of the most fascinating and complex topics in the history of architecture, representing a paradox inherent in the capacity to transfigure dense materials through technical innovation and design intelligence into an experience of suspension and equilibrium. At its ontological foundation, “heavy lightness” designates a designed condition of phenomenological contradiction: a building's actual structural mass — measurable, gravitationally determined, materially irreducible — is systematically counteracted by a constellation of spatial, structural, and perceptual strategies, so that the observer experiences the material not as inert weight but as suspended, dynamic, or dematerialized presence. The contradiction is not resolved but held in productive tension: matter remains fully present and structurally legible, yet its gravitational character is phenomenologically neutralized.¹

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1. The concept of phenomenological neutralization of gravitational character draws on by M. Merleau-Ponty, *Phénoménologie de la perception* (Paris: Gallimard, 1945), particularly Part II, “The World as Perceived.” See also: P. Zumthor, *Atmospheres: Architectural Environments, Surrounding Objects* (Basel: Birkhäuser, 2006), 17-24.

This distinguishes “heavy lightness” from mere visual illusion or decorative lightening — the mass is not concealed, but transfigure.² At the operational level, the category identifies three distinct but interacting registers of design intervention. of load-bearing elements — through cantilevers, cable systems, shell geometries, or the suppression of intermediate supports — so that structural weight is redistributed in ways that visually negate the logic of gravity.³ The second is morphological transformation: the metamorphosis of mass through continuous curvature, plastic fluidity, or formal dynamism, whereby the building’s volume appears not to compress the earth beneath it but to emerge from or hover above it.⁴ The third is luminous dematerialization: the calibrated modulation of natural and artificial light across concrete or masonry surfaces, which dissolves the perception of material thickness and density into vibration, reflection, and atmospheric diffusion.⁵

These three registers may operate independently or, in the most powerful instances, simultaneously and synergistically. At the disciplinary level, “heavy lightness” functions as a comparative framework with transhistorical reach, capable of identifying, across radically different architectural languages and historical periods, the specific design operations through which matter is phenomenologically transfigured.⁶ It is therefore neither period-specific nor style-dependent. The Gothic flying buttress, Brunelleschi’s *pietra serena* grid, Borromini’s undulating walls, and Niemeyer’s continuous curved surfaces all instantiate the category through technically and formally distinct means, yet are unified by the same operative ambition: to ensure that built matter, while preserving its physical and structural integrity, offers itself to perception as something other than weight.⁷

2. The distinction between concealment and transfiguration is grounded in K. Frampton, *Studies in Tectonic Culture* (Cambridge, MA: MIT Press, 1995), 1-27; and G. Semper, *The Four Elements of Architecture and Other Writings* (Cambridge: Cambridge University Press, 1989), for the foundational distinction between structure and cladding (*Bekleidung*) underpinning modern debates on material honesty and perceptual transformation.

3. On tectonic suspension as structural and expressive category, see H. Engel, *Structure Systems* (Stuttgart: Hatje Cantz, 1997), 234-267. For cable-suspended concrete, see C. Balmond, *Informal* (Munich: Prestel), 309-343. See also P. Rice, *An Engineer Imagines* (London: Ellipsis, 1994), on the relationship between structural economy and spatial poetry.

4. Morphological transformation through curvature is theorized in A. Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames & Hudson, 2004), 149-173. For its instantiation in Niemeyer’s work, see D. Underwood, *Oscar Niemeyer and the Architecture of Brazil* (New York: Rizzoli, 1994), 88-124. The philosophical implications of formal dynamism are explored in G. Deleuze, and F. Guattari, *What Is Philosophy?* (New York: Columbia University Press, 1994), 163-200.

5. On luminous dematerialization and light in the phenomenology of concrete surfaces, see J. Pallasmaa, *The Eyes of the Skin: Architecture and the Senses*. Chichester: Wiley, 2005), 45-52; H. Plummer, *Poetics of Light* (Tokyo: a+u, 1987; and S. Holl, *Intertwining* (New York: Princeton Architectural Press, 1996), 11-40.

6. The transhistorical comparative approach draws on A. Colquhoun, *Essays in Architectural Criticism* (Cambridge, MA: MIT Press, 1981), 129-144; and C. Rowe, and F. Koetter, *Collage City* (Cambridge, MA: MIT Press, 1978), for the transhistorical persistence of spatial types.

7. On the Gothic flying buttress, see R. Mark (Ed.), *Architectural Technology up to the Scientific Revolution* (Cambridge, MA: MIT Press, 1993), 89-134. On Brunelleschi’s *pietra serena* grid, see E. Battisti, *Filippo Brunelleschi* (Milan: Electa, 1981), 45-98. On Borromini’s walls, see P. Portoghesi, *Borromini: Architettura come linguaggio* (Milan: Electa, 1967), 112-167. On Niemeyer’s curves, see C. E. D. Comas, *Oscar Niemeyer: Curves of Irreverence* (New Haven: Yale University Press, 2010), 23-67.

This transhistorical applicability is precisely what confers upon “heavy lightness” the status of an analytical category rather than a period concept or a stylistic label.⁸ Critically, the category also presupposes an active observer: “heavy lightness” is not a property of the object alone, but an intersubjective phenomenon arising at the intersection of designed space and embodied perception.⁹ It belongs, therefore, to the tradition of architectural phenomenology — from Bachelard’s “spiritualization of matter”¹⁰ and Norberg-Schulz’s “apparent gravity”¹¹ to Pallasmaa’s multisensory ambiguity¹² and Böhme’s “atmospheric architecture”¹³ — while simultaneously maintaining a structural and technical grounding that prevents it from dissolving into pure aesthetics. It is this dual anchorage — in measurable tectonic reality and in lived phenomenological experience — that makes “heavy lightness” a genuinely operative category: one that can orient both the critical reading of existing works and the design intelligence of new ones.¹⁴ Far from being a twentieth-century invention, this dialectic has traversed architecture from classical antiquity to contemporary practice, manifesting itself in diverse formal and technical solutions united by the same aspiration: to transcend the apparent limits of matter in order to create spaces that elevate the human spirit.¹⁵

The historical depth of this phenomenon is evident in numerous canonical examples that demonstrate how each epoch has sought, with the technical and cultural means at its disposal, to resolve the contradiction between structural necessity and aspiration to lightness. The Caryatids of the Erechtheion on the Athenian Acropolis (421–406 BCE) perhaps represent the first and most eloquent manifestation of this tension: the female figures appear to support the entablature effortlessly while maintaining a graceful and natural pose, transforming lithic weight into human presence and structural support into choreographic gesture.

8. The distinction between an analytical category and a period concept is developed in E. Panofsky, *Meaning in the Visual Arts* (Garden City, NY: Doubleday, 1955), 1-31; and P. Eisenman, “The End of the Classical,” *Perspecta* 21 (1984): 154-173.

9. The intersubjective constitution of architectural experience is theorized in G. Böhme, *Atmospheric Architectures* (London: Bloomsbury, 2017), 12-29; D. Seamon, “Architecture and Phenomenology,” in D. Lu (ed.) *The Routledge Companion to Contemporary Architectural History* (London: Routledge, 2024), 1-14; and E. Relph, *Place and Placelessness* (London: Pion, 1976), 1-56.

10. G. Bachelard, *La terre et les rêveries de la volonté* (Paris: José Corti, 1948), particularly ch. IX, “La dureté, le dur et le durci,” 214-247. See also Bachelard, *La poétique de l’espace* (Paris: PUF, 1958).

11. C. Norberg-Schulz, *Genius Loci: Towards a Phenomenology of Architecture* (New York: Rizzoli, 1979), 14-23. See also Norberg-Schulz, *Architecture: Meaning and Place* (New York: Rizzoli, 1988), 34-56.

12. J. Pallasmaa, *The Eyes of the Skin: Architecture and the Senses* (Chichester: Wiley, 2005), 10-30. See also Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture* (Chichester: Wiley, 2009), 87-112.

13. Böhme, *Atmospheric Architectures*, 2017, 87-104. For the original formulation, see Böhme, “Atmosphere as the Fundamental Concept of a New Aesthetics,” *Thesis Eleven* 36 (1993): 113-126.

14. The dual function of an operative category is argued in R. Moneo, “On Typology,” *Oppositions* 13 (1978): 22-45; and V. Gregotti, *Inside Architecture*. Translated by P. Ghirardo and E. Ghirardo (Cambridge, MA: MIT Press, 1996), 34-58.

15. On the transhistorical trajectory of the weight-lightness dialectic, see Frampton, *Studies in Tectonic Culture*, 1995, 1-27; S. Giedion, *Space, Time and Architecture* (Cambridge, MA: Harvard University Press, 1954); R. Banham, *Theory and Design in the First Machine Age* (London: The Architectural Press, 1960), 320-330; and J. Rykwert, *The Dancing Column: On Order in Architecture* (Cambridge, MA: MIT Press, 1996), 1-45.



Figure 1. *Porch of the Caryatids, Erechtheion, Acropolis of Athens (421–406 BCE). The Female Figures support the Entablature, transforming Lithic Weight into Choreographic Gesture*

Source: S. Rugino.

Gothic architecture brought this research to even more radical consequences. The slender columns, flying buttresses, and ribbed vaults of the great medieval cathedrals literally dissolved the massive Romanesque stone walls into luminous screens, transforming the sacred edifice into a cage of light where matter seemed to volatilize into pure spiritual transcendence. The flying buttresses, in particular, represent a masterpiece of constructive intelligence: by rendering explicit on the exterior the system of thrusts and counterthrusts that sustains the nave, they liberate the interior from all structural encumbrance, permitting almost entirely glazed walls that negate the very perception of mural mass.

In the Florentine Renaissance, Filippo Brunelleschi (1377–1446) elaborated subtler but no less effective strategies. The small columns that “disappear into the walls” in his architectures — visible in the Old Sacristy of San Lorenzo (1421–1428), the Pazzi Chapel (1429–1461), and the Ospedale degli Innocenti (1419–1427) — represent an operation of refined perceptual ambiguity: the gray *pietra serena* of the architectural members stands out against the white plaster of the walls, creating a visual grid that articulates space without oppressing it. The load-bearing elements are not hidden but sublimated into a geometric design of such purity as to appear almost two-dimensional, as if the architecture were a spatial theorem rather than a material construction.

The dome of Santa Maria del Fiore (1420–1436), with its self-supporting double shell and hidden wooden chains, represents the culmination of this research: an

enormous mass of brick that seems to rest with impossible lightness on the octagonal drum, defying both gravity and the constructive conventions of the time.



Figure 2. Filippo Brunelleschi, *Dome of Santa Maria del Fiore, Florence (1420-1436).*
The Brick Mass seems to rest with Impossible Lightness on the Octagonal Drum
Source: S. Rugino.

Italian Mannerism of the sixteenth century explored the weight-lightness tension through deliberate structural inversions and visual paradoxes that questioned Renaissance certainties. In Michelangelo's Laurentian Library (1524–1559), the columns of the *ricetto* do not support but are supported, set into wall niches that invert the traditional relationship between support and load; the corbels beneath the paired columns project without anything to bear; the staircase seems to flow downward like petrified *lava*.



Figure 3. Michelangelo, Ricetto of the Laurentian Library, Florence (1524-1559). *The engaged Columns Set within recessed Niches Reverse the conventional Hierarchical Relationship between Structural Support and Load*

Source: S. Rugino.

Giulio Romano, in Palazzo Te in Mantua (1524–1534), inserted triglyphs that slip out of place and keystones that appear to yield, creating an architecture of disquiet where apparent stability is constantly threatened. These “licenses” were not errors but sophisticated reflections on the conventionality of architectural languages and the possibility of manipulating the perception of weight through design.

The dissolution of corners in many seventeenth-century buildings represents a further chapter in this history. Francesco Borromini (1599–1667), in works such as San Carlo alle Quattro Fontane (1638–1641) and Sant’Ivo alla Sapienza (1642–1660), bent walls into continuous undulations that eliminate every angular caesura, transforming the traditional mural box into a pulsating organism where interior and exterior, concave and convex, interpenetrate in perpetual movement. Matter seems to lose its rigidity to

acquire an almost organic fluidity, anticipating by three centuries the plastic experimentations of reinforced concrete.



Figure 4. *Francesco Borromini, San Carlo alle Quattro Fontane, Rome (1638-1641). The walls inflect into continuous undulating surfaces, anticipating the formal plasticity achievable with reinforced concrete*

Source: S. Rugino

Guarino Guarini (1624–1683), in the Chapel of the Holy Shroud in Turin (1668–1694), stratified arches and ribs in a vertiginous ascending spiral where each element seems to float above the one beneath, dissolving the perception of weight into pure luminous geometry.

The visionary engravings of Giovanni Battista Piranesi (1720–1778), particularly the *Carceri d'invenzione*, brought this dialectic to its theoretical extreme: impossible

architectures where conventional structural relationships are abolished. His visions profoundly influenced subsequent architectural imagination.

These precedents establish “heavy lightness” as a *longue durée* theme in Western architectural culture, a red thread connecting apparently distant experiences unified by the same aspiration: to ensure that matter, while preserving its physical presence and actual weight, offers itself to perception as suspended, dynamic, potentially volatile. With the advent of reinforced concrete in the twentieth century, this millennial aspiration found not its origin — as has often been erroneously claimed — but a renewed and more radical possibility of expression, thanks to the technical characteristics of a material capable of working simultaneously in compression and tension, spanning previously unthinkable distances with minimal thicknesses, assuming any form that formwork can contain.

The theoretical foundation of “heavy lightness” draws upon the phenomenological reflections of French philosopher Gaston Bachelard (1884–1962), who spoke of a “spiritualization of matter” in his seminal work *La terre et les rêveries de la volonté* (1948). For Bachelard, matter¹⁶ is never inert objectivity but always dreamed substance, imagined, transformed by the consciousness that inhabits it; architecture becomes authentic only when the physicality of the environment is experienced as an imaginative and memorial dimension, when walls cease to be mere boundaries to become membranes between inside and outside, between body and world, between present and memory.

This “overcoming” of material limits — which Bachelard investigates through the images of stone, cave, and crystal — resonates profoundly with what Italian writer Italo Calvino (1923–1985) defined as “lightness of thought” in his *Lezioni americane* (1988). For Calvino, lightness is not superficiality or evasion but the capacity to grasp the complexity of reality while maintaining a dynamic and non-oppressive equilibrium with matter; it is the quality of Perseus who defeats Medusa by avoiding looking at her directly, reflecting her in his polished shield. “My working method has more often than not involved the subtraction of weight”, writes Calvino; “I have tried to remove weight, sometimes from people, sometimes from heavenly bodies, sometimes from cities; above all I have tried to remove weight from the structure of stories and from language”. This subtraction does not eliminate substance but transfigures it, rendering it bearable, habitable, poetic¹⁷ — exactly what the architecture of “heavy lightness” pursues with respect to built matter.

In recent years, reflection on architectural phenomenology has experienced renewed interest, with studies that reread the relationship between body, light, and matter as the central nucleus of spatial experience. In particular, recent contributions on the phenomenology of light demonstrate how the articulation of concrete surfaces and envelopes can transform structural weight into a perceptual condition of suspension, confirming the centrality of the theme of heavy lightness in contemporary debates on architectural “atmosphere”.¹⁸

16. Bachelard, *La terra e il riposo. Un viaggio tra le immagini dell'intimità* (Milano: Red Edizioni, 1994).

17. I. Calvino, *Lezioni americane: Sei proposte per il prossimo millennio* (Milano: Garzanti, 1988), 7.

18. Q. Liu, “Architectural Phenomenology: Past, Present and Future Directions,” *Architectural Studies* 18, no. 1 (2024): 1-23.

The technological revolution of reinforced concrete represented an epochal turning point in this millennial history: it liberated architecture from traditional structural constraints — the pure compression of stone, the limited free span of wood, the modular rigidity of iron — enabling forms and spaces previously literally unthinkable and drastically redefining both constructive practice and the very perception of dwelling. Reinforced concrete, born from the encounter between the compressive resistance of cementitious mortar and the tensile resistance of steel bars, created a hybrid, almost alchemical material capable of behaving statically as a single monolithic body while combining the properties of two radically different substances.

As Swiss-American historian Sigfried Giedion (1888–1968) demonstrated in his monumental work *Space, Time and Architecture: The Growth of a New Tradition* (1954), reinforced concrete¹⁹ is not simply a new building material but the foundation of a new conception of space: it permits the construction of structures that openly defy gravity through cantilevers, brackets, self-supporting curved surfaces; it enables formal continuity between horizontal and vertical elements, between walls and roofs, between interior and exterior; it dissolves the perception of material heaviness into a new spatial experience — dynamic, fluid — where the boundary between structure and envelope, between bearing and borne, becomes increasingly labile. Le Corbusier’s “five points of a new architecture” (pilotis, roof garden, free plan, ribbon window, free façade) — all made possible by reinforced concrete — represent the codification of this perceptual revolution: the building rises from the ground, walls are freed from their load-bearing function, interior space flows without interruption.

British architectural historian Reyner Banham (1922–1988), in *Theory and Design in the First Machine Age* (1960), further elaborated how modern materials²⁰ — reinforced concrete, steel, glass — fundamentally altered the relationship between structure and expression, between constructive truth and formal appearance. For Banham, the architectural twentieth century is marked by the unresolved tension between the ethics of “structural honesty” — showing what the building is — and the temptation of “formal freedom” — making the building what one desires. Reinforced concrete exacerbates this tension because it is a material that can be molded into any form: it can feign the lightness of a sail or the heaviness of a bunker, can imitate stone or metal, can hide its structure or exhibit it brutally. This almost infinite versatility has opened the field to experimentations that have made “heavy lightness” no longer an exception or a tour de force but an ordinary design possibility, accessible to anyone who can master the language of concrete. From Auguste Perret to Pier Luigi Nervi, from Félix Candela to Eero Saarinen, from Tadao Ando to Zaha Hadid, the history of twentieth-century and contemporary architecture can be read as a continuous exploration of the possibilities offered by this protean material to conjugate mass and lightness, weight and suspension, terrestrial gravity and celestial aspiration.

In this context of renewed expressivity of reinforced concrete, architects Álvaro Siza Vieira (b. 1933) and Oscar Niemeyer (1907–2012) represent two emblematic but distinct approaches to the dialectic between weight and lightness, two voices that have been able to decline in profoundly personal ways the challenge of transfiguring built

19. Giedion, *Spazio, tempo ed architettura. Lo sviluppo di una nuova tradizione*, 1954.

20. Banham, *Theory and Design in the First Machine Age*, 1960.

mass into an experience of suspension and levity. Both developed their practice in countries of Latin culture — Portugal and Brazil respectively — characterized by a critical and creative appropriation of European modernism, filtered through local sensibilities, specific climatic conditions, and rooted constructive traditions. This common belonging to a “creative periphery” of modernism — distant from the canonical centers of Paris, Berlin, or Chicago — allowed both architects to elaborate original languages, free from functionalist orthodoxy while remaining faithful to the fundamental principles of architectural modernity.

Álvaro Siza, trained in the tradition of the Porto School under the guidance of Fernando Távora, manifests what Kenneth Frampton has defined as “critical modernism” or “critical regionalism”: an approach that combines the rationalist rigor²¹ of the European legacy with the Mediterranean and Atlantic culture of Portugal, simultaneously drawing upon local constructive tradition and international avant-gardes. His architecture arises from a patient dialogue with context — topographic, climatic, cultural — which translates into works where geometric rigor is never abstract but always rooted in the specific place. The apparently simple geometries of his plans and sections actually conceal complex mediations between functional requirements, site constraints, routes, and landscape views. The weight of concrete, in Siza's hands, dissolves not through structural virtuosity or formal acrobatics, but through proportional purity, millimetric calibration of openings, masterful control of natural light that sculpts interior surfaces, transforming them into vibrant screens. As Rafael Moneo has observed, in Siza's work “mass dissolves in perceptual experience”²² not because it is denied or hidden, but because it is sublimated into a higher order where each element finds its necessity.

Siza's training at the Escola Superior de Belas Artes do Porto in the 1950s exposed him to an intellectual environment that rejected both nostalgic provincialism and uncritical importation of international models. Távora, his teacher and later colleague, maintained that modernism should be intimately linked to local cultural and technological identity: it was not about applying prefabricated formulas but reinventing modernity from the concrete conditions of building in Portugal. This lesson has profoundly permeated Siza's work, which has always rejected both formalism for its own sake and reductive functionalism, seeking instead a synthesis where form emerges from the patient resolution of specific problems. His approach to reinforced concrete reflects this philosophy: the material is never brutally exhibited nor dissimulated under cladding, but treated with a sobriety that exalts its intrinsic qualities — plasticity, the capacity to assume any form, the possibility of creating continuous surfaces that modulate light.

Oscar Niemeyer, by contrast, represents a “tropical modernism” that radically transformed the European rationalist grammar into a plastic, sensual, and profoundly original vocabulary. Trained at the Escola Nacional de Belas Artes in Rio de Janeiro in Lúcio Costa's atelier — himself a privileged interpreter of Le Corbusier in Brazil — Niemeyer absorbed the principles of international modernism but subjected them from the outset to a metamorphosis that rendered them unrecognizable. Where European

21. Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, 1995, 298-334.

22. R. Moneo, *Theoretical Anxiety and Design Strategies in the Work of Eight Contemporary Architects* (Cambridge, MA: MIT Press, 2004), 199.

rationalism privileged the right angle, the modular grid, serial repetition, Niemeyer introduced the free curve, the organic form, the sculptural gesture. “It is not the right angle that attracts me”, he famously declared, “nor the straight line, hard, inflexible, created by man. What attracts me is the free and sensual curve, the curve I find in the mountains of my country, in the sinuous course of its rivers, in the waves of the sea, in the body of the beloved woman”.²³

This poetic declaration should not be misunderstood as mere aestheticism: the Niemeyerian curve is always structurally motivated, derived from the intrinsic possibilities of reinforced concrete to assume forms that other materials would not allow. Niemeyer’s “tropical modernism” celebrates the formal freedom guaranteed by concrete not as caprice but as an appropriate response to the Brazilian climate (curves create shadows, deflect winds, collect rain), to local culture (the baroque sensuality of colonial churches, the fluidity of music and dance), to the landscape (Rio’s mountains, the coastal curves, luxuriant vegetation). His works do not impose themselves on context but dance with it, establishing formal resonances that render architecture an integral part of the natural and cultural landscape.

The search for lightness in Niemeyer assumes radically different characters from that of Siza. Where the Portuguese architect pursues lightness through subtraction — eliminating everything non-essential until reaching an almost ascetic purity — Niemeyer obtains it through transformation: mass is not reduced but metamorphosed, rendered fluid, dynamic, apparently in movement. His buildings do not seem to weigh upon the earth but to emerge from it like geological or vegetal formations, or to hover above it like winged creatures. Columns attenuate until becoming almost filiform, roofs curve like sails swollen by wind, walls undulate like sand dunes. Reinforced concrete, in his hands, loses all connotation of heaviness and rigidity to acquire an almost liquid quality, as if it had been poured into forms and then solidified at the instant of maximum dynamism.

An illuminating comparison can be drawn between the two architects through their relationship with Le Corbusier, a tutelary figure for both but interpreted in diametrically opposed ways. Siza absorbed from the Swiss-French master especially the compositional discipline, proportional rigor, attention to the promenade architecturale, developing them in a direction of increasing essentiality and contextual rootedness. Niemeyer, who collaborated directly with Le Corbusier on the project for the Ministry of Education in Rio de Janeiro (1936–1943) and the plan for the United Nations in New York (1947), instead grasped the freer and more poetic component — that of Ronchamp and Chandigarh — bringing it to consequences that Le Corbusier himself might not have imagined. If Siza represents the “Apollonian” legacy of modernism — order, measure, proportion — Niemeyer embodies its “Dionysian” aspect — formal inebriation, sensuality, transcendence of limits.

This comparative research between Siza’s Portuguese Pavilion, realized for the 1998 World Exposition in Lisbon, and Niemeyer’s Casa das Canoas, built in 1953 in the mountains above Rio de Janeiro, analyzes two moments of synthesis of the respective design philosophies, two works that condense in paradigmatic form decades of research on the transfiguration of weight into lightness. The choice of these two case studies is not arbitrary: both works represent culminating points in the trajectories of their

23. Cfr. in Comas, *Oscar Niemeyer: Curves of Irreverence*, 2010, 45.

respective authors, moments when technical and conceptual maturity permits the achievement of results of particular expressive intensity.

The Portuguese Pavilion is distinguished by its large suspended roof of approximately 3,000 m² — one of the largest reinforced concrete slabs ever realized without intermediate supports — sustained solely by two thin longitudinal walls placed 65 meters apart. This apparently impossible configuration creates an emblematic volume of extraordinary emotional power, a covered public space where the mass of concrete seems literally to vanish in the perception of an “artificial sky”. The roof, with its slightly curved catenary profile and thickness varying from 20 centimeters at the center to 90 centimeters at the supports, offers itself to the gaze as a veil stretched between two mural wings, visually denying its structural weight while unequivocally affirming its material presence. The effect is that of a suspension of perceptual judgment: the observer knows that surface weighs thousands of tons, yet sees it as suspended, almost floating in air. It is precisely in this gap between rational knowledge and sensory perception that “heavy lightness” manifests itself in its purest form.

The pavilion was commissioned from Siza to represent Portugal at Expo ‘98, dedicated to the theme of oceans — a symbolically charged occasion for a country whose historical identity is indissolubly linked to maritime navigation and discoveries. Siza responded to this representative challenge not with explicit iconography but with an architecture that evokes the sea through purely spatial means: the suspended roof recalls a sail swollen by wind, but also the water’s surface seen from below, or a clouded sky that protects without oppressing. Conceived to host institutional events and ceremonial representations, the covered plaza of the pavilion has become over time one of Lisbon’s most vital public spaces, demonstrating how “heavy lightness” can generate architectures capable of taking deep root in the life of the city.

Casa das Canoas, built over forty years before Siza’s pavilion, exemplifies with equal eloquence Niemeyer’s capacity to dissolve traditional boundaries between load-bearing structure, architectural envelope, and interior space, generating an environment that appears sculpted from matter rather than simply constructed from assembled elements. The residence, designed by Niemeyer as his personal residence, is situated on a hillside site in the São Conrado district of Rio de Janeiro with views of the Serra dos Órgãos, and Niemeyer masterfully exploited this topographic condition to create a building that seems to emerge organically from the mountain landscape. The curved reinforced concrete walls do not simply delimit spaces but model them as a ceramist models clay, creating fluid environments where it is impossible to distinguish where structure ends and envelope begins.

The domestic program — spaces for living, bedrooms, services — is completely reinvented through spatial fluidity: environments are not juxtaposed boxes but intercommunicating cavities, separated by walls that never reach the ceiling or that curve to create niches, alcoves, unexpected expansions. Natural light, filtered by ample glazing that frames the landscape, penetrates interior spaces creating chiaroscuro effects that change continuously during the day, animating curved surfaces with a play of shadows in perpetual movement.

Despite evident differences in scale and program — a national representative pavilion versus a private residence, a monumental public space versus an intimate dwelling, a state commission versus a private commission — both works offer

paradigmatic insights into how “heavy lightness” operates as a critical category for understanding and interpreting twentieth-century and contemporary architecture. The differences themselves are illuminating: they demonstrate how the dialectic between weight and lightness is not tied to a specific scale or particular typology, but transversally traverses the entire field of architecture, manifesting itself with equal intensity in public monument and private house, in the space of collectivity and that of domestic intimacy.

The comparison between the two works also reveals how “heavy lightness” is not a replicable formula but a problem to be resolved each time in a specific way, through design strategies that depend on site conditions, functional program, available technologies, and the author’s expressive intentions. Siza and Niemeyer arrive at phenomenologically convergent results—both create spaces where reinforced concrete transcends its material heaviness—but through radically different paths: subtraction and essentiality for Siza, transformation and metamorphosis for Niemeyer. This divergence of methods and convergence of results suggests that “heavy lightness” is a potentially transversal category of architectural experience, one that appears applicable across different formal languages and scales, and recognizable by the peculiar perceptual quality of the space it produces — a space where matter, while fully present, seems to have transcended its gravitational limits.

Literature Review

The Dialectic between Heaviness and Lightness in Architectural History

The dialectical relationship between weight and lightness represents one of the most complex and enduring theoretical nodes in architecture. Its roots extend to the classical tradition articulated by Marcus Vitruvius Pollio (c. 80–15 BCE), who established the equilibrium between *firmitas* (structural solidity) and *venustas* (aesthetic beauty) as essential for architectural quality. This equilibrium, however, remained relatively static until the twentieth century, conditioned by traditional technologies and materials such as stone and brick.

The French poet and philosopher Paul Valéry (1871–1945), in his 1921 essay *Eupalinos ou l'Architecte*,²⁴ introduced a crucial distinction between “physical weight” and “perceptual weight”, anticipating the importance of perceptual psychology applied to architecture. For Valéry, the architectural work manifests its maximum potency when it renders a heavy mass as “heaviness without weight” — a formulation that prefigures contemporary phenomenological approaches.

The Norwegian architectural theorist Christian Norberg-Schulz (1926–2000), in *Genius Loci: Towards a Phenomenology of Architecture* (1979), developed²⁵ this duality by emphasizing “apparent gravity” — that perceived by the inhabitant — as one of the distinctive phenomenological characteristics of modern architecture. He clearly distinguishes between merely physical weight and dynamic, subjective weight,

24. P. Valéry, *Eupalinos o l'architetto* (Milano-Udine: Mimesis, 2011).

25. Norberg-Schulz, *Genius Loci. Paesaggio ambiente architettura* (Milano: Electa, 1997).

demonstrating how design capacity resides precisely in manipulating this second dimension through spatial, material, and luminous strategies.

The Finnish architect and theorist Juhani Pallasmaa (b. 1936), in *The Eyes of the Skin: Architecture and the Senses* (2005; expanded edition 2012), has deepened the theme of multisensory perception, highlighting how the perceived lightness of reinforced concrete derives from a complex sensory ambiguity:²⁶ although the material proves heavy to the touch due to its rough surface, it can appear visually light thanks to its form and the effect of light. This dual nature of the material broadens the understanding of heaviness as a complex and engaging experience.

More recently, Pallasmaa has developed these themes in “The Atmospheric Sense” (2019), emphasizing the role of peripheral perception in architectural experience, and in *Rootedness: Reflections for Young Architects* (2024), where he articulates the necessity of an architecture founded on ethical responsibility and reconnection with the environment.

The French anthropologist Marc Augé (1935–2023) introduced the concept of “fluid density” to describe a new dimension of architectural spaces realized with heavy materials that, through design, achieve experiences of lightness and aerial flow, characterized by fluid and dynamic spatial traversal. The British-American architectural historian Kenneth Frampton (b. 1930), in his influential *Studies in Tectonic Culture* (1995), has provided essential theoretical frameworks for understanding how material expression and structural logic combine to produce architectural meaning, distinguishing between “tectonic” (frame-based) and “stereotomic” (mass-based) approaches to construction²⁷.

The German philosopher Gernot Böhme (1937–2022) provided a fundamental contribution to the phenomenological understanding of architectural space through the concept of “atmosphere”. In *Atmospheric Architectures: The Aesthetics of Felt Spaces* (2017), Böhme articulates how atmosphere—understood as “tuned space” — constitutes the primary modality through which we perceive built environments. This perspective enriches the understanding of “heavy lightness” as a phenomenon that operates in the atmospheric sphere, where the perception of weight is not an objective property but a diffused quality of felt space.

Within the twentieth century, particular attention merits the exploration of contradictory relationships between non-load-bearing elements and transparent materials such as glass, a dialectic that has produced some of the most significant reflections on the nature of “heavy lightness” in architecture. A central figure in this research is James Stirling (1926–1992), British architect and 1981 Pritzker Prize laureate, who developed an architectural language founded on the tension between weight and transparency, positioning himself in open opposition to orthodox modernism. The Engineering Building at Leicester (1959–1963), designed with James Gowan, constitutes the emblematic example of this approach: massive volumes in red brick, evocative of Victorian industry, are counterposed to glazed surfaces inclined at 45 degrees that seem to defy gravity. The contrast between opaque towers and transparent classrooms is deliberately strident, as the architect seeks not harmony but exalts the dialectic between opposites, thus anticipating the strategies of critical postmodernism. Stirling’s legacy resides precisely in having demonstrated that the weight-lightness relationship can be explored not only through structural lightening, as in the works of Nervi or Candela, but

26. Pallasmaa, *Gli occhi della pelle. L'architettura e i sensi* (Milano: Jaca Book, 2007).

27. Frampton, *Studies in Tectonic Culture*, 1995.

also through the provocative juxtaposition of materials with opposite qualities, transforming the contrast itself into an expressive instrument.

The Portuguese Tradition and the Contribution of Álvaro Siza

The work of Álvaro Siza is solidly positioned within the constructive tradition of the “Porto School”, a movement rooted in the capacity to conjugate international modernism with a Mediterranean and Atlantic cultural identity, developing a dialectical and critical relationship with Modernism. This school expresses an architecture profoundly rooted in context, yet simultaneously open to global influences. Siza, together with prominent figures such as Fernando Távora (1923–2005) and Eduardo Souto de Moura (b. 1952), promotes a “rooted modernism” that surpasses passive acceptance of functionalist canons, reinterpreting innovation in local terms and valorizing the design culture and constructive traditions of the territory.

Kenneth Frampton defines this poetics as a virtuous synthesis between the rigor typical of Northern Europe and the plasticity characteristic of Southern Europe, where the structural component is not mere technique but translates into a poetic language capable of expressing technological authenticity and aesthetic quality.

