

## Article

# Industrial Heritage of Dubrovnik—Unaffirmed Potential of Gruž Bay

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**Abstract:** As a fortified medieval city, Dubrovnik was the centre of the Republic of Dubrovnik, one of the smallest states in the Mediterranean whose importance far surpassed its size. Just like in many other Croatian historic cities, its industrial heritage has remained in the shadow of the historic city, not properly acknowledged as an important segment of the city's history. This dichotomy inspired this research, whose focus was the cradle of industrial development—Gruž Bay. The research focused on archival sources, published and unpublished materials and a field study. The systematic integration of collected materials was upgraded with an analytical study, the valorisation, contextualisation and, finally, contemporary presentation. Gruž Bay was once an idyllic landscape with few Renaissance summer villas. The original matrix was overlaid with pre-industrial and industrial complexes: shipyards, a harbour, a railway, industrial and infrastructural complexes. At the turn of the 19th century, they were slowly gaining momentum, which was suddenly interrupted by nearby political turmoil, and ultimately a war. Since then, tourism has prevailed, and the industrial complexes have gradually become redundant. The affirmation of the value of the industrial heritage and its potential for reuse would contribute to the further development of this well-known UNESCO site.

**Keywords:** Dubrovnik; industrial and infrastructure complexes; turn of the 19th century; Gruž Bay; first phase of industrialisation; regeneration



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## 1. Introduction

Dubrovnik (Latin name Ragusium, Ragusaa) is a town on the eastern coast of the southern Adriatic Sea (Figure 1), whose medieval core is fortified and surrounded by walls. It held the legal status of a republic until the beginning of the 19th century, with a territory that roughly corresponds to the present-day borders of Dubrovnik-Neretva County. The importance of the city-state at that time greatly exceeded its size (Figure 1).

City life took place within the walls, and the two entrances to the city (eastern and western) were closed in the evening for the sake of the peace and safety of its inhabitants, while trade and seafaring, as the basic branches of the economy, knew no boundaries, reaching the very edges of the known world.

Once the Old Town could not accommodate everything the citizens needed, the city began to expand beyond the fortified area.

The Old Town Port was the first to become too narrow, and the shipyards next to it could not meet the new needs. The best natural conditions for the expansion were in Gruž Bay, and that is precisely where the new port and accompanying facilities first appeared. Logically, the construction of infrastructural buildings followed, first with roads, and then railways. Storage areas, oil processing facilities, a power plant, a tram line, all of this gave the town new contours, with Gruž Bay becoming the centre of Dubrovnik's economic activity.



**Figure 1.** Location of Dubrovnik (based on: [https://upload.wikimedia.org/wikipedia/commons/9/99/Europe\\_blank\\_map.png](https://upload.wikimedia.org/wikipedia/commons/9/99/Europe_blank_map.png), accessed on 11 August 2022, Wiki-vr, public domain, via Wikimedia Commons).

In the 19th century, residential construction took place in the west and east ends of the fortified town (Pile, Ploče), and the town expanded to the areas of Gruž and Lapad, reaching today's administrative borders. The narrowness of the space, due to the topographically conditioned situation of constriction between the hills and the sea, causes great pressure on every single possible location of new construction.

The Old Town, or as the locals simply call it, "town" (*grad*), is the name for the part of the city surrounded by walls. The unique well-preserved cultural and historical urban complex of Dubrovnik is protected as a cultural asset (label Z-3818) by decision of the Ministry of Culture and Media of the Republic of Croatia, as well as UNESCO.

It has been an inspiration and research area for many authors from various professions, and a rich bibliography on Dubrovnik exists.

The postulates of construction, design and relationship to the environment that led to the realisation of such a work were not re-determined later on, and other parts of the city, built later, have always remained somewhat in the shadow of such a unique form and its world-recognised value.

### *1.1. Specific Issues of the Industrial Heritage*

In such a context, industrial and infrastructure buildings in particular remain in the shadow of the exceptional historical core and natural environment. Dubrovnik never developed into a strong industrial city, and most of these buildings have disappeared, while the few that remain are the target of entrepreneurial appetites, mainly due to their location in the wider centre of today's Dubrovnik and the possibility of generating large profits.

Even the few objects that could have been kept as, for example, valuable spatial landmarks, identity features, markings of a historical period, architectural approach, etc., and were protected as such, have been demolished.

Therefore, the focus of research is the recording and valorisation of industrial and infrastructure facilities in the period from the turn of the 19th to the 20th century. By determining their current condition and their importance, as well as their potential for conversion, a spatial framework which meets the needs of citizens, and also preserves those valuable objects of industrial heritage, could be found, thus contributing to the memory of the city's developmental continuity.

### *1.2. Dalmatia Historic Overview*

Dalmatia is a geographical and historical region in southern Croatia, which stretches along about 400 km of the eastern coast of the Adriatic Sea. It covers the territory of four counties (coastal segment of Zadar County, Šibenik-Knin County, Split-Dalmatia County and Dubrovnik-Neretva County).

The history of Dalmatia can be continuously traced from the 4th century BC, when Ancient Greeks founded their colonies on the Dalmatian coast, surrounded by the local Illyrian population. Only a century later, Ancient Romans began their conquest of Dalmatia and their subjugation of the Illyrian tribes. The Roman era ended with the arrival of the Avars and Slavs in the 6th century AD. After moving into Dalmatia, Croats, being the strongest Slavic tribe, founded their principality, and in the 10th century Prince Tomislav became the first Croatian king. The Croatian ruling dynasty disappeared in the 11th century, while Dalmatia, as part of the Kingdom of Croatia, succumbed to the rule of the Hungarian Arpadović dynasty. In the 15th century, most of Dalmatia was ruled by the Venetian Republic, while the Ottoman conquests in the 16th century resulted in the annexation of Dalmatian hinterland to the Ottoman Empire. After Napoleon's conquests, Dalmatia, together with Dubrovnik and the Bay of Kotor, came under the rule of the Habsburgs. In 1918, Dalmatia became part of the Kingdom of Serbs, Croats and Slovenes (later to become the Kingdom of Yugoslavia and SFR Yugoslavia). Since 1991, Dalmatia has been a part of independent Croatia, which became a member of the European Union in 2013.

### *1.3. Dubrovnik Historic Overview*

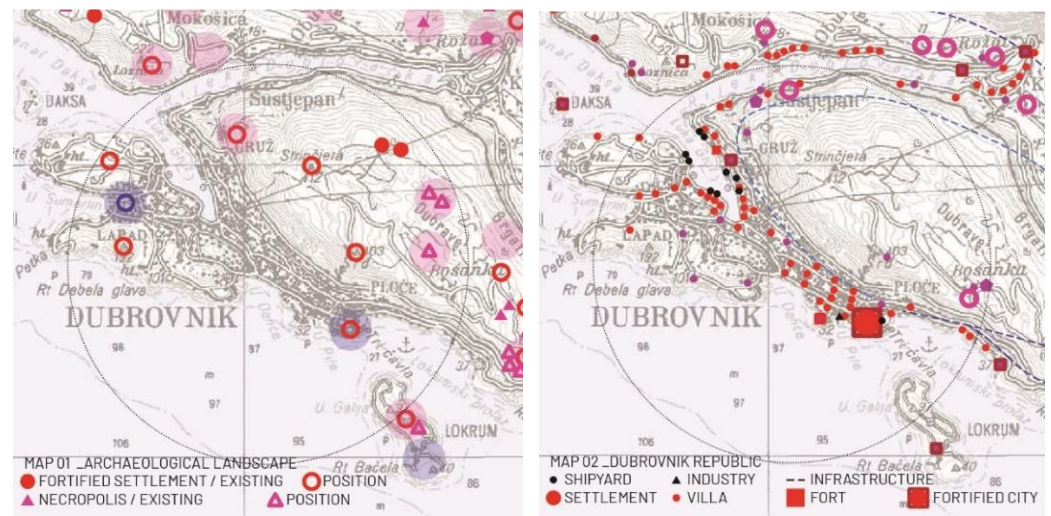
Dubrovnik's history is conditioned by its geographical and geopolitical position on the coast of Adriatic, on the border between the Mediterranean and the Balkan hinterland, between opposing civilizational powers.

The singularity of the Dubrovnik Republic—a city-republic—was reflected in the diplomatic skill in preserving freedom and independence. It balanced between great political interests and the Ottoman and Christian worlds around it, and gained political protection and economic concessions from both sides. The modest size of the territory of the Republic was completely disproportionate to its strategic importance which made it possible for the Republic to preserve its special and recognisable social, economic, cultural and political identity for six hundred years [1] (p. 15).

Initially, the introduction follows the Byzantine period from 537 to 1205. Under the Byzantine rule and protection, after Byzantine emperor Justinian exiled the Eastern Goths from Dalmatia, the Dubrovnik area functioned as a commune and represented the Byzantine stronghold on the Adriatic. It was a time of rivalry over important seaways and trade between two great states—Byzantium and Venice. The Venetian period lasted from 1205–1358. It marks the period of the Venetian rule, when the City (Old City of Dubrovnik) was a developed commune with self-government and the Duke appointed by Venice. In 1358, the City obtained the protection of the Hungarian–Croatian State and became a part of the Kingdom of Dalmatia and Croatia [2]. Dubrovnik was guaranteed independence, border inviolability, trade freedom and neutrality in case of war. At its peak (15th–16th century), Dubrovnik was among the most developed countries of the then-world thanks to the core activities (seafaring and trade) of what was first a commune and later an organised and independent aristocratic state—the Dubrovnik Republic. Types of buildings from the ancient time compared to those built during the “golden age of the Republic” are presented



in Figure 2, emphasizing the continuity of development from fortified settlements to villas and first industrial buildings.



**Figure 2.** Key objects and their distribution, from antique (left) to the 18th century (right) (adapted from: [1]) map 2.2.

From 1337, Dubrovnik started minting its money in its own mint (Sponza). At the time, the City had a large granary (Rupe) and the arsenal in the old harbour. From 1377, several wooden lazarettos (pesthouses) were built on the nearby islands (Mrkan, Bobara, Supetar). Finally, in the 16th century a stone lazaretto complex was built outside the old city, which is nowadays the only fully preserved quarantine complex on the European side of the Mediterranean (Figure 3).



**Figure 3.** Well-preserved lazarettos outside the Old City of Dubrovnik (photograph by Zrinka Barišić Marenić, 2022).



The streets of the City were cobbled. The building of a sewer system and, more importantly, the building of a public water system from 1436–1438 were proof of the City's advanced communal infrastructure. All of this reflected the high standard of this organised community [3] (p. 26). At the time of organised life and building in this area, when the discipline aimed at public good was exercised, there was a developed sense of space as an expendable good which should be taken care of. This resulted in controlled management of the territory, in complete harmony with nature. Such a rational attitude towards space, reflected in the laws, rules and regulations, enabled a high level of organisation [1] (p. 24).

Dubrovnik flourished in the era of the Ottoman invasion. At the beginning of the 15th century, the Republic was a respected naval and mercantile power, so it gained the exclusive right of trade with countries ruled by Islamic rulers [4]. That is how Dubrovnik became one of the most important intermediaries in the trade between the East and the West. The Republic followed the development of its merchant fleet and established more than 20 consulates in the 15th century (50 in the second part of the 16th century), mostly in the ports on the Apennine Peninsula and on Sicily. In Dubrovnik itself, many workshops for the manufacturing and colouring of textiles were opened, and textile manufacturing, goldsmithery, masonry, carpentry and many other crafts were developed. Its economic power was developed thanks to its traditional, long-standing activities: the monopoly on the trade of salt from Ston saltworks with the nearby Balkan countries and the maritime and mercantile expansion, as well as its intermediary role in the overseas trade of minerals (mainly silver) from Bosnia and Serbia. This money was used to buy Catalan wool, which helped develop the previously mentioned textile manufacturing. All of this contributed so that the Dubrovnik Republic had (in 1500) the per capita GDP of USD 900—20% higher than the one in Switzerland and 25% higher than those in England and France [3] (p. 28).

