

Preservation of Local Architectural Heritage in Slovenian Istria Against Coastal Flooding

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Abstract. This article examines the problem of preserving the local architectural heritage of the town of Piran against of flooding. It presents an overview of the materials and techniques used in traditional construction in Piran and in the Sečovlje salt pans as well as it constitutes a review of the state of the flooding situation in these two places. The gap between what is done on the ground and the needs of the place have their source in the poor management of such emergency situations and the possible erroneous choice of techniques and materials used for the restauration of the infrastructure or buildings. The main conclusion is that, beyond crisis management, flood risks need to be considered in a holistic way, respecting the ancient knowledge or techniques and materials of construction, and including different stakeholders in order to better anticipate, organize and preserve the local and architectural heritage for future generations.

Introduction

Piran, also known as the pearl of Slovenia, is a municipality and town in the extreme south of the country situated in the Slovenian coastal region of Istria. This ancient city lies on a narrow peninsula bordered by the Adriatic Sea, Croatia and Italy. Thanks to its historical past, the medieval town of Piran boasts a rich nautical, architectural, cultural, historical, linguistic, gastronomic and natural heritage. The list is long but not exhaustive: Venetian and Gothic-inspired buildings, ancient Greek, Roman and Byzantine remains, medieval ramparts and paintings by famous artists such as Carpaccio and Tintoretto. Piran benefits also of an extraordinary linguistic diversity ranging from Greek and Latin to Istro-Venetian, Italian and Slovenian language, as well as a Mediterranean gastronomy enriched by the salt from the Piran salt pans in Sečovlje, now national heritage site and natural park.

Over the centuries, this town in Slovenian Istria has always been exposed to and influenced by many people thanks to its strategic position. Istria was populated as far back as the Stone Age. The first fortified hills were built in the middle of the 2nd century B.C. The first civilization to live there was the Histres, mentioned as far back as the 5th century B.C. The Romans attacked the Histres around the 3rd century B.C., conquering them definitively around 178-177 B.C. Then came the Goths, Byzantines and Longobards, followed by the Franks in 788 [1]. The first Slavs probably appeared in the 7th century. In the mid-ninth century, Istria was annexed to the Holy Roman Empire and came under Italian rule. After 1209, Istria became a margrave of the Patriarch of Aquileia, and finally, in 1283, Piran was the last independent town in Istria to come under the rule of the Republic of Venice, although Istrian towns periodically came under the influence of Venice as early as 970 [2]. With the Serenissima, Piran began to flourish. It was during this period, marked by the intense exploitation of local production as a survival strategy¹, that Piran salt pans were first mentioned.

¹The Serenissima became interested in exploiting local resources when sea routes became dangerous, or even inaccessible, due to the presence of pirates [3].

With the fall of the Republic of Venice in 1797, the Venetian territories, including Piran and Istria, passed to Austria. In 1806, French troops occupied Venetian Istria. As a result, it became part of the Illyrian provinces from 1809 to 1813. In 1814, the region came under Habsburg control and remained so until the end of the First World War in 1918, when it was annexed to Italy. After the Second World War, the region was part of Zone B of the Free Territory of Trieste for a few years. In 1954, it became part of the former Yugoslavia, and in 1991, when Slovenia gained its independence, Piran officially became a municipality and city of the Republic of Slovenia [2].

This paper aims to present the traditional building materials used in the coastal city of Piran and its Sečovlje salt pans and wishes to show that these construction materials and methods play a crucial role in helping to prevent natural risks, especially flood damage.

The first part of the article explains that the traditional stone architecture found in Piran, as well as in the rest of the Mediterranean, is considered local heritage and is renowned for its durability and resistance to earthquakes, weather (floods, waves, strong winds), sea air and humidity. This is due to the characteristics of the stone used, as well as the choice of traditional building techniques employed. The second part of the article is an overview of the flooding situation in Piran and its salt pans, while the conclusion suggests some possible solutions to better anticipate, organize and preserve the local architectural heritage.

Materials and techniques

The building materials used in Piran came mostly from Piran and its inland territory (Fizine and Kanegra quarries, Karst plateau), but also from the quarries of Pazin and Aquileia or other places. However, as the researcher Tommasini [4] explains, the finest stones, such as those from the Rovigno quarry, which were white and red, were not used locally but were taken to the factories in Venice. However, Piran (but also Koper), could boast two or three kilns for tiles, flagstones, bricks and lime.

