

# **The São Sebastião fortress at Mozambique Island**

## **A testimony of the variety in sixteenth century military architecture**



Daan Lavies  
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Supervisor: prof. dr. K.A. Ottenheim

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History of Architecture & the Preservation of Monuments  
University of Utrecht

P.D. Lavies

Student number: 3017613

Contact: pdlavies@hotmail.com

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Faculty of Humanities

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# Contents

<b>Preface</b> .....	1
<b>Introduction</b> .....	3
<b>Chapter 1: Historical context of Mozambique Island and the São Sebastião fortress</b> .....	5
1.1 The arrival of the Portuguese on the East African coast .....	5
1.2 The position of Mozambique Island in the <i>Estado da Índia</i> .....	7
1.3 The rise of Portuguese military architecture on Mozambique Island .....	9
<b>Chapter 2: Renaissance innovations in military architecture</b> .....	13
2.1 The development of the bastion system .....	13
2.2 Renaissance military treatises .....	16
2.3 The spread of the system .....	22
2.4 Conclusion .....	24
<b>Chapter 3: The São Sebastião fortress today</b> .....	25
3.1 The current structure .....	25
3.2 Restorations .....	30
3.3 Additional fortifications .....	32
<b>Chapter 4: Phases of construction and modifications of the fortress</b> .....	35
4.1 The earliest descriptions and maps of the São Sebastião fortress .....	37
4.2 The consequences of the Dutch attacks on Mozambique Island .....	40
4.3 The initial outline of the São Sebastião fortress drawn by Erédia .....	40
4.4 A visualisation of alterations in Erédia's second map of Mozambique Island .....	44
4.5 The records on renovation from the <i>Livro das plantas de tôdas as fortalezas</i> .....	47
4.6 The atlas of Leonard Ferrari .....	51
4.7 The final alterations as depicted on two anonymous maps kept in Maputo .....	54
4.8 Conclusion .....	58
<b>Chapter 5: Interpretation of the São Sebastião architecture</b> .....	61
5.1 The initial layout evaluated as an exponent of renaissance military architecture .....	61
5.2 The geographical and strategic anticipations in the initial fortification design .....	66
5.3 The logic behind the modification plans made in the sixteenth and seventeenth century .....	68
5.4 A comparison between the bastioned fortification of Mazagão and Mozambique .....	79
5.5 The appearance of the 'hybrid' defence system in sixteenth century fortification theories .....	82
5.6 Conclusion .....	93
<b>Conclusion</b> .....	95
Appendix I: The architect of the São Sebastião fortress .....	99
Appendix II: The history of secondary fortifications of Santo António and São Lourenço .....	101
Glossary .....	105
Bibliography .....	109
Illustration sources .....	117



## Preface

Most people reacted surprised when I told them that a Portuguese fortress in Mozambique formed the focus of my Master thesis. Although the subject combines my passion for architecture with my love for Africa, the topic might indeed not have seemed to be the most obvious choice. If it was not for the internship that the Netherlands embassy at Maputo had offered me, this study would not have existed. In the spring of 2010 I was invited to come to Mozambique to write a report on the Dutch presence in the region during the seventeenth and eighteenth century. As will be mentioned in this thesis, also the São Sebastião fortress played a role in this history.

Having seen the fortress on *Ilha de Moçambique* I wanted to know more about it. Why was it built here? Which parts have been built when? And above all, what logic lies behind the design? Although the entire island has been inscribed on the UNESCO World Heritage List since 1991, the amount of studies that touched upon these questions proved to be very limited. Especially reliable non-Portuguese literature on the subject is scarce. Through this study hopefully more experts in the field of military architecture will become familiar with this fortification. This might help getting a more complete insight into the variety in renaissance military architectural theories. Furthermore, I hope that people who already know this fortress in Mozambique, will have gained a better understanding of the structure after reading this study.

I would like to thank all the people who have made this study possible and who gave me advice and support during the process. In Mozambique I have experienced a very warm welcome from the staff of the Netherlands Embassy. Furthermore, I would like to thank the architects José Forjaz and Francisco Monteiro for inviting me to their offices and for the information they shared with me. Also the cooperation from the museum of Mozambique Island is very much appreciated. Back in the Netherlands Edwin Paar helped me with the interpretation of the Portuguese texts which have been essential for this research. My supervisor prof. dr. Koen Ottenheim I would like to thank for the enthusiasm with which he gave his lectures in the past years and his advice during this study. Last but not least I would like to thank my family and my girlfriend for their patience and their tremendous support.

The writing of this thesis has taken more time than I could have ever imagined. Although I planned to invest some extra time in this study, I did not foresee that a traffic accident in April 2011 resulted in the fact that that during the following year no progress was made. With the completion of this thesis an end has come to my live as a student, although I hope to keep learning a lot in the future!

Daan Lavies

Utrecht, July 2012



## Introduction

At the end of the fifteenth century Portuguese voyages had reached out to all continents of the earth. Contemporaneously, within Europe, fortification architecture was in a phase of intensive development. These two very different evolvments eventually resulted in the establishment of European fortifications along many far away shores, following new insights in the field of military engineering. The most prominent invention of renaissance military architecture has undoubtedly been the angle bastion. As historian John Hale has noted: *'the application of the angle bastion to forts and town walls led to a homogeneity of style wherever the Europeans settled overseas.'* *'The international style par excellance of the renaissance was that of military architecture.'*<sup>1</sup> Indeed, such defences can be found in places as far apart as Malacca, Recife, Cape Town and Havana. The image of a homogeneous style which has been universally applied could, however, lead to oversimplification. As will be discussed within this research, this has led to studies in which absolute consensus on the principals of renaissance military architecture has been implied. Such an outlook makes it difficult to explain fortification forms which do not comply with what is considered to be the standard.

The assumption made in this study is that more variation has existed within renaissance military theories, than is commonly acknowledged. This hypothesis will be tested in a case study. This research focuses on a fort where aspects of its design are not built in agreement with the principals of renaissance military architecture as these are defined in most modern day literature. Because of the unusual shape of its outline, the São Sebastião fortress at Mozambique Island forms an interesting example. Within this case study the main aim is to gain a better understanding of this fortification. It will be tried to determine what approach to military architecture has led to its initial design and the applied modifications. Before this question can be answered, the different construction phases and the logic behind this will have to become clear. From there on, it can be investigated in what theories this design is embedded and where these ideas originate from. By critically analysing this extraordinary fortification, it is hoped that insights are gained which are also more generally applicable.

The focus of this study will be on fortification outlines and the logic behind these forms. The structure of this thesis is as follows. The first chapter will provide an historical context of the São Sebastião fort. Here the role Mozambique Island played in the Portuguese sphere of influence is briefly discussed. Furthermore, defence architecture built on the island before the São Sebastião fortress was built will be mentioned. The second chapter describes the improvements of military architecture during the renaissance. Mostly based on modern literature, the development and spread of the new bastioned defence system will be discussed here. In chapter three the São Sebastião fort in its current state will be described as a starting point for the further analyses. Subsequently, in chapter four, different construction phases within the fort will be distinguished based on historical sources.

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<sup>1</sup> John Rigby Hale has been the author of what is still considered as a standard work on the subject of renaissance military architecture titled *The early development of the bastion. An Italian chronology*. His plea for a more universal approach to the phenomenon, should be seen as a reaction to a tendency of chauvinism and romantic individualism which had been the legacy of 19<sup>th</sup> century historiography. Hale 1965, pp. 466-467.

In the last chapter the findings from the previous two chapters will be compared to the theoretical framework as described in chapter two. The different phases of the fort will thus be compared to the development within renaissance military theory and its general principles. Furthermore, the logic behind the structure is discussed and a comparison is made with a similar fortification. The chapter ends with a survey focussed on renaissance treatise texts which show a remarkable resemblance with what is found at the fortress of São Sebastião. After this, the final conclusions are formulated in the last section of this study.

In addition to this, two appendixes are added to which references are made in the different chapters of this thesis. These supplements successively discuss the available information on the alleged architect of the fortress and the secondary fortifications built on Mozambique Island. Finally, a glossary provides the definitions used in this study of specific foreign and technical concepts. The terms included in the glossary are printed cursive in the text when these are mentioned for the first time.

# Chapter 1: Historical context of Mozambique Island and the São Sebastião fortress

*Ilha de Moçambique*, or Mozambique Island is located on the East African coast. It lies in the north-east of the country which eventually would be named after this island.<sup>2</sup> In order to understand what brought the Portuguese to this region and what role it played in their vast maritime empire around the Indian Ocean, the first two paragraphs of this chapter provide a brief historic overview. The last paragraph will highlight the Portuguese fortifications on Mozambique Island from the very beginning until work started on the building of Sebastião fortress in the second half of the sixteenth century.

## 1.1 The arrival of the Portuguese on the East African coast

With the rounding of the southern tip of Africa by Bartolomeu Dias in 1488, the Portuguese had found the sea route to the Indian Ocean. Until then the main focus of the Portuguese activities in Africa had been military expeditions against the Moors in Morocco and acquiring gold and slaves in West Africa.<sup>3</sup> Circumventing Africa gave Portugal the opportunity to discover the east coast of the continent, where the mythical *Preste João*, or Prester John, was thought to have his Christian empire.<sup>4</sup> Perhaps even more important, sailing the Indian Ocean could provide Portugal with access to the spices of Asia.

At the time the Portuguese first got involved in trade on the Indian Ocean, Arabs and Persian controlled much of the trade. Triangular trade routes existed between the Red Sea and Persian Gulf, the west coast of India and East Africa. Along the East African coast a chain of rivalling Muslim trade ports reached from Mogadishu in the north, to Sofala in the south.<sup>5</sup> The main commodities that were traded on this so called *Swahili Coast* were African slaves, ivory and gold in exchange for beads and textiles, probably mainly from Indian origin.<sup>6</sup> Furthermore the Swahili Coast stood in contact with Madagascar, through which an indirect trade link with India and Indonesia existed.<sup>7</sup> Before the arrival of the Portuguese none of the powers engaged in the trade on the Indian Ocean maintained a navy.<sup>8</sup> Trading vessels were

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<sup>2</sup> Historically the name *Moçambique*, or Mozambique had exclusively referred to the island. Since today the island and the country have the same name, in this study the terminology is adjusted to the current situation.

<sup>3</sup> Bethencourt 2007, pp. 1-2; Axelson 1973, p. 24.

<sup>4</sup> It was believed, throughout Europe, that Prester John was ruling a long-lost mighty Christian kingdom. The Portuguese were determined to find these fellow Christians somewhere in Africa. It was hoped they could help find the way to India and support Europe in the struggle against the Turks. The connection between this myth and Mozambique carried through into the 17<sup>th</sup> century. The mainland across the bay in which *Ilha de Moçambique* lies is for instance still described as '*Priester Johannis Landt*' in a journal Johann Verken, who visited the island with a fleet of the Dutch East India Company in 1608. *Johann Verken, Molukken-Reise 1607-1612, Franckfurt am Main 1612*, republished in: Honoré 1930, p. 23; Silva 1959, p. 17; Kock 1957, pp. 30-33.

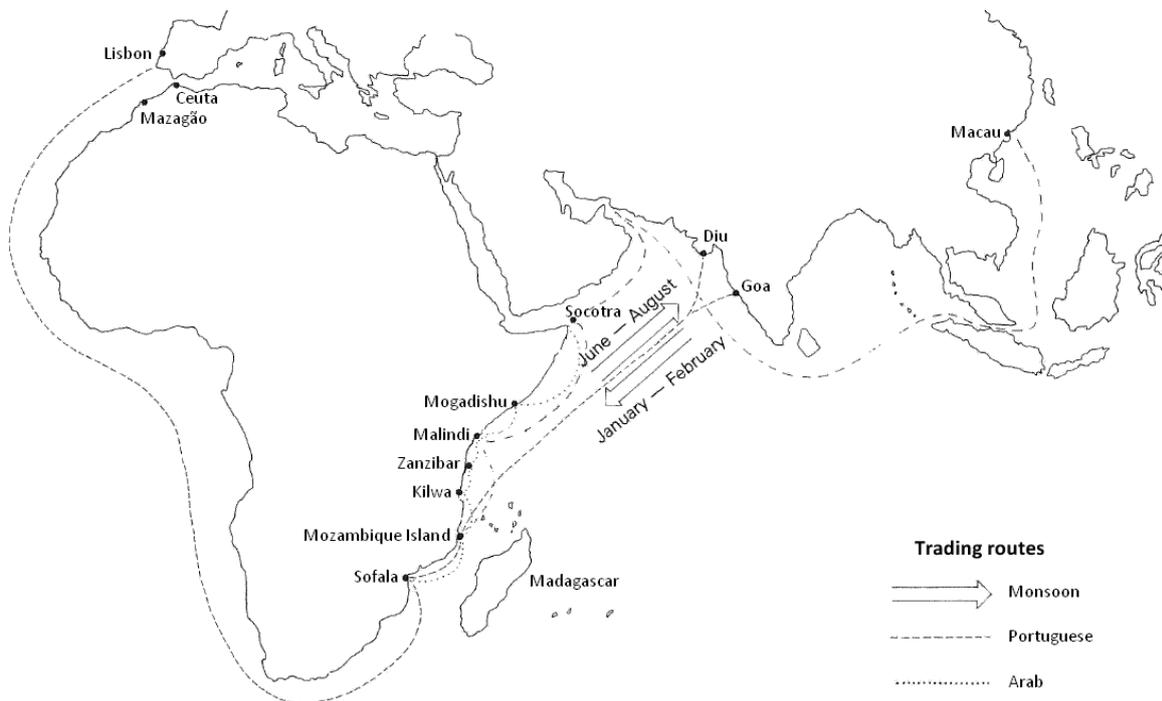
<sup>5</sup> Sofala was located near the present-day city of Beira in Mozambique.

<sup>6</sup> Boxer & Azevedo 1960, pp. 14-18.

<sup>7</sup> Newitt 2009, p. 7; Panikkar 1959, p. 28.

<sup>8</sup> The only exception being China. However due to isolationist politics an end had come to China's maritime expansions of the previous decades. Therefore the navy was only deployed as a defence mechanism of the Chinese empire. Boxer 1969, p. 44; Black 2002, p. 173.

lightly built and thus unprepared for what was about to come.<sup>9</sup> The first fleet that was sent out from Lisbon to make use of Dias' discovery stood under the command of Vasco da Gama. The fleet sailed up the East African coast along Natal, southern Mozambique and reached Mozambique Island in February 1498. The Sheik of Mozambique was found willing to trade fresh provisions needed for the journey, which continued via Mombasa and Malindi. Here the service of an Arab navigator was obtained, who led the way to Calicut in India. Da Gama's return to Lisbon in 1499 meant this had been the first successful voyage to India circumventing Africa.<sup>10</sup> Many fleets would follow in the centuries to come.



**Fig. 1.1:** Indication of Arab and Portuguese trade routes along the East African coast.

Portugal's ambition became to dominate trade on the Indian Ocean. Instead of conquering vast areas of land, the Portuguese focussed on controlling the sea by taking possession of only a relatively small number of strategically located trading posts. This strategy was possible due to the military supremacy the Portuguese had. Portugal's naval strength ensured that their ships could sail the Indian Ocean freely and that offensives were very successful. On the Asian continent Hormuz, Diu, Goa and Malacca were amongst the most important centres of commerce which soon came under Portuguese control. Here spices and other luxury goods could be traded and distributed before the profits would eventually reach Europe.<sup>11</sup> At the East African coast the Portuguese used their naval supremacy to fight the competition of the Muslim traders by claiming tributes of their trade settlements.

<sup>9</sup> Newitt 2009, pp. 13-17; Black 2002, pp. 170-173.

<sup>10</sup> Trindade 1986, p. 11; Ferreira & Roux 2008, p. 62.

<sup>11</sup> Axelson 1973, p. 38; Kock 1957, p. 64; Boxer 1961 a, p. 42.

The rulers of Malindi agreed to the terms and became allies of the Portuguese. Other city-states including Mombasa, Kilwa, Brava, Zanzibar and Pemba resisted and were plundered.<sup>12</sup> Forts were built at Kilwa and Socotra in order to gain influence along the north-east African coast. From Socotra the Portuguese hoped to control the passage to the Red Sea, for Kilwa they had high expectations for the amount of gold and ivory that could be traded for clothes and beads.<sup>13</sup> The main focus of the Portuguese undertaking in East Africa would however be on a region further south, known as *Monomotapa*. Tales about this inland African kingdom which was supposed to be incredibly rich in gold had reached Europe long ago. The fact that the Portuguese were in urgent need of desirable commodities to be able to trade goods in Asia gave it high priority to reach it.<sup>14</sup> At Sofala Vasco da Gama had already witnessed the trading of gold coming from the inland. In 1505 the building of a fortress at this trade port started, thus hoping to be able to monopolise this trade. Before the end of the first decennium of the sixteenth century, the combination of navel supremacy and a relatively small number of fortifications had enabled the Portuguese to take control over trade along the East African and on the Indian Ocean. The *Estado da Índia* would soon extend from East Africa to Persia, Japan and Indonesia.<sup>15</sup>

## 1.2 The position of Mozambique Island in the *Estado da Índia*

It was soon realised that a way station was needed where the ships that sailed between Portugal and India could be repaired and supplied with fresh provisions. Also a hospital was required somewhere along this route.<sup>16</sup> Portuguese ships sailed up East Africa either east of Madagascar or through the Mozambique Channel, depending on the season.<sup>17</sup> Further north a favourable Monsoon wind was needed in order to be able to cross the Indian Ocean to Goa. Because of the strategic location of Mozambique along this route the Portuguese continued to use this island as a way station for both outgoing and home bound ships ever since the first visit by Vasco da Gama in 1498.<sup>18</sup> The island of Mozambique was strategically very appealing to the Portuguese, just as it had been for the Arabs. Firstly Mossuril Bay provided a good natural harbour, where ships could wait safely for favourable monsoons, while in the meantime repairs could be done and fresh provisions obtained. The entrance to this bay could be controlled from the island. Secondly a settlement on an island is easier to defend in case of attacks from local people, than a trade post on the mainland.

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<sup>12</sup> Boxer & Azevedo 1960, pp. 16-17; Newitt 2009, pp. 16-18.

<sup>13</sup> Kilwa has been claimed to be the first Portuguese settlement on the east coast of Africa. But the Portuguese occupancy of Kilwa (1505-1512) and (Socotra 1507-1511) had been short lived. Axelson 1973, p. 40; Boxer 1960, p. 17; Diffie & Winius 1977, pp. 342-344; Newitt 2009, p. 19; Theal 1964, pp. 211-212.

<sup>14</sup> Boxer 1961 a, p. 33; Newitt 2009, p. 17.

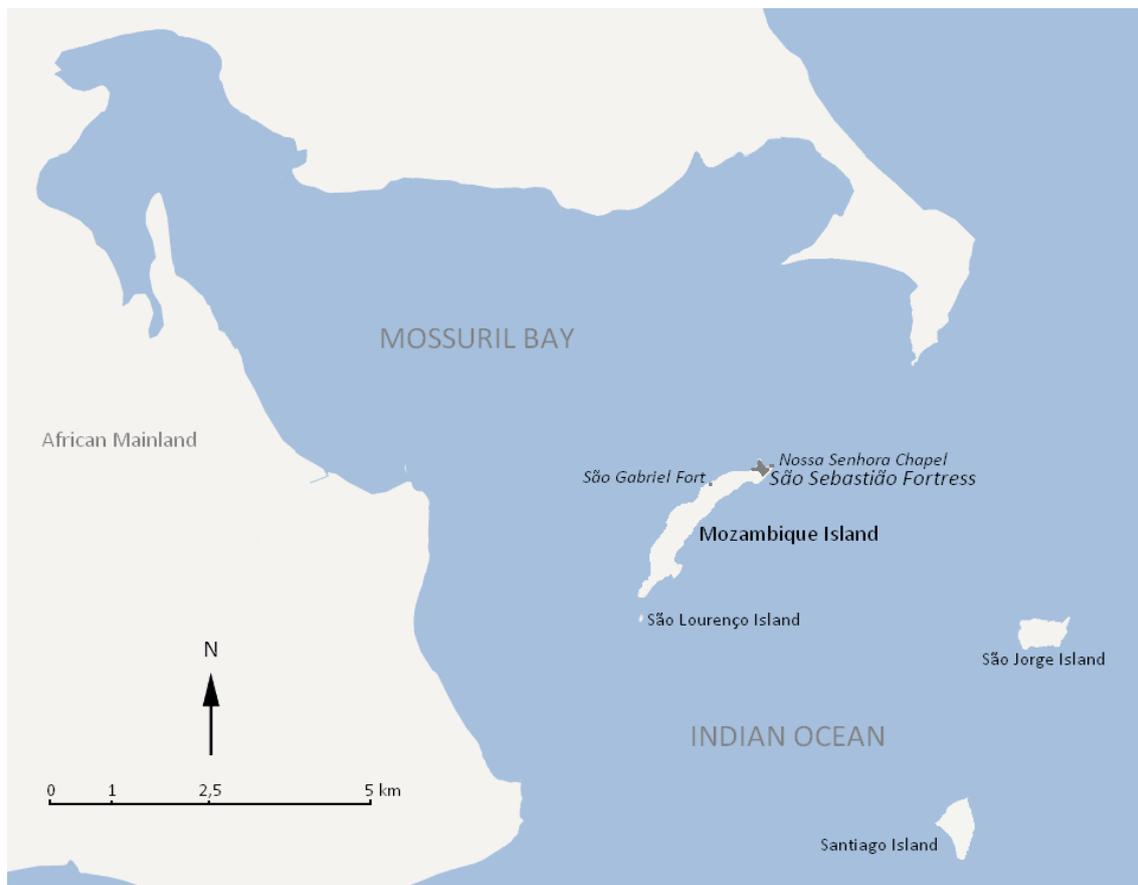
<sup>15</sup> The term *Estado da Índia* (State of India) is used by the Portuguese to cover not only India, but all conquests east of the Cape of Good Hope under the Portuguese Crown. The Portuguese tactic to control this vast territory was heavily based on their striking power at sea. The number of fortresses was kept to a minimum to not overstretch the resources of both men and money. Axelson 1973, p. 39; Black 2002, p. 59; Bethencourt 2007, pp. 26-30.

<sup>16</sup> Theal 1964, p. 204; Welch 1948, p. 5.

<sup>17</sup> Under the reign of King João III (1521-1557) the voyages to India were further regulated. Because of weather conditions outward bound ships which passed the Cape of Good Hope before the 25<sup>th</sup> July were obliged to sail through the Mozambique Channel. Ships which arrived later were ordered to sail the outer passage, east of Madagascar. Boxer 1961 b, p. 97.

<sup>18</sup> Ferreira 2007, p. 154; Theal 1964, p. 204.

At the same time the island was close enough to the mainland to make use of its fertile soil where vegetables and fruits could be grown. The commodities the Portuguese obtained from trade on Mozambique Island were mainly ivory, gold, slaves, ambergris and pearls. Because the island lies halfway between the main Portuguese trade ports of that time, namely Kilwa and Sofala, it was also very suitable to function as a distribution centre for merchandise. Moreover Mozambique Island was used as a base for a small squadron of vessels that would patrol the East African coast in order to obstruct the Muslim competition.<sup>19</sup> Since the Portuguese had taken control of Kilwa, to which the Sheik of Mozambique had been subject, also the Islamic residents of Mozambique Island had become submissive to the Portuguese presence.<sup>20</sup>



**Fig. 1.2:** The situation of Mozambique Island and Mossuril Bay.

Although the island did not provide fresh water and the climate was notoriously unhealthy, a permanent settlement was founded at Mozambique in 1507.<sup>21</sup> The settlement would become the main port to call between Lisbon and Goa and the most important Portuguese stronghold on the East African coast. Initially Sofala had this position, but disappointing trade profits had resulted in the decision of the Crown to decrease the investments made

<sup>19</sup> Axelson 1973, p. 64; Ferreira 2007, p. 3; Diffie & Winius 1977, pp. 341-344.

<sup>20</sup> *Gasper Correa, Lendas da Índia (ca. 1555)*, consulted partial reproduction: Stanley 1869, p. 286; Trindade 1986, p. 11; Theal 1964, p. 205.

<sup>21</sup> Axelson 1973, p. 61; Boxer 1961 b, pp. 98-102; Theal 1964, p. 205.

into the post. The fort was continued to be used for trade, but it became of less strategic importance within the *Estado da Índia*.<sup>22</sup> After the abandoning of the short-lived fortifications at Kilwa and Socotra, no Portuguese forts remained along the Swahili Coast north of Mozambique Island. Portugal's presence in this region would remain merely of a maritime nature until Fort Jesus was built at Mombasa in 1593.<sup>23</sup>

The position that Mozambique Island had acquired as primary African port and way station in the *Carreira da Índia*, would be reconsidered several times in the next two and a half centuries. Due to the unhealthy climate on the island, which had cost the lives of many Indiamen, it had been suggested that ships should sail between Goa and Lisbon without stopping anywhere underway. Alternatively it was considered to abandon Mozambique Island in favour of healthier locations like Mombasa, Madagascar or the Quirimba Islands further north.<sup>24</sup> However these plans did not come to practice. Only at the end of the nineteenth century Mozambique Island lost its position as Portugal's principal settlement in East Africa, when it was decided to move the Mozambiquean capital to Lourenço Marques.<sup>25</sup>

### 1.3 The rise of Portuguese military architecture on Mozambique Island

As a result of the commercial and strategic benefits the Portuguese ascribed to Mozambique Island, the Portuguese presence evolved during the sixteenth century. The focus of this paragraph will be on the rise of Portuguese military architecture that was built to enforce the interest of the Crown on the island preceding the São Sebastião fortress.

Vasco da Gama had already left behind a small trade factory on Mozambique Island after he had made peace with its rulers on his second voyage in 1502.<sup>26</sup> But it was not until 1507 that the Portuguese settled on the island permanently. From then on extensive building activities were undertaken. A Portuguese contemporary historian by the name of Gaspar Correa reports that King Manuel I of Portugal had ordered to build; *'a tower of two stories in which people might lodge, large buildings in which to store merchandise landed; and above all a hospital for those arriving sick from Portugal'*.<sup>27</sup> Building plans, as well as parts for the structures prefabricated by skilled craftsmen, were sent from the homeland. The undertaking proceeded quickly as seaman of the various ships, which lay in the harbour waiting for favourable winds, helped labouring ashore. Stone was quarried and lime

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<sup>22</sup> For further details about the disappointing gold revenues see: Axelson 1973, pp. 75-84; Theal 1964, pp. 215-224. Another disadvantage of Sofala was the difficulty for large vessels to reach the harbour safely. Theal 1964, p. 206.

<sup>23</sup> Boxer & Azevedo 1960, p. 17.

<sup>24</sup> Boxer 1961 b, p. 113.

<sup>25</sup> In 1898 it was decided to move the capital of Mozambique from Mozambique Island to Lourenço Marques. The capital has been renamed Maputo after independence in 1975. Ferreira 2007, p. 150; Newitt 2009, p. 558.

<sup>26</sup> Diffie & Winius 1977, p. 342; Ferreira 2007, p. 155.

<sup>27</sup> Gaspar Correa (ca. 1495 - ca. 1561) also spelled as Correia or Corrêa. His *Lendas da Índia* (ca. 1555) is considered to be one of the earliest and most important works about the *Estado da Índia*. The manuscript is believed to have remained unpublished until the 19<sup>th</sup> century. Different published, translated extracts from his text are used in this research. Original text quote: *'huma torre de dous sobrados, em que se aposentasse, e fizesse grandes casas pera recolhimento das fazendas que se descarregassem, e sobre tudo fizesse hum esprital pera os doentes que hy chegauão do Reyno'*. Consulted reproduction: Theal 1898-1903, vol. II, pp. 17-18, 43-44.

prepared.<sup>28</sup> Because of the health problems the Portuguese faced, firstly the hospital was built. Secondly work started on a church dedicated to São Gabriel, which despite the presence of a hospital, was soon surrounded by a sizable graveyard.<sup>29</sup> Lastly the fort, also named after holy Gabriel, came under construction. The chosen strategic location was on the north-western shore of the island near the best place for ships to land.<sup>30</sup> Gaspar Correa reports that in accordance with the plans and recommendations sent by the king, they built; ‘a square two-storied tower, enclosed in quadrangle stone walls with battlements and embrasures and other towers at the corners on the battlements. Within they built large houses for the merchandise and military stores, and in the towers lodgings for the factor and officers, all very well arranged.’<sup>31</sup> This quote describes a very common *Manueline* layout form. At the time Portuguese fortification architecture, overseas as well as in Portugal itself, was still connected to the mediaeval tradition. Along the African coast the trade forts of São Jorge da Mina in Ghana and São Caetano at Sofala originally have had been based on a very similar design with high stone walls.<sup>32</sup>

It was around this structure that the Portuguese settlement started to evolve.<sup>33</sup> Fort São Gabriel to which would later be referred to as *Torre Velha*, meaning old tower, functioned as the main structure of defence on the island for more than fifty years. In addition to this a *battery* on the north-eastern tip of the island controlled the entrance to the bay.<sup>34</sup> On this spot a chapel was built in 1522 which was appropriately dedicated to *Nossa Senhora do Baluarte*, Our Lady of the Bulwark.<sup>35</sup> The connection this *Manueline* architecture still had with the mediaeval style elements is most visible in the vaulting, the ornamentation along the edge of the roof and the decoration style of the gargoyles, which are carved in the form of cannons and lion heads. The double function of this structure can be seen best at the three openings at the choir of the chapel, which show the combination of a cross shape and a round gun port.<sup>36</sup>

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<sup>28</sup> João de Barros, *Décadas da Ásia, Lisboa 1552–1559*, partly republished in: Theal 1898-1903, vol. IV, p. 293; Gaspar Correa, *Lendas da Índia (ca. 1555)*, consulted partial reproduction: Theal, 1898-1903, vol. II, p. 43; Theal 1964, pp. 207-210; Axelson 1973, p. 65.

<sup>29</sup> The notorious health situation on the island is partly explained by the state in which the poorly nourished sailors on the outbound ships arrived and partly as a result of the unhealthy climate and tropical diseases. Theal 1964, pp. 208-209.

<sup>30</sup> This site has been used as a harbour until the present day because on the landside of the island the water is calmer and at this location deep waters are near the shore.

<sup>31</sup> Original text quote: ‘*El Rey mandara, e tanto emcomendaua que se fizesse aly castello, se metterão no castello, e fizerão huma torre quadrada de dous sobrados, e em quadra della fizerão grande cerqua de pedra, com amêas e bombardeiras, e nas quadras outras torres no andar das amêas, e dentro fizerão grandes casas pera recolhimento das fazendas, e casas pera almazem, e nos cubellos o feitor e officiaes aposentados, e tudo bem concertado.*’ Gaspar Correa, *Lendas da Índia (ca. 1555)*, consulted partial reproduction: Theal, 1898-1903, vol. II, pp. 18, 44. The *feitor*, or factor, would supervise trade conducted at the post for the Crown.

<sup>32</sup> Joustra & Six 1988, p. 258; Montez 1954; Valla 1999, n. pag.

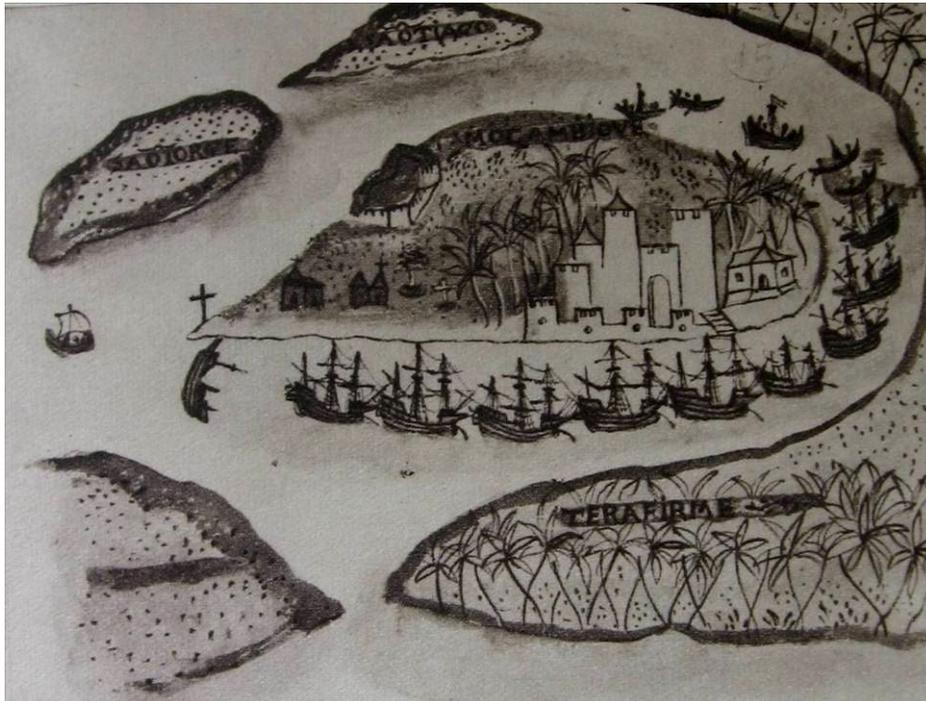
<sup>33</sup> For an overview on the urban development on Mozambique Island see: Trindade 1986; Teixeira 1990.

<sup>34</sup> The deep channel that provides access to the bay is said to have been located a musket shot away from this point. António Bocarro, *Livro das plantas(...)* (1635), published in: Bragança 1936-1940, vol. IV, p. 9.

<sup>35</sup> That artillery would have been placed here before the church was built is described by: João dos Santos, *Ethiopia Oriental, Évora 1609*, quoted in: Newitt 2009, p. 132.

<sup>36</sup> Ferreira & Roux 2008, pp. 62-63; Kirkman 1966, p. 210. The combined form of the cross with a gunport was very common in Portuguese fortification design as can be seen in the famous manuscript *Livro das Fortalezas* made by Duarte de Armas in 1509. Consulted reproduction: Almeida 1943.

In the year 1542 João de Sepúlveda, the *Capitão* of Mozambique, wrote to King João III that the need for better fortification was very great. He tells the king that he only has the resources to further strengthen the São Gabriel fort, but that there should actually be a new fortress built on another place. The *capitão* ensures that this would not cost much money or time if only a master mason and few workers would be sent.<sup>37</sup> But no immediate action was undertaken. Three years later João de Castro, who would become the fourth *Vice-Rei* of the *Estado da Índia*, visited Mozambique on his way to Goa. Considering the importance of the island, he also judged the defences to be inadequate. In his opinion not only was the site of Fort São Gabriel badly chosen from a military point of view, he also reported the structure was too small to defend the island. Furthermore it would be unable to withstand modern artillery. In a letter to King João III he recommended that a new fort should be built on the north-eastern point of the island.<sup>38</sup> The steep coral shore on this headland would make this location easier to defend. Moreover with a modern fort built here the entrance of the bay would be secured.<sup>39</sup> Such a big project and structural solution could only be undertaken if approved in Portugal. Awaiting this decision, a *breastwork* for temporary use was built on this location during the stay of João de Castro.<sup>40</sup>



**Fig. 1.3:** View on Mossuril Bay, Mozambique Island and its main buildings (ca. 1560). Fort São Gabriel is depicted surrounded by the religious buildings of the island. The structure on the far left would be the Nossa Senhora chapel. At the back, a secondary defence work is shown. This could either be the battery raised by João de Castro or the São Sebastião fortress under construction.

<sup>37</sup> *Letter from João de Sepúlveda to the King. Mozambique, 1542 August 10*, published in: Axelson 1962-1989, vol. VII, pp. 139-140.

<sup>38</sup> For quotes of the original letter in Portuguese see: Dias 2010, p. 26.

<sup>39</sup> João de Castro also believed that this spot would be healthier than that of the old fort, due to the higher location and the sea breeze. Axelson 1973, p. 138.

<sup>40</sup> The breastwork would have been located east of where now the São Sebastião fortress stands. Fonseca 1973, p. 67.

Eventually, King João III authorised the new fort to be built on the location that João de Castro had proposed. He sent the fortification expert Francisco Pires with predesigned plans. But because the fleet fell behind schedule they had to take the outer passage round Madagascar and sailed to Goa without stopping at Mozambique Island. In 1547 still no engineer had arrived on the island. Fernão de Sousa, who was to be shipped from India to Mozambique to become the next *capitão*, had requested the *vice-rei* yet to send Pires with him. He refused because he rather employed Pires to improve the defences of Diu and Hormuz. Instead, sixteen quarrymen were appointed to Mozambique. Fernão de Sousa expected this would be enough to prepare stones and work on a ditch before Pires would eventually arrive. In a letter he promises the king that everything would be done to finish the fortress in a short time. However, in reality progress was slow due to the continuous absence of a fortification expert.<sup>41</sup>

It was not until 1558 during the reign of Queen Catharina of Habsburg, that work on the new fortification gained momentum in anticipation of the rise of Ottoman maritime aggression at the Indian Ocean.<sup>42</sup> It was then decided that this new fortress would become the permanent residence of the highest official on the East African coast.<sup>43</sup> In modern literature it is generally stated that Miguel de Arruda has been the engineer responsible for the design of the São Sebastião fortress. However till what degree the plans made by this famous Portuguese architect have been followed remains somewhat unclear.<sup>44</sup>

As will be further discussed in chapter four, works on the São Sebastião fort were largely completed round the turn of the sixteenth century. It would then be described as one of the strongest Portuguese fortifications within the *Estado da Índia*.<sup>45</sup> In this chapter the reasons behind building defences of such a scale at this location have been clarified. As has been discussed Mozambique Island had become the most important Portuguese stronghold along the East African coast as well as the principal way station between Lisbon and Goa during the sixteenth century. Since it had evolved into a place of great strategic interest, retaining control over the Island was therefore considered to be of the utmost importance. The construction of a well-designed modern fortification at the island was thus judged necessary to defend the Portuguese interest in the region.

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<sup>41</sup> Axelson 1973, pp. 138-139; Ferreira & Roux 2008, p. 63; *Letter from Fernão de Sousa to the King. Bassein, 1547 November 24*, published in: Axelson 1962-1989, vol. VII, pp. 159-161.

<sup>42</sup> Queen Catharina of Habsburg (1507-1578) was the wife of King João III (1521-1557) and ruled Portugal as regent until 1568 when the rightful heir to the throne, their son Sebastião (1554-1578), was found old enough to rule. The Ottoman navel activities on the Indian Ocean got underway after the empire had expanded into Egypt (1517) an Iraq (1534). In the coming decades their ships mounted with cannons formed a rival for the Portuguese, mainly around the Arabian Sea. Ottoman navel activities however declined in the 1560's. Black 2002, p. 60. Also see note 182.

<sup>43</sup> Previously the garrison would have travelled back and forth between Mozambique and Sofala, but now each fortress would have its own *capitão*, with Sofala being subordinate to Mozambique. *João dos Santos, Ethiopia Oriental, Évora 1609*, republished in: Theal 1898-1903, vol. VII, pp. 186-187; Theal 1964, pp. 241-243.

<sup>44</sup> See appendix I for more detail on this statement.

<sup>45</sup> Original text quote: '*Esta fortaleza é uma das mais fortes que ha na India*', *João dos Santos, Ethiopia Oriental, Évora 1609*, consulted reproduction: Theal 1898-1903, vol. VII, p. 130.

## Chapter 2: Renaissance innovations in military architecture

As described in the previous chapter only decades after orders were given to build fort São Gabriel on Mozambique Island, it was judged to be outdated and the decision was made to build a new fortification. In contrast to its predecessor the São Sebastião fortress would be specifically designed to withstand modern artillery. This chapter will highlight the changes which occurred in military architecture as result of the increasing threats by the development of artillery since the fifteenth century. Because Mozambique Island was under the Portuguese sphere of influence, the development of European fortification architecture will be used as a theoretical framework to which the building history of the São Sebastião fortress, as described in chapter four, will be compared in chapter five. In this chapter in the first paragraph a short overview will be provided of the main developments that took place in fortification design in reaction to the evolution of artillery fire. The second paragraph will highlight some major points of discussion which occurred in sixteenth century military treatises. The final paragraph will give an insight on how these ideas travelled through Europe and especially to Portugal.

### 2.1 The development of the bastion system

Gunpowder had been used on European battlefields since the thirteenth century. But artillery had posed no serious threat towards fortifications till the second half of the fifteenth century when cannons cast in one piece were introduced and stone projectiles were substituted by iron.<sup>46</sup> Not only did traditional fortification constructions prove to be very vulnerable to the new weaponry, they were also unsuitable to make use of cannons in a defensive role. New fortification architecture had to be developed to resolve these problems.

Initially walls were lowered and made thicker or were reinforced with earthworks. This not only made them more stable but also diminished their size as a target. This would delay damage from being done, but it could not prevent a persistent attacker from doing so. Since walls were more easily breached by siege fire and mines, the use of flanking fire became of critical importance to the defence system, ensuring the enemy would be unable to reach the walls. The principal of defending fortress walls through flanking fire from towers had been known since ancient times and had been practiced since.<sup>47</sup> In addition to horizontal flanking fire however, the so called vertical defence, where walls were defended by dropping down heavy objects from the *machicoulis*, had always been of similar importance. On the contrary fortifications adjusted to artillery fire would become solely based on a horizontal defence system in which towers protected the adjacent walls and each other. In this new setup towers had to facilitate cannons in a defensive role and be able to withstand the impact of enemy projectiles.

