

Guarini's models for the drawing of the 'regular fortress'. Comparison with the pentagonal citadels in Turin and Modena.

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3 DEFENSIVE ARCHITECTURE OF THE MEDITERRANEAN XV to XVIII Centuries

Giorgio VERDIANI (Ed.)



DEFENSIVE ARCHITECTURE OF THE MEDITERRANEAN

XV TO XVIII CENTURIES

Vol. III

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Age Fortifications of the Mediterranean Coast
FORTMED 2016

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XV TO XVIII CENTURIES
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Guarini's models for the drawing of the 'regular fortress'. Comparison with the pentagonal citadels in Turin and Modena

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Abstract

The author who has studied on several occasions the relationship between geometry and design in Guarini's work, presented at the last Fortmed 2015 a research culminating in the drawing of a geometric deconstruction concerning the 'regular fortress', a graphic scheme drawn by Guarini in the *Trattato di Fortificatione* (1676), which shows some similarities with the Citadel of Turin depicted in the *Theatrum Sabaudiae*.

The present research arises as a progression of this earlier investigation and deepens, thanks to some refinements of the previous deconstruction and new graphical analyses, the comparison, in terms of shape and dimension, between Guarini's scheme and that of two citadels - Turin and Modena - Guarini certainly knew, both for having seen them directly, and for having examined their representations by numerous drawings and views.

Keywords: drawing, geometry, treatise, graphical analysis.

1. Introduction

The *Trattato di Fortificatione* by Guarini is numbered among the numerous writings that relate to modern fortifications, made necessary, since the fifteenth century, to respond to the innovations in artillery. Guarini himself said that "against the new artillery machines invented... it was necessary... the new art of fighting, pushing back through new findings to fortify, and this is the science that now I am going to expose" [Guarini, 1676, p. 34]. In this context, the greatest attention was paid to the shape of the fortifications, which was related to that of the bastions and the shooting trajectories.

The modern fortifications arise therefore as geometric system, in which the change of an element affects the totality [Fara, 1998, p. 117]. It is perfectly consistent with Guarini's work method, based on geometric

concatenations, already noted by scholars in his most famous works, both theoretical and practical, concerning the civil architecture [Millon, 1970; Portoghesi, 1970; Spallone, 1997].

In the first plate of the treatise, the scheme of the 'regular fortress', based on the regular pentagon, remembers a series of fortifications having the same figure of reference, built between the XVI and XVII centuries (Turin, Mantova, Antwerp, Parma, Ferrara, Modena...). In particular, Guarini has to be remembered as he wrote the treatise while he was in Turin, where he lived from 1666 as an architect, engineer and mathematician for Carlo Emanuele of Savoy and, between 1671 and 1676, he travelled to Modena to deal with the enlargement of the city, called by Duke Francesco II, and the convent of San Vincenzo, at the request of the Theatines.