A crucial but often neglected influence on Siza’s approach to “heavy lightness” is the work of Antoni Gaudí (1852–1926), the visionary Catalan architect whose research on structural form represents one of the highest peaks of constructive innovation between the nineteenth and twentieth centuries. Siza himself has acknowledged this debt on numerous occasions, stating with particular eloquence that from Gaudí he learned that “plumbing, steel tubes and stone could dance, as if levitating”. This declaration reveals a profound understanding of what makes Gaudí’s work so singular: the capacity to make the heaviest materials — stone, brick, iron — appear endowed with an internal dynamism that makes them appear in perpetual movement, suspended in an equilibrium that defies conventional expectations about architectural stasis.

The recognition of this debt connects Siza’s research on lightness to a broader and more ancient Mediterranean tradition of organic and expressive structural form, extending well beyond the rationalist legacy typically associated with the Porto School. Gaudí represents the antithesis of rationalism, yet his architecture, inspired by nature and organic forms, is founded on a rigorous structural logic in which every curve responds to the flow of forces. In his works, stone and brick are transfigured into forms that evoke waves, bones, geological formations: weight is exhibited in the materiality of surfaces but simultaneously negated by the dynamic form that seems to animate inert matter.

This lesson did not escape Siza, who operates in an antithetical formal register: where Gaudí is exuberant, Siza is sober; where Gaudí accumulates, Siza subtracts. Yet they share a profound sensibility: the awareness that architecture is not mere construction but the creation of spatial presences capable of evoking emotions, memories, moods — and that materials can transcend their physical nature through the intelligence of form.

The theme of “heavy lightness” pervades Siza’s work beyond the Portuguese Pavilion. Casa Cardoso (1988–1994) in Moledo exemplifies his capacity to integrate heavy concrete volumes with the landscape through careful positioning and proportioning. Casa Beires (1973–1976) in Póvoa de Varzim demonstrates early explorations of how geometric manipulation can visually lighten massive forms. The residential ensemble in

The Hague (1984–1988) shows his ability to create urban monuments that seem to float despite their substantial mass. The Galician Center of Contemporary Art in Santiago de Compostela (1988–1993) masterfully resolves the apparent contradiction between the granite-clad mass that responds to the historic context and the luminous, weightless quality of its interior spaces. These works collectively reveal a sustained investigation into how design intelligence can transcend material heaviness.

The recent monograph *Before/After: Álvaro Siza Duccio Malagamba* (Phaidon, 2024) documents twenty projects from Siza's career, confirming the persistence of his research on lightness through minimalist forms and masterful control of light.

The Spanish architect and theorist Rafael Moneo (b. 1937) explicitly describes this duality as a tension between *gravitas* and *levitas*, using the expression²⁸ “transparent density” to define Siza's capacity to create walls and roofs that, rather than oppress, liberate space, generating a new spatiality within apparent heaviness. The Italian architect and critic Vittorio Gregotti (1927–2020) emphasizes how this quality of lightness does not translate into a decorative presence or mere functionalist architecture, but rather represents the manifestation of a conception of architecture as the art of building and as a complex experience, where technique and poetry are profoundly interwoven.²⁹

The Poetic-plastic Modernity of Oscar Niemeyer

Oscar Niemeyer represents another pole of the fusion between weight and lightness in architecture, with a contribution of primary importance in the context of Brazilian and international modernism. He profoundly influenced twentieth-century architectural culture by advancing a poetic and sculptural use of reinforced concrete. His training at the Escola Nacional de Belas Artes in Rio de Janeiro, in the atelier of Lúcio Costa (1902–1998) — himself a collaborator of Le Corbusier — favored the emergence of a “tropical modernism” adapted to Brazilian climate and culture.

The French architectural historian Yves Bruand (b. 1926), in *Arquitetura Contemporânea no Brasil* (1981), identified in Niemeyer³⁰ the capacity to liberate concrete from its intrinsic gravity through the fluidity and continuous geomorphy of his surfaces, transforming it from rigid constructive matter into plastic material in movement. This transformation makes Niemeyerian architecture a sort of three-dimensional dance, in which form defies the laws of gravity and becomes emotional and symbolic experience.

The Greek-American architect and critic Stamo Papadaki (1906–1992), in *Oscar Niemeyer: Works in Progress* (1950),³¹ and Brazilian curator Lauro Cavalcanti³² emphasize the sculptural, almost baroque dimension of Niemeyer's work, where structure becomes form and form becomes spatial experience, creating environments that seem to possess what has been defined as “choreographic structure”, where architecture directs fluidly modulated space as in a choreography. The Brazilian-

28. P. Testa, *The Architecture of Álvaro Siza* (Porto: Faculdade de Arquitectura da Universidade do Porto, 1996).

29. Gregotti, *Dentro l'architettura*, 1996.

30. Y. Bruand, *Arquitetura Contemporânea no Brasil* (São Paulo: Perspectiva, 1981).

31. S. Papadaki, *Oscar Niemeyer: Works in Progress* (New York: Reinhold, 1950).

32. L. Cavalcanti, *When Brazil Was Modern: A Guide to Architecture 1928–1960* (New York: Princeton Architectural Press, 2007).

Argentine architect and historian Roberto Segre (1934–2018),³³ in *Arquitetura Contemporânea no Brasil* (1999; previous edition 1986),³⁴ indicates Casa das Canoas as an example of equilibrium between formal research and functionality, demonstrating the poetic transformation of everyday programs into occasions for spatial innovation.

Critical Comparisons and Future Research Directions

Despite evident analogies in both architects' capacity to transform material weight into a perceived experience of lightness, the literature that directly relates Álvaro Siza and Oscar Niemeyer remains surprisingly limited. Much of the available scholarship tends to privilege approaches of a stylistic, formal, or biographical nature, neglecting a deeper analysis of the sensory and phenomenological dimension that significantly characterizes their respective design poetics. Both authors share, albeit through different formal languages, a profound interest in constructing a spatial experience that transcends the mere materiality of architecture, triggering perceptual dynamics that border on lyricism.

Roberto Segre has highlighted important points of contact between the two masters,³⁵ emphasizing their common ability to transfigure apparently crude materials — first among them reinforced concrete — into veritable instruments of poetic expression. According to Segre, this capacity manifests itself through profoundly different design strategies, but equally effective in generating an architecture in which physical mass is sublimated into spatial lightness. Other scholars, such as Portuguese architectural historian Ana Tostões (b. 1959)³⁶ and Spanish-Catalan architectural theorist Josep Maria Montaner (b. 1954), have contributed to broadening the discourse by highlighting the existence of reciprocal influences and both architects' belonging to a sort of shared tectonic tradition, founded on the capacity to conjugate constructive rigor and expressive freedom in the treatment of reinforced concrete.

However, significant gaps remain on both theoretical and methodological planes. In particular, there is a notable absence of systematic analysis of the perceptual and cognitive processes that permit the experience of “lightness” beyond simple reduction of mass or weight. There also lacks an analytical apparatus capable of exhaustively and comparatively relating design strategies that — despite their apparent distance — converge in constructing a profoundly engaging and sensitive spatial experience. A further deficiency concerns the absence of a structured definition of “heavy lightness” as an autonomous critical category, equipped with interpretive and design instruments capable of orienting the reading of contemporary architecture. The present research proposes to fill these gaps, offering a comparative and in-depth reading of the two case studies, with the objective of revealing possible syntheses between constructive technique, aesthetic quality, and sensory perception of space.

Methodology

33. D. Underwood, *Oscar Niemeyer and the Architecture of Brazil* (New York: Rizzoli, 1994).

34. R. Segre, *Arquitetura Brasileira Contemporânea* (Rio de Janeiro: Viana & Mosley, 1999).

35. J. M. Montaner, *Del diagrama a las experiencias, hacia una arquitectura de la acción* (Barcelona: Gustavo Gili, 2014).

36. A. Tostões, *Modern Architecture in Africa: Angola and Mozambique* (Zurich: Park Books., 2015).

The investigation of the phenomenon of “heavy lightness” in architecture is based on a multidisciplinary approach of a qualitative and comparative nature, which centers on the comparison between two emblematic works: the Portuguese Pavilion designed by Álvaro Siza and Casa das Canoas realized by Oscar Niemeyer. This integrated method surpasses simple descriptive analysis to structure itself as an articulated dialogue between technical, spatial, and phenomenological dimensions, with the objective of unveiling the complexity and richness of this concept.

The analysis develops across three closely connected and complementary levels. First, a technical-constructive study aims to deepen understanding of the structural solutions adopted, the materials employed, and the technological innovations that characterize the works, enabling a rigorous evaluation of constructive and functional modalities. In parallel, a theoretical-critical analysis frames the concept of heaviness and lightness in its multiple historical, cultural, and philosophical aspects, in order to comprehend its value and implications in the broader context of architectural modernity.

Finally, a phenomenological evaluation dedicated to the perceptual and spatial experience generated by the buildings takes into consideration sensory aspects and the relationship between observer and architecture. The comparison between the two works is conducted according to four explicit analytical criteria. The first criterion concerns structural parameters: span-to-thickness ratios, load-path configurations, and the presence or absence of intermediate supports—factors that allow quantification of the structural “economy” through which perceived lightness is achieved. The second concerns spatial parameters: the ratio between built mass and void, the hierarchy of enclosure, and the relationship between scale and program, which determine the experiential amplitude of the spaces produced. The third concerns material and surface parameters: surface texture, colour, and the modulation of natural light on concrete surfaces, all of which condition the haptic and visual register of the observer’s encounter with matter. The fourth criterion—perceptual parameters—constitutes the most epistemologically complex of the four, since it addresses qualities of architectural experience that are irreducibly subjective yet methodologically tractable through a combination of phenomenological analysis, critical reception, and direct observation. Within this research, perceptual parameters are operationalized across three interrelated dimensions.

The first is the quality of suspension: the degree to which a structure appears to defy gravitational logic in the observer’s experience—whether through the visual negation of load-bearing elements, the perception of mass as floating or tensioned rather than resting, or the cognitive dissonance between known structural weight and perceived weightlessness.

The second is spatial fluidity: the capacity of the architectural interior to generate a sense of continuous, uninterrupted movement through space—the absence of hard boundaries, the dissolution of corners, the interpenetration of zones—which produces an experience of lightness not in the vertical (gravitational) sense but in the horizontal (spatial) sense.

The third is atmospheric continuity: the perceived dissolution of the boundary between interior and exterior, between structure and landscape, between built matter and natural environment—drawing on Böhme’s concept of atmosphere as “tuned space”³⁷

37. Böhme, *Atmospheric Architectures: The Aesthetics of Felt Spaces*, 2017, 12-29. The concept of “tuned space” (*Stimmungsraum*) was first introduced in Böhme, “Atmosphere as the Fundamental

and Seamon's notion of "environmental wholes",³⁸ treating the building not as an isolated object but as a field condition³⁹ that extends perceptually beyond its physical limits.⁴⁰

Together, these three dimensions of the perceptual criterion are assessed through systematic cross-referencing of: a) primary sources—architects' writings and interviews expressing design intentions; b) critical literature—independent scholarly descriptions of spatial experience; and c) direct observation, where accessible. This triangulated approach confers sufficient methodological rigour to the perceptual criterion without reducing lived experience to numerical data. Taken together, the four criteria provide a replicable comparative framework that enhances the transparency and reproducibility of the analysis.

It is appropriate to recognize the intrinsic difficulties of a comparison between works of radically different scale and program: the Portuguese Pavilion is a public architecture of national representation, conceived to host official ceremonies and large gatherings, with a roof covering approximately 3,000 m²; Casa das Canoas is instead a private residence of contained dimensions, designed for the domestic life of a single family. This programmatic and dimensional asymmetry, far from constituting a limitation, represents precisely the heuristic value of the comparison: it permits verification of how the weight-lightness dialectic is articulated across different scales and functions, revealing transversal design principles that transcend typological contingencies. The comparison does not aim to establish formal equivalences, but to identify common phenomenological strategies in the use of reinforced concrete as expressive matter.

The initial phase of the research is characterized by a systematic documentary analysis that includes theoretical texts, technical documents, specialized bibliographic references, and academic studies focused on the evolution of reinforced concrete, its structural morphology, and the phenomenology of

Concept of a New Aesthetics," 1993. Atmosphere is defined not as a property of subject or object alone but as a diffused quality of felt space pervading the environment and experienced prior to any cognitive act of perception. See also T. Griffero, and M. Tedeschini (Eds.), *Atmosphere and Aesthetics: A Plural Perspective* (Cham: Springer, 2019).

38. Seamon, "Architecture and Phenomenology," 2024. Seamon distinguishes three modalities through which buildings operate as places: "lived worlds" (the taken-for-granted environmental background of daily life), "architectural atmospheres" (the affective tonality a building generates), and "environmental wholes" (the integrated perceptual unity of a place experienced as greater than the sum of its parts). The third modality is directly operative in the analysis of both case studies. Seamon's approach is grounded in Merleau-Ponty, *Phénoménologie de la perception*, 1945; and Relph, *Place and Placelessness*, 1976.

39. S. Allen, "Field Conditions," in *Points + Lines: Diagrams and Projects for the City* (New York: Princeton Architectural Press, 1999), 90-103. Allen argues that field thinking displaces the traditional focus on individual form in favour of the relational logics that organize elements across a surface or volume. Though his formulation is primarily urban in orientation, its epistemological premise—that architecture can be understood as a distributed perceptual condition rather than a self-contained artifact—applies directly to the atmospheric dimension of both case studies examined here.

40. See A. Pérez-Gómez, *Built upon Love: Architectural Longing after Ethics and Aesthetics* (Cambridge, MA: MIT Press, 2006), particularly his discussion of architecture as the construction of a "horizon of meaning"; and Pallasmaa, *The Eyes of the Skin: Architecture and the Senses*, 2005, 45-52, where peripheral and haptic perception are shown to extend the body's spatial awareness beyond the visual field. Both accounts converge in suggesting that the experiential boundary of a building is phenomenologically wider than its tectonic boundary—a condition that "heavy lightness" exploits by designing for the dissolution of material edges.

architectural space. Particular attention is directed to studies that deepen the relationship between perceived lightness and the materiality of concrete, providing a solid critical foundation for interpreting the realizations. The research draws upon original sources including the engineering documentation of the Portuguese Pavilion and published interviews with both architects regarding their design intentions.

For the Portuguese Pavilion, the technical-structural analysis utilized engineering documentation published by Cecil Balmond and the Arup team, including specifications on the cable system and the in-situ casting process. Descriptions of the spatial experience derive from direct observations conducted on-site, only for the Lisbon Pavilion, and from existing critical literature, particularly studies from the “Critical Monumentality” project on Siza’s works in the context of the Polis program. For Casa das Canoas, given lesser documentary accessibility, the analysis was based predominantly on monographic publications dedicated to Niemeyer, available photographic documentation, and the architect’s own theoretical writings regarding the relationship between form and structure. It is necessary to acknowledge that the absence of direct access to original design archives constitutes a limitation of the research, partially compensated by the richness of available secondary literature.

David Seamon (2024), in his systematization of the phenomenological approach to architecture in *The Routledge Companion to Contemporary Architectural History*, has distinguished three modalities through which buildings operate as places: “lived worlds”, “architectural atmospheres”, and “environmental wholes”. This framework offers tools for understanding how “heavy lightness” manifests itself simultaneously across all three levels.

Subsequently, a careful morphological and structural analysis proceeds through examination of plans, sections, and elevations, analyzing the dimensional and compositional characteristics of the works. The relationships between solids and voids, load-bearing elements and spatial elements are examined, placing particular emphasis on the function of structural elements such as walls, columns, and roofs in architectural space. These analyses permit clarification of the technical strategies that suggest a sensation of lightness in otherwise massive structures.

In parallel, an in-depth material analysis focuses on the materials used, finishing techniques, and surface treatments applied to reinforced concrete structures, dwelling on surface textures and especially on the interaction between matter and light — a fundamental element for the perception of lightness. A comparison is also conducted between the constructive processes employed in the Portuguese Pavilion and the casting techniques present in Casa das Canoas, also considering the dimension of material memory, with matter’s capacity to evoke sensations and memories profoundly rooted in local cultures.

The phenomenological analysis phase privileges the experiential aspect, combining available photographic documentation, testimonies from the authors, critical reviews, and behavioral studies on how users perceive space. The specific perceptual dimensions investigated—suspension, spatial fluidity, and atmospheric

continuity—are assessed through the triangulated methodology detailed in the analytical criteria above.

To conduct an exhaustive comparison, various analytical tools and parameters are adopted: measurement and comparison of structural proportions (thicknesses, dimensions, free spans, and surface curvatures); study of constructive techniques (post-tensioning, continuous casting, and surface finishing); evaluation of spatial experience, with analysis of the presence of suspended environments or significant voids; and assessment of atmospheric qualities and continuity or dissolution between interior and exterior. Photographic documentation and graphic representations permit visualization and comparison of the effectiveness of applied lightening strategies and the perceptual rendering of surfaces under different light conditions. The relationship with context is a fundamental criterion, with a comparison between works that highlights contrasts between public monumentality and landscape mimesis or residential fluidity.

The criteria for case study selection are based on three fundamental principles: technical innovation, theoretical relevance, and cultural impact. The choice of works benefits from the availability of technical and critical documents that permit in-depth analysis and meaningful comparison. The approach is essentially qualitative and interpretative, concentrating on the sensory, cultural, and phenomenological depth of the research, beyond quantitative data, with the awareness that the interpretative nature and partiality of data impose limitations that must be addressed in the future through more objective instruments such as advanced structural simulations and neuroscientific studies on users' perceptual responses.

Results

The Portuguese Pavilion by Álvaro Siza: Structural Configuration and Tectonic Conception

The Portuguese Pavilion represents one of the most audacious realizations of contemporary architecture in reinforced concrete. Its principal structure consists of a rectangular roof measuring 65×45 meters ($2,925 \text{ m}^2$) whose technical realization requires careful clarification. Contrary to initial appearances that might suggest prefabrication, the roof was cast in situ using a complex system involving steel cables. The project's responsible engineer, Cecil Balmond of Arup, confirmed that the concrete was cast on-site and that, critically, "it was not a pre-stressed structure" in the conventional sense: the pre-tensioning of the cables served primarily to give them form rather than to induce compression in the concrete.⁴¹



Figure 5. *Álvaro Siza Vieira, Portuguese Pavilion. The Concrete Canopy ($65 \times 50 \text{ m}$ span, 20 cm thick) is suspended in a Catenary Curve between Two Portal Frames*
Source: S. Rugino.

This technical distinction is essential for understanding the achievement of "heavy lightness" in the pavilion. The roof hangs in catenary form between two

41. Balmond, *Informal*, 2002, 309-343. The chapter dedicated to the Portugal Pavilion documents the entire engineering process of the roof. On p. 319, Balmond, at the time Deputy Chairman of Arup and head of the Advanced Geometry Unit, describes the greased-sheath cable system that allows the concrete to 'ride' the cable rather than bond to it, and recounts how the collaboration with Siza led him to abandon the initial steel solutions in favour of a concrete 'drape'. For the Italian account of the design process, cfr. Balmond, "La linea che scorre," *Domus* 854 (2004), 75; further documentation in *a+u Architecture and Urbanism*, Special Issue (November 2006); and *El Croquis* 95 (1999).

portals, suspended by cables that are embedded in the concrete slab. The variation in roof thickness — from 20 cm at the edges to 90 cm at the supports — responds both to structural criteria (optimal distribution of stresses) and to expressive requirements, accentuating the perception of thinning toward the edges and conferring lightness to the structure. The longitudinal curvature, with a deflection of 87 cm, provides the necessary rigidity to resist wind and asymmetric loads, while simultaneously contributing to the visual impression of a suspended fabric.



Figure 6. *Portuguese Pavilion, Detail of the Roof-portico Junction. The 45° Bevel Optically Cuts the Structural Thickness, Accentuating the Perception of Structural Slenderness*

Source: S. Rugino.

The vertical load-bearing structure consists of only two parallel longitudinal walls, placed 45 meters apart and having variable thicknesses from 30 cm at the base to 60 cm at the top. Beyond their load-bearing function, these walls integrate technological systems such as rainwater drainage. The absence of intermediate columns is made possible by the effectiveness of the cable suspension system and

the roof's curvature. This creates an interior space free of almost 3,000 m², known as a "suspended void" — a condition that transforms structural weight into an exceptional experience of lightness.

From a material perspective, the concrete of the roof retains the imprints of the wooden formwork used during construction, with a surface texture that recalls the grain of Portuguese maritime pine, contributing to humanizing the material's hardness. The cement used is white Portland with calcareous aggregates, and the variation in its coloration produces a visual dematerialization effect that changes with lighting, reinforcing the impression of lightness. It is important to note that a significant portion of the concrete is lightweight and non-structural, further contributing to the visual effect of weightlessness while reducing the actual mass.

The load-bearing walls present differentiated finishes: externally the texture is rough, leaving the imprint of in-situ casting, while internally the surface is polished. This choice accentuates the contrast between the anchoring function of the walls and the suspended, protective function of the roof, creating a sort of expressive tension between earth and sky. Natural light assumes a central role, reflecting and diffusing in ways that further dematerialize the structure. The roof acts as a calibrated reflective surface, modulating light and creating a system of multiple reflections that uniformly illuminates the area below without generating sharp, oppressive shadows. The 45° chamfer of the structural edge optically cuts the roof's thickness, accentuating its perceived thinness. The combination of wooden texture and raking light generates an effect of "luminous vibration" that renders the surface alive and dynamic.



Figure 7. *Portuguese Pavilion, underside of the Roof Structure. The Texture of the Maritime Pine (Pinus pinaster) Formwork combined with raking Light Produces a "Luminous Vibration" Phenomenon*

Source: S. Rugino.

Finally, the pavilion inserts itself into the urban and landscape context as an autonomous object but also as an urban device that creates a covered public space—an “aerial plaza” protected and open simultaneously, establishing an intense relationship with the Tagus River and the surrounding landscape. The visual tension between the apparent lightness of the roof and its actual material presence creates what might be defined as a “controlled disproportion” — the structural mass seems to defy expectations, generating wonder rather than unease.

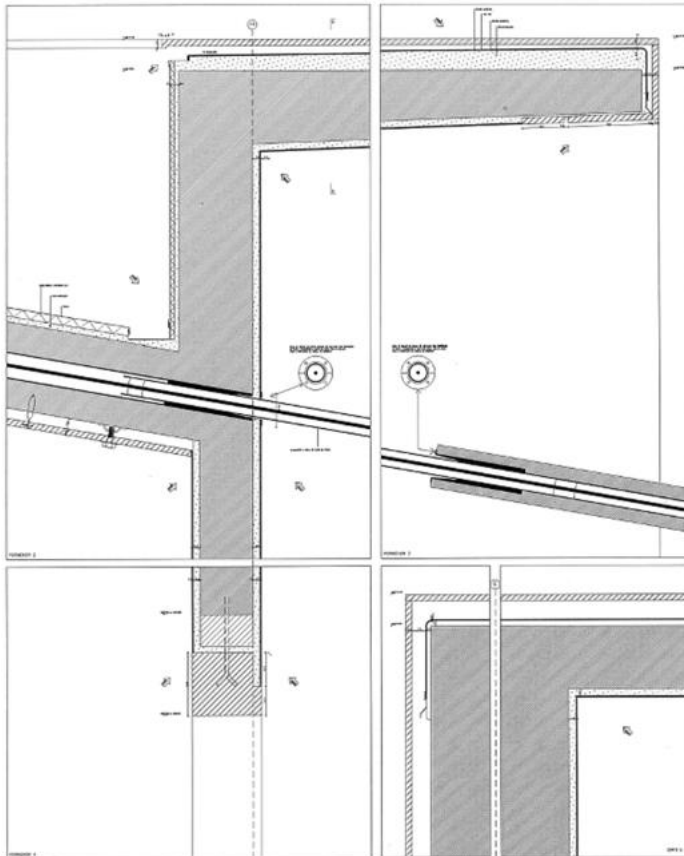


Figure 8. *Portugal Pavilion, Cross-section. Structural System Scheme showing Steel Cables embedded within the Concrete Slab*

Source: Redrawn from: *El Croquis* 95 (1999): 114-141.

Casa das Canoas by Oscar Niemeyer: Structural Configuration and Stereotomic Conception

Casa das Canoas constitutes a significant example of Niemeyer’s sculptural design approach, where traditional distinctions between load-bearing structure and envelope dissolve into a spatial continuum characterized by curved surfaces. The development occurs across two levels connected by a staircase that is simultaneously a structural and distributive element.



Figure 9. Oscar Niemeyer, *Casa das Canoas*. *The curved roof Canopy Integrates Harmoniously with the Mountainous Landscape of the Serra dos Órgãos Mountain Range*

Source: Redrawn from: *Domus* 302 (1955).

The load-bearing structure combines circular reinforced concrete columns (30 cm diameter) in a modular grid with curved load-bearing walls that define the envelope and internal distribution simultaneously. The columns absorb vertical loads, while the curved walls perform the role of bracing and resistance to horizontal forces. The continuous casting technique applied to the perimeter walls eliminates joints, creating monolithic surfaces that accentuate plastic continuity, contributing to a sense of fluidity and lightness.

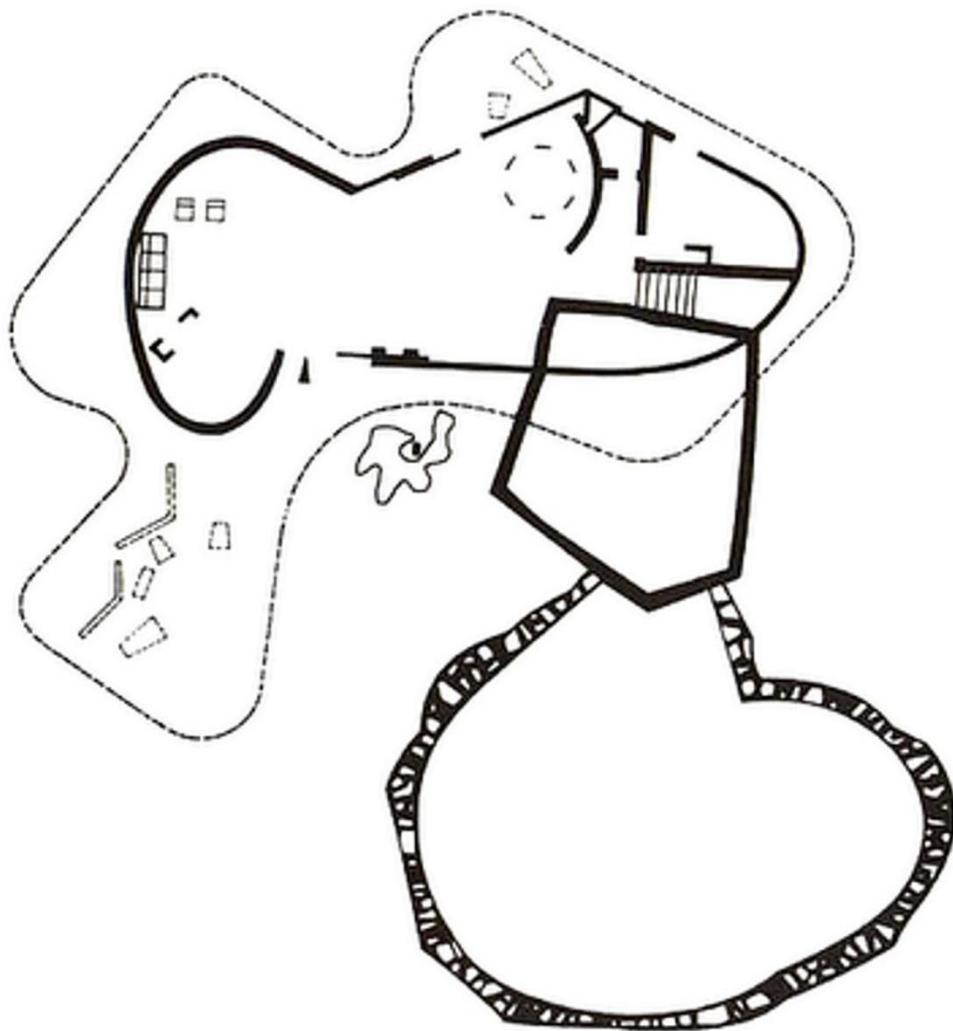


Figure 10. Oscar Niemeyer, *Casa das Canoas*. Plan. *The Circular Columns and curved Walls Simultaneously define Structure and Circulation*

Source: architectuul.com.

The curved walls, executed in cast-in-place reinforced concrete, are veritable structural sculptures that combine function with aesthetic virtuosity. They transform what could be mere elements of spatial delimitation into the experiential core of the house, fluid surfaces that unfold through space, converting material heaviness into a perception of dynamic lightness.

The material treatment shows refined modulation: the polished surfaces of external walls, obtained with metal formwork, also respond to climatic requirements, facilitating water runoff and contributing to thermal comfort through solar reflection. Conversely, the columns maintain a rough texture that emphasizes their structural function, establishing a tactile hierarchy that communicates the logic of forces.



Figure 11. *Oscar Niemeyer, Casa das Canoas. Interior View of the Living Room: The Natural Rock Penetrates the Domestic Space, dissolving the Boundary between Architecture and Landscape. The Extensive glazing and Circular reinforced Concrete Column define a Spatial Continuum between Interior and Exterior*

Source: architectuul.com.

Natural lighting plays a fundamental role, with ample glazed surfaces that frame the surrounding landscape and carefully designed solar control through orientations and screening. The curvature of internal walls modulates light, generating diffused illumination that eliminates sharp shadows, while zenithal light on the staircase creates a “luminous chronometer” that marks spatial time during the day.

The landscape integration of the Casa is marked by morphological mimicry, with curved forms that echo those of the surrounding hills, dissolving the sharp separation between built and nature and using the white color of concrete as an element of contrast and harmony with tropical vegetation. Unlike Siza’s public monumentality, Niemeyer proposes an intimate and domestic experience where lightness becomes an integral part of daily life.

Comparative Analysis: Convergences and Divergences

The structural strategies implemented to generate the sense of lightness differ substantially but converge in the perception produced. Siza’s Pavilion utilizes a “structural subtraction”, minimizing built supports to the essential to create a large suspended void: the reduction to the minimum of load-bearing elements — only two longitudinal walls supporting a roof of almost 3,000 m² — produces what we might define as a “tectonic suspension”, where space is born from the recognizable assembly of few clearly readable structural elements. By contrast, Niemeyer

applies a “morphological transformation”, effecting a metamorphosis of mass into plastic forms through an integrated system in which columns and curved walls merge into a unitary continuum: this “stereotomic fluidification” generates a space that appears carved from a continuous mass, with total plastic fluidity.



Figure 12. *Álvaro Siza Vieira, Portuguese Pavilion. Strategies of “Heavy Lightness”: The “Tectonic Suspension” of the Portugal Pavilion*

Source: Redrawn from: S. Rugino.

The relationship with gravity further evidences this polarity: Siza founds lightness on suspension and void, with large masses that seem to levitate thanks to controlled disproportion between structural weight and spatial perception; Niemeyer fluidifies matter, modeling space as crystallized and dynamic movement where structural complexity is accompanied by uninhibited spatial fluidity. Both strategies, though radically different in formal premises, converge in producing analogous phenomenological effects, revealing a set of recurrent perceptual conditions associated with the generation of perceived lightness within this comparative frame: spaces with dimensional excess relative to load-bearing elements, use of light to dematerialize surfaces, and integration between technical constraints and formal language.

The temporal experience proposed is comprehensively different: Siza’s is contemplative, suspending time, while Niemeyer’s is dynamic, marking movement and perception through spatial sequence and light management. On the scale level, Siza’s Pavilion addresses public and monumental space, creating a collective experience of lightness. Casa das Canoas proposes a more intimate and domestic experience, where lightness becomes an integral part of daily life. These

scalar differences, far from undermining the comparison, illuminate how “heavy lightness” adapts to different programmatic and social requirements while maintaining its essential phenomenological character.

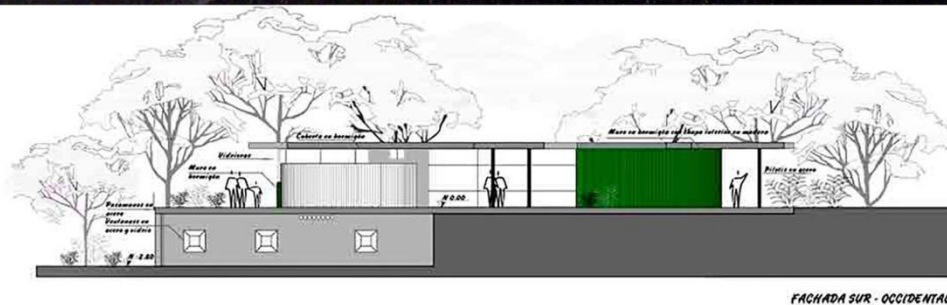


Figure 13. Oscar Niemeyer, Casa das Canoas. Strategies of “Heavy Lightness”: The “Stereotomic Fluidification” of Casa das Canoas
Source: Redrawn from: S. Rugino.

Discussion

The present investigation has highlighted how “heavy lightness”, while evoking Oriental suggestions in its formulation, actually constitutes a central theme profoundly rooted in aesthetic and design reflection throughout historical periods. The expression, apparently oxymoronic, describes a dialectical tension between opposites — mass and suspension, gravity and lightness — that is concretized in numerous significant works from antiquity to the present day. This is not a simple perceptual game or a technical expedient aimed at astonishment, but a veritable aesthetic and conceptual category that finds its most authentic expression in the conscious use of different building materials across epochs, with reinforced concrete representing only its most recent and perhaps most dramatic manifestation.

“Heavy lightness” manifests itself fully when rough and powerful materiality is not dissimulated but rather exalted, in dialogue with sensations of suspension, dynamism, or visual delicacy. In this sense, reinforced concrete architecture is not only a constructive means but a philosophy of building capable of fusing structural solidity and expressive intensity in an only apparently perceptual contradiction, as demonstrated by Le Corbusier’s late-career works, through Tadao Ando’s minimalist poetry, to Peter Zumthor’s material intensity, in which concrete becomes an instrument for poetic essentiality.