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<sup>46</sup> Black 2002, p. 69; Eltis 1995, p. 77; Pepper 1986, pp. 9-11; Parker 2000, p. 389.

<sup>47</sup> The writings of Vitruvius and Vegetius on this issue were for instance still closely followed in Leon Battista Alberti's *De re aedificatoria* which was completed in 1452 and first published in 1485. His theories had still hardly been adjusted to the use of modern weaponry. Hughes 1974, p. 69; Croix 1963, pp. 32-34.

Ideally the entire outline of the fortification had to be swept by flanking fire, leaving no *dead ground* where an enemy could take refuge. To meet these demands towers and the fortification system as a whole had to be reinvented.

Placing cannons inside towers proved to be an unsatisfactory option because the openings could only provide a very limited field of fire and ventilation was mostly inadequate to effectively get rid of the smoke when the gun was fired. Instead from the middle of the fifteenth century onwards high mediaeval style towers were gradually replaced by solid gun platforms which would have the same height as the walls. The cannons which were placed upon these platforms could now be set up in any direction. Aiming either towards an approaching enemy, or flanking the adjacent *curtain wall* and opposite bastion.<sup>48</sup> Initially the round form, that had also been common for mediaeval towers, formed the example for the *rondelle* bastion type. This form was commonly believed to be most resistant to ballistics.<sup>49</sup>

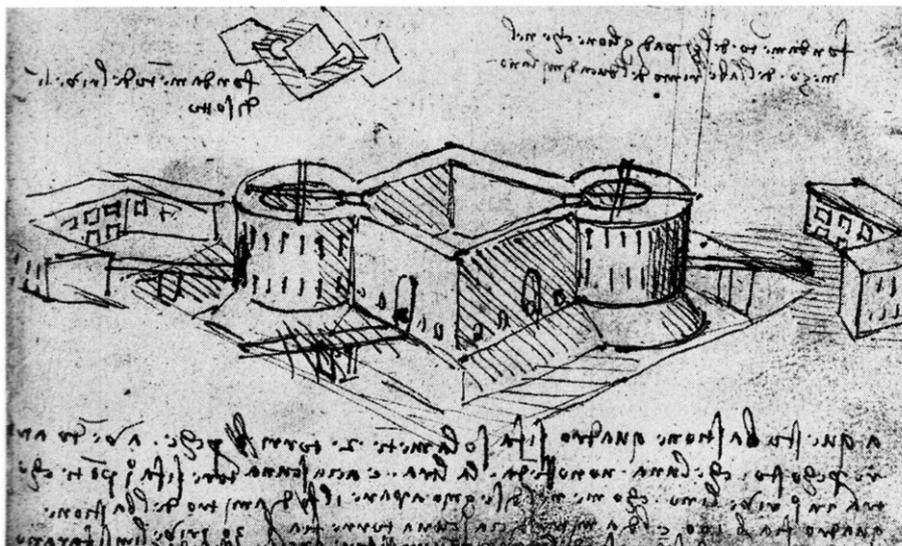


Fig. 2.1: Sketch of a fort with two rondelle bastions by Leonardo da Vinci (1487-1490).

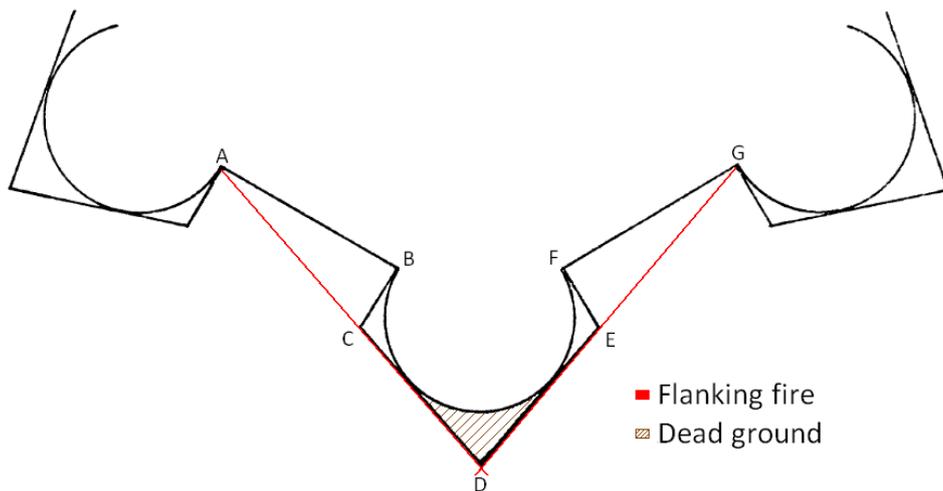
The disadvantage of round bastions was however that it left a blind spot in front of it, which could not be swept from gun positions on the adjacent bastions. Moreover as a result of the round form of the *parapet* the amount of cannons that could be installed in a flanking position was limited to one or two.<sup>50</sup> These problems would be solved by the development of the angle bastion that would change the appearance of defence works for the coming centuries.

<sup>48</sup> Hale 1965, p. 475.

<sup>49</sup> Vitruvius already discusses the vulnerability of the angles of a square tower and thus recommended a circular or polygonal form. Consulted reproduction: Peters 2008, p. 44. The treatise written by Albrecht Dürer *Etliche Unterricht zu Befestigung der Stett, Schloss und Flecken*, printed in Nürnberg in 1527 is amongst the most famous publications showing experiments with round bastions.

<sup>50</sup> Croix 1960, pp. 266-267.

This pointed, pentagonal construction is connected to the *terreplein* through the *gorge*, which is the open side of the bastion facing towards the inside of the fortification. The other four wall sections of the angled bastion are part of the outer walls of the fortification. The two shortest of these walls, forming an angle with the adjacent curtains, are the *flanks*. From this position the adjacent curtain and bastion could be swept. The two longer outward facing bastion sides are called the *faces*. Cannons lined up along the faces could provide offensive fire, disrupting an advancing enemy. The straight parapets of the *angle bastions* enabled that more cannons could be aimed at the same target, compared to what would be possible with a circular bastion of similar dimensions.<sup>51</sup> The point where the two faces come together forms the *salient*. This angle pointing outward eliminates the blind spots that had existed in front of the round bastion (fig. 2.2).



**Fig. 2.2:** Comparison between the round and angled bastion.

AB / FG – curtain wall  
BC / EF – bastion flank

CD/ED – bastion face  
BF – bastion gorge

D – Salient

<sup>51</sup> The fire power of a rondelle was more scattered than that of the angle bastion. Due to its circular form a maximum of two or three cannons could generally be aimed at a specific target. Croix 1960, pp. 266-267; Duffy 1979, p. 25.

Vasari tells us that Sanmicheli had been the inventor of the angular bastion, but amongst others also Brunelleschi, Filarete and Leonardo have also been named. The modern consensus is however that the development of the angle bastion is the result of a more gradual process started off in Italy during the second half of the fifteenth century.<sup>52</sup> Angle bastions, and prototypes of it, were first implemented in smaller defence structures. The earliest bastions that would be incorporated into a city wall were built in 1515 at the Papal port of Civitavecchia.<sup>53</sup> However it would take until the 1530's that angled bastions would become the standard and round bastions the exception.<sup>54</sup>

The fact that Italy took the lead in this development is commonly explained by the political situation on the peninsula, where wars were constantly fought between the many independent states. Also the invasion of the French under Charles VIII in 1494 and the constant threat of the Ottoman Turks will have worked as a stimulus to develop better defence methods.<sup>55</sup> During the sixteenth century the fortification system based on bastions would further evolve through the studies of many Italian humanist and later specialised military engineers. It was not until the seventeenth century that Italy would gradually lose its dominant role in the development of fortification and the publication of literature about this subject. In Germany, France and the Low Countries distinctly new systems were engineered focussing mainly on the extension of *outworks*. The basic concept of the bastion system would however remain largely unchanged until the nineteenth century.<sup>56</sup>

## 2.2 Renaissance military treatises

The development of the bastion system as described, had greatly took place without the use of books dealing with the subject. As specialist on the subject John Hale puts it: '*Drawings, models, discussions on the spot: these had sufficed to transform the appearance of fortresses and town walls in Europe, the New World North Africa and in Portuguese India.*'<sup>57</sup> Indeed publications discussing the new invention of the *bastioned system* lagged behind progress in the field. The fact that the first prints of the angled bastion were only made halfway into the sixteenth century, illustrates this.<sup>58</sup> This discrepancy can be explained to a large extent by the fear amongst military authorities that enemies might benefit from such publications.<sup>59</sup> Despite the fact that early treatises thus discuss the development of military architecture with some delay, compared to the progress made in practice, these books can still provide a

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<sup>52</sup> Croix 1960, pp. 266-267; John Hale (1965) has described the early development of the bastion as it gradually took place between circa 1450-1534 in Italy. This study has been much quoted and confirmed by other scholars in the field. The effort made by Tzonis & Lefaivre (2003) to attribute the discovery of the bastioned system to an individual, namely Leonardo, can be seen as an exception.

<sup>53</sup> The citadel of Civitavecchia built by Bramante in 1508 did not yet feature angle bastions, but these new ideas were soon brought into practice in the design for the city defence made by Antonio da Sangallo the younger in 1514. Croix 1963, p. 38.

<sup>54</sup> Hale 1965, pp. 488-494.

<sup>55</sup> Hale 1965, pp. 471-472.

<sup>56</sup> Croix 1963, p. 44; Hale 1965, p. 466 ; Martens 2009, p. 34.

<sup>57</sup> Hale 1985, p. 38.

<sup>58</sup> The illustrations of pentagonal bastions in the second edition of the *trattato* by Nicolo Tartaglia dating from 1554 (fol. 72, 77), are amongst the first published. Bury 1985, pp. 21-23.

<sup>59</sup> It was especially feared that the Ottoman Turks would benefit from such publications. Bury 2000, p. 97.

good insight into the debates and theories that formed the basis for renaissance fortifications.

In correspondence with the initial lead Northern Europe took in the development and effective use of artillery, works about new fortification systems written north of the Alps had been more ingenious and numerous than in Italy. However, from the end of the fifteenth century and throughout the sixteenth century Italian treatises would be highly dominant.<sup>60</sup> Initially military architecture was only one of many subjects dealt with in these writings made by humanist scholars who studied and practised a wide variety of science, arts and architecture. Their search for ideal theoretical fortification concepts was based heavily upon ancient sources like Vitruvius. Similar to other architectural projects in the renaissance, fortifications were preferably designed on a regular, symmetrical layout, making use of what were believed to be ideal proportions.<sup>61</sup> This approach to fortification from holistic, philosophic, mathematical science would become substituted by a more practical, specialist approach from the middle of the sixteenth century onwards. Instead of the '*homo universalis*' of the early renaissance the military engineers took over. This process was also reflected in the writings, where a split between civil and military architecture treatises occurred.<sup>62</sup> As a result of this specialisation not only did the amount of treatises published about military architecture increase, authors would also discuss fortification more comprehensively.<sup>63</sup>

Although most authors would agree upon the basic principles of the new manner of fortification, different treatises would suggest different solutions about subjects like the ideal layout form of fortifications, the optimal distance between bastions, what building materials would be most suitable or what geographical setting should be considered most advantageous. Typically in treatises from the sixteenth century onwards, firstly it is described what the ideal fortification should look like, after which examples are given of how these fortifications should be adapted to various geographical settings. In the theoretical discussion about the ideal fortress the layout plan is of crucial importance. Different ground plan forms have been suggested to be most suitable for fortifications of different sizes. Curtains were typically advised to be built straight. This ensured the whole wall could be overseen and thus most effectively be swept. Furthermore, from a cost efficiency point of view, a straight line between two given points is always the shortest, thus the cheapest to build.<sup>64</sup> Because fortification projects generally resulted in a heavy burden on the patron's budget this would indeed be a valid argument. For this reason also the design preferably required as little costly bastions as possible needed to protect the fortification. For a small fortress a square enclosure with bastions on two diagonal opposite corners might be

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<sup>60</sup> Art historian Horst de la Croix has provided a historiographical overview of this Italian "monopoly" in his article *The Literature on Fortification in Renaissance Italy* (1963).

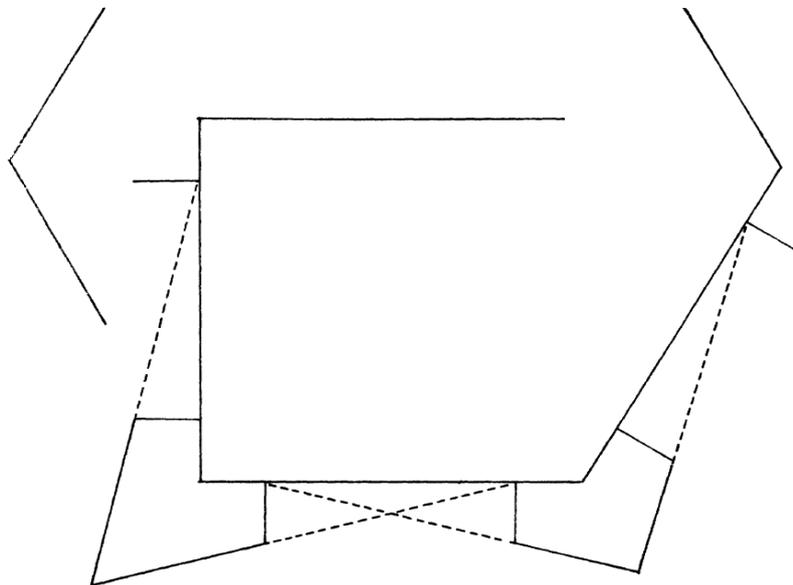
<sup>61</sup> Wittkower 1996, p. 121; Heuvel 2006, p. 102; Hale 1965, p. 473.

<sup>62</sup> Exceptions are the treatises written by Pietro Cataneo and later Vincenzo Scamozzi in which military as well as civil architecture is being discussed. Croix 1960, p. 274; 1963, p. 41.

<sup>63</sup> It has been suggested that the increase of publications has been due to the urge of more practically orientated military engineers to advertise their knowledge and skills to potential patrons via this medium. Croix 1963, p. 40.

<sup>64</sup> The necessity of straight curtains to facilitate effective flanking fire is insisted upon in the majority of military treatises. The idea of angled curtains encountered much criticism from contemporary theorists. Croix 1960, pp. 269-281.

considered sufficient.<sup>65</sup> Also triangular ground forms with three bastions have been suggested.<sup>66</sup> Such forms would however be inadequate to use for projects on a bigger scale like city fortifications. Given the limited effective reach of cannons the interval between bastions would become too big to provide sufficient flanking fire.<sup>67</sup> If a big surface like for instance a city had to be protected, theoretically the most efficient form in which to build a wall would be a circle. This shape namely delivers the biggest enclosed surface per circumventing meter and would for that reason be perfect considering the building costs.<sup>68</sup> However, since straight lines of defence are needed to make effective use of artillery fire, different polygonal forms have been suggested instead. Accordingly the bigger the amount of corners in the perimeter, the bigger the inner surface. Moreover if the faces of a bastion are being aligned to the *line of defence* from the adjacent flanks, as shown in figure 2.2, an increase in the amount of bastions in the circumvention of a fortification results in less sharp *salient angles*. This decreases the constructions vulnerability.<sup>69</sup>



**Fig. 2.3:** Comparison between the bastion forms in a square and hexagonal fortification. With equal curtain and flank sizes, the salient can be built less acute if the circumvention has a higher number of corners.

<sup>65</sup> Although flanking fire could sweep the curtains in this setup, crossfire could not be provided along the walls, nor could the faces of the bastions be effectively covered. See for instance figure 2.1.

<sup>66</sup> The biggest drawback of this setup is that in order to align the faces of the bastion to the line of defence the salient angles would have to be built very acute. This would make the points of the bastions vulnerable.

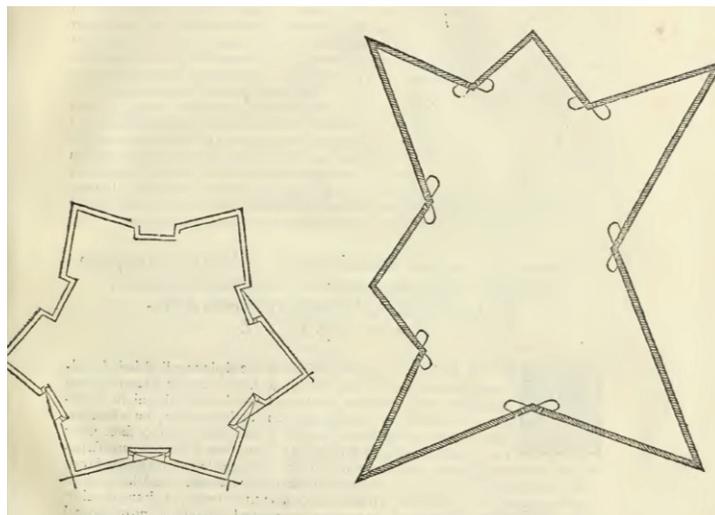
<sup>67</sup> In order to effectually sweep the face of the adjacent bastion with cannon fire, recommendations of 16<sup>th</sup> century theorist for the curtain lengths varied between 260 and 350 meters. Croix 1960, pp. 281-282.

<sup>68</sup> Based on the geometrical principal that the circle is the form with the highest area/perimeter ratio, using this form would mean the least meters of costly wall are needed to encircle any given surface.

<sup>69</sup> Since breaching the curtain was no longer sufficient to enter a fortification due to crossfire from the bastions, attackers started to focus on destroying adjacent bastion as well. To make the bastion as resilient as possible, the use of vulnerable angles had to be minimised. In the treatise of Giovanni Batista de' Zanchi, *Del modo di fortificare la Città*, published in Venice 1554, for instance an entire chapter is spent on the weakness of the square fortification, due to the inevitable use of sharp salient angles (fol. 34-39). He is amongst the early writers that state that the closer the ground form of the fortification resembles a circle the more perfect it is (fol. 29).

On paper, the theorist and military architect Galasso Alghisi for example experimented with fortifications with up to twenty-one bastions.<sup>70</sup> While for instance the fortification of Palmanova, in the northeast of Italy, has nine bastions placed on a regular interval. This fortified town is often referred to as the ultimate combination the humanist ideals of geometry and proportion as well as military practicality due to the order in its design.<sup>71</sup> However, in addition to the immense building cost of such a great number of bastions, it would also demand an enormous amount of artillery and soldiers to occupy them. Considering the basic layout principles and restrictions, generally a more moderate number of bastions was suggested to be built. Mostly theorists came to the conclusion that five or six sided fortifications formed the optimal compromise.<sup>72</sup>

In addition to the defence system based on the angle bastion another layout form propagated in Italian renaissance treatises should be mentioned. Alberti, reverting to Vitruvius and Vegetius, had already suggested that a star shape with 'scissor-like' curtains might be most suitable form for a fortification. It was in later treatises that this idea would be further elaborated for artillery fire.<sup>73</sup> Although star shaped fortifications are commonly confused and mingled with the bastions system, its defence setup functions in a significant different manner. With the star shaped outlay there is no distinction between bastion and curtain, instead cannons sweep the walls from their position on the adjacent wall. This setup is also referred to as the *tenaille system*.



**Fig. 2.4:** Pietro Cataneo's treatise *L'architettura (...)* (1567), for example shows the bastioned system and tenailed system on one page. He recommends to build the latter only if the geographical setting leaves no other option

<sup>70</sup> This extraordinary design printed in the treatise of Alghisi, *Delle fortificationi libri tre* published in Venice 1570, combines bastions with *tenailles*. Despite the great number of bastions, this layout left relatively little inner space (pp. 298-299). His defence system will receive more attention in chapter five.

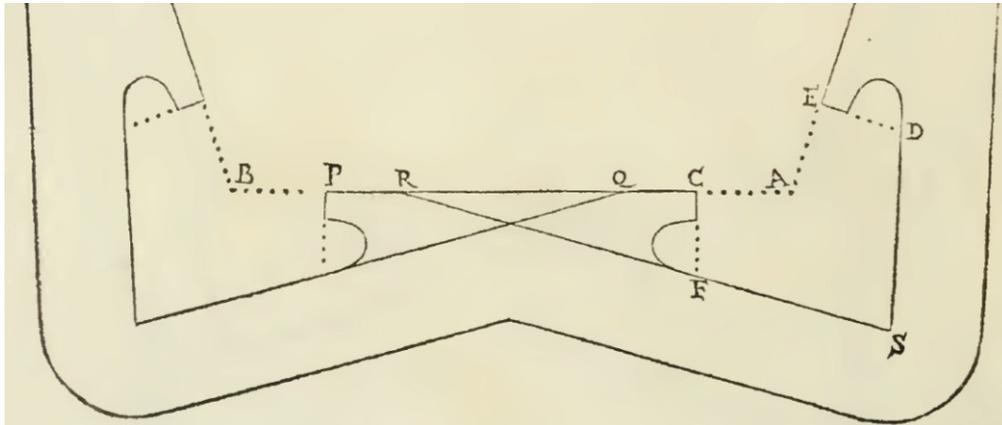
<sup>71</sup> The monographic study *Palmanova, A Study in Sixteenth Century Urbanism* conducted by Horst de La Croix (1966) has shown that although the fortification seems to be the result of an ideal design, it has been the product of a frequently altered planning and a compromise between conflicting civil and military ideals. See also: Heuvel 1991, pp. 15-19.

<sup>72</sup> Heuvel, 1991, p. 3.

<sup>73</sup> Tzonis & Lefaivre 2003, pp. 168-172; Parker 1988, p. 9.

Initially the tenaille trace would be fiercely criticised by most authors, mainly because of problems with dead ground in the ditches and the vulnerability of the pointed walls. An early, at the time highly controversial, example of a fortification applying this system was the six-pointed fort of San Elmo built on a hilltop overlooking Naples. To justify his design, the Spanish engineer Pedro Luis Scrivá wrote a treatise, dated around 1538, in which he showed how to insert flanking guns in the inward-bent angles.<sup>74</sup> Despite the initial quarrel amongst theoreticians, the tenaille system eventually became an accepted solution at rugged terrain where no conventional fort could be built, or for small forts surrounded by water.<sup>75</sup> Moreover some treatises kept experimenting with the tenaille system in an ideal layout, but this would only become increasingly popular from the seventeenth century onwards.<sup>76</sup> Both on paper and in practice in the sixteenth century, the bastioned system would remain most common.

The ideal form of a bastion proves to be another debated topic throughout the history of fortification development. The faces of a bastion should be adapted to the line of fire from the gunning positions that are supposed to provide cover. This position could be the flank of the adjacent bastion as shown in figures 2.2 & 2.3. But also other setups have been suggested. In his *trattato*, first published in 1596, Buonaiuto Lorini for instance shows that the faces of the bastions in his ideal hexagonal fort are aligned to three-fourth of the length of the intermediate curtain. In addition to the artillery positions on the flanks this creates extra gun positions along the last quarter of the curtain from where the face of the bastion could be effectively swept.<sup>77</sup>



**Fig. 2.5:** Detail from Buonaiuto Lorini's model for the defence of a hexagonal fortification (1597). He recommends to align the bastion face (FS) to three-fourth of the curtain wall (R), creating extra gun positions from where the bastion can be swept (PR).

<sup>74</sup> Although his *Apologíá en excusacion y favor de las fábricas del reino de Nápoles*, would only be published in 1878, in the 16<sup>th</sup> century the manuscript is known to have circulated amongst scholars. His work is for example cited by Gabriello Busca. Bury 1985, pp. 17-18.

<sup>75</sup> For a short overview of the debate about the star shaped layout see: Bury 1978, p. 14; Hughes 1982, p. 74.

<sup>76</sup> A beautiful example of a late 17<sup>th</sup> century Portuguese star fort built in Mozambique forms the São João Baptista fortress at Ibo Island.

<sup>77</sup> Buonaiuto Lorini, *Della Fortificationi libri cinque*, Venice 1597, pp. 12-14.

This idea has also been taken further, with faces oriented towards the middle of the curtain from where a gunning position could sweep both adjacent faces.<sup>78</sup> It however has to be understood that aligning the faces to a point on the curtain closer to the bastion means the salient angle becomes more acute, which makes it more vulnerable. In order to make a balanced design the length of the curtain walls as well as the shooting range of the artillery would be factors of consideration in the alignment of the faces.

Another part of the bastion that can be found to have various forms in different treatises is the flank. Straight flanks would quickly be succeeded by *retired flanks*. In this setup the outward projected so called ‘shoulders of the bastion’ would help to protect the flanking position from enemy fire. This was so widely adopted by Italian architects that it would become a distinctive feature of Italian bastion design. These projected shoulders were built in either a square or a round form, so called *orillons*, depending on the architects’ preferences. To maximise the firepower of the flanks, not only could cannons be installed on top of the bastion but also on a lower level in the *casemate*.<sup>79</sup>

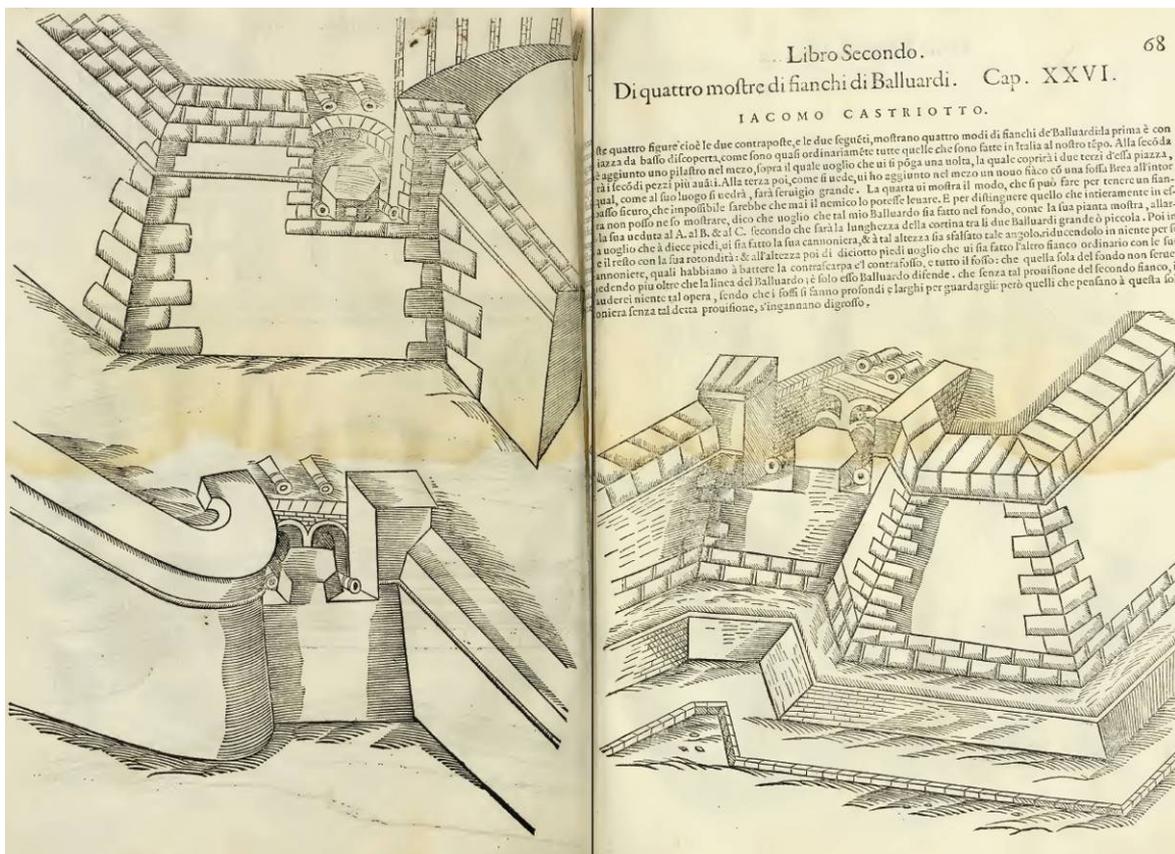


Fig. 2.6: Folio from the treatise by Maggi & Castriotto (1564), showing different forms of bastion flanks.

<sup>78</sup> In these situations generally a raised gun platform, called a *cavalier*, is built upon the terreplein. Sweeping the bastions from such a position could either provide a form of additional cover, or can be completely replacing mutual bastion defences in case the intermediate distance had been too big to provide direct cover.

<sup>79</sup> The fort at Nettuno (1501-1503) built by Giuliano da Sangallo (1445-1516) already featured retired flanks. He preferred to use *orillons*, while for instance his brother Antonio da Sangallo the Elder (ca. 1455-1534) favoured the angled variety. Hale, 1983, p. 468; Duffy 1979, pp. 30-31.

Where bastions were unable to provide sufficient mutual flanking fire, because the mutual distance exceeded the range of the artillery, initially a system was adopted where additional fire support was given from small semidetached bastions at the middle of the curtain, or from a platform on top of the wall. During the sixteenth century this inadequacy was solved by enlarging the bastions and increasing its fire power whilst decreasing the mutual distance of the bastions.<sup>80</sup> At the middle of curtain detached *ravelins* would be built instead. These isolated outworks were introduced to protect the curtain wall and keep enemy siege fire on a greater distance.

Outside the *ramparts* also the ditch, which had been used since ancient times, would remain of great importance. It would not only act as a barrier to slow down attackers, but could also be built to keep the low profile walls of the modern fortifications out of sight and thus out of reach from direct artillery fire. Theorist disagreed whether dry or wet moats should be considered most desirable. Although water filled ditches would make counter attacking a besieging enemy more difficult and stagnant water could cause sanitary problems, most authors did prefer this option because it would prevent the enemy from placing mines under the ramparts.<sup>81</sup>

The theoretical discussions and publications of treatises contributed to the continues improvements made in the field of military architecture during the sixteenth century. The initial supremacy artillery had against defence structures was countered by the Italian method of defence which made it possible to make effective use of artillery in a defensive role. The more the defence systems developed, the rarer successful assaults on fortifications became.<sup>82</sup> As mentioned before this process started in Italy, but would soon spread across Europe and its overseas territories.

### 2.3 The spread of the system

As described previously military architectural had changed in reaction to the more effective use of artillery. The development towards more resilient, low gun platforms had taken place throughout Europe. However, the final step in this development towards the angle bastion had taken place in Italy. Furthermore, during the sixteenth century military architectural publications almost exclusively came from Italy. This had made Italian military engineering leading in Europe. During this era the knowledge about the new defence system would be spread by Italian engineers working abroad as well as foreign investigations into the Italian art of defence, which included the translation of treatises.<sup>83</sup>

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<sup>80</sup> This change defines the distinction, that can be found in modern literature, between the so called "old" and the "new-Italian system". Heuvel, 1982, p. 10.

<sup>81</sup> Eltis 1995, p. 81.

<sup>82</sup> Instead of successful artillery assaults lengthy sieges were mostly deployed, hoping shortage of supplies would break the defences. Eltis 1995, p. 88; Black 2002, pp. 69-97.

<sup>83</sup> For instance the treatise of Giovanni Batista de' Zanchi, *Del modo di fortificare la Città*, published in Venice in 1554 was published in French by François de la Treille, *La manière de fortifier villes, chasteaux, et faire autres lieux fortz*, Lyon 1556, making it the first book on the subject of the new fortification method in this language. From French it would be translated in English three years later in a manuscript written by Robert Corneweyle titled *The maner of fortification of cities townes castelles and other places(...)*. Neither of these translations

The Habsburg Empire had closely followed fortification developments on the Italian peninsula. Italian engineers in service of Spain would soon be sent out to frontlines all across the empire, including the Low Countries, Poland and Hungary. From the 1530's onwards Italian military engineers would also be working in German, French and English service.<sup>84</sup> However, the focus here will be on Portugal. Information about military engineers in Portuguese service during the first half of the sixteenth century is scarce. In some cases it remains unclear how the Italian fortification methods reached Portugal. This is for instance the case with the small fort at Vila Viçosa built around 1530, which closely resembles designs made by Leonardo da Vinci (fig. 2.1).<sup>85</sup> More is known about the notable Portuguese humanist Francisco de Holanda, who played an important role in bringing knowledge about modern fortification to his home country. He was sent out by King João III to Italy in 1537 to study the arts, with the instructions to especially focus on the art of fortification. During his four years of travelling he visited many fortifications in Spain, France and most importantly Italy, of which he brought back sketches and notes.<sup>86</sup> Furthermore de Holanda tells us that, back in Portugal, he had designed what would become the first 'well-fortified' fortification on the African continent.<sup>87</sup> This meant his plan for Mazagão, the present El-Jadida at the Atlantic coast of Morocco, was based on the bastioned system. To oversee the work an Italian military engineer in service of Emperor Charles V by the name of Benedetto da Ravenna was lent by King João III in 1541.<sup>88</sup> Interestingly the Portuguese military engineer Miguel de Arruda, who is also associated with the design of the São Sebastião fortress at Mozambique, is known to have joined Benedetto during his inspection. This example shows another way by which Italian architects and their methods reached Portugal, namely through the Spanish court. Not only was King João III a brother-in-law of the Emperor, the inspection of fortifications along the North African coast would have also been of mutual Portuguese Spanish interest. Later in the sixteenth century Iberian relations were further intensified when King Phillip II of Spain also became King Phillip I of Portugal in 1580.<sup>89</sup> Because great parts of the Italian peninsula also stood under his reign, this fostered a further influx of Italian ideas and military engineers into Portugal.<sup>90</sup>

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name the original Italian author. For more information about these translations see the introduction by Martin Biddle in the reproduction of the English version. Corneweyle & Biddle 1972.

<sup>84</sup> For more detailed information about the spread of Italian engineers over Europe see: Westra 1992, pp. 7-10; Parker 1988; Martens 2009.

<sup>85</sup> Westra 1992, p. 9; Bury 1984, pp. 499-501.

<sup>86</sup> Bury 1978, pp. 12-30; Bury 1981, p. 14; Bury 2000, pp. 78-107. Looking back Francisco de Holanda (ca. 1517-1584), writes in his 1571 manuscript titled *Da fabrica que felçe ha cidade de Lysboa: 'El Rei me mandou a Italia ver e desgnar as fortalezas d'ella'*. Bury 1994, p. 35. Consulted report on de Holanda's travels see: Boon 1993.

<sup>87</sup> *'feita por meu desenho e modelo, sendo a primeira força bem fortalecida que se fez em África, a qual desenhiei, vindo de Itália e de França'*. Carita 2004, p. 143.

<sup>88</sup> Bury 1978, p. 8; Bury 1994, pp. 33-38.

<sup>89</sup> The period of the so called Iberian Union in which the kings of Portugal would be from the Habsburg house lasted until 1640. Bethencourt 2007, p. 381. In this study there will be generally referred to Phillips as the King of Portugal, therefore the Portuguese numbering will be followed, unless specifically stated otherwise.

<sup>90</sup> An example of the latter category is formed by the career of the Italian military architect Giovanni Batista Cairati, known in Portugal as João Batista Cairato. In 1577 he came from the Habsburg duchy of Milan to Spain in service of King Phillip II of Spain. Six years later he would become the chief-architect or *Arquitecto-mor* to inspect the Portuguese fortifications overseas and would amongst many other things produce a plan for the fort Jesus at Mombasa. Boxer & Azevedo 1960, pp. 89-95.

## 2.4 Conclusion

This chapter has shown why fortification techniques dating back to the middle ages, which were still applied at fort São Gabriel, could no longer sufficiently withstand modern artillery fire in the sixteenth century. The improved offensive power besiegers had to their disposal, had to be countered by military architecture which was more resilient and could effectively use guns in a defensive role. These new requirements initiated the development of the angled bastion and its systematic application in fortification architecture, in which Italy played a dominant role. At the time the first plans were made for a new fortress, adapted to modern artillery at Mozambique Island in the 1540's, Italian architects had already been experimenting with the concept of the bastioned system for decades. At this stage it can at least be concluded that the Portuguese had then already been interested in Italian fortification methods. Publications concerning the theories behind this new discourse within military architecture would hardly be printed before the middle of the sixteenth century. Nonetheless cooperation between Italian and Portuguese engineers already existed in the decades before work on the São Sebastião fortress took off.

## Chapter 3: The São Sebastião fortress today

More than four and a half centuries after the building process started, today São Sebastião fortress still occupies the north-eastern tip of Mozambique Island. In this chapter the present situation of the fortress will be briefly described. In this way the actual situation can be used as a point of reference when the subsequent construction phases of the structure will be distinguished in the next chapter.

### 3.1 The current structure

The São Sebastião fortress has a considerable size with the contours of the outside walls adding up to a length of about 900 meters. The ground plan shows roughly a trapezoidal form, tapering towards the east. Angled bastions stand on each of the four corners of the structure.



**Fig. 3.1 & 3. 2:** Areal views of the São Sebastião fortress at present. From above the traces of older building phases are clearly visible.

The northern bastion is named after São João, but has formerly also been referred to as '*Santiago*'.<sup>91</sup> East of it stands, next to the chapel of Nossa Senhora do Baluarte, the Nossa Senhora bastion.<sup>92</sup> The south-eastern corner is currently called the Santa Barbara bulwark, while it was previously named after Santo António.<sup>93</sup> West of it lies the São Gabriel Bastion. To avoid confusion the currently used names will be adopted in this study. As can be seen in figure 3.2 the bastions differ greatly in form as well as in size, with Nossa Senhora being the

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<sup>91</sup> Relying on the information provided by old maps, which will be further discussed in chapter four, the bastion must have gotten its new name around the first decades of the 17<sup>th</sup> century (fig. 4.3, 4.7). It could be speculated that the bastion was renamed after João IV, who was born in 1603 and would rule over Portugal after the restoration in 1640, till his death in 1656.

<sup>92</sup> This bastion has also been referred to as '*Nossa Senhora da Vitória*' in copies of the map made by Erédia with are discussed in note 138. However this name only seems to have been used incidentally.

<sup>93</sup> For example António Bocarro refers to this bastion as '*Sancto Ant.*<sup>o</sup>' in his *Livro das plantas de todas as fortalezas, cidades e povoaçoens do Estado da Índia Oriental* from 1635. Published in: Bragança 1936-1940, vol. IV.

smallest and São Gabriel the largest. In between the bastions the curtain walls stand. Of these walls only the shortest one, on the east side of the fort, is built straight. The other curtains have concave forms. The western curtain has two angles, which divides the wall in three segments.<sup>94</sup> The middle part which holds the main gate runs about parallel to the straight wall between Nossa Senhora and Santa Bárbara bastion, tapering somewhat to the south. The northern curtain, as well as the landside wall, is built up out of two wall sections.<sup>95</sup>

The height of the bastions and the walls differ little throughout the structure. Also the small outlook posts, of which in total nine have been built on corners of the ramparts, only rise about a meter above the parapets. This gives the fortification a horizontal silhouette when viewed from a distance (fig. 3.3). How high the coral stone ramparts rise, varies greatly depending on the relief of the surface. At the lowest point the outside wall measures up to twelve meters from the ground to the tip of the parapet. While the distance between the top of the fortress wall and the inner courtyard amounts only about six meters.<sup>96</sup> At the place where the tilted *scarp* meets the parapet a thin shelf of stone extends out from the walls. This so called *cordon*, visible on cross-section images in figure 3.4, runs around the entire outer wall of the rampart. The main reason for this ledge is to keep rain from running directly down the walls of the fort.



**Fig. 3.3:** The western front of the São Sebastião fortress as seen from the bay of Mossuril.

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<sup>94</sup> In respect to the middle part of this wall, the angles towards the segments that run up to São Gabriel and São João successively measure approximately  $135^{\circ}$  and  $145^{\circ}$ .

<sup>95</sup> The blunt angles in both of these curtains measure approximately  $160^{\circ}$ .

<sup>96</sup> These measurements are based on topographical survey maps made by Forjaz Architects, commissioned by UNESCO. For the complete assessment report see: Forjaz Arquitectos 2007.