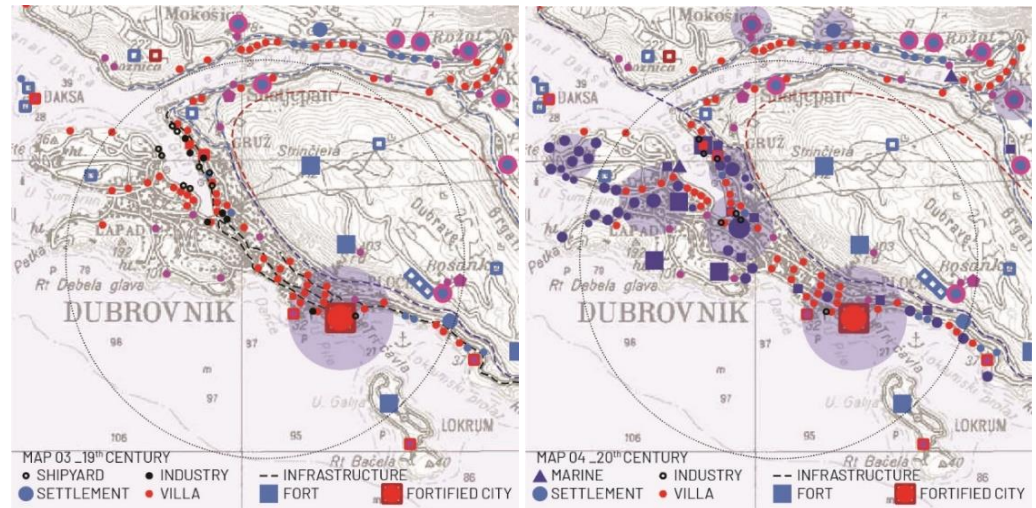
In its state and legal framework, Dubrovnik managed to preserve its full political independence up to Napoleon's invasion at the beginning of the 19th century. The Dubrovnik Republic ceased to exist in 1808, and the seafaring of Dubrovnik also began to see its decline. By the decisions of the 1815 Congress of Vienna, the territory of the former Dubrovnik Republic was given to the Habsburg Monarchy. It remained a part of the Monarchy until 1918, after which it was made part of other states. It is now part of the Republic of Croatia. In 1867, after Austria made a deal with Hungary, the Habsburg Monarchy was transformed into the Austro-Hungarian Monarchy (1867–1918). After that, the Dubrovnik area became part of the Kingdom of Yugoslavia (which then became the Kingdom of Serbs, Croats and Slovenes). After World War II, it became a part of the Socialist Federal Republic of Yugoslavia, and from 1991 (after the beginning of the Homeland War) to date it is part of the Republic of Croatia.

The first decades of the 19th century under the Austrian administration were riddled by penury, poverty, illnesses and earthquakes. Economic stabilisation began sometime in the mid-19th century and, thanks to trade and seafaring, the City slowly started to develop again. Intensity of development is graphically shown in Figure 4.

#### 1.4. Objective

The objective of this article was to research the period of initial industrialisation in Dubrovnik, as well as evidencing existing buildings, their condition and their purpose. In addition, the aim is to direct attention towards the systematically unexplored and overlooked technical heritage of the Bay of Gruž, the cradle of industry in Dubrovnik. By showcasing the potential of such complexes and the importance of this neglected technical heritage, the intense degradation of Gruž's utilitarian architecture could be stopped.

The aim was to detect and evaluate what is left of industrial and infrastructural buildings and propose a model to preserve the valuable ones, by using their potential for reuse while accommodating the citizens' needs—as a global city's concept, not only partial interventions.



**Figure 4.** The 19th and 20th century Dubrovnik with many industrial and infrastructural objects complementing and overlapping older layers (author: Ivana Tutek, graphic layout: Bernarda Lukač, according to data in [3] (p. 42)).

### 1.5. Questions

- What of the systematically non-researched industrial heritage exists today; in what condition is it; is it being used for its original (primary) purpose or a new (secondary) purpose; is it abandoned; is it under protection?
- Are there any buildings (dating from the period that is the focus of this study) that are valuable and worth preserving and (re)using?
- Could this still be achieved, in view of their conditions?
- What would be the best approach, i.e., the best model to conceive that?

### 1.6. Hypothesis

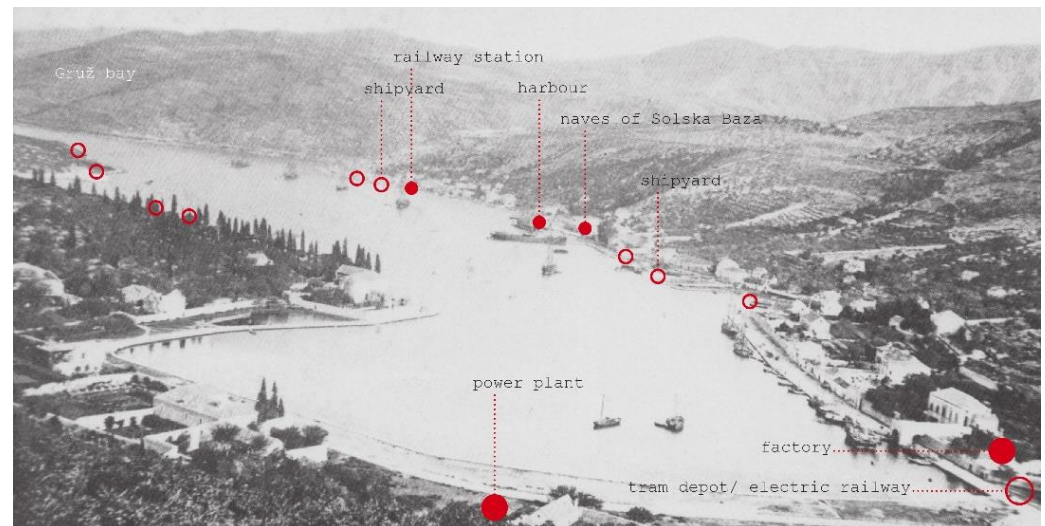
In a city with so many historical layers, one layer was not thoroughly researched and well documented since the beginning of the 19th century. At least a few buildings or building complexes (in terms of industrial heritage) deserve to be identified and acknowledged as representational objects of that period and typology, in order to carry the important role of preserving that memory, as a contribution to the city's continuous development.

It is assumed that this segment of heritage has been left unexplored and is without systematic valorisation, and that industrial heritage has been left to decay, while not being adequately used in accordance with its potential. It is necessary to conduct systematic research that would contribute to preservation and reuse. Abandoned buildings must be reutilised, because only use prevents their devastation.

### 1.7. Materials and Methods

This research contributes to the research of Croatian industrial heritage and its presentation to the international scientific community. Since Rijeka is the cradle of industrial development in Croatia and its heritage has been thoroughly explored, this paper aims to focus on the far southeastern corner of Croatia.

The area considered is a part of Dubrovnik that hosted the industrial development—Gruž (at the time mostly known by the name *Gravosa*) Bay. Going through the archival sources, published and unpublished materials, urbanistic plans and finally adding a field study, led to research, systematisation and analysis of the dispersed materials. Figure 5 shows the disposition of the buildings, solid dots pointing to the locations of those that are still here, circles indicating positions of those that no longer exist.



**Figure 5.** Industrial heritage within the harbour in Gruž Bay at the beginning of the 19th century (panorama of the harbour at the beginning of the 19th century (DUM PM 1760 Maritime Museum Dubrovnik) graphic intervention: Ivana Tutek, Bernarda Lukač).

Probably overshadowed by numerous layers of history inscribed into the old part of town, most of the 19th and 20th century buildings were not considered as valuable and worth preserving. Among them, the industrial buildings attracted the least attention and were almost never considered as valuable in terms of “heritage”, thus worth preserving.

Along with the references already mentioned, the paper uses other references relevant to industrial heritage in Dubrovnik from the period researched.

Given that the topic of industrial heritage in the Bay of Gruž was not researched or analysed in scientific literature, this study was focused on primary sources—archival funds. It was upgraded by field research and integrated with segments of published and unpublished sources focusing on the period at the turn of the 19th century. Furthermore, an ongoing and unpublished doctoral thesis focusing on architectural heritage of tobacco stations in Dalmatia, conducted by PhD student Ivan Vukojević at the Faculty of Architecture, University of Zagreb, will yield and present new results within a year. The PhD research focuses on the region of Dalmatia, but a section of the paper will include a tobacco station in Dubrovnik.

Contemporary photographs of Dubrovnik and its architectural and urban heritage in this paper are a product of the authors’ research, focusing on a layer of heritage not previously systematically researched.

Maps of Dubrovnik present historical layers of its heritage throughout history, with a focus on the cradle of industrial development—the Bay of Gruž.

Contextualisation of Dubrovnik’s industrial heritage at the turn of the 19th century is presented within a Croatian example, the referential Adriatic city of Venice, and the most significant industrial heritage sites in western Europe, as concisely as possible for the frame of one scientific article.



### 1.8. Plan for the Future Research

- Research of the architecture of production facilities of the pre-industrial period in Dubrovnik.
- Research of the reuses of manufacturing and infrastructural pre-industrial buildings.
- Research of industrial buildings of the 20th century.
- Research of the reuses of industrial heritage of the 20th century.
- Research of the wider Dubrovnik area with a focus of industrial and pre-industrial complexes.
- Affirmation of the industrial heritage of Dubrovnik and the surrounding region.

## 2. Gruž

Gruž was the oldest part of Dubrovnik situated outside of the city walls, developed in the 9th century but probably even earlier. It occupied the area from the western part of the city walls all the way to Lapad and Kantafig [5] (p. 55). The space was much bigger than the urban centre within the city walls, but it was sparsely populated. A village in Gruž was mentioned in the 13th century, and in 1440 Filip de Diversis described Gruž as “a vast and safe port decorated by vineyards, magnificent palaces and beautiful gardens around it” [6]. From the 15th century, it was where the nobles started to build their summer villas “a complex of buildings with terraces, gardens and water” [7] (p. 7). Green slopes overlooking the sea, neat *giardini* gardens and *orsani* boat houses were the main components of a carefully designed residential space, a space with country houses and farms in harmony with the environment. As their name suggests, summer villas were residences with a country house and a farm in which the nobles spent time in the summer months, outside of the densely populated Old City. They spent time in the country, overseeing the harvest. The Dubrovnik countryside architecture—a set of summer villas in Gruž Bay and Rijeka Dubrovačka to the west—is a specific part of the Croatian building heritage. This idyllic landscape intertwined with villas can also be seen in Gruž Bay prior to industrialisation, as shown in Figure 6.



**Figure 6.** View of the harbour in Gruž Bay at the beginning of the 19th century, with summer villas and their gardens on both sides of the bay [8].

In the words of the prominent art historian Milan Prelog: “In our devastated land, it is difficult to find a collection of monuments which gives us more right to utter the words ‘cultural heritage’ with so much pride than the collection of Dubrovnik summer villas” [9].