The comparative study between the Portuguese Pavilion and Casa das Canoas has revealed how the two design strategies identified in the analysis—though radically different in formal premises—converge in producing analogous phenomenological effects. Thus emerge a set of recurrent perceptual conditions, consistent across the two cases examined: spaces with dimensional excess, use of light to dematerialize surfaces, and integration between technical constraints and formal language.

A central aspect that emerged is the “controlled disproportion” between structural mass and spatial perception, as in Siza’s Pavilion, where the imposing weight of the roof contrasts with an impression of suspension, or in Casa das Canoas, where structural complexity is accompanied by uninhibited spatial fluidity. This disproportion does not transmit precariousness but generates constructive wonder that renders architecture an aesthetic and contemplative experience. “Heavy lightness” is thus interpreted as a philosophy of design and construction, a paradigm that surpasses the dichotomy between matter and form, technique and poetry, function and aesthetics, configuring architecture as a critical space of synthesis in which apparently irreconcilable opposites find equilibrium.

The design experience is nourished by a dialogue between technical rigor and aesthetic sensibility, transforming every structural element — beam, column, slab — into a narrative instrument capable of communicating spatial, symbolic, and emotional values. This vision finds confirmation in experiences from brutalism to poetic minimalism, where the contradiction between heaviness and lightness dissolves into active harmony. Contemporary works demonstrate that no unique formula exists, but diversified strategies aimed at a superior equilibrium between materials, structures, and space, with technology as an enabler of increasingly refined controls over structural performance and perceptual qualities.

In a context of global environmental crisis, “heavy lightness” also assumes ecological valence: reducing materials and weights becomes an ethical imperative and sustainable strategy, with the use of innovative low-impact materials, renewable energies, and efficient resource management. New frontiers include smart materials, adaptive structures, 3D printing, and artificial intelligence applied to design, introducing a temporal and plastic dimension capable of responding to changing conditions. The current challenge is to expand this paradigm by integrating it with emerging technologies and environmental urgencies, maintaining alive the relationship between technique and poetry, innovation and tradition, weight and lightness.

On the technological front, recent developments in the field of ultra-high-performance concrete (UHPC) offer new possibilities for sustainable “heavy lightness”. Recent studies demonstrate how UHPC enables thinner structural sections with superior performance, significantly reducing CO₂ emissions in the life cycle compared to conventional concrete.⁴²

Conclusions

The concept of “heavy lightness” in architecture represents one of the most complex and fascinating questions of the discipline, a critical category that transcends simple technique to embody itself as a philosophy of building and phenomenological strategy. The transformations of twentieth-century and contemporary architecture find in this dialectic between mass and perception one of the principal design drivers and frameworks for critical reading. This research has demonstrated that “heavy lightness” is not a mere decorative effect or apparent contradiction, but a true design philosophy that unites technical innovation and poetic distinction, generating spaces in which the dialectical tension between dense materiality and perceived lightness produces experiences of high aesthetic and functional quality. The material element is transfigured into a sensitive and narrative subject, manifesting itself primarily as a perceptual phenomenon: the massive matter of reinforced concrete is transposed through constructive and visual strategies into an experience of suspension, lightness, and spatial purity, mediated by light, finishes, transparency, and voids around structural elements.

The analyses conducted on the Portuguese Pavilion and Casa das Canoas confirm how Siza’s constructive rigor and Niemeyer’s formal plasticity represent two complementary declinations of the same aspiration: to transform the massiveness of reinforced concrete into an experience of lightness. Technical innovations in reinforced concrete constitute the basis of these experiences: post-tensioning, suspension by cables, shell structures, and tensile structures permit thin elements with large free spans while maintaining resistance and stability; structural optimization reduces thicknesses and functionally distributes load-bearing elements, while minimization or disappearance of supports increases the effect of suspension and lightness; innovative materials such as cross-laminated timber,

42. J. Fan, et al., “Sustainable Reinforced Concrete Design: UHPC in Life-Cycle Structural Performance,” *Engineering Structures* 316 (2024); M. Amran, et al., “Recent Trends in Ultra-High Performance Concrete (UHPC),” *Construction and Building Materials* 352 (2022).

aerogel, and high-performance composites further favor sustainability with high energy performance and low environmental impact.

The original contribution of this study resides in the systematic articulation of “heavy lightness” as an operative critical category. The two strategies identified — tectonic suspension and stereotomic fluidification — have both proven effective in producing the perceptual negation of weight, suggesting the existence of phenomenological invariants transversal to different architectural languages.

The research limitations include the absence of direct access to design archives, which prevented analysis of decision-making processes during design; the lack of empirical investigations on user perception through neuroscientific methodologies or structured questionnaires; and the focus on only two case studies, which limits the generalizability of conclusions. Moreover, the comparison between works of different scale and program, though methodologically justified, requires caution in extending results to other architectural typologies.

Future research perspectives suggest extending the analysis to other masters of reinforced concrete (Tadao Ando, Zaha Hadid, Peter Zumthor) to verify the validity of proposed categories; integrating empirical methodologies from environmental psychology to measure perceptual responses; studying the implications of “heavy lightness” for sustainability in light of UHPC technologies that permit thinner sections with equal performance; and historical investigation of pre-modern precedents of the concept, from Gothic to Mannerism, for a more complete genealogy of the weight-lightness dialectic in architecture.

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From Adaptive Skins to Adaptive Cities

By Katia Gasparini* & Sara Moro[±]

The article explores the role of adaptive building envelopes as an innovative strategy to mitigate the Urban Heat Island (UHI) effect and enhance environmental sustainability in cities. While adaptive envelopes are traditionally studied for energy efficiency and indoor comfort, this research evaluates their potential at the urban scale by analysing their ability to dynamically interact with the microclimate through solutions such as evaporative cooling, vegetative integration, and high solar reflectance materials. Through a comparative analysis of 50 case studies (25 traditional versus 25 adaptive envelopes), the study highlights how ceramic materials, due to their high Solar Reflectance Index (0.75) and Thermal Emittance (0.90), are among the most effective in reducing surface temperatures. Additionally, the integration of active cooling systems and bioreceptive surfaces demonstrates significant potential in improving air quality and urban resilience. The findings emphasize the need to move beyond static building envelope approaches, proposing instead a model of adaptive urbanism in which architecture becomes an active agent in managing urban climate. The study concludes that, despite current limitations in quantitative data availability, adaptive envelopes represent a promising solution for addressing the climatic and social challenges faced by urban areas.

Introduction

The increase in greenhouse gas emissions and the expansion of soil consumption, direct consequences of rapid urbanization, necessitates the adoption of innovative and multidisciplinary strategies to mitigate the effects of climate change, particularly in urban areas.¹ In this context, the urban heat island (UHI) phenomenon constitutes an increasingly urgent environmental and social challenge.² Given these premises, adaptive envelopes, which have been the subject of research and development for several years, emerge as promising technological systems capable of improving the thermo-environmental comfort of buildings and contributing to the reduction of UHI thanks to their intrinsic requirements of adaptability to environmental stimuli.

Despite this potential, their large-scale adoption remains limited and fragmented, primarily due to technological complexity and difficulties in integrating them into consolidated building and urban fabrics. The literature highlights that adaptive envelopes are mainly implemented for energy efficiency and indoor comfort, while there is a lack of comprehensive studies exploring their use at the urban

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1. IEA, *Technology roadmap: Energy efficient building envelopes* (Paris: IEA, 2013).

2. S. Vardoulakis, K. Dear, and P. Wilkinson, "Challenges and opportunities for urban environmental health and sustainability: The HEALTHY-POLIS initiative." *Environmental Health* 15 (2016): 36.

scale for improving public spaces and mitigating the effects of urban heat islands.³

In the transition from the building to the city scale, the envelope presents itself as a connecting element, cooperating to improve urban quality and well-being for citizens. The concept of adaptivity transposed to the urban scale relates to the ability of a city to respond flexibly and effectively to complex and changing challenges, such as the climate crisis and environmental degradation, to name a few. Adaptive cities use the principles of complex adaptive systems theory to guide urban governance, emphasizing resilience, dynamic planning, and the integration of various indicators—environmental, social, and economic—to assess and improve urban well-being and environmental quality. This approach contrasts with traditional static urban models, focusing on continuous learning, feedback, and targeted interventions to optimize both environmental conditions and the well-being of citizens. Similar to the adaptive envelope, the city thus becomes an adaptive organism, where the envelope is a key component and primary actor. Ongoing research demonstrates that adaptive strategies can improve air quality, increase access to open spaces, and promote social cohesion, all factors linked to higher levels of urban and social well-being. Overcoming the traditional conception of the adaptive envelope as a functional element solely for indoor comfort at the scale of the dwelling unit, current research proposes an extension of the adaptive paradigm to the urban scale. In this new perspective, the envelope no longer represents just a filter between the internal and external environment but an active device within a complex urban system, contributing to the definition of resilient and climate-aware strategies. Adaptivity, understood as the capacity for dynamic response to variable environmental and energy conditions, is configured as a guiding principle for a new urban model. In this framework, the city is interpreted as an adaptive organism capable of integrating the building envelope into its ecological infrastructure. In this change of scale, the envelope is no longer limited to responding to the needs of individual buildings or dwelling units but becomes an active part of an interconnected network capable of influencing urban quality and collective well-being. Adaptive envelopes can contribute to mitigating the effects of the urban heat island, improving air quality, and optimizing the microclimate, becoming tools for environmental equity and social well-being. The study aims to offer a new interpretation of the concept of adaptivity, extending it from architectural skins to the city. The objective is to evaluate whether adaptive technologies can evolve into tools capable of improving outdoor comfort and effectively responding to the microclimatic conditions of cities. The analysis focuses on identifying even consolidated technologies present in the literature that are most compatible with this objective, contributing to outlining a more integrated design framework between the envelope, public space, and urban resilience.

3. L. Aelenei, D. Aelenei, R. Romano, E. S. Mazzucchelli, M. Brzezicki, and J. M. Rico-Martinez, *Case Studies – Adaptive Facade Network* (TU Delft Open, 2018).

Research Question

Given the premises, in a policy of controlling the Urban Heat Island (UHI) effect through the choice of materials for adaptive facades, it appears fundamental to correlate not only the superficial requirements of facade components (colour, reflection, texture, etc.), but also the phenomena of mutual reflection between vertical surfaces (facades) and horizontal surfaces (road pavements and building bases). Within these considerations, what role can adaptive envelopes play in the phenomena of reflection and UHI control? These are dynamic envelopes that vary with climatic conditions; therefore, they can inherently mitigate UHI by directing solar rays away from the ground or absorbing them based on the climate and the physical-material requirements of the components (colour and surface texture). Typically, these facades are made of metal in natural, white, or reflective shades. Recent studies have shown a growing interest in the relationship between the colour of the cladding and the values of solar reflectance and emittance. Furthermore, Synnefa et al.'s 2007 research indicates that the use of low thermal inertia materials on facades can help reduce the intensity of urban heat islands.^{4,5}

The ongoing research investigates the potential and requirements of adaptive envelopes as climatically active devices, capable of dynamically interacting with the urban microclimate and significantly contributing to the quality of urban spaces, promoting collective thermal comfort and urban resilience, also in relation to materials with high reflectance and thermal inertia. The shift from the concept of "adaptive skin" to that of "adaptive city" would transform the adaptive envelope into an urban strategy, capable of contributing to the mitigation of UHI, the reduction of energy demand for cooling, and the overall climatic quality of the built space.

Literature Review

The implementation of effective measures to mitigate the effects of global warming following record-breaking greenhouse gas emissions aligns with the sustainability objectives established for 2030.⁶ Among the sectors with the highest environmental impact, the AEC industry (Architecture, Engineering, and Construction) is widely acknowledged for its substantial consumption of materials, waste generation, and greenhouse gas emissions.⁷

Research by the IPCC indicates that the construction sector accounts for 50% of global material extraction while generating 21% of total emissions. The transition toward a sustainable economy lies at the core of European strategies,

4. A. Synnefa, and M. Santamouris, *Cool-colored coatings fight the urban heat-island effect* (SPIE Newsroom, 2007).

5. K. Gasparini, "Exploring responsive and adaptive building skins: texture, materials, color, and environmental integration," in *19th Advanced Building Skins Conference & Expo*, Bern, 28-29 October 2024, 88-94.

6. United Nations Environment Programme (UNEP), *Emissions Gap Report 2024: No More Hot Air... Please!* (Nairobi: UNEP, 2024); UNEP, *Global Status Report for Buildings and Construction* (Nairobi: UNEP, 2024).

7. IEA, *Technology roadmap: Energy efficient building envelopes*, 2013.

with the AEC industry playing a pivotal role in this challenge.⁸

Concurrently, building envelope design has undergone a profound transformation, shifting toward improved indoor comfort and energy efficiency. Moving beyond static, massive construction aimed at ensuring thermal inertia, contemporary solutions increasingly embrace dynamic, modular, and technologically sophisticated approaches. The evolution of cladding systems, now engineered as high-performance industrial products, has led to the development of adaptive facades—intelligent envelopes capable of actively modifying their physicochemical properties in response to external environmental conditions. These systems represent a cutting-edge frontier in architectural and engineering research, often inspired by natural adaptation mechanisms and based on the integration of advanced materials, sensing technologies, automation, and parametric design.

Loonen et al. define adaptive facades as building envelopes that can repeatedly and reversibly alter their properties in reaction to environmental changes, thereby enhancing indoor comfort while reducing energy consumption.⁹ The term "adaptive" is typically reserved for self-actuating systems incorporating embedded sensors and actuators, whereas "responsive elements" can also include externally controlled components.¹⁰ These researchers emphasize that flexibility is central to adaptive envelopes, in contrast to the rigidity of traditional systems, and propose principles of adaptability, multifunctionality, and evolvability to address current and future demands.¹¹ There is also kinetic architecture, which involves macroscopic changes in form or configuration and represents a distinct category, as illustrated by the Acclimated Kinetic Envelopes (AKE) proposed by Wang et al.¹² Literature indicates that the primary objective of adaptive technologies is to optimize indoor comfort, particularly through the environmental control of the building envelope. The COST ACTION TU database reveals that the main characteristics of adaptive envelopes concern thermal comfort (30%) and visual comfort (24%), suggesting that over half of the analysed solutions aim to enhance indoor environmental quality. This data confirms that thermal gains and glare represent central challenges in sustainable design, particularly due to the high environmental impact of Heating, Ventilation, and Air Conditioning (HVAC) systems.¹³ However, emerging case studies demonstrate that these technologies can extend their effectiveness beyond internal microclimate regulation, contributing to the improvement of external microclimatic conditions and the mitigation of the urban heat island (UHI) phenomenon. The UHI effect, a consequence of intensive urbanization, is

8. Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022: Mitigation of Climate Change* (Cambridge: Cambridge University Press, 2022).

9. R. C. G. M. Loonen, M. Trčka, D. Cóstola, and J. L. M. Hensen. "Climate Adaptive Building Shells: State-of-the-Art and Future Challenges." *Renewable and Sustainable Energy Reviews* 25 (2013): 483-493.

10. P. Heiselberg (Ed.), *Expert Guide – Part 1: Responsive Building Concepts* (Aalborg: Aalborg University, 2009).

11. Loonen, Trčka, Cóstola, Hensen, "Climate adaptive building shells: State-of-the-art and future challenges," 2013, 483-493.

12. J. Wang, L. O. Beltrán, and J. Kim, "From Static to Kinetic: A Review of Acclimated Kinetic Building Envelopes," in *World Renewable Energy Forum* volume 5, 4022-4029 (2012).

13. Aelenei, Aelenei, Romano, Mazzucchelli, Brzezicki, and Rico-Martinez, *Case Studies: Adaptive Facade Network*, 2018.

characterized by significantly higher temperatures in urban areas compared to surrounding rural regions, primarily due to the replacement of natural surfaces with constructed materials and the consequent reduction in vegetation cover.¹⁴ The capacity of urban surfaces to store and release heat, combined with anthropogenic heat emissions, contributes substantially to thermal accumulation in cities. Key influencing factors include soil structure, the presence of vegetation, population density, and local meteorological conditions.¹⁵ Urban surface temperature plays a critical role in altering the energy balance of the built environment, thereby affecting the city's microclimate and various ecological processes. Contemporary research defines the UHI effect as an increase in summer temperatures in urban areas. UHI mitigation can be achieved through urban and architectural design strategies aimed at reducing its impact. Among the most common techniques are the use of high-albedo surfaces and reflective materials to minimize heat absorption, as well as the design of buildings and urban spaces that promote natural ventilation and mitigate the effects of urban canyons. UHI mitigation can be achieved through urban and architectural design strategies aimed at reducing its impact. Among the most common techniques are the use of high-albedo surfaces and reflective materials to minimize heat absorption, as well as the design of buildings and urban spaces that promote natural ventilation and mitigate the effects of urban canyons. Green and reflective surfaces are particularly effective, as they also enhance building energy performance. The materials used in these solutions typically exhibit high solar reflectance (SR) and high thermal emittance (TE). The combined application of reflective and green surfaces on roofs and building envelopes represents an effective mitigation strategy, wherein green surfaces reduce heat through evaporative cooling, while reflective surfaces limit net absorbed radiation. Experimental studies, such as those conducted by Akbari et al., have demonstrated that these approaches can reduce sensible heat flux compared to conventional concrete surfaces.¹⁶

Although many simulations have focused on horizontal surfaces (e.g., roofs and pavements), it is essential to recognize that urban façades interact with these surfaces through mutual solar radiation reflection. Current research has explored adaptive technologies, phase change materials (PCMs), and thermochromic materials. "Cold" materials represent a heterogeneous category that includes highly reflective natural surfaces, artificial white materials, low-temperature pigmented coatings (cold-coloured materials), and advanced nanomaterials.^{17 18} In

14. U.S. Environmental Protection Agency, "Green Roofs," in *Reducing Urban Heat Islands: Compendium of Strategies* (Washington, DC, 2008).

15. T. Oke, "City Size and the Urban Heat Island," *Atmospheric Environment* 7 (1973): 769-779.

16. H. Akbari, M. Pomerantz, and H. Taha, "Cool Surfaces and Shade Trees to Reduce Energy Use and Improve Air Quality in Urban Areas," *Solar Energy* 70 (2001): 295-310; Akbari, and S. Konopacki, "Calculating Energy-Saving Potentials of Heat-Island Reduction Strategies," *Energy Policy* 33 (2005): 721-756.

17. L. F. Cabeza, C. Castellón, M. Nogues, M. Medrano, R. Leppers, and O. Zubillaga, "Use of Microencapsulated PCM in Concrete Walls for Energy Savings," *Energy and Buildings* 39, no. 1 (2007): 113-119.

particular, the use of reflective or high-solar-reflectance materials on façades can contribute not only to reducing the thermal load on buildings but also to the overall radiation balance of urban spaces, in synergy with the albedo characteristics of horizontal surfaces. Supporting this, recent studies have highlighted how cool façades, thanks to their combination of high solar reflectance and thermal emissivity, are able to significantly lower external surface temperatures and reduce cooling energy demand, thereby improving indoor thermal comfort—especially in Mediterranean climate contexts where the urban heat island effect is particularly relevant.¹⁹ This confirms the necessity of considering vertical façade treatments in climate-responsive urban design. Figure 1 illustrates three experimental projects presented as distinct case studies. Experimental projects, such as the AeroLeaf system—featuring mobile ceramic evaporative cooling components applied to residential buildings—or the bioreceptive terracotta façade developed by a multidisciplinary team comprising Henning Larsen, Thornton Tomasetti, and VS1 by Innovation Glass, which promotes moss and microorganism growth to activate climate-responsive surfaces, illustrating how living materials can enhance environmental performance, represent concrete examples of this approach.²⁰ Additionally, the Cool Cacti project integrates passive and evaporative cooling into a freestanding urban structure, demonstrating how adaptability can address both functional needs and shared environmental and spatial qualities. These design experiences outline a still largely unexplored area of research, in which adaptive architecture emerges as a potential climate control mechanism for urban space, expanding the scope of the building envelope to a broader territorial scale.²¹

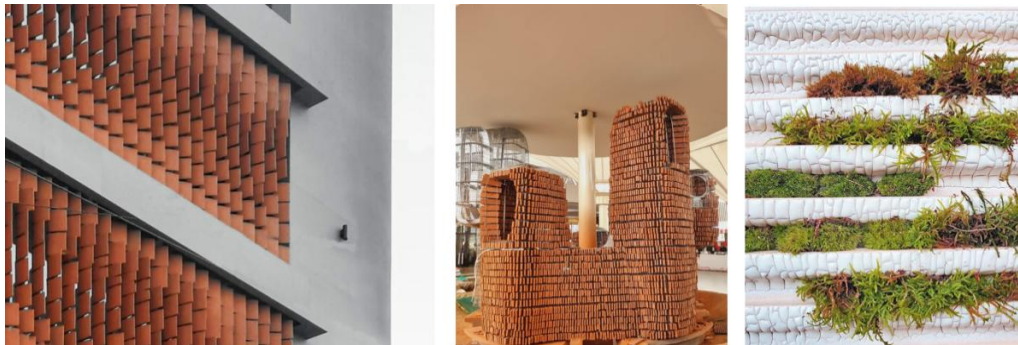


Figure 1. *Examples of Climate-Responsive Designs: (a) AeroLeaf System with Mobile Ceramic Cooling (2023); (b) Cool Cacti Passive and Evaporative Cooling (2023); (c) Thornton Tomasetti Sustainable Façades with Bioreceptive Surfaces (2023)*

Source: fig. 1a-1b, courtesy by CoolAnt, 2025; fig. 1c, www.ThorntonTomasetti.com, 2025.

18. Karlessi, T., M. Santamouris, A. Synnefa, D. Assimakopoulos, P. Didaskalopoulos, and K. Apostolakis, "Development and Testing of PCM Doped Cool Colored Coatings to Mitigate Urban Heat Island and Cool Buildings," *Building and Environment* 46, no. 3 (2011): 570-576.

19. A. L. Pisello, M. Santamouris, and F. Cotana, "Active Cool Roof Effect: Impact of Cool Roofs on Cooling System Efficiency," *Advances in Building Energy Research* 7, no. 2 (2013): 209-221; M. Zinzi, "Exploring the potentialities of cool facades to improve the thermal response of Mediterranean residential buildings," *Solar Energy* 135 (2016): 386-397.

20. P. Jayasankar, *An Innovative Product for Sustainable Cooling: CoolAnt Aero-leaf – Breathing Façade* (Smart POV, 2024); ArchCeramic Workshop, *ACAW 2024 – Architectural Ceramic Assemblies Workshop*.

21. CoolAnt, *CoolAnt Gallery – Façade*.

Materials and Methods

The selection of case studies for this research is based on the database developed within the Research about the "High-Performance Ceramic Building Envelopes: Prototyping and Monitoring" University of Sassari.

This study forms part of a broader systematic review of the state-of-the-art in adaptive and ceramic building envelopes, which resulted in the collection, analysis, and cataloguing of 329 internationally selected case studies. The case study research was conducted by examining peer-reviewed articles published in scientific journals, technical manuals, and additional materials sourced from open-access repositories (Scopus, Web of Science, and Google Scholar), as well as web-based searches (Google) and journal publications.

The methodology employed integrates both quantitative and qualitative analysis, structured into three distinct phases (Table 1):

- An initial phase of data collection and systematization of the state-of-the-art on adaptive envelopes and the urban heat island (UHI) phenomenon;
- A subsequent phase dedicated to the selection of case studies and the development of a comparative database.
- A final phase focused on the critical analysis of the selected projects, aimed at identifying recurrent design patterns and effective mitigation strategies for improving the urban microclimate.

Table 1. *Outline of Research Methodology Phases*

PHASE 1 DATABASE	PHASE 2 COMPARATIVE ASSESSMENT
Analysis criteria Analysis matrix with quantitative and qualitative indicators: 1. Material data 2. Adaptive technology 3. Physical performance 4. Climatic context 5. Degree of adaptivity	Evaluation indicators Key indicators (optical, physical, climatic): 1. Solar Reflectance 2. Thermal Emittance 3. Solar Reflectance Index (SRI) 4. Albedo 6. Surface temperature variation (ΔT)
Methods • Bibliographic research • Scientific and regulatory research • Deductive method • Direct experience and professional contacts	Methods • Quantitative and qualitative analysis • Deductive-comparative method • Classification by adaptivity score
Tools • Summary sheets for analysis and data collection	Tools • Comparative material performance tables

Study Sample Definition

The urban heat island (UHI) phenomenon is influenced by multiple factors, including the thermophysical properties of construction materials, vegetation coverage, morphological configuration, urban density, and local meteorological conditions. The 329 case studies were initially evaluated based on their adaptivity scores and subsequently classified using optical and thermal performance indicators—specifically Solar Reflectance (SR), Thermal Emittance (TE), and Albedo—to assess the capacity of vertical surfaces to absorb, reflect, and emit thermal radiation. These parameters enable quantification of façade contributions to either mitigating or exacerbating UHI effects. This integrated analytical approach facilitates a comprehensive evaluation of bioclimatic interventions combined with specialized building envelope materials and technologies. The primary objective is to compare the environmental performance of various design solutions, establishing a quantitative foundation for developing design guidelines aimed at enhancing microclimatic resilience and reducing UHI intensity. The 329 catalogued case studies were analysed according to criteria derived from state-of-the-art research and supplemented with geographic and building envelope characteristics. Given that materials effective in UHI mitigation must demonstrate high solar reflectance (Solar Reflectance Index, SRI), high thermal emittance (TE), and adaptability (both mechanical and intrinsic), these parameters were established as key indicators for evaluating the selected case studies. The SRI criteria for the initial selection of the selected case studies were also derived from the legislation currently in force in Italy, serving as a basic reference. Ministerial Decree No. 256 of June 23, 2022, Official Journal No. 183 of August 6, 2022 (the so-called CAM Decree), which establishes the adoption of minimum environmental criteria (CAM) for buildings, thus aligning with environmental protection strategies already established internationally. Regarding the SRI, Section 2.2.6 of Ministerial Decree No. 256 establishes that, with reference to "Reduction of the impact on the microclimate and air pollution," waterproof surfaces must be made of materials with a high solar reflectance index.²² In particular:

- external surfaces (e.g., pedestrian walkways, sidewalks, squares, cycle paths, etc.): $SRI \geq 29$
- roofing materials must guarantee an SRI of at least 29 for slopes greater than 15%, and at least 76 for slopes less than or equal to 15%.

The international LEED standards, however, establish an initial SRI of at least 39 for steeply sloped roofs and a three-year SRI of 32.

For the purposes of the ongoing research, a reference SRI value for vertical surfaces was established, averaging between the two standards and ranging from 29 to 39. Therefore, the initial selection criteria are:

22. Ministry of Ecological Transition, *Minimum Environmental Criteria for Buildings* (Official Journal of the Italian Republic, No. 183, August 6, 2022).

- $29 < SR < 39$
- Adaptivity requirements for the façade system or components (Adaptivity scoring)
- Climate range (Koppen 1991-2020/2041-2070/2071-2099)
- Visual requirements for the material (colour and texture)

A matrix of indicators was then defined to provide a second didactical analysis of the selected case studies, for optimal integration into the urban context aimed at controlling the UHI (Table 2).

Table 2. Analysis Criteria Matrix

Analysis criteria	Description
1. Cladding material data	
Material type	Specify if the material is: metal, composite, ceramic, stone or other
Color	Specify the color hue (white, grey, others.)
2. Architectural facade data	
Type of adaptivity (Inherent or mechanical)	Specify whether the construction system is mechanically adaptive or whether the material is adaptive
3. Physical Requirements Data	
Solar Reflectance	The fraction of the incident solar energy that is reflected by a surface.
Thermal Emittance	The ability to emit energy in the form of thermal radiation
SRI - Solar Reflectance Index	Measures a material's ability to reflect solar energy and dissipate heat.
Albedo	The fraction of sunlight reflected
4. Climate range	The location based on Environmental requirements
5. Technological integration	
Plant systems integration	Integration of green facade systems (living walls) or new generation bio-inspired materials
Integration of technical systems (cooling, air, etc.)	Integration of air- or water-cooling channels

Cataloguing

For the analysis of the case studies, a synthetic data sheet model was developed to simplify the systematization of the data. The first section focuses on the project's profile data (construction date, location, intended use, status), while the second section concentrates on the identified technological criteria, categorized and subdivided accordingly. The data collection and archiving process involved gathering both quantitative and qualitative data through the bibliographic research. The references for each case study were compiled in the corresponding data sheets. Furthermore, the information obtained through bibliographic research was supplemented by the author's direct experience, which gathered additional details

through professional interactions with companies and research centres, thereby ensuring a comprehensive investigation of the subject matter.

Research Limitations

The case study analysis revealed a significant gap in the availability of specific data based on the established criteria. This deficiency is significant because it indicates that adaptive façade design remains largely disconnected from outdoor environmental concerns, being predominantly aimed at energy savings and enhancing indoor comfort.

Comparative Analysis of Catalogued Data

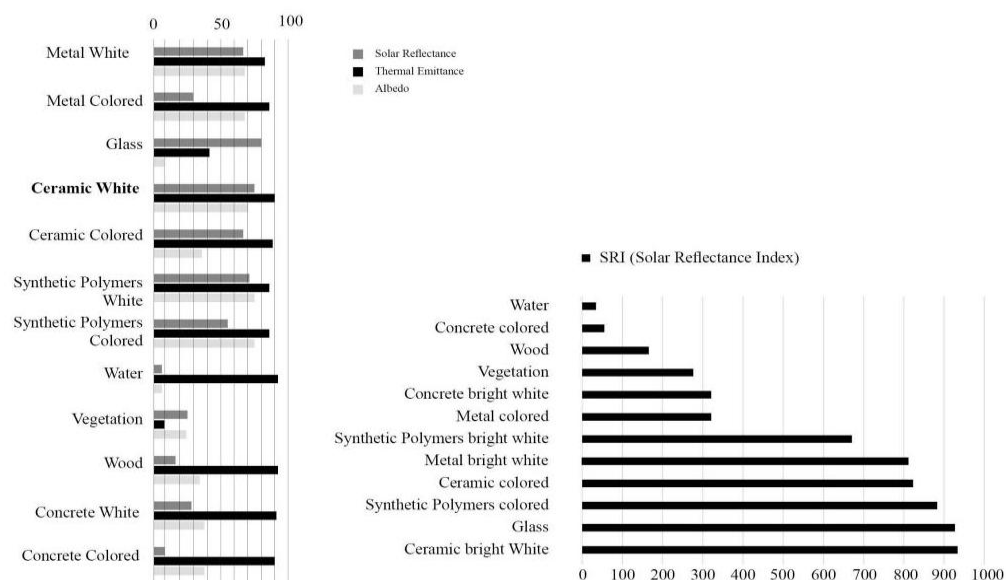
The analysis of the material composition of building envelopes revealed a total of 176 applications of metal, 72 of glass, 50 of ceramic, 39 of synthetic polymers, 26 of water surfaces, 21 of vegetation, 19 of wood, and 13 of concrete. The comparative analysis assessed the effectiveness of the selected materials in reducing the impact of the Urban Heat Island (UHI) effect. Specifically, ceramic envelopes exhibited high values of Solar Reflectance (0.75), Thermal Emittance (0.90), and Albedo (0.70), ranking among the most efficient materials in reflecting solar radiation. The Solar Reflectance Index (SRI) of white ceramic reached a value of 93.2, the highest among the analysed materials. The 50 ceramic façades present in the sample of 329 case studies, including 25 adaptive and 25 traditional ones, were further analysed to investigate the contribution of this material within more complex adaptive strategies, integrated with evaporative cooling systems and façade vegetation, with the aim of further optimizing the environmental performance of building envelopes (Tables 3-4, Figure 2).

Table 3. *Analysis of the Materials Used in the Database Using the Indicators: Solar Reflectance (SR), Thermal Emittance (TE), Solar Reflectance Index (SRI) and Albedo*

Applications	Material	Color	SR	TE	SRI	Albedo
176	Metal	Bright White	0.67	0.83	81.3	0.68
		Colored	0.30	0.86	31.9	0.68
72	Glass		0.80	0.40	93.1	0.08
54	Ceramic	Bright White	0.75	0.90	93.2	0.70
		Colored	0.67	0.89	82.3	0.36
39	Polymers	Bright White	0.72	0.87	88.7	0.75
		Colored	0.56	0.87	67.1	0.75
26	Water		0.07	0.93	3.6	0.07
21	Vegetation		0.26	0.90	27.6	0.25
19	Wood		0.17	0.93	16.6	0.35
13	Concrete	Bright White	0.29	0.92	32.1	0.38
		Colored	0.09	0.91	5.6	0.38

Table 4. *References of Indicators Used for Material Analysis in Evaluating Urban Heat Island Mitigation*

INDICATORS	REFERENCES
SR (Solar Reflectance) TE (Thermal Emittance)	Hoffmann, C., & Geissler, A. (2022). Climate Change and Building Materials in Urban Areas: Materials Catalog and Recommendations. Summary. Federal Office for Housing (UFAB). UNI 8477-1. (1983). https://coolroofs.org/directory/roof?keywords=glass&page=2 https://www.pce-italia.it/html/dati-tecnici-1/link/tabella-gradi-di-emissione-materiali-non-metallici.htm https://www.otm.sg/complete-list-of-glass-properties https://www.otm.sg/sri-calculator
SRI (Solar Reflectance Index)	https://www.otm.sg/sri-calculator
A (Albedo)	Gul, MS, Kotak, YS, Muneer, T & Ivanova, S 2018, 'Enhancement of Albedo for Solar Energy Gain with Particular Emphasis on Overcast Skies', <i>Energies</i> , vol. 11, no. 11, 2881. https://doi.org/10.3390/en11112881 H. Taha, D. Sailor, H. Akbari (1992), "High-Albedo Materials for Reducing Building Cooling Energy Use", Energy and Environment Division, Lawrence Berkeley Laboratory, University of California.
ΔT (Surface temperature decrease)	Versini, P.-A., Castellanos-Diaz, L. A., Ramier, D., & Tchiguirinskaia, I. (2024). Evapotranspiration evaluation using three different protocols on a large green roof in the greater Paris area. Zhang, L., Zhang, R., Zhang, Y., Hong, T., Meng, Q., & Feng, Y. (anno). The impact of evaporation process on thermal performance of roofs.

