

Spatial analysis of the significance and role of the fort Imperial during the defence of Dubrovnik in the 1991 Croatian Homeland War

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In addition to the defensive ring around the old town of Dubrovnik, fortifications like fortresses and walls were erected between the 14th and 19th centuries in strategically vital locations of the then-Republic of Ragusa. We conducted a military geographical analysis of battleground around Dubrovnik during the Croatian Homeland War. OAKOC procedure and GIS tools were used to reconstruct the impact of terrain and employed military tactics during the military operations of 1991. The military-geographical elements were examined to ascertain the significance and role of the fort Imperial in the successful defence of Dubrovnik, as well as the failure of the attackers. The analysis uncovered several critical factors for the successful defence. Firstly, there was only one avenue of approach for attackers to reach the fort Imperial, greatly favouring the defence. Secondly, the fortress's placement facilitated excellent surveillance and monitoring of both friendly and hostile forces. Thirdly, logistical support relied on a single footpath leading directly to the heart of Dubrovnik, concealed from the attackers' view, ensuring that defenders were never without supplies. Holding the hill Srđ with the fort Imperial in the hands of the defenders proved to be a key and decisive terrain during the siege of Dubrovnik.

Although the evolution of warfare has diminished the significance of traditional defensive fortifications, the example of the fort Imperial demonstrates that they can still be of crucial importance even in the era of modern conventional warfare.

Keywords: decisive terrain, Dubrovnik, key terrain, KOCOA, military geography, OAKOC

INTRODUCTION

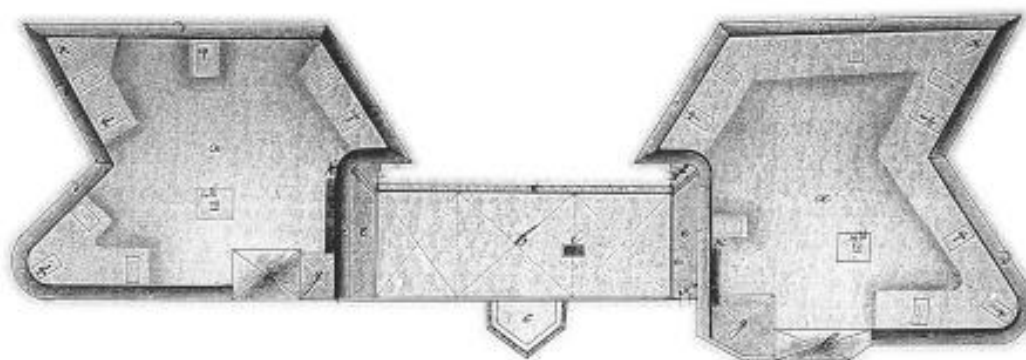
Historical overview

Numerous historians agree that the foundation and early development of Dubrovnik can be traced back to the period between the 5th and 6th centuries (Beritić, 1955, p. 9-10). This historical timeframe allows us to trace the origins of Dubrovnik's fortifications, which were established on the former rocky island of Laus. The chosen location is surrounded by high and difficult-to-reach seaside cliffs. Throughout its history, a network of fortresses interconnected by walls was constructed, leading to the constant extension and expansion of the fortifications, thereby enlarging the core of the ancient city. The existing fortresses were systematically reinforced, and additional sections of walls were continuously added as part of planned expansions. Concurrent with the enlargement of the defensive perimeter around the old city core, fortifications in the form of both fortresses and walls were erected around the city's outskirts, including the city of Ston and the Sokol Grad fortress above Konavle field. The fortifications were built along the borders of the then-Republic of Ragusa, in strategically important positions to secure the movement of goods and prevent direct enemy attacks and incursions into the Republic's headquarters.

Throughout the historical epochs of the Republic of Ragusa, Srđ hill¹ has consistently held a pivotal defensive role. Its earliest documented mention dates to the 1441 session of the Republic's governing body, the Minor Council, where an order was issued for the repair of the guardhouse roof at the current site of the fort Imperial (Beritić, 1955, p. 63-104). With the technological advancements in artillery and the evolution of artillery doctrine during the 17th and 18th centuries, which particularly resulted in increased range and effectiveness on targets, it became evident that the defensive ring around the old city of Dubrovnik no longer offered adequate protection for the city. Following the conquest of Dubrovnik by the French army under

¹ By the 9th century, the hill was named Vergatum (from the Latin word *Vergo*, meaning *to rise, incline, lean, descend, ascend*). In memory of the original protectors of Dubrovnik, St. Srđa and Bacchus, a small church dedicated to St. Srđa and Bacchus was built on the top of the hill, and since then the hill itself has been called Srđ.

Marshal Marmont, who was given the title of Duke of Dubrovnik (French: *duc de Raguse*), significant fortification efforts were initiated to secure Srđ hill. Marmont initiated the construction of the fort Imperial (Fig. 1), designed to accommodate a substantial number of soldiers and military equipment due to its size and armament. It consequently became a strategic stronghold for the defence of Dubrovnik's northern flank. The primary aim of the construction was to thwart enemy artillery assaults targeting the city at its base (Piplović, 2012; Vuković, 2000). Until the Homeland War, the structure was not utilized for its intended purpose. Marshal Marmont envisioned the development of a comprehensive defence system of fortifications within the immediate vicinity of Dubrovnik, encompassing the defence of both land and sea routes extending westward towards the Illyria province. Dubrovnik's defence system constituted a cohesive entity, with artillery battalions stationed on the islands of Daksa, Koločep, Lopud, and Šipán, along with the establishment of a new fortress overlooking the town of Ston. The defence strategy for the islands and the town of Ston was integral to Marmont's vision for safeguarding internal sea routes, while Ston also served as a crucial resting place and communication point between Dubrovnik and central Dalmatia (Marmont, 1984, p. 277).



Slika 1. Tvrđava Imperial, prvotni tloris, 1806. – 1812.

Figure 1 *Fort Imperial, original ground-plan, 1806–1812*

Izvor: Austrijski državni arhiv – Ratni arhiv, Beč (preuzeto iz Vuković, 2020) / *Source: Austrian State Archives – War Archives, Vienna (acquired from Vuković, 2020)*

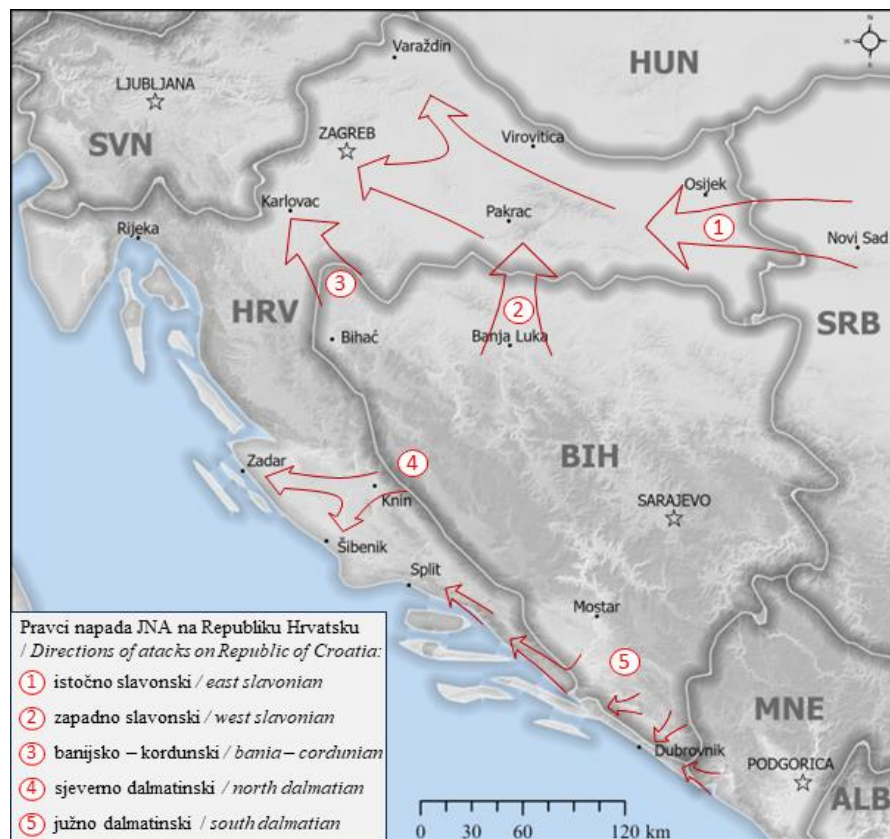
The operational context of the defence of Dubrovnik in the Homeland war