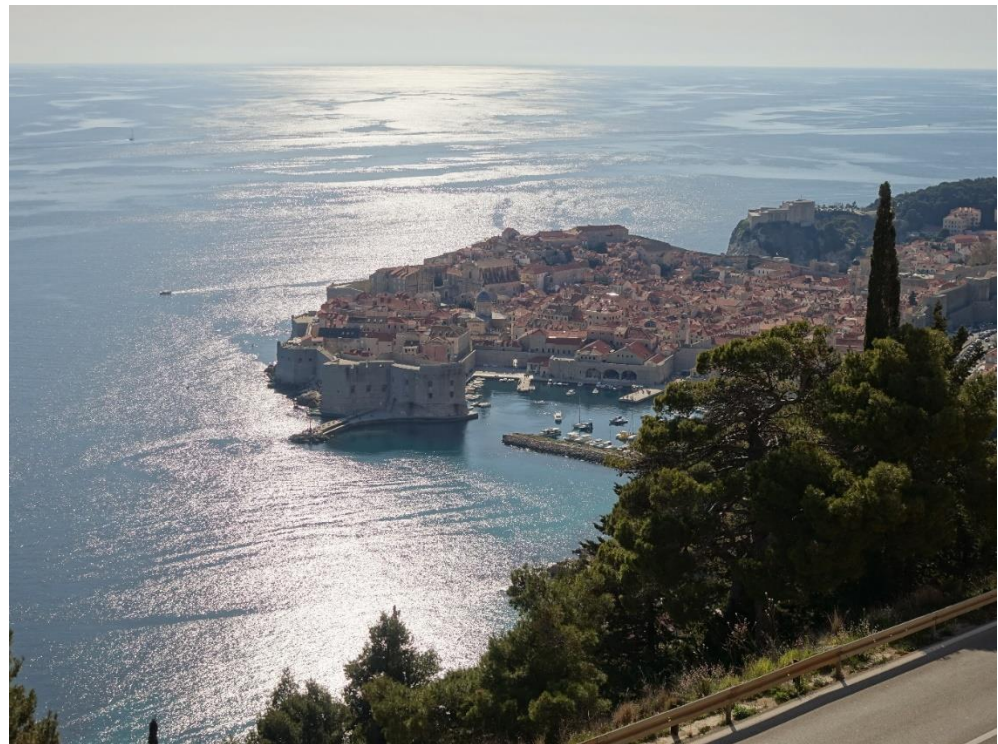
### 2.1. Gruž Bay

Gruž Bay is a geographically suitable place for a harbour (Figure 7). Safeguarded from the winds, it has long served as a natural storm refuge for ships (there are many different ships to be seen in Figure 6, nowadays large cruiser ships are often seen in the harbour, Figure 7).



**Figure 7.** Panorama of the Gruž harbour (photograph by Roberta Pavlović, 2007).

The fortified and well-secured harbour in the Old City (Figure 8) had long been the primary harbour for all purposes due to the fact that the then-Republic could not ensure the same level of safety in Gruž Bay. However, the first ship was built in Gruž as early as in mid-14th century (1342), and after that the shipbuilding in that bay developed significantly.



**Figure 8.** Old City of Dubrovnik, UNESCO World Heritage Site with harbour in front (photograph by Zrinka Barišić Marenčić, 2022).

The Dubrovnik ships (built in Gruž) were widely praised because they were well built and sturdy. In addition, they had good equipment and maritime ability. Therefore, the type of ship used for transporting valuable cargo was named *argosy* (=“from Dubrovnik”) by the English [10] (p. 178). In the 14th and 15th century, the Dubrovnik merchant navy was at its peak. It reached its peak in the 16th century. Intensified building of merchant and war fleets meant that the shipyard in the Old City had become too small, which is why the shipyard on Cape Kantafig, in Gruž Bay, was built.

## 2.2. Shipyards

In 1525, the Senate reached the decision to create a public shipyard on municipal land on the northern side of Gruž Bay [11] (p. 117). Although there were several other, smaller private shipyards named after the last names of their owners, this one was the largest and the most functional shipyard.

The new public shipyard, built with beautifully carved stones, was 40 *sežanj* long (*sežanj* = cca 2 m) and 20 *sežanj* wide, out of which 8 *sežanj* were on land and 12 stretched into the sea. Fresh water was also found there, which prompted the building of two stone wells. An extension was added to the stone bungalow on the shore, for use by shipbuilders. This is where shipowners would stay while their ships were being built to carefully oversee the construction [11] (p. 118).

The large shipyard on Kantafig used to be called *Stari škar* (“Old Shipyard”). This is where the first long-distance sailboat was built in 1817. In mid-19th century, *Novi škar* (“New Shipyard”) was also built on the site of today’s Gruž Park. At the time, this was a bay with a wide platform for sailboat construction and repair. It was fenced by a semicircular wall, along which buildings for depositing shipbuilding tools and wood for ships were built [11] (p. 130). The new shipyard can be seen in photographs [11] (p. 121), as well as on the cadastral map of Gruž [12] (p. 119) and the map by M. Skurić made in 1811 [11] (p. 125). In 1869, the Dubrovnik Maritime Association (Associazione Marittima di Ragusa) was founded, and it made *Novi škar* (“New Shipyard”) its own shipyard. During the 19th century, there were eight other, smaller shipyards. In 1811, architect and painter



Lorenzo Vitelleschi came to the Dubrovnik area as the district engineer. In his notes on the Dubrovnik district, made in 1827, he gives information on the Gruž shipyards, where the road is interrupted by shipyards “where new ships are constantly being made”. He describes the sturdy merchant ships as ships with a “beautiful shape and sailing well, although they have always built them based on their experience, without the shipbuilding expertise” [13] (p. 127). The wood used to be purchased in Albania and Istria [13] (p. 129).

At the beginning of the 19th century, Gruž was badly hit in the battles of the Russian and Montenegrin army with the French troops taking place in the Dubrovnik area. The shipyards and many ships located there were burnt down. After the war, trade was disrupted, seafaring slowed down, crafts regressed (the main crafts at the time were the manufacturing of cloth and woollen blankets as well as leather tanning) and agriculture intensified [14] (p. 129). However, in 1818, a new *pulaka* (Mediterranean three-sail sailboat) called *Gruž* was plunged into the sea [10] (p. 179).

The stagnation of the construction of wooden ships caused by the rise of steamboats, which dominated in maritime traffic, slowly closed the Gruž shipyards. Gruž Bay then entered a new era with its harbour. Where the now-closed shipyards had once been, a wharf was built. As early as in the 19th century, it was an important merchant and passenger harbour (Figure 9).



**Figure 9.** Warships in Gruž Bay 1880 (DUM PM 1654, Maritime Museum Dubrovnik).

### 2.3. Lazarettos

Squeezed between the hills and the sea, Dubrovnik relied heavily on well-established communication with its hinterland. The border between the Dubrovnik Republic and its hinterland was also the border between the area in which epidemiological measures were fervently implemented and the area where there were no anti-plague measures in place and where local authorities mainly relied on the Dubrovnik measures. It was very important to be well informed, so they established a network of notifications of the onset of infectious diseases via consules, tax collectors and captains, but priests, merchants, courriers, soldiers and watchmen contributed to it, too. A quick reaction to the news on the plague protected the inhabitants but also the trade of the Republic. The supervision of ships, passengers and goods were carried out by the Health Office founded in 1390 with the aim of protection

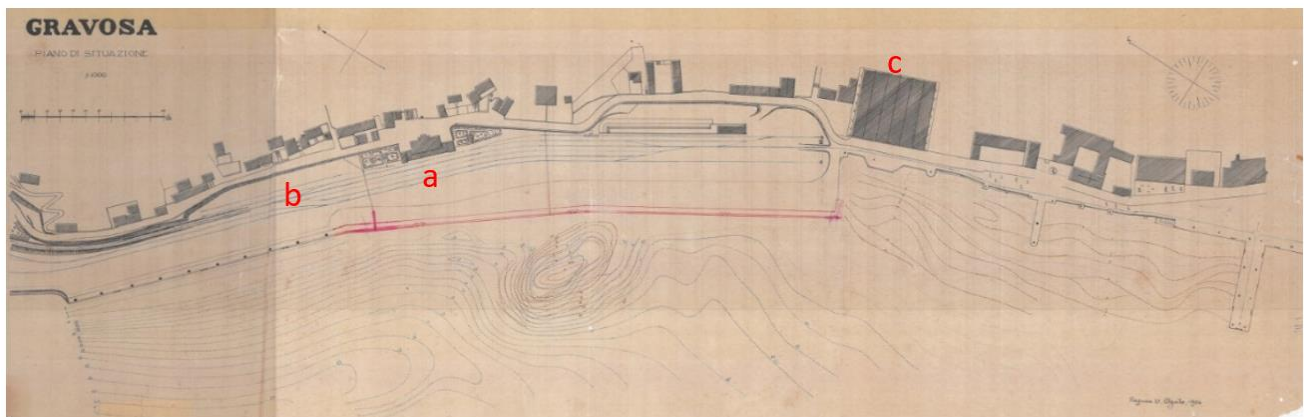
from the spread of the epidemics in the Dubrovnik area [14,15] (p. 85). Prompted by frequent epidemics in the 14th century, the Grand Council of Dubrovnik issued a directive on quarantine in 1377 [16] (p. 182). It was decided that anyone coming from the infected areas may not enter Dubrovnik or its territory before spending 30 days isolating on the island of Mrkan or in Cavtat. These 30 days (*trentina* in Italian) were later extended to 40 days, which is where the term “quarantine” comes from (*quaranta*, 40 in Italian). Such a means of protection, i.e., the imposition of a quarantine to fight against the plague in the Mediterranean, was first started and established by Dubrovnik (96 years before Venice). In the context of today’s pandemic, it just goes to show how innovative and progressive it was. This very measure is currently being used around the globe. The first quarantines were located on the islands of Mrkan, Bobara, Supetar and in Cavtat, later in Danče. In 1647, a complex of lazarettos in Ploče replaced all the previous ones [16] (p. 182) (Figure 3). The Dubrovnik concept of quarantine was a hybrid between the total disruption of the movement of people and goods in western Europe and the partial movement regardless of the plague in the Ottoman Empire [14]. It carefully maintained the delicate balance between protection and profit. At the beginning of the 19th century, on the southwest side of Gruž Bay, in the part closest to the then-sparsely populated Lapad Peninsula, a maritime lazaretto was planned so that the bay could receive ships from infected areas. However, because of the high costs of the purchase of the existing building and its necessary adaptation to serve the intended purpose (a warehouse on the ground floor, a room for quarantine and for the sick above), the project came to a halt and a new, better project was never realised because of its high costs [14] (p. 163).

#### 2.4. Narrow-Gauge Railway

In 1901, in a period of major development, the military and strategic interests of the Austro-Hungarian Monarchy greatly prompted the construction of the narrow-gauge railway. Long-time efforts of the Dubrovnik region to connect with its hinterland had long been obstructed by the political situation and the overlapping interests of various states and empires, as well as by the financial difficulties that had to be overcome before the launch of such a demanding project.

As the second town on the eastern Adriatic Sea coast with a railway line (after Rijeka), Dubrovnik became the port of entry and exit for the wider Balkan hinterland. The reactions were contradictory; there was enthusiasm, resignation but also resistance to the destruction of the idyllic beauty of the bay [8]. However, the expected result was the rise of goods and passenger traffic in the harbour [17] (p. 27). The Gruž harbour soon became the fifth harbour based on the tonnage of the ships, wood from Bosnia was its greatest export and tourist visits from inland started taking place at the beginning of the 20th century [18] (p. 63, 300).

Figure 10 shows the tracks along the coastline, cargo area and freight tracks located further west and warehouse *Solska baza* east of the station building (shown in Figure 11).



**Figure 10.** Situation plan (1906), position of the railway station (a), the tracks (b) and all six naves of *Solska baza* (c) in relation to Gruž (HR-DADU 21/1, with the permission of State Archives in Dubrovnik).