**Figure 2.** *Comparative Analysis of the Materials Used in the Selected Projects from the Database, Based on Key Indicators to Assess their Potential for Mitigating the Urban Heat Island (UHI) Effect*

Among the analysed case studies, three deserve in-depth examination for their potential in combining the physical-material requirements of materials, adaptability requirements, and thermal requirements. The AeroLeaf system (previously mentioned) is installed on the façade of a riverside residence in Raipur, closing off a portico. The system is particularly noteworthy due to its use of extruded ceramic elements shaped like leaves, stacked on a steel post. The ceramic elements can rotate freely and are manually adjustable. Water is dripped through a second cavity in each "leaf" via an irrigation pipe, with the goal of moistening the ceramic pieces and enhancing cooling performance.²³ The bio-receptive ceramic façade designed by Make Architects in collaboration with Arup in 2024 (manufactured by Boston Valley Terracotta) is also composed of modular elements, arranged in a diagonal and curved pattern. The pattern integrates unglazed inserts with horizontal grooves designed to slow down rainwater runoff. The curved diagonal components channel airflow, while the inserts collect water in their grooves. The porous ceramic mixture used for the inserts creates a bio-receptive surface that fosters the growth of algae and other microorganisms, generating a vital layer that enhances water retention and further slows down runoff.²⁴ Also in 2024, CoolAnt developed the Cool Cacti project: an artistic installation that integrates the CoolAnt Binary evaporative cooling system. The sculpture is clad with a double zinc-coated mesh containing standard bricks, which are moistened by water poured from above and collected at the base. This system leverages evaporation to enhance cooling, combining functionality and aesthetic quality. The project achieved an adaptability score of 12, representing an example of sustainable innovation in the field of adaptive architecture.²⁵ These projects are concrete examples included in the database and represent diverse technological and material approaches that contribute to the definition of new strategies for adaptive building envelopes, with potential positive impacts on environmental sustainability.

Results and Discussion

The investigation of a sample of 50 ceramic envelope systems, comprising 25 adaptive and 25 traditional designs, revealed that 22% of the adaptive envelopes employed effective strategies to improve the urban microclimate, a characteristic exclusive to this group. The prevalence of high-performance solutions among adaptive envelopes suggests a correlation between adaptability and environmental performance, particularly in reducing surface temperatures and enhancing urban comfort. Among the 25 adaptive projects, approximately 12% incorporated vegetation systems directly into the building envelope, while 32% featured active cooling solutions. Notably, one case (4% of the total) combined both vegetation and active cooling strategies, resulting in a hybrid system that synergistically leveraged passive and active climate control mechanisms. The integration of

23. Jayasankar, *An Innovative Product for Sustainable Cooling: CoolAnt Aero-leaf – Breathing Façade*, 2024.

24. ArchCeramic Workshop, *ACAW 2024 – Architectural Ceramic Assemblies Workshop*, 2024.

25. CoolAnt, *CoolAnt Gallery – Façade*.

ceramic materials with adaptive systems, often based on plant-based or water-based elements, proved particularly effective. Indicators related to Solar Reflectance (SR), Thermal Emittance (TE), Solar Reflectance Index (SRI), and albedo did not reveal significant variations or improvements between adaptive and traditional systems. However, the surface temperature variation (ΔT surface), based on data from studies by Versini et al. and Zhang et al., indicated a substantial reduction in façade surface temperature, equal to approximately 5.6 °C for water-based systems and 1.5 °C for vegetated façade systems. While this analysis primarily focused on surface properties and associated temperature variations, a comprehensive assessment of the effectiveness of adaptive systems in mitigating the urban heat island effect requires the integration of microclimatic data, including ambient air temperature and environmental comfort parameters, which can be acquired through in-situ measurements or advanced microclimatic simulations. These in-depth microclimatic assessments represent a crucial future development for fully understanding the overall impact of adaptive technologies in urban contexts.²⁶ The comparative approach adopted enables a direct relationship between two formally similar but functionally distinct building envelope categories, isolating the role of adaptivity as an independent variable and providing a useful basis for design considerations. The focus on ceramic materials, known for their thermal and reflective properties and durability, ensures material homogeneity within the sample, strengthening the investigation's coherence. The emerging evidence suggests the opportunity to expand the study to a larger and more diverse sample, incorporating envelopes made from various materials, such as metals, composites, or natural stone, and exploring a broader range of climatic and geographic contexts.

A further area of interest concerns the integration of phase change materials (PCMs) in adaptive envelopes, analysing their thermoregulatory potential in both dense urban environments and climate-extreme zones. Expanding the database and utilizing advanced energy and environmental simulation tools could enable an objective assessment of envelope performance, integrating indicators such as surface temperature, heat flow, thermal comfort, and energy consumption. Furthermore, connecting adaptive envelopes to intelligent control systems and environmental sensors could enhance their performance, opening scenarios in which the envelope becomes an active component of a responsive and resilient urban system (Tables 5-6).

26. L. Zhang, R. Zhang, Y. Zhang, T. Hong, Q. Meng, and Y. Feng, "The Impact of Evaporation from Porous Tile on Roof Thermal Performance: A Case Study of Guangzhou's Climatic Conditions," *Energy and Buildings* 136 (2016): 119-129; P.-A. Versini, L. A. Castellanos, D. Ramier, and I. Tchiguirinskaia, "Evapotranspiration Evaluation Using Three Different Protocols on a Large Green Roof in the Greater Paris Area," *Earth System Science Data* 16 (2024): 2351-2366.

Tables 5-6. Analysis of the Presence of Urban Heat Island (UHI) Mitigation Strategies Using Evaporative Cooling Systems, carried out on a Sample of 50 Case Studies: 25 Traditional Building Envelopes and 25 Adaptive Building Envelopes Incorporating Ceramic Materials. Traditional Building Envelope Table

	Project	System Type	Materials	Adaptivity Scoring:	SR	TE	SRI	Albedo	ΔT (°C)
1	Algueña Concert Hall and Music school MUCA	Ceramic pearlescent glaze	Ceramic (White)	0	0.75	0.90	92.9	0.70	0
2	Girasol	Direct fix cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
3	Biblioteca pubblica di Nembro	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
4	Center of Asian Art	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
5	Central library and municipal archives	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
6	Ceramic House	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
7	Ceramic Morphologies	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
8	Ceramic scales screen_Hande	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
9	Chongwenmen M-Cube	Rainscreen cladding - sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Ceramic (White)		0.75	0.90	92.9	0.70	
10	Dearborn Residence - Filoramo Talsma LLC	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
11	Denizli Han Office Building	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
12	Dynamic terracotta	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
13	Escola Martine	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (White)		0.75	0.90	92.9	0.70	
14	Viralgen	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (White)		0.75	0.90	92.9	0.70	
15	Villa Nurbs House	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (White)		0.75	0.90	92.9	0.70	
16	Wasl Tower	Curtain wall single skin	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Glass		0.80	0.42	90.0	0.08	
17	Viralgen	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (White)		0.75	0.90	92.9	0.70	

18	Villa Nurbs House	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (White)		0.75	0.90	92.9	0.70	
19	Vanke Pavilion Expo 2015	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
20	TR House	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Ceramic		0.67	0.89	81.5	0.36	
21	Torrejon de Ardoz	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
22	Thin terracotta cladding	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
23	Teresianas School	Sun screen	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
24	Tarraco Arena	Rainscreen cladding	Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
25	Spanish Pavilion Expo 2005		Metal	0	0.67	0.83	81.3	0.68	0
			Ceramic		0.67	0.89	81.5	0.36	

Adaptive Building Envelope Table

	Project	System Type	Materials	Adaptivity Scoring:	SR	TE	SRI	Albedo	ΔT (°C)
1	AeroLeaf facade installation	Ceramic panels	Metal	13	0.67	0.83	81.3	0.68	5.6
			Ceramic (Colored)		0.67	0.89	81.5	0.68	
			Water		0.07	0.98	6.7	0.68	
2	Bio Ceramic System - IAAC	Bioreceptive ceramic panel	Vegetation	5	0.26	0.96	29.3	0.25	1.5
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
3	Bioreceptive ceramic facade - ARUP	Rainscreen cladding	Vegetation	5	0.26	0.96	29.3	0.25	1.5
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
4	IPV Rainscreen Facade	Rainscreen cladding	Metal	1	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			PV panels (Grey)		0.72	0.87	88,00	0.75	
5	Ceramic green wall_Carnegie Mellon	Hydronic system Rainscreen cladding	Metal	7	0.67	0.83	81.3	0.68	0
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			"Synthetic polymers"		0.72	0.87	92.9	0.75	
6	Ceramic green wall_Eric Parry	Hydronic system Rainscreen cladding	"Synthetic polymers"	7	0.72	0.87	92.9	0.75	7.1
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Water		0.07	0.98	6.7	0.12	
			Vegetation		0.26	0.9	29.3	0.25	
7	Ceramic green wall_Henning Larsen	Curtain wall	Glass	5	0.8	0.42	90.0	0.08	1.5
			Ceramic (White)		0.75	0.9	92.9	0.70	
			Metal		0.67	0.83	81.3	0.68	
			Vegetation		0.26	0.96	29.3	0.25	
8	Kuggen - Wingårdh	Lightweight	Metal	5	0.67	0.83	81.3	0.68	0

9	Arkitektkontor	wall facade	Ceramic (Colored)	1	0.67	0.89	81.5	0.36	0
			Glass		0.8	0.42	90.0	0.08	
			Metal		0.67	0.83	81.3	0.68	
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
10	Co-mida - Biophotovoltaic vertical garden	Rainscreen cladding	"Synthetic polymers"	8	0.72	0.87	92.9	0.75	1.5
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Vegetation		0.26	0.9	29.3	0.25	
11	Counter Current Heat Exchanger	Curtain wall single skin	Metal	4	0.67	0.83	81.3	0.68	5.6
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Water		0.07	0.98	6.7	0.12	
12	Cool Brick	Fired bricks	Ceramic (Colored)	5	0.67	0.89	81.5	0.36	0
13	Cool Cacti	Sun screen	Metal	12	0.67	0.83	81.3	0.68	5.6
			Ceramic (Colored)		0.67	0.89	81.5	0.36	
			Ceramic (White)		0.07	0.98	92.9	0.70	
			Water		0.67	0.83	6.7	0.12	
14	De Castillia 23 - Progetto CMR	Mass wall facade - rainscreen cladding	Metal	3	0.8	0.42	81.3	0.68	0
			Glass		0.75	0.9	90.0	0.08	
			Ceramic (White)		0.75	0.9	92.9	0.70	
15	Eau Solei - Ennead Architects	Sun screen	Ceramic (White)	4	0.07	0.98	92.9	0.70	5.6
			Water		0.67	0.83	6.7	0.12	
16	Xinjin Zhi Museum	Curtain wall	Metal	1	0.67	0.89	81.3	0.68	0
			Ceramic (Colored)		0.8	0.42	81.5	0.36	
			Glass		0.67	0.83	90.0	0.08	
17	Water Wall	Hydronic system	Metal	8	0.07	0.98	81.3	0.68	0
			Ceramic (Colored)		0.8	0.42	81.5	0.36	
			Glass		0.67	0.83	90.0	0.08	
			Vegetation		0.07	0.98	29.3	0.25	
18	Terracotta skin - Behnisch	Rainscreen cladding	"Synthetic polymers"	4	0.26	0.96	92.9	0.75	5.6
			Metal		0.72	0.87	81.3	0.68	
			Ceramic (White)		0.67	0.83	92.9	0.70	
19	Terrabyte	Mass wall facade	Water	5	0.75	0.9	6.7	0.12	5.6
			Metal		0.07	0.98	81.3	0.68	
			Ceramic (Colored)		0.67	0.83	81.5	0.36	
20	Sun louvres_BKSK	Sun screen	Water	1	0.67	0.89	6.7	0.12	0
			Ceramic (White)		0.07	0.98	92.9	0.70	
21	Spanish Pavilion Expo 2008	Sun screen	"Synthetic polymers"	5	0.75	0.9	92.9	0.75	5.6
			Metal		0.72	0.87	81.3	0.68	
			Ceramic (White)		0.67	0.83	92.9	0.70	
22	Sony City Osaki	Curtain wall	Water	7	0.75	0.9	6.7	0.12	5.6
			Glass		0.07	0.98	90.0	0.08	
			Metal		0.8	0.42	81.3	0.68	

			Water		0.67	0.83	6.7	0,12	
23	Siemens Wind Turbine Facility	Curtain wall	Ceramic (White)	4	0.07	0.98	92.9	0.70	0
			Metal		0.75	0.9	81.3	0.68	
			Ceramic (White)		0.67	0.83	92.9	0.70	
24	Selfie Facade	Curtain wall double skin	Glass	12	0.75	0.9	90.0	0.08	0
			Glass		0.8	0.42	90.0	0.08	
			Metal		0.67	0.83	81.3	0.68	
25	Sapphire	Mass wall facade	Ceramic (White)	3	0.75	0.9	92.9	0.70	0
			Glass		0.75	0.9	90.0	0.08	
			Metal		0.8	0.42	81.3	0.68	
			Ceramic (White)		0.67	0.83	92.9	0.70	

Conclusion

The Urban Heat Island (UHI) phenomenon is one of the primary environmental concerns arising from increasing urbanization, with significant impacts on microclimatic comfort, public health, and energy sustainability in built environments. The analysis conducted on a homogeneous sample of 50 ceramic envelopes – evenly distributed between traditional and adaptive systems – revealed a clear correlation between the degree of adaptivity and the effectiveness of UHI mitigation strategies. The results indicate that only adaptive envelopes integrate significant evaporative cooling and vegetation-based solutions, confirming the potential of these approaches in reducing surface temperatures and regulating the urban microclimate. Unlike traditional passive strategies based on thermo-optical properties such as albedo, emittance, or solar reflectance, the effectiveness of the most performant solutions appears to depend on their ability to dynamically interact with the external environment through cycles of moisture absorption and release, natural shading, and active cooling. However, the analysis highlighted some limitations related to the limited availability of quantitative data and the heterogeneity of design documentation, emphasizing the need to expand the sample and rely on advanced monitoring tools. The comparative approach enabled the isolation of adaptivity as a strategic design variable, capable of significantly impacting the climatic quality of urban spaces. In the future, the integration of innovative materials (such as Phase Change Materials), intelligent control systems, and environmental sensors can further enhance the role of envelopes as active and responsive devices. These findings open scenarios in which architecture is not just a passive element of the urban landscape, but an ecological infrastructural component, capable of interacting with the environment and contributing to the resilience of cities.

Declaration

1. The authors declare that they contributed equally to the article. Specifically: Sara Moro wrote the introduction, literature review, and discussion, while Katia Gasparini wrote the methodological section and conclusions. Sara Moro performed the statistical analyses. All authors have read and approved the final version of the article.
2. This work utilized AI (ChatGPT-4, Grammarly, DeepL) exclusively for proofreading and linguistic polishing. All claims, data, and interpretations remain human-generated and validated by the authors.

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Evolution of Latvian Urban Space in the Context of Nature on the Eastern Shore of the Gulf of Rīga

*By Silvija Ozola**

Latvian urban space has been formed over many centuries due to human activity. On the eastern shore of the Gulf of Rīga, the landscape and, first of all, the territory were important resources for the viability of people. Natural elements provide optimal living conditions for inhabitants, regardless of the size of continuously inhabited settlements. The Seaside Lowland, situated in the central part of Latvia, spans the southeastern coastline of the Gulf of Rīga, measuring up to 20 kilometres in width and approximately 80 kilometres in length. It was once the ancient Liv-inhabited land of Metsepole, which bordered the Estonian counties in the north, the Latgalian land of Tolowa and Ydumea County in the east, the Gauja River in the south and the Gulf of Rīga in the west. The flat terrain and dunes contributed to the formation of swamps in places of moisture congestion between the present seashore and the ancient coastal formations. Due to the wooded nature of the area, the fortified places were far apart from each other. The strategically important coastal route from Rīga headed north along the eastern coastline of the Gulf of Rīga and the Gulf of Finland in the Baltic Sea. It passed to Sontagana in present-day Estonia. A straight track roughly coincided with the current Rīga-Pärnu road, involving a Latvian port town of Ainaži by the Gulf of Rīga near the border with the Republic of Estonia, the city of Salacgrīva at the mouth of the Salaca River, where the Liv settlement Saletsa developed already in the 5th century, and the city of Saulkrasti formed in the territory of fishing villages of the ancient land of Metsepole. Population influences urbanisation and the relationships between humans and nature. In turn, cities constantly impact natural components, deforming and adapting them to their needs. Today, urban areas are continually evolving. It is necessary to obtain a harmonious balance between the natural environment and human functional and economic needs. Research problem: Latvian cities have not been sufficiently studied in the context of nature to preserve their identity. Research goal: analysis of the evolution of urban space in the Latvian cities of Ainaži, Saulkrasti and Salacgrīva. Novelty: analysis of common and distinctive artistic and functional features of Latvian cities on the eastern shore of the Gulf of Rīga. Methods: analysis of archive documents, cartographic materials, study of published literature, inspection of cities in nature, and photo fixation.

Introduction

In Latvia, there are no great cities, like elsewhere in the world. Our ancestors understood nature and, as experts in this field, perfectly integrated wooden dwellings into the landscape, thereby initiating the traditions of environmental aesthetics and urban planning. Choosing to live near water sources, such as rivers, lakes, or the

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seacoast, is not a modern-day merit. The essence of this study is to analyze the evolution and spatial development of the Latvian urban environment from its beginnings to the present day. The research question is the evolution of urban space in the Latvian cities of Ainaži, Salacgrīva and Saulkrasti, which are developing along the eastern coast of the Gulf of Rīga. For this purpose, diverse cartographic materials and research by different generations of Latvian archaeologists have been used. The insights expressed by Latvian historians and archaeologists, outstanding specialists and personalities, are used unreasonably little in everyday life. Their achievements are not sufficiently appreciated. This study uses the results of archaeological research obtained by an archaeologist and Honorary Doctor of the Latvian Academy of Sciences, Dr Hist. Jānis Apals (1930–2011), an archaeologist at the Institute of the History of Latvia, Dr Hist. Māris Atgāzis (1935–2018), a Latvian historian and archaeologist and a full member of the Latvian Academy of Sciences, Professor Dr Hab. Hist. Andris Caune (b. 1937), an archaeologist at the Institute of the History of Latvia, academician, Professor Dr Hab. Hist. Ēvalds Mugurēvičs (1931–2018), a Latvian archaeologist Eduards Šturms (1895–1959), a Latvian archaeologist, Dr Hist., Dr Hab. Art Juris Urtāns (b. 1952), a Latvian historian, archaeologist, academician of the Latvian Academy of Sciences, and leading researcher at the Institute of the History of Latvia at the University of Latvia and Professor at the Turība University, Dr Hist. Guntis Zemītis (b. 1955). A Latvian historian, Dr Hist. Muntis Auns studied the history of the city of Limbaži. Academician of the Latvian Academy of Sciences, Dr Hist. Ieva Ose (b. 1961) explores German-built stone castles. Professor Dr Arch. h. c. Eižens Laube (1880–1967), Honorary Doctor of the Latvian Academy of Sciences, Meritorious Architect of Latvia, Officer of the Order of the Three Stars, former Chief Artist of the City of Riga, Professor, Dr Habil Arch Ivars Strautmanis (1932–2017), an architect, urban planner Professor Oļģerts Buka (1925–2010), as well as notable Latvian architect and interior designer Voldemārs Šusts (1929–2001), who influenced interior design education in Latvia, and an architect Uldis Volrāts made significant contributions to the development of the Latvian urban environment.

The first people to arrive in the territory of Latvia came from the southeast along the Daugava River¹ or Western Dvina,² forming areas with numerous swamps, lakes, and dunes at its ancient mouth into the Baltic Ice Lake. In the 9th millennium BC, people whose ethnic and cultural identity is still unknown settled on a dolomite erosion outcrop on the left bank of the Daugava (Figure 1), where the later built Sēlpils Hillfort³ and artefacts characteristic of the Balts date to the 1st millennium BC. From the 9th to 8th millennium BC, nomadic tribes whose main economic activity was reindeer hunting, similar to the modern Sami culture in northern Finland, Sweden, Norway and the Nenets culture in the Nenets Autonomous

1. Latin: *Duina Occidentalis*, *Duna* or *Dune*, Latgalian: *Daugova*, Livonian: *Vēna*, Estonian: *Väina*, *Väinajogi*, Scandinavian: *Dyna*, Belarusian: *Заходняя Дзвіна*, Finnish: *Väinäjoki*, German: *Düna*. The hydronym *Düna* is etymologically close to the Russian word *Двина*, which means a river flowing through dunes. The earliest mention of the Daugava is in the Scandinavian (Gothic) saga, written in the 10th–11th centuries and recorded only in the middle of the 14th century. Linguists believe that the hydronym Daugava originated after the 14th century.

2. Polish: *Dźwina*, Belarusian: *Заходняя Дзвіна*, Russian: *Западная Двина*.

3. Latvian: *Sēlpils pilskalns*.

Okrug,⁴ known as Nenetsia,⁵ a federal subject of Northern Russia, inhabited the Laukskola settlement⁶ of Salaspils (Figure 3) on the twelve-meter-high bank of the Lower Daugava.⁷

Reindeer-hunting tribes from the south traveled along the Lielupe /great river/ (Figure 1), the largest river in Zemgale⁸ (Figure 3). The Mūsa River,⁹ originating in Lithuania, and the Mēmele River, originating near Rokiškis City in northeastern Lithuania and called the Nemunėlis by the Lithuanians,¹⁰ merge near the Latvian city of Bauska, to form the Lielupe in the southern part of the Zemgale Plain,¹¹ part of the Central Latvian Lowland (Figure 2).



Figure 1. Detailed Topographical Map of Latvia with Terrain, Forests, Rivers and Cities¹²

4. Russian: *Ненецкий автономный округ*.

5. Russian: *Ненецья*.

6. Latvian: *Salaspils Laukskolas apmetne*.

7. A. Zariņa, *Ieskats Sēlpils vēsturē*, 1996, 133.

8. Latin: *Semigallia*, German: *Semgallen*, *Semegallen lant*, Polish: *Semigalia*, Lithuanian: *Žiemgala*, Livonian: *Zemgāl*.

9. Latvian: *Mūsa*; German: *Muhsse*, Lithuanian: *Mūšà*.

10. Latvian: *lietuvieši*, *lietuvi*, *leiši* (from the ancient self-name *leičiai*), Lithuanian: *lietuviai*.

11. Lithuanian: *Žiemgalos žemuma*, Latvian: *Zemgales līdzenums*.

12. www.vidiani.com/maps/maps_of_europe/maps_of_latvia/detailed_topographical_map_of_latvia.jpg



Figure 2. Physiogeographic Map of Latvia¹³



Figure 3. Geographer Jānis Turlajs; historian Guntis Zemītis; demographer and historian Ilmārs Mežs. Map of Latvia with Historical Latvian Regions, its Borders and Cities, 2020¹⁴

13. <https://enciklopedija.lv/api/image/original?name=d5cbe3eaa5e-63dc1ebf-1ab2-4865-9de-e-319b519eff3b.jpg>

14. J. Turlajs, G. Zemītis, and I. Mežs, *Latvijas kultūrvēsturiskā iedalījuma karte ar vēsturisko zemju robežām* (Rīga: SIA Karšu izdevniecība Jāņa sēta, 2020).

Around the 2nd millennium BC, the Baltic coastline took on its current shape. Bogs and sand were common in areas around the Daugava Delta at the southeastern end of the Gulf of Rīga. Consequently, the geology here was not suitable for the construction of hillforts. Some dunes in the Rīgava Plain¹⁵ (Figure 2), which stretches along a coastline as part of the Seaside Lowland,¹⁶ each a height of twenty-five meters. The Daugava River and its ancient branch, which turned at Kube or Ancient Hill,¹⁷ forming a circle before rejoining the Daugava, enclosed a peninsula formed on the right bank of the Lower Daugava. Part of the tributary from its turn at Kube Hill was called Ringa-Līkupe.¹⁸ At the end of the dune ridge between this branch of the Daugava in the south and marshy meadows north of the Daugava Delta, Kube Hill rose two meters above the spring-flooded coastal meadows and cannot be considered part of a flat peninsula.

In the late 2nd millennium BC, the Finno-Ugrians, the ancestors of the Proto-Finns, migrated westward from the Volga and Oka River regions. Even before the Balts arrived in the present-day territory of Latvia, the relations between the Balts and Baltic Finns played a crucial role in ethnic processes. Contact with Proto-Balts was vital to the formation of the Proto-Finnic peoples. Interactions essential for the ethnogenesis of Proto-Finnic peoples had to be intense and long-lasting, involving mixed settlements. Previous ethnogenesis studies have focused significantly on Finnic–Baltic contacts, dating their origins to the Late Neolithic. According to this theory, the bearers of the Corded Ware culture¹⁹ migrated from Central Europe to the East Baltic. The ancestors of the Proto-Balts arrived in areas occupied by Proto-Finnian peoples. North of the Daugava, Finno-Ugrians later assimilated the Proto-Balts, who were fewer in number. The Proto-Baltic language prevailed south of the Daugava. This process was most likely associated with intensive contact and mixed population (bilingualism) among representatives of the two language families, leaving significant traces in Proto-Finnic. Modern interpretations of the Proto-Finnic formation date this process in the Bronze Age, describing it as a migration from the Volga River region to the Baltic Sea. Finnish Indologist, Professor Emeritus of the University of Helsinki Asko Heikki Siegfried Parpola (b. 1941), specializing in the Indus Valley Civilization and Indus script studies, has proposed that a Proto-Baltic-speaking population originated from the local Corded Ware culture, inhabiting what is now Estonia and coastal Finland until the Early Iron Age (0–400 AD), and was later assimilated by invading Finno-Ugrians. The area where Baltic languages were once spoken was historically much larger than it is today, as the major hydronyms in

15. Latvian: *Rīgavas līdzenums*.

16. Latvian: *Piejūras zemiene*.

17. Latvian: *Senais kalns*, Latin: *Mons Antiquus*.

18. It is suggested that in the 5th–6th centuries, the Semigallians lived along the banks of the Daugava near a natural harbor on the river. After centuries of habitation along the river, it may have been named *Ringa* /*līkupe*, *ločupīte* in Latvian/ in their language. Before the 10th century, the name *Ringa* could have been granted by the Semigallians. By the 11th century, this name evolved into *Rīga*, which was also adopted by a village at the mouth of the River Rīga, flowing into the Daugava. The Lutheran pastor August Johann Gottfried Bielenstein (1826–1907) was the first to assert that the name *Rīga* has Baltic origins, attributed to the Semigallians.

19. The Corded Ware culture existed between 3000 and 2350 BC in Europe.

the vast region between Moscow and the mouth of the Vistula are of Baltic origin.²⁰ Santeri Junttila places Baltic and Finnic contacts between Estonia in the west and the area around modern Moscow in the east, a zone with evidence of Uralic settlement in the north and Baltic languages in the south. He dates the start of these contacts to the 'very initial phase of Proto-Finnic', when this language was still relatively unified.

In the mid-1st millennium BC, people of Slavic origin formed tribal alliances, migrated north along waterways, and drove out Finno-Ugric tribes from areas around Lake Ladoga. The ancestors of the Livs,²¹ one of the Baltic Finnic peoples, crossed the Neva River and reached the eastern coast of the Gulf of Rīga²² from the mouth of the Salaca. There, it widens to two hundred meters,²³ serving as a natural harbour.²⁴ Due to numerous shoals, navigation was difficult in the ninety-six-kilometer-long Salaca, originating from the through-flow Lake Burtnieks²⁵ (Figure 1), known as *Astijärv* or *Aster*. Unfortified settlements that have existed for a long time in the Seaside Lowland are considered Liv rural villages, consisting of six to ten closely clustered building groups along the Vidzeme coast, unlike Lithuanian and German villages with streets. Inhabitants settled along the banks of the Salaca up to the mouths of the Ramata²⁶ and Iģe (Īģe) Rivers.²⁷

Since at the end of the Last Glacial Period, people inhabited an area of the present-day Saulkrasti City (Figure 3), extending for seventeen kilometers from the fishing village of Pabasile (Latvian: Pabaži) on the bank of the Inčupe River in the south to the modern Skulte village on the bank of the Aģe River²⁸ in the north. The Aģe or Skulte River, flowing out of the through-flow Lake Aģe,²⁹ collects the waters of Lake Aijaži.³⁰ Stone axes have been uncovered in the vicinity of the Pēterupe, which runs parallel to the Vidzeme coast for more than a kilometer before entering the sea, forming a strip of land approximately fifty to one hundred metres wide, as well as near the Inčupe River. During the final stage of the Litorina Sea, approximately 4–5 thousand years ago, the White Dune formed from wind-driven beach sand over the clay deposits of Baltic Ice Lake as a steep bay shore at the mouth of the Inčupe River. This eighteen-meter-high sand outcrop gets its name from white, hardened sand layers. Both rivers flow into the Gulf of Rīga at Saulkrasti, which comprises historical fishing settlements with several populated areas along the banks of the Inčupe, Pēterupe, and Ķīšupe³¹ Rivers.

20. S. Junttila, *The prehistoric context of the oldest contacts between Baltic and Finnic languages*, 2012, 261.

21. Latvian: *lībieši, līvi, lībji*, Old Russian: *Любѣ, Любѣ*, Latin: *Livones*, German: *Liven*.

22. Also Bay of Riga, or Gulf of Livonia, Latvian: *Rīgas līcis*, Estonian: *Liivi laht*, Livonian: *Piški mer* /Small Sea/.

23. Now the city of Salacgrīva (German: *Salismünde*, Estonian: *Salatsi*) develops.

24. Mugurēvičs Ē. 1961. *Svarīgākie ceļi lībiešu un latgaļu teritorijā*, p.78.

25. Latvian: *Burtnieks, Burtnieku* or *Burtnieka ezers*, Livonian: *Astigerve*.

26. Estonian: *Raamatu jõgi*.

27. Many geographical and river names, such as *Salaca*, *Iģe*, *Ramata*, and *Ķīrele* of the Salaca's left tributary, originate from the Livonian language.

28. Livonian: *Adya, Ađā*, German: *Adja Fluss*.

29. Latvian: *Aģes* or *Palciema ezers*.

30. Latvian: *Aijažu* or *Lielais ezers*.

31. also Latvian: *Kižupe, Tišupe, Tīšu strauts*, in upstream *Viršupe, Višupīte*.

The Ķīšupe River begins at Lauga Bog, south of the Gauja River³² (Figure 1), flows through the Metsepole Plain³³ of the Central Latvian Lowland³⁴ and the Seaside Lowland, and enters the bay. Sea levels gradually stabilized at the end of the Neolithic and the beginning of the Bronze Age, and the Finno-Ugric-origin Livs inhabited the western coast of the Gulf of Rīga, the Irbe Strait, and the Baltic coast of the Courland Peninsula³⁵ (Figure 3), situated between the Baltic Sea and the Gulf of Rīga. Throughout the Bronze Age, distinct borders were established between Finno-Ugric and Baltic tribes. Baltic Finns, Volga Finns, and Permian Finns crystallized as separate branches of the Finns. At least until the 4th century, Finno-Ugric-speaking tribes occupied the northern part of Eastern Europe.

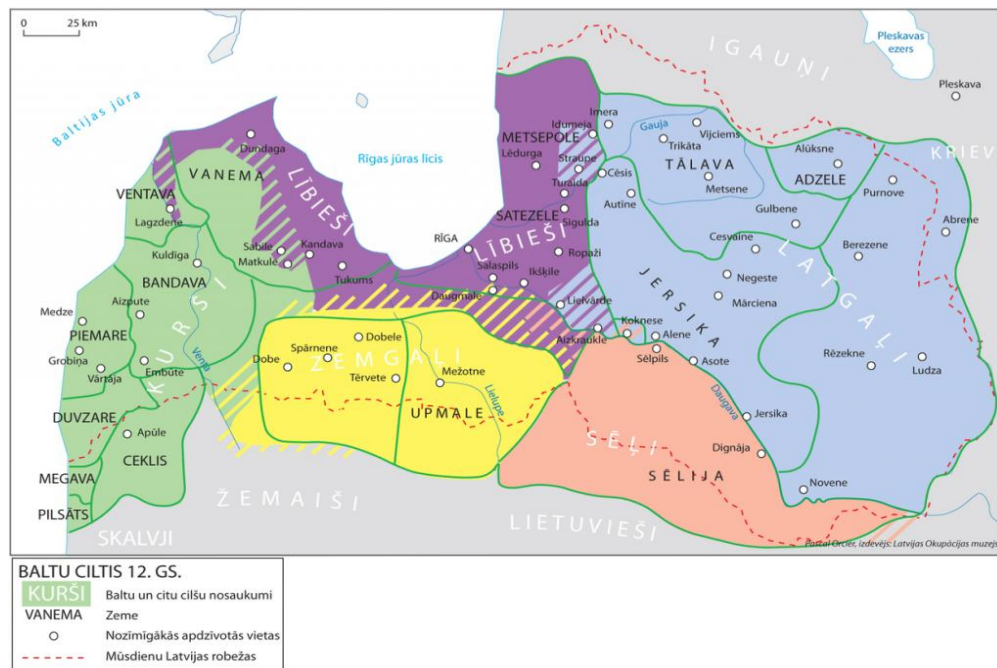


Figure 4. The Areas of the Livs and Baltic Tribes in the 12th Century in the Territory of Latvia³⁶

Since Rīga's founding in the 2nd century, the Livs (Figure 4) have inhabited the undulating Ropaži Plain.³⁷ Rīga did not initially develop as the center of a large cultural region³⁸. In the 5th century, the Liv settlement *Salets* emerged at the mouth of the Salaca River.