The late 1991 assault on Dubrovnik, which isolated the greater Dubrovnik area from the rest of the Republic of Croatia, initiated an implementation of the Yugoslav People's Army (JNA) broader strategy aimed at overpowering Croatian forces. The objective was to impede the process of independence and the international acknowledgment of the Republic of Croatia as a sovereign entity within the boundaries it held as one of the republics within the former

Socialist Federal Republic of Yugoslavia. The strategy of JNA involved establishing several lines of attack from (Fig. 2):

- 1) Vojvodina towards Baranja (Croatian part) and East Slavonia;
 - 2) Banja Luka towards the city of Virovitica and the border with the Republic of Hungary.
- As per plan, lines 1 and 2 in some moment consolidate and attack should reach Zagreb and the city of Varaždin;
- 3) Bosnia and Herzegovina to Banovina and Kordun towards the city of Karlovac and the border with the Republic of Slovenia;
 - 4) Knin towards Zadar and Šibenik, with a goal of the outbreak on the Adriatic coast;
 - 5) Right flank from Herzegovina along Neretva River valley towards the town of Ploče and the City of Split. The left wing of the attack from Herzegovina and Montenegro was supposed to reach the coast east of the City of Dubrovnik and at the town Slano (northwest of Dubrovnik).

The City of Dubrovnik represented one of the main targets in this plan, with its conquest and breakthrough onto the Adriatic coast aiming to bring the southernmost part of Croatia under the control of the JNA forces.



Slika 2. Skica planiranih strateško-operativnih pravca napada na RH od strane JNA
Figure 2 Scheme of planned strategic-operational directions of attacks on the Republic of Croatia by JNA.

Military-geographic analysis of the terrain: applied methodologies and previous research

There is a significant amount of applied research for military practice that delves into the impact of geographic terrain features on the planning and execution of military operations. The Intelligence Preparation of the Battlefield manual stands out as a pivotal tool for describing and comprehending a given geographic area (Headquarters, 2019). Military analysis in operational planning is encapsulated in the acronym METT-Tc (Mission, Enemy, Terrain and Weather, Troops and Support Available, Time Available, and Civil Considerations). The standard military analysis procedure, known as OAKOC or KOCOA (Observation and Fields of Fire, Avenues of Approach, Key or Decisive Terrain, Obstacles – both man-made and natural, Cover and Concealment), encompasses terrain and weather considerations. Historians, geographers, and archaeologists also use OAKOC to study the outcomes of battles throughout history. The development of GIS has advanced research in the field of military terrain analysis (Headquarters, 2017). Studies employing GIS spatial analysis methods and the standard military OAKOC process were conducted by: Borisov et al. (2010), Brown (2021), Cvijanović et al. (2018), Fleming et al. (2009), Grindle et al. (2004), Pahernik & Kereša (2007), Spennemann (2020) and Zečević et al. (2017).

There are numerous studies that assess the impact of terrain on battles fought in the past, aiming to understand better its influence on future military operations (Roskin, 2020; Roskin & Dekel-Dolitzky, 2020). However, there are few studies like this one that use GIS and a methodology of military geographic assessment based on military principles. Throughout history, strategically positioned fortifications have provided significant advantages in the outcomes of battles. For example, Nicolle (1998) and binti Majlan and Alatas (2022) describe the significance of the Alhambra fortress, whose position on elevated and prominent terrain enabled the establishment of a defensive stronghold and control of communications in the city of Granada (1491-1492). However, Alhambra was not used for defensive purposes in modern warfare. There is a similarity in tactical importance, positional advantage, and geological structure of fortified positions on karst terrain in operations conducted during different historical periods such as: the defence of Gibraltar, the eastern coast of the Bay of Kotor in 1914, and Monte Cassino in 1944.

Gibraltar Peninsula was formed on a rocky mass with steep slopes, composed of Jurassic dolomitized limestone. Its surface and the interior (network of underground passages/tunnels) are interlaced with various fortification structures constructed and upgraded in different forms by the Moors, Spanish and British throughout various historical periods. Gibraltar experienced

15 major sieges between the years 1309 and 1989 (Rose, 2001). It was an important naval stronghold during World War II, with a strong British garrison, port infrastructure, and an airport.

The Austro-Hungarian fortresses of Goražda (German: *Werk Gorazda*), Vrmac (German: *Werk Vermac*), and Trašte (German: *Werk Traste*) were part of the defensive system protecting the Bay of Kotor and ensuring a safe base of the Austro-Hungarian fleet in the naval port of Boka Kotorska. The fortresses were built on karst terrain, protecting the eastern side of the Bay of Kotor. During October 1914, they endured attacks and shelling from Montenegrin artillery on Mount Lovćen, using 120 mm and 155 mm calibre cannons, without suffering significant functional damage to the forts that could not be quickly repaired (Martinović, 2015).

The position of the Monte Cassino abbey dominates over the nearby town of Cassino and overlooks the valleys of the Liri River (the avenue of approach towards Rome) and the Rapido River. The Rapido River encircles the town of Cassino, and it was a water obstacle during the movement of Allied forces (US Army, Free French Forces, Polish Army, British Army, and forces of the British Empire) manoeuvres. The elevated point built from Mesozoic carbonate rocks (mostly limestone and dolomite), on which the Monte Cassino abbey is located, represented key terrain on the 'Gustav Line'. This defensive line was a system of fortified positions in the mountains that stretched from the Adriatic to the Tyrrhenian Sea (Ciciarelli, 1994). The positions below Monte Cassino abbey were defended by portion of the German parachute division. After the abbey was destroyed in air raids, the ruins were turned into well-fortified defensive positions. The German forces further strengthened their position by flooding the Rapido River valley, creating a natural barrier towards the key terrain above the town of Cassino. During 1944 (from February to May), the Allied forces made four attempts to capture the fortified positions at Monte Cassino. They were repelled three times, and in the fourth attempt, with heavy losses, they captured the ruins of Monte Cassino.

The focus of the paper is on the fort Imperial, deemed the primary stronghold in the defence of Dubrovnik (Pezo, 2015). Its significance is underscored by its elevated location atop Srđ, overlooking the city of Dubrovnik and its surroundings. The authors were prompted to write this article by the lack of literature addressing the importance of military geographical elements during the Homeland War in Croatia.

METHODS, DATA, AND MILITARY GEOGRAPHICAL CHARACTERISTICS OF THE STUDY AREA

All events, timelines, positions of troops and weapons were taken from literature cited in the paper, with most references taken from Pezo (2015). With the support of GIS tools, OAKOC analysis was used as the base for the explanations of courses of action during battles. As part of the spatial analysis of military geographic factors, we delved into the primary geographic elements that shaped the development and outcome of the conflict during the assault on the city of Dubrovnik and its environs in late 1991. The analysis of the terrain and events during the defence of Dubrovnik towards the end of 1991 was executed using the OAKOC analysis procedure, a method employed in the military profession to reconstruct the influence of terrain and applied military tactics in military operations (Department of the Army, 2003; Headquarters, 2017). Some scientists use other permutations of the acronym OAKOC, such as OCOKA or KOCO A during archaeological battlefield research (Brown, 2021).