The Gabela-Zelenika narrow-gauge railway was 155.5 km long, with the Uskoplje-Gruž branch line, which was 16.6 km long [18] (p. 53). Its characteristics were those of a mountain railway, with a minimum radius of 70 m and a track transition curve of a minimum of 300 m. Its maximum speed was 20 km/h. Uskoplje is located 350 m above sea level and Gruž stretches almost to the coast itself, 1.9 m above sea level, with a slope of 28 per mill [18] (p. 42). With all the buildings in the harbour, the railway enabled direct transshipment of cargo between carriages and ships. From 1910, there was a starting point of the tram line, which further distributed the local passenger traffic.

Next to the terminal building, there were five tracks (for reception and departure of trains, manipulative tracks, tracks for loading and unloading of cargo, for providing the locomotives with fuel and water) and there was one industrial track which led to Batahovina [18] (p. 55). Next to the terminal building, there was also a water cistern, built in cement-lime mortar with a stone-vaulted ceiling. Residential buildings were built along the tracks for railway personnel and their families. Railway post offices were built next to the stations. Gruž Railway Station was later renamed Dubrovnik Railway Station.

By closing the railway line in 1976, the activity in the Gruž harbour slowed down and Dubrovnik isolated itself towards the inland. The harbour warehouses and railway buildings were all abandoned or demolished, or they slowly changed their purpose. The focus of the harbour became passengers and tourists, after centuries of seafaring, in the 19th century Dubrovnik became known for tourism [19] (p. 8), just like today (the operational part of the coast has been widened a few times to make it suitable even for the largest cruisers).





**Figure 11.** Arrival of the first train in Gruž, 1901 (DUM PM 1767, Maritime Museum Dubrovnik).

#### 2.5. Coal Warehouse of the Austro-Hungarian Navy (Now Called *Solska Baza*)

At some time around 1880, on the northern coast of Gruž Bay, a warehouse was built for storage of coal intended for the steamboats of the Austro-Hungarian Navy. Initially, the warehouse had six parallel naves perpendicular to the seafront. Every nave had a double-sloping roof, so when seen from the sea the western façade formed a rhythmical series of stone gable façades, as seen in Figure 12.

The structural system is determined by seven parallel stone walls, 55 m long and with a span of 10.7 m, as well as by a wooden roof construction of every nave. During the 1920s the roofs and a part of the gable walls were removed from the southern part of the second and fifth nave to create courtyards [20].

In 1940, because of road tracing (“Customs Route”), the fifth and the sixth nave in the west were knocked down. After World War II, the complex served as a salt warehouse [20]. This is why the complex is still colloquially called *Solska baza* (“Salt Base”). What remains today are four eastern bays, marked by a stone façade with properly carved squares, the central entrance with a semicircular archway and a circular window over it (Figure 13).

All round contours of the openings are accentuated by bricks. The double-sloping roofs have mission tile (*kupa kanalica*) roofing. In the warm Mediterranean climate, there is no snow; therefore, the gutters of roofs between the bays are on load-bearing walls, and the stone gutters along the main southern façade rhythmically articulate the structure of the building when seen from the sea, from the Gruž harbour. Something similar to the rhythmical series of the salt warehouse can also be found on the longitudinal gable façades of the salt warehouse in Pag, on the island of Pag located in the northern Adriatic.



**Figure 12.** Gruž harbour at the beginning of the 19th century with the view of naves of *Solska baza* (DUM PM 1748, Maritime Museum, Dubrovnik).



**Figure 13.** The current state of the naves of *Solska baza*—view from the west (photograph by Zrinka Barišić Marenić, 2022).

Today, the warehouse is home to various activities (a car repair shop, a brewery and a pub—Dubrovnik Beer Company—a nightclub, a bakery, etc. (Figures 14 and 15)), and although the complex is partially truncated, it has the same authentic character of the original 19th century Gruž harbour activities thanks to the clear rhythmicity of the stone gable façades (Figure 13).



**Figure 14.** The current state of the northern nave of *Solska baza*—view of the car repair shop and Dubrovnik Beer Company (photograph by Zrinka Barišić Marenčić, 2022).

From 1954–1955, the garage of the company Luka and the warehouse in Dubrovnik were annexed.

## 2.6. Power Plant in Batala

Jaruga, the first Croatian hydropower plant, was built in 1895 in the Šibenik back-country, at Skradinski buk on the Krka River (nowadays National Park Krka). It served for the production and distribution of alternating current, as patented by the inventor Nikola Tesla, who was born in Croatia. It was opened just two days after the opening of a similar hydroplant in Niagara Falls, also realised according to the Tesla patent.

An offer for electrification of Dubrovnik goes back to 1897. Electrical lighting was introduced in Dubrovnik in 1898, and it substituted the kerosene lanterns used for public lighting [21] (p. 552), [22] (p. 77), [23]. The newly opened Secession Imperial Hotel in Dubrovnik was lit by electricity in 1897. Therefore, the electrification of Dubrovnik is directly connected with the beginning of tourism, and it was revolutionary even before the opening of the power plant. Based on the contract between the Dubrovnik Municipal Administration and Gesellschaft für Elektrische Industrie ELIN, the Austrian company obtained the monopoly—an exclusive, 45-year concession to public and private electrical lighting, as well as to the commercial use of electricity and the right to build a tram line [23].





**Figure 15.** The current interior of the western nave of *Solska baza*—Dubrovnik Beer Company (photograph by Zrinka Barišić Marenić, 2022).

Electrical Central Institute in Gruž was built in Batala, in the southern part, at the end of Gruž Bay [23]. The agreement was signed on 2 September 1898, the building permit was issued on 18 June 1900 and the certificate of occupancy on 1 July 1901. The mechanical designs date back to 23 March 1900. On 1 June 1901, the operating permit was issued (engineer Eduard Pik), which was approved by a surveyor and a doctor. It was stated that no public interests were threatened, and the interested parties did not say anything. The construction lasted from 1 July 1900 to 15 May 1901. On the seafront, there was a longitudinal two-storey stone house with a rhythmical series of windows and a shallow double-sloping roof (Figure 16). Large boiler rooms and engine rooms were located at the back of the southern part of the main building, along the coast. The engine rooms had generators and turbines, which were initially steam-powered (3000 V steam engines) and oil-powered.

Up to 1905, the power plant operated only at night, but the increase in the use of electricity resulted in its opening during the day too [21] (p. 552). The workshops for servicing the southern plant were located on the ground floor of the main building, whereas the flats of the employees (the stoker, the plant manager, the machinist) were located on the second floor. The southern vertical of the chimney was an indicator of the infrastructure of Gruž. The power plant was a cause of complaints by both the municipality and the citizens, who claimed that the energy it provided was not strong enough and that there was not enough of it. They also claimed that it was charged excessively. In 1927, ELIN gradually gave its rights to *Nederlandische Maatschappij voor elektrische Industrie* from Amsterdam [23].

The extension of the engine room of the Dubrovnik power plant in Gruž (Elektrizitätswerk Gravosa der Gesellschaft für Elektrische Industrie in Wien) was carried out in 1912, when the southeastern plant annexe was added and a new diesel engine installed. Union-Baugesellschaft is signed as the contractor on the designs [25]. After the 1918 fire, a re-building of the burnt-down southeastern part of the Gruž power plant was initiated. A bilingual letter to the German and Croatian Dubrovnik Municipal Administration is sent by the Dubrovnik—Gruž Power Plant, Elektrizitätswerk in Gravosa, der Gesellschaft für Elektrische Industrie in Wien; Ragusa—Gravosa. Plan der Rekonstruktion und Erweiterung des Elektrizitätswerk in Gravosa (Kesselhaus und Maschinenhaus, Erweiterungsbau des Maschinensraumes 64,000 m<sup>2</sup> cca) [25].



**Figure 16.** A postcard from the beginning of the 19th century showing power plant with chimney (From the book [24]).

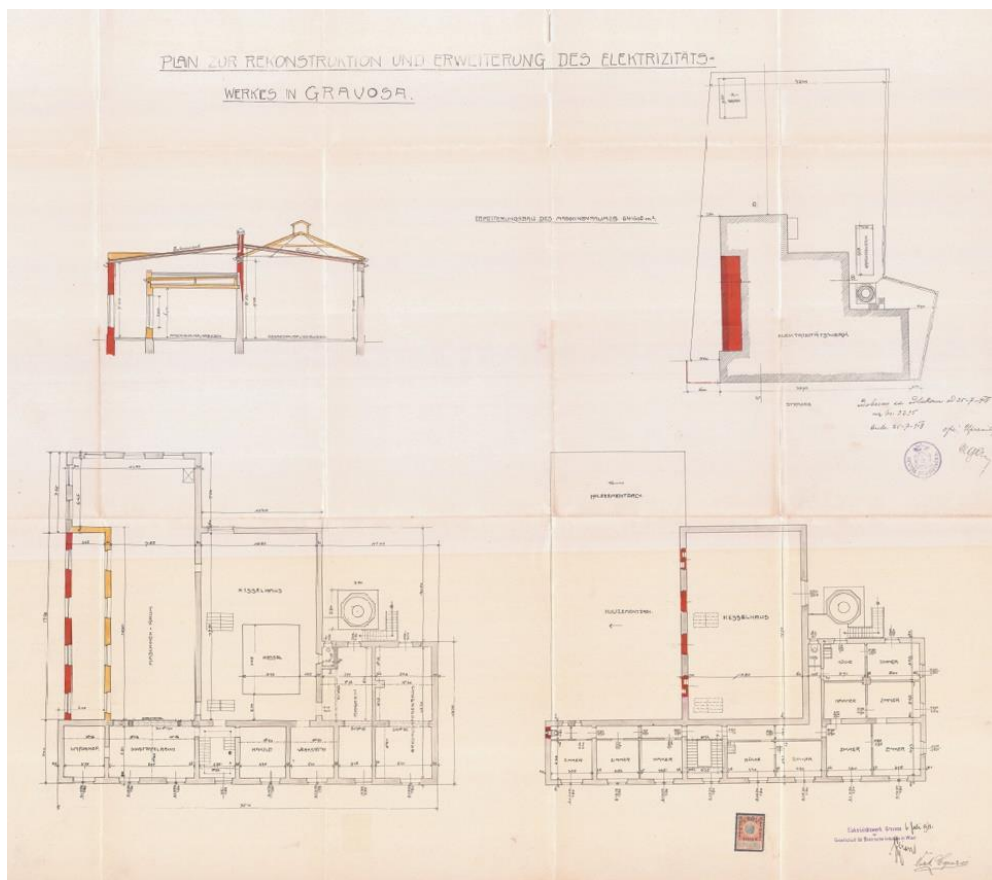
In addition, a new gable roof with a slight slope and wood and cement roofing was built, and it was perpendicular in relation to the main building (Figure 17). Electrical energy was used by few citizens, and the main consumer was the tram line (Pile) of Old Town—Gruž, on the western, industrial outskirts. The tram operated until 1970, when the line was cancelled because of a serious traffic accident in Pile in which one person died and several were injured [21] (p. 556).

The main building along the coast was extended in two phases. In the first one, commissioned by Elektrojug, the second floor was built with modernist ribbon windows. The more recent, post-modernist extension inappropriately exploits the maximum floor area ratio and negates all the valuable features of the original infrastructure building (Figure 18).