32. Estonian: *Koiva jõgi*, German: *Livländische Aa*.

33. Latvian: *Metsepoles līdzenums*.

34. Latvian: *Viduslatvijas zemiene*.

35. Latvian: *Kurzemes pussala*.

36. <https://laaj.org.au/wp-content/uploads/2015/10/lvhistory2-1024x743.png>.

37. Ropaži Plain (Latvian: *Ropažu līdzenums*) borders the Seaside Lowland and Rīgava Plain to the west, the Lower Daugava Valley to the south, and Metsepole Plain and the Gauja River Valley to the north.

38. E. Šturms, *Akmens laikmeta atradumi Rīgā /Stone Age finds in Rīga/*, 1936, 65.

Evolution of Trade Settlements along Earth Roads during the Migration Period and the Development of New Principal Waterways in the Viking Age

The strategically important ‘Queen of all Roman roads’ or ‘Queen of the Long Roads’³⁹ originated in 312 BC from Rome (Figure 5) as the dominant power in the Mediterranean coastal areas, forming the unique Roman road network that expanded alongside Roman conquests in the 4th century BC. The infrastructure of Roman roads⁴⁰ played a crucial role in the maintenance and development of the Roman Republic.⁴¹ The road from Rome led to Arezzo, one of the Etruscan capitals (Capitae Etruria), and Roman cities of Firenze, Ravenna, Bologna, Padua, Venice, Aquileia, and extended to Carnunto (Figure 5) at the junction with the Danube River on the northern border of the Roman Empire in the Alps. At the entrance of the Grand Canal into the Venetian Lagoon, artisans and merchants established a fishing settlement from the 5th to the 9th centuries.⁴² Rialto (Rivo Alto) became the center of the Duchy of Venice. The city of Venice developed along the Adriatic coast and came under the influence of the Eastern Roman Empire.⁴³ In the 13th century, a monk from Alsace created a copy of a 4th–to 5th-century Roman road map. He recorded the Roman legionary fortress,⁴⁴ marketplace and naval base of Carnunto, which was the starting point of the Amber Road (Figure 5), officially called the *Via Sucinaria Romana* by the Romans, the shortest and oldest branch from the Mediterranean Coast. The Amber Road beyond the Danube led to the large West Slavic fortified settlement of Biskupin (Polish: *Biskupinie*) on the peninsula of Lake Biskupin,⁴⁵ located in present-day North-Central Poland.

The fall of the Western Roman Empire⁴⁶ led to the Migration Period,⁴⁷ which began in 375 (possibly as early as 300) and ended in 568.⁴⁸ Human migration southward started from the impoverished Scandinavian Peninsula⁴⁹ and became part of the Great Peoples’ Walk from the 3rd to the 6th centuries. Active trade took place on the island of Gotland in the middle of the Baltic Sea. Scandinavian sea warriors engaged in large-scale trading throughout European trade routes, which played a central role in economic, cultural, political, and religious interactions between East and West. The Scandinavians conquered the great rivers of Eastern Europe, replacing the Great Silk Road, a network of over 8,000 kilometres of land and sea routes, which connected most of Central Asia and Northern Europe.

39. Latin: *Regina Longarum Viarum*.

40. Latin: *viae Romanae*, singular: *via Romana* /Roman way/.

41. Latin: *Res publica Romana*, *Libera-res publica Romana*; 509–27 BC.

42. Italian: *Laguna Veneta*.

43. The Byzantine Empire (*Imperium Romanum Orientale*, *Romania*; 395–1204, 1261–1453) or Byzantium.

44. Latin: *castra legionis*.

45. Polish: *Jezioro Biskupińskie*, Latvian: *Biskupinas ezers*.

46. Latin: *Imperium Romanum Occidentale*; 395–476.

47. Latvian: *Lielā tautu staigāšana*.

48. It is also known as the Barbarian Invasions, which occurred between 300 and 700 from the Roman and Greek perspectives.

49. Swedish: *Skandinaviska halvön*, Norwegian: *Den skandinaviske halvøy* (*Bokmål*) or Nynorsk: *Den skandinaviske halvøya*, Finnish: *Skandinavian niemimaa*.

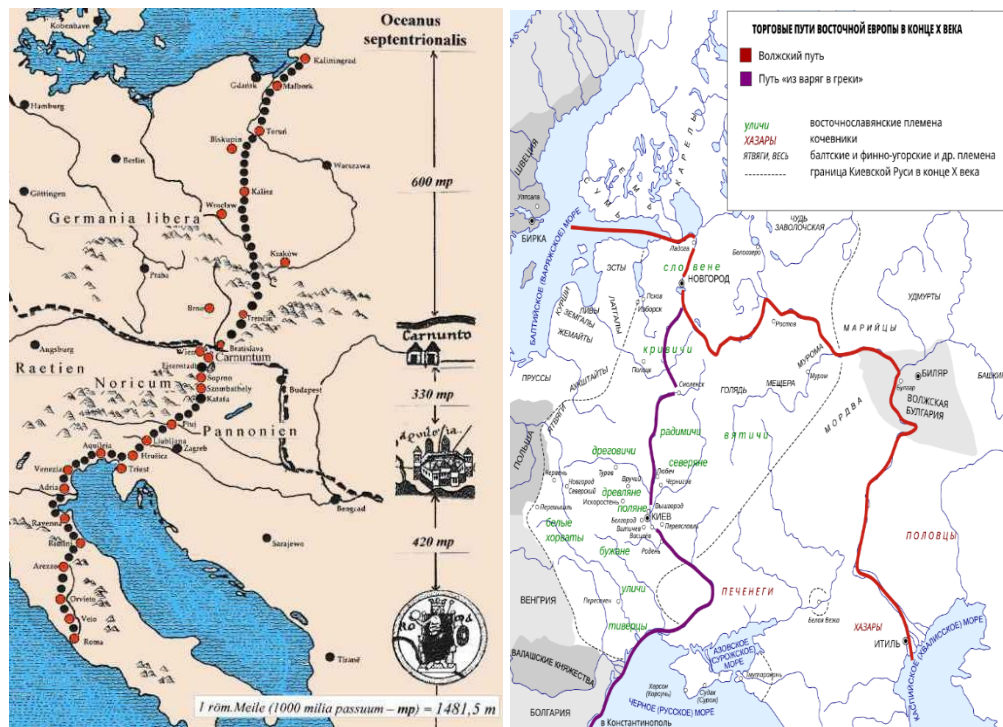


Figure 5. The Trace of Roman Roads and the Amber Road as an Ancient Trade Route from the Mediterranean Coast to the Coastal Areas of the Baltic Sea⁵⁰

Figure 6. Nikolay Omonov. The 10th Century Trade Routes in Eastern Europe, 2023⁵¹

In the early 6th century, Frankish emporia known as Quentovic emerged near the mouth of the Canche (Dutch: *Kwinte*).⁵² Trade took place in a simple fairground. Ephemeral trading settlements, known as *emporia*,⁵³ characterised by a lack of infrastructure, including churches and a fortification system, emerged in Europe between the 6th and 7th centuries, and persisted until the 9th century.

The Old East Slavic chronicle ‘The Tale of Bygone Years’⁵⁴ first mentions Vikings, whom the Greeks and East Slavs called *Varyags*, and used their Old East Slavic name.⁵⁵ Already in the 7th century, Viking Sagas referred to the north of Eastern Europe with the term *Gardaríke* or *Gardaríki*,⁵⁶ meaning the land of castle mounds. All lands east of Scandinavia were named *Gardar* by the Vikings. They spoke of the Eastern lands,⁵⁷ or the Eastern Way⁵⁸ (Figure 6). Vikings used early

50. https://lvexperiment.files.wordpress.com/2015/05/alte_karte.jpg.

51. upload.wikimedia.org/wikipedia/commons/3/31/Kievan_Rus_and_trade_routes_in_10th_century_%28ru%29.svg.

52. A river flowing into the English Channel (Latvian: *Lamanšs*), an arm of the Atlantic Ocean that connects the southern part of the North Sea through the Strait of Dover.

53. Latin: *emporium* /traveler, merchant, merchant/.

54. Old East Slavic: *Повѣсть временныхъ лѣтъ*, Russian: *Повесть временных лет*. It has traditionally been ascribed to Nestor’s Chronicle, known as the Russian Primary Chronicle (or simply the Primary Chronicle), and was originally compiled around 1113 in Kyiv.

55. The Eastern Romans referred to the *Varangians* (Old Norse: *Væringjar*) as Vikings.

56. This term combines words: *Gardr* /hillfort, later – town/ and *riki* /land, later – country/.

57. *Austríki* or *Austrlōnd*.

58. The name *Norway* originates from *Norð vegri*, meaning Northern Way.

waterways of major rivers from the 8th to the 13th centuries to establish the Baltic–Volga Way, known as the Volga Trade Route,⁵⁹ linking Northern Europe and Northwestern Rus' with the Caspian Sea and operated alongside the Dnieper Trade Route used by the Vikings.

Around 650, Scandinavian traders reached the southeastern Baltic Sea coast. A significant marketplace in the Liv-inhabited village at the Līva Port was established near the earthen road, which provided traffic along the seacoast and connecting seaports. The Livs and Cours lived near the water-rich Bārta River (Figure 1). It flows into the Līva River water system, forming a lake (now Latvian: *Liepājas ezers*). The Cours resided on Skābarži /hornbeam/ Hill (Latvian: *Skābaržkalns*) at the natural harbor of the Ālande River, just before it enters the lake, and established settlements along an important land road originating in German lands and leading through Prussian-inhabited territories.⁶⁰ At the turn of the 7th and 8th centuries, a Prussian trading post Truso emerged near the Ifing River.⁶¹ Truso was located on the Baltic coast, developed into a multi-ethnic trading settlement (*emporium*) along the Amber Road, establishing trade links with major centers on the island of Gotland and Birka, founded around 750 on the island of Björkö in Lake Mälaren. The route from the Lower Neman led to the Courland Peninsula and inland regions of Southern Kurzeme, where hillforts began to emerge in the late 2nd millennium BC. Thus, goods were imported to the Lower Daugava via the Curonian-inhabited Hill Hamlet (Latvian: *Kalnamiests*, German: *Bergflecken*) on the left bank of the Winda River,⁶² south of Old Kuldiga Hillfort, and fortified sites of Valgale, Sabile, Kandava, and Vecmokas Hillforts on the densely populated banks of the Abava River (Figure 1), approximately in its middle part.⁶³ Two Roman coins were found on Holme Islet, at the crossroads of major traffic routes⁶⁴ on the Daugava, which united people and guided merchants on long journeys. Near Skābarži Hill, Scandinavian immigrants founded the colonial center of Seaborg,⁶⁵ also known as *Esestua*.⁶⁶

In the 8th and 9th centuries, the historically significant medieval trade route connecting the Varangians to the Greeks⁶⁷ included the Dnieper, Volkhov and Volga Rivers (Figure 6) and linked ports across the Baltic, Black, and Caspian Seas. Viking Sagas noted the widely used Varangian or Eastern Way.⁶⁸ It crossed the Baltic Sea, forming part of the Amber Road trade network. The Vikings reached the southeastern

59. Russian: *Волжский* or *волго-балтийский торговый путь*.

60. Henricus de Lettis, *Heinrici Chronicon Livoniae*, 1993, 133-153.

61. Polish: *Elbląg*, Old Norse: *Ífingr*.

62. Latvian, Lithuanian: *Venta*, German: *Windau*, Polish: *Windawa*, Latin: *Winda*, Livonian: *Vānta jout*, Estonian: *Vindavi*, Samogitian: *Vēnta*; the etymology of the word *Venta* remains unclear. It is linked to Uitau in an early 11th-century inscription on the runestone (in Gotland), which mentions a Viking who died abroad. In the 13th and 14th centuries, the Venta River was known as *Vinda*, *Venda*. *Venta* derives from the Livonian word *vēna* /meaning river inlet into the sea or port/. *Winda* (*Wynda*) in Latin was first mentioned in the 1206 text regarding the Wends in *Heinrici Chronicon Livoniae*.

63. Ē. Mugurēvičs, "Matkules apkārtnes senvietas," in *Komunisma Rīts* no. 72 (1965).

64. Mugurēvičs, *Dzelzs laikmeta atradumi Salaspils Mārtiņsalā*, 1996, 61-65.

65. Latvian: *Jūrpils* or *Ezerpils*, now in the city of Grobiņa.

66. Western Baltic: *azeran* /lake/ + *tauvas* /close/.

67. Latvian: *Ceļš no varjagiem uz grieķiem*, Old Slavic: *путь из Варягъ въ Гръкы*.

68. *Austrvegr*, Icelandic: *Austurveg*.

coast, where the Livs and Cours⁶⁹ lived. From the mid-9th century, Vikings, sailing by sea, tried to establish themselves in the Lower Daugava area, where branches of the Eastern Way originated at Rīga. The Livs of Finno-Ugric origin inhabited the lower reaches of the Daugava and Gauja, living west of the middle Gauja, reaching to its entry into the Gulf of Rīga⁷⁰ (Figure 4). The Eastern Way extended to the Gulf of Rīga, with its wooded eastern coast and river mouths suitable for establishing fishing villages. The Eastern Way led along the northern coast of the Estonian lands, entered the Gulf of Finland, continued along the Neva River, crossed turbulent Lake Ladoga, followed the Volkhov River with its rapids, passed through the Rurik settlement to Lake Ilmen, and then up the Lovat River. The Eastern Way followed the Volkhov River upstream past Ladoga and Novgorod at the confluence of the Volkhov River and near Lake Ilmen. The socio-economic relations among Finno-Ugrians and the Slavs were a lengthy process, with Scandinavians acting as catalysts by establishing a trade route from Scandinavia to Eastern Europe, closely linked with the Eastern Way. The route from the Varangians to the Greeks was divided into the Smolensk–Novgorod–Baltic direction, along which, starting from the 13th century, intensive trade with the Hanseatic League took place. The ‘Greek’ direction, which enabled Kyiv to communicate with Byzantium, remained in use until the mid-13th century.

Scandinavian traders from the settlement of Visby, a leading trade center in the eastern Baltic, sailed eastward along the rivers and, in 1080, established a trading station known as Gutenhof (or *Gotenhof*, *Gutagard*) in Novgorod, which was easily accessible from the Baltic Sea via the Neva River and a direct trade route from the east. This expanded trade relations in Eastern Europe and Byzantium, making it a conduit for exchanging goods between Europe and the East via the Great Silk Road. The Vikings’ rising economic power led to a remarkable expansion between 800 and 1000. In the early years of the 12th century, merchants from Kyivan Rus’ visited Gotland, where merchants from North German towns stayed.

The Development of a Local Road Network and Urban Spaces along Main Roads and Waterways

In the late 10th century, the Livs arrived on the sandy peninsula, where crafts and trade thrived. They appeared in Rīga later than the Balts⁷¹ and stayed along the Rīga River, which meandered towards the Daugava and formed Lake Rīga, a fifty-meter-wide and approximately four-meter-deep body of water that served as a natural harbor. Branches of the Eastern Way from Rīga stretched along the Daugava and Gauja. Following the 10th century, a new influx of Livs was recorded in the economically significant Lower Daugava region, where transit land roads and wide

69. Written historical sources mention the Cours in the 9th–16th centuries.

70. J. Apals, *Arheoloģiskie pieminekļi Gaujas nacionālajā parkā*, 1986, 7.

71. In Zemgale, earthen roads facilitated traffic from Lithuanian lands to the natural harbor at the estuary of the Rīga River and Selonian regions to the west. An earthen road from Zemgale ran alongside the Lielupe River and Lake Babīte towards the Daugava Delta.

waterways intersected (Figure 7). The Livs resided here in considerable numbers.⁷² The origins of the main modern Latvian roads can be traced back to ancient Liv trading settlements in the Lower Daugava region, from which the Gauja Coastal Road (Figure 7) started north of Rīga and followed the Gauja Waterway, one of the branches of the Eastern Way, passing through Toreida Land to Pskov. The other branch of the Eastern Way followed the Daugava–Dnieper Waterway as part of the trade network between the Baltic and Black Seas. It led along the Dnieper River, with rapids, and passed through Kyiv.

The main transit routes north of Rīga led along the sea⁷³ to the village known as *Vicus Salis* (Latvian: *Salacgrīvas ciems*) and Pernau (*Pernaw*), with parallel roads situated further inland. The flat coastal road was the main traffic artery, passing by Liv fishing settlements in sparsely inhabited Metsepole⁷⁴ (Figure 8), extending to Soontagana⁷⁵ (*Suntaken*) (Figures 7 and 8), the first Estonian seaside region. The Baltic Coastal Road (Figure 7), which roughly follows the current Rīga–Pärnu Road along the eastern coasts of the Rīga and Finland Gulfs,⁷⁶ and the waterways influenced the layouts of ethnically diverse settlements and Liv villages amidst extensive forests. The fishing village named *Sarnikau* (now Carnikava) by the Livs and called *Koivemund* /the river's mouth/ by the Germans marked the entry point of the Gauja, which was suitable for a harbor. The straight coastal road led past the fishing village of *Pabasile* at the mouth of the Inčupe River, and a road branch from *Pabasile* reached the Liv fortification *Koldesalla* (*Koldeselle* or *Koldselle*) /Sand Dune Hill/ near the Pēterupe River in Toreida Land. Another side road from *Pabasile* led through the Liv village of *Ennisele* (now Sējas village) at the Puska River. At the start of the 13th century, a transit road developed along the sea, branching into several routes. One starting at the mouth of the Salaca River, where Saletsa was situated at an important trade crossroads. From there, one could travel north to Soontagana, and another along the river towards Lake Burtnieks. An archaeologist Ēvalds Mugurēvičs marked on the map a local road from *Toreida* to *Vitesile* and further to the square-shaped Liepupe Hillfort⁷⁷, as well as a route from *Raupa* (now Straupe) to Lemsal.⁷⁸ These marked routes are only indicative directions, not actual roads.⁷⁹

72. M. Atgāzis, 1968. *gada izrakumi Nariņos, Strautniekos un Vecdolē*, 1969, 24.

73. Henricus de Lettis, *Heinrici Chronicon Livoniae*, 1993, 133-153.

74. E. Mugurēvičs, *Svarīgākie ceļi lībiešu un latgaļu teritorijā*, 1961, 78.

75. Estonian: *Soontagana*, from *soo* /swamp/ and *tagana* /behind/, *Sontagana*, *Sontackele*.

76. Mugurēvičs, *Svarīgākie ceļi lībiešu un latgaļu teritorijā*, 1961, 78.

77. Latvian: *Liepupes pilskalns*.

78. Мугуревич Э. С. 1965. Восточная Латвия и соседние земли в X–XIII вв. Экономические связи с Русью и другими территориями. Пути сообщения, 113-114.

79. M. Auns, *Limbažu pilsēta un mikroreģiona saimnieciskā telpa un apdzīvotība Hanzas periodā*. Materials of the conference 'Hanza un lokālā vēsture. Jaunākie pētījumi', 2017, 157.

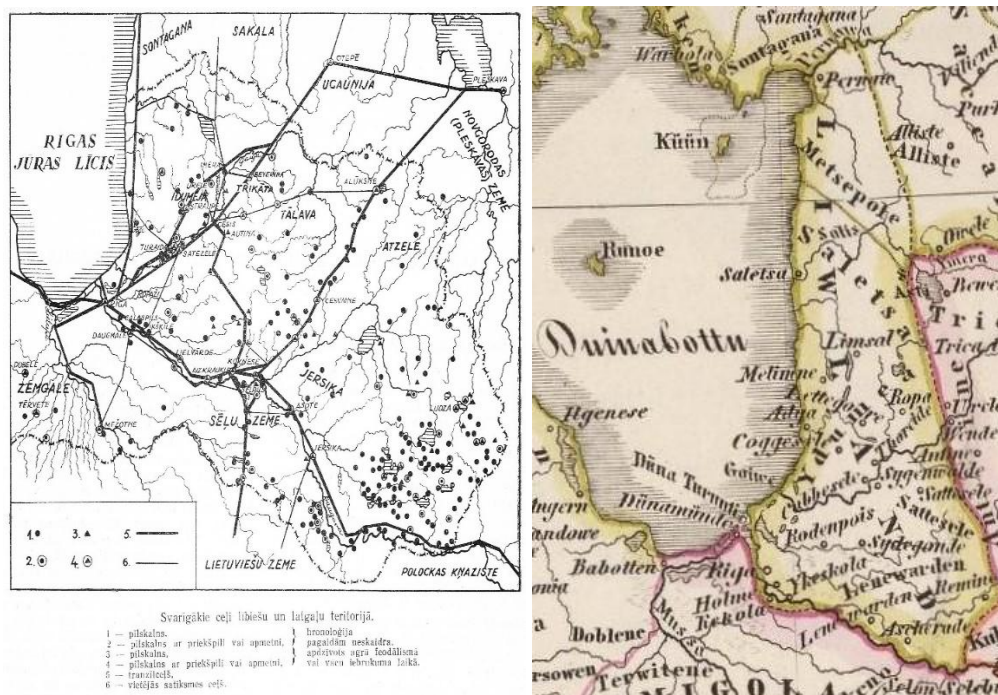


Figure 7. The Most Significant Earth Roads in the Liv and Latgalian Territories⁸⁰

Figure 8. German Cartographer and Scholar Karl Spruner von Merz (1803–1892). The Liv inhabited Territory and Significant Centers along the Eastern Coast of the Gulf of Rīga and the Right Bank of the Daugava in the 13th Century, 1854⁸¹

Historical sources from 1226 mention *Castrum Mezepol*, possibly located on Skulte or Stārasti Hillfort,⁸² featuring a fifty-meter-long and twelve-meter-wide plateau alongside a small fortification of Metsepole Livs. This hillfort, set on a topographic formation enclosed by the Aģe River Valley, a ravine, and a fifty-meter-long moat, was situated along an inland waterway created by the navigable Aģe River leading to its mouth, serving as a stopping point for ships. North of Skulte Hillfort, the Metsepole Livs inhabited the village of *Pernigele* and established Liepupe Hillfort, built on flat ground on the left bank of the Liepupe River.⁸³ The main Liv center, *Castrum Remin* (*Remyn*), on an ancient warpath, remains unidentified with certainty. Some hypotheses suggest that the Metsepole settlement was located on the bank of the Liepupe River, referred to as *Pernigele* in documents from 1403.⁸⁴ To the north, in the coastal lowland relief, an ancient Liv fishing village developed along the Baltic Coastal Road. The settlement was located in a rocky area, in a remote place on the edge of swampy forests. Its name, *Āinast*, is most

80. Mugarēvičs, *Svarīgākie ceļi lībiešu un latgaļu teritorijā*, 1961, 62.

81. Spruner von Merz K. 1854. *Die Ostsee-Laender, Polen und Litthauen im Anfange des XIIIten. Jahrhunderts. Die Ordens-Gebiete in Preussen und Livland bis 1525 und 1562.* (with) *Gegend um Riga.* (with) *Die Kirchliche Eintheilung der Ostseelaender bis zur Reformation.* (with) *Die Ostseelaender bis 1773.*

82. Latvian: *Skultes* or *Stārastu pilskalns*; the hillfort's exact date is unknown.

83. The village and the river that flows through it get their name from the Latvianized ancient Livonian word *Pernigele* (Livonian: *pārns* /linden/, *jougs* /river/).

84. O. Pumpa, *Autotūrisma maršruti Latvijā*, 1985, 68.

likely related to the village's secluded location and derives from the Livonian word *ainagi*, meaning lonely.

People lived along the banks of Glāžupe,⁸⁵ Pērļupe, Svētupe, and Vitrupe,⁸⁶ as well as the Aģe (Livonian: *Adya*) and Kīšupe Rivers. Metsepole and Rosula⁸⁷ counties extended from where the Lemme River (Estonian: *Lemmejõgi*) flows into the Kīšupe. At least until the 9th century, these regions were inhabited only by Latgalian communities. The Lemme, northwest of Orājõe, marked the northern border of Metsepole County (11th century–1207), whose main centers were Skulte and Liepupe hillforts and the village of Lemeselle. The Skulte settlement, on the right bank of the Aģe, had developed along the Baltic Coastal Road. Nearby, the road branched off toward the ten-meter-high Kēzberi Hill (Latvian: *Kēzberkalns*).⁸⁸ The Livs lived here from the 9th to the 12th centuries. A marketplace formed at the crossroads on the eastern coast.⁸⁹

Since the 10th century, significant changes have occurred in the population's economic life, and an alliance of Baltic Finnic tribes existed on the eastern coast of the bay. On the right bank of the river, less than a kilometer from where the Salaca River meets the sea, the Livs built a hillfort to control the river's mouth. Over time, the Metsepole Liv territory expanded northward along the coast, mainly through the establishment of fishing villages. A new settlement with a mixed population began to emerge between traditional settlements of Livs and Estonians along the sparsely populated coast north of the Salaca River. Livs, Estonians and Latgallians formed another mixed settlement in the northeastern part of Metsepole County,⁹⁰ extending north of the Gauja Liv lands and bordering Sakala beyond the Salaca River to the north, Tolowa to the east, the Gauja River to the south, and the Gulf of Rīga to the west. Near the Salaca River, a branch of the Baltic Coastal Road connected with Ymera⁹¹ and Tolowa. Parallel to the Salaca Waterway was a dirt road, and at Lake Burtņieks, it probably connected to the route from *Castrum Viliende*.

Near Mazsalaca, the more notable of the two mounds was Skaņkalne Hillfort (Latvian: *Skaņkalnes pilskalns*), featuring Liv wooden fortifications at the corner of the bank between the Salaca River and its tributary Dambjupīte ravine, where several small caves are situated. The rocky left bank of the Salaca had been eroded by a small river, forming a deep ravine with steep banks on the north and west – an advantageous position for an irregularly shaped hillfort, known by various names in historical documents over time.⁹² People settled in this area during the Late

85. Also Latvian: *Dzirnupe*, in upstream *Līvupe* or *Munca*.

86. Also Latvian: *Naužupe*, in upstream *Baurupe*, *Lielupīte*, *Reiņupe*.

87. Livonian: *Rosula*, Latvian: *Rozula*, also *Rozbeķi*; the place name *Rosula* is a Latinized form of the Livonian term *ros-ala*.

88. The Liv-fortified Lemeselle village, dating from the 10th to 12th centuries, developed at the foot of the hill. A stream connected Lake Dūņezers of Limbaži and the through-flow Lake Mazezers, allowing for navigation. The residential area of Lemeselle (Livonian: *Lemisele*, *Lembsele*, *Lemeselle*/ wide island in a forest swamp/, now in the city of Limbaži) lies at Lake Dzimezers.

89. Henricus de Lettis, *Heinrici Chronicon Livoniae*, 1993, 386.

90. A. Vunk, "Metsepole Livonians from the 14th to the 17th century," in *Esti ja soome-ugri keeleteaduse ajakiri* = *Journal of Estonian and Finno-Ugric Linguistics* 5, no. 1 (2014): 37-60.

91. Henricus de Lettis, *Heinrici Chronicon Livoniae*, 1993, 183-187.

92. It was once called Ogļu Hill (Latvian: *Ogļu kalns*). An older name was Skulberģi or Kolberga Hillfort (Latvian: *Skulberģu* or *Kolbergas pilskalns*). Possibly, following the subjugation of Liv-inhabited

Neolithic.⁹³ Near Salaca Road, this hillfort, now known as Lībji Hill (Latvian: *Lībju kalns*) and Mazsalaca Hillfort (Latvian: *Mazsalacas pilskalns*), dates from the 10th to 12th century.⁹⁴ The second, less significant hillfort, of unknown date, was situated at the confluence of the Laņgupīte River and a stream. Vīkšēni Hillfort (Latvian: *Vīkšēnu pilskalns*) was sparsely populated. Most likely, it was associated with pagan cult activities. The adjacent areas were inhabited.⁹⁵

In Burtnieks Plain⁹⁶ (Figure 2) of the Tālava Lowland,⁹⁷ Latgalian and Estonians established a harbor at the source of the Salaca River, north of Lake Burtnieks, which became the natural boundary between areas inhabited by the Balts and Baltic Finns during the Early Iron Age. Their inhabited lands can be distinguished. Estonians of Finnish origin lived north of the Gauja and its tributaries, where contact zones existed between different ethnic groups. An ethnically mixed population developed in regions between the inhabited lands of these various groups. No hillfort has been identified in the coastal floodplain meadows surrounding Lake Burtnieks, except for a hideout (Latvian: *pilene*) at the lake's southern end.

Over time, the Eastern Way declined in relevance. It remained important until the early third of the 11th century. Factors such as the fragmentation of Rus', centralization in Scandinavian countries, and the decline of Byzantium⁹⁸ contributed to these changes. By the mid-12th century, the Pope and the Holy Roman Emperor expressed interest in regions inhabited by the Baltic tribes,⁹⁹ initiating the spread of the Catholic faith among the Balts and the Baltic Finns, heralding a new era along the southern coast of the Baltic Sea. In the second half of the 12th century, the Germans became well acquainted with the Daugava Delta and aimed to establish direct relations with merchants on the East Baltic Coast. They needed to sail the river estuaries in the Baltic Sea to become intermediaries in international trade between Eastern and Western Europe. These motives fueled their aggression in the Baltic and attempts to establish control over the Daugava Delta, overseeing the lower reaches of the Lielupe, Gauja, and other rivers. German merchants, along with missionaries striving to convert locals to Catholicism, increasingly appeared in the foreign land of the Lower Daugava, where Rīga was a major population center, inhabited by the Daugava Livs and

Metsepole, the German conquerors took refuge in this fortification for some time, which could explain the emergence of the German name *Salisburg*, with *burg* indicating the existence of a fortification.

93. Lasted in the territory of Latvia from approximately 3000 to 1800 BC.

94. Mugarēvičs, *Svarīgākie ceļi lībiešu un latgaļu teritorijā*, 1961, 78.

95. J. Urtāns, "Arheoloģijas pieminekļi Mazsalacas apkārtnē," in *Liesma*, no. 154 (1985).

96. Latvian: *Burtnieka līdzenums*

97. Latvian: *Tālavas zemiene*, also *Ziemeļvidzemes* or *Ziemeļlatvijas zemiene*

98. In 1054, a partition occurred in the Christian Church: Eastern churches refused to admit the superiority of the Pope and the Roman Church. Consequently, the Roman Pope excluded the Patriarch of Constantinople from the Church. The Western or Roman Catholic Church and the Eastern or Byzantine Orthodox Church were formed.

99. I. Ose, *Latvijas viduslaiku pils, II. Latvijas viduslaiku pīļu pētniecība 18. – 20. gadsimtā*, 2001, 22.

Livs from Northern Kurzeme.¹⁰⁰ By the end of the 12th century, Rīga began to emerge as a marketplace,¹⁰¹ showing early town features around 1200.

The Development of Population, Industrial, and Recreational Centers along the Eastern Coast of the Gulf of Rīga

In 1201, on the peninsula within an ethnically mixed environment, where the Livs, Cours, Semigallians, and Wends lived,¹⁰² Bishop Albert of Rīga constructed *Domus Episcopi*, the third strongly fortified bishop's yard, in its eastern part on the bank of the Rīga River and a cathedral,¹⁰³ which was named after Saint Mary. In 1202, the first German settlers arrived on the river's right bank. German merchants purchased Livonian land to oversee the Great Sandy Road, one branch of which led to Lake Rīga, and the other directed to the marketplace at the junction, where Saint Peter's Church, intended for the Catholic Parish of townspeople, was located on Skārņu Street, and a four-meter-wide street began leading to the waterfront. A side street branched off from the other main street, running parallel to the Rīga River. Medieval Rīga, founded by German immigrants in a strategically advantageous location among Liv villages, developed like many German towns, featuring marketplaces. In 1204, on the western side of *Domus Episcopi*, the Livonian Brothers of the Sword (1202–1209), who encouraged military aggression against the Livs, built the dolomite *Domus Wittenstein* or Saint Georgi fortified yard, which housed a cult building.

In 1207, Bishop Albert and the Knights divided Livland, establishing the Bishopric of Livonia¹⁰⁴ on the right bank of the Gauja. Therefore, this river became a border between their territories. A chapel dedicated to Saint Peter (German: *Peterskapelle*) was built as the first place of worship in Metsepole. The conquerors claimed the Liv lands along the Aģe River.¹⁰⁵ They began constructing financially and economically independent stone castles as multifunctional buildings on raised banks of navigable rivers, initiating profound territorial changes. In 1226, Bishop began constructing a fortification on the elevated right bank of the Salaca River to control the strategically significant waterway. This fort, known as the Salaca Gate, had access to the entire Salaca basin from the sea. Probably at the end of the 14th century,¹⁰⁶ the Archbishop of Rīga built Salaca Castle on a hillfort where the Livs lived.¹⁰⁷ Protective moats were dug around the

100. A. Caune, *Koka ēku jumtu māla segumi Rīgā 12. – 13. gadsimtā*, 2007, 258.

101. Caune, *Rīga zem Rīgas* (Rīga: Zinātne, 1985), 35, 37.

102. Henricus de Lettis, *Henrici Chronicon Livoniae*, 1993, 53-57.

103. burned on 4 March 1215.

104. Latin: *Episcopatus Livoniensis*, 1207–1255.

105. The lands downstream of this river were named *Adiamünde* (Latvian: *Āgesgrīva*). The ancient name *Adiamünde* of the district comes from the Livonian word *adia* /edge/ and the German word *Münde* /estuary, at the mouth of the Aģe/.

