Constructing aspects of building the Split baroque bastion fort

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Abstract
At the beginning of the 17th century the City of Split was still surrounded by mostly medieval elements of fortifications adapted to the remaining walls and towers of the ancient palace of the Emperor Diocletian. Since the outbreak of the War of Candia in 1645 the City is fortified on several occasions with different types of fortification works to the final bastion fort, built between 1660 and 1668. Building chronology and geometric elements, as well as building and constructing techniques of this bastion fort, can be precisely followed, described and analyzed by studying extensive written and graphic historical materials, and by investigating physical remains of the fort parts. Between numerous documents related to building the bastion ring around the city there are reports of Sopraintedente all'artiglieria Filippo Besseti Verneda, dated from the period between 1663 and 1665. They represent an exceptional source of data on duration and costs of building, on necessary work force, and on building materials and tools. Current paper offers results of the research on geometric elements and profiles of the mentioned bastion fort, building techniques, used materials, work costs and work force members necessary for carrying out such a building venture.

Keywords: Split, bastion fort, building techniques, profiles

1. Introduction
The City of Split has its origins in the palace of the Roman Emperor Diocletian, built at the beginning of the 4th century on the eastern coast of the Adriatic, near an important ancient port of Salona. Until the end of the Middle Ages high walls and towers of the palace were subjected to minor modifications, and provided exceptional protection from aggressors. Once a more destructive weapon of artillery entered the historical scene, the warfare assumed an entirely new form, and defence of Split had to adapt to these changes.

At the end of the 16th century Split, due to its geostrategic position, became an important trade centre between the Republic of Venice and the Ottoman Empire. For this purpose, along the coastline of the city, a vast system of Lazaretto was built in several stages, where an extremely successful trade was taking place, bringing Venice considerable profits in the first half of the 17th century (Perojević, 2003).

But towards the end of the mentioned period it was the time of rather intense political affairs between La Serenissima and the Ottoman Empire, culminating in the outbreak of the War of Candia (1645-1669). The defensive power of Split, at that time still largely determined by elements adapted only to medieval warfare, had to be improved and modernised quickly.

For this purpose, a great extent of work on fortifying the city was undertaken in three different stages (Marasović, 1993). The first was the covered way system (strade coperte), then the redan system (mezzalune, as they are usually called in the historical documents which are
related to its construction) and finally, the bastion fort which had a form of a half of a regular heptagon (circumradius of the heptagon ~330 meters) and it was built according to a design of Don Innocentio Conti, which was executed from 1660 to 1668. The fort consisted of three bastions (Priuli, Cornaro and Contarini) and two demi-bastions spreading at the edges of the coastline with curtain walls (cortina) among them.

Besides the described construction which enclosed the core of the city (1), two separate fortresses were also built in the area of Gripe (2) and the area of Bačvice (3).

Fig. 1- Split - Bastion fort (a half of a regular heptagon) in the 17th century (author, 2012)

1. Problems of fortifying Split from the aspect of the position of the city

The two earlier stages of fortifying the city with the systems of strade coperte and mezzalune along the Bernardi bastion (4) which was built in 1658 in the south-western corner of the city (later enclosed with the bastion ring), were not satisfactory enough, and it was considered that the only solution was to fortify the city with a modern bastion fort which would be in accordance with modern techniques of fighting with firearms. However, many believed it was a poor solution considering the position of the city. One person describes the position of Split from the aspect of defence as being entirely defective - it is located in a place surrounded by hills which offer a view of the entire city; the enemy had an easy access due to indented relief; advantages provided by sheltered access roads, trees, houses in the suburbs, churches and monasteries - all in favour of the attacker and at the expense of defenders (A.S.V., Prov.vi da Terra e da Mar, f. 476, Relazione di Pietro Antonio Darcila, 1654). Even designer Innocentio Conti at some point thought it would be best to relocate the population of Split and destroy the city so it would not fall into the hands of enemy (Perojević, 2003: p. 123).

Position of the Gripe fortress was much more significant for defense of the city since it was located on a hill from which the city, as well as its surrounding area and land access to the city, could have been easily controlled and defended (Perojević, 2013).

Proof on how much Split was unfavourably positioned in the area, and in order to be fortified properly, comes from army engineer Napolion Eraut (Perojević, 2006), who analysed the carried out condition in 1682. Eraut states that it would be better if the city was not even fortified with the bastion fort since it was surrounded and squeezed.