### 2.7. The Dubrovnik Electrical Tram, Depot and Administrative Building

The construction of the railway prompted the idea of connecting the Old City (nearby Pile) with Gruž, which at the time was a harbour and represented the outskirts of Dubrovnik. The busiest Dubrovnik line was Gruž–Pile, which had two great rises that horse carriages were not able to surmount. That is why the introduction of a tram line which would connect the Old City with Gruž Bay had been planned since the mid-1890s. The horse-drawn tram started operating in New York in 1850, and in Zagreb in 1891. The first electrical tram started operating in Lichterfeld south of Berlin in 1881, in Ljubljana in 1901 and on the eastern Adriatic Sea coast in 1904—in Pula, the largest Austro-Hungarian naval port on the Adriatic—and in 1908 on the Matulji–Opatija Lovran line, near Rijeka. The Zagreb Electrical

Tram started operating in 1910. The realisation of the project in Dubrovnik depended on the availability of electricity, and the conditions for the introduction of the electrical tram were met in 1901, after the construction of the power plant in Batala. On 4 January 1901, the Dubrovnik Municipal Administration sent a request to the Ministry of Railway in Vienna to approve the introduction of the electric tram from Gruž to Pile. The request was granted and engineer Janauschek first designed the line for 990 krone. The Dubrovnik Electrical Railway (*Akcijsko društvo dd Dubrovačka električna željeznica*) was founded and stocks (500,000 krone) were invested to finance the construction [19] (p. 102). The Ministry of Railway in Vienna approved the project in 1909 and the works immediately started by widening the path at Boninovo.



**Figure 17.** Design of reconstruction and extension of Gruž power plant (HR-DADU 80/2, with the permission of State Archives in Dubrovnik).

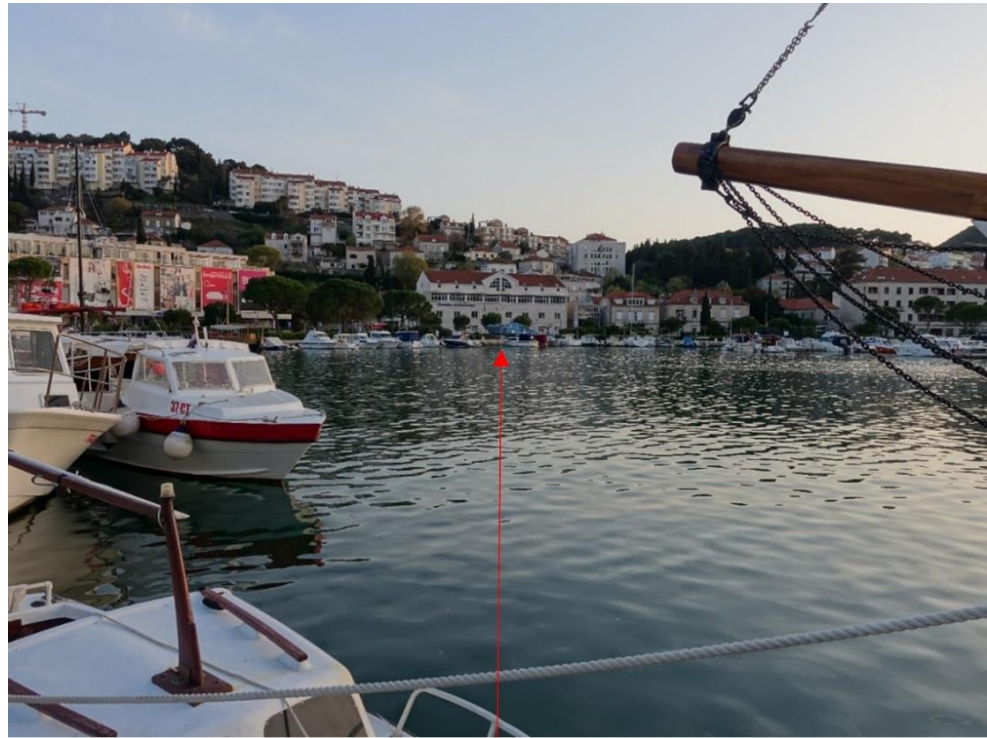
The tramline which went down today's Ante Starčević Street was finished in 1910, and it became a link between the old and the new Dubrovnik harbour.

Further on, in 1928, a dead-end branch line was constructed to connect Sumartin Cove with the Lapad coast, the southern coast of Gruž Bay. It was very important for the urban structure of Dubrovnik, similar to the construction of the railway for the wider area, connecting Dubrovnik with the hinterland and the northern region.

The construction of the complex made up of the depot and the administrative building of the Dubrovnik Electrical Tram started on the eastern side of the site of the future Radeljević Oil Factory and partly in the eastern part of the garden of the Gradi-Vuić summer villa. The Croatian term *remiza* used for a "tram depot" stems from the Italian expression *rimessa da carri*, meaning "carriage garage".



In 1910, the Dubrovnik Municipal Administration bought the land to build the depot in the northern, more secluded part of the lot. The tram depot is a large space with a span of  $17 \times 33$  m and two large tram entrances located on the southern façade. The busy building with large openings, a large span and a simplified shape stands out among other buildings in Gruž and it stands in contrast to the Srđ backdrop. The depot in Gruž is the only building of its kind in Dalmatia, and the first one in Croatia (Figure 19).



**Figure 18.** The Elektrojug building is these days almost unrecognisable because of the extensions (photograph by Zrinka Barišić Marenčić, 2022).



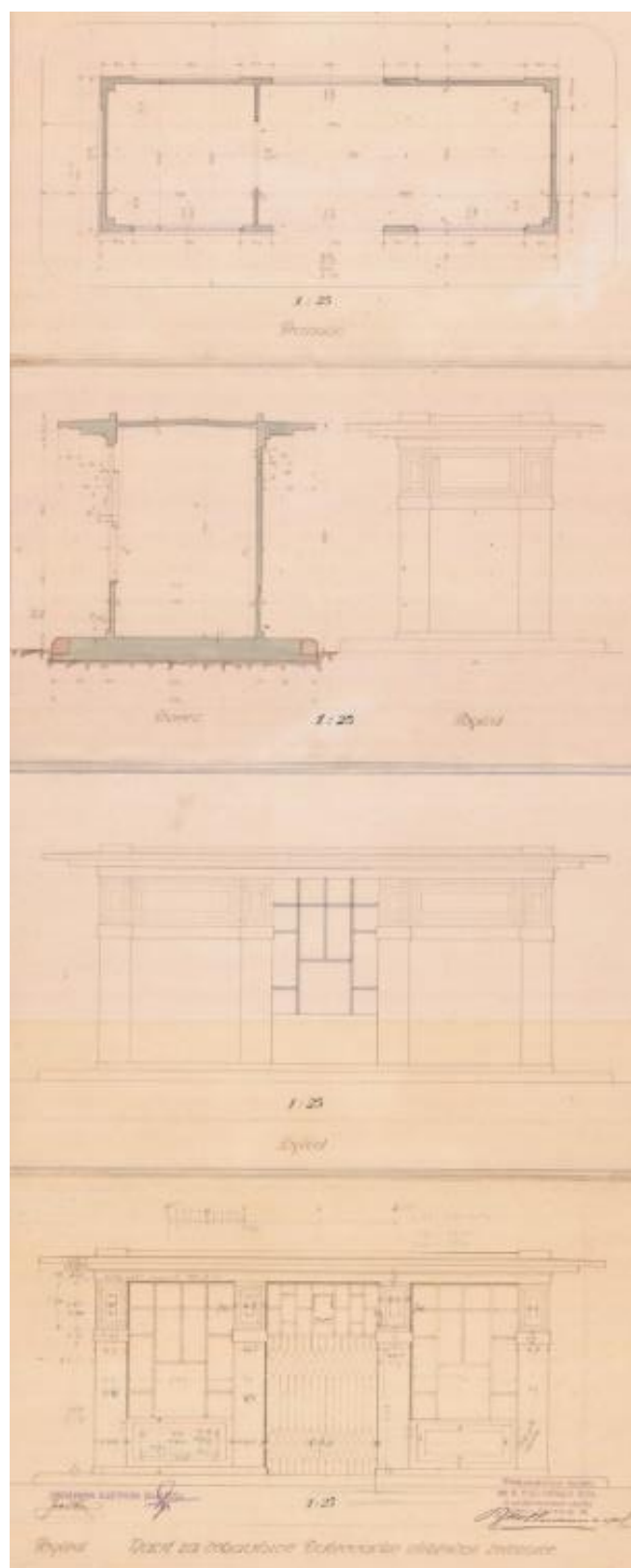
**Figure 19.** Depot before the first tram ride in 1910 (Photo from the book [24]).

The tram depot in Osijek was constructed by Charles B. MacDaniel Jr., Belgrade branch from 1925–1926 (the designs were signed by the construction manager, engineer Milan Manojlović) [26] (pp. 157–159). The Zagreb depot in Trešnjevka was constructed from 1935–1936 by a working group under the leadership of Ivan Zemljak—Vlado Antolić, Zvonimir Kavurić, Franjo Bahovec and Josip Gaupp [27].

The administrative building of the Dubrovnik Electric Tram, i.e., the building of the Dubrovnik Electric Railway administration, was designed in 1913 by Czech architect Václav Vítězslav Chytrý [28,29] (p. 102). Architect Václav Vítězslav Chytrý (1865–1917) worked in Prague, influenced by the Secession. From 1910, he designed a series of buildings in the Dubrovnik area. The Dubrovnik Municipal Administration signed two agreements with engineer Karl Weigman to build the administrative building and the depot [19] (p. 104). In the southwestern part of the lot, the area along Vukovarska Street is dominated by the representative administrative building in Secession style. The administrative one-storey building with a loft is characterised by a plastically articulated shape of the corpus, uncommon for the Dubrovnik area. What stands out is the northern annexe of the entrance vestibule with a circular staircase and a Secession cast iron fence in its interior [30] (p. 18). The influence of residential buildings from Prague (1904–1905, residential building, Nad Královskou oborou 29–31) are notable, mainly because of the use of Secession décor, articulated volume and polygonal ledges [31]. Few Secession buildings in the Dubrovnik area are characterised by modest use of Secession decorations on the façades.

In 1928, the construction of the eastern annexe of the depot workshop and the Dubrovnik Electrical Railway flats started in the northwestern corner of the lot, following the project by engineer Fridrih Valenta [32]. Mostly unknown in professional literature, Fridrih Valenta was architect or building contractor active in Dubrovnik [33]. It was an L-shaped one-storey building, with workshops and a warehouse on the ground floor, and flats and a sleeping hall on the first floor. Its roof was shaped honouring the traditional Dubrovnik style of architecture [30]. As the tram needed to reach the new, extended depot, the eastern part of the garden of the Gradi-Vuić summer villa was bought. After World War II, the eastern extension of the Dubrovnik Electrical Railway complex was built on the former army land, with army warehouses (1940). A series of extensions of the complex followed and degraded the appearance of the whole. The construction is realised as a substitute for the two expropriated and demolished naves of the so-called *Solska baza* during road tracing [30].

Along the Uskoplje–Gravosa (Dubrovnik) tram line of the Dubrovnik Electrical Railway, four tram stop shelters were designed in 1913. The State Archive in Dubrovnik keeps the designs of the tram stop shelters for Pile, Lapad, Hotel Petka and Kasarna (“Barrack”). The person stated on the designs regarding the construction work is B. Hollmann A. Spol, a civil engineer from Prague (for construction work) [34]. In places, there are also the signatures of Václav Vítězslav Chytrý, the Czech architect who designed the administrative building [34]. The tram stop shelters, as big as the carriages, were placed in parallel with the tram track. They were designed as 6 m × 2 m pavilions, with a height of 4 m. The possibility of annexing the tram stop shelter in front of the existing building is left only in front of Kasarna. The use of a flat roof with exposed eaves is new for Dubrovnik. The large windows are characterised by the Secession geometrism promoted by its founder Joseph Hoffman. Although the construction of one pavilion in Gruž was started and then stopped due to incompatibility and the other pavilions were never built, they represent pioneer tram stop ideas in Croatia [35] (communication with Staatsbahnsdirektion Trieste) (Figure 20).