The thickness of the ramparts differs throughout the structure. Naturally the most robust spots are the bastions, which are built as solid gun platforms. Only at the Santa Bárbara bastion a small open space exists behind the retired flank. Along the curtain walls two construction methods can be distinguished, which have resulted in contrasting wall widths as can be seen in (fig. 3.4). At most parts the ramparts consist of two layers of coral stone walls, which are filled up with loose material. This results in a broad terreplein. At the narrow wall sections the rampart is completely built up out of carved coral rock. Here the walls do not provide enough space to mount cannons upon them. This is the case at the northern curtain and at the wall section above the main gate. Along about two thirds of the rampart, *embrasures* are constructed within the parapet. Notably these are, however, absent at the entire north side of the fortress facing the channel which provides access to the bay. Also the eastside of the Nossa Senhora bastion, the middle wall section in the western curtain and half the parapet on the landside wall are not fitted with embrasures. The absence of these openings along the narrow stretches of wall, where gun platforms could not be built, seems logical. At the other places other reasons must have been at play for not building embrasures.<sup>97</sup>

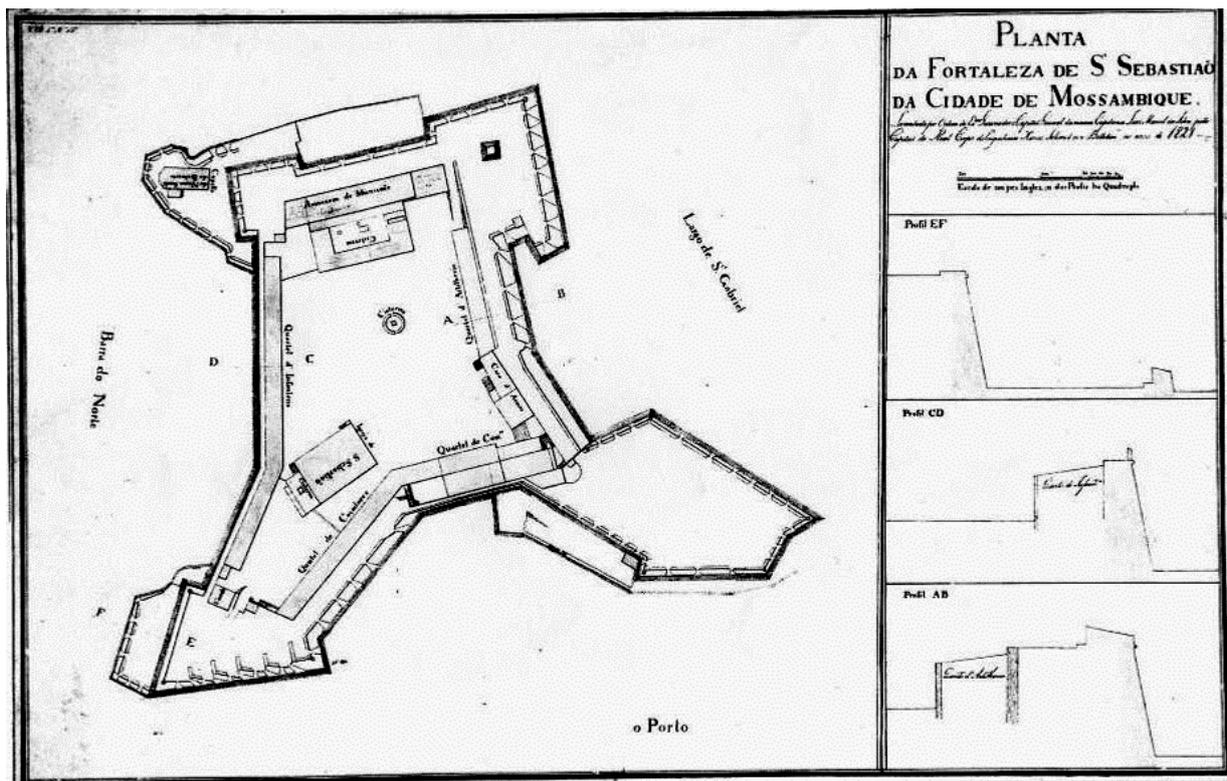
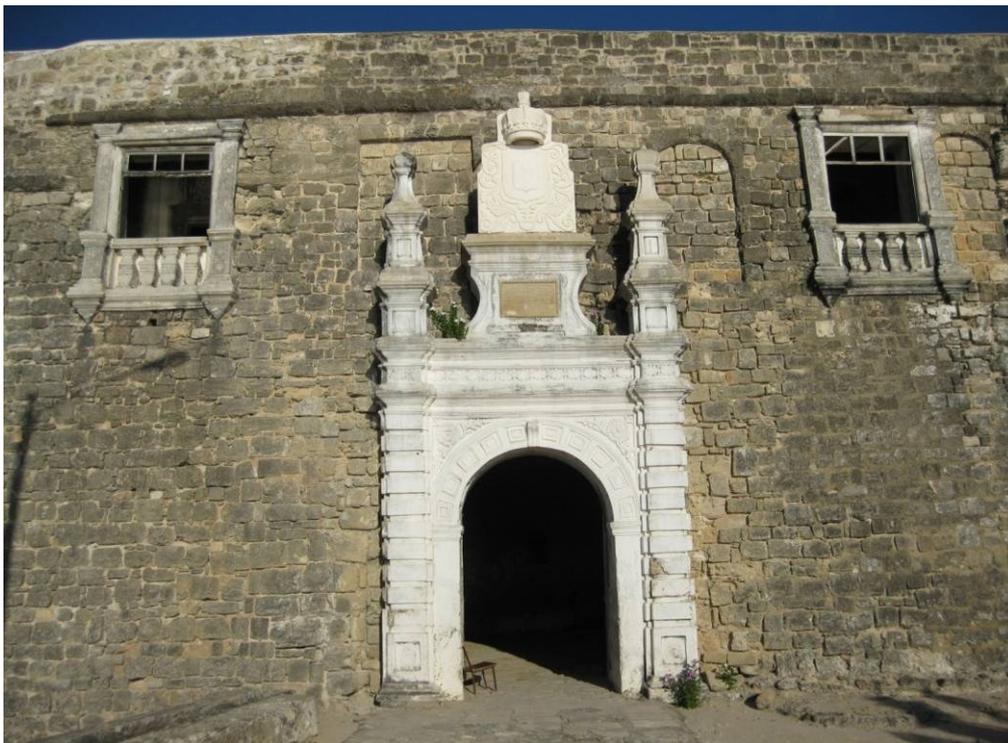


Fig. 3.4: Plan of the fortress (1821) with cross sections of the ramparts.

<sup>97</sup> At the north-east face of the São João bastion the parapet is so low, that it does not obstruct the gun positions, making embrasures superfluous. The Nossa Senhora bastion, as will be later discussed, has been rebuilt in the 20<sup>th</sup> century. It seems likely that formerly the parapets of the bastion did have embrasures, since these are clearly depicted on for instance on figure 3.4 and 5.11. For the logic behind this see paragraph 5.3 in which the 1754 map will be discussed.

The fortress has four gates, of which three are currently functioning. As mentioned, the main gate is located in the middle segment of the western wall. The façade of this entrance is highly decorated (fig. 3.5). In contrast to the rough and porous local coral stone which has been used throughout the fortress, harder stone more suitable for carving has been used for the gate.<sup>98</sup> The arch is flanked by partly overlapping pilasters. These are made to look extra robust with a finish of horizontal bands. Unconventionally the bases of the pilasters are placed under what might otherwise be typified as the pedestals. In the same way there is no clear separation between the capitals and the architrave. Typically the first would visually support the latter. Instead, here these two elements are part of the same horizontal profile. The decoration of the frieze above shows a pattern of ovals. Further upwards the forms of the capitals are echoed in the profiles of the cornice and in the two corner pinnacles. Also the square form of the pseudo-pedestals reoccurs. Right above this gate stands a plaque which is topped with a, recently restored, stone showing the Portuguese coat of arms. Passing through the gate, two right angled turns have to be made within the wall structure before the courtyard can be reached. Two smaller points of entry to the fortress are through inconspicuous openings on both ends of the northern curtain wall. From within the fortress these provide access to the low-lying batteries located in front of São João bastion and round the chapel of Nossa Senhora.



**Fig. 3.5:** Main gate of the fortress, located within the western curtain. Above the decorated façade traces of earlier windows are still visible.

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<sup>98</sup> Usually finely carved building elements like this would be prefabricated in the home country. As already mentioned in chapter two, for instance elements of the São Gabriel fort would have also been sent overseas. An analyses of the stones used for this gate should be carried out to test this suspicion.

The fourth and final gate is located at the middle of the southern wall. Its size is comparable to the main gate, but it is not decorated. The outside opening of this gate stands well above ground level, which makes it currently unusable (fig. 3.6). A vault visible within the flank of the Santa Bárbara bastion suggests that at some point there would have been another opening within the rampart of the fort, but at present it is closed (fig. 3.7).



**Fig. 3.6:** Former main gate of the fort, located within the southern curtain at the point where the two wall section meet. **Fig. 3.7:** The retired flank of the Santa Bárbara bastion, showing the traces of what would have been a vaulted opening.

From the courtyard within the fortress, ramps lead up to the bastions of Santa Bárbara and São João, while stairs provide access to São Gabriel. Only the bastion of Nossa Senhora has no direct pathway linking it to the ground floor. Around the courtyard barracks and other rooms are located against the ramparts. Exclusively along the western wall and the western part of the southern wall these buildings have two storeys. The thickness of the structure behind these rooms varies. Along the southern curtain the rampart is about twelve meters thick, while the width of the northern curtain barely measures five meters. Only at the middle section of the western curtain rooms consist throughout the wall. This explains that the only two windows looking out of the fortress are located here. The decoration of these windows, facing towards the bay, corresponds with the main gate above which these openings are symmetrically aligned (fig. 3.5).

As with other buildings on the island the roofs within the fortress are utilised to collect rainwater. Gutters and small aqueducts direct the water to the cisterns located within the fortress walls. Great amounts of water can be stored here for times of scarcity. The main cistern is built adjacent to the eastern wall and lies behind small covered spaces facing the courtyard. The small cistern and the church of São Sebastião together form the only freestanding buildings within the fortress walls. However, in this study the attention will remain on the design of the outline of the São Sebastião fortress.

### 3.2 Restorations

It goes without saying that the fortress in the current form, as described, is the result of many building phases and modifications since the sixteenth century. But before the structure we see today will be compared with images and descriptions of the long past, some recent interventions and restorations will be mentioned.

The role the fortress plays today, solely as an historical monument and tourist attraction, has been a relatively recent phenomenon. The fortification has long remained in use by the Portuguese military forces. The amount of soldiers that would be based here increased through time from a few dozen in the sixteenth century to several hundred in the nineteenth century. Until Mozambique became independent in 1975 allegedly some of the buildings were used to keep prisoners.<sup>99</sup> Because the fort remained to be intensively used up until the 20<sup>th</sup> century much of the buildings surrounding the courtyard have continuously been modernised. This explains why many constructions made out of reinforced concrete can be found in this sixteenth century monument. Since the interior of the fortress is of minor importance in this study, the focus here will again be on the outer walls. From the outside of the fortress it is less apparent that modern interventions have taken place.

Nevertheless, although it is hardly noticeable, one of the bastions is actually just over a hundred years old. The bastion of Nossa Senhora has namely been rebuilt after the explosion of the armoury which took place on the 21<sup>st</sup> September of 1903 destructing the north-eastern corner of the fortress. Luckily the chapel of Nossa Senhora do Baluarte suffered only minor damage (fig. 3.8).<sup>100</sup> The rebuilding of the bastion was commenced directly after the accident. It has been carried out in line with the former design, using corral stone and the same building techniques. As a result, today the Nossa Senhora bastion does not stand out from the rest of the structure.



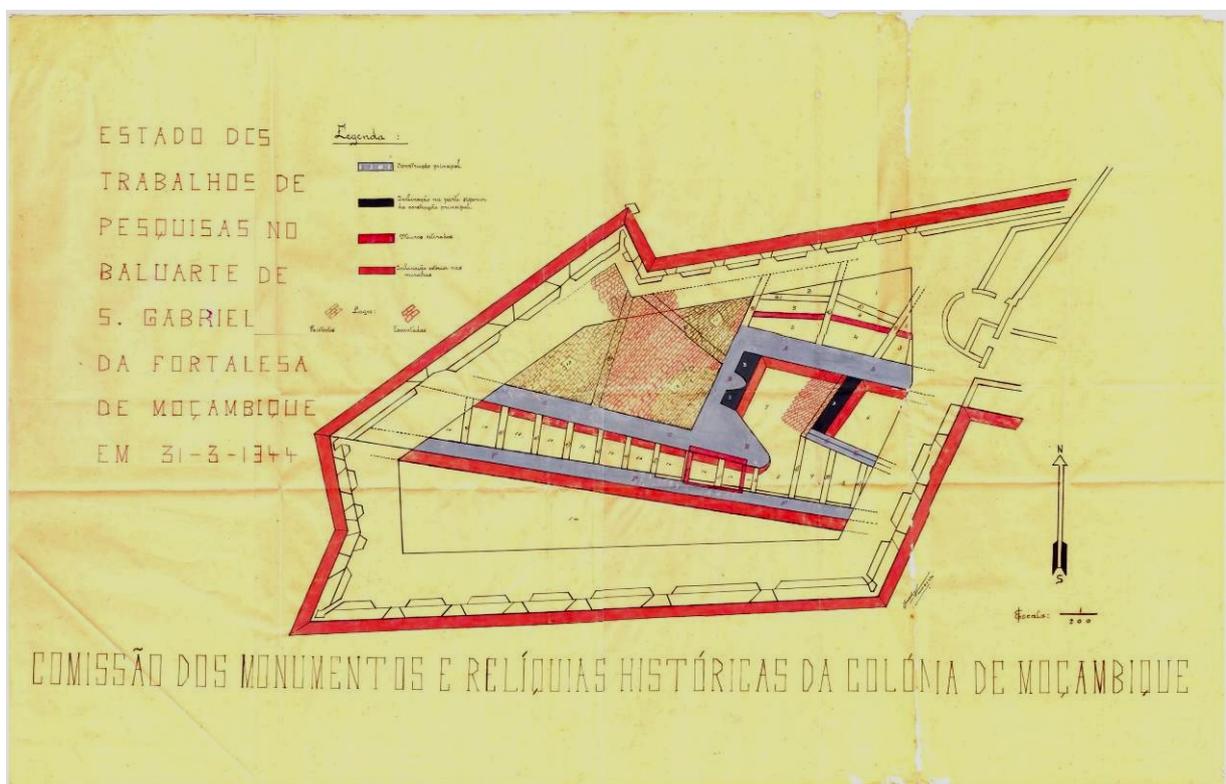
**Fig. 3.8:** Interior view of the fortress after the explosion in 1903 which heavily damaged the north-eastern corner of the structure.

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<sup>99</sup> UNESCO 2009, p. 12.

<sup>100</sup> A description and photo of the damage caused by the explosion is published in: Jesus 1904, p. 20.

Other relatively recent noteworthy changes have taken place at the fortress during works that were undertaken in the 1940's under the *Comissão dos Monumentos e Relíquias Históricas de Moçambique*. It was then that restorations have been carried out at the gate located in the southern curtain. This gate had been blocked, but was excavated and reopened, giving it its current appearance (fig. 3.6). Furthermore excavations were carried out at the bastions of São Gabriel and Santa Bárbara under the supervision of this commission.<sup>101</sup> The different wall segments that were found within the São Gabriel bastion have been mapped (fig. 3.9). The research conducted at the Santa Bárbara bastion seems to have been less extensive, no maps showing the result of these excavations are known. Nonetheless, since these works were carried out, former outlines of the rampart walls have remained visible on the floor of the current bastions (fig. 3.2). In the next chapter these tangible traces will play an important role in reconstructing and dating the former outlines of the fort.



**Fig. 3.9:** Map made by the heritage commission of Mozambique, depicting the results of the research carried out at the São Gabriel bastion in 1944. Here the different layers of construction still visible on top of the bastion are shown. Also the inner wall structure becomes clear, but these historical construction phases are not dated here.

At the time Mozambique Island including the São Sebastião fortress was inscribed on the UNESCO World Heritage List in 1991, Mozambique was still entangled in civil war. As a result of this tumultuous period naturally the buildings on the island have suffered heavily from

<sup>101</sup> Lobato 1967 n. pag.; Kirkman 1966, p. 211; Pereira 1966, p. 172-225.

lack of maintenance. After years of decline, recently an overall maintenance and restoration project has been carried out. This has had a major impact on how the fortress looks today.<sup>102</sup> To protect the structure, overgrowth was removed and the eroding walls were repaired. Amongst other things carried out during this operation most parts of the terrepleins have been repaved and roofs were made waterproof. This helps to preserve the construction and was also necessary to get the water collection system functioning again. A new cistern was added to the system. It has been built just outside the rampart wall between the São Gabriel and Santa Bárbara bastion to provide water to inhabitants of the island. Apart from the fort being a tourist attraction, plans have been made to rehabilitate the structure by allocating new functions to it.<sup>103</sup> This strategy might help to save São Sebastião for the future.

### 3.3 Additional fortifications

Although the focus of this thesis is on the architectural history of the São Sebastião fortress itself, for a better understanding of this fortification it should be analysed in combination with the other, smaller defence structures of Mozambique Island. Since the island is too big to be swept effectively by its main fortress alone, different gun positions had to be used to form an integrated defence system. Before the development of the São Sebastião fortress will be dealt with in the next chapter, an insight into the chronology of the secondary defences of the island will be provided.

Three fortifications that predated the São Sebastião fortress have already been mentioned in the first chapter. Fort São Gabriel, which had been the first fortification the Portuguese built on the island, no longer exists. It had become outdated and disused after the new bastioned fortification was taken into service. In 1610 the plot on which the ruined fort stood was donated to the Jesuit order by *Vice-Rei* Rui Lourenço. Nowadays the church of São Paulo and the former convent stand here, which currently houses the museum of the island.<sup>104</sup> In contrast to the loss of the former main fortification, the fortified chapel of Nossa Senhora do Baluarte, dating back to 1522, still stands on the north-eastern tip of the island. In the current situation it could be described as an integrated part of the São Sebastião fortress, since it is surrounded by the low-lying batteries in front of the rampart wall. This is also the case with the ruins of the earlier mentioned battery raised under João de Castro. Not much of it is left, but it would have functioned as an integrated part of the new fort.<sup>105</sup>

In addition to these three structures, two other fortifications have been built after the São Sebastião fortress, were taken in to use. At a greater distance from the main fortress, on a small headland along the eastern shore of the island, stands the fort of Santo António. Like the Nossa Senhora do Baluarte chapel the structure has a religious as well as a defensive function. It comprises of a church dedicated to the holy António which is embraced by a U-shaped coral stone breastwork with embrasures. Due to the limited space of which the

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<sup>102</sup> In 2003 *The Rehabilitation of Saint Sebastian Fortress* project was launched coordinated by UNESCO. Extensive reconstruction and preservation works have been carried out since. For more detailed information see: UNESCO 2003; Forjaz Arquitectos 2007.

<sup>103</sup> UNESCO 2003.

<sup>104</sup> Ferreira 2010, p. 97-99. Parts of the ruined São Gabriel fort have been incorporated into the current structure. Fonseca 1972, pp. 55-72.

<sup>105</sup> Fonseca 1973, pp. 65-67.

structure comprises, the low walls and the lack of bastions, this fortification might best be typified as a battery instead of a true fort. The location is however very strategically chosen, looking out over the beaches along the east coast of the island to the north. The current fort would have been finished during the captaincy of Pedro de Saldanha e Albuquerque between 1758-1763.<sup>106</sup> Major repairs and renovations took place at the church as well as the breastwork in 1820 and 1969, giving it its present occurrence.<sup>107</sup>

Finally another fortification survived which was part of the former defences of the island. It stands on the tiny Island of São Lourenço which lies just off the coast at the southern tip of Mozambique Island. The water dividing the two islands is so shallow that at low tide it can be easily reached on foot. Here stands the small, almost triangular fort of São Lourenço. The only entrance of the fortification is on the south side which is flanked by two *half-bastions*. Inside a ramp leads up the coral stone walls. Embrasures are fitted in the parapet ensuring that cannons on the terreplein could be aimed in all directions. While the São Sebastião fortress covered the northern entrance to Mossuril Bay, from this point the southern shallower inlet could be controlled. The building of this fort started in 1695 and was completed in 1714.<sup>108</sup> A depiction of the fortress on a French map from 1725 shows the fort would by then already have had its current form, leading to the believe that any later interventions have had minor impact on the outline of the structure.<sup>109</sup>

Together with the main fortress of the island, fort São Lourenço and the gun positions at fort Santo António would have covered the entire eastern shore of Mozambique Island and the two access points to the bay, preventing enemies from landing. Probably already in the sixteenth and seventeenth century smaller gun positions would have temporarily been used at these strategic points. But the integrated defence system would probably only become to consist out of sizable permanent fortifications during the eighteenth century.<sup>110</sup> This means that in the hundred and fifty years after construction works had started on the São Sebastião fortress, the defences of the island would almost solely rely on the main fortress.

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<sup>106</sup> Lima 1983, p. 49.

<sup>107</sup> Ferreira 2010, p. 91.

<sup>108</sup> Ferreira 2010, p. 91; Lima 1983, p. 48.

<sup>109</sup> The French map depicting the São Lourenço dated 1725 and titled *Plan de la baye de Mosambique* has been republished in: Fonseca 1973.

<sup>110</sup> For a more detailed overview of the debate on this issue see: Appendix II.



## Chapter 4: Phases of construction and modifications of the fortress

In the previous chapter the São Sebastião fortress has been briefly introduced as it stands today. To find out to what extent this structure still looks like the initial design and from what time the different alterations date, in this chapter the fortress will be compared to the available old maps and descriptions. The intention is not to provide a complete overview of all known historical sources on the fortification. Only maps and descriptions accurate enough and based on reliable observation that can help to date the different building phases are included in this analysis. In this era mapmakers often closely followed pre-existing examples. In some cases this resulted in a great number of maps with only minor differences. For this study it has been tried as much as possible to consult the oldest archetype. The selected maps and descriptions will form steppingstones which highlight building phases influencing the layout of the fort. The aim is to get an overview of the alterations that took place until the structure got its current outline.

### 4.1 The earliest descriptions and maps of the São Sebastião fortress

As mentioned in chapter one in 1547 works on the São Sebastião fortress were already underway. But due to the initial absence of a fortification expert and the sheer size of the project, work on the fortress took long. The first map that shows a fortification facing the entrance of the bay was part of the so called *Livro de Lisuarte de Abreu*. This manuscript atlas is believed to have been made between 1558 and 1564.<sup>111</sup> Notably, the view of the Mossuril Bay in this atlas, still focuses on the São Gabriel fort which is surrounded by religious buildings (fig. 1.3). As has been discussed in chapter one, the Manueline fort would be the most important defence structure on the island until the São Sebastião fortress would be constructed. Interestingly, in the background of the map, along the east coast of the island some defence walls are shown. Unfortunately the drawing is too vague to get a good impression of the structure. It thus remains unclear, if it means to depict the battery raised by João de Castro, or the São Sebastião fortress under construction. The fact that the ramparts seem to form an enclosed space would suggest the latter. However, due to the little information the drawing provides no structural analyses of the São Sebastião fortress can be based on this map.

In the decades that followed the building process further progressed. In 1583 the structure would have been adequate for *Capitão* Nuno Velho Pereira and the first garrison of the island to be quartered in the fortress.<sup>112</sup> In the same year the Dutchmen Jan Huyghen van Linschoten stayed on Mozambique Island en route to Goa.<sup>113</sup> He writes that a strong and

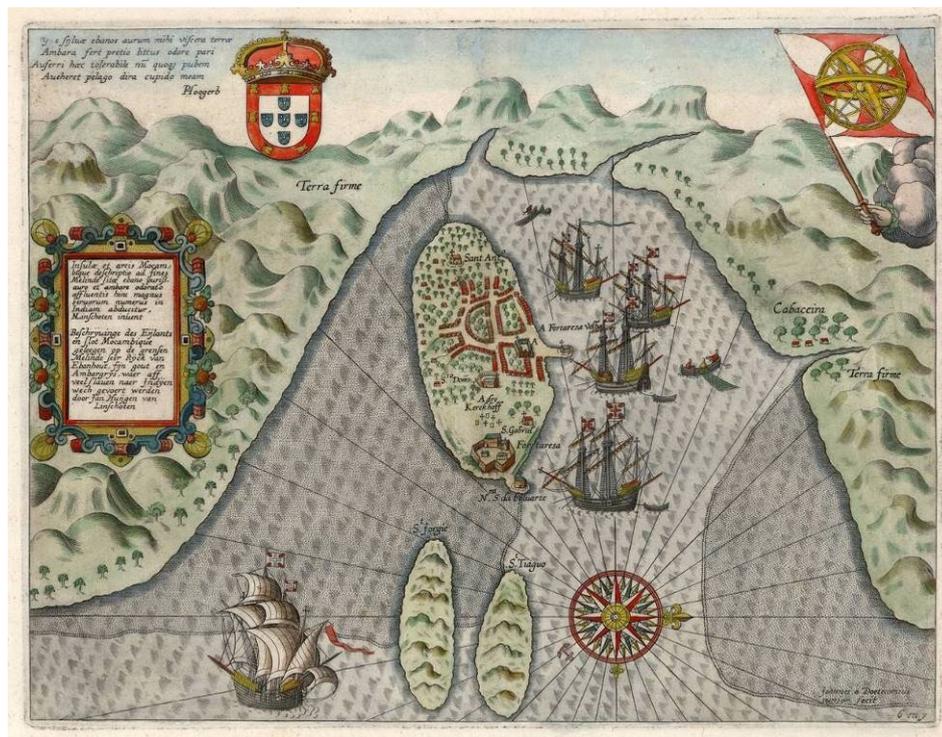
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<sup>111</sup> Cortesão & Mota 1960, vol. I, pp. 169-172. The manuscript atlas is kept at the Pierpont Morgan Library in New York.

<sup>112</sup> Kirkman 1966, p. 210.

<sup>113</sup> Jan Huyghen van Linschoten (1563-1611) was in service of a Portuguese Dominican friar who had been appointed to Goa in 1583. En route he arrived at Mozambique Island on the 5<sup>th</sup> of August where he stayed for fifteen days. Back in home Van Linschoten published the two volumes of a book about his time in Portuguese service between 1579-1592, based on his own observations and information from Portuguese texts, maps and illustrations, which he had access to in Goa. This book proved to be of great value to Dutch seafarers. Kern 1939-1955, vol. I.

well-built fort stands there, that controls the entrance to the bay. Van Linschoten tells us that the fortress was the only structure of defence on the island and that it hardly had any people and little artillery and ammunition to defend it.<sup>114</sup> According to him the building was completed ten or twelve years before his visit. In contradiction to this report, works on the walls continued till at least 1595. Moreover, even in 1604 King Phillip is known to have insisted on a swift completion of the works, if anything still had to be done.<sup>115</sup> All in all, most of the work was finished round the turn of the sixteenth century. According to Friar João dos Santos, the São Sebastião fortress should at that time have been considered as: ‘one of the strongest within the Estado da India’.<sup>116</sup>



**Fig. 4.1:** Coloured print of Mozambique Island as it has been published in Van Linschoten’s *Itinerario* (1595-1596).

<sup>114</sup> ‘Die Portugaloyfers hebben daer een seer schoone ende stercke fortresse, die nu eerst binnen thien oft twalef jaren volmaect is, ende respondeert recht teghen die voorste eylandkens ende incomst van die schepen, ende is een van die beste ende sterckste. [...] het eylandt en heeft anders gheen beschutsel dan alleenlicken dese fortresse; die reste is altemael open ende vlacke strand [...]weynigh geschut ende munitie noch ghereetschap op, desghelijcks gheen soldaten, dan alleenlijck den capiteijn met zijn dienaers, die daer op woont’. Quoted from original text: Jan Huyghen van Linschoten, *Itinerario, voyage ofte schipvaert (...)*, Amsterdam 1595-1596, republished in: Kern 1939-1955, vol. I, pp. 21-22. Notably the *Torre Velho* and the *Nossa Senhora do Baluarte chapel* do occur on Van Linschoten’s map (fig. 4.1). Certainly the report of a poorly defended fort must have stimulated the Dutch in trying to take over the stronghold at the beginning of the 17<sup>th</sup> century.

<sup>115</sup> Kirkman 1966, p. 210; Axelson 1973, p. 169. Original text quote: ‘e se ainda ouer que fazer neste particular encomendo vos muito que o ponhaes por obra com toda a brevidade posivel’. Letter from the King to the Vice-Rei, Valladolid, 1604 March 23, published in: Axelson 1962-1989, vol. IX, pp. 79-83.

<sup>116</sup> Before returning to Portugal, Friar João dos Santos would have seen the fort around the turn of the century. Original text quote: ‘Esta fortaleza é uma das mais fortes que ha na India’, João dos Santos, *Ethiopia Oriental*, Évora 1609, consulted reproduction: Theal 1898-1903, vol. VII, p. 130.

The oldest surviving map that depicts the São Sebastião fortress as the prime fortification on the island was published in Van Linschoten's *Itinerario* (fig. 4.1).<sup>117</sup> During Van Linschoten's stay in Goa, in Portuguese service, he would have had access to many maps and descriptions. He is known to have made copies, which would later become of great importance for Dutch navigators. However, claims that his particular map would have been made after a Portuguese prototype are being debated, since no older version of it is known. Possibly Van Linschoten himself made the required observations during his stay on the island.<sup>118</sup> Although the map is not very accurate, it provides an overview of Mozambique Island and the location of the main buildings on it. The representation of the buildings is so schematic that little reliable information on the form of the fortress can be drawn from it. But Dutch visits of a completely different nature, some twenty years later, would provide more precise information on the fort.

#### 4.2 The consequences of the Dutch attacks on Mozambique Island

In the first decade of the seventeenth century the Dutch East India Company attempted to take possession of the strategically located stronghold on Mozambique Island. Three subsequent attacks which took place in 1604, 1607 and 1608 formed the first mayor tests for the fortification. The detailed reports of these events were made by both the Portuguese and the Dutch. These provide useful information about the structure and the functioning of the fortress design.

During the sieges the attacker managed to land on Mozambique Island without any resistance, while the Portuguese retreated to the fortress. None of the accounts mention defence structures that were in use other than the São Sebastião fortress and the Nossa Senhora do Baluarte chapel. Although the Portuguese defence was in bad condition at the time of the first blockade, the Dutch considered that São Sebastião fortress was too strong to be taken by force. This time no attempts were made to capture it and the Dutch only managed to disrupt trade by seizing a number of ships and their cargo.<sup>119</sup> During the second attack in 1607 they were able to steal ships from right beneath the ramparts and fire at the fortress from a small distance. The Portuguese were unable to return fire because the artillery standing on the walls did not provide cover on this close range. This flaw was resolved later that year by adding batteries outside the walls round the chapel of *Nossa Senhora do Baluarte*. These works are reported to have been finished before the third attack took place.<sup>120</sup>

During both the second and third siege, attempts were made to take over the fortress. The Dutch hoped that the walls of the fortress would soon collapse when taken under cannon fire. This hope was based on information provided by locals and a Portuguese captive. They had declared that the walls of the fortress were made out of thin outer layers of stone filled up with sand in between. The Dutch commander believed this, as he could not see the

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<sup>117</sup> An earlier map only depicts some sort of fortification being under construction on the location (fig. 1.3).

<sup>118</sup> Gosselink 2007, pp. 34-35; Cortesão & Mota 1960, vol. III, p. 99.

<sup>119</sup> Axelson 1964, p. 16

<sup>120</sup> By August 1607 a battery with five cannons was installed. Booy 1968-1970, vol. I, pp. 42-43; Axelson 1964, p. 23.

materials needed to build strong fortress walls to be available on the island.<sup>121</sup> During the siege in 1607 both the Dominican convent and the São Gabriel chapel were used as military strongholds and were destroyed.<sup>122</sup> The offensive tactic was to dig trenches and install multiple batteries, from where the fortress was taken under fire. Also the attackers tried to shoot over the parapets by building a *cavalier*. Furthermore attempts were made to undermine the walls. Attacks focussed on vulnerable salient angles and the main gate, which was located between the São Gabriel and Santa Bárbara bastions. The reports tell us that in front of the gate, a drawbridge was located crossing a small moat and a ravelin protecting it.<sup>123</sup> In order to strengthen their defence, the Portuguese had blocked the main gates every time Dutch ships had come in sight. After the Dutch had managed to breach the landside wall during the third siege in 1608, the landside gate was definitively blocked. It is since then that the western gate would function as the main gate instead.<sup>124</sup> Although the Portuguese had managed to keep control over fort São Sebastião, their belongings on the rest on the island were either robbed or destroyed during these raids.<sup>125</sup> Throughout the Portuguese history of Mozambique it would have been these hostilities that had the biggest impact on the structure of the São Sebastião fortress as well as its surroundings.

Both before and after the Dutch attacks King Phillip II had repeatedly emphasised on the primal role Mozambique played within the maritime system of the empire and had ordered measures to be taken to improve the defences. The amount of men and guns had to be increased. Furthermore orders were given to dig a ditch in front of the fort and to erect *palisades* along the shore. Finally also an old fortification, which according to the letter would have stood on the south-western side of the island, had to be restored.<sup>126</sup> The reports of the sieges as well as these letters from the king have provided some information on the design of the fortress and how it functioned in battle. These descriptions will play an important role in the interpretation of the map that will be discussed in the next paragraph. In seventeenth century Dutch books describing these sieges, prints were sometimes added to the text. These however do not seem to have been made by engravers who have visited Mozambique, since no resemblance with the actual design of fort São Sebastião can be found (fig. 4.2).<sup>127</sup> Instead the first accurate depiction of the fort was made by a Portuguese hand.

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<sup>121</sup> Apparently the Admiral did not realise the widely available coral stone could be utilised to make lime, which had been used for these constructions. This becomes clear in a letter which he later writes to his superiors: *'datt oock scheen wel waar te mogen wesen overmits opt eylant anders niet en is als sant om te vullen, ende in de tijden dat het casteel bebout werde quaalyck soo groote cantiteyt van calck daer te becomen was om heel swaare muuren daar omme te trecken'*. *Brief Admiraal Paulus van Caerden aan de Heren XVII, 9 januari 1608*, published in: Booy 1968-1970, vol. II, p. 128; Booy 1968-1970, vol. I, p. 43.

<sup>122</sup> Before leaving the Dutch had set fire to both places of Catholic worship on 13<sup>th</sup> of May 1607. The ruins were erased by the Portuguese in June of the same year. Axelson 1964, pp. 22-23.

<sup>123</sup> *Isaac Commelin, Loffelijcke voyagie op Oost-Indien (...), Amsterdam 1644*, partially published in: Booy 1968-1970, vol. I, pp. 105-108.

<sup>124</sup> Booy 1968-70, vol. I, pp. 42-44.

<sup>125</sup> For detailed eye witness accounts of these events see: *Brief Admiraal Paulus van Caerden aan de Heren XVII, 9 januari 1608*, published in: Booy, 1968-70, vol. II, pp. 127-137; *Johann Verken, Molukken-Reise 1607-1612, Franckfurt am Main 1612*, republished in: Honoré 1930, pp. 22-34; *João dos Santos, Ethiopia Oriental, Évora 1609*, consulted reproduction: Theal 1898-1903, vol. VII, pp. 333-337; Axelson 1964, pp. 15-29.

<sup>126</sup> Welch 1950, pp. 308-311; Axelson 1964, pp. 16-17. For more information on these different letters and the order to restore a secondary fortification, see: Appendix II.

<sup>127</sup> In addition to the print republished in this study, reproductions of other 17<sup>th</sup> century prints of the Dutch sieges at Mozambique Island can be found in: Booy 1968, p. 42; Opstall 1972, p. 217; Axelson 1964, p. 30.



**Fig. 4.2:** Print by Theodore de Bry titled *Obsidio Urbis et Castelli Mozambiquensis* (1612) giving an impression of the Dutch siege in 1608, based on accounts of Johann Verken.

#### 4.3 The initial outline of the São Sebastião fortress drawn by Erédia

The oldest map that gives a detailed image of the forts ground plan is part of a manuscript atlas by Manuel Godinho de Erédia (fig. 4.3).<sup>128</sup> The title page of the manuscript is dated 1610 and states it had been commissioned by the *Vice-Rei* Ruy Lourenço Távora. This atlas consisting of twenty maps, is the earliest known collection of plans to give an overview of the Portuguese fortifications in the *Estado da Índia*. However, the majority of these maps are believed to have been based on pre-existing drawings and descriptions dating from the end of the sixteenth century rather than on self-conducted surveys.<sup>129</sup>

The map the atlas holds of Mozambique, shows a ground plan of the São Sebastião fortress. With the four bastions standing on the corners of a trapezoidal form, Erédia's image of the structure looks comparable to what we see today. Although the resemblance is far from absolute, the bastions facing the entrance to the bay and the walls along the reef look not unlike the current situation. On the other hand the side of the fortress facing the island looks more different. Most notably the southern curtain is depicted to be straight in contrast to the concave form we see today. Furthermore an entrance gate is drawn to be built in this wall.

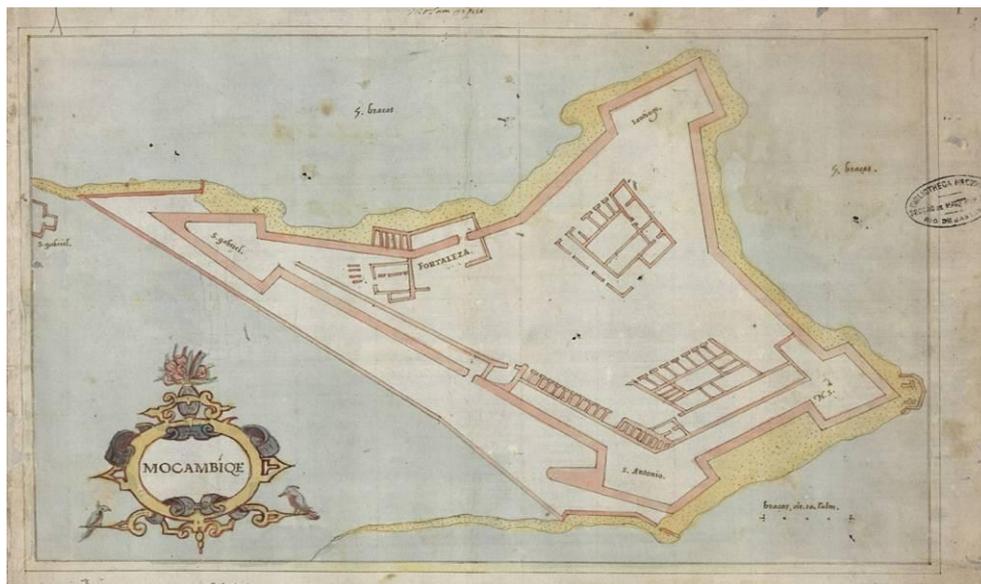


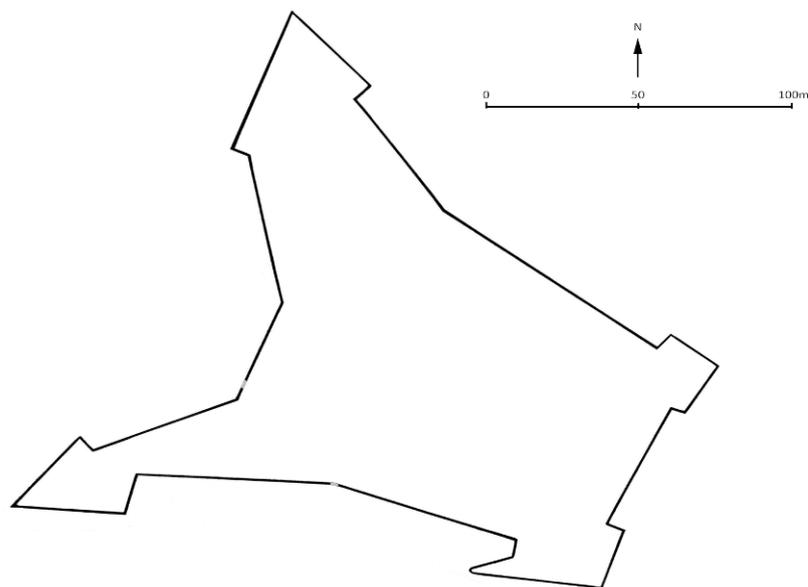
Fig. 4.3: Plan of the São Sebastião fortress as drawn by Manuel Godinho de Erédia (1610).

<sup>128</sup> Erédia is sometimes written Herédia. His twenty page atlas is titled *Plantas de praças das conquistas de Portugal. Feitas por ordem de Ruy Lourenço de Távora Vizo rey da India. Por Manoel Godinho de Eredia Cosmographo 610*. It is kept at the National Library of Brazil in Rio de Janeiro, for this study a digitalised version is consulted provided by this institute.

<sup>129</sup> Influential sources for Erédia's atlas are believed to have been the drawing and descriptions made by the architect Giovanni Batista Cairati after he was sent to the east in 1583; and maps the king had ordered the *Vice-Rei* to provide in 1598. Cortesão & Mota 1960, vol. IV, p. 48; Boxer & Azevedo 1960, p. 93.

Remarkably the São Gabriel bastion is depicted to be smaller than the São João bastion. It has a pointed form with an acute angled salient. The flanks of this bastion are shown to stand in an angle of about  $90^\circ$  towards both adjacent curtain walls. The Santa Bárbara bastion, named Santo António on the map, is shown to have a blunt salient and a very big orillon. With respect to the eastern curtain wall, the flank of this bastion makes an angle of about  $90^\circ$ . But the *angle of the flank* is much bigger towards the landside wall. Between the fortress and the rest of the island a line is drawn. It gives the impression of a wall or *counterscarp* delimitating the outside of a moat. To the left of this, the plan of the São Gabriel chapel is sketched, whereas peculiarly on the other side of the fortress the Nossa Senhora chapel is not depicted or named on the map. Only a vague battery-like structure stands in its place. The part of the battery raised by João de Castro, which would have stood along the east side of the fort facing the ocean, is not depicted.

All in all this early map of the fortress provides a relatively detailed image of its outline. In this study it will form an important source of information, helping to distinguish and date different building phases within the structure. In order to do this the map has to be compared not only to the outline of the current fortress, but also to descriptions and excavated traces of older constructions still visible at the fortress today. As mentioned in the previous chapter, the wall segments that can still be seen at the Santa Bárbara and São Gabriel bastions are of special interest. They indicate the outlines these structures formerly would have had.