106. *Saltze* was first mentioned in 1391. Audit data from 1624 and 1638 indicated the earliest state of the village *Salis*→*Salcze*→*Schweineckzembs*. The Port of Salaca was referenced in documents from 1392.

107. German: *Schloß Salis*, Latvian: *Salacgrīvas pils*.

castle. Ships sailed along the canal around the castle mound, while a fortification protected the only port¹⁰⁸ in the Archbishopric of Rīga. German merchants and craftsmen built houses in the settlement adjacent to the castle, leading to the development of *Vicus Salis*, first mentioned in 1433. In 1485, the Archbishop regained the fortress, which had been occupied by the Swedes in 1474 and by the Teutonic Order in 1479. The Swedish military leader Thomas von Embden (?–1621) was one of the first owners of *Alt-Salis*.¹⁰⁹ During the Livonian War (1558–1582), Salaca Castle became a target of attacks. Rīga's negative attitude and clogging hindered the development of the port, diminishing its importance in maritime shipping. From 1596, *Alt-Salis* Manor belonged to Georg (Jürgen) von Tiesenhausen (1537–1608).

The Livonian War destroyed the Livonian Confederation (1243–1561), and political control of cities changed. In 1561, Sigismund II Augustus,¹¹⁰ the King of Poland and Grand Duke of Lithuania from 1529 to 1572, established the Livonian Duchy of Pārdaugava,¹¹¹ north of the Daugava. Vidzeme, Latgale¹¹² and South Estonia became part of the Grand Duchy of Lithuania¹¹³ in 1566, and was joined the Poland and Lithuania Commonwealth¹¹⁴ in 1569. Koltzen Estate¹¹⁵ (Figure 9) was established on the site of the Liv village of *Koldselle*.¹¹⁶

108. Auns, *Limbažu pilsēta un mikrorēģiona saimnieciskā telpa un apdzīvotība Hanzas periodā*. Materials of the conference 'Hanza un lokālā vēsture. Jaunākie pētījumi', 2017, 27.

109. *Alt-Salis* was mentioned in 1555.

110. Polish: *Zygmunt II August*, Lithuanian: *Žygimantas Augustas*.

111. Latin: *Ducatus Livoniae Ultradunensis*, Latvian: *Pārdaugavas Livonijas hercogiste*, Lithuanian: *Uždauguvio kunigaikštystė*, Polish: *Księstwo Zadziwińskie*, Estonian: *Liivimaa hertsogkond*; 1561–1629.

112. Latin: *Lettgallia*, Latgalian: *Latgola*, Russian: *Лотыгольская земля, Лотыгола*, German: *Lettgallen*, called *Lettia* in Latin texts.

113. Latin: *Magnus Ducatus Lithuaniae*.

114. Latin: *Privilegium Unioniscum Magno Ducatu Lithuania*.

115. Livonian: *Koldselle*, German: *Gutshof Kolzen*, Latvian: *Bīriņu muiža*.

116. Sigismund II mortgaged Koltzen Estate to Thomas von Embden (?–1621) in 1568. The manager and clerk Johann Biering of Helmstadt owned Koltzen from 1574 to 1601, and the name *Burningshof* came from his surname; thus, the Latvian name *Bīriņi*. After Biering's death, the estate changed hands several times.



Figure 9. French Cartographer Nicolas Sanson (1600–1667), who served under Two Kings in Matters of Geography, and French Cartographer Guillaume Sanson (1633–1703), Active in the latter part of the 17th Century. Map Fragment of the Region of Livonia North of the Daugava River, Depicting Rīga, Treiden, Lemsal (Lemsel), Salis, Lake Burtnieks (Burtnick), Sigulda (Sewold), and Koltzen Estate, 1663¹¹⁷

At the beginning of the Polish-Swedish War (1600–1629), the Swedes invaded Livonia in 1600 and destroyed a wooden prayer house, or Saint Peter's Chapel, located on a hill at the mouth of the Pēterupe River. Only three fishermen's houses of the Pēterupe village remained on the seashore in the early 17th century. From 1621, the Kingdom of Sweden governed most of the duchy, known as Swedish Livonia, while the remaining territory was later organized into the Infantian voivodeships of the Polish–Lithuanian Commonwealth. On 30 September 1623, Swedish King Gustavus Adolphus restricted the transport of goods. He allowed only three ports in Livonia: Rīga (Figure 9), Pernau (Figure 9), and Revel. However, the Port of Salaca was important for the transport of goods by boat.¹¹⁸ The Swedes acquired Vidzeme and Rīga, establishing four districts. Salaca Castle served as the administrative center known as *Saliß* (Salis) (Figure 9) in 1601 and *Schweineckzembs*

117. N. Sanson, and G. Sanson, *La Livonie Duché divisée en ses Principes. Parties Esten, et Letten & Par le Sr. Sanson d'Abbeville Geogr. ordinaire de Sa Maj-té. A Paris Chez Pierre Mariette Rue St. Iaques à l'Esperance. Avecq Priuilege pour Vingt Ans. 1663.*

118. Auns, *Limbažu pilsēta un mikroreģiona saimnieciskā telpa un apdzīvotība Hanzas periodā*. Materials of the conference 'Hanza un lokālā vēsture. Jaunākie pētījumi', 2017, 23.

(Latvian: *Zvejniekiems*) in 1624. In Haynasch,¹¹⁹ only fishermen were mentioned. There were four of them in 1624 and five in 1638.¹²⁰ *Vicus Salis* was established on the lands of *Alt-Salis*¹²¹ and *Neu-Salis*.¹²² The Baltic Coastal Road crossed the river here, and a ferry operated in the 17th century. Most likely, it existed already in the Middle Ages. Rīga alderman Michael von Diepenbrock (1592–1667) acquired *Alt-Salis* Manor in 1653. The Swedes established the Pēterupe Lutheran parish in the former territory of Metsepole County in 1640. The first church building in Pēterupe village was constructed in 1641, and a pastor served there from 1653 to 1700.

During the Great Northern War (1700–1721), Salaca Castle, which had passed into the hands of the Germans, then the Russians, Swedes, and Poles, was destroyed between 1702 and 1703 and was never restored. The Great Plague raged from 1700 to 1711, causing substantial damage to Pēterupe village, which had been devastated during the war. Until the mid-18th century, small, poor fishing villages with few inhabitants still existed on the southern coast of the Gulf. *Alt-Salis* Manor, as the most populated area, lent its name to the entire region in the 17th and 18th centuries. After the war, the Vidzeme Governorate (1721 (1796)–1918) was established. The southern coast of the Gulf of Rīga became part of the Russian Empire in 1721. The wooden building of the Evangelical Lutheran Church was constructed in 1777. Landlords of German origin noticeably influenced the upper class of the Russian Empire, initiating the construction of architect-designed manor houses and palaces.

After the reduction of manors, Claudius Hermann I von Samson-Himmelstjerna (1670–1737) became the owner of Koltzen Estate. In 1725, Koltzen (Latvian: *Kolcene*) was sold to Karl Friedrich (Frederik) von Mengden (1666–1734), the lieutenant general of the Swedish Army. The next owner, Karl Johan von Mengden (1702–1763), built a new manor house in the Swedish Baroque style, along with several outbuildings. The manor began to flourish. Landmarshal Karl Gustav (1723–1775) was the last heir of the Mengdens. After her husband's death, the widow Eleonora Philippine de la Forest (1729–1804) managed Koltzen. In 1782, a year after the marriage of its youngest owner Helena Augusta von Mengden (1763–1812), daughter of Karl Gustav, to the Landrat of Vidzeme, Major of the Russian Army Ludwig August von Mellin (1754–1835), a prominent figure in the society and politics of his time, Helena transferred the manor to her husband, who was close to the Russian Emperor. He actively fought for the abolition of serfdom, collected folk songs, and was a cartographer for his long-standing work on topographical maps of Latvia and Estonia. Three years later, Count Ludwig August von Mellin retired from the army and devoted himself to managing Koltzen. His youngest daughter, Anna Auguste Henriette von Mellin (1798–1863), who inherited this manor, married

119. The name of the Liv fishing village *Haynasch* (Latvian: *Ainaži*) first appeared in official documents in 1564. The origin of *Haynasch* is connected to an ancient Liv village by a river in a swampy area. Livonian fishermen called it *Ainagi*, which means 'lonely' in Livonian.

120. Auns, *Limbažu pilsēta un mikroreģiona saimnieciskā telpa un apdzīvotība Hanzas periodā*. Materials of the conference 'Hanza un lokālā vēsture. Jaunākie pētījumi', 2017, 121.

121. Latvian: *Vecsalacas muiža*, formerly — *Vecsalace*, Estonian: *Vana-Salatsi mõis*.

122. *Neu-Salis* (Latvian: *Svētciema muiža*, also called *Jaunsalacas muiža*, Estonian: *Uue-Salatsi mõis*) was founded after 1638 and named *Dorff Swatzhem*. It belonged to the *Alt-Salis* district. *Dorf Haynasch* came under the ownership of *Neu-Salis*.

Russian Army Lieutenant Colonel Alexis Jöran Erich von Pistohlkors (1792–1870). The Pistohlkors period¹²³ at the manor began.

Friedrich Hermann von Fersen (1741–1790) and his wife, Martha Dorothea (1743–1829), acquired *Alt-Salis* Manor (Figure 10) in the mid-18th century. The settlement, known in German writings from 1638 as *Dorf Haynisch*, developed on both sides of the Baltic Coastal Road (now Krišjānis Valdemārs Street). Later, it was called simply *Haynasch*.¹²⁴ Surrounding lands from the mortgaged *Neu-Salis* (Figure 10) were detached in 1800. Haynasch Manor was founded. Later, the Baron Meyendorff family of Baltic German origin, the owner of Klein-Roop (Latvian: *Mazstraupe*), acquired Haynasch. From 1848, Haynasch, and *Alt-Salis* Manor belonged to Christoph Gustav Alexander von Meyendorff,¹²⁵ a civil servant and economist of the Russian Empire. Svētiems, on the banks of the Svētupe River, was established near the center of *Neu-Salis* by the coastal road. On 20 October 1854, he sold Haynasch Manor to Maximilian Behaghel von Adlerskron (1808–?), who leased it to the Bavarian forester Alexander Wolf.¹²⁶ The Svētupe area was the last place in Vidzeme where Livonian speakers lived in the mid-19th century. The previous owners of *Neu-Salis* Manor were the Barons von Vegesack, farmers and horse breeders. On 8 April 1864, Reinhold Leopold von Vegesack (1847–1895) took over the manor. Count August von Mellin temporarily acquired Haynasch.

Vicus Salis developed in response to the growth of coastal shipping in the Gulf of Rīga. To enable ships to access the port instead of earlier barges, the Salaca riverbed was deepened. A breakwater was built of boulders at the river's mouth. *Vicus Salis* became an important transshipment point for further transporting of timber, flax and grain from Northern Vidzeme to Pernau and Rīga. The Evangelical Lutheran Church was constructed of bricks between 1853 and 1857. It was expanded in 1892 to hold 500 seats, with an altar room added. The Orthodox Church of the Holy Mother of God,¹²⁷ employing Byzantine architectural forms, was built according to a design developed by the German-born architect Robert August Pflug (1832–1885) and was consecrated on 15 April 1873. Around 1870, shipping began to flourish in the Baltic Sea, and *Vicus Salis* started to evolve into a town – the origin of the present-day

123. Pistohlkors, also Pistolekors (German: *von Pistohlkors*), is the name of a Swedish-Baltic noble family whose lineage continues to this day. The ancestor of the family was the Scottish-born Swedish army officer Jöran Olofsson (1596–1663), who was ennobled by Queen Christina of Sweden in 1645, granted a coat of arms and the family surname *Pistohlkors* /crossed pistols/. Lieutenant Jöran Olofsson, elevated to the Swedish nobility on 22 February 1645, established his family's lineage. The eastern Finnish family of agrarian origins had extensive lands. In 1647, the family was entered in the Swedish knighthood register. His sons established branches of the family in Finland and Estonia. Pistolkors, who migrated to Swedish Estonia in the 17th century, later spread to Vidzeme, where the family owned Bīriņi (from 1813), Eikaži, Igate and Garšmuiža Manors.

124. Other written sources mention the name *Ainiži*.

125. Russian: *Александр Казимирович Мейендорф*; 1798–1865.

126. The lease agreement, signed on 6 October 1856 for 50 years, stipulated that Wolf was responsible for improving the manor's operations. A series of cottages, including Indes, Baloži, Ramaņi, Mengelji, Untes, Puriņi, and Kaktiņi, were set up. Wolf built a small wooden manor house for himself, naming it *Baltā muižiņa* /the White Manor/. He was tasked with constructing a pub along the coastal road and completed a glass factory.

127. Latvian: *Sv. Dievmātes Patvēruma pareizticīgo baznīca*, Russian: *Церковь в честь Покрова Пресвятой Богородицы в Салацгриве*.

Salacgrīva City. By the century's close, there were more than 70 residential buildings and 40 warehouses.



Figure 10. Cartographer Ludwig August von Mellin (1754–1835); engraver Carl Jäck (1763–1808); bookseller, publisher Johann Friedrich Hartknoch (1768–1819). Map of the Wolmar District. Its fragment depicts the Baltic Coastal Road, Salis, Alt Salis, and Neu Salis, 1793¹²⁸

Figure 11. Map Fragment Illustrating Salismünde, Alt Salis, and Neu Salis, 1897¹²⁹

Salismünde started developing around 1870 on the territories of the *Alt-Salis* and *Stevciems* estates. Thanks to the flourishing coastal trade in the Baltic Sea, the Port of Salismünde emerged as a key trading hub in Northern Vidzeme. Approximately 160 sailing ships entered the port each year. Steamers on the Rīga–Pernau route docked in the port's roadstead, approximately two kilometers from the coast. In Salismünde, eighteen sailing ships, with one vessel constructed in Kuiviži (Estonian: *Kuivaste*), a former fishing village that is now part of the town, were built between 1859 and 1929. By the late 19th century, up to two hundred ships entered the port annually, contributing to local population growth. By the end of the 19th century, the Social Society started operating in Salismünde. The Social Society Library was founded on 4 August 1902. In 1909, one of the first reinforced concrete bridges in the Baltics was opened over the Salaca River. The Society House was built in 1912. It provided a home for the library. The Russian government planned to deepen the port to accommodate larger ships. However, the rapid expansion of the Port of Haynasch and the construction of the Rīga–Walk (now Valka) railway line, which reduced the supply of local goods to ports on the Vidzeme coast, disrupted these plans. The Haynasch–Wolmar–Smiltēn railway line, a 114 km long 750 mm narrow gauge railway connecting the Port of Haynasch and the station in Wolmar (now Valmiera) and continuing to Smiltēn (now Smiltene), was inaugurated in 1912. At the start of the 20th century, the construction of the railway in Vidzeme caused a decrease in the flow

128. L. A. Mellin, C. Jäck, J. F. Hartknoch, *Der Wolmarsche Kreis = Le cercle de Wolmar*, 1793.

129. *Übersichtskarte von Mitteleuropa 1:300.000 [T58]* – Walk. Berlin: Kartographischen Abteilung der Kgl. Preuß, 1897.

of goods to Salismünde (Figure 11), as most products were transported to the newly established Haynasch Port, which was connected to the hinterland by a narrow-gauge railway. Salismünde became the fishing center of Vidzeme, with other important sources of income being agriculture and timber transportation on the Salaca River.

On the Vidzeme coast of the Gulf of Rīga, forests rich in massive pine trees contributed to the growth of the shipbuilding industry and lively trade. In the mid-19th century, when maritime shipping began to flourish along the coast, the fishing villages of Vidzeme benefited from an abundance of available labor. The strategic coastal location of Haynasch and its proximity to timber made it an ideal place for shipbuilding. Consequently, the enterprising residents of Haynasch started building ships, which led to the development of the first sailing vessels and a demand for captains. In 1864, prompted by Krišjānis Valdemārs, an Estonian long-distance captain of Swedish descent, Christian Johan Dahl,¹³⁰ who was recognised as a polar explorer, maritime school teacher, a titular advisor to the Russian Empire, and author of various research papers and textbooks on maritime studies, established in the servants' house of the former Haynasch Manor the first Latvian Naval School, with the support of local sailors. In 1868, a Latvian shipowner and captain of Estonian origin Juris Georgs Veide (1830–1894), together with his brother Andrejs Veide (1832–1889), who had become wealthy through fishing, as well as Jānis Miķelsons and Miķelis Miķelsons, purchased the Haynasch Manor and the entire territory of the parish from the then-owner. The main building was used for the maritime school. Initially, residents financed the school in the house owned by Juris Veide with their own funds. Later, the Russian government took responsibility. Education in Latvian, Estonian, and later also Russian was provided free of charge. Haynasch flourished and, in 1869, gained town status and its name. A dedicated structure for the maritime school (Figure 12) was erected in 1870. However, the fate of the manor lands differed. Part of the land was sold to *Alt-Salis*, and after several changes of ownership, the remaining part was purchased in 1879 by Alexander Oskar von Stryk (1830–1902). The last owner of the manor was the nobleman Marshal Heinrich von Stryk (1873–1938). In the 1870s, Haynasch experienced a period of significant expansion, marking the start of its history in shipbuilding and seafaring. Juris Georgs Veide sons Jānis Roberts Veide (1860–1910), Mārtiņš Teodors Veide (1865–1923), and Miķelis Vilhelms Augusts Veide (1869–1941) were also long-distance captains and ship owners. Between the 1880s and 1890s, the school graduated twenty to thirty long-distance captains and helmsmen each year. The Orthodox Church of Saint Arsenius the Great¹³¹ was constructed between 1894 and 1895 according to the design of the architect Jānis Fīdrihs Baumanis.¹³² Haynasch flourished throughout the rest of the 19th century. The town boasted windmills, a fish-processing plant, and a brick kiln. Ship and railway cargo taxes supplemented the town's revenue, establishing Haynasch as an active trading hub (Figure 15). In 1902, a seaport construction project was developed. It provided for the construction of a railway, and a new two-story maritime school building (Figure 13) was constructed on land donated by Jānis Roberts Veide, a long-distance sailing captain and shipowner.

130. Latvian: *Kristiāns Juhans Dāls*; 1839–1904.

131. Latvian: *Svētā Arsēnija Lielā pareizticīgo baznīca*, Russian: *Церковь святого Арсения Великого*.

132. German: *Johann Friedrich Baumann*; 1834–1891.



Figure 12. *A Special Building with a Traditional Gable Roof and Sloping Ends was Constructed for the Maritime School in 1870¹³³*



Figure 13. *A New Two-story Maritime School Building, Built in 1902 on a Plot of Land Donated by Jānis Veide¹³⁴*

Haynasch, with a large port built from 1900 to 1905, ranked second only to Rīga. From 1857 to 1913, more than 50 seaworthy vessels were constructed in Haynasch, and by 1880, 83 sailing ships were registered in the Port of Haynasch (Figure 14). The railway station was opened in 1902. The town of Haynasch began to form on both sides of the Rīga–Pernau route. Near it, the asymmetrically designed Haynasch Manor House with a three-story tower, an artistically designed gable and corner gables was located, and Captain Veide built a two-story wooden building with luxurious facade decoration (1902). By the onset of World War I, Haynasch was the fourth-largest port in what is now Latvia and the leading port in Vidzeme, surpassing the nearby Port of Salismünde. The Haynasch Naval School continued to operate until the outbreak of World War I.

133. Postcard Ainažu jūras skola. 1930s. [In Latvian]

134. Postcard Haynasch – Seemannsschule. [In German]



Figure 14. Map Fragment Featuring the Newly Built Railway Line Leading to the Port of Haynasch, 1914¹³⁵

135. No author information. Спец[иальная] карта Европейской России. Санкт-Петербург: Военно-топографический отдел Генерального Штаба, 1914.



Figure 15. Map Fragment Featuring the Railway Line and the Surroundings of Haynasch, 1918¹³⁶

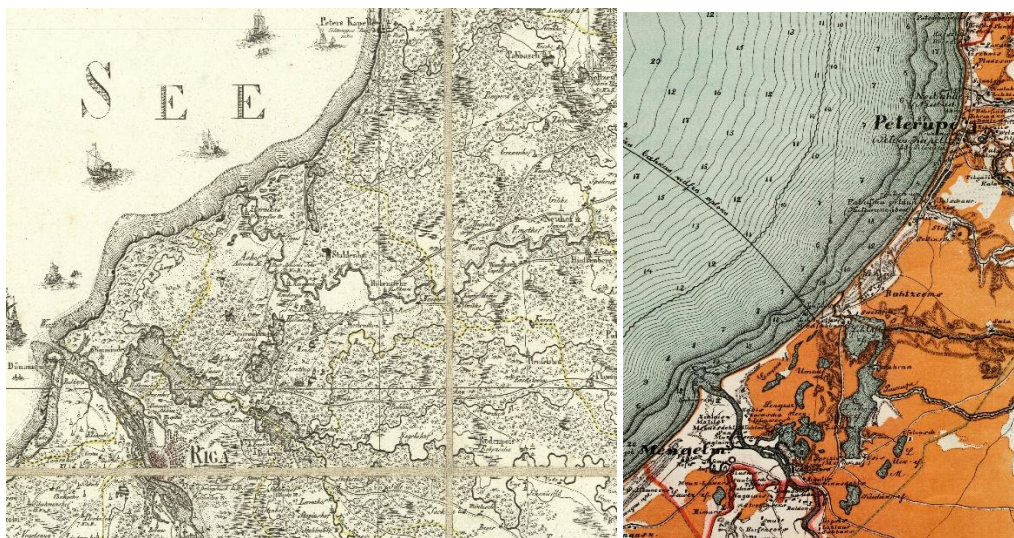


Figure 16. Cartographer Ludwig August von Mellin, engraver Carl Jäck, and publisher Johann Friedrich Hartknoch. Map of the Rīga District. Its fragment depicts Rīga, Zarnikau, Peters Kapelle, Pabbasch and Koltzen Estate, and the beginning of the Baltic Coastal Road, 1791¹³⁷

Figure 17. Latvian teacher, ethnographer, and the first cartographer to compile and publish maps in Latvian, Matīss Siliņš (1861–1942). The fragment of the map shows the mouth of the Gauja River, Lake Lilaste, Pabaži swimming area (Katherinbad), Pēterupe Church (Peters Kapelle) and Neibāde (Neubad) along the coastline of the Gulf of Rīga, 1894¹³⁸

136. *Karte des westlichen Rußlands, P10, Haynasch*. Berlin: Kartographische Abteilung der Preußische Landesaufnahme, 1918.

137. Mellin, Jäck, and Hartknoch, *Der Rigische Kreis = Le Cercle de Riga*, 1791.

138. M. Siliņš, "Vidzemes arheoloģiska, vēsturiski etnogrāfiska un speciālkarte," in *Vidzemes un Kurzemes speciālkarte pēc pašiem pilnīgākiem, jaunākiem izdevumiem, pagastu kartēm, pilsētu*

In Vidzeme, at the beginning of the 19th century, the owners of Koltzen and other manors began to show interest in seaside recreation. Baron Karl Magnus von Reutern (1787–1859), the owner of Loddiger (Latvian: *Lēdurgas muiža*), and Alexis von Pistohlkors, the owner of Koltzen, built the first summer cottages north of the Pēterupe and in the territory of Koltzen Manor (Figure 16), south of the Ķīšupe. A new bathing place for nobility by the sea, known as Neubad (Latvian: *Neibāde*) (Figure 17), was opened in 1823. Until the mid-19th century, the summer houses at Neubad belonged exclusively to Koltzen Manor. By that time, Neubad had begun thriving as a resort. Thanks to the efforts and financial donations of the owner of Koltzen Manor, the fourth building of the Pēterupe Church (Figure 17) was constructed in 1856. This new stone church was consecrated in 1864. After the peasants were liberated in Vidzeme, barge construction increased along the Gulf of Rīga coastline, with fishermen engaging in cabotage shipping and transporting various cargoes to Rīga and other ports. The shipbuilding of larger, long-distance sailing ships began to develop rapidly after the Crimean War (1853–1856). In 1870, Oskar Otto Freytag von Loringhoven (1832–1882) acquired Adiamünde (Latvian: *Skultes muiža*) as collateral property. The seashore along the Pēterupe and at Skulte¹³⁹ near Āģe's mouth became a popular construction destination. It developed into a key shipbuilding site from 1857 to 1913. The boundary between Skulte and Pēterupe was simple: Pēterupe belonged to Koltzen's owner, and it was a parish of a foreign lord with foreign residents. From 1857 to 1914, Latvian fishermen and sailors from Vidzeme worked extensively along the coast of the bay, wherever it was profitable. Pēterupe and Kuiviži served as two centers of Latvian sailboat construction. Fishermen from the Āģe River estuary gradually formed a settlement near Neubad. Baltic-German Baron August Friedrich Woldemar von Pistohlkors (1822–1886), son of Alexis von Pistohlkors and owner of Koltzen, married Emilie Natalie von Harder (1829–1894), the foster daughter of St. Petersburg millionaire Stieglitz, and built a new manor house. He also laid out Emilie Park for his wife. Architect Friedrich Wilhelm Hess from Rīga designed a palace between 1857 and 1860. August Friedrich Woldemar also acquired Neubad, built a road to the seashore in 1870, and developed a new resort there. He established a spa, a school, and a white church. His son, Alexander Ludwig Johann Gustav von Pistohlkors (1851–1904),¹⁴⁰ was one of the last members of the Pistohlkors family. After 1886, he extensively renovated the estate, laid out roads, and promoted Neubad's further development. In 1888, a doctorate building was erected for the local doctor of the Pēterupe Lutheran congregation. It housed a pharmacy and the first doctor's practice. In the same year, Alexander Arvid von Engelhardt (1856–1920), invited by Baron Alexander von Pistohlkors, became the first doctor in Pēterupe and the surrounding area, working there for 19 years before emigrating to Germany in 1907.

plāniem u.c. M. Siliņa sastādīta un izdota /Special map of Vidzeme and Kurzeme based on the most complete, recent editions, parish maps, city plans, etc., compiled and published by M. Siliņš/ (Rīga: Lithography and printing house Alexander Stahl, 1894).

139. From the beginning of Russian times, the name *Skulte* came into being, the origin of which is attributed to the former owner of the manor, Schultzen. During their time, three separate local manors merged into one.

140. He had two sons, Erich (Erix) Alexander August von Pistohlkors (1883–1912) and Max August von Pistohlkors (1887–1911).

He established a private school on the top floor of the doctor's house. His daughter Natalie Renata von Pistohlkors (1890–?), the last owner of the manor, married forester Paul Bernhard Theophil Moltrecht in 1915. Between 1895 and 1931, Jānis Stāmers served as pastor in the Lutheran congregations of Pēterupe, Skulte, and Sarnikau. He owned the villa 'Jūras miers' /Sea calm/ (German: *Meeresruh*), built around 1890 in Pēterupe, where a school was established. In 1898, land from the former Livonian fishing village of *Pabasile* (German: *Pabbasch*, Latvian: *Pabaži*) was divided into summer cottage development plots, creating a resort called Badeort Catharinenbad (Figure 17) or Pabbasch Seaside. Knowledge gained from establishing parks in suburban areas helped cultivate an atmosphere suitable for natural recreation, entertainment, and healing within urban settings. From the late 19th century to World War I, bathing facilities emerged. Mineral water was used for healing in the Russian Empire. Coastal resorts of the Baltic Sea became a component of urban planning. Boulevards and alleés linked the urban green elements in a united system. In the late 19th century, eclecticism was expressed not only in landscape but also in the composition and structure of green spaces. Symmetrical compositions created by birch, ash, horse-chestnut and linden alleés, or decorative tree rows and flower carpets with geometric patterns were designed for pedestrian promenades. Alleés were set up according to the advice of landscape architect Georg Friedrich Ferdinand Kuphaldt (1853–1938) from Plön, who from 1876 to 1878 had studied at Potsdam Royal Horticultural School, and agreed to become the director of Riga Gardens and Parks from 1 January 1880. It was possible to reach a compositional unity among various plants.¹⁴¹ Rīga-Strand (Latvian: *Jūrmala*) developed into a resort, renowned for its lively cultural scene across the Russian Empire, with celebrated European musicians and symphony orchestras performing in summer concert halls.

At the start of the 20th century, shipbuilding along the coast declined due to high timber prices. Thanks to the growth of Neubad Resort, the demand for rural goods increased, and the lives of Skulte fishermen and farmers improved. The lack of transport routes and a fishing port prevented Skulte from benefiting from the significant economic boom from 1907 to 1914. The passenger steamer 'Neubad', ordered by Koltzen Manor from the Rīga shipyard 'Lange & Co' in 1907, began daily traffic from Rīga to Neubad Resort. This greatly increased the popularity of the Neubad bathing spot. With direct connections to Rīga, a post office was opened in Neubad, followed by a telegraph office and a state savings bank. Hotels, shops, restaurants, craft workshops, and various service institutions were established in Pēterupe and Neubad. Before World War I, vacationers from Vidzeme manors, Rīga, St. Petersburg, Jurjev, and other parts of the Russian Empire stayed in Neubad. The subsequent hostilities, with the front nearby in 1917, caused damage and marked the end of the German manorial era and Neubad Resort. Salismünde was repeatedly shelled, and the merchant fleet was destroyed. From June 1915 to April 1916, the Russian army was stationed in Haynasch to protect the coast of the bay. The coastline was fortified with defensive structures to guard against German landings, bridges were mined, and the railway was destroyed. The port's infrastructure was devastated. The

141. S. Ozola, The Visual Image and Function of Main Traffic Highways of the 19th Century in European Cities (Part Two).

entire shipping fleet was lost. On 13 October 1917, a squadron of German ships bombed the coast for two hours. At the end of December, seven German aeroplanes bombed Haynasch, which suffered extensive damage.

Creating a Latvian Urban Setting within a Context of Nature

After World War I, the Republic of Latvia (1918–1940) was proclaimed on 18 November 1918. The State of Latvia had been established by uniting historical Latvian lands and based on the unwavering will of the Latvian nation to have its own State and its inalienable right of self-determination to guarantee the existence and development of the Latvian nation, its language and culture throughout the centuries, to ensure freedom and promote the welfare of the people of Latvia and each individual.¹⁴² In February 1919, the Estonian army drove the Germans out of Ainaži and occupied the town. Ainaži came under Latvian control, although the Estonians were the majority. Estonian troops remained stationed there until 1920, with Estonia retaining the northern part – Ikla. In 1920, the Latvian-Estonian border was established. Therefore, most of Ainaži remained part of Latvia, leaving the small village of Ikla (Figure 15) on the Estonian side. On 20 July 1920, the Latvian government granted village municipality rights to one part of Ainaži. On 16 September 1920, the Constituent Assembly adopted the ‘Decision on Agrarian Reform in the Republic of Latvia’. The national economy prompted the creation of new administrative centers and transport hubs. Densely populated areas or villages emerged during the agrarian reform in some former manor centers. Koltzen was officially renamed Biriņi. In 1925, Neibāde was designated as a densely populated area. Pēterupe 6-grade primary school (now Saulkrasti District secondary school) opened in 1933. This year, Neibāde and Pēterupe were united under the new name Saulkraste. On 21 March, the two small fishing villages of Pēterupe and Neibāde merged and received a new name – *Saulkrasti*.

In the new socio-economic and political conditions, the construction of mass affordable housing gained relevance. Latvian citizens received plots of land to address their housing needs and establish their farms. In 1920, the construction of single-family residential houses was encouraged. A garden became an inseparable part of a Latvian farmer’s yard. Low-rise residential houses, situated among water bodies and clusters of trees, beautifully harmonized with the landscape and natural elements, prove to be more hygienically valuable than separate blocks. Sunlight, air temperature, wind and precipitation greatly influenced the settlements’ planning and their construction. They determined the mutual arrangement of city parts, street directions, and buildings’ architectural solutions, the types of greenery, the city’s improvement, and its artistic form. Urban space began to be maintained in accordance with Latvian traditions, creating a backyard fruit and vegetable garden and connecting it with a single building complex. It contributed by using ethnographic values and continuing folk building traditions. A comprehensive approach to solving construction problems transformed the understanding of urban aesthetics.

142. Constitutional Assembly. The Constitution of the Republic of Latvia. 1922. In: *Latvijas Republikas Saeimas un Ministru Kabineta Ziņotājs*, Nr. 6, 31.03.1994.

For the first time, measures were introduced for the comprehensive development of Latvian cities. Building regulations and functional zoning of territories were developed. City municipalities managed development processes of master plans to create a high-quality urban environment for the city center, residential areas and industrial zones. The concept of parks was redefined to align with the development trends of public parks that emerged in Europe during the interwar period. Picturesque green public spaces, guided by renowned Latvian gardeners, created a new visual identity and character for the Latvian city. Special attention was paid to the city center and its architectural image. The awareness of urban aesthetics changed: wide grasslands with scenic shrub groups were cultivated, making green areas lighter, more colourful and cheerful. Latvian landscape gardener and landscape architect Andrejs Zeidaks (1874–1964), who learned from Georg Kuphaldt by 1900, installed low hedges, wide lawns, and beds of flowering perennials in the gardens. The urban environment was shaped according to the mentality of local inhabitants. The Constitution of the Republic of Latvia was adopted on 15 February 1922. In 1923, general regulations were established on the development of state, public and industrial buildings to ensure a rational and planned construction policy in Latvia. Solutions rooted in historical construction were sought to create a visual identity for small towns. The implementation of the agrarian reform facilitated planned urban development. The ‘Construction Supervision Law’, which came into effect on 9 July 1927, and the ‘Urban Lands Law’, which came into force on 22 March 1928, mandated the establishment of city boundaries.