**Figure 20.** Design of waiting rooms for Dubrovnik Electric Railway (HR-DADU 74/11, with the permission of State Archives in Dubrovnik).



Tram stop shelters are rare in Croatia; the tram stop shelter in the Zagreb neighbourhood Gupčeva Zvijezda (by Ivan Zemljak and Zvonimir Kavurić, 1935) is a listed building [35]. The Osijek shelter in the main square (1926) does not exist anymore, and the 1930s modernist shelter near Tvrđa (by architect Juraj Denzler) stands out in that modest series of similar buildings [36] (pp. 70–71). After the major 1970 accident in Pile, trams stopped running and the Dubrovnik Electric Railway complex was given to the public bus transportation provider “Libertas” [30] (p. 20). The tram depot was used as a bus garage. One tram carriage was exhibited in the Technical Museum in Zagreb [24] (p. 76). After the depot and administrative building were taken over by a private owner, the administrative building (1913), proclaimed a cultural asset and protected by the provisions of the spatial plan. Both buildings were demolished in 2017 [37]. It is disappointing that not even the fact that a building is protected can prevent the demolition of technical heritage (Figure 21).



**Figure 21.** The site of the demolished, although protected, former administrative building (and depot in second plan) of the Dubrovnik Electrical Tram (photograph by Zrinka Barišić Marenić, 2022).

### 2.8. The Radeljević Oil Factory

The Gradi-Vuić and Bassegli-Gozze Renaissance summer villas characterised the southeast of the very end of Gruž Bay. In 1922, the construction of a big industrial complex of “The First Dalmatian Company”, founded in 1907, started alongside these complexes of country houses and farms and north of the top of Vukovarska Street (the link between Gruž Bay and the City) [38] (p. 130). The office building, designed by engineer Ivan Juračić, was built in 1922 in the area of the Bassegli-Gozze summer villa complex, alongside Silvije Strahimir Kranjčević Street, north of the summer villa and the chapel of the Gradi-Vuić complex [39] (Figures 22 and 23).



**Figure 22.** The ruined complex of the Radeljević Oil Factory with the Gradi Vuić Renaissance summer villa and the ruined Bassegli-Gozze summer villa (photograph by Zrinka Barišić Marenčić, 2022).



**Figure 23.** The former Radeljević Oil Factory HQ building with the chapel of the Gradi-Vuić Renaissance summer villa complex (photograph by Zrinka Barišić Marenčić, 2022).

The longitudinal one-storey building parallel to the street is characterised by a deviation of the entrance corpus with the ground-floor doorway below the arch, representing the connection between the seashore and the industrial complex in the back, alongside the northern building of the Bassegli-Gozze summer villa. The eastern annexe to the original office building was designed by engineer Vinko Karlovac and built in 1940, respecting the original two-wing floor plan disposition and the traditional shape [39].



What later followed was the continuation of a phased construction at the back of the complex in order to move the utilitarian and manufacturing buildings into the background, away from the coast and the view of the city from the sea. This practice is typical for Dubrovnik's Gruž. The construction of the administrative building of the oil factory, the warehouse, the garage and the stable according to the design of engineer Kuckhoff was first approved. Later, in 1931, the construction of a series of warehouses for oil seed storage and seed-drying were also approved [39]. A tall chimney, built in 1928, represents a landmark in the wider area of the city and strong evidence of industrial activity. By gradual construction and extension of the industrial complex of the later renamed Radeljević Oil Factory (e.g., by annexing the two-storey building by engineer Cvjetko Kušta in 1956), the original complex of the country house and farm of the Bassegli-Gozze family was almost entirely ruined. The only thing remaining is the summer villa, surrounded today by a degrading parking lot (Figure 24).



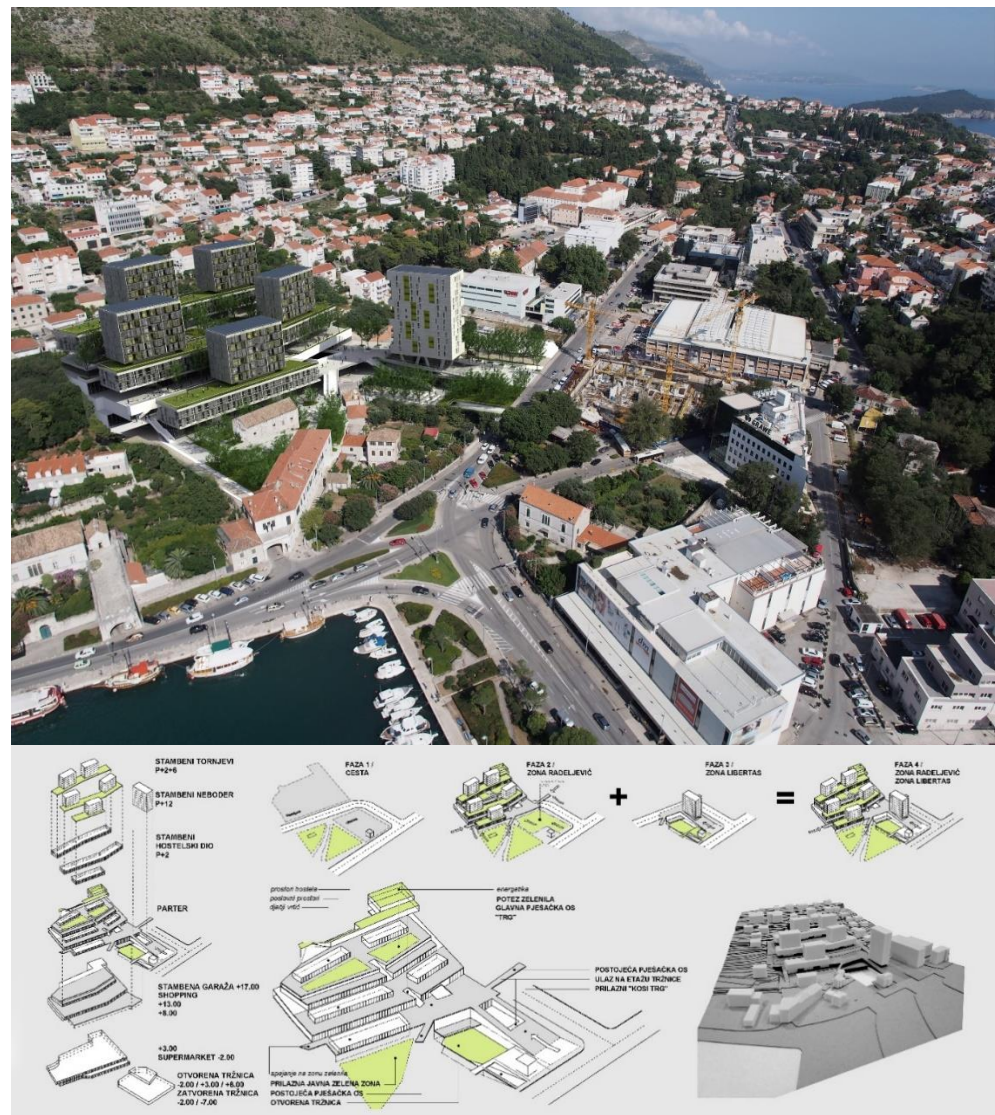
**Figure 24.** The ruined Bassegli-Gozze Renaissance summer villa (on the left) and the former Radeljević Oil Factory administrative (HQ) building within the Radeljević Oil Factory (photograph by Zrinka Barišić Marenić, 2022).

After the Homeland War, the Radeljević Oil Factory was closed. Given the high value of the land in the wider city centre of Dubrovnik, the northern factory buildings of the Radeljević Oil Factory and the chimney were demolished. The northwestern three-storey building for the press and the original administrative building of the factory, as well as the Bassegli-Gozze listed summer villa, are the only remaining buildings. In an effort to use the valuable city location to create a new business centre, a big architectural and urban planning competition was launched in 2012 for a complex with commercial, office and residential space in the location, however, the complex was never built [40].

An open competition with well-prepared documentation attracted many architectural teams. They offered a wide scope of methods to address the issue and led the jury to award five projects and three repurchase agreements of equal value. Although there were no realisations, it is the recommended, if not overall best, way to approach projects in such a delicate and complex location.



The winners of the first prize, Ante Kuzmanić, Samuel Martin, Ivan Novaković, Luka Mužinić, Mirjana Radoš, Sanja Vondra and Marin Kaliterna, respected the existing structure of the summer villas and the first phase of the industrial complex (Figure 25 as was set out in the conditions of the competition [41,42]. They positioned the greatest part of the newly planned structure parallel to the contour lines of the lot and the northern Bassegli-Gozze summer villa. They were inspired by a residential complex further to the west built for the employers of the Factory of Carbon Graphite and Electro-Contact Products—TUP (an impressive and humble late modernist building which has frequently been left out of research). The group of authors incorporated the majestic newly designed residential and commercial complex into the existing structure with cascades and corpuses parallel to the contour lines of the lot (Figure 25). Unfortunately, not even the ideas of the winners of the first prize were implemented.



**Figure 25.** Commercial–business–residential complex on the site of the former Radeljević Oil Factory and the public transport company Libertas in Dubrovnik (photomontage and concept axonometries, 1st award in the urban architectural competition, <http://antekuzmanic-arhitekt.hr/radovi/radeljevic-libertas-dubrovnik.html> (accessed on 5 July 2022) [41] and Archive of the architect Ante Kuzmanić).

### 3. Discussion

The industrialisation of Croatia happened much later than in Great Britain, the cradle of the Industrial Revolution, and in western European countries. It is particularly noticeable in Dubrovnik, the extreme southeast of Croatia. The Old City of Dubrovnik is a globally known site listed on the UNESCO World Heritage list. The UNESCO website says: “The ‘Pearl of the Adriatic’, situated on the Dalmatian coast, became an important Mediterranean Sea power from the 13th century onwards. It managed to preserve its beautiful Gothic, Renaissance and Baroque churches, monasteries, palaces and fountains” [43].

The dichotomy of the dense urban structure of the Old City and Gruž Bay to the east is expressed on several levels. The Old City is a compact urban structure enclosed by a strong fortification system developed as a result of the eastern Ottoman threat. The stereotomy of the impressive fortification system has a very defensive character. The system and the well-known Dubrovnik diplomacy are the reasons why the Ottomans never even tried to attack Dubrovnik. The Old City harbour in the east is enriched with the arsenal and lazarettos which inherited the oldest quarantine in the world. Gruž Bay in the west is an agricultural area under Srđ, where the nobles used to build their complexes made up of country houses and gardens scattered along the coast and the area since the 15th century. Over time, the deep and well-protected Gruž Bay gradually and intensely took over the shipyard and harbour functions. The narrow-gauge railway—the link between the hinterland and Bosnia—led to the development of harbour and warehouse activities, as well as shipbuilding and industrial activities. The construction of the tram line representing a link between Gruž and the Old City enabled the connection of the urban part of the area with the industrial outskirts in the west, which were developed and urbanised as a result. The power plant, the tramline and the depot were basically the first buildings of their kind on the eastern Adriatic Sea coast. The development of land and maritime traffic and the construction of the power plant led to greater development of the industry and the building of the resulting warehouse and transport complexes along Gruž Bay at the turn of the 19th century.