The choice of location and building materials did indeed reflect the economic power of the owner. Thus, the best houses were those around the harbour² and in Piazza Vecchia [6]. Wealthy families, nobles and the clergy could afford more prestigious, expensive and resistant materials to build their sumptuous residences, such as white stone³, mortar, rendering, marble, lime and sand⁴, brick and wood. Modest families, on the other hand, built smaller, simpler homes. They used cheap or free⁵ mixed materials and dry-stone construction. The outer walls of their dwellings were thicker, while the inner walls were thinner and plastered with wooden [4].

Piran adopted mostly a vertical urbanism of individual houses, separated from each other by narrow cobbled streets. These dwellings covered a small area, but were multi-storey and housed a single family.

Rather than fighting nature, the ancient "Piranesi" lived in harmony with it, using the omnipresent natural elements to their advantage: sea, water, wind and sun. Thus, the first floors, which in the autumn months and with heavy rains risked being flooded, were never inhabited. With its own cool, damp microclimate, this part of the house was used as a storehouse for water, barrels of wine, oil, fruit, vegetables, fishing nets and animals (chickens, donkeys). An internal

² Piran's harbour, which corresponds to today's Tartini Square, was covered in 1894 for hygiene reasons [5]. Researcher Apollonio [6] points out that in the 19th century, the architectural appearance of the town of Piran was different. The most striking detail is undoubtedly the absence of the shoreline and the sea that bathes the houses.

³ White stone from Pazin was softer than the one from Kanegra and therefore less waterproof. For this reason, it was appreciated and used for decorative elements on buildings. Kanegra's white stone was harder, and as water penetrates it only slightly, it was used in the construction of buildings.

⁴ Sand was purchased in a centre at the mouth of the Soča, while the quicklime used to coat walls was bought from local concrete producers [7].

⁵ The author explains that the "modest" houses of Piran used the stones they took from the surrounding land to build their homes.

(and rarely external) staircase in wood or stone led to the warmer upper floors, where the living quarters were located: kitchen and bedrooms. Most houses also had an "altane" or terrace, ideal for drying corn and laundry. The roof was usually two-sloped or low-pitched, covered with curved tiles and rarely with stone shingles [8]. In winter, when they needed warmth, families slept in the bedrooms upstairs, while in summer, in the cool of the first floor.

It wasn't just the choice of building materials that enabled Piran's inhabitants to live in harmony with the elements of water, wind, sea air and sun, but also the architectural construction of the town itself.

Indeed, the narrow cobbled lanes inside the city of Piran, similar to those in Venice, were built in the shape of a turtle shell, so that water and dirt could drain away into the side sections. Similarly, these city's sloping lanes and numerous gateways allowed warm air to circulate and rise to the top, creating draughts, shade and coolness. Today, you can still admire this heritage, revealing the traces of the past, and walk through the labyrinth of small, winding streets, hidden between Piran's beautiful buildings.

The Piran salt pans are also an example of local architectural heritage designed to withstand the challenges of nature and the elements.

In the past, Piran's economy was based on fishing, maritime trade, agriculture and, above all, salt. Salt, also known as white gold, was highly prized and, in the days of the Venetian Republic, was the currency par excellence. Although Cumin [9] believes that the activity of salt harvesting was already present in the territory of Istria in prehistoric times, other documents lead us to believe that the beginning of the history of the Istrian salt pans was around the year 543 [10], when they were mentioned in an ecclesiastical document. However, the researcher Nicolich [11] believes that they existed already in the 6th or 7th centuries.

In any case, the first document attesting to the presence and activity of the Piran salt pans is the Statute of Piran dating from 1274 [12]. The Piran salt pans were built following the example and know-how of the Pag salt pans, and the municipality of Piran had 3 sites or salt pans: those in the Sečovlje Valley, those in Strunjan and those in Fasano-Santa Lucia, which no longer exist today. Near Piran, salt was also harvested in the Isola, Koper, Trieste and Muggia salt pans [3].

According to research by Professor Nicolich [11], Piran had 1,200 crystallization basins by the time the town politically entered the sphere of economic interests of the Venetian Republic. Around 1574, Piran had 2,680 basins: 327 basins in the Fasano-Santa Lucia salt pans, 167 in the Strunjan salt pans and 2,186 basins in the Sečovlje Valley salt pans [13].

During the years 1945-1954 the displacement of a large part of the indigenous population took with it the knowledge, know-how and experience of the salt production and other professions. This is important because of the loss of knowledge about salt production, the tradition of seasonal work, the seasonal migration and living in the salt pans.