After 15 May 1934, Prime Minister Dr Kārlis Ulmanis (1877–1942) came to power in Latvia. Nationalism increased the people’s self-confidence and united people to achieve common goals. On 14 January 1936, the National Construction Committee began its work under the Cabinet of Ministers with a special council, divided into five commissions. The prominent Latvian architect, Professor Eižens Laube, whose expertise and knowledge in architectural theory were evident in urban planning, headed the Architectural Issues Commission. Professor Dr Arch. (1940) Artūrs Krūmiņš (1879–1969) headed The Urban Development Commission, and he wrote: Bad cities are the evil of the nation. Let us not forget that we are now carving the paths of our own history and that no foreign, unwelcome power is any longer binding us in the field of urban construction. The National Construction Committee was tasked to coordinate the planned construction on a national scale, taking care of monuments and monumental buildings in populated areas, resolving construction finance issues, promoting road development, protecting the environment and cultivating the landscape, strengthening nationalism in construction, and developing proposals for the protection of monuments. The committee established commissions for solving architecture, rural and urban construction, monuments and monumental buildings, as well as traffic issues.

In independent Latvia, the fish market was limited. It was not profitable to build new ports and factories. In the 1930s, after the division of building plots in the territory of the former manor, Skulte became a larger settlement. It was granted the status of a densely populated area (village) in 1933. In 1934, a railway bridge across the Gauja was opened, and on 15 September 1934, the railway line reached Saulkrasti and Limbaži. On 1 October 1934, a railway station was established. The continuation of the line to Rūjiena was opened on 4 December 1937. After the opening of the Rīga–Rūjiena railway line, the Pabaži railway station was built in Saulkrasti. The Saulkrasti railway

station was constructed between Neibāde and Pēterupe. Railway traffic rapidly promoted the development of Saulkrasti as a summer resort. On 26 July 1936, the fishermen's organizations of Skulte parish¹⁴³ united in a cooperative, 'Jūras zivs' /Sea fish/. On 21 May 1937, the President of Latvia (1936–1940) Kārlis Ulmanis announced the start of construction of the Skulte fishing port. The foundation was laid for the modern village of Zvejniekciems. The ceremonial opening of the Skulte Port¹⁴⁴ took place on 7 October 1939.

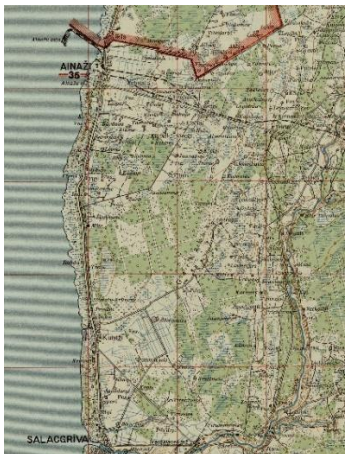


Figure 18. Map Fragment Depicting Salacgrīva and Ainaži, 1927¹⁴⁵

Figure 19. Latvian Architect, Ethnographer and Professor at the University of Latvia Pauls Kundziņš (1888–1983). The Building of the Ainaži Cultural Society, 1928¹⁴⁶

Salacgrīva and the surrounding villages became the fishing center of Vidzeme (Figure 18). In 1921, Salacgrīva was granted town status, and cultural life began to flourish. A secondary school also opened in Salacgrīva. The Lutheran parish and the Ladies' Committee of the Firefighters' Association organized the town's cultural and social life. The Evangelical Lutheran Church of Lielsalaca was renovated in 1927. On 7 February 1928, Salacgrīva was granted city status. On 13 May 1928, the granting of city rights was celebrated with a church service, a festive parade, and sports competitions. Trees planted by residents on the castle mound and near the Public Assembly Hall are evidence of this remarkable event. Sixty-one street names were approved. The paved Rīga Street led past the Town Hall, a pharmacy, a bakery, and several shops up to the ferry for crossing the river. In the summer season, a wooden bridge replaced it and was rebuilt every spring. In Salacgrīva, a sports field and Unity Square were created, the 15th of May Grove was planted, and Melnalkšņi Park was landscaped. The urban environment of Latvia was formed before World War II.

143. In 1935, the territory of Skulte parish had 2,411 inhabitants, mainly Latvians.

144. In the autumn of 1938, a storm partially destroyed what had been built, but the project was recognized as nationally important and continued. In 1938, the first coastal motorway was constructed to the Skulte coast.

145. No author information. *Army topographic map Ainaži-35*. 1927. Rīga: Department of Geodesy and Topography of the Latvian Army.

146. Postcard Ainaži. 1920s-1930s. [In Latvian]

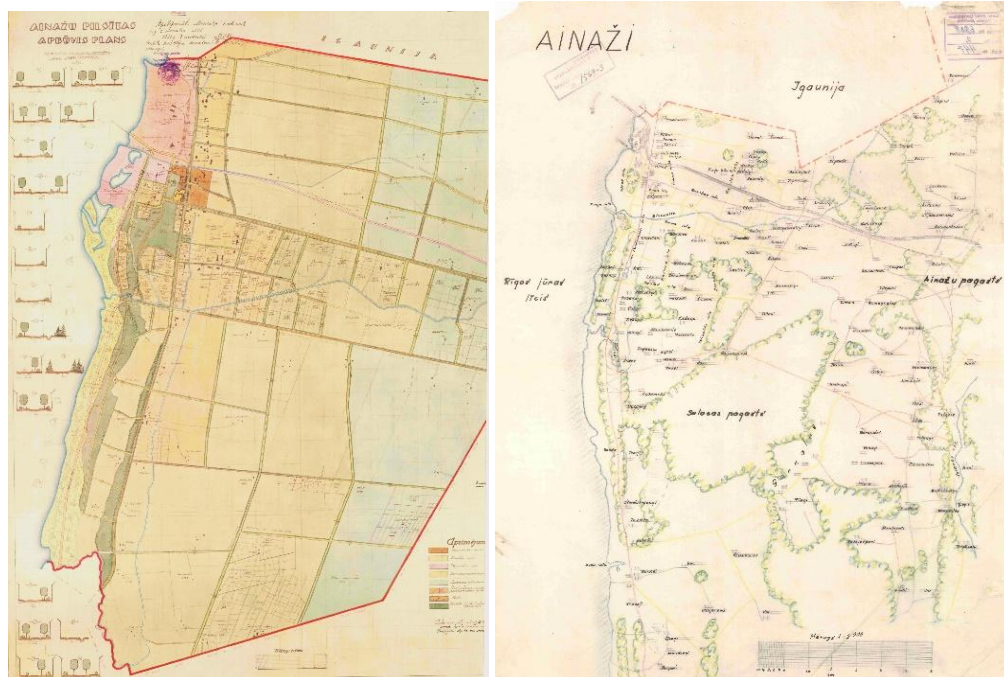


Figure 20. Surveyor Sils V.; Engineer Jansons A. *A Development Plan for Ainaži City, 1931*¹⁴⁷

Figure 21. *Project for Constructing a Railway Connection to the New Pier, Enabling Ships to Dock Directly at the Port of Ainaži*¹⁴⁸

In independent Latvia, Ainaži, developing on the site of an ancient Liv fishing village, underwent revitalisation. The port board and primary school were housed in the maritime school building. In 1920, Ainaži¹⁴⁹ was approved as an independent municipality, and the restoration of the port began in 1923. From 1923 to 1928, a 527-meter-long breakwater was constructed. The port was deepened. Its dock became the fourth largest port in Latvia after World War I. Ainaži–Valmiera–Smiltene railway terminated at Ainaži Port in 1926. The beautiful seashore and pine forest of Ainaži attracted those who love quiet relaxation and those seeking to improve their health. Ainaži (Figure 18) was predominantly an agricultural town,¹⁵⁰ where residents also engaged in fishing and seafaring, excelling as mariners due to their maritime heritage. On 7 July 1926, Ainaži was granted city rights. The Ainaži Cultural Society constructed a new building in 1928 (Figure 19) to support social and cultural activities, establishing one of the best-equipped society houses in the area. A new 22.8-meter-high lighthouse was constructed in 1930. Approximately fifty ships visited the port each year, and port activity slowed down due to the onset of the economic crisis. To reactivate the port's operations, the Latvian government began constructing a new

147. Ainažu pilsētas apbūves plāns, 1931, stored in the State Archives of Latvia, Fund 6828, Description 2, Case 446.

148. Ainaži, stored in the State Archives of Latvia, Fund 6828, Description 2, Case 447.

149. The name of this seaside port town originated from the Livonian word *āina* or the Estonian word *hain* /hay/ or *hainastee* /road/, which referred to the pathway used to transport hay from the seaside meadows.

150. The town's land was divided into 202 plots.

pier in 1936. It allowed ships to dock directly, thus eliminating the need for transferring cargo between boats and ferries (Figure 21). This development provided significant benefits for Ainaži¹⁵¹ (Figure 20) and affected the well-being of the local population. The pier was renovated, the port's waters were cleared of sunken ships and deepened. A lighthouse was built, and in the 1920s and 1930s, work was carried out to revitalize the Port of Ainaži; this was only partially successful. Ships were still unable to dock at the port pier; their cargo had to be reloaded onto barges with the help of tugboats.

Development of Latvian Urban Areas adapted to the Soviet Union Model

World War II (1 September 1939–2 September 1945) interrupted city-building traditions established during Independent Latvia. The Soviet Army entered Latvia on 17 June 1940, Soviet power was restored on 21 July, and Latvia was incorporated into the Union of Soviet Socialist Republics on 5 August. In the Latvian Soviet Socialist Republic, ideologically and economically isolated from Western culture, urban spaces were adapted to the Soviet Union model, subject to direct orders from Moscow. The imposition of political dogmatism led to a decline in architecture, stifling creative talents. The nationalization of property began, introducing socialist ideals of social equality based on public property. Collectivism became the guiding principle for people's social life and work, fostering unity in achieving common goals, often prioritising public needs over personal desires. During the war, fierce battles for the defence of Riga took place in the Saulkrasti surroundings, and the Germans established defensive lines near the Ķīšupe. The northern part of Saulkrasti village suffered heavy damage. The German army blew up all the bridges, destroying the railway and its stations. Soviet dive bombers attacked Ainaži in 1944. While retreating, the German army destroyed the port infrastructure. Both maritime school buildings were devastated.

In 1945, Skulte parish was divided into the villages of Skulte and Straume, which were reunited in 1954. Due to the collectivization of farmers, the Molotov collective farm took the Skulte territories. In 1947, the Soviet occupation authorities nationalized the properties of the Skulte fishing community. On 13 July 1947, 211 peasant farms with their inventory and approximately 400 fishermen along the thirty-kilometer coastal strip from Lilaste to Dunte were united into an artel or collective farm. A fish production plant 'Zvejnieks' /Fisherman/¹⁵² was established in 1948, uniting approximately 800 fishing farms. Thanks to its port, the collective farm quickly became one of the wealthiest in Latvia. The port's location and the cannery determined the choice of the mouth of the Āģe River, leading to the establishment of the Soviet settlement Zvejniekciems. The Āģe Port was rebuilt in 1951, and fishermen's dwellings began to be moved from the wide coastal strip to the newly established collective farm village next to the port. It became the Zvejniekciems

151. According to the 1935 census data, Ainaži was home to 434 men and 484 women.

152. The exact boundaries of the collective farm 'Zvejnieks' were kept so secret that they were not revealed even in the 1980s. The center of the collective farm could be located anywhere within this territory.

settlement. The collective farm territory was limited to the coastal zone of the former Skulte parish. The Skulte cannery evolved into a strategic economic entity.

By the late 1940s and early 1950s, social restructuring occurred within the urban environment. Public works in Soviet Latvia were organised according to socialist ideology. Green areas were transformed by planting trees in damaged areas, without considering the quality of the city's greenery. Primitive architectonic forms integrated into urban spaces elicited negative emotions among residents. Architects became civil servants who adhered to the technical and artistic standards set by the government. Construction methods evolved, leading to the development of socialist culture in Latvia from 1945 to 1955. Knowledgeable people who managed the collective farm 'Zvejnieks' established a cultural center in Zvejniekciems. In 1952, the foundations of the Culture House, designed by the renowned architect Marta Staņa (1913–1972), a supporter of functionalism, were laid.¹⁵³ The central space in the Culture House is a large auditorium with 700 seats (Figure 22).¹⁵⁴ The Culture House 'Zvejniekciems', opened on 8 November 1956, was one of the most modern facilities in Rīga District and the entire Latvian SSR. In 1963, one of the most modern secondary school buildings in Latvia was constructed in Zvejniekciems, and a music school was soon established.

Socialist architecture formed independently of Western cultural ideology and adopted its motto: 'Socialist content in national form'. In 1957, the Communist Party of the Soviet Union and the Soviet government issued a resolution 'On the housing development in the USSR', laying the groundwork for construction industrialization. An attempt in urban planning to address family life outside of apartments led to the concept of a micro-district and its variations. The essence of this idea was the expansion of housing beyond the traditional apartment, encompassing a group of residential buildings along with shops, kindergartens, canteens, repair shops, schools, and other public facilities needed for a specified number of apartments.¹⁵⁵ The location and design of the micro-district were dictated by macro-relief, comprising plains and hills of varying heights across a wide area, and micro-relief, shaped by local surface irregularities, ravines and slopes. Microclimatic conditions, such as wind speed and direction throughout the year, influenced the choice of inhabited areas and urban planning decisions. Expressive planning was used to create a distinctive silhouette for the city. The functional use of specific territories was considered important for urban development. These factors were taken into account to determine the street layout and the orientation of buildings relative to the sky and the surrounding vegetation.¹⁵⁶ Industrial progress spurred the advancement of villages, leading to the emergence of town-like settlements. Small fishing villages with seasonal structures were demolished

153. The construction took five years to complete.

154. The rooms for the library and the reading room are below the large auditorium. Two rows of decorative columns, one and a half stories high, support the ceiling of this hall. A sports hall, a lobby, and a cloakroom are adjacent to it. The administrative rooms of the fishermen's artel, a large meeting room and classrooms for various groups occupy the ends of the building's basement. An auditorium for 50–60 listeners, teaching rooms, visual aids, and other needs are on the mezzanine floor.

155. V. Šusts, *Telpas uztvere un kompozīcija* /Spatial perception and composition/ (Rīga: Zvaigzne), 6.

156. O. Buka, and U. Volrāts, *Pilsētībūvniecība* /Urban planning/ (Rīga: Zvaigzne).

during the Soviet era, transforming the Baltic Sea's coastal communities into summer cottage villages.



Figure 22. *An Outstanding Latvian Architect and a Supporter of Functionalism, Marta Staņa (1913–1972). Auditorium with 700 Seats and a Stage of the Culture House 'Zvejniekciems', built in 1956¹⁵⁷*

Figure 23. *Sculptor Leja Novoženeca; Architect Jānis Pētersons. The Memorial for the Sailors who did not return from the sea and the Soviet Soldiers who fell in World War II in Salacgrīva, 1986¹⁵⁸*

Saulkrasti, the center of Saulkrasti District from 1949 to 1956, was a small resort in need of renovation. In 1950, Pabaži village was incorporated into Saulkrasti. On 21 February 1950, it was granted the status of a workers' village and named Saulkraste until 1952. On 23 December 1961, Saulkrasti was recognized as a town-village. The Nature Park '*Piejūra*' /Seaside/¹⁵⁹ at the mouth of the Daugava was established in 1962 to protect a complex of coastal ecosystems of European Union importance. By 1966, the potential for establishing new factories and economic districts in the Latvian SSR was exhausted. On 10 January 1967, a decree was issued for the new administrative-territorial division of the Latvian SSR. The territory of the collective farm 'Zvejnieks' was separated from Skulte village and added to the so-called Saulkrasti rural territory. In 1967, Zvejniekciems was incorporated into Saulkrasti and became part of it, although one could argue that Zvejniekciems was probably larger than Saulkrasti at that time. The border of Rīga District separated Zvejniekciems from Skulte village, transforming Saulkrasti into a vast 'urban village' the size of a city. However, it was not classified among them. In 1970, a state-run Soviet farm was established from three, and later from four, former collective farms.

During the USSR period, significant changes occurred in the economic life of Salacgrīva, leading to the establishment of a fish factory originally intended for Ainaži. In 1949, the fishermen's collective farm 'Brīvais Vilnis' /Free Wave/ was established. A fish cannery, public buildings and residential houses were built in

157. Photo by Jānis Brencis, 15 April 2024.

158. Photo by Aivars Gulbis, 13 May 2023.

159. The specially protected nature area along the Gulf of Rīga coast, north of Rīga, encompasses the territories of three municipalities: Rīga, Saulkrasti, and Carnikava. It became the third-oldest nature park in Latvia.

Salacgrīva. This led to the port's renovation. In 1956, research was conducted to begin planning and designing the concrete bridge. Its construction began on 18 February 1959. It was completed in 1961. The population grew, and this encouraged the construction of new residential buildings. In the second half of the 20th century, Salacgrīva became the main trading port in Northern Vidzeme. Over the years, fishermen's collective farms became increasingly prosperous and sought to enhance the city. A stadium was built in the northern part of Fishermen's Park, along with one of the largest and most visited open-air stages¹⁶⁰ on the Vidzeme coast. In 1986, the memorial features the image of a woman holding a small child on her shoulders,¹⁶¹ dedicated to the sailors who did not return from the sea and the Soviet soldiers who fell in World War II, was created in Salacgrīva (Figure 23).

During Soviet times, the Port of Ainaži was partially restored; however, the city never experienced prosperity. Ainaži was overshadowed by nearby Pärnu and lost its fish-processing factory to Salacgrīva. With the construction of the Port of Pärnu, the Port of Ainaži began to lose its economic importance, and in 1977, the railway line to Valmiera was closed. After World War II, *Baltā muižiņa* housed the Ainaži Elementary School. A new Ainaži Primary School was built on Parka Street in 1966. In 1969, the Ainaži Maritime School Museum was opened in the renovated Maritime School building.

Sustainable Urban Development along the Vidzeme Coast of the Gulf of Rīga

Over many centuries, Latvia has cultivated a rural landscape and urban environment rich in nature and architectural forms, associated with cultural values and traditions. Professor Eižens Laube wrote: If we allow Latvian architecture to develop without the participation of a leading, critical mind, the result will not be complete: the support of an important soul function will be missing. Architecture that reflects the incomplete activity of the souls of its creators cannot be worthy of modern and cultural Latvia. Architectural traditions must be developed. Feeling alone without reason and other faculties of the soul can easily lead Latvian architecture astray and cause it to appear improperly cultivated. The content of Latvian buildings should include unique elements that are characteristic of Latvian art. Therefore, the essence of Latvia must be understood as deeply and comprehensively as possible. Architecture must reflect the essence of Latvia, so it is not permissible to build in Latvia that characterizes the peculiarities of other

160. The Open-Air Stage, built in 1967 as part of the sports and recreation complex Fishermen's Park, established by the fishermen's collective farm 'Brīvais Vilnis', hosted a variety of cultural events, including traditional annual celebrations such as town festivals, open-air performances, concerts, and children's events. Every year, during the second week of July, the Fishermen's Festival took place at the port and on the Open-Air Stage, becoming a cherished tradition.

161. By the 1970s, international modernism had entered its late phase, giving rise to Postmodern architecture. It was complex and often concealed surprises, expressing itself through diverse means and the semantic nature of spatial forms. The motto 'ideas justifying everything' allowed for greater freedom in composition and the broadest interpretation of technical and artistic tools. The diversity of architectonic spatial structures evoked emotions, fostering a dialogue between people and space. New ritual traditions were established. Postmodern symbolism incorporated elements of life.

countries. Construction should be suited to the Latvian unique physical and spiritual environment. Architecture that clearly represents and harmonises with Latvia's essence must be chosen consciously and deliberately. Latvian beauty can be expressed in countless forms that often seem contradictory: there is no single definition that can explain Latvian beauty in one sentence. Latvian beauty is expressed in many diverse ways, governed by different rules and circumstances, and can be understood and described in various ways. It is essential to study Latvia's physical and spiritual environment, its land, wealth, nature, and the distinctiveness of ethnographic regions. Understanding local nationalities—especially the main group, Latvians—is crucial. One must grasp the political, economic, and spiritual life of the Latvian state, along with its unique course—what character and cultural ideals most Latvians hold, and what the goals of the new state are. It is necessary to explore Latvia's ancient past and modern history. We should study local architecture, art and literature. It's important to understand traditional building techniques and materials used in construction. Additionally, gaining insight into the unique construction of Latvian towns, cities, and rural areas—by comparing them with other regions—is vital to deepening our understanding of Latvia's essence.¹⁶² An interesting coincidence occurred in the USA in 1960. Not only did the outstanding Latvian architect Eižens Laube publish articles about architecture, but Kevin Lynch (1918–1984), an influential American urban planner and designer, introduced the concepts of legibility and urban perception.¹⁶³ His innovative ideas about city planning emerged from a deep interest in how urban environments shape human perception and behavior. He introduced key concepts such as imageability and legibility. They profoundly impacted urban design theory by emphasizing the importance of how city inhabitants perceive and navigate their surroundings. In-depth analysis of the five key elements: Paths, Edges, Districts, Nodes, and Landmarks, reveals their integral role in shaping the urban image. Each of these elements contributes uniquely to how people experience and relate to a city, influencing not only navigation but also emotional connections and memories formed within the urban landscape. Paths are the channels through which people move; they may be streets, walkways, or transit routes that lead individuals through the city. Well-defined, tree-lined boulevards offer not only practicality for commuting. They also create pleasant environments that encourage walking or cycling, ultimately fostering a sense of community engagement. Edges serve as boundaries that delineate different areas of the city. These can be physical barriers, such as rivers and walls or conceptual lines, such as socio-economic divides. Recognizing and integrating edges into the urban design is crucial. Effective planners can transform them into dynamic interfaces, perhaps through parks or cultural zones, thus bridging gaps and promoting interaction. Districts represent the distinct areas within a city that possess unique identities characterized by common elements, activities, or demographics. Effective urban planning ensures that these districts are easily recognizable and navigable, and allows inhabitants and visitors alike to understand the city's diversity. Nodes are strategic focal points, such as plazas or public squares, where people can gather and interact. These hubs serve as meeting places that strengthen the city's social fabric

162. E. Laube, *Raksti par arhitektūru* / Articles about architecture/ (Lincoln: Vaidava, 1960).

163. K. Lynch, *The Image of the City* (Cambridge, MA: MIT Press, 1960).

and encourage communal activities and accessibility. Effective urban design can amplify the function of these nodes, turning them into lively centers of culture and engagement. Each element, when thoughtfully combined, contributes to a cohesive urban image that not only guides inhabitants through the environment but also enriches their experience, shaping the city's identity. Perception plays a critical role in shaping individuals' experiences within urban environments, significantly influencing how they engage with and understand the city. A city's image is not just an aesthetic or architectural concern but deeply rooted in the perception of its inhabitants. Clarity in urban design emerges as a pivotal factor in shaping a strong city image. Lynch argues that well-structured environments facilitate easier navigation and comprehension, promoting positive perceptions among residents and visitors. When pathways (the routes people travel), landmarks (significant reference points), edges (barriers or boundaries), nodes (focal points of activity), and districts (distinctive areas) are clearly defined and integrated, it simplifies the cognitive load on individuals as they traverse various urban spaces. A cohesive city image is not merely an aesthetic goal; it enhances the functionality and livability of urban spaces. Urban planners and designers are tasked with integrating the five key elements Lynch identified to forge a harmonious and engaging urban experience. Effective urban design can facilitate ease of movement by enhancing the visibility and accessibility of pathways. Districts, as urban zones with distinct identities, can further contribute to the city's image by fostering community engagement and cultural expression. Nodes, or pivotal points that draw people together, play a critical role in shaping movement patterns within a city. Strategically placing public spaces, gathering areas, or transportation hubs can transform these nodes into lively centers for activity and connection. Landmarks also serve as essential visual anchors. Unique structures or notable features that stand out within the urban fabric can enhance navigation and impart a sense of place. Lynch's framework encourages cities to leverage these elements to create a cohesive narrative that resonates with the public, contributing to an enriched urban experience. Planning for memorable cities necessitates a careful balance of these elements to create an urban landscape where residents can easily navigate, find connection, and engage meaningfully with their surroundings. The synthesis of Lynch's theories into urban planning strategies presents a roadmap for future developments, encouraging efforts that will result in cities that are not only well-designed but imbued with a strong image that reflects the unique identity of their communities.

After World War II, Classical and foundational authors explained urban space and its transformation. Manuel Castells (1942–), a Spanish sociologist, analyzed the city as a result of economic, political, and communicative processes in the information age. He developed the idea of the “network society”, a social structure characterized by the pervasive use of digital networks and information technologies, fundamentally transforming communication, organization, and individual identity, and the “informational city”, the spatial expression of a new form of social organization that is made up of the interaction of new information technology and social and cultural information. The paper examines the relationship between technological change and information technology. It describes major processes of social and economic restructuring in our society and the role of technology in shaping, and analyses the interaction of socioeconomic and spatial processes. An important social consequence

of these spatial developments is the loss of control (and meaning) of place, as networks and spatial flows become dominant. Yet in a world economy, local governments may have more importance than national ones. A review of the original French edition of this book in the *American Journal of Sociology* hailed it as “the most finished product yet to emerge from the new (Marxist) school of French urban sociology. The aim of the book was nothing less than to reconceptualize the field of urban sociology. It is carried out in two stages: a critique of the literature of urban sociology (and urbanization) and an attempt to lay the Marxist bases for a reconstructed urban sociology”. The problems facing the world’s cities, whether problems of development or of decay, cannot be solved until they have been diagnosed. The brilliant exposition of the function of the city in social, economic and symbolic terms illuminates the creation and structuring of space by administrative, productive and more immediately human action. The interaction of environment and lifestyle, the complex of market forces and state policy against a background of traditional social practice, is scrutinized to establish concepts and research methods that will enable us to come to grips with the cities themselves and the way in which we view them. Castells draws on urban renewal in Paris, the English New Towns, and the American megalopolis for concrete data in his empirical and theoretical investigation.¹⁶⁴

David Harvey (1935–), a British-American academic best known for Marxist analyses that focus on urban geography and the economy more broadly, interprets urban space from a Marxist geography perspective. He focuses on capitalist accumulation and struggles for the right to the city.¹⁶⁵ A renowned geographer and urban theorist is known for his critical analysis of the relationships between capitalism, urbanization, and social inequality. In 1942, the federal government was in effect running a nationalized economy. The United States was in alliance with the communist Soviet Union in the war against fascism. Strong social movements with socialist inclinations had emerged in response to the depression of the 1930s, and sympathizers were integrated into the war effort. Robert Moses, who, after World War II, did to the whole New York metropolitan region what Haussmann had done to Paris, changed the scale of thinking about the urban process through the system of highways and infrastructural transformations, through suburbanization, and through the total re-engineering not just of the city but of the whole metropolitan region. He defined a way to absorb the surplus product and resolve the capital surplus absorption problem. This process, when taken nation-wide, as it was in all the major metropolitan centers of the United States (yet another transformation of scale), played a crucial role in the stabilization of global capitalism after World War II. The suburbanization of the United States was not merely a matter of new infrastructures. It entailed a radical transformation in lifestyles and produced a whole new way of life. Suburbanization alongside militarization played a critical role in helping to absorb the surplus in the post-war years. It did so at the cost of hollowing out the central cities, leaving them bereft of a sustainable economic basis.¹⁶⁶

164. M. Castells, *The Urban Question: A Marxist Approach* (Paris: Flammarion, 1972).

165. In Latvia, the works of the repressive and occupation regime dictators, such as Lenin and Stalin, are not viewed.

166. D. Harvey, *Social justice and the city* (London: Edward Arnold, 1973); D. Harvey, *Rebel Cities: From the Right to the City to the Urban Revolution* (London, New York: Verso, 2012).

Henri Lefebvre (1901–1991) proposes that space is not a neutral container, but a social construction produced by relations of power, capital, and everyday life. He introduces the notions of perceived, conceived, and lived space.¹⁶⁷ Lefebvre had theoretical attachments to the idea of a psychogeography of the city, the experience of the urban derive through Paris.

Sharon Zukin (1946–) studies gentrification, cultural consumption,¹⁶⁸ and urban authenticity in contemporary capitalism.¹⁶⁹ Since its initial publication, *Loft Living* has become the classic analysis of the emergence of artists as a force of gentrification and the related rise of “creative city” policies around the world. Sharon Zukin reveals the economic shifts and cultural transformations that brought widespread attention to artists as lifestyle models and agents of urban change, and explains their role in attracting investors and developers to the derelict loft districts where they made their home. Prescient and dramatic, *Loft Living* shows how a declining downtown Manhattan became a popular “scene,” how loft apartments became hot commodities for the middle class, and how investors, corporations, and rich elites profited from deindustrializing the city’s factory districts and turning them into trendy venues for art galleries, artisanal restaurants, and bars. The artists who led the trend are now priced out of the loft market. Even in New York, where the loft living market was born, artists have no legal claim on loft districts, nor do they get any preferential treatment in the harsh real estate market. Zukin explains how once-edgy districts are transformed into high-priced neighborhoods, and how no city can restrain the juggernaut of rising property values.

As cities have gentrified, educated urbanites have come to prize what they regard as “authentic” urban life: ageing buildings, art galleries, small boutiques, upscale food markets, neighborhood old-timers, funky ethnic restaurants, and old, family-owned shops. These signify a place’s authenticity, in contrast to the bland standardization of the suburbs and exurbs. In *Naked City*, Sharon Zukin shows that the rapid and pervasive demand for authenticity – evident in escalating real estate prices, expensive stores, and closely monitored urban streetscapes – has helped drive out the very people who first lent a neighborhood its authentic aura: immigrants, the working class, and artists. Zukin traces this economic and social evolution in six archetypal New York areas – Williamsburg, Harlem, the East Village, Union Square, Red Hook, and the city’s community gardens – and travels to both the city’s first IKEA store and the World Trade Center site. Zukin looks at what gives neighborhoods a sense of place, but argues that over time, the emphasis on neighborhood distinctiveness has become a tool of economic elites to drive up real estate values.

Edward Soja (1940–2015) developed the theory of the “third spatiality” and “spaces of justice” and linked urbanism with post-Fordist dynamics.¹⁷⁰ Soja’s trilogy on urban studies began with *Postmodern Geographies* and continued with *Thirdspace*.

167. H. Lefebvre, *The production of space* (Blackwell, Oxford, UK & Cambridge, USA, 1974).

168. S. Zukin, *Loft Living: Culture and Capital in Urban Change* (Baltimore: Johns Hopkins University Press, 1982).

169. Zukin, *Naked City: The Death and Life of Authentic Urban Places* (Oxford, New York: Oxford University Press, 2010).

170. E. Soja, *Postmetropolis: Critical Studies of Cities and Regions* (Oxford: Blackwell Publishers Ltd., 2000).

It was the first comprehensive text in the growing field of critical urban studies to deal with the dramatically restructured megacities. They emerged worldwide in the second half of the 20th century.

There is no city in Latvia with a population of one million. In the global context, Latvia is characterized by small and medium-sized cities. They have a different scale compared to the megacities studied by Classical and foundational authors, and also completely different development problems. Honorary Doctor of the Latvian Academy of Sciences, Professor Ivars Strautmanis wrote: The Latvian people have long been characterized by an organic closeness to nature, which is manifested in spiritual rituals and folklore, as well as in building forms and the degree of transformation of the surrounding environment. The historically formed architectural-spatial environment of urban and rural sites has assimilated local traditions and building culture in the process of its creation, and to this day, it has also preserved the efforts of previous generations to create architecture appropriate to local conditions, the study of which provides many interesting insights. And finally, every nation has a characteristic sense of scale and proportion, developed over many generations, lived in a certain spatial environment and socio-economic conditions. It has at all times influenced not only the form and nature of our concrete building activity, but also the relationships in space and time between the individual and the public, the particular and the general. In the modern perspective, regional architecture can be considered as being based on all aspects of the context, which has been created or originated in a specific environment and time, ensuring the uniqueness of the relevant spatial environment, or architecture that embodies the spatial uniqueness of its land in terms of development prospects. The main requirements are: the inclusion of traditions and all contextual moments; the adaptation of the world's progressive architectural experience in time and space; the realization of local material, technical and economic possibilities. In Latvia, the problem of the regional and national acquires special significance. Now it is important to recognize the real goals and opportunities to revive the urban and rural landscape features and relationships associated with local culture and traditions. For a democratic living space to be formed in Latvia as well, it is important to develop our own model of national regionality. Regional peculiarities and their development in the light of world architectural achievements would become the basis for further identification of individuality in all areas of life. All those objective factors that determine architecture's relationship with society, its development opportunities and tasks acquire special importance. Architecture, as the broadest field of human creativity, has at all times more or less objectively reflected the social structure, traditions, and material and technical capabilities of its land.¹⁷¹ This explains the methodology for selecting bibliographic sources that are related to Latvianness. The cities of Ainaži, Salacgrīva and Saulkrasti have an agricultural character, and the Latvian urban environment on the Vidzeme coast of the Gulf of Rīga is being developed according to the city scale.

Latvia re-declared its national sovereignty on 4 May 1990. In the renewed Republic of Latvia, environmental design traditions are rooted in the development of rural and urban housing. Cities developing along large rivers typically exhibit

171. I. Strautmanis, *Latviskā telpa /Latvian space/* (Rīga: RTU izdevniecība, 2011).

elongated planning structures that follow the contours of the riverbanks. The Latvian urban environment has evolved in harmony with nature, and urban space-making traditions founded in the first half of the 20th century have been continued. Planned recreational areas expanded, and the implementation of balanced growth principles became a significant topic of interest. The unique colors and beauty of Latvia's natural landscapes are its national treasure, while its cultural heritage contains information about many past processes. Territorial planning should focus on people and their living areas, ensuring access to employment, healthcare services, recreation, transportation, and utilities, while also promoting the rational use of natural resources. Architectural elements can create new autonomous spatial structures. Human beings, their homes, and living spaces should be prioritized in formulating a spatial plan for a visual image. Water bodies organically fit into residential areas. Commercial and public centers, ports, and warehouse areas are located near waterways. Increased attention has been paid to the nature protection and historical and cultural values. In the era of globalization, culture and art embody the identity of a numerically small nation. In developing projects, various territories should be preserved in cities to maintain industrial and cultural heritage alongside the local landscape, thereby creating a contemporary cultural environment. In seeking harmony, individuals highlight the most important places and natural elements in their living environment through artworks that meet aesthetic standards. Environmental transformations give rise to new ideas that reflect harmonious relationships between nature and people.