The spatial analysis was carried out with ArcMap 10.5 together with the Spatial Analyst extension, as well as Global Mapper 20. The spatial analysis conducted in this paper was based on the digitization of several key maps and military terrain models, providing a comprehensive foundation for our research. To be more specific, the official Topographic map of the Republic of Croatia at a scale of 1:25,000, the base map of Croatia at a scale of 1:5,000, and military terrain models with a raster cell resolution of 5×5 metres were used.

In order to generate realistic spatial analysis outcomes, we employed the Digital Terrain Model (DMT) to assess the visibility of individual locations. This model, which encompasses the Digital Model of Relief (DMR), incorporates data on vegetation height and the actual height of built structures. Approximate values for the height of land cover were assigned in visibility analysis, with forests estimated at 15 meters and bushes at 3 meters. Furthermore, for vegetation and land use analysis, CORINE land cover data from 1990 was used (European Environment Agency, 2023).

Fields of fire were presented based on the maximum potential range of weapons. Terrain trafficability of the T-55 tank (the only type of tank used by JNA in operation) was evaluated considering factors such as relief slope, water bodies, vegetation, soil, weather conditions, and man-made structures (Heštera & Pahernik, 2018). Each factor was assigned a vehicle deceleration rate from 0 to 1, where 0 represents immobility and 1 denotes the maximum off-road speed (40 km/h), following Heštera (2021) methodology. Possible T-55 tank movement was

categorized into four terrain trafficability categories: GO, Slow GO, Very Slow GO, and NO GO (Heštera, 2021).

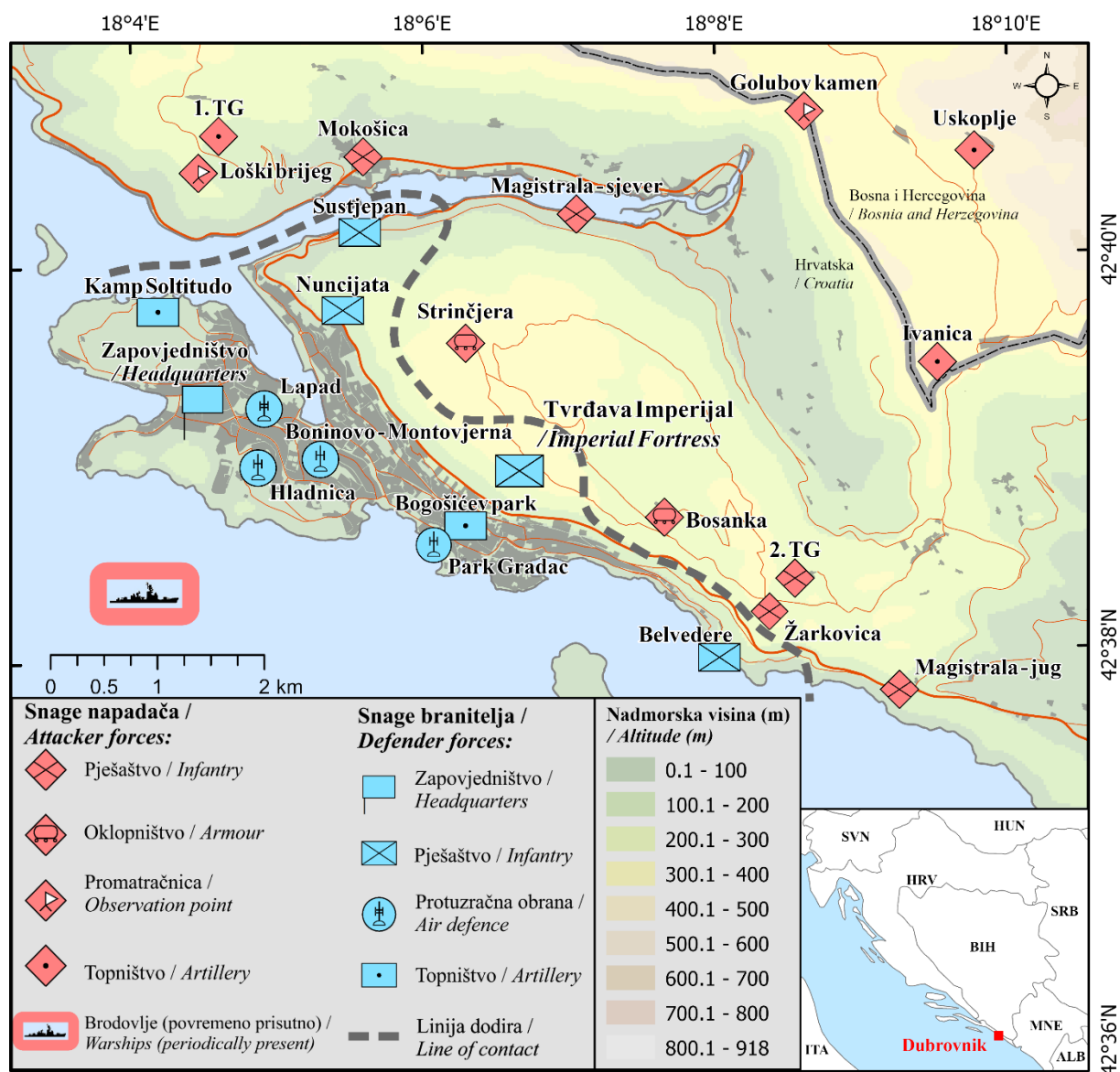
The combination of the synergy between natural elements and developed fortifications ensured Dubrovnik withstood sieges and attacks by various aggressors for centuries. Fortification structures and their arrangement in the Dubrovnik area were described in the introduction. During the Homeland War, the primary tactical-operational characteristic of this area was the extreme tactical shallowness of the territory, which limited the manoeuvring of units in depth. The area around Dubrovnik represents a typical Mediterranean landscape protected by natural barriers, including the steep slopes of the surrounding hills and rugged rocky shores that limit access to attackers from the sea. The peninsular position of the city in a natural harbour, with its centuries-old walls, is further defensively strengthened by the Dinaric orientation of the terrain (northwest-southeast direction), which is basically parallel with national border to Bosnia and Herzegovina. The geological and geomorphological features of the area are defined by karst limestone, dolomite, and flysch bedrock with a very thin soil layer. Apart from the Ombla river, the area lacks significant surface watercourses, with underground runoff of precipitation predominating. Drinking water is sourced from limited underground springs and artificial cisterns. The soil and climate, characterized by hot summers and mild humid winters, are the primary reasons for the dominance of low vegetation and poorly developed forest cover. Dubrovnik is the main urban (nearly 50,000 inhabitants in 1991), administrative, political, and economic centre. Other settlements are mainly located along the coast and within levelled flysch zones in hinterland. Considering the ethnic composition in 1991, Croats dominated (78%), while Serbs were the most significant minority (9%) (Republički zavod za statistiku, 1992). The road network is limited to the narrow coastal strip, there are no railways, and the airport is located 20 km inland from the city in Konavle field. In the event of war, Dubrovnik represents a gravitational centre and a strategically important city for the entire southern Dalmatia, and had it been conquered, for Croatia it would mean loss of control over the entire region.

RESULTS

Operational context and troop positions

The ability to defend Dubrovnik and its environs is severely constrained by its highly disadvantageous defensive position. The stretch from Neum to Prevlaka spans slightly over 90 kilometres, with the Croatian territory at its widest point measuring only 14 km while at its narrowest point it is just 1 km. Consequently, in the event of an attack from the north and northeast, the defenders of Dubrovnik and the surrounding region would find it challenging to establish a network of reserve positions due to the scarce depth of the area. This demands a resolute defence of the critical terrain, which represents the final line of defence, notably Srđ.