Fig. 2- Position of the developed defence system of Split in the 17th century (author)
by the nearby hills, and from one of them you could even see people walking along the streets of the city, all clearly visible from his drawings (B.N.M., Manoscritti Italiani classe IV cod. 28 (5093) CVI.2.NM). It is interesting that the built bastion fort had never been attacked so it could have never proven its quality or its defects.

2. Construction of the bastion fort

Despite doubts and remarks regarding its justifiability and efficiency, this major construction project was carried out in a relatively short period of time.

Larger parts of the bastion fort had been demolished through the history. Luckily, numerous historical and archive documents, both written and graphic ones, have been preserved, which, along with today’s preserved parts of the fort, provide a precise and well based ground for reconstruction of its appearance, time and methods of construction, while also offering numerous data related to other elements of building such a large and demanding architectural endeavour.

The aforementioned Eraut’s drawings from 1682 and descriptions by Soprintendente all’artiglieria Filippo Besseti Verneda which date from the period between 1663 and 1665, fall among the most significant documents, providing data which are mostly used later in the text.

2.1. Escarps - scarpe

Escarps of all the preserved remains of the bastion elements for the entire Split fortification have been measured, except for the Bačvice fortress which has not been preserved. The aspect ratio for scarpe was 1:4 at both the Bernardi bastion and the Gripe fortress, and it was 1:3 in all parts of the bastion ring around the city, with minimum deviations of the measured angles ranging from 71°30’ to 72°.

Besides these parts of the fortification, there were other reinforcements of the earlier systems of fortification which have been preserved in Split,
and the escarps (scarpe) of these elements range from 1:3.5 to 1:9.5. It can be concluded from the aforesaid that the older parts had a steeper escarp (scarpa) in relation to the part of the bastion ring around the city which was constructed last.

2.2. Profiles

Apart from studying the physical remains of all parts of the fortification, the already mentioned Eraut’s drawings were extremely useful for reconstruction of the profile itself.

Eraut draws contramine galerie (escarp gallery / counter-mine) at all cross sections of the bastion fort, but during the process of its demolition and construction on its different parts, no remains were found except for in two places. During demolition of a part of the Priuli bastion in the 20th century and the removal of the terrapien on the inside of the defensive wall, an opening was found for which it was assumed that belonged to the counter-mine area - contramine (Belamarić, Bulimbašić & Nikšić, 2003). The only safely preserved remains are a part of the escarp gallery - contramine (Fig. 7 left), and small room (Fig. 7 right) (probably magazine or listening gallery) preserved in the remains of the demibastion (mezzobaluardo) at the eastern end of the ring.

Santini’s drawing from 1666 records the same gallery at the western demibastion, and it was also mentioned in Verneda’s text (A.S.V., Provv.ri da Terra e da Mar, f.494, Relazione del Cavalier Verneda, 6 May 1665).
2.3. Smaller elements, techniques and materials used for the construction

Santini’s drawing (Fig. 8) also shows the turrets (caselli di muro per le sentinelle) in the corners. Up to this date, only a part of one turret bottom on the Priuli bastion (baluardo) has been preserved. According to historical drawings, there were 13 turrets, positioned on the outer corners of the bastion and demi-bastion.

There were two entrances through the bastion ring - Porta Priuli and Porta Corner (with a smaller passage in the middle of curtain (cortina) between the Cornaro bastion and the Contarini bastion, but none of these gates were preserved.) They are shown most accurately in a drawing by Antonio Corir from 1796 (A.S.V., Rason vecchie, b.181 dis.611, neg.6833 p.p.x pos.646).

In the aforementioned document, Verneda (4 February 1663) notes the overall costs of the gateway - Porta Corner, including construction of an vaulted passage, constructions for a guardhouse - corpo di guardia and decoration of the Corner gate with qualche ornamento d'architettura civile, in the amount of 10,000 ducats.

All outer corners of the bastion ring were built with regular-shaped blocks (about 35 to 60 cm high), horizontally laid, and interconnected with iron cramps, sealed with lead.