**Fig. 4.4:** Sketch of what is believed to have been the initial outline of the fort, prior to the Dutch attacks. Notably, this plan shows two major entranceways and only one landside orillon.

Figure 4.4 shows the outline of the building traces which seem to correspond with Erédia's map. The former outer walls of the Santa Bárbara and São Gabriel bastions show a remarkable similarity to the drawing by Erédia. At the São Gabriel bastion, where different layers of older outer walls exist, this sketch follows the contours delimitating the smallest, thus probably oldest, bastion outline (fig. 4.5).<sup>130</sup> At the Santa Bárbara bastion the remains of the orillon as shown by Erédia is still clearly visible (fig. 4.6). The tangible traces also clearly show that the former alignment of the landside face, would indeed have resulted in a blunt salient.



**Fig. 4.5:** The surface of the São Gabriel bastion, showing the traces of different historical building phases.

**Fig. 4.6:** Building traces of the orillon of the former Santo António bastion, still visible within the Santa Bárbara bastion.

The most substantial inconspicuousities between what the fortress would have looked like around 1610 and the way it is depicted in Erédia's map, are found at the landside of the fort. The depiction of the former main gate in the southern curtain, as well as the São Gabriel chapel further afield, confirms the presumption that this map was based on obsolete information. As mentioned previously, both had namely already ceased to exist as a result of the second Dutch attack taking place in 1607. Although there would no longer have been a gate in this wall in 1610, the winding form of the entrance does resemble the old excavated gate which is again visible today. Presuming the illustration of São Gabriel bastion and the southern gate resemble the traces of these structures we see today, the presence of a straight southern wall seems virtually impossible. If namely the Santa Bárbara would have been standing in this same line, this implicates the bastion must have been built almost

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<sup>130</sup> Observations have not conclusively shown that the first orillon at the São Gabriel bastion was added in a different building phase. However, given the precision with which Erédia has drawn the orillon of Santa Bárbara, it seems highly unlikely that he would not have drawn it for São Gabriel if it would have been built at that time. It might have been planned from the beginning, but not have been finished yet.

standing against the bastion of Nossa Senhora.<sup>131</sup> It seems more likely that some mistake is made with the making of the map. This might also explain the strange parallelogram formed floor plans of the buildings within the fortress, which in reality are rectangular.<sup>132</sup> Analysing the structures standing outside the ramparts of the fort, the fact that the Nossa Senhora chapel is not depicted should not lead to the conclusion that it would not have been there at the time. The chapel is namely depicted on other maps made just a few years before and after this one. Furthermore, no historical sources have been found to suggest it would have been rebuilt. The vague battery-like structure standing in its place might depict the remains of the construction raised by João de Castro. Since at the time of the first Dutch attacks no low-lying battery would have stood there, it was probably already in a state of disrepair at the time the map was drawn. No reference is made to the old battery in later years, nor does it occur on any seventeenth century maps. Only some archaeological findings are claimed to have been found of it, in front of the ramparts along the eastern shore.<sup>133</sup> Finally the representation of a moat corresponds with the descriptions of the Dutch. The attackers however also described a ravelin and a drawbridge which Erédia does not depict. No physical evidence is known of these structures that could confirm if these constructions have existed and how these would have looked.<sup>134</sup>

It can be concluded that the map has been based on earlier observations which are made prior to march 1607 and which might date back as far as 1583.<sup>135</sup> Although the general projection of the map is not highly accurate, it proves to be a useful source of information for dating earlier building phases. The outlines of the four depicted bastions are largely corresponding with either their current outlines, or seem to match with the remaining building traces. On the other hand this is not the case with the landside curtain. It seems impossible that this wall was straight at any time. Why it has been drawn like this remains unknown. It could be speculated that this derived from measurement mistakes or the imagination of the illustrator, to whom a straight curtain wall might have made more sense. The comparison of Erédia's map with descriptions and tangible traces at the fortress has provided a hypothesis of how the outline of the structure would have looked, around the turn of the sixteenth century (fig. 4.4). No traces have been found of earlier building phases that contradict this plan. Since no reliable earlier maps of the fortress are known this can be seen as the earliest reconstructible building phase of the fortress. Considering that around this time works on the fortress were being completed, in this study this sketch is regarded as an indication of the initial outline of the São Sebastião fortress.

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<sup>131</sup> Another factor making it highly unlikely that the southern wall has ever been straight, is that the two wall sections in fact intersect right above the old gate which does occur on the map (fig. 3.6).

<sup>132</sup> A good example of this distortion in the image is the depiction of the grand cistern with the buildings around it alongside the eastern wall of the courtyard. In reality the corners of these structures approximate straight angles (fig. 3.2).

<sup>133</sup> Fonseca 1973, pp. 63-67.

<sup>134</sup> Theoretically these could have been built in the time after the observations for the map were carried out, before the Dutch attacked.

<sup>135</sup> The oldest information that Erédia is believed to have based his maps on dates back to 1583. See note 129.

#### 4.4 A visualisation of alterations in Erédia's second map of Mozambique Island

In addition to the drawing in the atlas from 1610, another map depicting Mozambique Island has been ascribed to Manuel Godinho de Erédia. It is estimated to date from around 1620 (fig. 4.7).<sup>136</sup> In contrast to the previously discussed map, many different versions with only small alterations exist of this image.<sup>137</sup> Some of these copies are believed to have been made by the same author, but also other cartographers have closely followed the archetype throughout the seventeenth century and even well into the eighteenth century.<sup>138</sup>



Fig. 4.7: Map providing an overview of Mozambique Island, attributed to Erédia (ca. 1620).

This second map of Mozambique made by Erédia provides a view of the position of the island with respect to the mainland, the bay of Mossuril and the Islands of São Jorge and

<sup>136</sup> This map derives from the anonymous *Atlas-Miscellany* (private collection) which has been ascribed to Erédia based on style similarities with signed work of him. The date of the Mozambique map is estimated at ca. 1620. However some additions to the map are believed to be from later date. Cortesão & Mota 1960, vol. IV, pp. 53-58, vol. V, pp. 71-73.

<sup>137</sup> In contrast to other maps from the 1610 atlas, like for instance that of fort Jesus, it seems that the Mozambique map has not directly been used as an example by other mapmakers. No maps bearing a great resemblance to it are known. Kirkmam 1974, p. 183.

<sup>138</sup> The atlas titled *Livro de Plantaforma das Fortalezas da índia* (kept at the library of the fortress at São Julião da Barra at Oeiras in Portugal) includes a highly similar map of about the same age. This version is also ascribed to Erédia in: Cortesão & Mota 1966, vol. V, pp. 71-73; Borges 2007, p. 97. Although without further explanation the same atlas has also been ascribed to João Texeira. See: Lima 1983, p. 16. Around 1750 the French geographer Jacques Nicolas Bellin for instance made a map titled *Plan du Fort de Mozambique, tire de Faria* which still closely resembles Erédia's prototype. Also later Dutch versions of this print are known. See for instance a reproduction published in: Lima 1983, p. 18.

Santiago. Although the proportions are still incorrect, this map resembles the actual situation slightly better than the map made by Van Linschoten. Moreover a compass rose and the depth of the waterway are depicted. The provided information confirms the strategic position of the São Sebastião fortress. It stands alongside the channel that is deep enough to provide access to the bay.<sup>139</sup> The visualisation of the island combines a ground plan view with some buildings drawn in perspective. Note that all religious buildings on the map are illustrated in the same way, varying only in size. These illustrations should thus be interpreted as icons of churches in general, instead of as accurate representations of these specific buildings. Notably both the São Gabriel chapel and the Santo Domingo monastery are depicted, although these did not exist anymore at the time the map was made. Unlike the previously discussed plan, this map is however not believed to be based on observations carried out before the Dutch attacks. The sketches of the low-lying battery in front of the Nossa Senhora chapel, as well as the absence of the former main gate, indicate that the map depicts a later situation.<sup>140</sup>

Because the map provides an overview of the entire island we can also get an impression of the other defence structures on the island. Although the old São Gabriel fortress would not have been in use anymore, on the mainland shore a tower is shown, named *fortaleza velha*.<sup>141</sup> On the opposite side of the island a kind of wall is drawn along the shore. This might represent the palisade King Philip II had ordered. Further south a kind of battery like structure in front of the Santo António church seems to flank this shore. Finally on the small island which nowadays is named São Lourenço, just as the fort that stands on it, forte Santo António is depicted. There are little reliable sources about the history of the two defence structures. The fact that during the seventeenth century both were named after Santo António must have added to the confusion. It could be that at the time the map was made the structures were in fact in state of disrepair and would only be restored in times of imminent threats. Alternatively the drawings might be intended as prospect for what was yet to be built. All in all it is hard to get a clear image of what would have been built at the island of São Lourenço at that time.<sup>142</sup>

At first glimpse the picture provided of the São Sebastião fortress seems to be very contradictive compared to both Erédia's map of 1610 and the situation today. It gives a more symmetrical and ordered image of the structure than what would be realistic. But despite its schematic style, the map does provide useful information. In accordance with the current form of the fortress the wall on the ocean side is the only straight curtain. Both adjacent curtains have angled walls. Also like in the current situation, the western wall consists of three sections of which the middle-one holds a gate. Although the four bastions are depicted to have an almost uniform size and form, the illustration makes clear that both

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<sup>139</sup> Although the unit of measurement is not named on the map, water depths would normally be indicated in *braças*, which is reckoned approximately 2.2 meter. On the map the fairway that leads to the natural harbour is indicated to at least eight units deep. A depth of over seventeen meters would be more than enough for any Portuguese ship to reach the harbour.

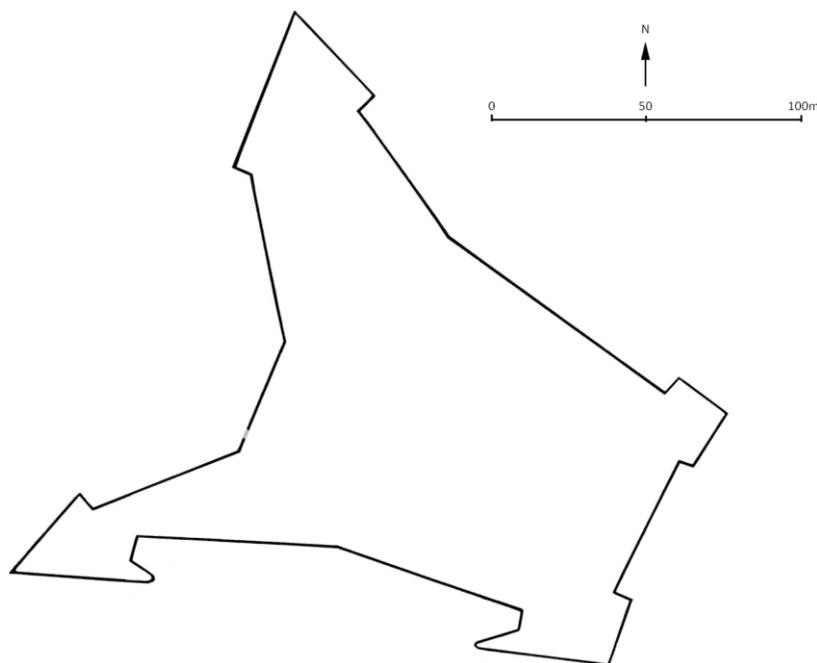
<sup>140</sup> It could be speculated that the reason for depicting the disappeared religious buildings nonetheless, could be of a commemorative nature, or in anticipation of rebuilding these structures.

<sup>141</sup> The old defence tower had fallen into ruin since the São Sebastião fortress had taken over its role. In 1610 it ultimately lost its defensive allocation, since the *Vice-Rei* of India donated the ground to the Jesuit order. Ferreira 2010, pp. 97-98.

<sup>142</sup> For a brief overview on secondary defences on the island see: Appendix II.

Santa Bárbara and São Gabriel have an orillon facing the landside. At each of the bastions the line of defence is drawn in line with the faces of the bastion. All except one, run from the corner between the curtain and the flank to the salient of the opposite bastion. Only the line of defence that is drawn along the face of the São João bastion ends in the middle of the western curtain.<sup>143</sup>

In correspondence with the written history of the modifications executed, there is no longer a gate drawn on the landside of the fortress. Also the low-lying battery near the Nossa Senhora chapel that was added in 1607, which was a vague spot on the map of 1610, is made clearly visible. No breastwork is shown yet to have been built in front of the São João bastion. Within the walls the *Casa da Capitão* is the only building depicted, although we know, both from descriptions and the maps of 1610, many other structures must have stood there. In correspondence with the reports made during the Dutch attacks, a moat and an outwork are shown to protect the landside of the fort. The moat is shown to run right across the island from the ocean to the bay. The manmade gap in the corral, visible today just in front of the Santa Bárbara bastion seems to confirm this, although no other traces remain. The impression is given that the *cava* is filled with water, but no bridge is drawn. In another version of this map, also ascribed to Erédia, the moat is coloured brown, indicating it would be dry.<sup>144</sup> It could be that the moat would only be filled with water on high tide, although no reference is made to this in any reports.



**Fig. 4.8:** Sketch of what the outline of the fort is believed to have looked like around 1620. On the landside the gate is now closed and a second orillon added.

<sup>143</sup> The lines of defence at the fortress will be further discussed in chapter five. For a comparison between the situation as drawn by Erédia and the actual situation, see note 174. The only cannon in the picture that is set up to provide cover along these *lines of enfilade*, stands in the northern flank of the Santa Bárbara bastion. But in reality the amount of cannons might have been much bigger. Furthermore also muskets would have been used to provide crossfire.

<sup>144</sup> The similar map is part of the earlier mentioned atlas titled *Livro de Plantaforma das Fortalezas da índia* is kept at the library of the fortress at São Julião da Barra at Oeiras in Portugal. Also this atlas is ascribed to Erédia in: Cortesão & Mota 1966.

To conclude, compared to previously made maps, Erédia's second map of Mozambique Island has provided more detailed and accurate information on the setting of the São Sebastião fortress in relation to its surroundings. Concerning the fortification itself, the map provides an updated image of the structure. The modifications which are described to have taken place after the Dutch attacks are visualised. Although no historical descriptions are known that confirm this, the sketch seems reliable enough to assume that at the time it was made, the second landside orillon had been finished. Based on the physical traces on the São Gabriel bastion the following drawing gives an impression of what the outline of the fortress probably would have looked like at this stage (fig. 4.8).

#### **4.5 The records on renovation from the *Livro das plantas de tôdas as fortalezas***

Roughly fifteen years after Erédia had drawn the atlas that holds the previously discussed map, a new project was set up to make an inventory of Portugal's possessions in the far east and along the shores of the Indian Ocean. In 1635 the chronicler António Bocarro sent two copies of the *Livro das plantas de tôdas as fortalezas, cidades e povoações do Estado da Índia Oriental* from Goa to Lisbon. Three years before, these had been commissioned by King Philip III. Bocarro writes in a subjoined letter to the king that the quality of the 52 images is not up to standard due to the enormous scope of the task and lack of persons skilled to make the illustrations.<sup>145</sup> He does not even mention the illustrator, which later research has revealed to have been Pedro Barreto de Resende.<sup>146</sup> Otherwise he ensures that the descriptions could be fully trusted. Despite the graphical shortcomings of this manuscript, the combination of the map and the description does provide new insights in the development of the São Sebastião fortress. Many copies have been made after this codex. But also the oldest two, almost identical, versions of the atlas have survived. For this study digitalised and republished versions of the original manuscript kept at the Évora public library have been consulted.<sup>147</sup>

Bocarro's description gives an impression of life and trade on Mozambique Island. Amongst other things he describes the amount of soldiers, cannons and provisions present. However, here the focus will be on the description of the fortification itself. The four bastions of the fortress are described by Bocarro to have a triangular form, with the São Gabriel bastion being the only one that sticks out.<sup>148</sup>

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<sup>145</sup> Analyses of the illustrations of this codex, has shown that older prototype from Erédia's time would have been used. Both original manuscripts presently hold 48 maps instead of the 52 Bocarro mentions. Cortesão & Mota 1960, vol. V, p. 59-63.

<sup>146</sup> Cortesão & Mota 1960, vol. V, pp. 59-81; Ruas 2005, p. 78. Despite the limited reliability of the images, they have been copied with minor alterations in multiple different manuscripts in the first half of the 17<sup>th</sup> century.

<sup>147</sup> In the years that followed several copies of the manuscript have been made by Resende as well as other mapmakers. Although differences between these maps exist, these do not seem to be based on new information. Cortesão & Mota 1960, vol. V, pp. 59-81. These alterations rather should be interpreted as being the result of the fantasy or incompetence of later artists. These maps of later date are therefore not further mentioned of this analysis.

<sup>148</sup> This corresponds with the image provided by Resende. If the thick wall sections that lead up to the São Gabriel bastion are interpreted to be part of the bastion, this would indeed be the only bastion that sticks out.

He continues to suggest that due to the irregular form of the defence structure the bulwarks are *'not able to protect the walls in the way this would be possible with a perfectly formed fortification'*.<sup>149</sup> Furthermore Bocarro tells us the walls rise three and a half *braças* above the inner courtyard and that they are at least two *braças* thick.<sup>150</sup> Interestingly the description tells us that at the time observations were made for the atlas, works were carried out at the fortress.<sup>151</sup> Improvements are reported to be made on the Santa Bárbara bulwark.<sup>152</sup> This bastion is described to be enlarged by adding a new wall ten *pes* away from the existing structure, after which the space in between would be filled. It is mentioned that the same work has recently been finished at the bastion of São Gabriel.<sup>153</sup>

Finally the outworks are described. Bocarro mentions works are also carried out at the ditch. It is described to run from shore to shore and was being deepened at the time of writing. Furthermore, according to the descriptions, a ravelin had been built in front of the new main gate in order to protect it. On the other side of the fort, the sea is said to have damaged the foundations of a wall that would have ran along the shoreline in front of the northern rampart. The situation that would have emerged as a result of this erosion corresponds with the current situation. Today there would be no space available to accommodate a parallel breastwork in front of this curtain. Instead two separated batteries stand in front of the bastions. Also a wall standing on the east side of the fortress is described. It would be built parallel to the ramparts, leaving a space of eight *braças* in between.<sup>154</sup> The description of this wall seems to correspond with the breastwork raised by João de Castro. Unfortunately Bocarro writes nothing about the state this structure is in, or whether it is still in use. Some remarkable differences come to light when the descriptions of António Bocarro are compared to the accompanied illustration made by Pedro Barreto de Resende (fig. 4.9).

The map provides an overview of the entire island and land nearby. The general outlay and orientation resembles that of the previously discussed map made by Erédia (fig. 4.7). However, the physical form of the island, as well as its location in relation to the islands of São Jorge and Santiago, is represented even less reliable than on this earlier chart. Bocarro names no other defence structures apart from the São Sebastião fortress, while on the map a mediaeval-looking tower stands on the island of São Lourenço. The image provided, complete with machicoulis, seems to be a very liberal interpretation of the vaguely drawn defence work Erédia depicted in the previously discussed map (fig. 4.7). Again it has to be concluded that little is known about what would have stood at this location at this time. In

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<sup>149</sup> *'[...] e posto que cada baluarte fica defendendo o lanço de muro que corre ate o outro como he custume, contudo não se pode defender hu baluarte ao outro como se custuma na perfeita forma de fortificação'*. Quoted from text: António Bocarro, *Livro das plantas de todas as fortalezas, cidades e povoaçoens do Estado da Índia Oriental (1635)*, consulted reproduction: Bragança 1936-1940, vol. IV, p. 4.

<sup>150</sup> *Ibid.*, p. 5. The *Braça* was a commonly used Portuguese unit of measurement which is the equivalent of approximately 2,2 meters.

<sup>151</sup> These observations would most probably have taken place between 1632, when the atlas was ordered, and 1635 when the book was finished.

<sup>152</sup> The Santa Barbara bastion is still referred to as the Santo António bastion in this text. It could be speculated that this bastion was renamed after it was enlarged.

<sup>153</sup> *Ibid.*, p. 5. The Portuguese foot, or *pé* would measure about 33 centimetres. Other measurements mentioned in Bocarro's description are hard to interpret since no clear points of measurement are provided. His measurements of other fortresses, like for instance fort Jesus in Mombasa have also proven to be unreliable. See for instance: Kirkman 1974, p.67.

<sup>154</sup> António Bocarro, *Livro das plantas(...)* (1635), published in: Bragança 1936-1940, vol. IV, pp. 5-6.

Bocarro's description no reference is made to any further defensive structures on the eastern shore of the island.<sup>155</sup> As one might expect, the fort and chapel named after São Gabriel as well as the Dominican monastery are no longer depicted since these had indeed seized to exist.



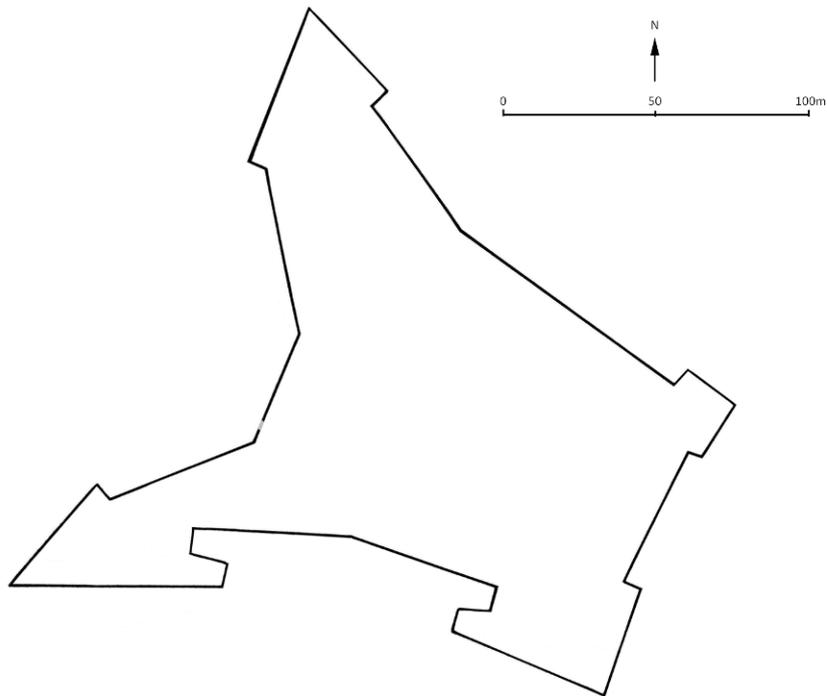
Fig. 4.9: Map of providing an overview of the island, made by Pedro Barreto de Resende (1635).

Although in the description the form of the fortress is correctly classified as being highly irregular, Resende has drawn an almost rectangular shape. Unfortunately his map cannot provide any reliable information on what the extension works looked like. In contrast to what is written in the description, on the map the ditch does not seem to run from shore to shore. Although this seemed to be the case on the map from 1620, whether or not the ditch is filled with water is not mentioned in the text and hard to tell from the picture. Note that in further contrast to Erédia's second map of Mozambique Island, in this manuscript a ravelin on the land side of the fort is neither illustrated nor mentioned. In front of the new main gate a kind of elevated space is shown to which stairs lead, but it does not seem to be a ravelin. Unlike both the description and the current situation, Resende has drawn a low lying battery along the entire northern side of the fortress, aimed at the entrance to the Mossuril Bay. Bearing in mind the more convincing depiction of the geographical situation on earlier maps, it seems unlikely that the breastworks this has never looked like this. In contrast, the illustration of the Nossa Senhora Chapel looks very recognisable.<sup>156</sup> On the map no attention is given to any wall that still might have stood on the east side of the fort.

<sup>155</sup> For an overview of the secondary defences on Mozambique Island see: Appendix II.

<sup>156</sup> The two maps by Erédia should be considered more convincing because in contrast to Resende's map both show landforms that can still be clearly recognised today. Note that some unidentified barrack-like structures

Based on the information discussed above, an indication can be given for the date of another alteration at the São Sebastião fortress. The description tells us that some time before 1635 the São Gabriel bastion had been enlarged and similar works were undertaken at the Santa Bárbara bastion.<sup>157</sup> Compared to the situation as shown in the previously discussed map both bastions are known to have indeed been enlarged at some point (fig. 4.8). The extensions Bocarro describes, consisted of walls built at a small distance from the existing bastions. The space in between would subsequently have been filled in. Looking at the remains of extensions phases that would have been carried out similarly at both bastions, only one phase of construction seems to fit the descriptions. It is assumed that the extension phase as sketched in figure 4.10 dates back to Bocarro's time. Unfortunately this hypothesis cannot be confirmed by the drawing of Mozambique Island provided in the manuscript atlas. The drawing has proven to be too unreliable. The map that will be discussed next, might provide a better image of the overhauling of these two bastions.



**Fig. 4.10:** Sketch showing what is believed to have been the situation from around 1635.

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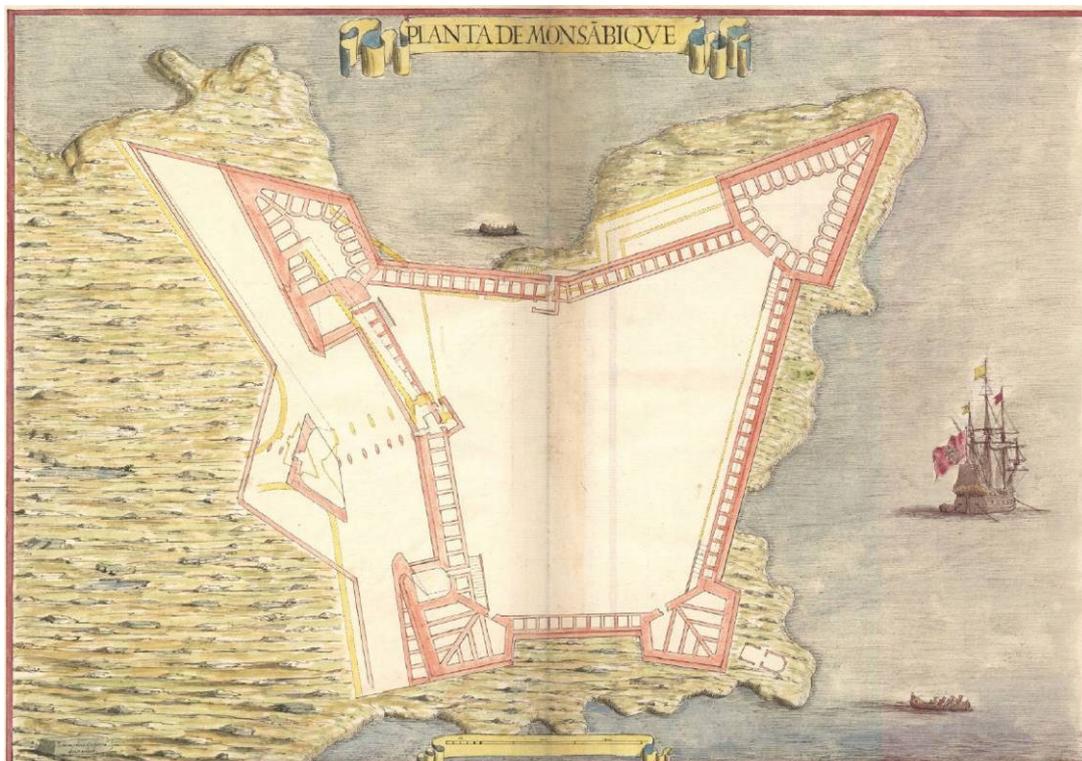
are depicted in the breastwork. Resende might have only wanted to show the battery round the Nossa Senhora chapel, which might have grown out of proportion simply because of the amount of detail put into the drawing.

<sup>157</sup> Although he already writes that work on Santa Bárbara is in progress and had reached eight *pes* above the foundation, the enlargement would not have been finished until the Captaincy of Francisco de Lima (1653-1656). *António Bocarro, Livro das plantas(...)* (1635), published in: Bragança 1936-1940, vol. IV, p. 5; Kirkman 1966, p. 213.

#### 4.6 The atlas of Leonardo Ferrari

In contrast to the previously discussed atlases, which had been ordered by Portuguese kings, the atlas that will be discussed here was ordered by a Spanish aristocrat and art collector. In the beginning of the 1650's the Marquis of Heliche, Gaspar de Haro y Guzmán, commissioned the Italian painter Leonardo Ferrari, who lived in Madrid. He finished it in 1655. The manuscript consists of 131 drawings of cities, fortresses and battles, representing 104 different places. The focus of the atlas is on the borders of the Spanish Empire both in Europe and overseas. Portuguese possessions were also included, although after the restoration of Portugal's independence in 1640 these would no longer stand under Spanish control.<sup>158</sup>

The atlas holds a remarkable drawing of Mozambique (fig. 4.11). Only the northern tip of the island which is occupied by the São Sebastião fortress is shown. This makes the composition of the image comparable to that of Erédia from 1610. The fortress is viewed from straight above, while on the waters surrounding the fort three vessels are drawn in perspective. The focus of this image is clearly on the walls of the fort, since no attention is given to the interior. Notably the outlines are represented in two colours. On the south and west side of the fort yellow and red lines overlap. The yellow lines seem to represent older phases of construction and the red lines improvements. Although the picture gives a recognisable overall presentation of the structure, many details seem to be incorrect.



**Fig. 4.11:** Plan of the São Sebastião fortress as drawn by Leonardo Ferrari (ca. 1655).

<sup>158</sup> Oliveira 2007, pp. 279-309. The manuscript atlas titled *Plantas de diferentes plazas de España, Italia, Flandes y las Indias* (ca. 1655), has been in Swedish possession since the end of the 17<sup>th</sup> century, it has been kept at the *Krigsarkivet* in Stockholm since 1880. Recently the maps have been reproduced: Rubio 2004.

Starting at the bottom of the image, at the smallest curtain, both angles of the flanks are bigger than 90°. It seems highly unlikely that this representation is correct, because both on earlier maps as in the present situation, these flanks are standing in a straight angle towards the curtain.<sup>159</sup> Compared to this detail, the fact that the curtain between the bulwarks of Nossa Senhora and São João is depicted completely straight, forms a more striking difference. Again no other maps are known on which the outline of the fortress appears like this. Obviously it neither corresponds with the present-day situation. Furthermore the depiction of the São João bastion does not seem very accurate. The outline as drawn in the earliest map of Erédia gives a more recognisable image of its form than either the red or yellow outline do on this map.

Also the comparison between Ferrari's representation and the known situations of the west side of the fort, at the top of the image, proves to be somewhat problematic.<sup>160</sup> Concerning the representation of the São Gabriel bastion, the yellow lines seem to match the outlines of the initial design as these have already been sketched in (fig. 4.4).<sup>161</sup> The first orillon seems to be depicted in red, matching figure 4.8. According to Ferrari's drawing after this the bulwark would have been enlarged towards the former main gate, but not towards the island. This stands in contrast with both the description of Bocarro and what the tangible remains suggest.

As mentioned previously, Bocarro had written sometime before 1635 that the bastion would have been enlarged with walls built parallel to the old construction. The spaces in between would later be filled up. Indeed the traces at the São Gabriel bastion indicate that the new position of the flank as shown by Ferrari, would have been built simultaneously with the new landside face as described by Bocarro. Also according to the map made in 1944 by the *Comissão dos Monumentos e Relíquias Históricas de Moçambique* these modification on the bastion would have been part of the same building phase (fig. 3.9). This leads to the believe that the map by Ferrari is again not very accurate at this point. As has been stated in the previous paragraph, at this point in time the face of the bastion would almost certainly have already been extended more towards the island side (fig. 4.10).

Discrepancies have thus been found to exist between Ferrari's map and other sources concerning the development of the São Gabriel bastion. In contrast to this, his depiction of the Santa Bárbara seems to match Bocarro's report on the enlargement of this bastion quite well. The initial outline of the bastion, as shown by Ferrari, also roughly corresponds with the sketch of it in Erédia's first map of the fort (fig. 4.4).

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<sup>159</sup> No indication has been found to suggest that the angles of the flanks have been modified. It seems that Ferrari depicts an idealised form, following the developments in 17<sup>th</sup> century military engineering. See also note 190.

<sup>160</sup> Compared to the situation drawn in red, in which the concave wall consists of only two sections, the yellow curtain which consists of three sections looks more familiar. However, due to the exaggerated size of the São João bastion in this representation, the overall image is still out of proportion. Although the red outline might be interpreted as a proposed improvement, in this situation the flank of São João would not be orientated optimally to sweep the opposed face of the São Gabriel bastion.

<sup>161</sup> The yellow line running across the courtyard is harder to interpret. As mentioned before the walls running up to the São Gabriel bastion do indeed merge, forming a single terreplein. The yellow line might indicate this although its position seems somewhat inaccurate. Based on tangible remains, the inside wall of the rampart is namely not believed to have been straight.

The way in which the extended outer wall of the bastion is drawn tapered towards the former, closely resembles the situation which can still be seen today.<sup>162</sup> There thus seems to be little doubt about the fact that this image shows the current face of this bastion. Based on Ferrari's map it is hard to get a clear idea of what the elevation of these two bastions would have looked like. It seems like flanking fire might have been provided from different levels.<sup>163</sup> The almost wineglass shaped surfaces, behind the most outer flank wall, might represent batteries on a lower level. These areas seem to be connected to the courtyard by small corridors leading through the rampart wall. Having only this orthogonal view of the situation is unfortunately not sufficient to understand precisely how the image suggests these flank defences would have functioned.

Interestingly the map discussed here is the first to give an idea of how the rampart walls and bastions would have been reinforced. Ferrari's map shows this by depicting walls inside the ramparts. The place where this representation can be best compared to the actual structure is at São Gabriel. As has been mentioned in chapter three, extensive archaeological excavations have been carried out here. During this process the interior wall structures of this bastion have been mapped (fig. 3.9). Comparing these images with the drawing by Ferrari, it has to be concluded that the São Gabriel bastion does not match these findings. In addition to the rampart walls, the map depicts some structures standing outside of the fortress. The counterscarp of a moat and a ravelin are drawn both in yellow and red. The image seems to suggest that a bridge connects the outworks with the former gate. The yellow ravelin and bridge pillars give an idea of what the situation might have been like before the Dutch attacks. In red the gate is also depicted. However, no other sources suggest this entrance has ever been taken into use again. Apart from the moat and ravelin in front of the fortress, the only structure depicted outside the walls is the outline of the Nossa Senhora de Baluarte chapel. No attention is given to the low-lying batteries which most likely must also have stood there at the time.

To conclude, this somewhat curious map with its double coloured outlines, has proven to be hard to interpret. This is partly due to the fact that the depiction of the fortress outline is not without mistakes. For instance the fact that on this map the northern curtain is depicted to be straight, conflicts with all other observations. Also the depicted bastions should not be seen as very accurate representations of what the fort would have looked like.

In the previous paragraph, the extension works described by Bocarro have been linked with the tangible traces that fitted his descriptions best. Despite its shortcomings, Ferrari's map can help verify the assumptions made based on this description (fig. 4.10). The map undoubtedly confirms that in comparison to the situation of around 1620 the São Gabriel and Santa Bárbara bastion have indeed been enlarged (fig. 4.8). The image of the Santa Bárbara bastion provides a good match with both Bocarro's descriptions of the works carried out as well as the actual situation of the structure. Only the form of the projected shoulder

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<sup>162</sup> Also the inner wall connections roughly seem to correspond with tangible remains that have become visible on the surface of the bastion during restoration works carried out in 2008 (conclusion based on a study of unpublished photo material at the *Ilha de Moçambique* field office of UNESCO in 2010).

<sup>163</sup> Such a gun alignment was indeed commonly practised. See for instance the image of it shown in chapter two (fig. 2.6).

does not completely correspond.<sup>164</sup> Otherwise this drawing generally seems to follow the outer walls of this bastion as it currently stands. This thus leads to the believe that the outline of the bastion would have changed little since at least 1655. Indeed this most probably are essentially the same walls Bocarro reported to have been built roughly twenty years earlier. On the other hand Ferrari's depiction of the extension of the São Gabriel bastion provides a less harmonic image. No parallel wall is to be found here, marking the extension of the bastion towards the south. The depicted form of the projected shoulder neither matches with any traces found during the extensive archaeological research carried out at this bastion in the 1940's. Assuming the map is wrong at this point seems the most reasonable explanation, taking into consideration the indisputable measurement mistakes found elsewhere in Ferrari's work. No convincing arguments have been found to reconsider the match between Bocarro's descriptions and the historic building phase that has resulted in the outline sketch presented at the end of the previous paragraph (fig. 4.10).

#### 4.7 The final alterations as depicted on two anonymous maps kept in Maputo

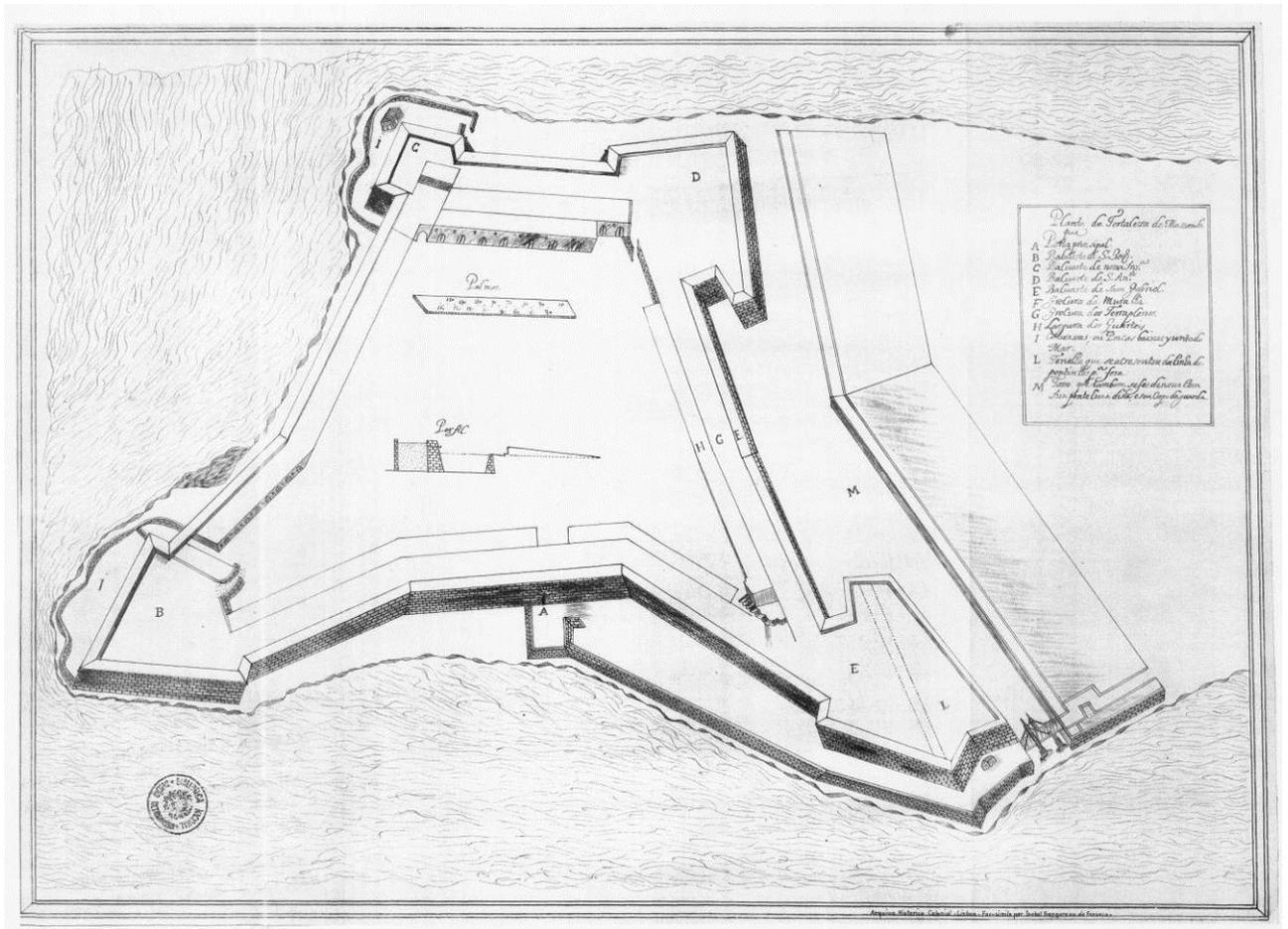
The last two maps that will be described in this chapter will provide an insight into the last major modifications that have been taken place in the outline of the fortress. Both maps are kept at the *Biblioteca Nacional de Moçambique* in Maputo. The drawings are facsimiles made in 1948 and 1950 which consecutively refer to Lisbon and Goa as the place where the original drafts are kept.<sup>165</sup> Both maps are signed by those who made the copy, but not by the authors of the original drafts. It also remains unknown from when exactly the drawings date.

Information provided on the back of the oldest map suggests that this illustration of the São Sebastião fortress was sent to the king of Portugal by *Vice-Rei* Luis Mendonça Furtado on the thirteenth of October 1671 (4.12). Like the previously discussed maps from 1610 and 1655, only the tip of the island occupied by the fortress is depicted. However, here it is represented from a bird's-eye view. Unlike the drawings of the fortress in perspective, made earlier by Van Linschoten and Resende, this image looks very recognisable and realistic. The proportions and angles of the ground plan seem to coincide with the actual situation. It would however be a mistake to ascribe mathematical precision to it. Probably as a result of the projection, the western wall looks somewhat oversized, compared to the wall on the ocean side. The other two curtains are shown to be angled walls, although the angle on the landside is more subtle than would be realistic. Again little attention is given to the structures built within the fortress. Instead a scale bar and a profile of the landside wall are depicted inside the courtyard.