According to the JNA commander, Admiral Mile Kandić, the 472nd Motorized Brigade was entrusted with the task of "... breaking out as soon as possible on the Adriatic road in the broader Dubrovnik area, unblocking the Kupari military installation, occupying the Srđ installation, blocking the city of Dubrovnik, and isolating it from the rest of the territory of the Republic of Croatia." (Pezo, 2015, p. 103). The importance of capturing Srđ and the fort Imperial for the implementation of JNA aggression in the south-eastern part of the Republic of Croatia can be inferred from the intention of the commander of the military maritime area ('vojnopomorska oblast') expressed through the order for the attack. Upon the capture of Srđ, Dubrovnik was anticipated to surrender. Figure 3 illustrates the approximate battlefield situation in late 1991. The situation for Dubrovnik at that time was extremely unfavourable, as the city remained isolated in terms of transportation and was narrowly connected to the mainland. The remaining territory consisted of a peninsula surrounded by the attacker, who had occupied prominent high ground in the wider area, with only fort Imperial remaining under the control of the defenders. It should be noted that the precise size of the force remains unknown as both sides exaggerated their troop numbers.



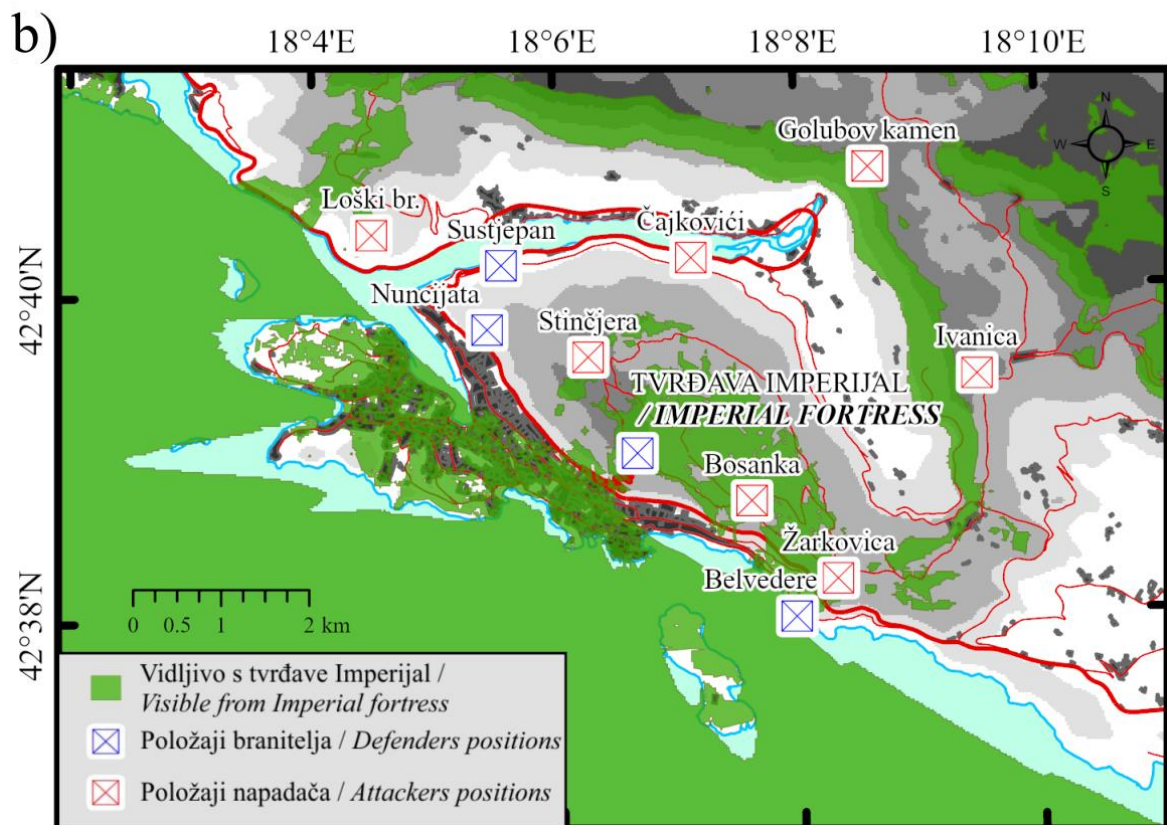
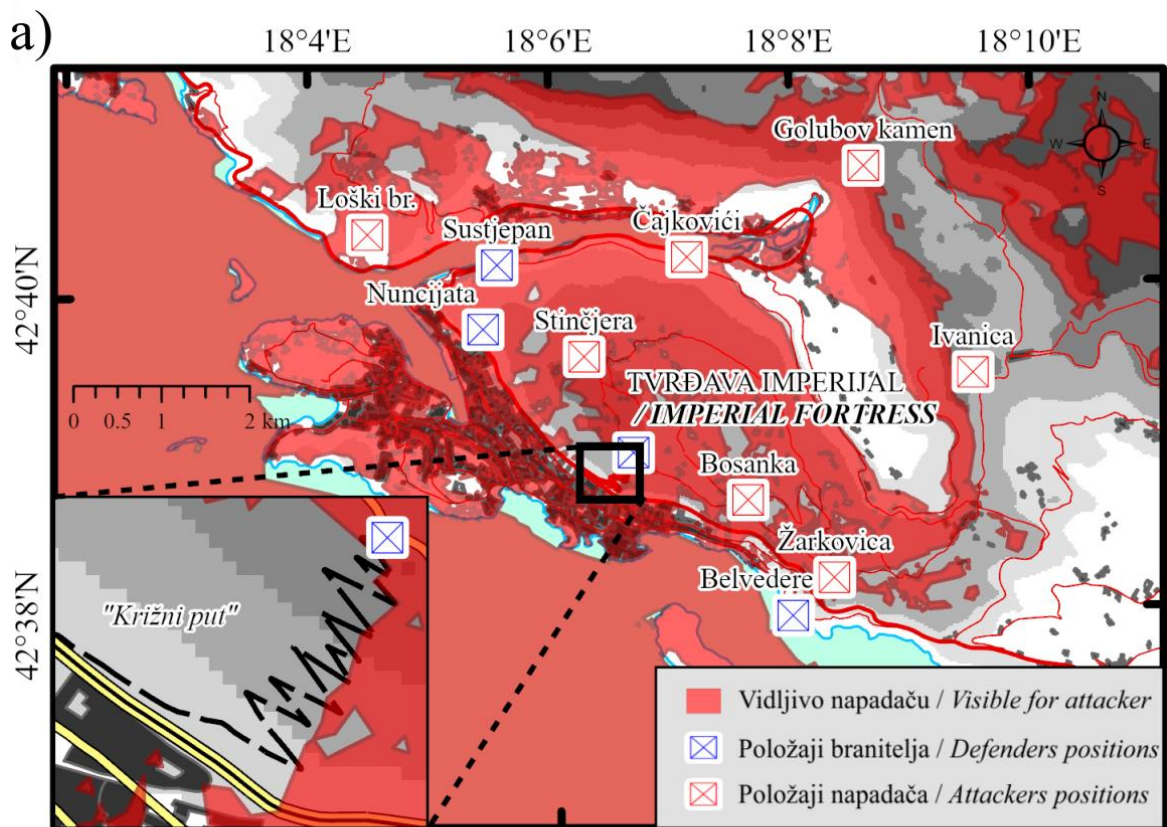
Slika 3. Raspored snaga krajem 1991. godine
Figure 3 Force deployment at the end of 1991.