The rest of the front part of the scarpa was faced with carved stone blocks of slightly smaller dimensions (Fig. 12), and they were placed vertically (Fig. 13 left) on the scarpa. The inner part of the bastion fort towards the terreplein (terrapieno) was formed with partly dressed rubble (Fig. 13 right).
The internal part of the bastion was built with rubble in mortar (*malta*), which was made from red soil (*terra rossa*) and lime (*calcine*), and it was smoothed at the height of each row of blocks on the front part of the bastion (Fig. 13 left).

The parapet and the banquette (*bancheta*) were covered in grass clumps (*lotte di prato*) (A.S.V., Provv.rì da Terra e da Mar, f.491 n.129, Relazione del Cavalier Verneda, 2 February 1664). Remains of the semicircular cordon - (*cordone*), with a diameter of 1 piede, were partially preserved on the Cornaro bastion.

### 2.4. Time for construction and costs

Data on building cost, including all the required participants, shown according to the type of work:

<table>
<thead>
<tr>
<th>type of work</th>
<th>measuring unit</th>
<th>price (in ducats)</th>
</tr>
</thead>
<tbody>
<tr>
<td>quality wall</td>
<td>1 <em>paso</em>³</td>
<td>30</td>
</tr>
<tr>
<td>terrapieno</td>
<td>1 <em>paso</em>³</td>
<td>4</td>
</tr>
<tr>
<td>muretto (ronda)</td>
<td>1 <em>paso</em>³</td>
<td>30</td>
</tr>
<tr>
<td>contrascarpa</td>
<td>1 <em>paso</em>³</td>
<td>4</td>
</tr>
<tr>
<td>caselli di muro</td>
<td>1 <em>paso</em>³</td>
<td>30</td>
</tr>
<tr>
<td>gateway</td>
<td>1 piece</td>
<td>10,000</td>
</tr>
<tr>
<td>covering the parapet</td>
<td>1 <em>migliaro</em></td>
<td>6</td>
</tr>
</tbody>
</table>
The payment (1 ducato = 48 soldi) of manual workers was divided into the following categories:

<table>
<thead>
<tr>
<th>type of workers</th>
<th>wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>soldiers</td>
<td>12 soldi/per day</td>
</tr>
<tr>
<td>locals</td>
<td>5 soldi/per day</td>
</tr>
<tr>
<td>galley rowers</td>
<td>6 soldi/per day</td>
</tr>
</tbody>
</table>

Time necessary for the construction was defined as a ratio of the required number of persons to make a certain number of passi\(^3\) per day (1 passo \(\approx 5.26\text{m}^3\)), and for a certain type of work:

<table>
<thead>
<tr>
<th>required number of workers</th>
<th>measuring unit</th>
<th>type of work</th>
<th>time for construction months+days (number of workers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 stonemasons</td>
<td>5 passi(^3)</td>
<td>building the wall</td>
<td>8+9 (492)</td>
</tr>
<tr>
<td>(14 stonemasons building and 6 stonemasons cutting stones)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 workers</td>
<td>1 passo(^3)</td>
<td>constructing terrapieno</td>
<td>5+4 (550)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If all this is taken into account in the context of the fact that Split at that time had approximately 4,000 inhabitants, we get an even more picturesque image of performing building of such magnitude.

3. Conclusions

In the second half of the 17th century and during the beginning of the War of Candia Split was badly fortified and in direct danger from the Turkish conquest. Also, geographic position of the town which was surrounded by the hills was extremely unfavourable for defence based on a bastion fort. Despite objections made by military engineers, and even Innocentio Conti, designer of the system, the city was enclosed by 3 bastions and 2 demibastions, based on a regular heptagon. This great architectural venture was completed in about eight years, and apart from preserved parts of the fort, numerous historical drawings and written documents provided enough information to reconstruct its appearance and to define its specificities, some minor elements, the technique of construction and used materials. Also, data on the required number and type of workers, costs of the work, as well as quantities, prices, required time and the number of workers for the construction of certain components of the entire bastion fort, compared to the number of inhabitants of Split at that time, are the most clear evidence of the importance and complexity of this construction venture.

Notes

(1) All historical and archive documents are written in Italian, so the original names are written in italic in the text, referring to a description of certain parts of the fort.

(2) Used abbreviations:
A.S.V. – Archivio di stato Veneziano (Venetian State Archives)
B.N.M. – Biblioteca Nazionale Marciana (National Library of St Mark’s)
M.G.S. – Muzej grada Splita (The Split City Museum)
References