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<sup>164</sup> This seems to be a mistake of the cartographer rather than a historical building phase, since during archaeological research no traces of such a form have been found at either of the bastions.

<sup>165</sup> The archives, as referred to on the facsimiles, to hold the original maps are consecutively the: *Arquivo Histórico Colonial* in Lisbon (fig. 4.12) and the *Arquivo Histórico do Estado da Índia* in Goa (fig. 4.14). At present both institutions have ceased to exist under this name. The first has evolved into the *Arquivo Histórico Ultramarino*. The institute that nowadays keeps the *Livro das Monções do Reino*, where the 1697 map is a part of, is the *Arquivos Históricos de Goa*. It has not been possible to acquire the original images for this research, so the analysis is based on the facsimile maps kept in Maputo.



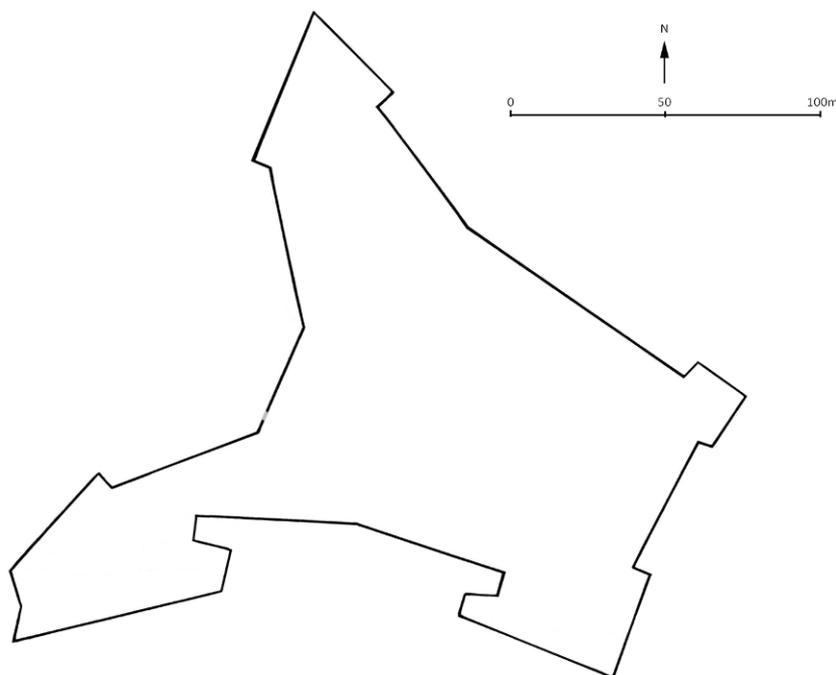
**Fig. 4.12:** Anonymous perspective drawing of the São Sebastião fort. Facsimile (1948) of map dated 1671.

Most interestingly this map can help to further distinguish and date the different phases of construction of the Santa Bárbara and São Gabriel bastion. Compared to the Ferrari's map the projected shoulders of both bastions are depicted to be more robust. These angular forms match the historic building traces. As has been argued in the two previous paragraphs, the shape of these bastions most probably dates back to around 1635. However, this map from around 1671 would be the first to give a clear image of the structure that was already described by Bocarro. Compared to this image, the outline of the Santa Bárbara bastion has hardly changed. Only the presently visible vault, mentioned in chapter three, inside the flank and the opening behind this wall are not depicted. Because this illustration is drawn in perspective it also provides a better overview of the flanking structures, which was somewhat hard to interpret from the previous map. Here nothing suggests that flanking fire might have been provided from batteries on different levels.

At this stage the São Gabriel bastion seems to have looked more like a mirror image of Santa Bárbara than it does today. Unlike the present situation, the São Gabriel bastion is namely depicted to have a retired flank behind an angular shoulder. This outline clearly matches the traces of the enlargement phase still visible on top of the bastion (fig. 4.5). What is believed to have been the landside face of this bastion since around 1635 is indicated on this map with a dotted line. The map thus shows a further enlargement, which has given the faces of

the bastion the distinctive shape still currently visible. The reasons behind this particular shape will be further discussed in the next chapter. This enlargement of the São Gabriel bastion seems to be the only modification concerning the outline of the fortress. The map does not raise the attention on any modifications carried out at the other two bastions or the intermediate curtains. Outside the ramparts, on the landside of the fort, a ditch is drawn. Notably no ravelin stands in front of it, as shown in some other maps. The moat runs right across the island, but does not seem to be filled with water. The cross section drawing of this side of the fort provides a view on the terreplein curtain wall, the moat, the counterscarp, the *covered way* and the *glacis*. A wooden drawbridge is shown to cross the moat, near de São Gabriel bastion. Also a small guard house has been depicted there. From here the path leads to the main gate. If the drawing is closely analysed three small opening above the undecorated gateway can be distinguished. The traces of these earlier windows can still be seen in this section of the wall today (fig. 3.5).

In contrast to Erédia's and Resende's drawings, where only breastworks near the Nossa Senhora chapel were depicted, two separate batteries to guard the channel are shown on this map. The need for a second low-lying gun position at the base of the São João bastion had already been stated in a letter written by *Capitão* Felipe Mascarenhas to the *vice-rei* dating from 1635.<sup>166</sup> It might be that this second battery facing the channel was built soon afterwards. This could however not be checked since unfortunately Ferrari's map did not provide an image of any breastworks outside of the ramparts. Anyhow, the battery depicted on this map closely resembles the current situation. As at present the two batteries can be reached through different gates, which are located near the Nossa Senhora and São João bastions. Clearly the mapmaker has put less emphasis on a realistic representation of the Nossa Senhora chapel.

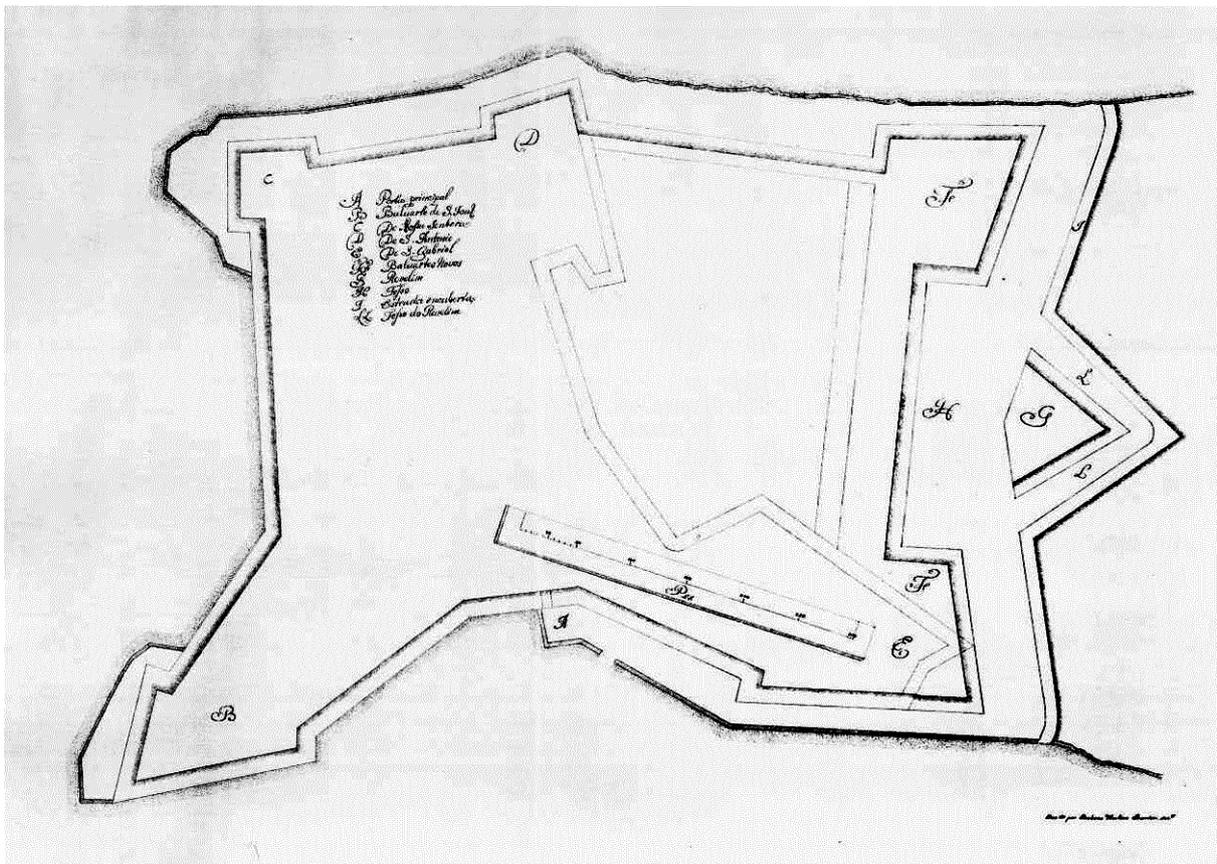


**Fig. 4.13:** Sketch showing what is believed to have been situation that around 1671. In the period after 1655 the São Gabriel bastion shows to have been expanded for a second time.

<sup>166</sup> Axelson 1964, p. 109.

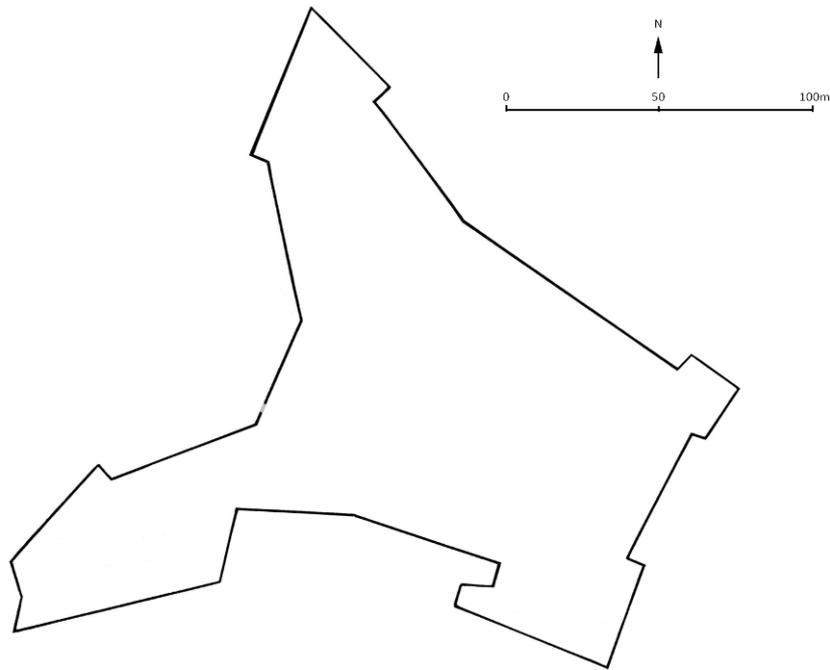
It can be concluded that this map, drawn in perspective, has provided a clear overview of the structure. Compared to figure 4.10 the only changes in the outline of the fortress are observed at the São Gabriel bastion. Since building traces and the present day outline of the fortress closely match the depicted extension, shown in figure 4.13, it is trusted to depict a truthful representation of this phase. North of the fortress the outworks depicted on the map also closely resemble what is visible today. However, of the outworks on the landside no physical evidence has remained to verify the plan.

The final map that will be briefly discussed in this chapter was sent across the oceans in the year 1697 (fig. 4.14). The description written on the back of the map tells us that it was affixed to a letter sent by the *vice-rei* to the king on the 22<sup>nd</sup> of March. The orientation and scope of the drawing is much like that of the previously discussed map, but planar. A more substantial difference is that it visualises a plan that would have changed the fortress drastically. On the island side of the fortress, the dotted line depicts the existing structure. Everything south of it is new. Because the enlargement has not been carried out and thus played no role in the building history of the current monument, this aspect of the map will not be discussed here. In the next chapter this map is further dealt with, together with other unimplemented modification plans, made during the eighteenth century.



**Fig. 4.14:** Anonymous map of the São Sebastião fort. Also showing a proposed expansion plan. Facsimile (1950) of map dated 1697.

The focus here remains on the insights the map provides concerning the situation the fort at the time. Comparing this map to that of 1671, does not raise the suspicion that any changes have taken place at the bastions of São João, Nossa Senhora or Santa Bárbara. However, at the São Gabriel bastion the re-entrant angle, protecting the retired flank, is shown to have been filled in. This alteration can be seen as the final modification carried out in the outline of the fortress. This map dating back to 1697 is the oldest to depict the shape of the São Sebastião fortress as it still is visible today (fig. 4.15). Since then only repairs and minor changes have taken place within the structure.<sup>167</sup>



**Fig. 4.15:** Sketch showing the present outline of the São Sebastião fort. This situation is believed to have already existed in 1697.

#### 4.8 Conclusion

Through the analyses of historical sources in this chapter, different modifications that have taken place in the design of the São Sebastião fortress have been distinguished and dated as precisely as possible. Apparently in 1583 construction works on the fortress had progressed till such an extent that the first garrison was stationed there and Van Linschoten assumed that the structure was already finished. The oldest map providing a reliable, detailed image of the São Sebastião fortress depicts a situation from around the turn of the sixteenth century. This map made by Erédia is considered the best source of information to reconstruct what the initial design of the fortress would have looked like. Notably some

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<sup>167</sup> This finding contradicts with suggestions made by James Kirkman who, without referring to historical sources, estimated that the filling of the re-entrant corner would date from the beginning of the 18<sup>th</sup> century and the earlier discussed, second enlargement of São Gabriel from the end of that century. Kirkman 1966, p. 213.

parts of this hypothetical initial design already resembled the current structure. For instance the outlines of all curtain walls are believed to have remained essentially unchanged. Also the bastions of São João and Nossa Senhora appear not to have undergone any major design adjustments.

Instead modifications carried out would focus on the weak spots of the fortress which came to light during the Dutch attacks that took place in the first decade of the seventeenth century. During these events, the most vulnerable part of the ramparts proved to be on the island side of the fort. As a direct consequence of the Dutch attacks the main gate was moved away from the landside curtain. Also the bastions would be upgraded in the years that followed. At first, sometime before 1620, an orillon would have been added to the São Gabriel bastion, similar to the one the Santa Bárbara bastion already had.<sup>168</sup> But more drastic structural changes were carried out around 1635, when both landside bastions would be enlarged. This resulted in new outer walls, built along the landside faces and flanks of these bastions. This construction phase has given the Santa Bárbara bastion its final form. At the São Gabriel bastion, on the other hand, two further modification phases can be distinguished. Firstly, somewhere between 1655 and 1671, the bastion was again enlarged along the landside face. While between 1671 and 1697, finally the retired flank has been filled in. This last modification gave the fortress its shape it still has today. In this survey links have been made between historical sources and present day remains. This analysis has shown from which period the outline design of the different outer walls date, enhancing the understanding of the structure (fig. 4.16). It can be concluded that most of the outlines of the São Sebastião fortress have not changed since the end of the sixteenth century and thus follow what is believed to be the initial design. At the places where major design changes did occur, these were carried out within the seventeenth century.

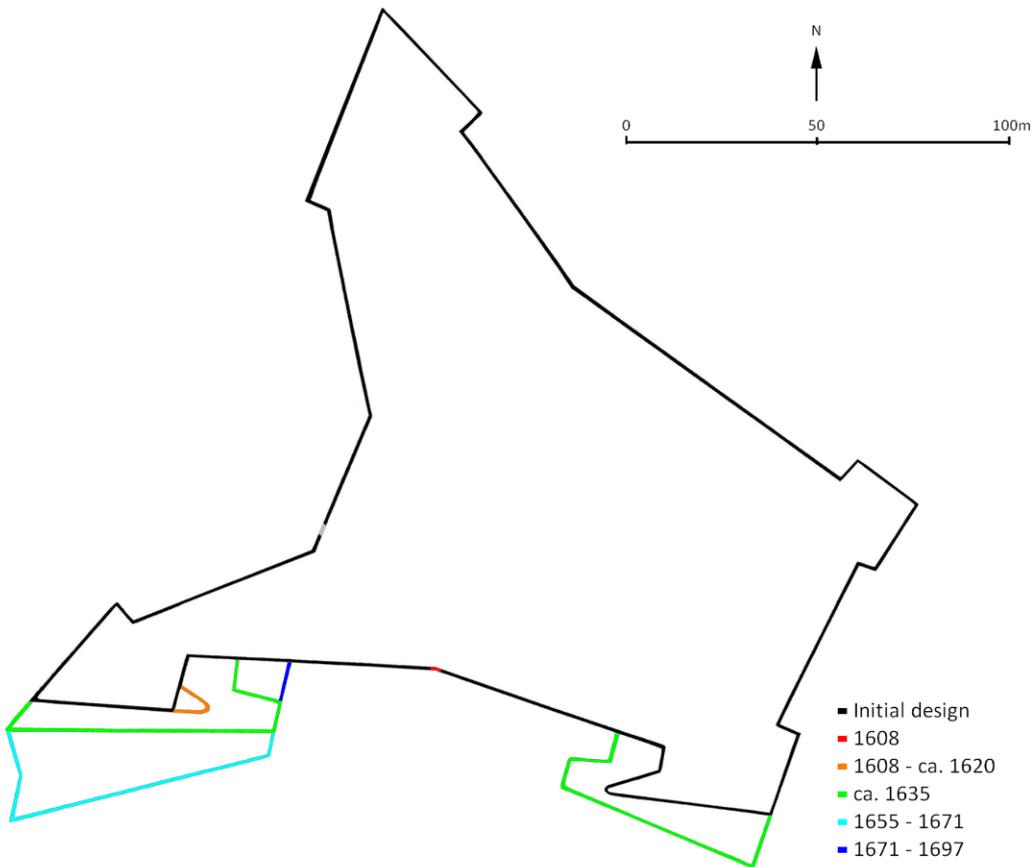
Like the landside rampart of the fortress, the outworks had proven to be a weak spot in the defences, during the Dutch attacks. Different modifications have been registered concerning the moat, low-lying batter and ravelins. However, compared to the coherent overview that has been obtained of the development of the ramparts, the image of these outworks become less clear. For two reasons the latter analyses has proved to be more difficult. Firstly, the mapmakers did not always chose to depict these structures on their maps. Secondly, these structures might have been built for a more temporary use, in a more improvised nature. The battery raised by João de Castro, which predated the São Sebastião fortress, sporadically reoccurs on maps throughout the history of the fort.<sup>169</sup> Parts of it will have probably been reused when the low-lying battery around the Nossa Senhora chapel was built in 1607. The oldest map on which a clear image of the battery built around the chapel occurs, dates from 1620. A similar breastwork still occupies this headland. The second low-lying battery is first mentioned in a letter dating from 1635, but only first occurs on a map which was sent to Portugal in 1671. The existence of a moat along the island side of the fortresses is mentioned in almost all historical sources. Moreover a gap cut into the coral stone along the eastern shoreline of the island also indicates such a barrier would indeed have been built. If a ravelin has ever stood in front of this ditch is less evident. No traces can

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<sup>168</sup> This second orillon is not shown on Erédia's first map of the fortress. It is therefore assumed to be built after 1583, although it might have been part of the initial plan. Since the precise date of construction of this addition is unknown, it could have already been finished before the Dutch attacks. See also note 130.

<sup>169</sup> For a short overview see: Fonseca 1973, pp. 65-67.

be found of it and only two maps depict it. As described by the attackers, probably some sort of defensive structure would have stood in front of the landside gate at the time of the Dutch sieges. Probably a ravelin has been raised multiple times, only for temporary use in case of imminent threats. Notably the otherwise very accurate map from around 1671 does not show a ravelin but a glacis to keep the rampart out of sight. Maybe this slope replaced the earlier outwork. A second ravelin that would have stood in front of the new main gate on the east side of the fort has only been mentioned by Bocarro. What this structure would have looked like remains unclear. Now that through this historical overview reliable information has come available on the different stages in which the fort has developed, the logic behind the design of the São Sebastião fortress can be properly analysed.



**Fig. 4.16:** Image combining al hypothetical historical outlines with an indication of the periods within which these alterations would have taken place.

## **Chapter 5: Interpretation of the São Sebastião architecture**

Based on historical descriptions and maps, the previous chapter has provided an overview of how the outline of the fortress evolved during the sixteenth and seventeenth century into what we see today. The logic behind this design will be analysed in this chapter. What has influenced the development of the fortress? Which military architectural principles are behind it? To enhance the understanding of the São Sebastião fortress, the different factors that are believed to have been of influence in its design are dealt with in separate paragraphs. In the first paragraph the initial outlay will be compared to general principles of renaissance fortification design. The functioning of the mutual defences of the bastions will be evaluated, but also the influence of more abstract design principles will be analysed. The second paragraph will focus on the influence that the specific strategic and geographical factors at Mozambique Island has had on the outline of the fortress. In the third paragraph the modifications of the initial fort will be discussed. It will be analysed what incentives there have been for these alteration plans. Elements of the fortification design which have not been explained satisfactory in these paragraphs are the main focus of the remainder of the chapter. São Sebastião will be compared to other fortification projects in paragraph four. This is done in order to find out if these specific military architectural design features can be traced back to personal preferences of the involved military engineers or specific treatise texts. After this, in the fifth and final paragraph a survey of sixteenth century military treatises will be made, focussed on the specific design solutions found at the São Sebastião fortress. All in all this chapter aims to analyse the origin of the principals behind the fortification designs of the São Sebastião. At the end of this chapter it should be better understood why the structure that was built on the northern tip of Mozambique Island looks the way it does.

### **5.1 The initial layout evaluated as an exponent of renaissance military architecture**

Renaissance architects would typically try to order their designs based on ideal proportions and orderly symmetry. Accomplishing a perfect arrangement did however prove even more complicated in reality than it had been on paper. Examples like the earlier mentioned Palmanova fortress, which look like a treatise model built in stone, are exceptional. But also in more irregularly built fortifications, the aim for the same ideals can be often distinguished. To find out till what extent the São Sebastião fortress can be seen as an exponent of renaissance fortification architecture, in this paragraph different components of the structure will be compared with principles and ideals as described in chapter two.

At first glimpse the layout of the São Sebastião fortress looks highly irregular. The four bastions would already in the initial design have differed in form, size and mutual distance. Moreover, this became more pronounced after the extensions of the Santa Bárbara and especially the São Gabriel bastion. If one nevertheless tries to distinguish a geometric shape in the design to typify the ground plan, the trapezium seems to be most fitting. Although far from absolute, it could be claimed that the design has some symmetrical characteristics. This feature is most evident if the form of the curtain walls is reflected along the longitudinal axis of the trapezium.

The comparison between the outline of São Sebastião fortress and architectural design ideals of the renaissance could even be taken one step further by approaching the layout as an anthropometric inspired design. Indeed there are many examples of renaissance texts, inspired by Vitruvius' description of architecture following the human proportions, in which elements of fortifications are being compared to parts of the human body.<sup>170</sup> Such parallels can also be found in modern fortifications terminology. One can for instance refer to 'the shoulder' of a bastion, or the 'orillon', which derives from the French word for ear. Just like has been done in a study of the earlier mentioned fort Jesus at Mombasa, the batteries facing east, looking out towards the ocean, could be interpreted as the head of the fort. The neighbouring bastions would then be arms and São João and São Gabriel the two feet. In this metaphor, the angles in the north and south curtain walls of São Sebastião, could be interpreted as the points where the torso connects with the legs. However, as renaissance historian John Hale argues this kind of comparison is probably taking the parallel to literally.<sup>171</sup> Just as this interpretation of fort Jesus remains dubious and debated, there are no historical sources that indicate that the human body was directly used as a model for the design of the São Sebastião fortress. Such an explanation of the outline thus seems highly unlikely. Certainly, even if the idea of an anthropometric ideal would have played a role in the design, it cannot explain the layout in detail.

More fruitful might be to compare the fortress to the more practical aspects of renaissance architectural principles. With angular bulwarks placed on each of the four corners, the fortification should be classified as an example of the bastioned trace. In this system it is crucial that crossfire provides protection to the bastions and curtain walls. However, as Bocarro already mentioned, at São Sebastião the standard defence practice is somewhat different because of the irregular form the fortress has.<sup>172</sup> Probably Bocarro would have expected the outlay of a regular fortification to have straight curtains and flanks from which the curtain walls, as well as the opposite bastion faces could be swept. At Fort São Sebastião the curtain walls and bastions have various forms and sizes. Only the eastern front has a straight curtain, the remaining three curtain walls have an inward-bent form. This phenomenon is not regularly advocated by fortification theorists, nor is it often put to practice. As has been mentioned in chapter two, most theorists agreed that constructing straight walls was the strongest and cheapest way to build ramparts. Moreover, the enclosed surface would be bigger when the walls would not be pointing inwards.

Why this design was chosen despite these apparent disadvantages, and how this exceptional layout effected the defence system of the fortress will be further analysed. The only part of the fortification which is built in accordance with the general model is the eastern side. Here the straight curtain can be swept from both symmetrically aligned flanks. This setup minimises the amount of ground out of the cannons reach. The concave curtains make it impossible to provide cannon fire as close to the walls. Especially on the western side of the fortress, sweeping the curtains from flanking positions would be problematic. When firing a

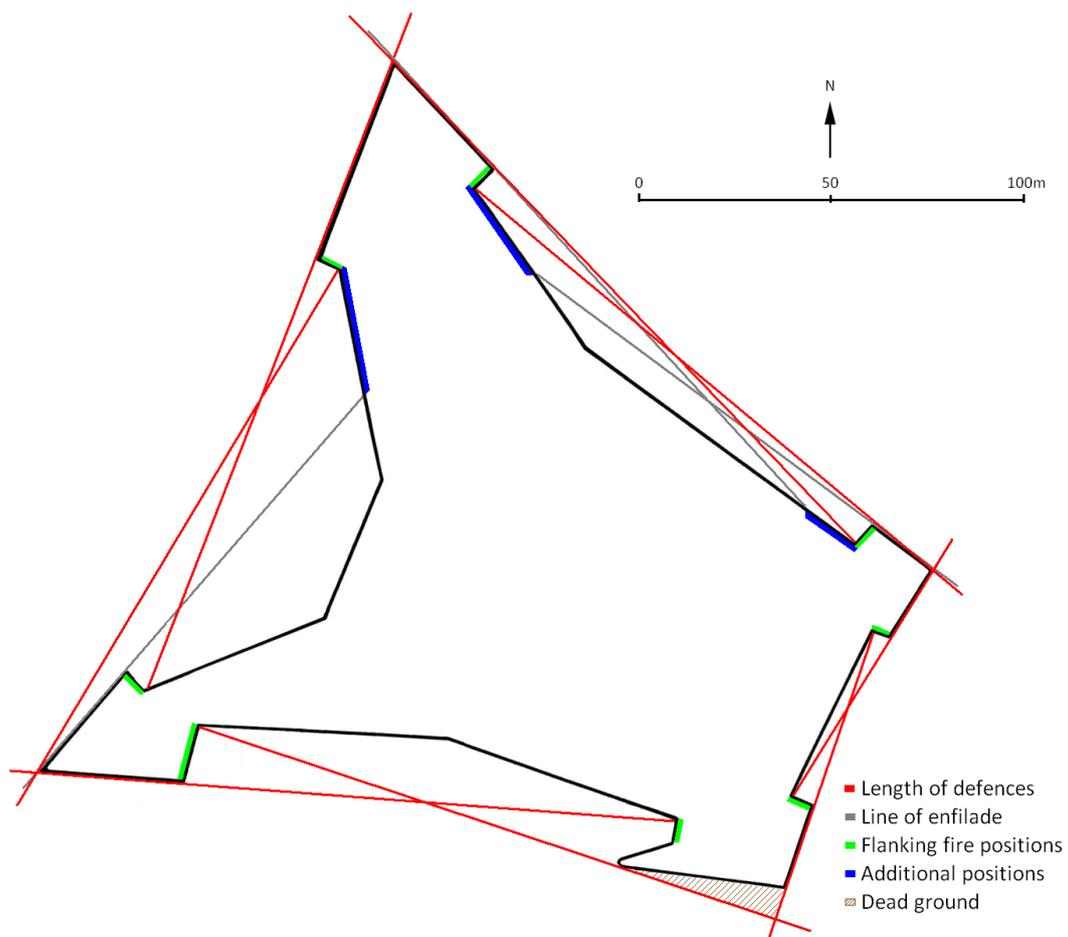
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<sup>170</sup> For some of Vitruvius' arguments how the human body should lead to balanced proportions in architecture see: Peters 2008, pp. 85-88. Some striking examples of renaissance fortification architecture inspired by the human proportions are mentioned in: Hale 1977, pp. 41-44; Boxer & Azevedo 1960, pp. 108-110.

<sup>171</sup> The theory of an anthropomorphic basis for the design of fort Jesus by Carlos de Azevedo is not followed in an extensive later study of by James Kirkman and has been heavily criticised by John Hale. Boxer & Azevedo 1960, p.110; Kirkman 1973; Hale 1977, pp. 41-44.

<sup>172</sup> See note 149.

cannon, the length a cannonball travelled through the air could hardly be adjusted. This implies that shooting into a concave wall segment was discouraged by the risk of hitting the rampart. The same problem existed at the two other concave walls. Although to a lesser extent, as the milder inward-bents allow flanking batteries to provide crossfire closer to the curtain (fig. 5.1). At the terrain in front of the ramparts that could not be swept by cannon fire, defenders had to rely on musket fire or even the old-fashioned vertical defence technique of dropping objects on the attacker. In the initial design dead ground would have existed at the former Santo António bastion. Before the bulwark was enlarged and was renamed after Santa Bárbara, it was impossible to effectively sweep the landside face of this bastion from any position. At all other faces cover could be provided by horizontal defences. At the symmetrical eastside of the fortress the faces of the bastions are perfectly adapted to the imaginary line running between the bastions salient and the point where the opposite flank meets with the curtain. In this common setup the faces can be optimally swept by guns placed at the flanks. As discussed earlier, aligning the face to the furthest end of the curtain ensures the salient angle could be made less sharp and thus most robust (fig. 2.3). However, at the São Sebastião fortress some bastion faces are not optimally swept from the flank of the adjacent bastion.



**Fig. 5.1:** An analyses of the cover that could be provided along the ramparts with the initial design. As indicated, parts of the curtain could effectively help to sweep the faces because the *lines of enfilade* are oriented towards these walls. Dead ground existed in front of the old south-east bastion.

As shown on figure 5.1 the orientation of the northern flank of the São Gabriel bastion seems far from ideal to provide cover for the São João Bastion. Although the face of the latter is orientated towards this flank, the flanking parapet is built almost perpendicular to the section of the curtain next to it. This setup makes it somewhat difficult to place a cannon in the right position to provide cover. The defence lines at the western side of São Gabriel bastion and the northern side of the Nossa Senhora bastion are also somewhat atypical. Here the faces of the bastions are not aligned to the opposite flanks, but instead to a part of the rampart. As has been shown in the earlier discussed model of defence published by Lorini, this setup enables artillery placed on parts of the wall to provide additional cover for the face (fig. 2.5). Indeed the wide terreplein wall section next to the São João bastions, towards the western gate, could have provided these extra gun positions. The wall running towards the Nossa Senhora however seems too narrow to have been used for this purpose.<sup>173</sup> It is interesting to see the difference between this analysis of the defence system of São Sebastião and the way this situation has been sketched by Erédia around 1620 (fig. 4.7). As has been discussed earlier, this map should be interpreted as a somewhat stylised and idealised representation of the actual situation. In that sense the image seems to confirm that faces aligned to flanks were considered a preferable defence layout in an ideal situation. In this image this is the case at all but one of the faces. Nevertheless this created no problems covering the grounds in front of the Santa Bárbara bastion. Only at the western side of the fort, at the bottom of the image, the drawing shows that a bastion face could indeed be swept most effectively from the terreplein, instead of from a flank.<sup>174</sup>

Notably the biggest flanks, which would have been the only two able to accommodate two cannons along the parapet, are on the landside of the fortress. As mentioned in chapter four the first map made by Erédia indicates only the Santa Bárbara bastion would initially have had an orillon. It could be speculated that an orillon was not built at São Gabriel because it would effectively shorten the parapet of the flank, which would further complicate the already problematic cover in front of the face of Santa Bárbara. There are, however, no sources that suggest the situation at Santa Bárbara was already any different at the time the orillon at São Gabriel was added.<sup>175</sup>

Although the use of orillons to protect the flanks from enemy fire had been a familiar feature of renaissance fortifications, the specific form these have at São Sebastião fortress are somewhat atypical. Here the outlines of the projected shoulders of the bastions are more tapered. They also end in a more pointed fashion than what is commonly encountered at fortifications, as well as in military treatises.<sup>176</sup> The more slender formed orillons at São Sebastião might have been preferred because these would leave more room for artillery fire

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<sup>173</sup> Note that, as discussed in chapter three, the outline of the original Nossa Senhora bastion might have been slightly different, it could be that in the initial design the northern face of the bastion would have been aligned with the São João flank.

<sup>174</sup> Oddly the defence situation of the western side of the fortress, as represented by Erédia, seems to depict a mirror image of the actual situation (fig. 5.1). On the map from ca. 1620 the line of enfilade of São João instead of São Gabriel has namely been drawn towards a section of the curtain wall (fig. 4.7).

<sup>175</sup> Alternatively the orillon at the São Gabriel bastion might have been part of the initial plan, but was not yet finished at the time observations were made for Erédia's map prediction the pre-1607 situation.

<sup>176</sup> The orillon depicted in the earlier discussed images of figures 2.5 shows a more common form for this type of flank defences.

from the flank. A downside of this design would have been that these pointed constructions would be more vulnerable than roundly built orillons.

It has been suggested that originally the main gate of the fortress would have stood behind the projected shoulder of the Santa Bárbara bastion. A layout where the entrance is protected in such a way, can indeed be found in Portuguese fortifications at for instance Mombasa, Hormuz and Daman. This phenomenon is also advocated in contemporary Italian military treatises.<sup>177</sup> However, the arguments supporting the idea that the landside entrance of the São Sebastião fortress would have been built here are somewhat problematic.<sup>178</sup> In this study therefore, the assumption remains that the gate blocked during the Dutch attacks has been the location of the initial main entrance. The two biggest gates of the initial fortress would both have had double elbow-corner bends inside the wall structures behind them. The aim of such a layout was making an intrusion more difficult for attackers. This type of fortified entrance can be found in renaissance military treatises. But already centuries earlier, probably inspired by the Arabs, similar layouts would already be applied in mediaeval Portuguese castles.<sup>179</sup> This design should therefore not be interpreted as an exponent of renaissance military architecture, neither is it conflicting with it.

Finally, the outworks will be discussed. As mentioned in chapter two, ditches would have already been used in ancient time to strengthen defence positions. The only thing that changed with the introduction of the cannon is the way these would be swept. Angular outworks, like ravelins, built aligned to cannon fire would be a renaissance innovation. Based on the findings in the previous chapter, it is assumed that initially a ravelin has stood in front of the fortress. Unfortunately the outline cannot be checked with tangible remains. The structure which might have been raised multiple times for temporary use, has been described and depicted to have been positioned right in front of the main gate (fig. 4.7, 4.11). Building a ravelin here would indeed be common practice. A considerable distance is shown to have existed between the ramparts and the outwork. In this setup the moat behind the ravelin could be swept by crossfire provided from the flanks. The faces of the ravelin would be swept by guns firing from the faces of both adjacent bastions.

All in all the initial design of the São Sebastião fortress proves to have the characteristics which make it indubitable that it is strongly connected to the theories of military architecture that evolved in Europe. The idea of an integrated defence system of bastions and curtain walls clearly shows the influence of the developments that started in Italy earlier in the sixteenth century. However the overall form of the initial fortress outline and especially the broken curtain walls do not fit the general ideal of renaissance defences as

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<sup>177</sup> An Italian publication throughout which the entrance is consequently proposed to be built in this way is for instance: Giovan Battista Bellucci, *Nuova inventione di fabricar fortezze, di varie forme*, Venice 1598.

<sup>178</sup> Without referring to specific sources, Pereira states that in the 'original plan of Miguel de Arruda' the gate was planned to be built at the Santa Bárbara bastion and that probably Francisco Pires would have altered his plan. Pereira 1966, p. 225. According to this theory the vaulting visible at the flank of the current bastion would be a remnant of this former gate. As will be discussed in this study, alternatively these remains might better be interpreted as a former casemate instead of a gate, see note 192. Moreover, as has been argued in chapter four, the current flank of the bastion would have only been built during a later extension (fig. 4.8, 4.10). Even if this wall would have been as old, it would still not have stood protected behind the orillon due to the smaller dimensions of the initial bastion.

<sup>179</sup> Gil & Cabrita 1986, p. 229.

described in chapter two. In the next paragraph it will be assessed till what extend this might be explained by the specific geographic conditions and strategic considerations regarding this fortress.

## 5.2 The geographical and strategic anticipations in the initial fortification design

A fortress cannot just be analysed as the product of the architectural ideals of its time. As has been shown in the previous paragraph, not all components of the initial São Sebastião fortress design could be explained solely by this approach. To enhance the understanding of the structure, in this paragraph the focus will be on the role the geographical setting, the pre-existing structures and strategic considerations have played. It will be analysed till what extend the influence of these interrelated components can explain the size and form of the fortress.

As mentioned in chapter one, the choice to build the São Sebastião fort at the northern tip of the island can be justified based on its preferable natural setting as well as strategic anticipations. Not only does this spot stand nearest to the channel that provides access to the bay, the site also features the highest point of the island. This would have added to the appeal of the location, since traditionally the Portuguese preferably built their defence structures on high ground.<sup>180</sup> Notably, this strategic spot near the channel had not been chosen for the first Portuguese fort that was built on the island. Instead the São Gabriel fort which still largely depended on vertical defences had been built near the harbour, facing Mossuril Bay. At other places overseas where the Portuguese had built mediaeval style fortresses, these usually formed the bases for later modernisations and extensions of the defence architecture. This has for instance been the case with the forts of São Jorge da Mina in Ghana, São Caetano at Sofala and Nossa Senhora da Vitória in Hormuz.<sup>181</sup> At Mozambique however, since the initial main fort was judged to stand in the wrong position, the São Sebastião fortress had to be built from the ground up. No old defence structures are thus incorporated into the new fortress. The only pre-existing buildings taken into account with the design of the fortress, will have been the Nossa Senhora chapel and the battery raised by João de Castro. The fact that the chapel already occupied the tip of the island is probably the reason why the Nossa Senhora bastion is the smallest of the four bulwarks. Castro's battery was only meant as a temporary structure and can thus hardly be seen as obstruction for the building plans of the São Sebastião fortress. All in all the influence the manmade environment would have had on the shape of the new fortress can be considered limited.

The natural environment on the other hand shows to have been more decisive. The defensive advantages of building the ramparts right upon the steep coral cliffs probably led to the decision to let the fortress occupy the entire headland of the island. Evidently the shape of the shoreline has had its effect on the outline of the northern and western side of

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<sup>180</sup> Although this tactic might not be uniquely Portuguese, in Portugal this custom dates back to pre-Roman times and was continued, whenever possible, in the overseas territories. Teixeira 1990, p. 25; Hefting 2010, pp. 191-193.

<sup>181</sup> For an introduction to the architectural development of these forts with a Manueline origin at Ghana, Sofala and Hormuz, consecutively see: Joustra & Six 1988; Montez 1954; Kleiss 1978. For an analyses of similar developments that took place at different forts along the Moroccan coast see: Elbl 2000.

the fortress. The walls of both curtains, as well as the bastion of São João, are built largely right along the edge of the cliffs. North of the Nossa Senhora bastion and along the east side of the fortress the distance between the ocean and the ramparts is slightly bigger. As mentioned, this can be partly explained by the presence of the Nossa Senhora chapel. Furthermore it was apparently decided not to build the fortress right on top of the battery raised by Castro. By leaving some space between the eastern rampart and the shore, it remained possible to mount cannons on this strategic position. On the island side of the fortress the situation was different. Here neither pre-existing buildings nor specific geographical features can be distinguished that would have been of particular influence on the fortification design.

The demands from a military strategic point of view form another location-dependent component which would have influenced the outline of the fortress. Obviously, the design would be built anticipating on the direction the enemy was expected from and what offensive tactics were supposed to be used. As mentioned earlier, the São Sebastião fortress has been specifically designed to be able to withstand modern artillery fire. To resist the threats that could be posed upon the island from the Mozambiquean hinterland, the old fort would probably have been sufficient. At the time cannon fire was namely exclusively in use by foreign fleets. These ships sailing the Indian Ocean would form the biggest threat to the Portuguese defences. More specifically, the São Sebastião fortress was built in anticipation of a confrontation with the 'Turks from the strait of Mecca'.<sup>182</sup>

Given this situation it seems logical that, like most coastal fortifications, the design of the São Sebastião fortress would have the highest concentration of artillery directed towards the sea.<sup>183</sup> Indeed in some layout components of the initial fort, an ocean orientated design can be distinguished. For instance originally the São João bastion would have been the biggest bulwark, upon which the largest amount of artillery could have been placed. This would make sense since here the fortress stands nearest to the channel. Ships rounding the island could thus best be taken under fire from this bastion. The northern defences of the fortress would rely heavily on this gun platform. The Nossa Senhora bastion would have played a smaller role due to its limited size. Moreover, no cannons could be set up along the northern curtain due to the limited width of this wall. On the east side of the fortress the bastions facing the ocean are rather small, even though ships nearing the island would come from this direction.<sup>184</sup> The little space available on top of the bastions of Nossa Senhora and Santa Bárbara is however compensated by the width of the intermediate curtain wall. Already on the first map made by Erédia, a broad terreplein is shown to have existed here (fig. 4.3).<sup>185</sup>

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<sup>182</sup> 'D. Catharina por El-Rei D. Sebastião, se mandou fazer a fortaleza de Mozambique, com receio dos turcos do Estreito de Meca'. Quoted from: João dos Santos, *Ethiopia Oriental, Évora 1609*, consulted reproduction in: Theal 1898-1903, vol. VII, pp. 186-187.