The years '54-'60 of the twentieth century were marked by the destruction of dwellings in the salt works and the abandonment of salt production activity, not only due to the post-war political situation, but also because of the lack of manpower and the large-scale tourism development planned for the region, particularly in Portorose. It was only with Slovenia's independence that the municipality of Piran began to take a greater interest in protecting the salt pans as a cultural heritage and characteristic feature of Slovenian Istria. In addition to being recognized as a protected nature reserve in 1989, the Sečovlje peninsula and its salt pans have also been a cultural, ethnographic and technical monument since 2001 [3].

Situated next to the basins and along the navigable channels in order to be functional and easily accessible by boats, the typical salt pans dwellings or "salari"⁶ were built using traditional Istrian

⁶ These temporary dwellings were also present in the salt pans of Strunjan, Fasano-Santa Lucia, Koper and Muggia, but to a limited extent. Indeed, because of the proximity of the town, the workforce did not need to itch during the

materials. These included grey stone or sandstone, known as the least expensive, Kanegra limestone, which was the most resistant, and Pazin limestone, also known as white stone or Istrian stone, which was the most beautiful but porous and therefore not very resistant to the destructive action of the sea air [7].

The structure of these dwellings was made entirely of stone, often without plaster, and built on a floating base frame of wooden⁷ planks laid on a compact soil of limestone sand and clay. Load-bearing walls were either made of grey stone or square blocks of limestone (white stone). Exterior walls were plastered with lime, but never painted to prevent the sea air from destroying the layer of colour.

In the salt pans, many dwellings were built with mixed materials. In this case, the lower part was built of limestone and white stone, while the upper part was made of grey stone [7].

The last part of the structure ended with fir-wood transverse joists, which were fixed at the ends by metal⁸ beam brackets and embedded in the load-bearing wall. The roof was pitched and covered with curved tiles. The rooms were divided by thin plastered wooden walls that reached only as far as the rafters. There was no attic, and small windows with solid shutters, facing at least two different directions, enabled to observe weather changes and shelter salt in good time [14].

Two materials were used to build and consolidate the paths and dikes lining the basins: limestone sand and clay. They were laid in three vertical layers, with the outer two always made of sand and the middle one of beaten clay, which ensured that the construction was watertight. Naturally, the channels and dikes, as well as the silt, water and impurities in the basins, had to be cleaned regularly.

Each “salario” consisted of an upper living area and a storage area on the first floor. Some “salario” had an adjoining external storage area. The ground-floor warehouse used to store salt and tools had two doors. The door that opened onto the basins adjacent to the “salario” was also the one through which salt was brought into the warehouse, while the door that opened onto the canal was the one through which salt was loaded into the boats that docked along the channels.

Some dwellings, probably the oldest, had an external stone staircase. In the rest of the dwellings, an internal wooden staircase linked the first floor to the second floor, where the kitchen and one or two bedrooms were located [14].

“Salario” being temporary dwellings, they were inhabited by the families renting the basins during the period from late April/May to late September/early October. The heads of the families waited until the end of winter to leave for the salt pans to clean and repair the dwellings, depots, connecting channels, paths adjacent to the basins, dikes and evaporation basins that had suffered damage from the sea air and bad weather [7].

Despite the importance and high activity of the salt pans in the past, today only four of the 440⁹ “salario” that existed in the first half of the 19th century bear witness to life in the salt pans in the Sečovlje Valley, having been restored and turned into a museum. Some of the ponds have also been restored, and salt production in Piran continues today. The restoration work at the salt pans has brought together a number of local players who have collaborated to bring this project, led by the maritime museum in Piran Pomorski muzej Sergej Mašera, to a successful conclusion.

season, as was the case in the Sečovlje Valley salt pans [9]. In the first half of the 19th century, there were 17 “salario” in the Strunjan salt pans and 35 in the one in Fasano-Santa Lucia [14].

⁷ The planks were arranged in a frame to distribute the load, and even if they were made of wood, they would not rot, as bacteria, deprived of oxygen, could not grow on them.

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⁹ In 1984, 118 “salario” were counted in the salt pans of the Sečovlje Valley. They were all abandoned, while some of them were well preserved, others less.

Indeed, in Piran, as in all coastal towns in this region, it has been essential to adapt the way of life to the surrounding nature and its elements: sea, water, wind and sun. In fact, it is not uncommon for high tides to cause coastal flooding in Piran. This happens almost regularly in October, November and December. According to various researchers [15; 16], flooding is the result of a combination of factors such as south wind and wave action, low atmospheric pressure, meteorological fronts and the orographic configuration of the Adriatic Sea, i.e. its land-locked northern part. Other authors also add the importance of the influence of the autumn full moon on tides and sea level rise [17].