OAKOC: Observation and Fields of Fire

Observation, or visual control of the area, facilitates the monitoring of enemy and friendly forces' activities and movements, thus preventing unexpected attacks and enabling friendly forces to prepare their defence more effectively. Topography, vegetation, buildings, and meteorological conditions all influence surveillance capacity. In this location, there are no underground communication lines. Typically, elevated terrain offers optimal observation points, yet intervisibility lines may impose limitations. The attackers seized all prominent peaks in the marginal part of the mountain range and occupied all positions on Srđ plateau, except for the fort Imperial (Fig. 4b). From these occupied positions, they exercised visual control over the

entire peninsula of the city of Dubrovnik. The only area not visible to the attackers from any of their positions was the footpath named 'Križni put' ('Way of Suffering') connecting the city to the fort Imperial. Situated in a gentle valley on a steep slope, the path is only visible from the seaside or the city itself, rendering it concealed from the attacker's perspective (Fig. 4a and Fig. 5). It should be noted that surveillance was only possible from ships, but they were not constantly present in the waters near Dubrovnik.

Positioned on the far edge of the steep slope above the city peninsula, the fort Imperial allows defenders a comprehensive vantage point to observe the surrounding area in all directions (Fig. 4b). From this strategic position, the defenders had a sweeping view encompassing almost the entirety of Dubrovnik, the narrow expanse surrounding the city on Srđ plateau, and the slopes and peaks of the plateau extending from northwest to east. During the 1991 attack, the fort stood on open ground, ensuring that no assault could transpire unnoticed. Moreover, the fort Imperial lay at least 500 meters away from the nearest vegetation.



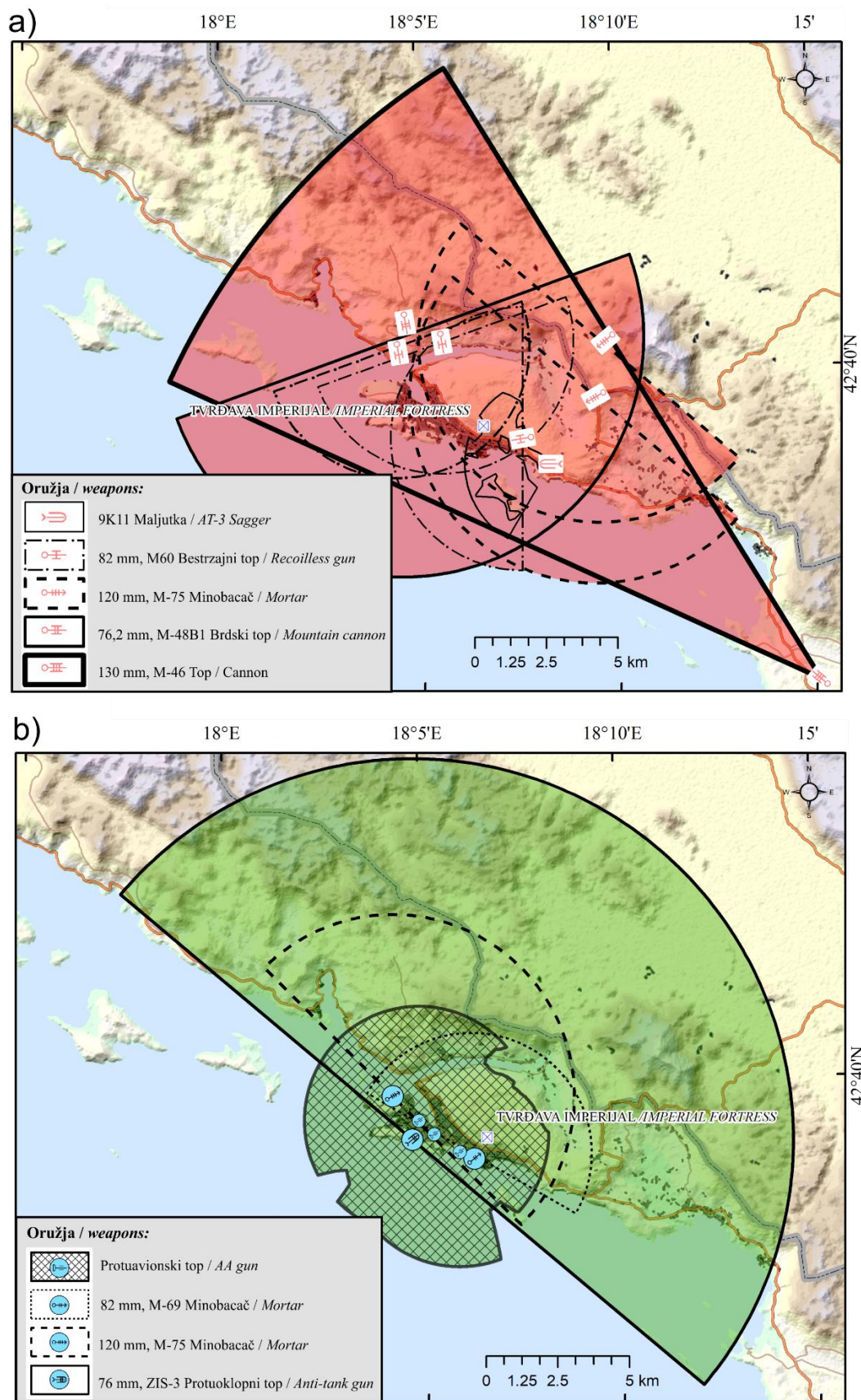
Slika 4. Mogućnost motrenja sa pozicija: a) napadača; b) Tvrđave Imperijal
Figure 4 Surveillance capacity from: a) attackers' positions; b) fort Imperial.



Slika 5. Pogled iz perspective napadača iz sela Bosanka prema Tvrđavi Imperijal
Figure 5 Attackers' view from the village Bosanka to the fort Imperial.

Fields of fire denote areas from which weapons can be effectively deployed from a given position. During the attack on Dubrovnik, the attackers enjoyed significant superiority over the defenders in terms of fire support, which comprised artillery, mortars, and antitank weaponry (Pezo, 2015), as illustrated in Figure 6a. The firing positions of the attackers allowed excellent efficiency and effectiveness of the weapons. Their fields of fire blanketed the entire area during the assault, allowing for the simultaneous engagement of defensive positions and other targets in the vicinity of Dubrovnik.

On Srđ plateau to the east, the field of fire from the fort Imperial faced limitations imposed by the eastern forest (500 meters) and intervisibility lines to the north and southeast (1000 metres). Moreover, due to the steep hill situated southwest of the fort Imperial (Fig. 6), the use of flat trajectory weapons from the city towards Srđ was restricted; instead, it was limited to mortar fire with the capability of 'plunging fire'. Nevertheless, positioned at the very edge of the plateau, the fort Imperial was a spot where nearly the entire city of Dubrovnik could be targeted from.