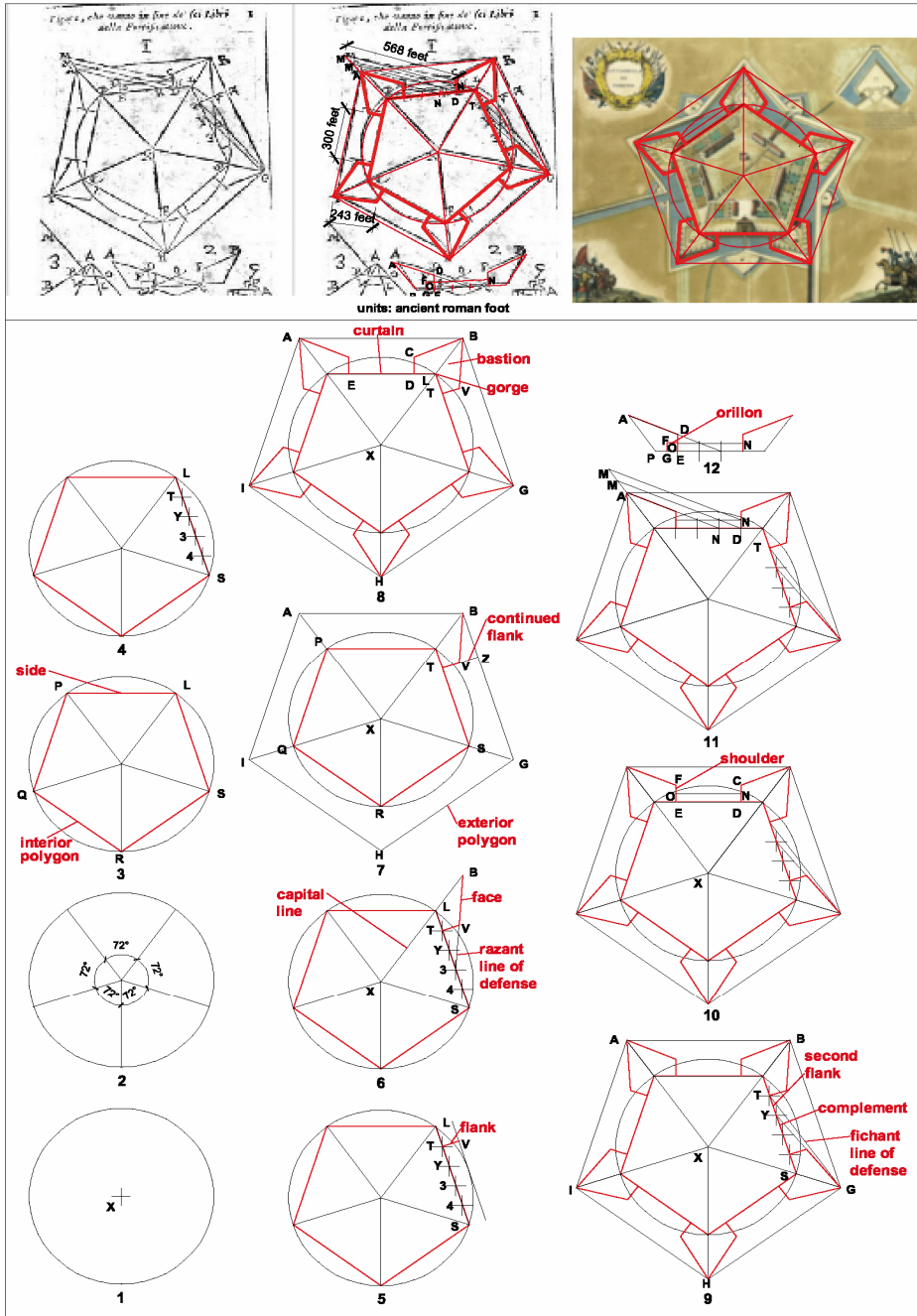


Fig.1- Top: The 'regular fortress' in Guarini's *Trattato di Fortificatione*; overlapping of geometric construction to the treatise and main dimensions; overlapping of geometric construction to the view of Torino's Citadel in *Theatrum Sabaudiae* (1682). Bottom: geometrical sequence of the 'regular fortress' construction. (Drawing and graphic processing by Roberta Spallone).

This paper aims to identify, using the tools of the graphical analysis and history of representation, Guarini's models for the 'regular fortress' and the variants between his theorization and the realized architectures as they appear in several drawings.

2. New geometric interpretations of the 'regular fortress', between architecture, geometry and ballistics

The deconstruction of the 'regular fortress' through a sequence of linked figures, that the author presented at FortMed 2015, allowed to define the nomenclature of the elements described in the text, and led to the discovery of a partial geometric correspondence between Guarini's scheme and the representation of the Citadel of Turin in a view of the *Theatrum Sabaudiae*, probably known by Guarini.

This deconstruction has been refined as a result of further investigation, which allowed to establish a closer relationship between geometry, architecture and ballistics, during the graphic interpretation, and to close further the dimensional values of the geometric construction to those recommended by Guarini.

The steps of deconstruction have been reduced from 14 to 12 and the construction of the shape of the bastions, the center of the interests of the military treatises of the time, was anticipated and related in a more compelling to the rasant line of defense. In Guarini's drawing, this line starts from a third of the curtain and, passing by the flank of the baluard, determines, with the capital line, the face and the vertex, which coincides with one of the exterior polygon vertices.

The rasant line of defense is related to the fichant line of defense that starts from the angle between the curtain and the flank and ends in the vertex of the bastion.

The curtain portion delimited by two defensive lines, represents the second flank that, as recommended by Guarini "you should never leave the wing, or second flank. Because being the first wing mostly occupied by the artillery; if there was not the second flank, a few musketeers would remain to defend the opposite side, with the consequence of a serious danger" [Guarini, 1676, p. 40].