<sup>183</sup> Lawrence 1963, p. 77.

<sup>184</sup> From for instance Van Linschoten's and Bocarro's descriptions we know that ships heading for the harbour of Mozambique had to sail between the islands of São Jorge and Santiago to reach the deep channel which led to the bay. Ships following this route would have to manoeuvre right in front of the eastern side of the fortress. Kern 1939-1955, vol. IV, pp. 26-27; Bragança 1936-1940, vol. IV, p. 9.

<sup>185</sup> Although the accuracy of this map concerning the land facing wall has already been discussed in chapter four, it could be that also this curtain has been broad enough to mount cannons upon.

Furthermore artillery could have also been installed at the space in front of this rampart.<sup>186</sup> All in all this fortification design provides a great amount of gun positions facing the water.

Although the initial design of the fortress should be interpreted as being more oriented towards the sea, it would also have to defend its land front. As would be later confirmed during the Dutch sieges, Mozambique Island was big enough for an enemy to land upon, out of reach from the fortress cannons. The possibility of an attack from this the landside of the fort could thus not be ruled out. Anticipating on this threat, for example the orillon of the Santa Bárbara bastion, a moat and a ravelin would have been built. Moreover, in contrast to the northern curtain, the landside front has a broad terreplein on which cannons could have been set up.<sup>187</sup>

To conclude, the natural setting of the strategically important northern tip of Mozambique Island required defences to be built on all sides of the fort. The prime goal of the fortification was, however, to guard the entrance to the bay. For this reason the fortress was built near to the shore. The coral cliffs also provided defensive advantages to the northern and southern ramparts of the fort. This situation has clearly influenced the form of the fort, explaining the inward-bent form of these curtains. However, the natural conditions did not provide a motivation to build an angled wall on the landside of the fort. Neither an explanation for this exceptional layout has been found, analysing the influence of pre-existing buildings or strategic considerations. The possible reasons behind the application of the broken curtain layout will be further analysed in the last part of this chapter. Prior to that, in the next paragraph, the logic behind the modifications of the initial design of the São Sebastião fortress will be discussed to get a better overview of how the defence system has evolved.

### **5.3 The logic behind the modification plans made in the sixteenth and seventeenth century**

In the previous two paragraphs the logic behind the initial fortress design has been analysed. As has been shown in chapter four, different modifications influencing the outline of the structure have taken place since then. Firstly, in this paragraph the focus will be on the military principals behind these alterations, to explain why these were carried out. Secondly, modifications plans which have not been implemented will briefly be discussed. This survey will provide an overview of what has been regarded as the strengths and weaknesses of the design. Through this it can be understood why modifications where applied at which places in the structure. Furthermore, the effects of these alterations will be analysed.

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<sup>186</sup> Indeed, when King Phillip II heard of the threats that had been posed on the fortress by the Dutch, he ordered four large cannons to be installed here. These where meant to sweep the ocean up to the Island of São Jorge. *Letter from the King to the Vice-Rei of India. Lisbon, 1607 January 18*, published in: Axelson 1962-1989, vol. IX, pp. 103-105.

<sup>187</sup> Erédia's 1610 map clearly suggest this had already been the case in the initial design (fig. 4.3). Presumably it was anticipated that if the fortress would be taken under siege form the landside, this would be lasting longer and would therefore have a bigger impact than naval bombardments. Ships would have to manoeuvre in to vulnerable positions to be able to fire effectively, while on land trenches could create some protection for the attackers.

### Modifications carried out

Generally propositions for improvements will only be made if either a concept is judged to be outdated, or has proven not to function adequately. The first real test the São Sebastião fortress underwent was formed by the Dutch sieges that took place at the beginning of the seventeenth century. During these attacks different flaws in the Portuguese defences came to light. The fortress had proven to be unable to carry out the main task it was built for. Despite the position of the São Sebastião fortress, close to the channel, it could not be prevented that enemy ships repeatedly entered Mossuril Bay. The northern ramparts would have provided enough gun positions, but initially a low-lying battery was lacking.<sup>188</sup> The first breastwork facing the channel was added in 1607. Even after this improvement the Portuguese were not able to prevent the Dutch from sailing right along the fortress. This leads to the assumption that a shortage of good artillery pieces, rather than a lack of artillery positions, had formed the biggest problem.<sup>189</sup> In later years the only change that took place at the northern defences was the addition of a second low lying battery in front of the São João bastion (fig. 4.12). The design of the northern front of São Sebastião apparently gave little reason for more radical alterations. Moreover, the geographical situation limited the possibilities of altering the layout on this side of the fort. Instead, the fortification improvements were mainly carried out on the landside of the São Sebastião fortress. The Dutch assaults had formed the first incentive for improving the defences here. During these encounters the defenders had not been able to hinder the besiegers from advancing till right beneath the fortress wall. Neither could it be prevented that the original main gate was taken under fire and that enemy artillery positions managed to breach the southern curtain wall. The most obvious measure taken after these events was to block this gate. The main entrance, which will always form a weak point within a rampart, moved to a more suitable position. In case of another attack the western curtain could namely not be taken under fire from enemy batteries setup on the island. Moreover, the narrow pathway between São Gabriel and the sea could be easily swept. This ensured that reaching the entrance via trenches or in a surprise assault, would have become more difficult.

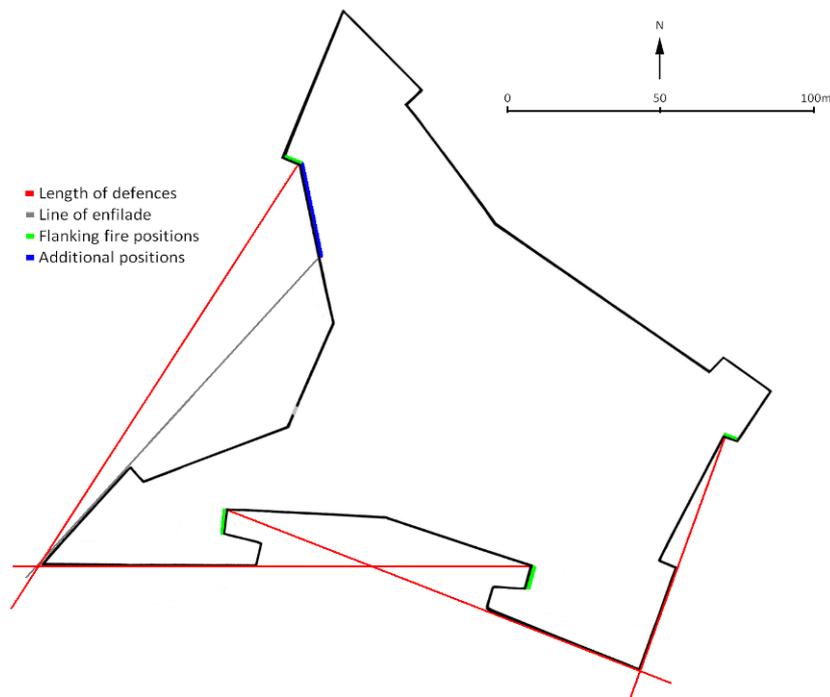
The different rampart modifications that followed would exclusively concern the landside bastions. As shown in the analyses of the lines of defence, dead ground would initially have existed in front of the Santa Bárbara bastion (fig. 5.1). Undoubtedly this situation would have been judged as an undesirable weakness in the defences. Perhaps also the orillons would have been thought of as inadequate, since their slender design would make these vulnerable. A new outline emerged after the works that were undertaken around 1635 were completed. Both bastions had been expanded towards one another and towards the island side. The overhauling resulted in a symmetrically functioning defence system. Most importantly, this new outline enabled that both landside faces could now be swept effectively by flanking fire provided from the opposite bastion (fig. 5.2). No dead ground would thus have existed anymore in front of the Santa Bárbara bastion. Another positive effect was that through this modification the serviceable space on top of both bastions had

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<sup>188</sup> The terreplein between the São João and the Nossa Senhora bastion would have been too narrow to set up cannons. But about ten pieces of heavy artillery aimed at the channel could have been accommodated along the northern parapets of the São João and Nossa Senhora bastions combined.

<sup>189</sup> Indeed complaints about the lack of good artillery pieces at the fort are to be found in many of the correspondence about the fort. For an inventory of the available artillery pieces made by Bocarro, see: Bragança 1936-1940, vol. IV, p. 7. See also Van Linschoten's report on this issue quoted in note 114.

been enlarged. At the São Gabriel bastion this had the biggest impact. Here the length of the landside parapet had been almost doubled, ensuring that more cannons could be brought in position. The retired flanks of both bastions were again built almost perpendicular towards the curtain. This was still customary at the time.<sup>190</sup> Compared to the former orillons, the new square bastion shoulders were more resilient against artillery fire. Also these were big enough to accommodate a cannon. On the downside, the new outline of the bastions made both salients more pointed. Especially the acute angle at the São Gabriel bastion would have been vulnerable.<sup>191</sup>



**Fig. 5.2:** Analyses of the cover that could be provided along the landside rampart around 1635. Dead ground on the island side had been eliminated. (at the other fronts no changes took place).

The outline of the Santa Bárbara bastion has not changed since this modification phase was completed. As mentioned in chapter three, the retired flank that is part of this outline shows the remains of a vault. This probably would have been the opening of a so-called *traditor battery*. From this position additional flanking fire could have been provided from a hidden casemate. Such a low level battery would have ensured that enemies positioned close to the

<sup>190</sup> Traditionally a flank was built perpendicular toward the curtain wall. Later in the 17<sup>th</sup> century flanks oriented towards the face, with an angle of the flank bigger than 90<sup>o</sup> would become more generally used. This idea was already expressed at the end of the 16<sup>th</sup> century by the German military engineer Daniel Specklin and would later be further developed and propagated by engineers like the Frenchmen Blaise François Pagan and the Dutchmen Henrick Ruse. Bruijn & Reinders 1967, pp. 19-20; Sneep 1982, pp. 38-43.

<sup>191</sup> Like this had been the case in the old situation, the landside face of the São Gabriel bastion would be built aligned to the flank of Santa Bárbara. Because the intermediate curtain had been effectively shortened as a result of the extension of both bastions, the salient-angle of the São Gabriel bastion became slightly sharper than before (fig. 5.3).

flank could have been hit easier.<sup>192</sup> Bearing in mind the integrated manner in which the overhauling of these bastions has been carried out, it might be assumed that the flank of São Gabriel bastion also would have accommodated a traditor battery. However, this cannot be proved, since this retired flank is no longer visible due to later modifications. Clearly the overhauling of the landside of the São Sebastião fortress in this building phase was a great improvement for the defence. Not only more cannons could be set up, also the new positions would be more effective. The new outlines of the bastion ensured the lines of defence would become better organised. Notably no alterations were made at the curtain wall. It was effectively shortened, but not made straight. Overall this extension phase was carried out in correspondence with the conceptions of military architecture of that time. Similar landside defences, with a short curtain flanked by pointed bastions with retired flanks, can also be found at other coastal fortifications. For instance at fort São Julião da Barra guarding the estuary of the Tagus near Lisbon. Here Miguel de Arruda directed the works when construction began under King João III.<sup>193</sup> However, this layout is so common, that it should not be interpreted as an invention connected to specific persons or military treatises, but rather a generally applied solution inspired on modern military architecture.<sup>194</sup>

Before the current outline of the fortress emerged, two more modifications were carried out. Both were extensions of the São Gabriel bastion, which would make the side of the fortress look less symmetrical. Somewhere between 1655 and 1671 the landside face of the bastion would be altered for the second time (fig. 5.1). This would again increase the serviceable space available on top of the bastion. Through this modification the face would no longer be aligned towards the flank of the Santa Bárbara bastion, but would be oriented to the concave curtain wall (fig. 5.3). The way in which this bastion face could now be swept, thus became more like the defence situation that had already existed along the north and west side of the fortress. Cover for the western face of São Gabriel bastion and the northern face of the Nossa Senhora bastion could already in the initial design be provided from artillery positions on the far end of the adjacent curtains (fig. 5.1). A positive effect of the alteration of the São Gabriel bastion would thus have been that cover along the landside of the structure could, from then on, be provided from more gun positions. On the other hand, this new outline would have been problematic if both faces had formed a salient angle in the conventional way. If the two faces of the São Gabriel bastion would have been extended, the salient had formed a slender point. In that case it had been very long, vulnerable and too narrow to use as a gun platform. To avoid this situation another design solution was applied. Instead of a salient the bastion was built as a small tenaille front. This construction is more robust. Moreover, the tenaille front improved the cover of the path leading toward the new location of the main gate. Also the western shore of the island could be more easily swept.<sup>195</sup> Although strictly speaking this setup has resulted in the dead ground in front of the bastion, this design seems to have been the most logical solution for this situation.

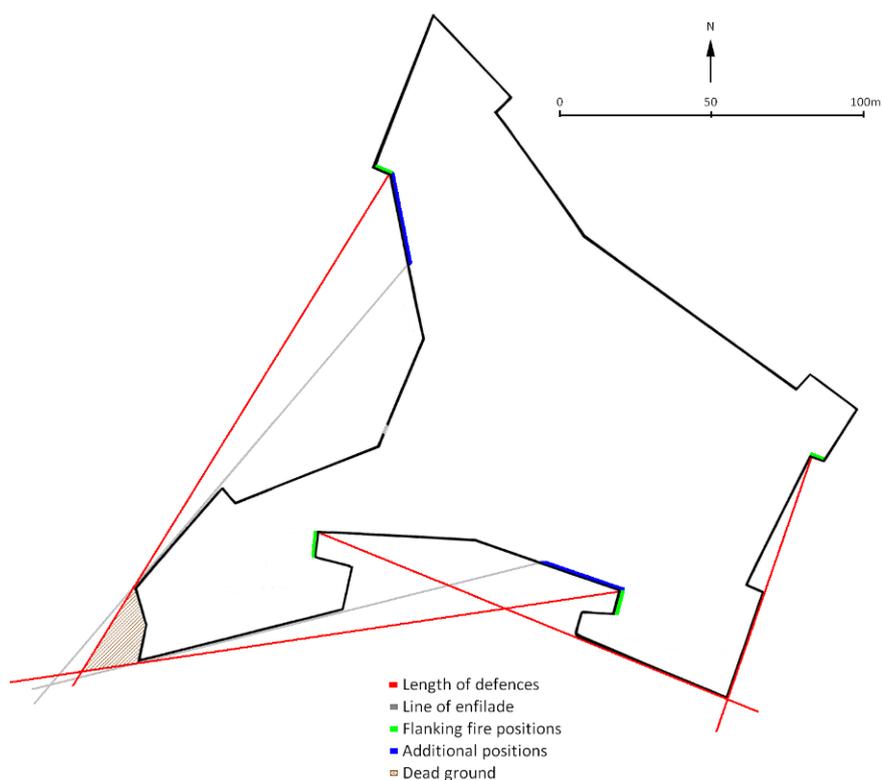
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<sup>192</sup> Cannons mounted on top of the ramparts would have difficulties hitting targets nearby, because these could not be aimed downwards. This is the same reason why the low-lying batteries were built north of the fort.

<sup>193</sup> Gil 1986, pp. 170-172.

<sup>194</sup> This scheme is also used on the landside of a coastal fortification at for instance fort San Elmo on Malta. Furthermore it has been applied to all sides of fortresses. As such it can also be found on geomantic idealised representations right into the 17<sup>th</sup> century. See for instance: Pietro Sardi, *Corona imperiale dell' architettura militare*, Venice 1618.

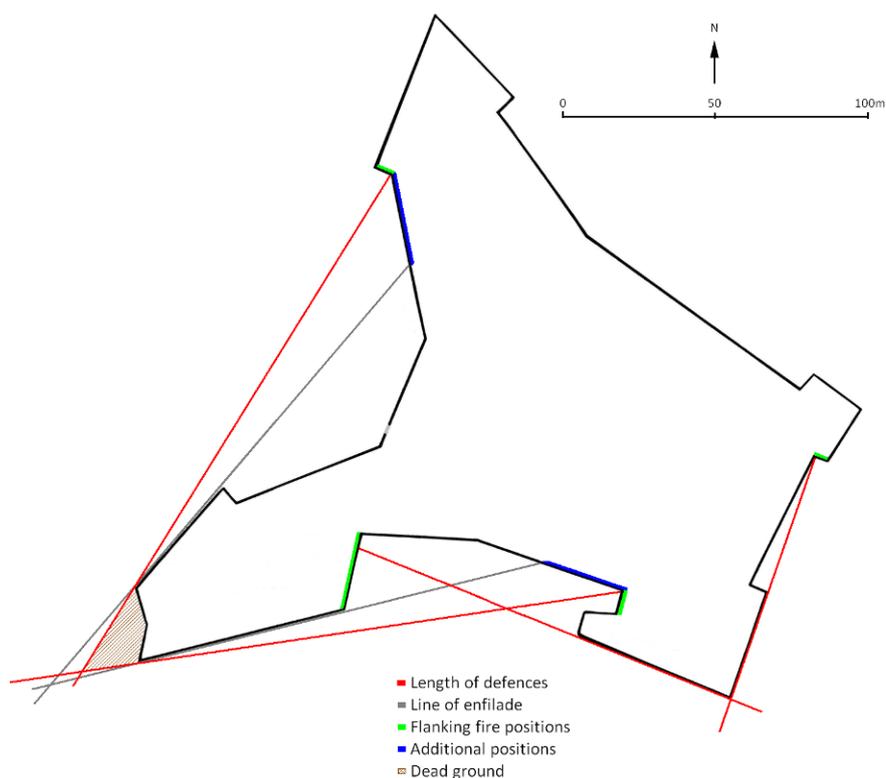
<sup>195</sup> In the parapet tenaille front of the São Gabriel bastion, in total four embrasures have been fitted.



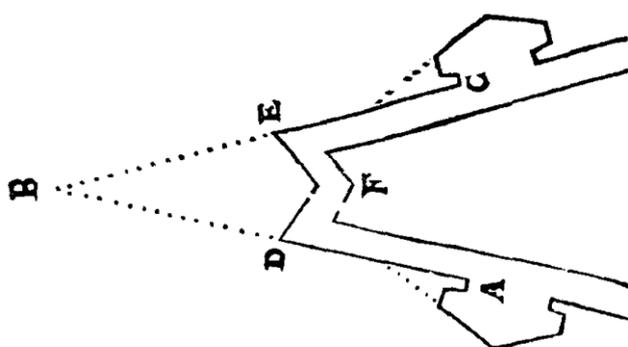
**Fig. 5.3:** Analyses of the cover that could be provided along the landside rampart in the construction phase dated between 1655-1671. A part of the landside curtain could now be utilised to sweep the São Gabriel bastion, but dead ground emerged in front of the tenailed side of this bastion.

Interestingly, a comparable situation has been discussed in the treatise written by the Fleming Simon Stevin. The design he recommends to avoid a pointy salient is very similar to what has been built at São Sebastião (fig. 5.5). This treatise was published about half a century before this modification was built and is considered to have been known in Portugal at the time. Because this design solution is rarely shown in practice and theory, it might be fruitful to conduct further research to find out if these cases are indeed related.<sup>196</sup> During the final modification that altered the outline of the São Gabriel bastion, the retired flank was filled in. Again this resulted in more available space on top of the bastion. Although this effectively shortened the adjacent curtain, the face of the Santa Bárbara bastion did not have to be realigned. It could still be effectively swept from behind the parapet of this newly created straightened flank (fig. 5.4).

<sup>196</sup> Simon Stevin, *Sterctenbouwing*, Leiden 1594. In contrast with what is the case in many of the Italian treatises, Stevin generally makes little references to the sources of the designs which he discusses. Concerning this specific layout suggestion, indeed no earlier version has been found in this study. It could thus be that he invented this layout (fol. 78). Furthermore, in the 17<sup>th</sup> century Portuguese military architecture is known to have been heavily influenced by the 'Netherlandish school' within which the ideas of Stevin were prominent. Paar 1996, p. 16.



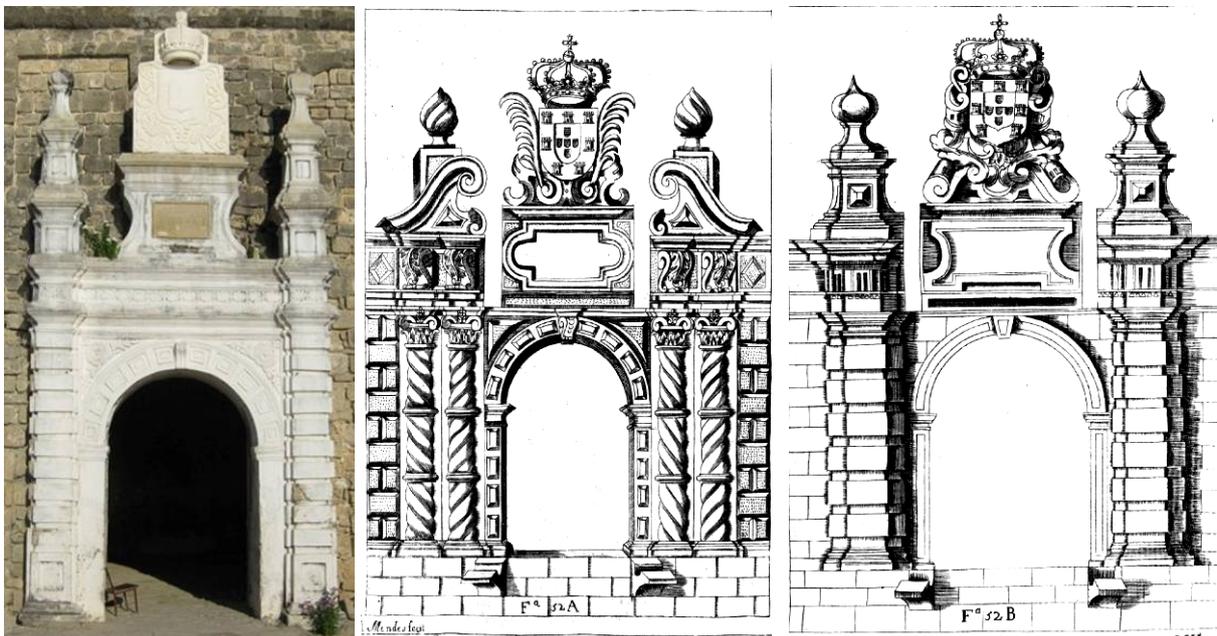
**Fig. 5.4:** An analysis of the cover along the ramparts at the final construction. The landside curtain has effectively been shortened due to the straightening of the flank of the São Gabriel bastion. This has had little effect on the defences of the fort.



**Fig. 5.5:** Model by Simon Stevin(1594), showing how a tenaille front can form an alternative for a sharp salient angle.

Although this study focuses on the outline of the fortress and the military principles behind this layout, also the modification of the main gate should deserve some attention. Design suggestions for the architecture of fortification gates were often included in military treatises. Interestingly the design of the main entrance at the São Sebastião, as described in chapter three, shows great similarities with two prints published three decades earlier in the

military treatise of Luís Serrão Pimentel (fig. 5.6, 5.7, 5.8).<sup>197</sup> Nearly all elements correspond with either of the two baroque gate designs shown in this book.<sup>198</sup> According to the inscription above the entrance, the façade dates from 1712. It would thus have been finished about thirty years after the book was published. All in all this leads to the presumption that the prints from this prominent Portuguese treatise would have been used by the craftsmen responsible for this work. Here the existence of a direct link between a specific European treatise and an executed design in Mozambique seems the most conclusive. The decoration of this façade has been amongst the last modification carried out on the outside of fortress.<sup>199</sup> As mentioned before, structural changes in the outline have not taken place after 1697. Although radical plans were made in the eighteenth century, these were not executed.



**Fig. 5.6:** The decorated façade in the western curtain. **Fig. 5.7 & 5.8:** Two gate designs for fortifications showing strong resemblances with the main gate at the São Sebastião fortress, published in the treatise by Luís Serrão Pimentel (1680). Note that repeating patterns are left out. The design overlaps probably to save paper.

<sup>197</sup> Luís Serrão Pimentel, *Methodo Lusitano de Desenhar as Fortificações das Praças Regulares e Irregulares*, Lisboa 1680. For the decoration design of a gate Pimentel advises to follow either designs made by Sebastiano Serlio, Vincenzo Scamozzi, or from the Northern European works by Wilhelm Dilich and Nicolaus Goldmann. The examples of gates shown in Pimentel's treatise are of the Composite and Doric order. Since the triglyphs are missing at Mozambique and considering the plainness of the columns the gate of São Sebastião might be best classified as being of the Tuscan order (fol. 150-152). Indeed, for instance Serlio recommends this order to be the most appropriate to apply at fortified places. Ackerman 1983, p. 15.

<sup>198</sup> The oval motif on the frieze is about the only exception. This modification looks a bit out of tune, since in contrast to most of the design it seems to follow a Northern European motif. The flowers carved above the arch are neither shown at the prints of Pimentel.

<sup>199</sup> An exception is probably formed by the outlook posts standing on some of the bastion corners. These are not yet shown on the perspective drawing from 1754 (fig. 5.10). A print from 1802 might be the first on which the lookout post as they can be seen today can clearly be distinguished. This map titled *Planta do quartelamento e fortaleza da Ilha de Moçambique*, made by Carlos José dos Reis e Gama is kept at the *Arquivo Histórico Ultramarino* in Lisbon. A reproduction has been consulted published in: Trindade 1983, p. 24.

### Unexecuted modification proposals

The initial design and the improvements have given the fort its current outline. However, if the three plans that will be discussed in the remainder of this paragraph would have been executed, the development of the São Sebastião fortress would have carried through into the eighteenth century. Probably practical reasons, like lack of resources, have prevented these plans from being put to practice. Although these plans did not influence the outline of the structure, they still can help to understand the fort better. Through the analyses of these modification plans, it can namely be seen what spots of the São Sebastião fortress were regarded to be inadequately defended, or wrongly built.

The earlier mentioned map of the fortress, which was sent to Portugal in 1697, is the oldest to depict the final alterations posed on the fortress outline (fig. 4.14). In addition to this, it proposes further improvements. In this extension plan a new bastion and landside curtain wall have been drawn. In front of it a moat and ravelin are planned. It could be that this extension plan was made because the fort was regarded too small. However, this seems unlikely given the enormous size the fort already had. Alternatively dissatisfaction with the landside defences and the inward-bent curtain might have been the incentive. Indeed, in the plan the landside front has a straight curtain. In the new situation the faces of the landside bastions would have been built aligned to the opposite flanks with would have resulted in a more orderly, symmetrical outline. Although perpendicular flank angles had become increasingly criticised during the seventeenth century, notably these were still proposed to be built in this plan.<sup>200</sup>

The preference for a bigger angle of the flanks would only be shown in a plan dating from 1741 (fig. 5.9). Here it was advised to remodel the only regularly built front of the fortress, adjusting the flanks of the Nossa Senhora and Santo António bastions. Also the eastward facing flanks of the São João and São Gabriel bastions were redesigned in this map in order to provide better cover for the bastion faces across. Most radical about this plan is the extension of landside defences by adding an arrangement of outworks. The map shows the former main gate to be used again. It stands protected behind a moat (Q) and a ravelin or *lunette* (S). A *demi-lune* (Z) is shown to protect the pathway which gives access to the secondary entrance (A). Further afield lies the covered way (T). This path is kept out of shot by the slope of the glacis (X). The main aim of this design would again have been to improve the landside defences. The proposed method to accomplish this, differs from the earlier modification plans. Here outworks have been put forward as the best solution. Firstly they would have kept an advancing enemy at a greater distance from the rampart. Secondly the slopes should keep the main fortification out of reach from direct siege fire from afield. Again the strategy proposed for the São Sebastião fortress shows to have followed the developments in European fortification architecture with some delay. Since the second half of the seventeenth century, inspired by the works of for instance the famous military engineer Sébastien de Vauban, the application of outworks had become more pronounced. In Europe vast networks of outworks had been constructed compared to which the proposed works at Mozambique are quite modest. What seems to have been a downside of

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<sup>200</sup> Compared to these earlier named European examples (note 190), in Portugal the transition process towards the angle of the flank wider than 90° seems to have been taking place later. Nearly all fortification schemes suggested in the leading Portuguese military treatise written by Luís Serrão Pimentel, still use the old setup, although in an appendix to the work the ideas of Pagan are mentioned. Pimentel 1680, pp. 533-545.

the plan made for the São Sebastião fortress, is that the proposed new front would nonetheless become relatively long. If alternatively the outworks would have been built right across the nearby narrow stretch of the island, the front facing the island would have been shorter. Moreover, a bigger surface could have been enclosed.

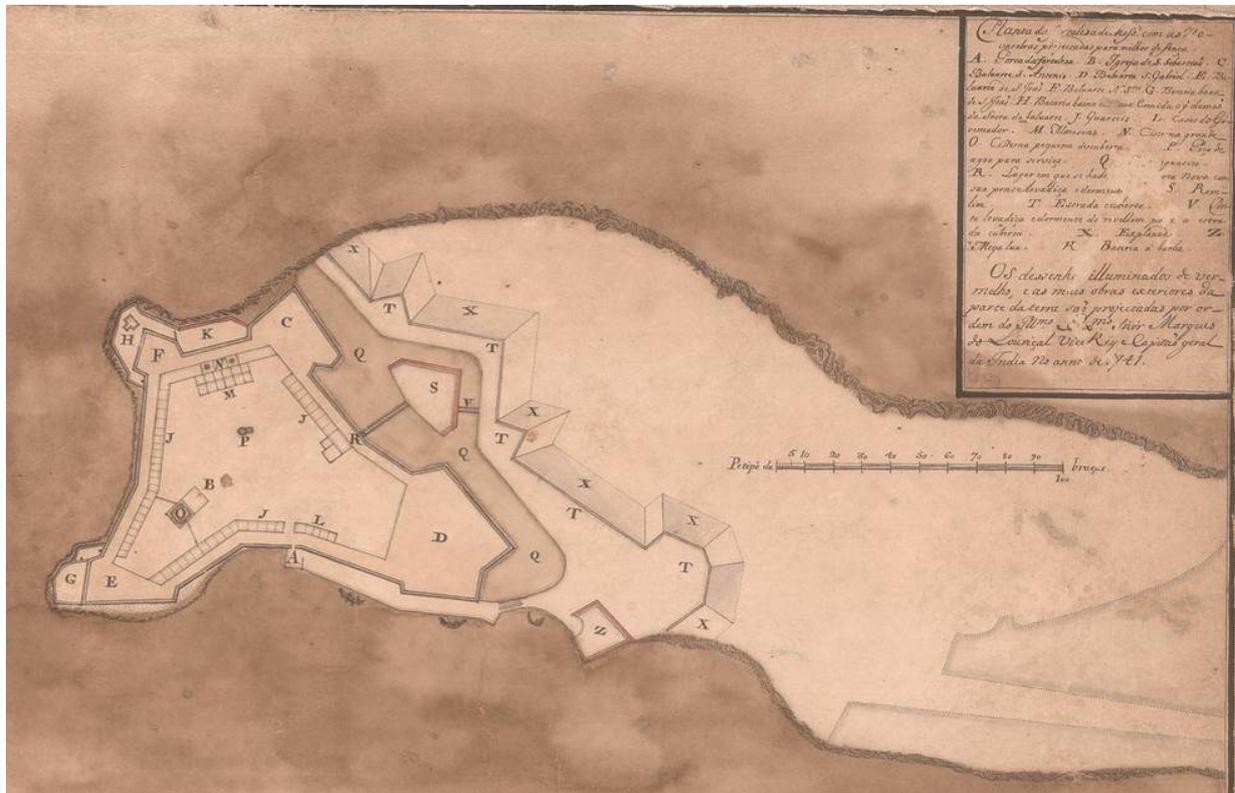


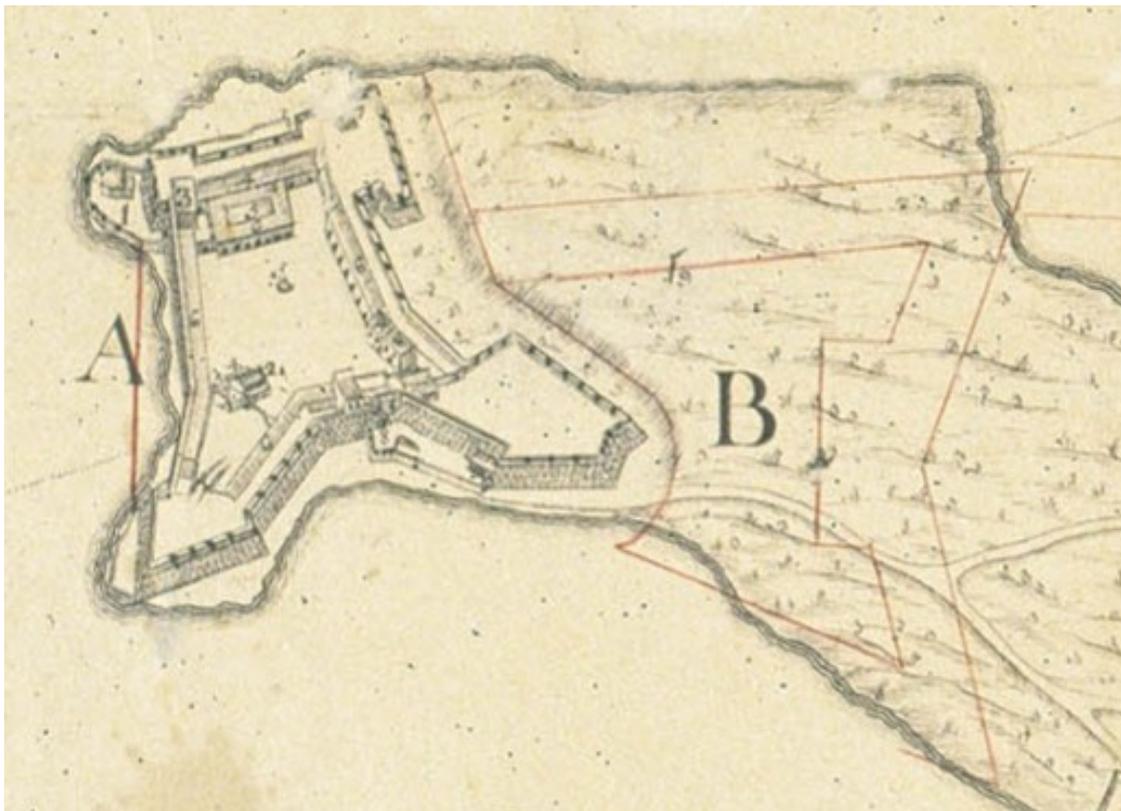
Fig. 5.9: Detail of anonymous map showing proposals to improve the defences of the fort (1741).

This seems to have been the strategy of the design proposal made thirteen years later in 1745 (fig. 5.10). This map provides an overview of defence improvements for all defensive structures, which should together guard Mozambique Island and the access to the Mossuril Bay. The focus here will remain on the proposed modifications of the São Sebastião fortress.<sup>201</sup> Concerning the main fortification of the island two structural improvements are depicted. Facing the channel a low-lying breastwork was devised to be built between the two existing batteries (A). The new breastwork is shown to have as many as twelve embrasures. This would be a great compensation for the lack of gun positions on the curtain behind it. But, because the drawing shows the structure should be built across the edge of the coral cliffs, it would be a labour intensive undertaking to build it. On the other side of the fortress an enormous outwork is drawn. Instead of the more intricate arrangements of smaller works and slopes, like in the previously discussed plan, this design proposes to build a single *hornwork* (B). This outwork would provide cover for the São Gabriel bastion and a part of the adjacent curtain. Also again it could help keeping an advancing enemy at a safe distance. The two walls of the hornwork which extend from the main rampart, would

<sup>201</sup> For a brief overview of the secondary defences on Mozambique Island see: Appendix II.



As has already been concluded in chapter four, the outline of the fortress we see today is the result of designs with exclusively date from the sixteenth and seventeenth century. The majority of the modification plans were made with the intension to improve the defences of the landside of the fort. This applies to the executed as well as the unexecuted plans. Two reasons behind this can be distinguished. Firstly, due to lack of space the opportunities of altering the other sides of the fortress were slim. Secondly, the defences on the landside where judged to be inadequate. To improve the situation bastions where repeatedly enlarged but also the lines of defence were altered so that cover could be provided in a more sophisticated way. Through the different phases of construction, crossfire could be provided with an increasing efficiency along the island side of the fort. Nonetheless, apparently in the eighteenth century the defences were again repeatedly considered to be insufficient. Undoubtedly different aspects of the fortress design would have been found to be outdated by contemporary military engineers. The plans shown, proposing to update the Mozambiquean fort, were however not implemented. The landside curtain remained concave, the flank angles remained straight and the amount of outwork is believed to have been kept to a minimum. Where other fortifications might show more divers construction layers based on military preference from different times, the São Sebastião fortress retained much of its original, somewhat curious, layout.



**Fig. 5.11:** Detail of previous map, focussing on the São Sebastião fortress (1754).

#### 5.4 A comparison between the bastioned fortification of Mazagão and Mozambique

In the first two paragraphs of this chapter the initial design of the São Sebastião fortress has been analysed against the background of military architectural theories, adapted to the specific strategic and geographical features of the place. This approach has shed light on many aspects of the design. But for instance the motivation to build an inward-bent curtain on the landside of the fortress has so far remained unclear. This feature contradicted the general principals of renaissance military architecture. In later centuries modifications have taken place at the fort, but the concave wall has remained present till this day. In an attempt to get a deeper understanding of the São Sebastião fortress layout, in this paragraph a comparison will be made with a contemporaneous project where the same circle of engineers has been involved.

The modernisation project of the defences along the North African coast, briefly mentioned in chapter two, forms an interesting case study. Firstly, because it was here that in 1540's the Portuguese introduced the bastioned system overseas. The application of modern fortifications at the cities as Ceuta and Mazagão formed a learning process for a new generation of Portuguese architects (fig. 1.1). This venture stood on the basis of the process in which fortifications throughout the overseas territories would be adapted to cannon fire. The focus will be on Mazagão, because the modern fortification design that would be introduced to North Africa in this project has been applied most thoroughly at that city.<sup>204</sup> Secondly, a direct link between the two projects existed in the person of Miguel de Arruda. Five years before he was given the duty to make a design for the fortress at Mozambique in 1546, he was dispatched to North Africa.<sup>205</sup> Previously, this architect is known to have been involved in the prestigious building project of the monastery of Batalha in his home country. However, historical sources linking him to earlier architectural projects with a military character are unknown. Miguel de Arruda would visit the outposts along the African coast together with the earlier mentioned Italian Benedetto da Ravenna. Records from him being a specialised artilleryist and military engineer date back to 1511. He would from then on have already been in Spanish service.<sup>206</sup>

Despite the imminent threat posed on the Christian territories along the North African coast due to the increasing use of artillery in the region, around 1540 defences were outdated and in a state of disrepair.<sup>207</sup> After examining the situation at Ceuta, in 1541 the two inspectors travelled to Mazagão which recently was appointed to become the main Portuguese stronghold on the North African west coast.<sup>208</sup> At the time the city still mainly relied on a

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<sup>204</sup> Carita 2004, pp. 135-147; Elbl 2000, pp. 377-382 . Also see note 87.

<sup>205</sup> Viterbo 1899-1922, vol. I, pp. 67-71. For Arruda's involvement in the design of the São Sebastião fortress see: Appendix I.

<sup>206</sup> Benedetto da Ravenna (ca. 1485-1556) has been part of the pioneer generations in the development of the angled bastion. His early defence works still featured rondelles, while in north Africa modern angle bastions would be built. Viterbo 1899-1922, vol. I, pp. 66-71; Bury 1994, pp. 27-38.

<sup>207</sup> Carita 2004, p. 140. Although plans to modernise the defences of Portugal's fortifications with the help of Italian architects already dated back to 1526, when a certain Carcía da Bologna was made *mestre de obras* and was sent to Safi, due to disagreement on Portugal's role in Morocco under King João III no action was undertaken. Instead, in this period the Manueline defence infrastructure fell into disrepair. Elbl 2000, pp. 352-380.