Latvia became a member of the European Union on 1 May 2004. On 25 May 2005, the European Commission adopted a declaration defining the primary goals and basic principles of sustainable development. No country can exist without its identity, which encompasses traditions, heritage, language, and environment, as well as the inner world of each individual and the country as a whole. Local identity is one of the essential prerequisites for sustainable development, which can be achieved by identifying, preserving, and restoring cultural heritage, natural elements and specific landscapes. Local-scale activities contribute to environmental, social and economic improvements. Studies of Latvian identity in the context of globalisation have become popular and relevant. Globalization encompasses and transforms everything—from the inner world of each person to the physical changes visible in the landscape, which contains natural and human elements and is constantly changing through natural processes and human activity. The landscape's identity is also evolving. The key aspect is self-realisation. It helps differentiate and prevent disappearance at both the individual and national levels. Two terms of identity are often conflated. Unity (*memete*) is the consistency of oneself over time; self (*ipseite*) is the distinction of oneself from others. Latin *identificare*, *identifico* means to identify, signifying the correlation of an object with oneself and the constant variability of the self, proving one's independent existence and separation from others. The second Latin term *identificus* means identity, the absolute correspondence or coincidence of two objects. The concept of identity is closely related to the definition of landscape, where a landscape is an objective reality, a part of the earth's surface, which is included in natural components and formations, as well as a combination of man-made elements. The idea of identity has a multidisciplinary, multidimensional structure, in which social and natural meanings of the landscape are closely interconnected with perception and the role of landscape in daily human activities. Politicians, historians,

geographers, architects, and landscape architects all employ the multidisciplinary concept of landscape identity, also influenced by the mutual relations between social and ethnic groups. Landscape identity refers to the distinctive characteristics and features that give a specific geographical area its unique appearance and significance, shaped by natural elements and human influences such as architecture, land use, and cultural practices. The cultural landscape, as the visible imprint of human activity on the natural terrain, reflects the community's cultural values, beliefs, and practices. Landscape identity encompasses the physical, cultural, social, and historical traits that give a particular landscape its unique character and importance to human interaction and perception. It is built through several interconnected components, each vital in forming the full image of a place. These include natural elements, which influence perception, human activities, historical landmarks, and architectural styles. Social interactions and community activities also contribute to the collective perception of an area. Understanding landscape identity is fundamental when exploring the relationship between humans and their environment.

The symbolic meaning of individual landscape elements is a component of landscape identity. It defines the identity of a particular place and significantly influences a person's visual and cognitive perceptions. An individual landscape element in landscape identity modeling fits into a specific landscape space. It, in turn, fits into the landscape type, region, and ultimately into the image of Latvia. The study of regional identity is not possible without historical and cultural research of a specific place, which coincides well with the stages of landscape identity assessment, where historical and cultural research explains the landscape structure, the existence and location of individual landscape elements and their groups, and reflects human relations with nature. Assessing historical structural elements of landscape identity involves a comprehensive study of the place's history—from the beginning of landscape formation, influenced by morphological and climatic factors, to the location of man-made elements—where changes in landscape structure and in individual elements result from human activity and mirror the country's political, social, and economic context. Landscape identity research relies on regional analyses of transformation processes and the impact of urbanisation on landscape identity. The development of Latvian landscape identity involves close interaction among natural, social, political, and emotional factors, which continuously shape the image of the Latvian landscape.

The term 'sense of place' refers to the emotional and symbolic bonds that individuals and communities form with specific locations, shaped by their experiences, memories, and cultural backgrounds. This multifaceted concept illustrates how unique characteristics, social interactions, and environmental elements contribute to a person's or community's identity and feelings towards a place, influencing cultural patterns and urban sustainability. Sense of place can vary markedly between individuals based on personal histories, cultural backgrounds, and social interactions within a locale. It highlights the deep emotional and cultural ties people have with their environments, and affects community identity and participation. Understanding this sense is vital for fostering sustainable practices and conserving cultural heritage in both urban and rural contexts. It encompasses subjective and emotional attachments to particular locations, influenced by physical features, cultural meanings, social interactions, and personal experiences. This concept is central in fields such as geography, environmental

psychology, and urban planning, helping to understand how people perceive and engage with their surroundings. Sense of place involves the feelings and memories associated with a location, fostering a sense of belonging and community identity. Unique aspects like traditions, festivals, and local arts contribute to it, shaping how communities express their identities. A strong sense can boost community involvement and support sustainable development, as people who feel connected are more likely to participate in local initiatives. Rapid urbanization and globalization can weaken this sense, leading to disconnection from local culture and heritage. This loss can impact community cohesion and identity. Understanding the sense of place enables urban planners to design spaces that resonate with communities, fostering pride and stewardship. It plays a vital role in heritage conservation by encouraging community ownership and involvement in safeguarding local history and identity. In urban environments, a robust sense of place can strengthen community engagement, promote sustainable growth, and increase civic participation. Promoting this sense helps address urban sustainability challenges by fostering pride in local surroundings and responsible stewardship. Conversely, its loss due to rapid urbanization or globalization results in diminished connection to local heritage. Heritage-led regeneration leverages the unique history and character of local places to revitalise communities and support the economy. Heritage-led regeneration focuses on using the unique history and character of local places to revitalize communities and boost the local economy. It involves targeted investments in restoring and reusing heritage assets, leading to broader economic and social benefits.

On 14 November 1991, Saulkrasti, formed from ancient fishing villages, attained city status. In 1993, the privatisation of collective farms began. The Skulte Port, taken over by the Saulkrasti municipality in 1997, began operating for export purposes. In 2007, the Saulkrasti bypass was built. Saulkrasti City,¹⁷² along with its surrounding rural territory, was reorganized into a municipality in 2009, and subsequently, the centre of Saulkrasti District was established. In 2010, the rural territory of Saulkrasti City was renamed Saulkrasti parish. Low-rise residential buildings in the east extend to the railway line and alternate with natural elements in a narrow strip parallel to the seacoast (Figure 28). Public buildings are located between Neibāde (Figure 26) in the northern part of the city, south of the Ķīšupe, and Pabaži in the southern part, on the right bank of the Pēterupe. Individual houses in Pabaži are located on the eastern side of the railway.

172. Today, the city borders are determined by the Zemitāns and Skulte railway lines, as well as the seacoast from Inčupe to Ķīšupe.



Figure 24. *The Sea and the White Sand Beach, Surrounded by Forest along the Coast of the Gulf of Rīga Near the City of Saulkrasti, 2020*¹⁷³

Figure 25. *The White Dune on the Bank of the Inčupe at its Mouth in Saulkrasti, 2017*¹⁷⁴



Figure 26. *The Ķīšupe River and the Church, Constructed in 1998 for the Catholic Parish in Neibāde, the Northern Part of Saulkrasti*¹⁷⁵

Figure 27. *Sculptor Ivars Drulle. Environmental Design Object ‘Listen to Nature’ in the Nature Design Park ‘The White Dune – Saulkrasti’*¹⁷⁶

The Nature Park ‘Piejūra’ and a Natura 2000 site, which includes the Nature Design Park ‘The White Dune – Saulkrasti’,¹⁷⁷ encompass wooded dunes, a natural river section and a wide beach (Figure 24) in Saulkrasti City. Sculptor Ivars Drulle designed environmental objects to promote closer observation, listening (Figure 27) and the understanding that many habitats and ecosystems, not only human ones, can be preserved. Local identity, history, ethnography, and a creative approach grounded in local traditions create favorable conditions for the sustainable continuity of residents. Saulkrasti City coexists with a protected natural site that regulates its residents’ activities within the urban environment. Creative and well-planned actions yield favourable results, confirming that a place’s identity can be decisive in many

173. Photo by Jānis Palulis.

174. Photo by Elīna Lieltīruma.

175. Photo by Ārne Arvīdsons.

176. Photo by Ārne Arvīdsons.

177. A project was developed in 2015 and 2016 to create a Nature Design Park ‘White Dune – Saulkrasti’, which encompasses the White Dune, a landmark of Saulkrasti, to mitigate risks to the preservation of natural values and ecosystems.

cases. A footbridge at the White Dune (Figure 25), opened on 7 December 2019, provides a 240-meter-long walkway. After a significant two-year reconstruction, Culture Club ‘Zvejniekciems’¹⁷⁸ was reopened in 2019.

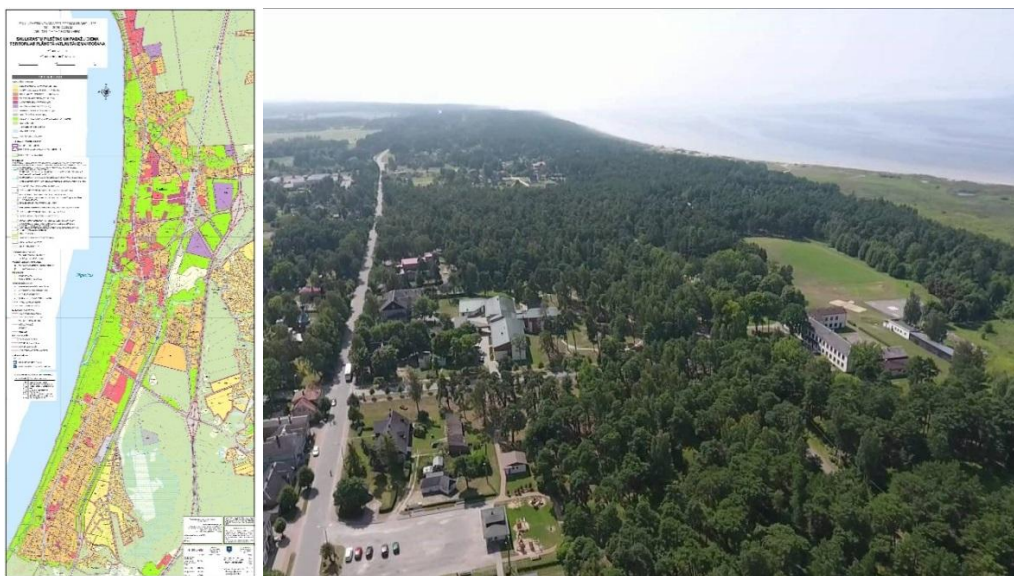


Figure 28. Head of Territorial Planning, Deputy Chairman of Saulkrasti Municipality Council, Normunds Līcis; Project Manager Māra Kalvāne; Spatial Planner Msc. soc. sc. Ilze Circene and Cartographer Jānis Skudra. Planned (permitted) Use of the Territory of Saulkrasti City from 2012 to 2024, as amended in 2016

Figure 29. View of the City of Ainaži on the Coast of the Gulf of Rīga, 2017¹⁷⁹

In 2021, the Saulkrasti and Sēja municipalities merged to form a larger Saulkrasti municipality as part of Latvia's territorial reform. In Saulkrasti, the Neibārde Park, surrounding the Open-Air Stage, has been improved. A monument to Karl Magnus von Reutern, the founder of Neubad Resort, has been restored near the Church of Divine Grace,¹⁸⁰ as well as near Saulkrasti Hospital, which was renamed ‘Saulkrasti Health and Social Care Center’ in 2021. Since 2021, after a significant reconstruction of the audience space and stage building, a variety of high-quality concerts and performances have been held at the Saulkrasti Open-Air Stage¹⁸¹ for 1948 spectators. The sea, wind and majestic pine forest peacefully coexist here with the architecture characteristic of a resort town, the leisurely daily rhythm and at the same time a saturated social life, inspiring, refreshing and enriching everyone who comes here. In 2023, the Neibārde Resort celebrated its 200th anniversary.

After Latvia regained its independence, a customs office and a wind turbine were built on the Estonian border in Ainaži. In 1994, two 600 kW wind turbines were placed near the border crossing point, marking the establishment of Latvia's

178. It accommodates the Vidzeme Seaside Music and Art School, the Youth Center, and the Amateur Art Collective of Saulkrasti, regularly hosting exhibitions, film screenings, and high-quality music concerts.

179. Ainaži, stored in the National Library of Latvia.

180. Latvian: *Dieva Žēlastības baznīca*.

181. Latvian: *Saulkrastu brīvdabas estrāde*; architects Zane Grava and Elita Kalniņa.

first large wind power plant. In 1990, the restoration of the Orthodox Church of Saint Arsenius the Great¹⁸² was initiated. Near the Estonian border in the former port town of Ainaži, the building that once housed the maritime school serves as the Museum of Ainaži Naval School,¹⁸³ dedicated to the history of shipbuilding traditions along the Vidzeme coast. Today, Ainaži,¹⁸⁴ which is the smallest town in Vidzeme (Figure 30), combines its heritage with modern appeal. This quiet town offers peace, rich history and a harmonious connection with nature, making it an unforgettable place for every visitor (Figure 29).

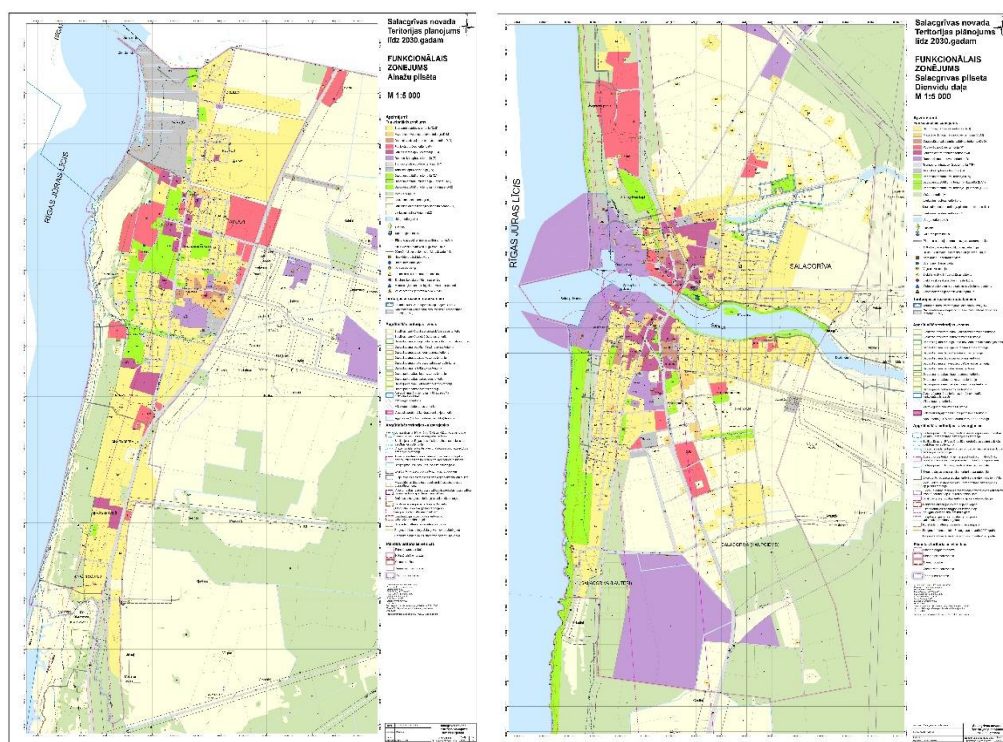


Figure 30. Spatial Planner Liene Some-Tiesnese; Planner Mg. oec. arch. Ilona Zeltiņa; Cartographer Ilona Zeltiņa, and Mg. oec. Edīte Ķemere. Functional zoning of the City of Ainaži until 2030, 2018¹⁸⁵

Figure 31. Spatial Planner Liene Some-Tiesnese; Planner Mg. oec. arch. Ilona Zeltiņa; Cartographer Ilona Zeltiņa, and Mg. oec. Edīte Ķemere. Functional zoning of the City of Salacgrīva until 2030, 2018¹⁸⁶

182. The Orthodox congregation regained its church in 1995. Ainaži also has a congregation of the Evangelical Lutheran Church. A Baptist congregation was established in 1991.

183. Latvian: *Ainažu Jūrskolas muzejs*.

184. In 2020, Ainaži had 655 inhabitants.

185. Salacgrīvas novada teritorijas plānojums līdz 2030. gadam. Salacgrīva: RP Alianse, 2018.

186. Salacgrīvas novada teritorijas plānojums līdz 2030. gadam. Salacgrīva: RP Alianse, 2018.



Figure 32. *View of the Port and the City of Salacgrīva, 2020*¹⁸⁷

Figure 33. *View of the Port of Salacgrīva at the Mouth of the Salaca River, 2020*¹⁸⁸

The Chairman of the Council, Dagnis Straubergs, admitted that the territorial planning, conducted by SIA RP Alianse, has been protracted. In the municipality's view, the document has shortcomings. It lacks several important aspects. Since the document will significantly impact the municipality's long-term development, it cannot be treated carelessly. The Salacgrīva Municipality Council decided to submit the 2018–2029 territorial plan for improvement in 2019. In the restored Republic of Latvia, municipalities must actively participate in regional planning and develop territory development strategies, as stipulated in the 'Local Government Law', which came into force on 1 January 2023, to address regional and balanced development issues effectively.

Over time, Salacgrīva has evolved from a fishing town into a port town (Figure 32), where ancient traditions are upheld. Nature is preserved, as the Salaca River is the only natural salmon spawning river on the Baltic Seacoast from the Neva to the Neman and Vistula. Green thinking has been ingrained in the inhabitants of this area since childhood. A new period in the development of Salacgrīva (Figure 31) began in the years following the restoration of independence. On 10 July 1997, the 200th anniversary of the Lielsalaca Evangelical Lutheran Church was celebrated. On 27 July 1997, His Eminence Archbishop Jānis Pujats consecrated the Church of Saint Mary Goretti for the Catholic Parish, designed by architect Dagnis Straubergs, the long-time chairman of the Salacgrīva Regional Council and the current Chairman of the Limbaži Regional Council. Māriņe Folkmane is the author of the mosaic dedicated to Saint Mary Goretti, while the artist Jānis Bārda created the cross and the image of Christ on the high altar. The year 1998 was particularly notable, as Salacgrīva was one of the first communities to unite with the neighbouring rural district of Salaca.

The Port of Salacgrīva (Figure 33) is unique in Latvia. Timber export, processing, food production, and trade remain of great importance in the modern economy of Salacgrīva. Even the historic lighthouse stands proudly on the Salaca coast next to the promenade leading to the yacht harbor. The Open-Air Stage¹⁸⁹ was rebuilt in Fishermen's Park. Now it facilitates a diverse range of events, ensuring residents have access to various high-quality cultural experiences in their locality.

187. <https://salacgrivaport.lv/lv/galerija/salacgriva>.

188. <https://salacgrivaport.lv/lv/galerija/salacgriva>.

189. Latvian: *Salacgrīvas Zvejnieku parka estrāde*.

The Fishermen's Festival takes place every year at the beginning of July alongside the Sea Festival, which has been celebrated since 2001. By rebuilding the stage, its façade was improved, and spectator seats were renovated. The interior of the stage has been enhanced with a sliding wall, and its use has been diversified – suitable dressing rooms for artists and groups have been created, and the space can be transformed into an exhibition hall or seminar room. In architecture, construction serves as a powerful means of expression, and when combined with the material used, it conveys heightened emotionality. The material has unique constructive possibilities and technological features. In an effective, constructive solution, it becomes more dynamic. A beautiful place for walking was created to protect the Salaca coast from erosion. The promenade in Salacgrīva was opened in May 2014, and in 2016, the 'Slavas aleja' /Alley of Fame/ was created. Every year, the alley is supplemented with new bronze handprints of artists. In 2021, the reconstruction of Bocmanis Square, Kalna and Krīperu Streets was completed on the right bank of the Salaca. The work was carried out by the local company NOBE. Currently, the city center consists of the yacht service building Bura, Yacht Square and the promenade. The area around the cultural center is also landscaped.

The current sixty-five-year-old bridge over the Salaca River has been completely demolished, and a new four-span reinforced concrete girder bridge with new supports and steel beams, according to the project of a limited liability company, 'Projekts 3', is being built in its place. On 12 November 2025, at 11 a.m., the new bridge over the Salaca River was ceremonially opened in Salacgrīva. The bridge over the Salaca River is located on the Rīga–Tallinn highway, which is part of the European transport network. The European highway route E67, or the Via Baltica section, provides local and international traffic.

Through the interaction of nature and human activity over the centuries, high-quality urban spaces have been formed in the regional cities of Latvia. This reflects the attitude of the population towards architecture, and a characteristic language has developed that embodies the essence of creative expression. During the restored Republic of Latvia, urban spaces of Salacgrīva, Ainaži and Saulkrasti have undergone significant changes. It has become Latvian. A garden has become an inseparable part of Latvian single-family low-rise residential houses, situated among water bodies and clusters of trees. They beautifully harmonized with the landscape and natural elements. The harmony between nature and the urban environment, which has become a rare luxury in the 21st century, reigns in the cities. The forest has entered the city in the most literal sense, giving its rhythm peace and harmony, and its residents and guests a sense of balance that is so lacking today. Sun, sea, wind, white sand, kilometers of long beach, air purified by pine trees – the city environment itself is as if created for a variety of forms of active recreation – long, peaceful walks, a simple run along the seashore, along forest paths and through dunes. For more than a century, historical stages and concert gardens have provided an extraordinary open-air concert experience. Today, visitors to open concert stages and seaside forest parks are delighted by music that sounds in perfect symbiosis with the scenography of natural light and the distant cries of seagulls. Well-maintained beach on the coast of the gulf is a real stage of the beauty and power of nature. Swimming culture on the coast of the Gulf of Rīga has a history of more than a

century, and it changes and develops according to the pace of life and habits of each time. The sun heats and cools, illuminates and shades the expanses of sand and water, playing out the most wonderful palette of colors in the evening. The winds change both the relief pattern in the white quartz sand and the temperament of the sea – from calm mirror water before sunset to fierce storms, from the mirror of ice in winter to the spring thaw, when the sea softens and throws its ice mask onto the shore. One of the most striking characteristics of the coastal cities of the Gulf of Rīga is wooden architecture. Already in the 19th century, wood was chosen for the construction of residences. The special aesthetics of wood have embodied motifs characteristic of their time. Today, new architectural objects built in the manner of functionalism also tend to join the tradition of wooden summer cottage architecture. Nature, architecture and artistic design form the modern urban landscape. The importance of natural landscapes has grown in urban spaces, while the richness of colors and diversity of architectural forms convey a semantic message. The interaction of spatial forms within living spaces leads to an increasingly complex environment.¹⁹⁰

Results

This study aims to analyze the evolution of the urban environment in the Latvian cities of Salacgrīva, Ainaži and Saulkrasti, to preserve their identity. Geographical conditions and nature determine common features of linear urban planning along the sea and the Rīga–Tallinn highway. The main result is the analysis of common and distinctive artistic and functional features of Latvian cities on the eastern shore of the Gulf of Rīga. Traffic from Rīga to Estonia was diverted along the newly built section of the Rīga–Tallinn highway on the eastern side of Ainaži (Figure 30), a former major port and naval school center in a four-kilometer-long strip between the seashore and the Rīga–Pernau route, and its section became Krišjānis Valdemārs Street, the main thoroughfare of Ainaži city. The Haynasch Manor House is located at 43 Krišjānis Valdemārs Street. Next to it, at 45 Krišjānis Valdemārs Street, the two-story wooden building of Captain Veide was built. The city has a relatively regular street layout. The three main streets are Krišjānis Valdemārs, Brīvības and Krišjānis Barons Streets. They surround a small central square, where the municipal and other institutions are located. The functional solution of urban space is laconic.

Salacgrīva (Figure 31), as a port and fishing center has developed on both sides of the Rīga–Pernau route on both banks of the Salaca River. Every part of the city has various functional and artistic features. On the right bank, where a versatile fish product processor ‘Brīvais Vilnis’ that delivers fish with innovative technology and a guarantee of taste safety is located, Bocmanis Square has developed as a city center, offering various public objects. The right bank of the Salaca, with many romantic places, is now landscaped. The left bank, where the Salacgrīva County Council is located, is functionally different. Here, large areas are designated for the construction of private houses.

190. I. Strautmanis, and B. Artmanis, *Telpa, kas sākas ar mums* /A space that begins with us/ (Rīga: Liesma), 25-27.

Saulkrasti (Figure 28) is mainly developing as a seaside recreation area. The Inčupe flows north behind the foreshore, while the Pēterupe and Ķīšupe flow south, in the direction of coastal sand drifts. The city of Saulkrasti, within its current borders, was formed gradually, combining several settlements on the banks of the Inčupe, Pēterupe and Ķīšupe. Neibārde, founded in 1823 on the land of the Bīriņi Manor, developed mainly as a bathing place for the North Vidzeme nobility with luxurious summer houses. In 1935, Neibārde was merged with Pēterupe village. This expanded recreation area, which stretched for three kilometers between the railway and the sea, was called Saulkrasti. In 1950, Pabaži was added to Saulkrasti. The Skulte fishing village along the dune road was formed in the 19th century, but the port of Skulte at the mouth of the Aģe River was established in the late 1930s. In 1967, Zvejniekciems was added to Saulkrasti, where the center of the collective farm 'Zvejnieks' had been established with multi-storey residential buildings, public buildings and a school. In the 1970s, Saulkrasti was the largest town-village in Latvia, with convenient rail connections to Rīga. Every part of this city has its own functional and artistic features because Saulkrasti consists of several parts, separated by forest belts and small rivers in the valleys – Aģe, Ķīšupe, Pēterupe and Inčupe.

Conclusions

Territorial development is a cyclical process, and the factors that drove growth in a particular period may not have the same influence in later stages of the city's evolution in Latvia. The international situation (such as the spread of Christianity, wars, and other events) was one of the significant factors that influenced, hindered, or altered the development of the urban environment. The city's status (as an administrative centre, port city, or key transport hub) heavily influenced the trajectory of urban growth at both local and international levels over a specific period, facilitating communication links. The initiatives of enterprising individuals to introduce the latest achievements also played a crucial role in the growth of cities along the eastern coast of the Gulf of Rīga.

Bishop Albert and the Knights began constructing financially and economically independent multifunctional stone castles, initiating profound territorial changes. They built a fortification on the elevated right bank of the Salaca River to control the strategically significant waterway. German merchants and craftsmen's houses adjacent to the castle formed the settlement, known as *Vicus Salis*. The Swedes acquired Vidzeme, and Salaca Castle became the administrative center at the Baltic Coastal Road, where it crossed the river. The Port of Salaca was used for the transport of goods by boat. After the Great Northern War, the southern coast of the Gulf of Rīga became part of the Russian Empire. *Vicus Salis* developed in response to the growth of coastal shipping and became an important transshipment point for further transporting of timber, flax and grain. *Vicus Salis* started to evolve into a town. Around 1870, Salismünde started developing on the territories of the estates. The Port of Salismünde emerged as a key trading hub in Northern Vidzeme. At the start of the 20th century, the construction of the railway in Vidzeme caused a decrease in the flow of goods to Salismünde. In 1917, the nearby front caused damage. Salismünde was

repeatedly shelled, and the merchant fleet was destroyed. In independent Latvia, the fishing center Salacgrīva began to flourish. On 7 February 1928, Salacgrīva was granted city status. During the USSR period, the fishermen's collective farm 'Brīvais Vilnis' was established, and a fish cannery, public buildings and residential houses were built. The population grew. Significant changes occurred in the economic life of Salacgrīva. This led to the port's renovation. Construction of the bridge was completed in 1961. After Latvia regained its independence, economic interests are aligned with the ecological requirements of the region and sustainable development. Now, the bridge over the Salaca River provides international traffic on the European highway route E67. A new period in the development of Salacgrīva began.

An ancient Liv fishing village Āinast developed along the Baltic Coastal Road. Later, the settlement, known in German writings as Dorf Haynisch, developed on both sides of this road. Haynasch Manor was founded. The strategic coastal location of Haynasch made it an ideal place for shipbuilding. The enterprising residents began building ships, which led to the development of the first sailing vessels and a demand for captains. The first Latvian Naval School was established. Haynasch flourished and gained town status in 1869. By the end of the 19th century, Haynasch, with a large port built from 1900 to 1905, ranked second only to Rīga. In 1902, the railway station was opened. At the start of the 20th century, most products were transported to the newly established Haynasch Port, which was connected to the hinterland by a narrow-gauge railway. Haynasch became an active trading hub. The railway line, connecting the Port of Haynasch and the station in Wolmar and continuing to Smiltē, was inaugurated in 1912. By the onset of World War I, Haynasch was the fourth-largest port in what is now Latvia and the leading port in Vidzeme. After World War I, Ainaži came under Latvian control. In 1920, Ainaži was approved as an independent municipality, and in 1923, the port's restoration began. On 7 July 1926, Ainaži was granted city rights. Due to the onset of the economic crisis, port activity slowed down. Work carried out in the 1920s and 1930s to revitalize the Port of Ainaži was partially successful. During World War II, Soviet dive bombers attacked Ainaži in 1944. While retreating, the German army destroyed the port infrastructure. During Soviet times, the Port of Ainaži was partially restored, but it began to lose its economic importance. The city never experienced prosperity. Today, Ainaži is the smallest town in Vidzeme. This quiet town offers its heritage and a harmonious connection with nature.

In the former territory of Metsepole County, the Swedes established the Pēterupe Lutheran parish and in 1641, they constructed the first church building in the Pēterupe village, where, at the beginning of the Polish-Swedish War (1600–1629), only three fishermen's houses remained on the seashore. In the Koltzen Estate, established south of the Kļīšupe after the Livonian War on the site of the Liv village of *Koldselle*, a new manor house in the Swedish Baroque style was constructed along with several outbuildings. At the beginning of the 19th century, the owners of Koltzen and other manors began to show interest in seaside recreation. A new bathing place for nobility, known as Neubad, was opened in 1823. In the Pēterupe village, where the wooden building of the Evangelical Lutheran Church was built in 1777, the owner of Koltzen Manor constructed the fourth building of the Pēterupe Church in 1856. The seashore along the Pēterupe village and at Skulte developed into a key shipbuilding site from 1857 to 1913. Pēterupe and Kuiviži became two centers of Latvian sailboat

construction. Fishermen created a settlement near Neubad. August Friedrich Woldemar acquired Neubad to develop a new resort. In 1898, the lands of the former Liv fishing village of Pabasile were divided into summer cottage development plots, creating a resort called Badeort Catharinenbad or Pabbasch Seaside. In 1907, the passenger steamer 'Neubad' began daily traffic from Rīga to Neubad Resort. With direct connections to Rīga, the popularity of the Neubad bathing spot greatly increased. Various service institutions were established in Pēterupe and Neubad. The subsequent hostilities, with the front nearby in 1917, caused damage and marked the end of Neubad Resort. During the period of independent Latvia, a densely populated area, Neibāde, was designated in 1925. In 1933, Neibāde and Pēterupe were united under the new name Saulkraste. On 21 March, the two small fishing villages of Pēterupe and Neibāde merged and received a new name – *Saulkrasti*. In the 1930s, after the division of building plots in the territory of the former manor, Skulte became a larger settlement. It was granted the status of a densely populated area (village) in 1933. In 1934, a railway bridge across the Gauja was opened, and on 15 September 1934, the railway line reached Saulkrasti and Limbaži. On 1 October 1934, a railway station was established. The continuation of the line to Rūjiena was opened on 4 December 1937. After the opening of the Rīga–Rūjiena railway line, the Pabaži railway station was built in Saulkrasti. The Saulkrasti railway station was constructed between Neibāde and Pēterupe. Railway traffic rapidly promoted the development of Saulkrasti as a summer resort. On 26 July 1936, the fishermen's organizations of Skulte parish united in a cooperative, 'Jūras zivs'. The ceremonial opening of the Skulte Port took place on 7 October 1939. The Soviet occupation authorities nationalized the properties of the Skulte fishing community. A fish production plant 'Zvejnieks', uniting approximately 800 fishing farms, was established in 1948. Thanks to its port, the collective farm quickly became one of the wealthiest in Latvia. The port's location and the cannery determined the choice of the mouth of the Aģe River, leading to the establishment of the Soviet settlement Zvejniekciems. Fishermen's dwellings began to be moved from the wide coastal strip to the newly established collective farm village next to the Aģe Port, which was rebuilt in 1951. In the renewed Republic of Latvia, Saulkrasti, formed from ancient fishing villages, attained city status on 14 November 1991. Saulkrasti is one of the cities in Latvia where everyone can not only observe the very current entry of contemporary art into public space, but also breathe the sea air and enjoy the aromatherapy of a pine forest – a large part of the urban space is made up of forest, and the beach is hidden behind dunes covered in conifers. Sunsets in Saulkrasti cannot be imagined. They can only be experienced. Watching them has already acquired the character of a ritual. There are rarely two identical sunsets, and they have no equivalent in magnificence. Each has its own unique colour palette for foreplay, afterplay, and play of light in its cloud shapes – from smooth, flowing watercolour transitions to the shape of a flaming, surreal 'fireship' that can be seen now and then on the horizon of the bay. In 1993, the privatisation of collective farms began. The Skulte Port, taken over by the Saulkrasti municipality in 1997, began operating for export purposes. In 2007, the Saulkrasti bypass was built. Over time, the functional division of the territory became apparent in the urban environment, affecting infrastructure development, spatial organisation, and city planning. As the city expands, the economic and efficient use of territory

becomes increasingly important. Therefore, the urban development plan must be devised by professional specialists who can evaluate past urban development processes and, considering local characteristics, identify future opportunities for urban growth. After the liquidation of the Rīga District in 2009, Saulkrasti City became the center of Saulkrasti Municipality. In 2021, the Saulkrasti and Sēja municipalities merged to form a larger Saulkrasti Municipality as part of Latvia's territorial reform.

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