The second flank "allowing the fichant shot on the salient" [Fara, 2013], increased the defensive potential of the fortress, was a central issues of the sixteenth and seventeenth-century debate on the art of fortifying.

The tracing of the regular pentagon could result from the constructions by Tolomeo, Dürer, Galileo [Fara, 2001, p. 151], but also, as stated by Guarini in the treatise, from the subdivision into five equal parts of the angle at the center of the circle.

The defensive line has to consider the musket shot, which does not exceed 750 o 850 feet (about 240 meters), so its dimension has to be within this value [Guarini, 1676, pp. 37-38].

In the new deconstruction by the author, imposing the curtain, the minimum dimension defined by Guarini (300 feet), the size of the face of the bastion which he described as about 240 feet, results about 243 feet, while the maximum defensive line measures about 658 feet. This operation allows to assess the consistency of the overall proportions of the reconstruction carried out and to appreciate the precision of the original drawing by Guarini (Fig. 1).

3. The citadels of Turin and Modena, between research of regularity and experimentation of the second flank

The two buildings considered for the comparison, the citadel of Turin, built between 1564 and 1577 on design by Francesco Paciotto, and that of Modena, commissioned by Francesco I d'Este who called various military engineers, even famous ones [Fara, 2012, p. 7], and realized from 1635, had shapes and dimensions comparable to each other. These two fortifications, no longer existing in their above-ground structures, can be studied using archival drawings and philological reconstructions, not always fully consistent with each other. The archival drawings can witness different stages of the buildings' life, from design, to the execution and modifications, through to the demolition. They are therefore conception drawings, construction and survey. In addition, there are other iconographic sources aimed at encomiastic representations, as pictorial views, at urban expansions, as master plans, at fiscal recoveries, as cadastral maps.