<sup>208</sup> After the loss of Santa Cruz do Cabo de Gué, the modern Agadir, to the Moors in March 1541, it was decided by João III, to apply all resources made available for the region to Mazagão. This decision eventually led to the

typical small, square Manueline fort with towers on each of the four corners. This structure had been built between 1514 and 1517 under the supervision of the brothers Diogo and Francisco de Arruda.<sup>209</sup> Since no earlier walls circumventing the city existed, the fortification had to be built from the ground up. For this high priority task of adding modern defences, Francisco de Holanda had drawn the initial model applying the bastion system. He did, however, never travel to Mazagão himself.<sup>210</sup> For the adaption of his plan to the local conditions, Benedetto da Ravenna and Miguel de Arruda had been responsible.<sup>211</sup> After these plans had been made the two inspectors left Mazagão. The construction was supervised by the *Mestre das Obras Reais* João de Castilho. Due to the great number of workers and materials made available, the construction was already mostly finished in the summer of 1542.<sup>212</sup> In a letter to King João III, João de Castilho assures that the building process proceeded in strict accordance with the instructions given by Benedetto da Ravenna.<sup>213</sup>

In order to be able to compare Mazagão to the São Sebastião fortress, the design of the modernised Moroccan city defences will be analysed. The original plans by Francisco de Holanda and Benedetto da Ravenna have unfortunately been lost. The oldest surviving map that reliably depicts the modernised fortification dates from 1611. This source is considered to provide the best impression of the original design of the bastioned defences (fig. 5.12).<sup>214</sup> The map shows a somewhat trapezium-like ground plan, where an angle bastion or half-bastion has been built on each of the four corners. These would have been topped by cavaliers. The flanks on the landsides are all shown to be protected by orillons. A fifth bastion stood at the middle of the western wall of the fortification. Inside this structure the main gate to the city would have been located (A). Outside the ramparts a ravelin (P) is shown to protect this gate and a moat would circumvent the city. Furthermore, the map indicates the presence of a counterscarp to protect a covered pathway. On the seaside the fortification would have provided a well-protected harbour where ships could moor (M).<sup>215</sup> The seaside curtain of the fort would solely be swept by the south-eastern bastion (N). Because of the form of the opposite half-bastion (i), flanking fire could sweep close to the

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abandoning of the subsidiary Portuguese strongholds of Azemmour (1513-1541) and Safi (1508-1541). This strategy explains why Mazagão became the most thoroughly modernised fortress town in North Africa. Bury 1994, p. 34; Carita 2004, p. 146; Elbl 2000, pp. 350-357, 380-381.

<sup>209</sup> Francisco de Arruda (? - 1547) was the older brother of Diogo (? - 1531) and father of Miguel de Arruda (? - 1563). Both brother works on prestigious Manueline building projects. Viterbo 1899-1922, vol. I, pp. 46-74; Elbl 2000, pp. 376-377.

<sup>210</sup> This is the only architectural design by Francisco de Holanda that is known to have been realised. He writes his plans were accepted, although it is not known till what extend these have been altered during construction. The fortification was for instance built out of carved stone instead of brick, as he had recommended to the king. Bury 1986, pp. 23-26.

<sup>211</sup> The final plan for the outline of the new fortification was agreed upon after consolidating with the local military and navel commanders as well as the already present *Mestre das Obras Reais* Diogo de Torralta, also spelled Torralva. Bury 1994, p. 33; Carita 2004, p. 144.

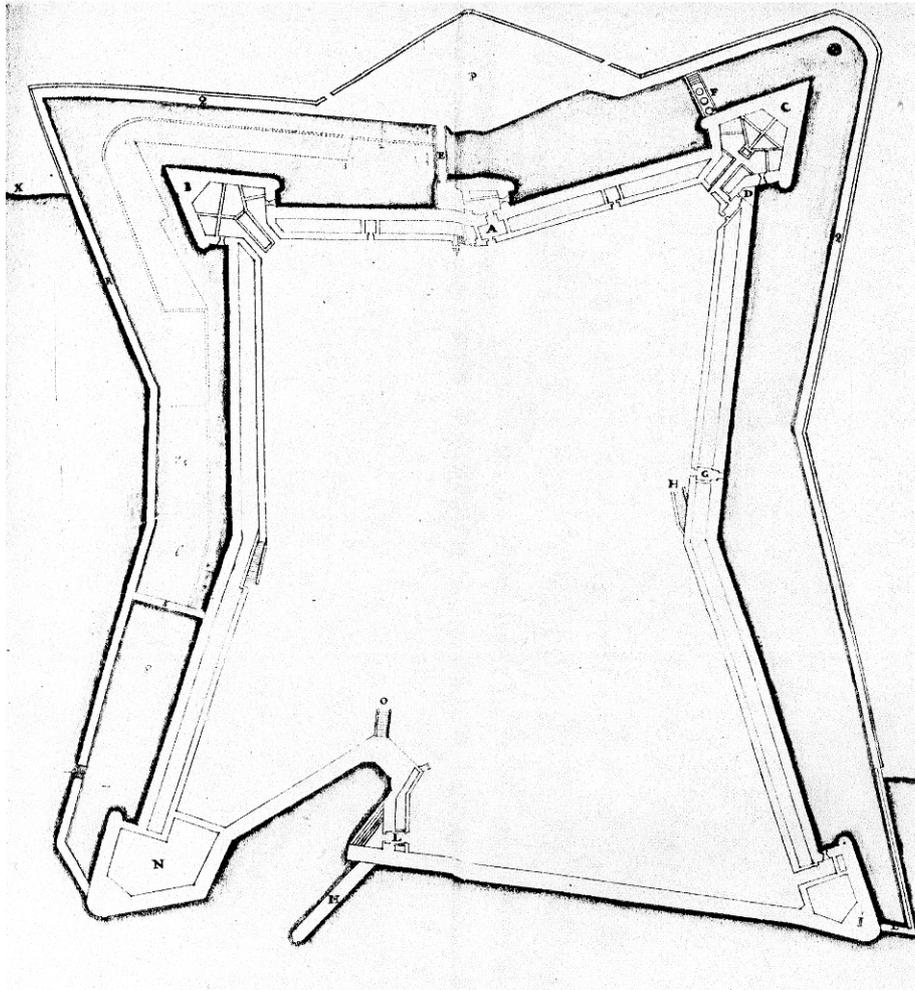
<sup>212</sup> Carita 2004, p. 144. João de Castilho (1470-1553) is due to his Spanish origin also known as Juan de Castillo. Notably also the proximity of this site to the homeland, compared to for instance Mozambique Island, would have had a positive effect on the speed of the construction process.

<sup>213</sup> 'E quanto ao que Vossa Alteza me escreveu que na obra não saia dos apontamentos de Benito de Ravenna, eu assim o fiz sempre e farei'. The complete set of letters in which he informs the king on the progress of the works is published in: Viterbo 1899-1922, vol. I, pp. 193-198.

<sup>214</sup> Farinha 1987, pp. 4-8.

<sup>215</sup> Ricard 1932, pp. 18-24; Farinha 1987, pp. 4-8; Elbl 2000, pp. 381-382; Bury 1978, p. 18.

rampart, but no crossfire could be provided. On the west side of the fortification, from the projected platform in the middle of the curtain (A), extra flanking fire could be provided. The faces of the bastions standing on either side of this platform (B & C) seem to have been built aligned to these extra artillery positions.<sup>216</sup> Along the north and south sides of the city, the *length of defences* measured up to three hundred meters. Such distances would make it hard to provide mutual cover between the bastions. This situation is probably the reason why the faces are not built aligned to the opposite bastions flanks. Instead these are aligned to the curtain walls (fig. 5.3). Cavaliers or other artillery position on the terreplein would thus have to provide cover for the bastions. At the São Sebastião fortress a similar situation would have existed at the São Gabriel and Nossa Senhora bastion of (fig. 5.1). It is basically the same concept that would later be proposed in for instance the treatise of Lorini, although the lines of defence at these two executed designs lack symmetry (fig. 2.5). A bigger difference between the setup that Lorini proposes and both fortifications is formed by the concave curtain wall. This was against one of the basic principles of the bastioned system as it is generally formulated by renaissance military theorists.



**Fig. 5.12:** Oldest reliable map of the bastioned defences of Mazagão, dating from 1611.

<sup>216</sup> As mentioned in chapter two, this setup with an intermediate projected gun platform at the middle a curtain, would be increasingly criticised during the 16th century. Also see note 80.

When comparing the two Portuguese fortifications, these inward-bent curtains undoubtedly form the most striking similarity. Not unlike the situation at Mozambique, at Mazagão the angles occur more or less in the middle of the ramparts. There are authors that have interpreted this phenomenon in Morocco merely as being the result of a design adaptation to the local features.<sup>217</sup> However, since the natural setting did not prevent the moat surrounding the city to be dug, it does not seem to have been impossible to construct straight curtains. Pre-existing buildings would neither have had a decisive influence on the outline. Although the planned city would soon grow and fill in the entire area within the ramparts, at the time the walls were constructed, the settlement was very small.<sup>218</sup>

To conclude, the comparison made between the São Sebastião fortress and the city defences of Mazagão have shown interesting similarities. It shows that the appliance of the concave curtain, is not exclusive to the outline São Sebastião fortress. Furthermore it has to be concluded that at Mazagão no convincing arguments have been found, why the surroundings would have determined this outline. Other factors must have been at stake leading to this unusual design. These two defence structures do not merely look alike. They are also connected through the person of Miguel de Arruda. It is impossible to distinguish what influence this individual would precisely have had on both designs. However, at least it has become clear that some individuals within his generation of architects, would have favoured this layout. At this point, the reasons behind this preference remain unknown. To get a better understanding of why engineers would choose this layout, the next paragraph provides an overview of a research done specifically into military treatise texts discussing this phenomenon.

## 5.5 The appearance of the 'hybrid' defence system in sixteenth century fortification theories

In the analyses of the fortification of Mozambique as well as Mazagão the application of a defence setup which does not correspond with the general principles of the bastioned system has been shown. Neither can these designs be categorised as exponents of the tenaille trace. The layout might rather be classified as a 'hybrid' system which tries to combine both distinctly different defence systems. Although in this system bastions are built on the corners of the forts, the curtain walls are shaped as tenaille fronts. The striking similarities between the two discussed interrelated Portuguese fortifications, as well as the questionable geographical explanations suggested, raise the suspicion of a theoretically underpinned preference. The aim of this paragraph is to find out if a niche in theoretical writings would have existed at the time, discussing the idea of concave curtains in combination with the bastioned system. Therefore sixteenth century treatises are specifically examined on this concept.<sup>219</sup> The treatises found, in which this topic is being

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<sup>217</sup> Historian Rui Carita judges: *'Articula-se ainda hoje num vasto quadrilátero quase regular, com todos os lados quebrados, salientando assim os baluartes implantados nos extremos, todos diferentes e especialmente adaptados ao local onde se implantam.'* Carita 2004, p. 144.

<sup>218</sup> Historian Martin Elbl concludes: *'Mazagan was only a small fort with a flimsy adjacent settlement, so that the new showpiece fortress was built virtually on virgin ground.'* Elbl 2000, p. 385.

<sup>219</sup> As many 16<sup>th</sup> century treatises as possible have been examined to see if similar design solutions are being debated. The extensive bibliographies published by Horst de la Croix 1963 and John Bury & Paul Breman 2000

debated, are separately discussed in a chronological order. If such a 'hybrid' fortification outline is recommended in a treatise, firstly it will be analysed how the author suggests this systems would function. Secondly, the system will be compared to the executed Portuguese projects. If interesting similarities arise between the theories and executed projects, it will be investigated how these might have influenced each other. This survey will thus help to answer the question if the fortifications of São Sebastião and Mazagão should be interpreted as isolated cases, or rather as part of an underexposed design tradition.

### **Tartaglia**

The oldest treatise that should be discussed is the *Quesiti et inventioni diverse* by Nicolo Tartaglia, first published in 1546. This book is amongst the earliest to show illustrations of the pentagonal bastion. Also it is supposed to be the first to propose flanking fire from these bastions to be combined with concave curtain walls.<sup>220</sup> The author criticises the layout of fortification on a quadrangle ground plan with straight curtains. In his opinion inward-bent curtains should ideally be used to provide crossfire in addition to the flanks of the bastions. Tartaglia argues that in this setup the salient could be built less sharp, making it more resilient to artillery fire.<sup>221</sup> The treatise does not hold a diagram of a complete fortification built after his ideas. Only in the second edition of the book, first published in 1554, a segment of Tartaglia's defence system is illustrated (fig. 5.13). In this setup two wall segments form an inward-bent angle, instead of a straight curtain between the outer bastions (A & C). Where these segments meet, in what appears to be a right angle, a third bastion is shown (B). Curiously this bulwark is illustrated to have the same form as the two other bastions, although in this position the flanks behind the re-entrant angles can hardly function in the same way. In this setup the salient of the outer bastions could indeed be built more blunt, without creating dead ground. The faces could namely be swept by cannons placed on the walls (R & P). In addition to this, a cavalier is drawn at the middle of both terrepleins (F & G). The curtain walls thus had a prominent role in providing cover along the ramparts. As a result of the concave outline of the fort, it might be argued that crossfire could be provided more effectively. Indeed, an enemy approaching the middle bastion could have been taken under fire from many different gun positions. However, in this setup heavy artillery could not have been used in all situations, because of the risk of hitting the ramparts wall.

Tartaglia's diagram shows some similarities with what the defences would have looked like along the western side of the fortification of Mazagão (fig. 5.10). Both show an intermediate bastion placed in the middle of a concave curtain. However, in Morocco the angle between the two curtain wall segments is much wider and the form of the intermediate bastion is better adapted to its position. At Mazagão the faces of the outer bastions can namely be swept from the flanking positions of the bastion in the middle. Moreover the salient of the intermediate bastion would have been more blunt, without creating dead ground. While in further contrast to what Tartaglia proposes, in this setup the two outer bastions still need

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have been used. However, due to the obvious restriction in accessibility of material, the overview provided should not be considered complete. The analysed publications are listed in the bibliography.

<sup>220</sup> Notably at the time this treatise was published the development of the angled bastion had already been taking place fifty years earlier. This delay might be explained by the fear amongst military authorities that enemies would benefit from such publications. Bury 1985, pp. 20-22; Bury 2000, p. 97.

<sup>221</sup> Nicolo Tartaglia, *Quesiti et inventioni diverse*, Venice 1554, fol.74.

acute salient angles to be swept effectively. There are thus some similarities between the concept published by Tartaglia and the ideas behind the design at Mazagão, but these are worked out quite differently. Comparing the treatise model to the Mozambiquean fort shows even less similarities, since here no intermediate bastion has ever been built along any of the concave curtain walls. Overall, it can be concluded that although Tartaglia pleads for a defence system which combines pentagonal bastions with the tenaille system, his diagram shows little resemblance to the Portuguese fortifications as a whole. The theorists of these different projects might have had some ideas in common, but in practice the systems functioned quite differently.

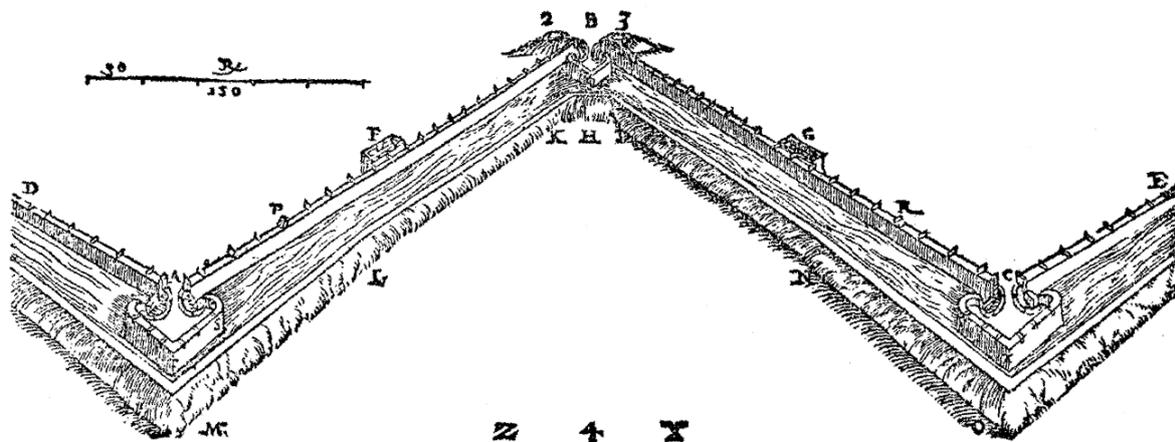


Fig. 5.13: Treatise model showing inward-bent curtains combined with bastions by Nicolo Tartaglia. Cavaliers are shown to stand on the middle of each curtain wall segment.

### Zanchi and the modernisation project of Roman defences

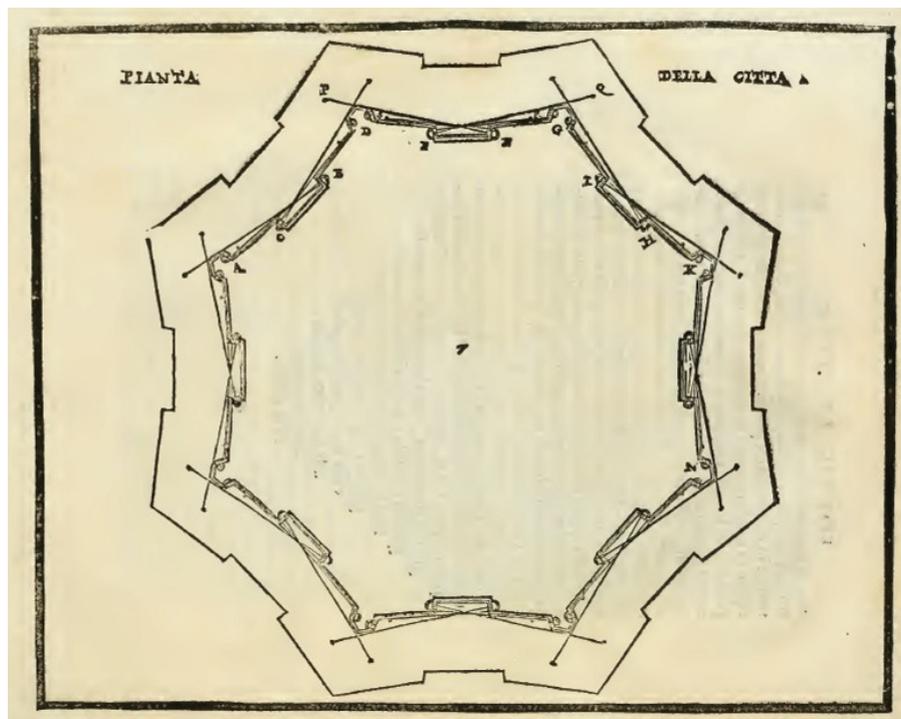
Giovanni Battista de' Zanchi has been another author who believed that the perfect fortifications would not have straight curtain walls. The solution published in his treatises was however quite different from that of Tartaglia.<sup>222</sup> He proposed that within a city wall extra flanks should be incorporated to be able to provide more crossfire along the curtains (fig. 5.14).<sup>223</sup> This setup shows great similarities to the famous so-called 'double bastion' design Antonio da Sangallo the Younger had made earlier for the defences of Rome.<sup>224</sup> The enormous project of ringing the city with modern defences started in 1534. Because the greatest military architects of the time would have been involved, it would become of great

<sup>222</sup> Giovanni Battista de' Zanchi, *Del modo di fortificar le Città*, Venice 1554. It is believed that work on this treatise already begun in 1546. Bury 1985, p. 46.

<sup>223</sup> In theory by making use of intermediate flanking fire the distance between bastions could be made bigger, which meant that less expensive bastions would be needed to defend big areas.

<sup>224</sup> Apart from this project near the Porta Ardeatina on which work started in 1535, Antonio da Sangallo made designs for various Roman defence projects between 1534 and 1546, but most were not built. Croix 1960, pp. 272-278; Pepper 1972, pp. 33-49.

significance to the development of military architecture.<sup>225</sup> This cooperative project also seems to have been a breeding ground for innovative ideas on fortification designs combining concave curtains with bastions. Probably with some inspiration deriving from Sangallo's much praised works of, Galasso Alghisi and Jacomo Castriotto would write treatises greatly based on this concept.<sup>226</sup> Although Francisco de Holanda is known to have met Antonio de Sangallo the Younger during his stay in Rome, it would make no sense to look for direct links between the Italian designs discussed so far on the one hand and the concave curtains of Mazagão and São Sebastião on the other.<sup>227</sup> The differences concerning the form and the defensive system are too big to presume causality. The parallel between the Portuguese fortifications and the treatises of the two latter named authors is however much stronger. The earlier theorists have only dealt with the possibilities of combining the stellar- and bastioned system very briefly. But the treatises written by Alghisi and the author duo Jacomo Castriotto and Girolamo Maggi are almost completely based on this concept. These two books should be considered the most extensive and well-illustrated renaissance studies promoting this concept.



**Fig. 5.14:** Treatise model by Giovanni Battista de' Zanchi, showing curtains which hold extra flanks, which can be utilised to cover the bastions.

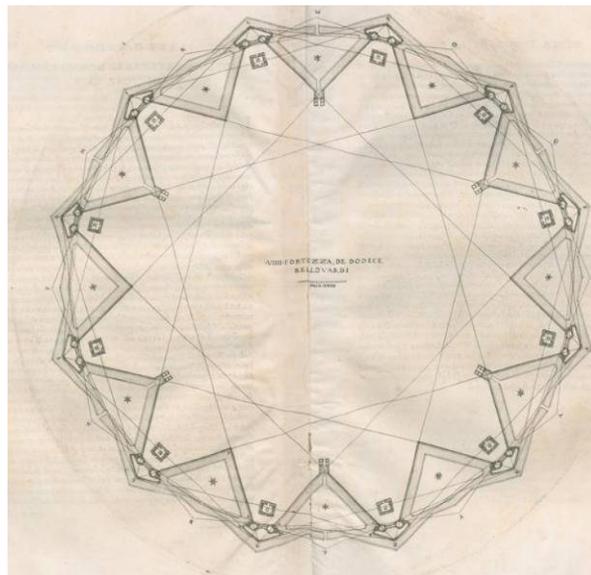
<sup>225</sup> In fear of a possible Turkish attack during the papacy of Paul III the best military engineers were hired. Apart from Antonio da Sangallo the Younger, Michelangelo, Giovanni Mangone, Giovanni Battista Bellucci, Francesco di Marchi, Giacopo Meleghino, Jacomo Castriotto, Galasso Alghisi and Francesco Laparelli are known to have been involved in the project. Croix, 1960, pp. 277-279; Pepper 1972, pp. 33-49.

<sup>226</sup> Alghisi would later claim in his *trattato* published in 1570, that it was in Rome in 1542 that his invention of a stellar-trace combined with bastions was copied by Castriotto, whom he accuses of plagiarism.

<sup>227</sup> Bury 2000, p. 79. Undoubtedly Holanda held Sangallo in high esteem, since he judged his Florentine *Fortezza da Basso* to be the finest fort in Europe. Hale 1965, p. 489.

## Alghisi

The fortification layouts that Alghisi proposes in his *trattato* published in 1570, can best be interpreted as a theoretical study based on an abstract system of geometrical perfection. The plans do not take into consideration, specific geographical settings or other practical factors. It is systematically discussed and illustrated how, according to the author, a stellar fortification with bastioned points should ideally be proportioned. The sequence of examples of the system starts with a five pointed star and ranges up to a fortification counting a staggering twenty-one bastions (fig. 5.15).<sup>228</sup> Superficially the forms of these multiple pointed circumventions might look like earlier drawings of stellar fortifications by for instance Antonio da Sangallo or even Antonio Filarete. However, crucially these examples lack bastions, which results in a significantly different defence system.<sup>229</sup> In Alghisi's system the increase of the number of bastions not only makes the angle between the inward-bent wall sections sharper, also the salient becomes blunter. The gates that are depicted at the concave angles, would indeed be very hard to reach through crossfire that could be provided from the concave curtains as well as the bastion flanks. Also a moat is drawn circumventing the entire fort and along the curtain walls, which shapes a kind of ravelin structure between the bastions. Defences are further strengthened by cavaliers which are shown to stand on top of the projected points of the *stellar trace*. The faces of the bastions are aligned to the lines of fire of cannons placed on these platforms.<sup>230</sup>



**Fig. 5.15:** Treatise model of Galasso Alghisi, showing a fortification combining the stellar trace with twelve angle bastions.

<sup>228</sup> Galasso Alghisi da Carpi, *Delle Fortificationi libri tre*, Venice 1570. The entire second book is devoted to the sequence of fortifications with an increasing number of bastions, all designed according to the same theoretical framework.

<sup>229</sup> For instance Filarete's plan of "Sforzinda" from his manuscript *trattato* (fol. 34) and the sketches of a radial fortification plan (Uffizi, arch. 1245) of da Sangallo both republished in: Croix 1960, pp. 273-274. As mentioned in chapter two the tenaille system, as shown in these examples, is often confused with bastioned system with broken salients. Alghisi is definitely not the inventor of the stellar system, but can be considered the first to extensively and systematically write a publication about the latter.

<sup>230</sup> Only in the first of the two examples Alghisi gives of a fortification with five bastions, the cavaliers lack and the faces are instead aligned to the adjacent flanks. Alghisi 1570, p. 44.

Alghisi's fortification designs required a large amount of artillery pieces for its defence. Also, enormously long curtain walls were needed to enclose a relatively small surface. Probably the costs of this ensured Alghisi's plans as such remain solely executed on paper. If his treatise is compared with the layouts of Mazagão and São Sebastião, some similarities can be seen in the way the bastion is connected with both adjacent inward-bent wall sections. Especially at the two western bastions of the fortification at Mozambique, the curtain segments form a pointed shape which projects the bastion from the centre of the fort in a way that looks not unlike it is illustrated in the Italian *trattato*. At Mozambique however, the intermediate wall between these bastions consists of three segments instead of two. Also the defences are organised in a different manner, without making use of cavaliers where Alghisi's design strongly relies upon.<sup>231</sup> Since Alghisi's study did not illustrate how his system should be adapted to different geographical situations, further comparisons are hard to make. Some of his theories are known to have influenced the designs made by the Italian engineer Marco Aurelio da Pasino, who has been a student of him.<sup>232</sup> But no proof has been found to suggest any direct connection between Alghisi's theories and the Portuguese examples of bastioned fortifications with inward-bent curtains. However, Alghisi's *trattato* does confirm that interest for this concept existed at the time the designs for the fortifications of São Sebastião and Mazagão were made.<sup>233</sup>

### **Maggi and Castriotto**

In the same period as the previously discussed treatise was written, the preparations for *Della fortificazione delle città* by Maggi and Castriotto must have been taking place. The manuscript of the author-duo is believed to have been finished later than that of Alghisi. But their treatise was first printed six years earlier in 1564.<sup>234</sup> These two publications deal with the science of fortification in a different manner. In contrast to the Alghisi's work, here all kinds of practical considerations are taken into account. This results in technical advices on how fortifications could best be constructed. Also a great variety of layout suggestions are given, adapted to diverse natural settings. Throughout the *trattato* the authors propagate their preference for inward-bent curtains. In the first book an overview is given of the works of other theoreticians, who applied this concept. References are made to the experiments

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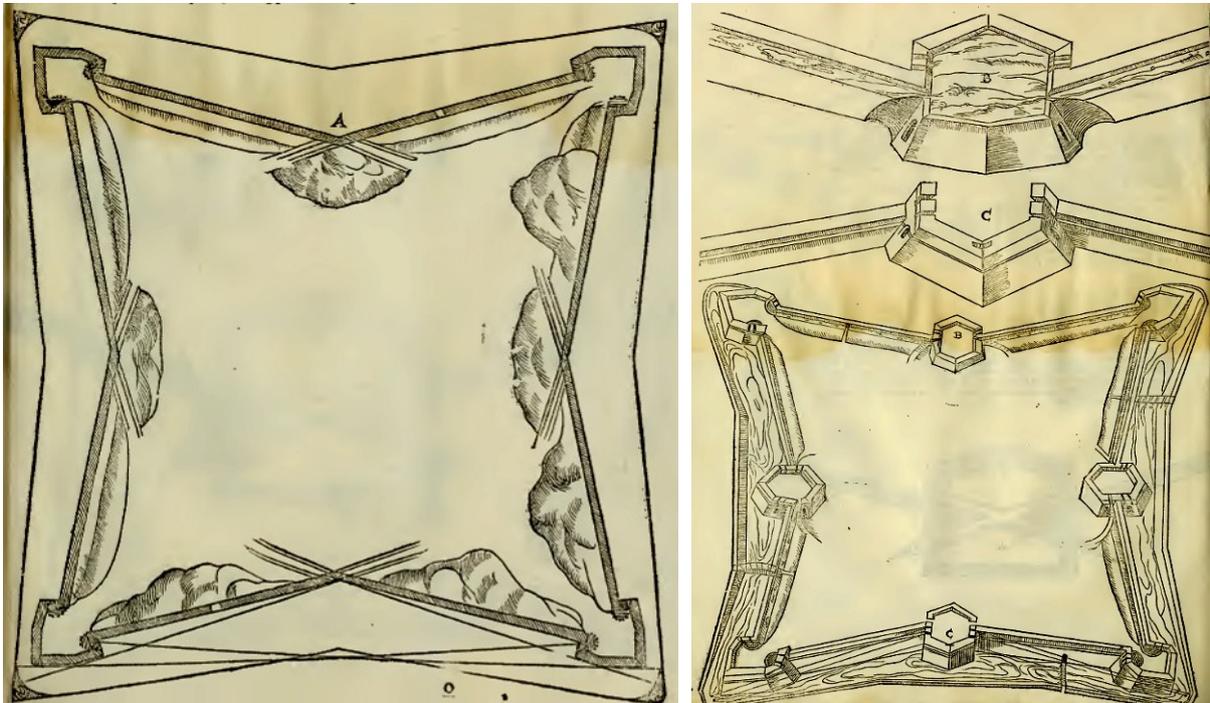
<sup>231</sup> No tangible remains, descriptions or drawings are found that would indicate the São Sebastião fort would ever have had cavaliers. In this study it is therefore assumed these were not built.

<sup>232</sup> Inspired by the work of his master, Marco Aurelio da Pasino would in 1579 publish his *Discours sur plusieurs points de l'architecture de guerre* in Antwerp. Here the benefits of the re-entrant angle are said to be discussed. Furthermore, at Sedan in modern northern France, he is known to have applied the distinctive broken curtains in his design for the bastioned city defences. During later modifications, the broken curtains are being straightened. Croix 1963, p. 41. Unfortunately it has not been possible to consult this treatise in this study.

<sup>233</sup> Although the treatise would only be published in 1570, as mentioned before Alghisi claims his idea of his fortification system already existed in 1542, see note 226. It has also been suggested, the text of the *trattato* was already written in 1548. Bury 1985, p. 40. This would show that Alghisi's studies into this concept would be more or less contemporaneous with that of Tartaglia.

<sup>234</sup> Throughout the treatise it is clearly indicated who wrote what. Parts of the first book and most of the two subsequent books are written by Castriotto. The *trattato* was complemented by texts of Maggi who would publish the treatise after his friend's death. Horst de la Croix has suggested Castriotto's contribution must have been completed 'prior to 1552 and quite possibly before 1549'. Croix 1960, pp. 278-279. John Bury however argues that parts of his contribution to the publication should probably be dated later than 1556. Bury 1985, p. 39.

with broken curtain walls by Tartaglia.<sup>235</sup> Also the idea of intermediate flanks within the curtain walls, as published in the *trattato* of Zanchi, is referred to and has been developed further.<sup>236</sup> Some other layouts look like the system of Alghisi, but this theoretician is nowhere mentioned.<sup>237</sup> All in all, the discussion on theories within military architecture is focussed on the opportunities that arise from the use of the inward bent curtain. In addition to the discussion on pre-existing theories, also different executed projects and battles are being described. Interestingly the siege that took place at Mazagão in 1562 is amongst the events mentioned in the descriptions made by Maggi. The fact that the Portuguese had managed to persist in their defences, must have strengthened the authors confidence in the system based on a combination of bastions and broken curtains.<sup>238</sup> In the second book, Maggi and Castriotto introduce their designs based on this concept. Here multiple quadrangular plans with inward-bent curtains are discussed.



**Fig. 5.16:** Treatise model of Maggi and Castriotto showing a slightly inward-bent curtain flanked by bastions (1564). In this layout, the complete curtain can be utilised to provide extra cover along the ramparts.

**Fig. 5.17:** Alternative solution from the same treatise with intermediate bastion within the concave curtain.

<sup>235</sup> Castriotto is known to have corresponded with Tartaglia. Bury 1985, p. 39. The latter's theories is referred to on folio 24-34. A situation very similar to figure 5.13 is printed, but here a slightly different defence system is suggested. At the concave angle of the curtain the cannons are not mounted on an extra bastion, but on the enlarged terreplein (fol. 51).

<sup>236</sup> A model very similar to that of Zanchi is published in the treatise (fol. 9). In the further developed version, the curtain walls are depicted to have two extra sets of flanks in between the bastions (fol. 64).

<sup>237</sup> Folio 9 and 54 depict fortification layouts that functions very similar to the six-pointed example in Alghisi's treatise. The inward bents are however made less sharp and not only the curtain walls, but also the faces consist of two sections.

<sup>238</sup> Bury 1978, p. 18. Mazagão, spelled "Mazacane", is referred to on folio 23 and 27.

In the defence systems they propagate crossfire to be provided from the concave curtain walls in addition to flanking fire provided from the bastions. The main argument mentioned in favour of multiple cannon positions, is that if the bastions would be taken under fire, artillery mounted on top of the curtains could still be used.<sup>239</sup> Different layouts are suggested to provide this form of extra cover. The simplest solution illustrated is to build earth cavaliers behind the concave angles of the walls to accommodate cannons as shown on figure 5.16. Alternatively an intermediate bastion could be built at the middle of the concave curtain (fig. 5.17). Although Mazagão is not specifically named here, the similarities are obvious. Especially the subtleness of the bent that is recommended to be built in the curtain is striking. No earlier treatise has been found to recommend such blunt angles between the two segments of a curtain wall.<sup>240</sup> A significant difference between the Moroccan fortification and the printed designs is that also the faces of the bastions are no longer straight in these illustrations. This modification was recommended by the authors in order to let the crossfire, provided from different positions, sweep the bastion most effectively.<sup>241</sup>

If the comparison is made with the São Sebastião fortress, the similarity of the blunt curtain walls is also striking. The model that looks most like this fort is published in book three of the treatise, which is dedicated to design solutions for coastal fortifications (fig. 5.18). The illustrations do not represent Maggi and Castriotto's ideas of an ideal universal fortification. Rather, the designs are adapted to specific geographical settings. However, despite the fact that the fortifications would be adapted to their environment, the depicted forts do not show a complete irregular form. Instead, like at São Sebastião and Mazagão geometrical shapes can be distinguished. This specific drawing is the only print found in any *trattato* to depict a single fort to have concave curtains consisting of two, as well as three sections. The match is however far from absolute. Unlike at the São Sebastião fort, all curtains are concave. Furthermore, the depicted fort has five instead of four bastions, of which four are half-bastions. This implies that in this model the artillery positions along the curtains would again play an important role in providing cover along the rampart walls. In this setup the half-bastions would namely best be swept from the middle sections of the curtains. Despite the similarities in form, in this model the defence system is thus distinctively different from that of the São Sebastião fortress.

Having identified some notable similarities between this treatise and the Portuguese fortifications, the question remains how these could be related to each other. Certainly the authors have known the fortification at Mazagão, as they describe the siege that took place there two years before the treatise was published. Although the manuscript version would have been partly written earlier, it is not known if texts would have existed before the fortification project in Morocco took place. No sources have been found to suggest the authors would have had direct influence on the design of any Portuguese forts. In contrast to

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<sup>239</sup> Indeed as discussed earlier, many treaties acknowledged the vulnerability of the pointed bastions. Instead of designing more blunt bastions, this backup-system can be seen as the solutions suggested in this *trattato* (Fol. 22).

<sup>240</sup> A later treatise that shows the possibility of using a similar lightly bent outline is: Jaques Perret, *des fortifications et artifices*, Paris 1601, n. pag. It has been suggested by architect historian Émilie d'Orgeix that this publication was inspired by the work of Maggi and Castriotto amongst others. Orgeix 2006, n. pag.

<sup>241</sup> Only at the quadrangular plans with intermediate flanks in the curtain walls are straight faces suggested (fol. 57).

Mazagão, Mozambique is not referred to in the treatise. If there would be a direct relation between Maggi and Castriotto's theories and the São Sebastião fortification, it is be hard to tell which might have influenced which, because the periods of realisation greatly overlap. There are no sources found that suggest Maggi or Castriotto would have known any designs made for São Sebastião. This cannot be ruled out although, the Portuguese would have probably tried to keep these secret. The possibility that the Mozambiquean fortress has influenced the treatises thus seems unlikely. Vice versa it remains unknown when the definitive form of the fortification has been decided upon. As discussed in earlier chapters the building process proceeded slowly. Although the first initiatives date back to the reign of João III, the earliest reliable image that can be reconstructed of the outline of São Sebastião fortification shows the situation around 1600 (fig. 4.4). Theoretically it might thus be that suggestions made by Maggi and Castriotto would have influenced the Mozambiquean fortification design. The fact that Maggi in the foreword dedicates the *trattato* to the 'Re del Mondo nuovo' Phillip II of Spain, makes it likely that the book would have been known by the Portuguese *Mestres das Obras Reais* of the time.<sup>242</sup> To find out in more detail how these ideas would have been related, requires further research. For now, it can be concluded that the idea of building broken curtains combined with bastions, is more widely spread than the Portuguese examples mentioned in this study. Moreover, in this publication Maggi and Castriotto regarded this concept to be a *preferable* defence system. It thus proves that these Italian theoreticians had similar ideas in the same period.

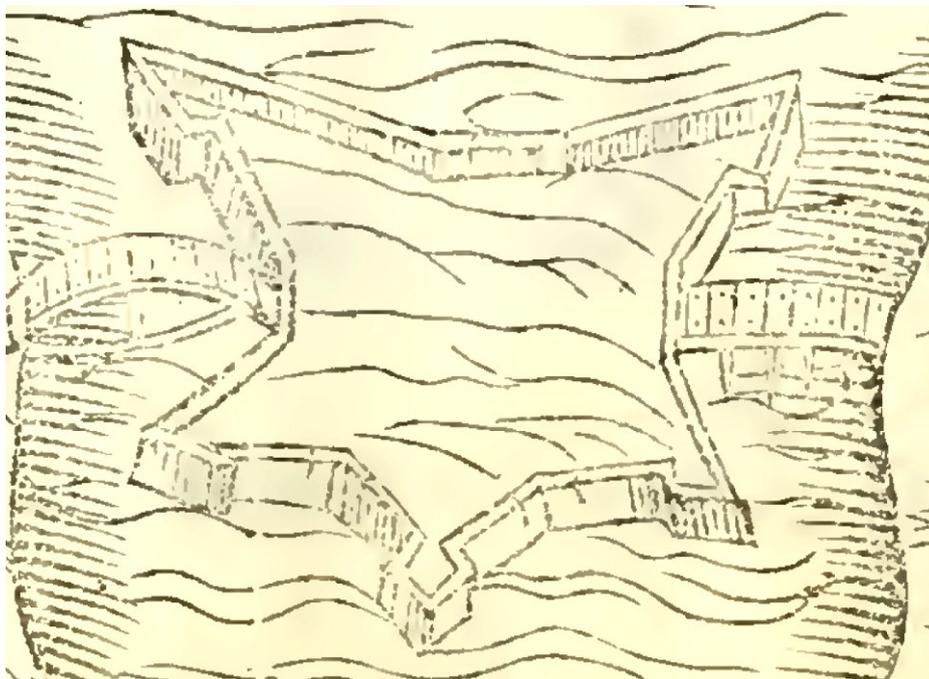


Fig. 5.18: Detail of a treatise model by Maggi and Castriotto, showing a fort surrounded by water.

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<sup>242</sup> (fol. 1). Maggi writes he dedicates it to Phillip II of Spain because he felt he was not only the most powerful amongst European rulers but also the defender of Christians against the infidel enemy. Hale 1985, p. 37.

### Various sixteenth century treatises briefly mentioning the concept

As mentioned earlier, the two previously discussed treatises should be considered to be the most extensive renaissance studies propagating the possibilities of building concave curtains in combination with bastions. In the decades after these treatises were first published, this setup would still be presented by other theoreticians. However, they would not make it the main theme of their *trattato*. On the contrary the concept would either be discussed as a phase in the historical development of fortification theories, to illustrate the diverse options for irregular formed fortifications or to be presented as an example of how fortifications should *not* be built. To illustrate this point, the four treatises found to touch upon this theme, all published in the sixteenth century, will be briefly presented.