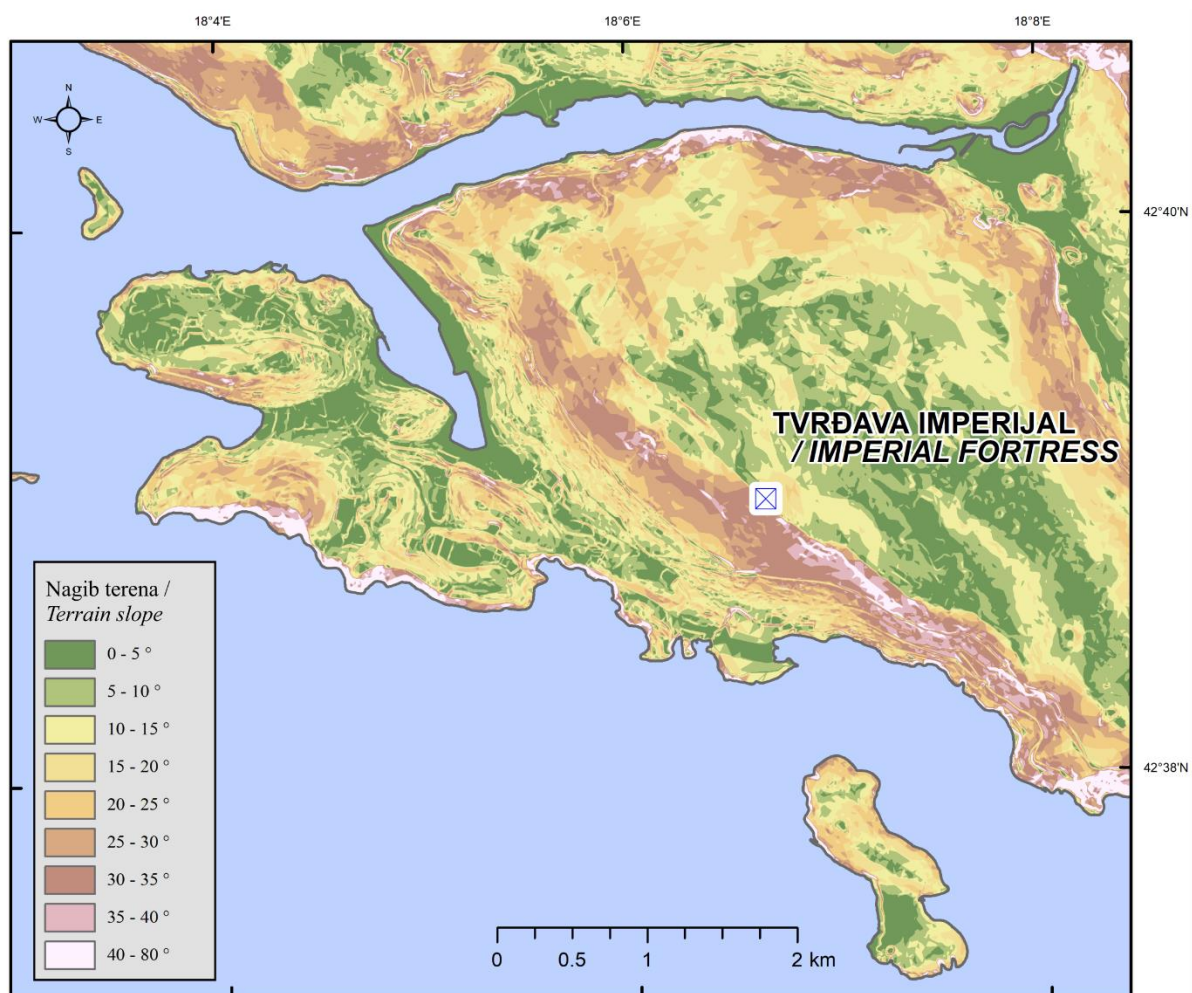
Slika 6. Paljbeni položaji i polja vatre (maksimalni dometi oružja): a) napadač; b) branitelj
Figure 6 Fire positions and fields of fire (maximum ranges): a) attacker; b) defender.

In contrast, the fire support available to the defenders of Dubrovnik was notably modest. Although the effective range of the weapons at their disposal allowed for targeting deep rear positions of the attackers, most of these weapons were allocated for city defence (Fig. 6b). A limited number of mortars and flat trajectory cannons provided supplementary fire support in the vicinity of the fort Imperial.

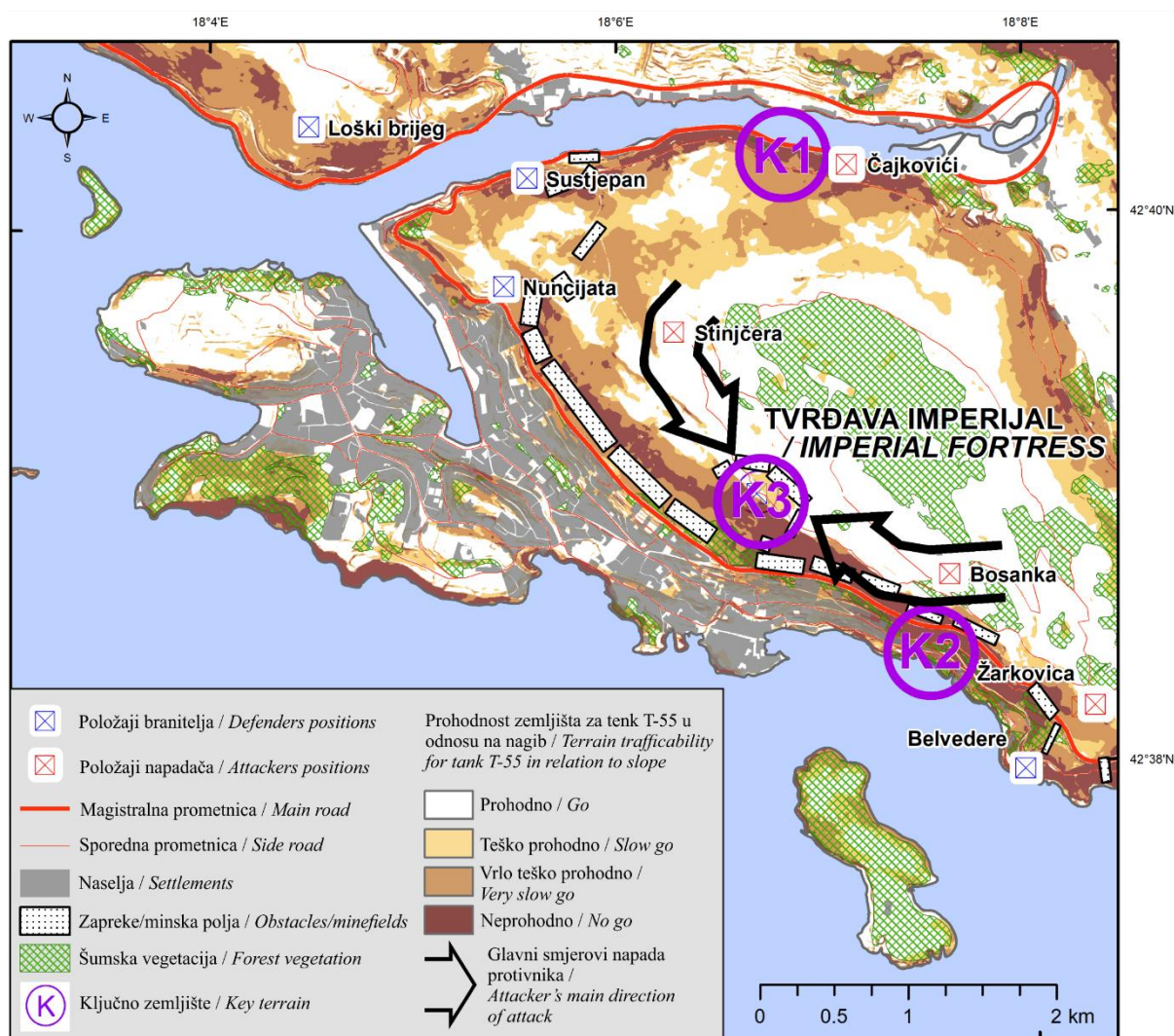
OAKOC: Avenues of Approach

An avenue of approach denotes a relatively unobstructed air or land route through which military forces can advance towards key terrain or other objectives within the area of operations. The transport infrastructure, relief features, vegetation, hydrographic networks, and soil condition all impact the trafficability and mobility of forces and vehicles in an area.