The buildings representing the technical heritage of Dubrovnik are characterised by a more progressive use of modern construction techniques and materials, as opposed to the usual and traditional stone construction, with a modular rhythm of smaller windows and the use of wooden roofs with mission tile roofing (which is mostly used in residential architecture and the historical centre of the city). The tram depots, the complex of the railway station, the power plant with the engine room and boiler room and the coal warehouses are all new types of buildings in the Dubrovnik area. They are characterised by a utilitarian function, the need for large warehouses, wider structures and consequentially the use of more modern materials. The architecture implements cast iron elements, big-format openings and windows and a flat roof—a more modern shape devoid of the imperative of the traditional, neostylistic expression of historicism. The beginning of the 20th century is also marked by the Secession.

In the urbanistic sense, there is an overlapping of matrices. The existing historical scattered raster grid of summer villas in Gruž Bay was gradually superimposed by a layer of transport facilities and traffic routes, and a raster grid of infrastructural and industrial buildings. A strong influence of tradition is notable in placing the industrial complexes in the background, away from the shore, at the end of Gruž Bay, behind the summer villas and administrative buildings. These buildings, shaped more traditionally or better looking, take the central spot. Utilitarian warehouses with fewer standard decorative neostylistic elements and less traditional means of construction are placed in the background. All of this leads to gradual affirmation of 1930s modern architecture in Dubrovnik.

It is in the very tissue of the Dubrovnik Gruž Bay that the import of engineering expertise and techniques from northwestern countries is noticeable. The designers of buildings belonging to the technical heritage of Dubrovnik are less-known engineers and architects, rarely seen names in Croatian professional literature. The administrative building of the tram and the tram stop designs represent few Secession buildings, with more noticeable plasticity, or the use of large-format glass openings with the geometry of metal raster grids of never-built tram stop façades. What is also interesting is the rare contribution of Prague architects in Dubrovnik, a sort of a curiosity in Dalmatia. The exception is the Czech architect Josip Kodl who, after graduation from the Czech Polytechnic in Prague in 1921, moved to Split where he had his works built. The Czech influence on modern Croatian architecture is linked to the idea of pan-Slavism [44]. Various students from Split chose to study architecture in Prague because of the similarities between the languages. The distinguished modern architect in Dubrovnik, Nikola Dobrović, graduated from the Czech Polytechnic in Prague (1923) and constructed the Yugoslav Student Dormitory in Prague (1932–1933) [45] (pp. 75–76). Czech architects were chosen because of better conditions, whereas the engineering influence from the Austro-Hungarian Monarchy is noticeable in the construction of the railway, the tram and the power plant. The import of engineering and architectural know-how from the Czech Republic and Austria was completely justified because engineering study programmes in Croatia were only introduced in 1919, with the foundation of the Polytechnic in Zagreb.

Significant industrialisation of Gruž Bay and good connections with the Old City and its hinterland led to an increase in population and a more intense urbanisation of Gruž Bay. Its specificity was the hybrid typology of its buildings, a mix of workspaces, technical plants and flats for employees, next to the railway station, in the depot and the power plant, partly even in the same buildings. Even in the old shipyards, ship commissioners used to live in the shipyards and oversee the construction of their ships. A link is noticeable with the hybrid character of the Gruž complexes of country houses and farms, built for the relaxation of the nobles in the warmer part of the year. They used to enjoy their Renaissance and Baroque gardens outside of the dense urban structure of the City, while also overseeing the harvest. Their complexes often integrated boat storages and sea-filled pools for fish.

Just like the industrialisation of Gruž Bay partly devastated the structure of summer villas from the 19th century onwards, the intense urbanisation of Gruž which started in the 20th century has partly devastated the industrial complexes. A part of the industrial heritage in Gruž Bay was demolished (most of the Radeljević Oil Factory). Solska baza was also partially demolished. A part of the complexes is protected due to their listed building status. Protected cultural property includes: Bassegli-Gozze, Gradi-Pozza-Cobenzl, Kaboga-Zec, Vuić and Bobaljević-Pucić summer villas. Registered cultural property are Gruž harbour (as an archeological site), *Solska baza*, Radeljević administrative building, J.P. Libertas administrative building (the administrative building of the Dubrovnik Electrical Railway (tram)—demolished in 2017), tobacco station (administrative building with a warehouse) and former Austrian barracks in Gruž [46]. However, although under protection, the administrative building of the Dubrovnik Electrical Tram was also demolished. The investor somehow managed to tear it down due to the procedural error in achieving the status of listed building. This shows that not even the protection of industrial heritage can preserve the endangered heritage which these types of buildings represent. Although still used for its primary function, the Elektrojug building is today almost unrecognisable because of its various extensions.

In the 21st century, the industrial buildings in the Gruž area are now partially occupied by various alternative culture associations and artists' studios. In the industrial buildings, there are studios of various artists: painter Dubravka Lošić (Radeljević complex), sculptor Pero Mrnarević (Solska baza complex), Anamarija Bezek Ceramics, The Red History Museum (artistic, historical and research project in the TUP factory, The Jadran Cultural Centre, Dubijoga, Dubrovnik Beer Company—craft live, Studio Bonsenjo—creative agency, Love bar—DJ and live band, etc. [47–53]. A sort of a spontaneous artistic hub has been formed in



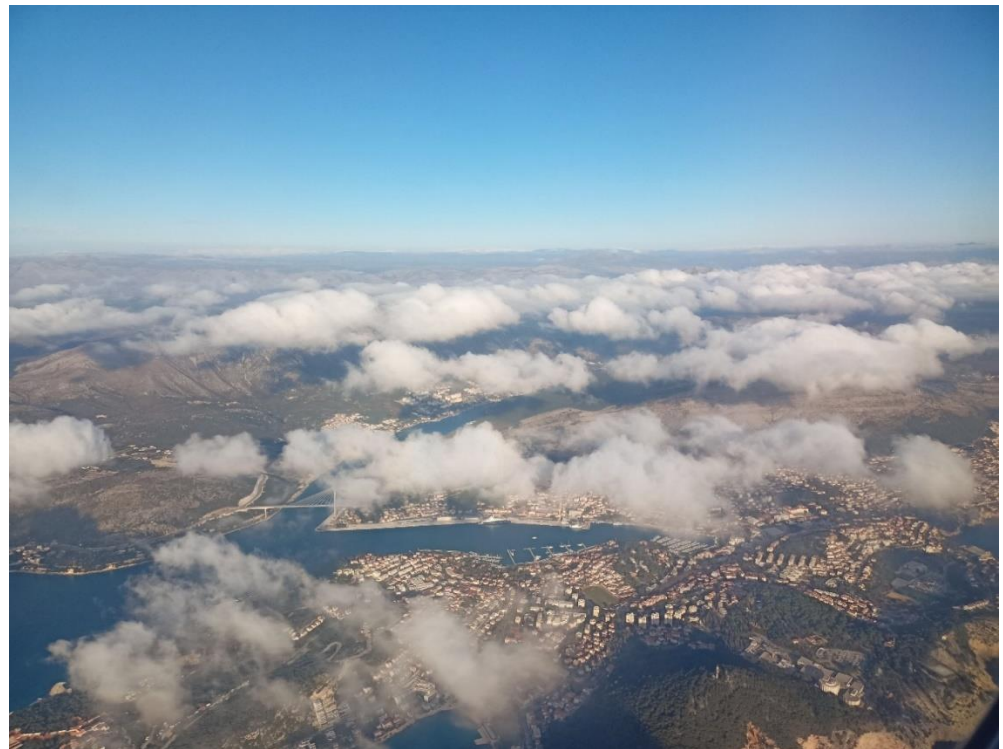
the area. This shows the need for free and public use of such a space, and its activation in order to serve all inhabitants of the city. It also shows the need for an adequate model of enhancement of the life of the entire community. Such an adaptation of the space builds on the current New European Bauhaus (NEB) platform of the European Union, which promotes interdisciplinary collaboration of art, science and technology in order to create an innovative, flexible and sustainable environment [54]. This is how physical space starts serving the local community, enables a better quality of life, becomes a place of learning and dialogue, with connection of art, interdisciplinary culture and community identity, available to all citizens.

The development of the traffic network gradually led to the construction of *Petka*, the first hotel in Gruž Bay (Figure 26). The first building in Gruž Bay built for tourism purposes was the announcement of strong touristification of Dubrovnik during the 20th century, which gradually changed the industrial character of the Gruž harbour. The tourist industry of the 21st century has dominated the economy of today's Dubrovnik. Since the industrial complexes are no longer used for what they were initially built for, there is a possibility to repurpose them to respond to the needs of the contemporary city. The aim of this scientific article is to turn the attention towards the systematically unexplored technical heritage of Gruž Bay, the cradle of industry in Dubrovnik. By showcasing the potential of such complexes and the importance of the technical heritage, the intense degradation of utilitarian architecture of Gruž may be stopped.



**Figure 26.** Panorama of the Gruž harbour with the first Hotel Petka (DUM PM 4737, Maritime Museum Dubrovnik).

Affirmation of the industrial heritage of Gruž Bay offers a possibility to accommodate facilities the citizens today greatly miss, at the same time marking its contribution to the historical continuum of the city's development. Aerial view shows dispersion on the hills around the bay (Figure 27).



**Figure 27.** Areal panorama of the Gruž harbour and Rijeka Dubrovačka (on the left) with Franjo Tuđman bridge (photograph by Roberta Pavlović, 2022).

#### 4. Contextualisation

##### 4.1. Analysis of Other Analogous Studies in Former Industrial Communities

Industrial architecture started developing as a new typology after the 18th century Industrial Revolution. During the process of deindustrialisation in western Europe after the 1960s, many industrial buildings were abandoned and left to decay. A reaction to many demolitions was the development of industrial archaeology as an interdisciplinary study. Great Britain was the cradle of not only the Industrial Revolution, but also of industrial archaeology. Significant focus on the British and the international realisations of conversion of industrial buildings are presented in the book *Industrial Buildings. Conservation and Regeneration* edited by Michael Stratton [55].

The first industrial site listed in the UNESCO World Heritage list was Ironbridge [56]. Prompted by the 250th anniversary of the first implementation of coke in iron-casting, the foundry's owners, Allied Ironfounders Ltd., initiated the excavation of the first furnace used by A. Derby back in 1709, marking the beginning of active conservation in Ironbridge Gorge and making it the first industrial site included in the UNESCO World Heritage list in 1986 [57]. Perception of industrial heritage thereafter rapidly changed worldwide.

After intensive deindustrialisation since the 1960s and 1970s, the German industrial and mining area along the Emscher River underwent tremendous economic and social crisis. Although authorities did not know what exactly to do with it at the end of the 1980s, they were wise enough to buy a part of the industrial complexes from the former owner and declare it a segment of industrial heritage in Germany. The year 1988 saw the launch of a federal programme for economic and social recovery and a restructuring of the region, which included 17 major cities of the Ruhr conurbation, with nearly five million inhabitants. The organisational framework of this programme was the International Construction Exhibition (IBA), and in the 1990s it included the entire Ruhr region [58]. It focused on abandoned industrial sites and the remaining unbuilt spaces where they explored the possibilities of urban, economic and social transformation. After 10 years, the sites in focus required self-financing, or self-sustainability. In 2007, OMA architects Rem

Koolhaas and Floris Alkemade realised the conversion of the coal-washing plant in Essen into the Ruhr Museum and Visitor Centre [59]. Finally, in 2001, UNESCO inscribed the coal mine industrial complex Zeche Zollverein in Essen onto its list of World Heritage Sites (industrial monuments) [60]. Numerous sites were revitalised within the IBA Emscher park project, and some of the industrial buildings were even musealised.

Situated on the coast of the Adriatic Sea, Venice is a well-known UNESCO site. Its dense urban fabric within a limited spatial framework led to early reuse of former pre-industrial shipyards as contemporary exhibition sites. Since the 1980s, segments of the International Biennale of Architecture or Art have been organised in former shipyards and armouries [61,62].