When the high tide is accompanied by a strong southerly wind and heavy rain, the material damage is considerable. In this region, flooding due to high tide was first mentioned in 1343 in a document found in the archives of the town of Pirano [18]. To date, the highest sea level ever recorded reached 395 cm in 1969.

On the Slovenian coast, Piran is the town most at risk due to its position as it is the most exposed to high tides and southeast winds. As a result, many buildings that are part of the town's architectural and cultural heritage are located directly on the shore, facing the sea and the wind. During high tides, a large part of the old town, home to almost a fifth of the population, is flooded [16]. The areas that are most frequently flooded in Piran are those from Punta to Street Gregorčičeva ulica, the 1.maj Square, the Shoreline Prešernovo nabrežje, the Tartini Square, the Shoreline Cankarjevo nabrežje, a part of the Street Župančičeva ulica and partially the Street Dantejeva ulica and the stretch from Riviera beach to Fornače.

Like the town of Piran, the Sečovlje Valley and salt pans are also located in a high-risk zone. Covering an area of 650 hectares and rising above sea level, the Sečovlje salt pans are among the most threatened wetlands in the Mediterranean. During the autumn months and the annual floods, they are largely inundated. And in the event of extreme flooding, they risk being almost entirely underwater.

Other potential negative effects of rising sea levels include accelerated coastal erosion, the destruction of basins, saltwater intrusion into salaries and subsidence. For example, in October 1896, as a consequence of the difficult management of the Dragonja river's waters following the poor state of cultivated land and because of the deforestation in the upper reaches of the valley, the salt pans were destroyed by a flood that wreaked havoc with the private management of this important and ancient city trade [6].

Conclusion

For decades now, floods have been occurring at the same time, under the same weather conditions and causing the same damages. It is clear, therefore, that the damage caused by marine flooding can be prevented. To achieve this, a combined approach that integrates prevention, protection of architectural heritage, preservation and application of ancestral building materials and techniques, use of appropriate building materials and techniques and proper management of the emergency situations is required.

Firstly, it would be necessary to conscientiously monitor the meteorological situation (in particular wind direction and speed, but also atmospheric pressure), while comparing it with the predicted tidal height [15].

In the city of Piran, channels and manhole covers should be regularly cleaned to ensure that they are clean and that water can flow freely into the watercourses [19].

It might be convenient to install one way valves/systems in order to prevent sea water flowing through drain pipe lines in the opposite direction (from the sea to Piran town surfaces).

Similarly, when restoring streets and buildings, it is essential to keep traditional construction and ancient building materials (street pavers, sand, stone) and do not replace it with other (modern) materials, such as concrete, or other types of stone other than the local ones that are already in use. The second one are more expensive and do not meet the needs of the place.

In addition, it would be necessary to install flood barriers all along the shoreline. In the flood of October 27, 2023, new flood barriers were tested in Piran's harbour area. The objective to prevent flooding in Tartini Square and Street Ulica Svobode was achieved, but to the detriment of Street Župančičeva ulica, which was flooded more than it would have been without the barrier. In the same context, it would also be interesting to see the best practices of other coastal cities and countries. The city of Venice, for example, has invested in the installation of a "mose" floating dike system, which has proved to be effective.

It would also be very important for buildings in the old town, especially those classified as architectural and cultural heritage, to be properly maintained against humidity and sea air. In this case, collaboration between the owners of the buildings, the municipality, the National Institute for the Protection and Restoration of Piran's Natural and Cultural Heritage, architects and experts in the field, as well as the professionals who carry out the restoration work, is essential.

Finally, storeowners and property owners in flood-prone areas must continue to use flood barriers or flood bags. And more important, ground floors should no longer be converted into apartments, as this choice has consequences - the property will be flooded and destroyed by sea water and humidity.

In the Sečovlje salt pans is therefore essential not only to restore, rehabilitate, clean and maintain these salt pans which are classified as a national heritage site and nature reserve. Here, too, the collaboration of many stakeholders is essential, going from the Maritime Museum Pomorski muzej Sergej Mašera in Pirano and the National Institute for the Protection and Restoration of Natural and Cultural Heritage in Pirano, to architects, experts and schools.

Above all, children in schools and future generations need to be educated and made aware not to fight nature but to live with it, while respecting and protecting ancestral know-how and the architectural, cultural, historical, linguistic, gastronomic and natural heritage that surrounds them.

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