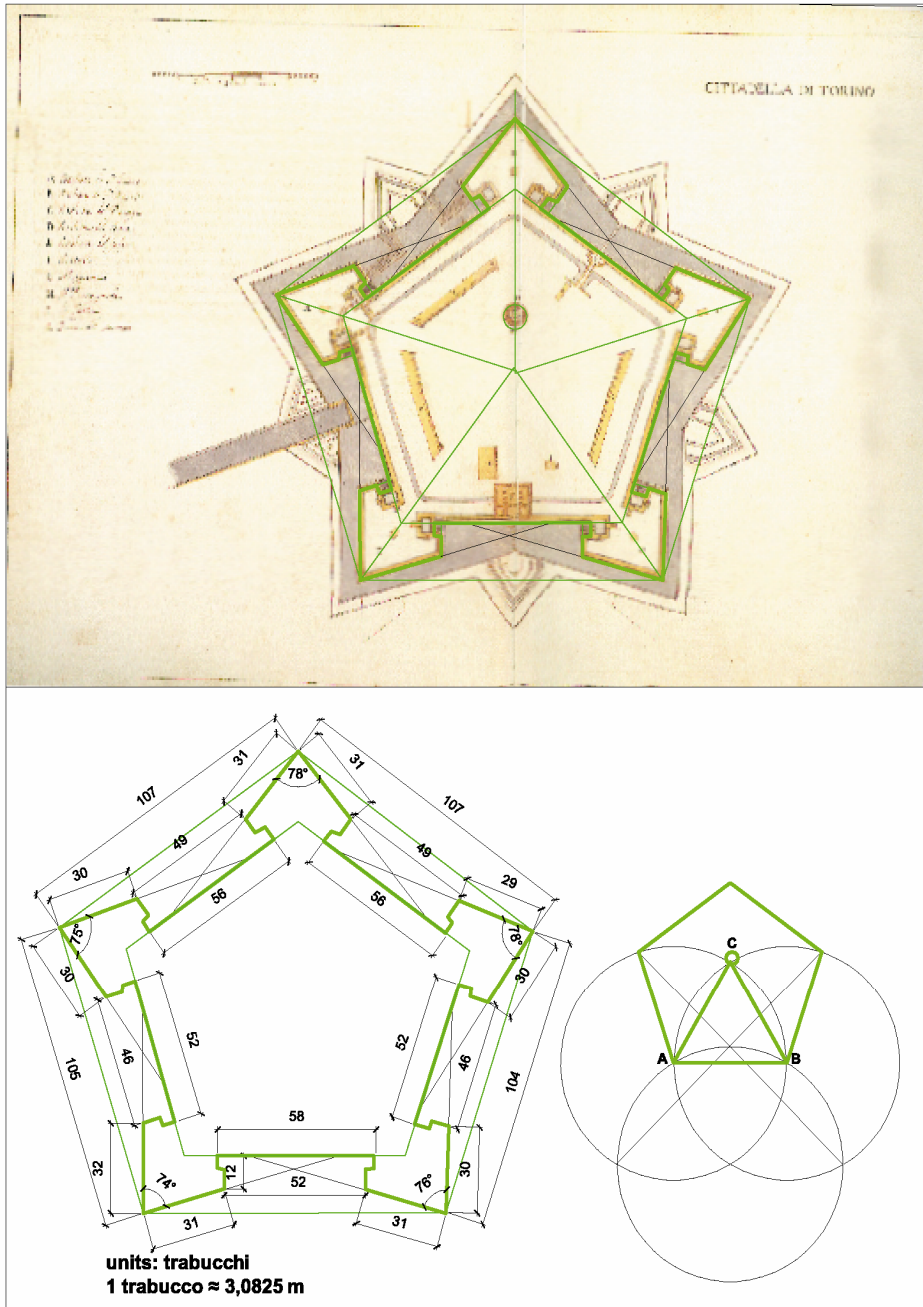


Fig.2- Top: overlapping of geometric construction to the survey drawing of Torino's Citadel by Carlo Morello (1656). Bottom: geometric construction with the measurements of the main part of the fortress; Durer's construction for the regular pentagon and location of the well. (Drawing and graphic processing by Roberta Spallone).

The geometric and metric reliability of such sources should therefore be critically evaluated, taking into account the purpose of the drawing, its scale, and eventual metric survey techniques.

Two drawings of the seventeenth century, among the numerous that document the two citadels, have been chosen; the first, related to the case of Turin, is considered a particularly reliable survey; the other, related to the case of Modena, is one of the final designs.

3.1. Graphical and dimensional analysis of the Citadel of Turin survey, drawn by Carlo Morello

The Citadel of Turin survey is part of the volume in large format (460x400 mm), written by Carlo Morello, *Avvertimenti sopra le fortezze di S.R.A.*, published in 1656. Morello was a military engineer at the Savoy Court that, being old, dedicated his work to Vittorio Amedeo I “with the aim to serve my Prince with the pen, in my declining age, as I served tirelessly with the sword, in my more vigorous years” (Morello, 1656). The experience in military actions and in the design of fortifications and roads stimulated Morello to collect in a codex, which contained drawings and descriptions of the towns and fortresses of the Duchy.

He drew two plans of the Citadel of Turin, one of the whole, the other of the details of a bastion. The description of the Citadel is particularly interesting for the definition of the artifact proportions: “The Citadel of Turin is pentagonal; but not equilateral, having two curtains of a measure, two of another one, and that of the dungeon of another one, which is somewhat longer for defense’s motive; but it is nevertheless true that the dungeon that is in the middle can defend some parts closer; therefore the difference that is between these curtains cannot decrease the fortification of this figure. This plan is the best that could be found...” [Morello, 1656, p. 18].

Morello’s drawing has a graphic scale in trabucchi (60 trabucchi equivalent to 96.5 mm), and had been reduced in about 1:1900. This drawing shows the different measurements of the curtains, verifiable through the graphical reconstruction by the author, which allowed to be traced back to the

measurements of each element, substantially comparable with those stated by Fara [Fara, 2001, p. 160], who attributed the pentagon irregularities to the existing foundations of San Solutore abbey.

The same Fara hypothesized the application of Dürer’s method for tracing the Pentagon, thought as regular, on the ground, as demonstrated by the location of the well at the intersection between the two circles having as center the ends of the curtain side where the dungeon is located [Fara, 2001, pp. 157-160].

The accurate tracing by Carlo Morello also highlights the innovative presence of the second flank, more or less pronounced, on the five curtains, varying in length from about one-fifth of the curtain, almost to zero, along the shorter curtains (Fig. 2).