Pre-industrial buildings have been reused in Dubrovnik as well, as early as the 1930s (the former arsenal in the Old City Port was revitalised as a city café and theatre as early as 1931–33, after an architectural competition won by Stjepan Gomboš in co-authorship with Mladen Kauzlarić) [53] (pp. 119–120).

The *Cotonificio Veneziano*, a 20th century abandoned textile factory from the Venetian industrial period, characterised by a concrete skeletal structure, was revitalised for the University of Architecture and Urbanism (Istituto Universitario di Architettura di Venezia—IUAV) in 1995 by architect Gino Valle [63]. The former factory, at the seafront of the Dorsoduro *sestiere*, houses one of ten locations of IUAV dispersed across Venice.

“Heritage–Driver of Development” was a part of cross border programme of Croatia–Montenegro in 2013, focusing on the Dubrovnik and Boka Kotorska region, aiming not only to enlarge professionals’ knowledge, but also increasing citizens’ awareness of how heritage can be used as the driver of development [64]. An international journal (Heritage) called for papers on “Heritage as a Driver of the Sustainable Development Goals” this spring, acknowledging heritage as an economy booster, at the same time fortifying the relationship of the community with the place [65].

#### 4.2. Analysis of Other Analogous Research Conducted in Croatia

When focusing on the Croatian part of the eastern Adriatic coast, the cradle of industry is the port of Rijeka. Like Ironbridge, the establishment of a citizen association of Rijeka, Protorpedo, was inspired by the 150th anniversary of the by the invention of the torpedo by a Croat, Ivan Blaž Lupis Vukić. In business cooperation with Englishman Robert Whitehead he launched production in Torpedo Factory. This non-government organisation (Protorpedo) for the promotion and preservation of the city’s industrial heritage was founded in 2003, as the first NGO devoted to industrial heritage in the Republic of Croatia [66]. The association’s aim is to preserve and regenerate the impressive technical and industrial heritage of the port city of Rijeka. Since 2003, Protorpedo has published a series of proceedings of its biannual international congresses. The most recent proceedings issue was published in 2022 [67].

Numerous activities aimed at affirming Rijeka’s industrial heritage culminated with the selection of Rijeka as the European Capital of Culture in 2020 [68–70]. Contemporary architectural realisations resulting from the conversion of Rijeka’s industrial heritage include the Museum of Modern and Contemporary Art (by architect Dinko Peračić) and the Children’s House (by architect Saša Randić), within the former Rikard Benčić factory [71,72]. The Museum of Modern and Contemporary Art was awarded the highest professional architectural awards in Croatia (Bernardo Bernardi Award for interior design of the Croatian Association of Croatian Architects, and the Medal for Conceptual Achievement by the Croatian Chamber of Architects) [73,74].

The industrial heritage of Rijeka has been analysed in numerous articles published by local researchers in Protorpedo’s proceedings. The most significant articles were published by Professor Nana Palinić and co-authors in the Industrial Archaeology Research journal [75,76]. Systematic analyses and presentation of Rijeka’s industrial heritage were followed by publication of the first map showing that aspect of the city’s heritage [77].



The research into and reuse of industrial buildings on the Adriatic coast are a significant reference for the reuse of the industrial heritage of Dubrovnik.

Split is the largest city in the Dalmatian region of the Adriatic coast. Its antique historic nucleus, Diocletian's Palace, is included in UNESCO's list [78]. In focus at the Split conservation office are the city's rich history and architectural heritage. However, significant examples of modern architecture and industrial heritage are omitted from the buildings listed. The cement industry of the Split region was studied at PhD level by Dujmo Žižić, architect, and published in a rare book dedicated to the industrial heritage of Croatia [79].

Sisak was one of the most significant industrial cities of Croatia. After intensive deindustrialisation since the 1990s, numerous industrial complexes were left abandoned. Aiming to affirm the city's significant architectural heritage, the Museum of the City of Sisak and historian Vlatko Čakširan, PhD published the second map of a Croatian city's industrial heritage [80].

The first symposium on the transformation of industrial heritage in Croatia was held in Karlovac in 2000. Prominent researchers participated in the congress and published their works dedicated to the industrial heritage of Zagreb, Split, Rijeka, Karlovac, Osijek, Duga Resa and Trogir: Mirjana Goršić, Tamara Rogić, Igor Čulig, Tomislav Premerl, Ivo Maroević, Biserka Dumbović Bilušić and Brankica Petrović, Branka Križanić, Stanko Piplović, Sandi Bulimbašić, Latica Tomašić, Marijan Bradanović, Grgur Marko Ivanković, Žarko Španiček, Darja Radović Mahečić, Krešimir Galović, Ljiljana Šepić, Berislav Šebečić and Helena Bunjevac [81].

The industrial heritage of the Croatian capital Zagreb was presented at three exhibitions organised by the Museum of the City of Zagreb and curated by historian Goran Arčabić. Each exhibition was supplemented with additional activities, such as visiting lectures by Croatian or international researchers or student workshops, all with significant media coverage. The research was published in the Museum's thematic publications [82,83].

A pioneer in the field of industrial archaeology within Croatia is architect Ljiljana Šepić, who was the first to introduce a relevant elective course to the curriculum of the Faculty of Architecture, University of Zagreb. Similar courses were introduced later at Croatian universities in Rijeka, Split and Osijek. The introduction of this interdisciplinary study with the focus on Zagreb and other Croatian sites was accompanied by numerous articles in professional and academic literature [84].

Industrial heritage has been undergoing numerous bottom-up interventions by young people, the independent cultural scene or artists. Artist Carl Michael von Hausswolff used red light as an artistic intervention in three abandoned industrial buildings in Croatia from 2003–2011, aiming to affirm the potential of these spaces [85,86].

It is important to mention that the use of abandoned industrial buildings in Labin (first phase realization of conversion of the mining complex for the municipal library, by Damir Gamulin, Ivana Žalac, Margita Grubiša and Igor Presečan; with Marin Jelčić and Zvonimir Kralj—competition project) and Zagreb (Pogon Jedinstvo, Klub Močvara, etc., in a former Jedinstvo factory, reconstruction project by Dinko Peračić and Miranda Veljačić) by the independent cultural scene led to collaboration with various Croatian institutions, and later design activities for the revitalisation of the complexes into mixed-use cultural centres [87,88].

Since many abandoned industrial sites in Dubrovnik's Bay of Gruž are being used by artists and museums, this might be a good model for their future reuse.

## 5. Conclusions

Hypotheses were mainly confirmed by this research, along with a few unexpected findings. Before this study, industrial heritage was not systematically researched, which is why this study is based on primary archival research, field work and Croatian reference literature or referential western European examples. Just like the Industrial Revolution, industrial archaeology expanded from western European centres towards eastern Europe.

Construction documentation on the industrial heritage of Dubrovnik and original archival material is being published for the first time in this paper. The archival material used is from all institutions which preserve original archival materials related to Dubrovnik, heirs of such documentation. Also presented here are unrealized projects for tram stations. The hypothesis about the deterioration of complexes proved to be correct.

The complexes are:

- neglected or left to decay;
- devastated and demolished—with no traces of their existence (e.g., the track of the former tram line);
- torn down.

The fact that several buildings, i.e., complexes were protected is commendable. However, what goes beyond the hypothesis is the fact that the one protected building (listed building; the administrative building of the Dubrovnik Electrical Railway (tram)) was demolished, despite the fact that it was registered as culturally significant property. This confirms the hypothesis that preservation is ensured only through the use of buildings, and that buildings being reutilised after their primary cycle of use is shut down can survive through new uses within their secondary function.

The research highlighted the fact that formal legal protection (registration of buildings as a cultural property) cannot guarantee their physical preservation. However, continuous use of buildings that have retained their primary function (power plant, today's HEP Elektrojug building) and a confined spatial framework bring about the buildings' degradation through a series of subsequent upgrades, with some having paid respect to the original architectural character, and others having brought devastation through excessive upgrades.

Dubrovnik has a long tradition of conducting public architectural competitions for the revitalisation of its heritage of technical culture: its beginnings date back to 1931, when the arsenal in the Old Dubrovnik city port was repurposed as a city café and theatre (by architects Kauzlarić and Gomboš). The 2012 call for a public architectural urban competition for the complex of the former Radeljević Oil Factory is a commendable approach, but the winning project remained unrealised. The independent cultural scene is happy to use abandoned industrial spaces and raise awareness of their potential (TUP, and the Atelier of painter Dubravka Lošić in the former Radeljević Oil Factory) [89,90]. Revitalisation of the former mining complex in Labin presents a good example of use of abandoned industrial complexes by the independent cultural scene (Labin Art Express), and thus the possibility of influencing institutional intervention and establishing collaboration among various stakeholder with a common aim—the revitalisation of industrial heritage [91].

The industrial heritage of Dubrovnik is a potent topic for the affirmation of tourist routes that would enrich the offer of the frequently visited city and its exploitation due to increasing tourism. The aim of the Herzegovina Bike Trail is to connect and network with the wider environment in the hinterland of the former narrow-gauge railway of Dubrovnik [92]. As a recommendation to help highlight and protect Dubrovnik's industrial heritage, besides the trails mentioned, influence could also be ascribed to the Protorpedo non-governmental citizen association in Rijeka. The potentials of Dubrovnik industrial heritage could be affirmed and presented within international committee, i.e., organisations dedicated to the promotion of the industrial heritage The International Committee for the Conservation of the Industrial Heritage (TICCIH) and the European Route of Industrial Heritage (ERIH, the tourism information network of industrial heritage in Europe) [93,94].

Within Dubrovnik, the Society of Friends of Dubrovnik Antiquities was founded in 1952, to sensitise the broader public on the importance of preserving Dubrovnik's cultural and historical heritage, raising awareness and interest on the topic, appealing to the pride and appreciation of the public [95]. Since this association is focused on antiques, the addition of Dubrovnik's industrial heritage within the scope of their sensible, caring and proactive scope would present a great benefit for the protection of the city's industrial heritage.

The Maritime Museum of Dubrovnik is settled in the St John Fortress in the Old City Port. It is important to emphasise that the Museum, dedicated to Dubrovnik's rich naval history, is one of only two sites within Croatia included in the European Route of Industrial Heritage (ERIH) list [96]. This step forward for Dubrovnik can be taken to inspire the inclusion of other locations in Dubrovnik on the list of ERIH, further adequate research and valorisation of Dubrovnik's industrial heritage, as well as raising awareness of the value and potential of the city's industrial heritage in the eyes of the scientific and professional public, as well as the general public.

Dubrovnik has not taken care of its industrial heritage of the 19th century, just like many other cities with extraordinary heritage of historic buildings. The technical heritage was left in the shadow of prominent historic heritage of the Old City, a UNESCO site. The remaining utilitarian structures are slowly being devastated (Figure 28), but the independent cultural scene has recognised its potential. This research is a call for the preservation of the industrial heritage of Dubrovnik and the revelation and affirmation of its potential to the international scientific community. It is only logical that, in a city with limited space, the existing, mostly large-format buildings are used for new needs and activities, when possible. Evaluating them and making the most of their presence would bring them closer to the general public, thus preserving the memory of that relatively short historical period. However, for many of these interventions we could unfortunately use a well-known phrase by prominent Croatian art historian, Prof. Milan Prelog, about "heritage without heirs" [9]. We will paraphrase his words and conclude that the industrial heritage of Gruž in Dubrovnik has yet to bring its heirs round too.



**Figure 28.** Situation at the beginning of 21st century Dubrovnik and Gruž Bay, positions of the abandoned industrial complexes marked with circles, locations of those still existing with solid dots (author: Ivana Tutek, graphic layout: Bernarda Lukač).

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