In the treatise written by Girolamo Catania, first published in 1564, a single print shows two types of non-straight curtain walls. One front looks like what is recommended by Maggi and Castriotto, with a slightly bent tenaille front flanked by bastions. The other example is similar to the concept of the broken curtain first published by Zanchi. Here however, these two designs are merely shown to emphasise how curtain walls should not be built since the author believes these should be straight.<sup>243</sup>

In the *Trattato* by Carlo Theti, first published in 1569, a whole chapter is devoted to the disadvantages of curtains that are not built straight. Many different shapes are illustrated and discussed. According to the author *forbici*, or ‘scissors’, meaning re-entrant curtains, should only be applied if the site makes it absolutely necessary. This could for instance be the case in mountainous terrain.<sup>244</sup>

Likewise, in the earlier mentioned treatise by Buonaiuto Lorini, dating from 1597, the ‘hybrid’ defence system is not shown in the first book discussing the science and reasons behind the forms of perfect fortifications. However, when the diversity of applied forms is discussed in book three, different illustrations showing sections of bastioned fortifications with broken curtains are printed. The author comments how this would increase the potential for the use of smaller pieces of artillery in the defence. Although the author acknowledges the strong defences this form could provide, he does not consider it to be amongst the ideal forms that should preferably be applied.<sup>245</sup>

More pronounced on the issue is the opinion expressed by Giovan Battista Bellucci. He was a friend of Castriotto and like him a great advocate for practical planning. Nonetheless he expressed his aversion of the ‘hybrid’ system in his *trattato*. Two plans of inward-bent curtains combined with bastions are illustrated to explain why these setups would not be strong. Instead, the author recommends the use of the conventional bastioned system, in which the faces are aligned to the flanks of the opposite bastions. In this setup, cannons standing on the curtain wall could indeed not provide extra cover for the bastions.<sup>246</sup>

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<sup>243</sup> Girolamo Cataneo, *Opera nuova di fortificare*, Brescia 1564, fol. 50.

<sup>244</sup> (Book I, pp. 13-19) Theti's treatise is known to be first published in Rome 1569, simply titled *Discorsi di fortification*. Croix 1963, p. 49. The version used in this research titled *Discorsi delle fortificationi, espugnationi, & difese delle città & d'altri luoghi* is however published Venice in 1589.

<sup>245</sup> The first chapters of the third book of Lorini's treatise give a historical overview of the development of fortification. The broken curtain wall is illustrated and discussed in different forms in. (ch. 7-9, pp. 142-144).

<sup>246</sup> Bellucci's *Nuova inventione di fabricar fortezze, di varie forme* would have been completed around 1554, but it took until 1598 that it was first published in Venice. The author's plea for practical design includes the

The final treatises included in this survey are the three books dealing with artillery and fortification written by Gabriello Busca, which were published around the end of the sixteenth century. The last and most elaborate of his books, which is titled *Della architettura militare libro primo*, provides a comprehensive overview of the development of the fortification techniques in the past century. References are made to many theoreticians, going back to Albrecht Dürer.<sup>247</sup> Also the subject of the 'cortine ripiegate in dentro' is being discussed in its different forms. In agreement with what has been found in the bibliographical survey carried out in this paragraph, Busca regards Tartaglia to be the first author to have published on this idea, followed by Castriotto and Alghisi.<sup>248</sup> Busca sharply criticises the concept. He argues that if the curtains would be used to sweep the bastions, the latter would become too pointed and fragile. Furthermore, Busca disagreed with the idea that had been expressed amongst advocates of the 'hybrid' system, that orillons could be omitted. For instance in some plans by Maggi and Castriotto this feature is shown to be absent because it would otherwise obstruct the optimal line of defence that could be provided from the concave curtains.<sup>249</sup> Busca's concern was that the flanks would become too vulnerable without this protection. All in all, like most theoreticians in the centuries to come, he concluded that building straight walls was not only the cheapest, but also the strongest method of construction.<sup>250</sup>

### Conclusions on the treatise survey

In the previous paragraphs it has already been concluded that the defence setup of the São Sebastião fortress as well as the fortifications of the city of Mazagão did not fully correspond with the general principles of the bastioned system, nor the tenaille trace. The analysis in this paragraph has shown that these examples are theoretically embedded in renaissance treatises. The setup of angular bastions with intermediate non-straight curtains has been described in many different varieties. The theoreticians discussing this concept have judged the qualities of this system very differently. Some authors merely express their aversion to the concept, others claim it should only be used if the local setting leaves no other options. But interestingly, in this paragraph also treatises have been discussed in which a more positive attitude towards the idea is expressed, applying the concept in ideal situations.

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recommendation that experienced soldiers should lead fortification projects since '*neither books nor proportions know how to fight*'. (p. 51; English translation of quote from: Lefavre & Tzonis 2004, p. 128). This might explain the dissatisfaction he shows to have with the plan illustrated in his treatises that looks similar to the system that had been the outcome of Alghisi theoretical approach (pp. 73-74).

<sup>247</sup> Gabriello Busca, *Della architettura militare libro primo*, first published in Milan 1601, the version used for this research dates from 1619. This publication was intended to be the first of a series of three books, but the other two are not known to have ever been written. About the scholarship of Busca, Horst de la Croix goes as far as to state: '*He was acquainted with all the printed treatises on the subject*'. Croix 1963, pp. 43-44.

<sup>248</sup> Busca concludes the idea comes from Venice, with is indeed at least the place of origin of these publications on the subject. Busca 1619, ch. 34, p. 107. Amongst many other theoreticians cited is Scrivá, which proves the circulation of his earlier mentioned manuscript dated ca. 1538 (*ibid.*, ch. 34, p. 104).

<sup>249</sup> In order to maximise the amount of curtain wall firing positions from where the faces of the bastions could be swept, the flanks should stick out as little as possible. For an earlier mentioned design of the broken face, minimising the length of the flank see for instance: Maggi & Castriotto 1564, fol. 21.

<sup>250</sup> Busca 1619, ch. 44, pp. 119-122. This statement is based on the fact that the 'hybrid' design is hardly applied in practice and barely has received any attention in modern literature. The only 17<sup>th</sup> century military treatises writers found in this study to discuss the issue extensively were Simon Stevin in his *Sterctenbouwing*, published in Leiden 1594 and Antoine de Ville in *Les fortifications* first published in Lyon 1641. These authors draw the same conclusions as Busca. For two earlier mentioned treatises with a more positive attitude towards the concept see notes 232 and 240.

The main argument expressed in favour of this system, is that this layout would enable artillery positioned on the curtain wall to provide additional cover along the ramparts. Executed examples of this concept precede the known publications. The Roman defence project led by Antonio da Sangallo the Younger from 1534 onwards, seems to have played a pioneer role in the development of these ideas. His famous 'double flanked bastion' can be seen as an early form of breaking up a straight curtain wall. Furthermore, the cooperation of such a great amount of military engineers involved in this project seems to have worked as a catalyst for the spread and evolution of similar ideas. Like the defences of Rome, the fortification of Mazagão was built before the first *trattato* would discuss the possibilities of the broken curtain in modern fortifications. Military theoretical publications did catch up from 1546 onwards. But in the same way only a small amount of engineers applied this 'hybrid' defence form, the renaissance text propagating this concept remained a niche. After the first publication on the subject by Tartaglia, the writings of Alghisi and Maggi and Castriotto dealt with the issue in a more comprehensive manner. Interestingly, these writers promoted the system as part of their ideal fortifications designs, instead of a layout that should only be built if the geographical settings provide no other options. This analysis has thus provided an alternative, a more likely explanation for the existence of the inward-bent landside wall at the Mazagão and Mozambique. Instead of geographical factors or other external influences, which would have led the architects with no other choice than to build a 'hybrid' system, this might very well have been the preferred layout form. This explanation seems even more plausible since these Portuguese fortresses were built in a period of time when also military treatises have been written that recommended this concept.

## 5.6 Conclusion

This chapter has shown that the São Sebastião fortress has been built as a bastioned fortification from the ground up. Pre-existing buildings will only have played a minor role in the development of the fort, while the natural environment has shown to have had more influence on the design. If the fortification would have been built further away from the shore, the design would not have to be adapted so much to the natural environment. In that case it might have been built more in accordance with the geometric design ideals propagated by humanist theoreticians. Strategic considerations are, however, supposed to have formed the bases for choosing this specific location. The northern headland was namely judged to be the most convenient position to defend the island. This location provided the best view on the channel as well as steep coral cliffs that would offer defensive advantages. The form of the west and north side of the structure most clearly shows to echo the shape of the headland. Here, most parts of the ramparts are built very near to the shore. Along the east side of the fort some space is left open. On the island side neither natural, nor man made features have been distinguished that will have been of influence to the design. Analysing the outline of the fort and the defensive system, the structure shows to be strongly connected to the development of military architecture that took place in Europe. The design of the fort clearly anticipates on the threats that cannon fire could pose on it. Moreover the bastions and wide terrepleins would make it possible to use artillery in a defensive role. At the time that the São Sebastião fortress was constructed the Italian influence on the art of fortification had been highly dominant. The use of angled bastions which provide mutual cover from the flanks already shows that theories originating from

Italy were implemented on Mozambique Island. When the structure is, however, analysed more closely, aspects come to light which would not be approved of by most Italian theoreticians. Most pronounced, amongst these possible points of dispute, would have been the inward-bent curtain walls of the fort. This layout is highly uncommon. Generally theoreticians would recommend curtains to be built straight and also in practice these concave walls are rare to find. It seems tempting to try to explain this phenomenon merely by the role the natural environment would have played in the design considerations of this fort. However, since the motivation for this solution seems to be absent at the landside of the fort, this interpretation does not seem to provide a conclusive justification. Furthermore the situation at the São Sebastião fortress is not unique. In a comparable manner the interestingly similar layout of the defences of Mazagão have been described as the result of an involuntary design adaption enforced by nature. Following this reasoning would be to underestimate the diversity of ideas which have circulated amongst fortification experts. A more focussed research into the treatises which were published around the time both Portuguese fortresses were built, has namely shown that there have been theoreticians propagating this layout. Variations on the concept have been proposed in different treatises. The most important, recurring argument would have been that guns positioned on top of the curtain wall could in this setup play a more prominent role in the defence of the ramparts. Muskets could more easily help provide crossfire along the wall because of this bend. Furthermore, the cannon positions on top of a concave wall could be better oriented towards the ramparts. Artillery placed here could thus provide cover for the bastions, in addition to the conventional flanking fire. This could be done most effectively if the orientation of the bastion face would be built adjusted to these lines of defence. In the initial design along the northern front of the São Sebastião fortress, the faces of the bastions would already have been aligned towards the wall. Also the western face of the São Gabriel bastion was built in such a way from the beginning. At other curtains, the lines of enfilade would be oriented towards the opposite flanks. Following the completion of the initial design of the fortress, different alterations were proposed. These mainly were focussed on improving the landside defences of the fort. As a result of the modifications, carried out between 1655 and 1671, the southern faces of the São Gabriel bastion would also become aligned towards the curtain wall. In a later extension plan of the fort it was proposed to build a straight landside curtain. However, this idea was not carried out. Instead the fort greatly retained its peculiar shape. All in all this chapter has shown how the design of the fort would have been effected by the possibilities and restrictions posed on it by the site. Related to this, strategic considerations would also have played a role. Focussing merely on these factors could, however, result in a misinterpretation of the design of the fortress. Till what extend the fortress outline could be seen as an exponent of renaissance military architectural theories could be easily underestimated. Firstly, the initial structure would have possessed more pronounced symmetrical proportions than what is visible today. The fact that modifications would only have been added on the landside of the fort has been the reason for this. Secondly, the outline of the fort follows a design concept which is unusual within the world of military architecture. It is however not an isolated case. Moreover, the application of the so called 'hybrid' defence system is shown to be a building method which is embedded in renaissance treatise writings.

## Conclusion

The aim of this study has been to obtain a better understanding of the São Sebastião fortress. More specifically, it has been tried to get an insight in what approach to military architecture has led to this fortification design. In order to answer this question, different aspects concerning the history of the fort and the development of contemporary military architecture have been discussed.

To comprehend the historical and geographical context of the fort in this thesis, the evolution of the Portuguese presence along the east African coast has been sketched. Mozambique Island is shown to have evolved into a major stronghold within *Estado da Índia*. This has helped to explain why such an ambitious fortification project was undertaken. In 1583 the São Sebastião fortress became in use as the primary fortification of the Island, superseding the Manueline fort of São Gabriel. An analysis based on the historical maps and descriptions has made it possible to distinguish different building phases within the structure that stands here today. Construction works gained momentum from the middle of the sixteenth century onwards. It has been concluded that the shape of most parts of the current outline date back to what is defined in this study as the initial design. This oldest reconstructible phase must have been finished around the end of the sixteenth century. While the last final modifications, that altered the shape of the ramparts, have taken place before the end of the seventeenth century. In the period that the initial plans had been drawn, Italian humanist scholars played a very dominant role in the development of fortification designs adapted to cannon fire. In modern publications the fort is therefore generally simply classified as an Italian inspired renaissance fortification.<sup>251</sup> Indeed, no sources have been found to suggest a strong influence in the executed design has derived from other 'schools of fortification'. Only the design of an extension, in which a small tenaille front instead of a salient was built at the São Gabriel bastion, might be assumed to have been inspired by the writings of Simon Stevin. Some eighteenth century modification plans show a more distinct French or Dutch influence, however, these remained unexecuted. All in all, the sixteenth century Italian fortification theories indeed must have formed the direct bases for at least most of its design.

However, if the design of the São Sebastião fortress is examined more closely along the general principals of renaissance military architecture, some peculiarities can be identified. The most striking discrepancy is formed by the fact that at the São Sebastião fort, three out of four curtain walls are built concave instead of straight. The need for straight curtain walls has been mentioned as a basic principal in many treatises. A variety of arguments has been formulated explaining why. Obviously, fortification in reality could never achieve the level of design perfection as treatise drafts on paper. Amongst many other possible aspects, the natural setting of the location will always make it necessary to adapt a concept till some extent. Indeed, at the São Sebastião fortress a strong relation can be seen between the outline of the ramparts built near to the shore and the shape of the island. Here the inward-bent curtains might thus be interpreted as an adoption to the local settings. On the landside front of the fort however, external incentives to build the curtain wall in this fashion lack.

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<sup>251</sup> UNESCO 2009, p. 7.

It thus has been proven not satisfactory to explain the application of the inward-bent in this manner.

In search for a better explanation for this phenomenon, a comparison is made with the defences of the North African Portuguese city of Mazagão. Although the scale of both fortifications differs, many parallels prove to exist. The same deviation from normal military architectural principals can be seen. Also here broken curtain walls are combined with the use of bastions. Again an explanation for this, based merely on the environment of the fort seems implausible. Furthermore, the first drafts for both fortifications had been only made five years apart and the same circle of engineers is found to have been involved in both projects. All in all, this has led to a strong suspicion of a theoretically underpinned preference for this unorthodox 'hybrid' system. A treatise analyses focussed on this issue has confirmed this presumption. It has been found that different theoreticians have suggested the use of this setup. Critically, it has not only been presented as a possible alteration to adapt a plan to its environment, but has also been found to be recommended as an ideal fortification system.

In renaissance literature the concept of the combined application of bastions and tenaille fronts can be found to be acknowledged as a separate defence system. For instance the invention of this concept was claimed by Galasso Alghisi. He accused Jacomo Castriotto of plagiarism, because in his plans he also combined the stellar trace with bastions. At the end of the sixteenth century, in retrospective Gabriello Busca separately described the development of this concept in military treatises. In correspondence with what has been found in this study he claims Nicolo Tartaglia is the first to have published on this concept. This had been in 1546. This analysis has revealed that at the time the inward-bent curtains were applied at the bastioned fortifications of Mazagão and São Sebastião, there also has been enthusiasm for this 'hybrid' concept amongst theoreticians.

It should be realised that, as has been shown with the development of the bastioned system, some years pass between the invention of a concept and the first publication on the topic. Although the first publication on the hybrid system dates from 1546, probably positive attitude towards concept already spread in manuscripts form, or through personal contacts. Even if the idea would have originated from Italy, it might already have been known amongst the planners in service of the Portuguese Crown before the first drafts for the two discussed Portuguese fortresses were made in 1541 and 1546. Francisco de Holanda for instance, had recently been to Italy to investigate the development of the art of fortification, at the time he draw his plans for Mazagão. The São Sebastião fortress might also have been influenced by the published treatises in later years, as it is not known till what extend the initial drafts where followed during the lengthy construction period.

Alternatively, since none of the Italian publications discussing the 'hybrid' concept predate the completion of the fort at Mazagão, it should also be considered that the inspiration for this concept could have derived from this North African example. Concerning architectural concepts in general and fortification theories in particular, throughout the sixteenth century Italy is mostly shown to have been an exporter. Nonetheless, the defences of the Portuguese city would to a big extend already be finished in the year 1542. This is the same year in which Alghisi claims, Castriotto would have gotten the idea from him. Furthermore, apart

from the fact that some models in the treatise by Maggi and Castriotto resemble Mazagão, references are made to this fortified city. More extensive research will have to be done to be able to conclude where the idea of the 'hybrid' system originates from. It would for instance be interesting to know if fortifications applying this concept, prior to the project of Mazagão, have been executed on the Italian peninsula. The works of Antonio da Sangallo the Younger built in Rome do show that experiments were carried out concerning the idea of a broken curtain. The form and the defence system of this design are however distinctly different from how the 'hybrid' concept would evolve.

In this study it has not been possible to provide a conclusive answer on the question of origin of this concept. Nonetheless, it can be concluded that at least in the period between 1540 and 1570 amongst architects and theoreticians there have been individuals who have preferred this fortification method. This insight has helped to better understand the layout of the São Sebastião fortification which at first glance could not be comprehensively explained. The conclusion formulated in earlier studies that the layout of this fortress contradicts with Italian renaissance theories has to be adjusted. Instead, the inward-bent curtains flanked by bastions can be linked to a niche within the Italian treatise writings. Furthermore, the outcome of this case study focussed on the fortress in Mozambique, might lead to the revision and better understanding of similar designs in other places. As mentioned these are rare, but in addition to what has been discussed in this study, for instance such forms can be seen at the fortification of Philippeville in present day Belgium. In modern literature on this fortification, the slightly inward-bent curtain walls have not been linked to the contemporary writings with a positive tendency towards this layout.<sup>252</sup>

If the defence system, which in this study is called the 'hybrid' layout, would in reality have been beneficial from a military point of view, remains questionable. Advocates of the system believed that if bastion faces would be aligned to the inward-bent curtain, cover along the ramparts could be provided more effectively. Not only would this system enlarge the amount of gun positions that could be used for this purpose, artillery placed on the curtain wall could also substitute flanking batteries if these were under enemy fire. Also it has been argued that lighter weapons, like muskets, positioned on top of the curtain wall would be able to sweep a tenaille front better than if it was built straight. On the other hand, critics emphasised the concave form resulted in a bigger distance between the lines of defence and the curtain. Moreover, the alternative aligning of the bastion faces, which was necessary to enable artillery positions on the wall to play a more pronounced role, led to a more vulnerable salient. Finally, it was argued that constructing non-straight walls was always more expensive than building along a straight line. All in all, judging on the uncommonness of this design concept, the consensus seems to have been that 'hybrid' defence systems were not advantageous. Apparently theoreticians agreed on this issue till such extend, that the setup of an inward-bent curtain flanked by bastion is rarely seen in practice or in literature. As a result, also in modern research this concept is mostly ignored. With this thesis it is hoped that a start has been made to change this situation.

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<sup>252</sup> Drafts for the Philippeville, made by Sebastiaan van Noyen (1555), and ordered by King Phillips II of Spain, show two out of five curtains to be designed concave. His plans have also been executed in this way. Although convincing similarities can be seen between this layout and for instance the writings of Maggi & Castriotto, this link is not made. Instead art historian Charles van den Heuvel notes: *'Het meest opvallend is de knik in de twee resterende lange courtines die zich niet door militaire, noch civiele, eisen laat verklaren.'* Heuvel 1991, p. 100.

In the provisional survey provided on the issue in this study, the impression has risen of a short-lived enthusiasm amongst military theoreticians and engineers for the concept of the 'hybrid' defences. A niche within the renaissance fortification literature has been identified propagating this system between 1540 and 1570. The 'hybrid' concept seems to have been highly controversial, not unlike the way in which the tenaille trace had received a lot of criticism in the time of Pedro Luis Scrivá. However, the latter system would from the seventeenth century onwards become widely practiced, whereas the defence system combining the tenailed system with the bastioned system seems to have been forgotten. Despite the fact that the period in which the concept has circulated amongst architects seems to have been short, it is of unquestionable importance to rightly interpret fortifications which applied the system at the time. The fact that relatively little changes have been made in the initial outline of the São Sebastião fortress at Mozambique Island ensures that this structure still stands as testimony of this approach to military architecture.

## Appendix I: The architect of the São Sebastião fortress

In modern literature it has occasionally simply been stated that Miguel de Arruda (?-1563) has been the engineer responsible for the design of the São Sebastião fortress.<sup>253</sup> Analysing the available historical sources, it however remains debateable till what degree the input of this famous Portuguese architect has been decisive.

The oldest known chronicle describing who would have been the architect responsible for the design of the São Sebastião fortress dates back to 1609 when Friar João dos Santos writes in his *Ethiopia Oriental*: 'It was designed, as was also that of Daman, by an architect who was a nephew of the holy archbishop of Braga, Dom Frei Bartholomeu dos Martyres, of the order of preachers. This architect, when a boy, went to Flanders, whence he returned very skilful in the art, after which he was sent to India by the queen Dona Catherina, when she governed this kingdom, to construct these fortresses. This was in the year of our Lord 1558, when Dom Constantino went as vice-rei to India. Upon returning from India, this architect went to Castile, where he took the habit of the order of St. Jerome, and was welcomed by King Philip II; and many parts of the Escorial were built from his designs.'<sup>254</sup> This description does absolutely not fit with what is known about Miguel de Arruda.<sup>255</sup> The fact that Francisco Pires did go to India where he worked on improvements for the fortifications of Dui, near to Daman, makes it more likely that this text refers to him.<sup>256</sup> However based on this vague source no conclusions can be drawn concerning the involvement of either of the engineers mentioned.

Letters sent between Lisbon and Goa provide more detailed information. In a letter from King João III to Governor João de Castro in Goa written on the 8<sup>th</sup> of March 1546 Miguel de Arruda is mentioned as the architect commissioned. He drew plans using the information of the situation provided via descriptions and drawings sent earlier by João de Castro.<sup>257</sup> Probably de Castro would first have sent sketches of the geographical situation and the place where he suggested the fortress could best be build. Maybe he even included a proposition for a fortification design. Based on this information Miguel de Arruda made a design which was sent to Goa. But because none of the drawings attached to these letters have survived it is impossible to investigate what influence they would have had in practice.

De Arruda was never sent to Mozambique himself. The supervision over the building process would be given to Francisco Pires. As mentioned in chapter one, despite the requests made by the *Capitão* of Mozambique, Pires was employed to improve the defences of Diu and Hormuz instead. As a result at Mozambique progress was slow. Since work on the

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<sup>253</sup> This is for instance stated without any questioning in: Ferreira 2010, pp. 23-25.

<sup>254</sup> 'foi traçada assim ella como a de Damão, por um architecto que foi sobrinho do arcebispo santo de Braga D. Frei Bartholomeu dos Martyres, da ordem dos prégadores; o qual architecto sendo mancebo se foi a Flandres, d'onde tornou grande official de architectura, e depois d'isso foi mandado á India pela rainha D. Catharina, quando governava este reino, para fazer estas fortalezas; o que foi no anno do Senhor de 1558 quando D. Constantino foi por vice-rei da India. E tornando este architecto da India, foi-se para Castella, onde tomou o habito da ordem de S. Jeronymo, e foi mui acceito a El-Rei Philippe II e por sua traça se fizeram muitas obras no Escorial'. Consulted reproduction Theal 1898-1903, vol. VII, p. 130, p. 316).

<sup>255</sup> Viterbo 1899-1922, vol. I, pp. 66-74.

<sup>256</sup> *Ibid.*, vol. II, pp. 299-303.

<sup>257</sup> *Ibid.*, vol. I, p. 71. This correspondence is partly republished in: Lima 1983, pp. 36-40; Dias 2010, n. pag.

São Sebastião fortress only really got underway in 1558, in the meanwhile other plans or modifications might have influenced the design of the project. It seems impossible to tell exactly what role the twelve year old plans made by de Miguel Arruda would have had at this stage. The only argument that might make it more likely that he would indeed have influenced the design at Mozambique could be that strong similarities can be seen with the fortification of Mazagão were he had been involved in five years earlier.

## Appendix II: The history of secondary fortifications of Santo António and São Lourenço

In modern literature some discrepancies exist concerning the history of the secondary fortifications of Santo António and São Lourenço. Different interpretations can be found concerning the development of the first forts on these locations.

That the current two forts date back to the eighteenth century seems clear. The oldest drawing, which partly resembles the present-day structure of the Santo António fort, occurs on a map from 1754 (fig. 5.10). This fort would have been finished during the captaincy of Pedro de Saldanha e Albuquerque which was between 1758-1763.<sup>258</sup> Major repairs and renovations took place in 1820 and 1969 on the church as well as the breastwork, giving it its present occurrence.<sup>259</sup> The building of the São Lourenço fort in its current form was ordered by the *vice-rei* in 1694. Construction started a year later and is believed to have been concluded during the second term of João Fernandes de Almeida as *Capitão* of Mozambique Island between 1712-1714.<sup>260</sup> Although traces of an older fortification were claimed to have been found by the *Comissão dos Monumentos e Relíquias Históricas de Moçambique* in 1945, no comprehensive research seems to have been done.<sup>261</sup> Most authors do not mention the possible presence of any defence structure built on the small island prior to the current fort. An exception forms the monographic work on Mozambique Island written in 1966. Here it is mentioned that the sources about this earlier structure are both little and inconsistent. Nevertheless the author felt confident enough to conclude that the construction of an earlier São Lourenço fortification most probably had taken place between 1587 and 1589 after which it was pulled down by order of the king in 1595.<sup>262</sup> In contrast to this publication, without referring to the previous book, a later monographic study on Mozambique Island initiated by the Aarhus University in 1986 comes to a different conclusion. In this study it is claimed that the São Lourenço Island would have been fortified since 1588. No intervening destruction of this fort is mentioned. According to this publication it was the Santo António fort instead, that after it was built 1587, was demolished in 1598.<sup>263</sup> Due to the poor references provided on this issue in both these studies, it has been impossible to check the historical sources were the conclusions of these publications are based upon.

The available sources on this issue will be re-analysed to come to a solid conclusion. Little historical descriptions seem to exist mentioning the existence of a fort at the São Lourenço Island or near the church of Santo António during the sixteenth or seventeenth century. As mentioned in chapter four, in 1583 Van Linschoten considered the São Sebastião fortress to be the only fortification on the island. Other Dutch reports, made more than twenty years later during the sieges of Mozambique, neither mention the existence of secondary forts.<sup>264</sup>

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<sup>258</sup> Lima 1983, p. 49.

<sup>259</sup> Ferreira 2010, p. 91.

<sup>260</sup> Bragança 1938, p. 172.

<sup>261</sup> Lima 1983, p. 48.

<sup>262</sup> Pereira 1966, p. 225.

<sup>263</sup> Trindade 1986, p. 83.

<sup>264</sup> Kern 1939-1955; Honoré Naber 1930; Booy 1968-1970; Opstall 1972. Only the ruins of the São Gabriel and the defensive function of the Nossa Senhora chapel are named in most of these reports.

However, secondary fortifications are mentioned in letters from the royal court in Lisbon. Both before and after the Dutch attacks, at the beginning of the seventeenth century, King Philip II had repeatedly sent orders to improve the defences of Mozambique Island.<sup>265</sup> Amongst the measures that should be taken was repairing fort Santo António.<sup>266</sup> This order of the king has commonly been interpreted to refer to the fort we call Santo António today. But since maps show both small forts were known by that name during the seventeenth century this could be debated.<sup>267</sup> The description in the letter of the king mentions a fort on the south-western side that should be repaired to defend the entrance of the port.<sup>268</sup> With this the location of the current fort Santo António could have been meant, but also the São Lourenço Island could have been referred to. Anyhow this source indicates there has at least been some sort of earlier additional fort at either of these locations. Historical maps hardly provide more reliable information because of their inconsistency on this issue. In fact different maps attributed to Erédia and Resende only sometimes show forts standing on either or both of these locations. Also it should be realised that these maps could possibly depict former fortification, or might have provided a prospect of plans to rebuild a fort on these spots.

Despite the discrepancies and constrains mentioned here, some preliminary conclusions on the issue can be formulated. Firstly the current forms of fort São Lourenço and Santo António do not predate the eighteenth century, although the idea to add secondary fortifications at both these locations had been made centuries earlier. Letters from the king as well as maps show that these plans at least date back to the start of the seventeenth century. Secondly, based on these plans, claims in modern literature and archaeological findings, it seems reasonable to assume that at least at some point earlier fortifications would have stood at the locations of the two current forts. The question remains however what form these would have had. Considering the little historical sources it seems reasonable to assume that these have been very simple structures. It might for instance merely have been breastworks which could occasionally have provided cover for cannons and musketeers. Even today the Santo António fort comprises of little more than this. While Van Linschoten's and Resende's map do not depict any fortification at this location at all, this image of the fort seems to be confirmed in Erédia's map where a defence wall is drawn next to the Santo António church (fig. 4.7). Likewise the fortification on the São Lourenço Island is also not shown on every map that depicts the tiny island. If the structure is shown, unlike the Santo António fort, it is depicted as a mediaeval tower (fig. 4.7, 4.9). It seems strange that no clear historical notes or descriptions would have survived of such a characteristic building. Moreover it seems unlikely that at the end of the sixteenth century such outdated defence architecture would have been built here. The influential map of Erédia, dating from around 1620, is the first image to show the São Lourenço fort in this form (fig. 4.7). This depiction might very well be best interpreted as an icon of a fortification, instead of a drawing of the

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<sup>265</sup> *Letter from the King to the Vice-Rei, Valladolid, 1604 March 23*, published in: Axelson 1962-1989, vol. IX, pp. 79-83. In this letter reference is made to 'Ilha de São Lourenço' but it seems that not the tiny island that has this name today is meant, but rather Mozambique Island itself.

<sup>266</sup> *Letter from the King to the Vice-Rei, Lisbon, 1607 January 18*, published in: Axelson 1962-1989, vol. IX, pp. 103-105.

<sup>267</sup> This is for instance the case on different maps made by Erédia. See for example figure 4.7 printed in this study.

<sup>268</sup> *Letter from the King to the Vice-Rei, Lisbon, 1607 January 18*, published in: Axelson 1962-1989, vol. IX, p. 105.

actual situation. As has been mentioned in chapter four, this same technique has also been applied with the depiction of the religious buildings on this map. They all look the same and should not be interpreted as realistic depictions of the individual chapels, churches and convents. Nevertheless it seems that this sketch by Erédia has unquestioningly been copied by later mapmakers, which has added to the confusion.

Further archaeological research might be needed to provide a more precise overview of how possible secondary fortifications would have looked in the sixteenth and seventeenth century. Since the defences are only shown on some maps and not even mentioned in for instance the Dutch record of the sieges of Mozambique, it seems that these most probably have not been substantial structures of a permanent nature. No absolute certainty can be given on the issue. But it seems that until the first versions of the current works were built in the eighteenth century, the locations would have been defended merely with occasionally raised breastworks. The strategic location of the two fortifications was undoubtedly already recognised in the sixteenth century, but nothing is found to prove that since then true forts have stood on these locations.



## Glossary

**Angle of the flank:** or angle of the curtain, the angle formed between a curtain wall and a flank of a bastion.

**Angle bastion:** specific type of bastion, originating from Italy. Essential to the outline is that the angled form is designed as an adaption to the lines of defence that can provide cover for the structure.

**Bastion:** or bulwark, a robust platform projecting from the curtain wall of a fortification overlook the surrounding area, designed to provide flanking fire to adjacent curtains and bastions. In Portuguese the word *baluarte* is used.

**Bastioned system:** in this system the angles and dimensions of all parts of the ramparts are adjusted towards one another to form an integrated defence system.

**Battery:** grouped artillery alignment, or fieldwork providing cover for gun positions. This type of fortification mostly comprises of breastworks fitted with embrasures. It can be used temporary to mount siege artillery or permanently for defensive purposes.

**Battlement:** see *parapet*.

**Braça:** a Portuguese length unit used in navigation and building. It equalled 2 *varas* or 10 *palmos*, which is reckoned at approximately 2,2 meters. This system has been in use throughout the Portuguese Empire until the metric system was adapted in the nineteenth century.

**Breastwork:** a cover generally made of earth or stone, thrown up to breast height which provides protection to the gun positions behind.

**Bulwark:** see *bastion*.

**Capitão:** Portuguese military rank used for a commander over a hundred men. Also used as a title for the highest authority at a fortress.

**Carreira da Índia:** name for the sea routes used by the Portuguese connecting Lisbon and Goa.

**Casemate:** a bombproof enclosure with embrasures in the rampart, generally located under the terreplein, for the purpose of housing artillery.

**Cavalier:** a raised platform upon the terreplein. Generally placed either halfway between two bastions or upon one, to obtain extra artillery positions to increase protection.

**Cordon:** a thin shelf of stone that extends out from the rampart where the parapet joins the scarp. It can be built for decorative purposes but also keeps rain from running directly down the walls of the fort.

**Counterscarp:** the side of the ditch opposite to the scarp of the fortification. Slope sometimes covered with stonework, rising from the ditch till the glacis.

**Covered way:** pathway running along the top of the counterscarp, provided with a protective embankment which is formed by the slope of the glacis. Used as defence position to keep the enemy at a distance of during counter attacks.

**Curtain:** or courtine, wall section stretching between bastions.

**Dead ground:** terrain out of reach of artillery fire.

**Demi-lune:** a type of outwork related to the ravelin in which the gorge has a round opening. Mostly used to protect the salient of a bastion.

**Embrasure:** an opening in a wall or parapet through which a cannon can be fired.

**Estado da Índia:** term that not only cover the Portuguese sphere of influence in India, but also conquests East of the Cape of Good Hope. In this network Goa formed the main administrative centre and was the seat of the *vice-rei*. On the African continent Sofala, Mozambique and Mombasa were the three major strongholds.

**Face:** the two outward facing sections of the bastion, between the flanking sections, together forming the salient angle of the bastion.

**Forbici:** see *tenaille*.

**Flank:** the section between the face and the curtain of the bastion, typically providing flanking fire to protect parts of the adjacent ditch, curtain and opposite bastion.

**Flanking fire:** gunfire provided from the flanks of a bastion. Ideally sweeping both the adjacent curtain wall, moat and the face of the opposite bastion.

**Glacis:** a broad, gentle slope, placed on the outside of the counterscarp. Enabling the surface to be swept ideally from the fortress terreplein and decreasing the exposure of the rampart.

**Gorge:** in a bastion, the interval between the place where the two curtains connect with the bastion. This space can either be completely filled in, or left mostly open.

**Half-bastion:** bastion which on the one half exists of a face and flank, while on the other side the bastion forms a straight line, connecting the salient with the courtine.

**Hybrid defence system:** term introduced in this study to describe the rampart outline with an inward-bent curtain, flanked by bastions. This system combines defence technics from the bastioned system with the *tenaille* system.

**Hornwork:** type of outwork consisting of two walls extending from the main fortification, each fronted by a half-bastion. The half-bastions can sweep the short intermediate curtain and the moat.

**Length of defences:** the longest possible line of defence, from the angle of the curtain to the salient of the bastion.

**Line of defence:** a supposed line drawn from the angle of the curtain or any part of the curtain to the salient of the bastion.

**Line of enfilade:** a specific line of defence, a supposed line drawn from the salient, oriented alongside the face of the bastion.

**Lunette:** type of outwork typically placed in front of a curtain inside a ditch. Consists of two faces and two flanks, mostly built to shield the ramparts and enfilade the ditch.

**Machicoulis:** upper-level cantilevered gallery with holes in the floor, allowing objects to be dropped on attackers at the base of a defensive wall.

**Manueline:** architectural style that evolved under the reign of King Manuel I of Portugal (1495-1521), marking a transitory period from Late Gothic to Renaissance. In military architecture of the period the role of artillery was started to be acknowledged, but defences still typically relied on towers and rondelles instead of angled bastions.

**Mestre de obras:** Portuguese title for master mason-architect.

**Mestre das obras Reais:** literally meaning 'Master of the Royal works', used for the architects and engineers who were given the most responsible tasks in service of the Portuguese Crown.

**Orillon:** a semi-circular projection at the shoulder of a bastion, protecting the flanking positions.

**Outworks:** collective noun for defence works built outside the walls of the main fortification but inside the glacis, to provide extra protection and keep enemies at a distance.

**Palisade:** fence or wall of wooden poles arranged vertically or obliquely in a row.

**Parapet:** a breastwork or wall used to protect the defenders on the upper part of the ramparts, either plain or provided with embrasures.

**Pé:** or plural *Pes*, Portuguese foot, would measure about 33 centimetres.

**Rampart:** rampart wall, the elevation to protect the enclosed area from artillery fire and to raise the gun positions for the benefit of the defenders. Thus including walls as well as bastions.

**Ravelin:** triangular outwork typically placed in front of a curtain. To shield the rampart or an entrance gate from direct artillery fire. Also more generally used as a collective noun for pointed outworks.

**Retired flank:** the form of a flank in which the gun positions are protected behind a projected part of the shoulder of the bastion.

**Rondelle:** round low lying bastion, mostly massive. Forming an early adaption of military architecture to cannon fire prior to the angled bastion. To describe this type of bulwarks in Italian the word *torrioni* is used, in Portuguese *torriões*.

**Salient:** in a bastion, the projecting point where the two faces of the bulwark meet.

**Salient angle:** or flanked angle, the angle in which the two faces of the bastion stand.

**Scarp:** the interior side of the ditch, forming the base of the rampart wall.

**Swahili Coast:** East African shore of the Indian Ocean between the Horn of Africa and the Zambezi river. Through the coastal trade network a culture with Arab influences developed here. The word derives from the Arabic *Sawahili*, meaning 'coast'.

**Stellar trace:** see *tenailed system*.

**Tenaille:** a broken front, where two wall sections form a concave angle providing mutual cover. This term of French origin is the now most generally used. In Italian treatises one speaks of *forbici*. Literary these terms could subsequently be translated as 'scissors' and 'pliers', symbolising the defence mechanism.

**Tenailed system:** defence system based on tenaille fronts. In this setup no distinction exists between the flanks and the curtain as in in the bastioned system.

**Terreplein:** a level space on the rampart behind the parapet to use as walkway and gun platform.

**Traditor battery:** gun position set up in a casemate which is hidden, mostly in the gorge of the bastion or within a retired flank. The Italian word *traditore* could be understood as referring to the 'treacherous position' of such a battery.

**Vice-Rei:** the highest Portuguese governmental position in the *Estado da Índia*. Since 1510 the headquarters were located in Goa. Sometimes this position was held by a Governor instead of a *vice-rei*, since the title would not always be awarded by the king. Only in 1752 Mozambique gained its own government, directly responsible to Lisbon.

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- 4.13 Sketch made by author (using data from Google earth).
- 4.14 Facsimile is kept at the *Biblioteca Nacional de Moçambique* in Maputo (Arch. nr. 22.4). Archive referred to on the facsimile, holding the original, is the *Arquivo Histórico do Estado da Índia* in Goa. This now has become the *Arquivos Históricos de Goa*.
- 4.15 Sketch made by author (using data from Google earth).
- 4.16 *Ibid.*
- 5.1 *Ibid.*
- 5.2 *Ibid.*

- 5.3 *Ibid.*
- 5.4 *Ibid.*
- 5.5 Simon Stevin, *Sterctenbouwing*, Leiden 1594, fol. 78. Consulted reproduction: Schukking 1964, p. 214.
- 5.6 Photo by author, April 2010.
- 5.7 Luís Serrão Pimentel, *Methodo Lusitanico de Desenhar as Fortificaçoens das Praças Regulares e Irregulares*, Lisboa 1680, fol. 52 A.
- 5.8 *Ibid.*, fol. 52B.
- 5.9 Anonymous, *Planta da fortaleza de Moss. com as novas obras projectadas para melhor defesa. Por ordem do Illustrissimo Excelentissimo Senhor Marques do Louriçal Vice Rey e Capitão Geral da India no anno de 1741*. Kept at the *Biblioteca Nacional do Brasil* in Rio de Janeiro: Coleção: Livraria do Conde de Redondo, cart. 544106. Consulted at the website of this institute: <http://bndigital.bn.br>.
- 5.10 Greório Thaumaturgo de Britto, *Carta Topográfica da Ilha de Mossambique que por ordem do Illmo. Exmo. Senhor Francisco de Mello de Castro(...) 1754*. Kept at the *Arquivo Historico Ultramarino* in Lisbon. Consulted reproduction: Lima, A.V. de, e.a. (red.), *A Ilha de Moçambique em perigo de desaparecimento: uma perspectiva histórica, um olhar para o futuro*, Lisboa 1983, p. 20.
- 5.11 *Ibid.*
- 5.12 Anonymous, no title. Kept at the *Instituto dos Arquivos Nacionais*, Torre de Tombo in Portugal. Consulted reproduction: Farinha 1987, n. pag.
- 5.13 Nicolo Tartaglia, *Quesiti et inventioni diverse*, Venice 1554, fol. 72.
- 5.14 Giovanni Battista de' Zanchi, *Del modo di fortificar le Città*, Venice 1554, p. 32.
- 5.15 Galasso Alghisi, *Delle fortificationi libri tre*, Venice 1570, pp. 191-192.
- 5.16 Girolamo Maggi & Jacomo Castriotto, *Della fortificatione delle città*, Venice 1564, fol. 54.
- 5.17 *Ibid.*, fol. 56.
- 5.18 *Ibid.*, fol. 83.