Dubrovnik is accessible via sea or via ‘Jadranska magistrala,’ a coastal road leading from the north to towns Slano (35 km), Gornji Brgat to the southeast (5 km), and Cavtat to the south (17 km). The terrain leading to Dubrovnik doesn't accommodate movement for motorized units in battle formations and is only suitable for road travel. Moreover, there is no rail network in this region. Srđ plateau, overlooking Dubrovnik, permits movement for battle formations but is encircled by steep hills on all sides except for the possible vehicle access from southeast via Gornji Brgat (Fig. 7). Access to the fort Imperial is attainable from the southeast via two loose surface roads: the route from the village Bosanka and a detour route circumventing the forest and traversing over the top of Strinčjera (Fig. 8). These two corridors, each approximately 500 meters wide and 1000 meters deep, served as the primary routes of attack. They accommodate company-level battle formations, consisting of three platoons of about 30 individuals each, with an average soldier spacing of approximately five meters (Headquarters, 2019, p. 53). During the most intense assaults on the fort Imperial, two tanks advanced from Bosanka and one from Strinčjera, accompanied by infantry. Given that observation positions favoured the defenders, the attackers resorted to using smoke screens and the cover of night to conceal their movements.



Slika 7. Nagibi terena u okolici grada Dubrovnika
Figure 7 Terrain slope around city of Dubrovnik



Slika 8. Ključni tereni, prohodnost zemljišta i avenije prilaza prema tvrđavi Imperijal
Figure 8 Key terrain, trafficability of terrain, and avenues of approach leading to the fort Imperial.

OAKOC: Key Terrain

In numerous instances throughout military history, geographical features of terrain have dictated the strategic significance of certain regions on the battlefield, providing the holding side with a significant tactical advantage over the opposition. In this context, two access roads and the summit of Srđ emerge as the three key terrains crucial for gaining control over Dubrovnik.

Two crucial land routes were effectively blocked by the attackers, severing the city's logistical supply. Dubrovnik remained cut off from supplies from the Croatian mainland due to the control of the northern route, depicted in Figure 3 as 'Magistrala – sjever,' and Figure 8 as Key terrain 1 – 'K1,' by the attackers. The attacker also controlled the southern route, key

terrain 2 – ‘K2’ (Fig. 8), or ‘Magistrala – South’ (Fig. 3), which connected the city with the local airport and the town of Cavtat in the south. With both routes closed, the only remaining supply route was the sporadic supply by fast boats, which took place mainly during the night. The fort Imperial atop the Srđ plateau represented the third key terrain – ‘K3’ (Fig. 8). The capture of the plateau overlooking Dubrovnik would have enabled the attackers to direct fire at city facilities, access routes, nearly all defender positions, and incoming ships. Even from the most advanced JNA position (Žarkovica), observers could not reach all parts of Dubrovnik (Fig. 4a). Considering the inability to observe all areas of the city, Croatian forces positioned mortars around ‘Kamp Solitudo’ to conceal firing positions (Fig. 3). Furthermore, Žarkovica position did not obstruct the boat access routes to Dubrovnik.

Srđ, along with the fort Imperial, not only constitutes a key terrain but also embodies all the characteristics of a dominant area. That is, due to its height, slope, dimensions, and position, it enables quality observation and provides firing sectors over the surrounding terrain. Therefore, the fort Imperial, with its characteristics, contains all the features of a decisive point on the terrain, even though it is not the only key terrain in the area of operations.

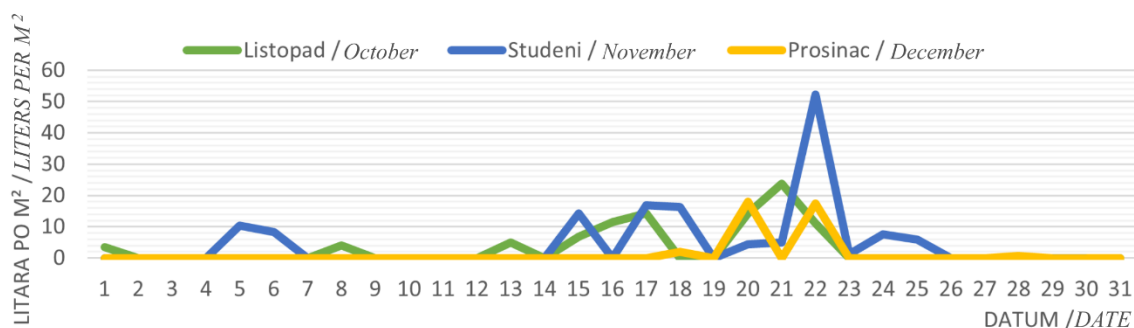
OAKQC: Obstacles

Obstacles, whether man-made or natural, played a critical role in the defence strategy. Defenders strategically positioned several minefields for infantry and anti-tank weapons along important traffic routes leading to the city, along the main road, in vicinity of the fort Imperial, and on the slopes of Srđ (Fig. 8). These obstacles on the main road facilitated traffic control by impeding the arrival of attackers motorized units. To deter infantry from swiftly infiltrating the centre of Dubrovnik, minefields were established at the foothill of Srđ. The rugged and uneven terrain posed challenges for concealing mines. In preparation for morning attacks, the attackers could clear minefields at the north of the fort Imperial under the cover of night. The installation of these barriers further underscored the position of the fort Imperial as the primary bastion of Dubrovnik's defence.

The relief of the wider Dubrovnik region is characterized by hilly and impassable terrain, highly vertically dissected from the coast to the mainland interior. Only a gentle slope on the south-eastern side of Srđ connects it to the hinterland, as it is surrounded by steep slopes from all other sides (Fig. 7). The south-eastern portion of the plateau of Srđ is accessible by vehicle. The sole road used by the attackers to maintain connectivity to all positions on the plateau of

Srđ traversed the south-eastern part of village Gornji Brgat. Topologically, Srđ is lacking prominent peaks, resembles a rocky plain that makes it easy for military vehicles to manoeuvre. However, the rocky terrain hampered the mobility of personnel and all vehicle types, impeding their progress. The forest cover and rocks rendered the central part of the plateau of Srđ impassable, while the remaining vegetation minimally affected troop mobility, except for the maquis, which restricted infantry movement.

The solid rock at the surface and the prevalence of shallow soils in Dubrovnik facilitated vehicle movement. The presence of brown, black, and red clays derived from dolomite-based soils characterizes this rugged karst region. These soil types exhibit an automorphic moistening, whereby rainfall freely percolates through the soil's solum, ensuring optimal drainage (Husnjak, 2014). Notably, the attackers encountered highly favourable weather conditions during the attack, with precipitation posing no impediment to troop movement (Fig. 9). Cloud cover, fog, temperature extremes, and wind variations had negligible effects on military operations planning or execution.



Slika 9. Padaline na području grada Dubrovnika krajem 1991. godine

Figure 9 Rainfall in the city of Dubrovnik at end of 1991.

Izvor: Državni hidrometeorološki zavod / Source: Croatian Meteorological and Hydrological Service.