The graphical reconstruction of Guarini’s scheme, overlapped to Morello’s survey highlights a kind of deformation of the regular pentagon by squashing, which mostly affected the two adjacent sides (about 46 trabucchi) of the longest curtain, where the dungeon was (about 52 trabucchi), while the two sides to the countryside had intermediate values (circa 49 trabucchi). All the main elements had therefore some dimensional changes, except the flank, which was around 12 trabucchi. The most significant difference between the two drawings is, however, the measure of the angle at the vertex of the bastion which had as a consequence the different distances between the interior and the exterior polygon.

In Guarini’s construction this angle had been generated from the tripartite division of the curtain, from which to start the rasant line of defense, with the aim of having a second flank of substantial size, and measured about 64°, compared with 76° on average, in Morello’s drawing.

On the contrary, the encomiastic iconography, as the *Theatrum Sabaudiae*, in which the Citadel view had been engraved from a drawing by Michelangelo Morello (1664), Carlo’s son, but also other drawings of the Citadel with different purposes and less sensitive to the real dimensions, regularized the shape in a regular pentagon similar to that by Guarini, in which only the angle at the bastion vertex varied.

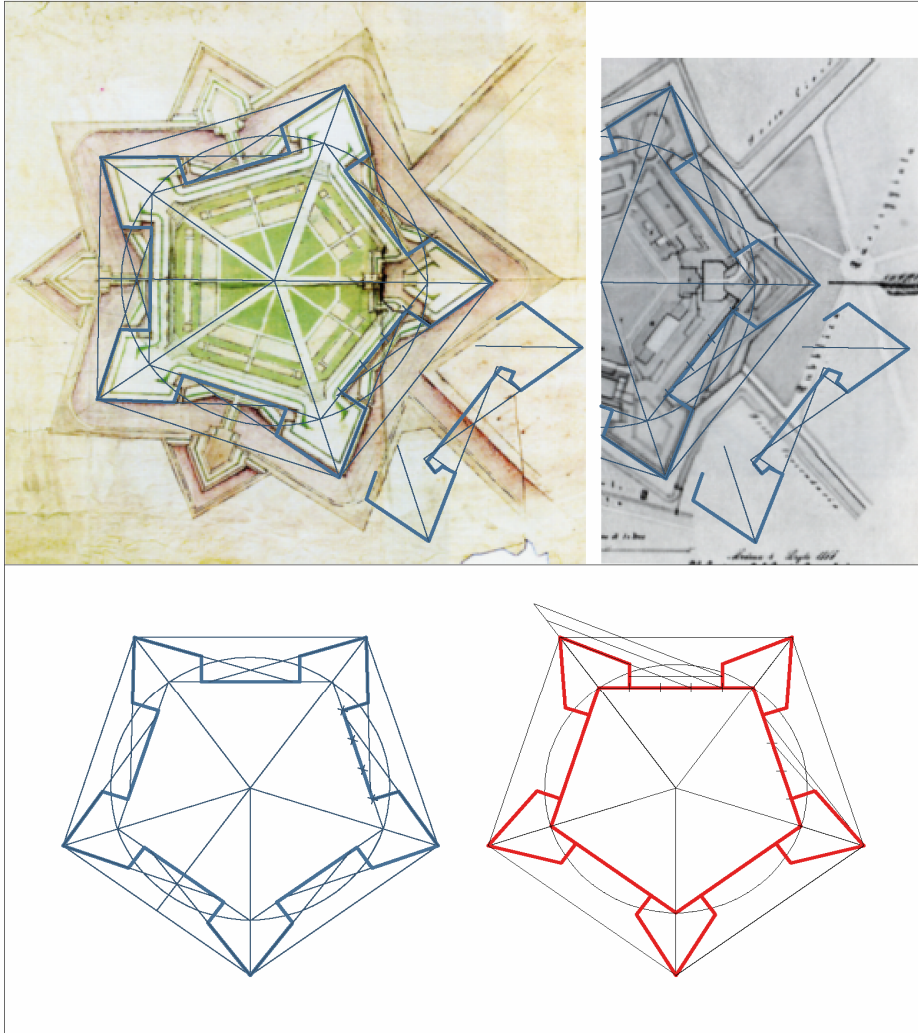


Fig.3- Top: overlapping of geometric construction to the design drawing of Modena's Citadel by Gasparo Vigarani (1636) and to the survey drawing by Vincenzo Pastore (1868). Bottom: comparison between the construction of Modena's Citadel and that of Guarini. (Drawing and graphic processing by Roberta Spallone).

3.2. Geometric deconstruction of the Citadel of Modena design, drew by Gasparo Vigarani

Relations between the Citadel of Turin and that of Modena, about seventy years later, are manifold. Fara remembers that, in 1628, Francesco I d'Este, Carlo Emanuele I's grandson, visited Paciotto's fortification and that Carlo di Castellamonte, engineer active in

Piedmont, had developed since 1629 a design for Francesco d'Este, maintaining consulting relationships with the Duke and creating other drawings and project plans up to 1635, the year of the tracing of the primary boundary [Fara, 2012]. In 1636, Gasparo Vigarani redrew the design, already in the executive phase, by Nicolino Candido.

This drawing, subject of investigation by the

author, presents numerous geometric similarities with Guarini's scheme, and dimensional ones with the Citadel of Turin. For its construction, in fact, you can use steps largely similar to those identified by the author in Guarini's scheme; in particular, the side of the interior polygon, a regular pentagon, can be divided into five equal parts, by identifying the location of the flank of the bastion. The rasant line of defense, however, does not start from the third of the curtain, but from about 1/12, near the corner of the curtain and the flank of the bastion, generating a second flank fairly reduced and an angle at the bastion vertex of about 75° and reducing the distance between the interior and exterior polygon. The

comparison between Vigarani's drawing and the survey, conducted in 1868 by Vincenzo Pastore (Fig. 3), shows a variant during the realization, that is the retreated flanks perpendicular to the defensive lines [Fara, 2012, p. 29]. The graphical analysis of the nineteenth-century survey, drawn in 1:2000 scale, shows that "the curtain reaches the length of 150 meters, while the fichant line of shot extends of approximately 240 meters" [Fara, 2012, pp. 33-34]. These measurements are very similar to those of the Citadel of Turin. In addition, the length of the shot appears to be consistent with the maximum indicated by Guarini in the treatise, as seen above, of about 240 meters (Fig. 4).

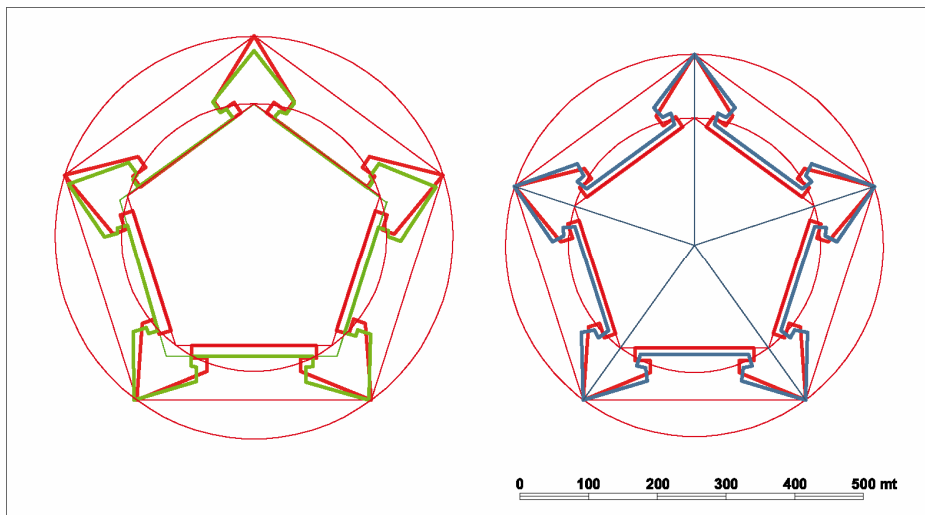


Fig.4- Comparison between the constructions of Turin (in green) and Modena (in blue) Citadels, represented in the same scale, and overlapping of Guarini's scheme (in red) (Drawing by Roberta Spallone).

4. Conclusions

The scheme of Guarini's 'regular fortress' is a major contribution within the culture of the modern fortification.

He stated he did not have any experience of building in this field and "I therefore will offer ancient delineations of Italy, Holland, France, but selected and confirmed by experience, and with the applause of the World, nor I will sell

my fantastic discoveries, but true and bare rule, that the same Fortresses already put in place, and defenses have solidly given birth" (Guarini, 1676, p. 3).

Among these models the citadels of Turin and Modena could be numbered, the first slightly irregular, the second not at all, both presenting the innovation of the second flank and dimensionally comparable.

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