OAKOC: Protection and Concealment

The term 'protection' in a military-geographical context pertains to the defenders' capacity to withstand enemy fire, which may manifest as direct fire or bombardment. Structures like buildings, trenches, canals, and walls serve as protective measures. The battlefield in the wider area of Dubrovnik and the Srđ plateau consists of karst terrain, with a very shallow soil layer (only a few centimetres), and very often without any soil cover, exposing limestone or dolomite rock on the surface (Jakšić & Martinović, 1984; Marković, 1971). The effect of artillery on targets in such terrain (open karst land with limestone or dolomite rock on the surface, and sparse low vegetation) is significantly greater than on land with a deep soil layer and lush

(dense) vegetation (Zečević & Jungwirth, 2007). The high efficiency of fragmentation grenades in open karst terrain (fragments from exploded grenades and sharp rock pieces scattered by explosions), along with the intensity of shelling, influenced the withdrawal of the Yugoslav People's Army (JNA) from that exposed area under mortar fire. In such karst environment with rocky terrain, it was difficult to quickly construct fortifications on Srđ (without heavy machinery and explosives), so defenders utilized existing fortification structures. In that context, the quality and position of the fort Imperial represented a significant advantage for the Croatian forces. Among all existing fortifications on Srđ, only the fort Imperial remained functional, serving as the command centre for the defence of Srđ. Other defensive positions were established among the ruins of other fortifications located near the fort of Imperial. The defenders utilized the remnants of the Delgorgue fortifications on Žarkovica, Strinčjera, and structures around the village of Bosanka. The attackers faced challenging conditions due to the effectiveness of the defenders' fire during manoeuvres over the open karst terrain. They also struggled with the inability to quickly construct trenches and shelters or to fortify the captured positions.

DISCUSSION

Srđ, with the fort Imperial, emerged as a key terrain in the Battle of Dubrovnik, along with other key terrains in the vicinity, notably the two access roads to the city. The territory of Srđ, centred around the fort Imperial, holds as decisive terrain, as its capture would grant the attackers strategic advantages, allowing them to neutralize or annihilate the defenders' forces, disrupt the city's logistical support, and target any point within the city. In such conditions, cut off from supply lines and undefended, it is likely that the city would have surrendered after a certain period due to the lack of basic resources.

The strategic significance of Srđ was underscored by JNA command order, where Admiral Mile Kandić emphasized the capture of Srđ as a crucial objective for the operation's success (Pezo, 2015, p. 103). The attackers' intention underscores the role of Srđ as not only a key terrain but also a decisive point on the ground, as defined by Jomini (1838).

The defender's biggest issue along quantity of long-range guns was ammunition. This arose due to transportation disruptions and insufficient logistical support, affecting ammunition and weaponry across all locations. With both roads to Dubrovnik controlled by the attackers, the logistic support was sporadic, mainly relying on occasional provisions delivered by speed-boats from the Armed Ships Detachment. These boats not only delivered material and technical

resources but also conveyed news and information to the besieged city (Pezo, 2015). With two of the three key terrains encircling the city falling under attacker control, the fort Imperial became their ultimate objective.

A single footpath 'Križni put' remained as the sole link connecting the city of Dubrovnik to the fort Imperial. None of the attacker's positions allowed for surveillance of this path, as it was visible only from Dubrovnik and the sea. Conversely, had the attackers seized control of the fortress, Dubrovnik would have fallen into their hands. The inability to monitor this footpath was crucial for Dubrovnik's defence. This link facilitated the delivery of both personal and logistical support to the defenders in the fort Imperial. Air surveillance was unfeasible due to the positioning of anti-aircraft guns within the town. Surveillance from the sea also posed limitations, as any ship detected near Dubrovnik would likely face continuous fire. Although the city was occasionally targeted by ships, the footpath remained a challenge for targeting due to its slope and concealment from the attackers' view. On 12 November, 1991, following one of the most intense attacks and the loss of the position at Strinjčera due to supply shortages, all defenders withdrew from the fort Imperial for that one night. The main bastion of defence stood undefended for two days (Pezo, 2015, p. 701). However, the defenders returned on 14 November, 1991. The attacker's failure to capture the fortress was solely attributed to the lack of visual control over this crucial communication line. Essentially, due to the lack of control over the supply route, the attackers did not have information about the number of defenders and the amount of weaponry in the fortress.

The attackers' forces couldn't gather in the immediate vicinity of the fortress due to the expansive open space spanning about 500 meters wide, accommodating the presence of company-level soldiers. If the attackers had opted to strike with additional troops, these forces would have been highly vulnerable to artillery or mortar fire, given the difficulty of separating men effectively. In the climactic battle on 6 December, 1991, the attackers launched a strike on the fort Imperial from two directions, backed by artillery support, infantry, and a tank platoon comprising three T-55 Soviet-era tanks. Despite gaining access to the fortress's upper levels, the defenders sought refuge in the basement. At the insistence of the defenders within the fortress, fire support was provided from the city of Dubrovnik directly onto the fortress while the defenders were inside. The rocky terrain and burst rock fragments from explosions reinforced the impact of the fire support. The fortress shielded the Croatian soldiers at lower levels, and the city's fire support inflicted severe casualties on the attackers' forces, compelling them to abandon their assault.

The outcome could have differed had the attackers directed their firepower towards the fort Imperial during the assaults. During the attack on the city despite possessing ample firepower, including air support, they utilized it inefficiently by targeting objects devoid of military significance, making it challenging to ascertain the necessary firepower to neutralize the fortress (Pezo, 2015, p. 608–617). According to the reports of the Institute for the Restoration of Dubrovnik, 594 objects within the city's historic core, under UNESCO protection since 1972, sustained damage (Blagoje, 2009), though the actual figure could be higher, considering unaccounted objects. The invader could have deployed Special Forces to breach the fortress but opted against it. It's unknown if the attackers had Special Forces available to engage in the battle.

Despite being defended by a relatively small contingent (around 30 soldiers), the defence forces successfully thwarted the attackers. The heaviest weapon employed from the fort Imperial was the heavy machine gun. The fortress's impact would have been more substantial had the defenders possessed access to more potent weapons akin to those used by the adversary.

The fort Imperial is decisive terrain because its capture would have made it impossible for the defenders to monitor the attackers' movements in any way. The defenders would no longer have been able to command and control artillery fire. Supply from the seaside would no longer have been safe or possible, as the attacker could have directly and indirectly affected the harbour and the vessels in it. The described scenario would very likely have led to the decision to surrender Dubrovnik to the attackers after the capture of the fort Imperial. The loss of hill Srđ would mirror the only case in history when the Republic of Dubrovnik was defeated in armed conflict; at that time, the occupation of Srđ resulted in the city being handed over to the army of Napoleon Bonaparte.

Throughout history, there have been numerous fortification objects or defensive systems fortresses on similar or identical land as where the fort Imperial is situated. Some of them fulfilled their role in modern warfare, of which, already mentioned in this paper, are the defensive complex of Gibraltar, a fortified position at Monte Cassino, the defence system of the fortresses in the eastern part of the Bay of Kotor (Goražda, Vrmac and Trašte) and the fort Imperial on the hill Srđ.

CONCLUSIONS

The analysis showed that the city of Dubrovnik was accessible only by two narrow land routes, apart from the sea. The main element of the battle is hill Srđ, which is close to the city and provides control over the entire area. One Napoleonic-era fortress situated on the edge of a plateau was enough to stop the attackers' advances. Another contributing factor on the defending side was the fact that the fortress' logistic supply was carried out using only one footpath, and no position held by the invader could have provided surveillance of that pathway. The attacker failed to monitor the only supply route by the sea, and the usage of drones at the time was, at least very limited.

If JNA had seized the fort Imperial as the primary and strongest fortification on Srđ, Dubrovnik's defence would have been significantly compromised. The city's fall would have granted the aggressor control over southern Dalmatia, plunging the Republic of Croatia into a precarious military and diplomatic predicament. Hill Srđ, with the fort Imperial at its heart, emerged as the key and decisive terrain for the operation. The unconquered fort Imperial and the city of Dubrovnik enabled subsequent operations to liberate Konavle and the surrounding Dubrovnik area. In essence, it facilitated the liberation of the entire southern theatre in the Homeland War of 1992.

The evolution of warfare has diminished the significance of traditional fortresses due to advancements in artillery, aviation, and mechanized forces. However, the example of the fort Imperial demonstrates that defensive fortifications can still have crucial importance in the era of modern conventional warfare.

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