# Chapter 3

# Simon Stevin and his Principles

## 3.1 Introduction

This chapter discusses the mathematician and engineer Simon Stevin (1548-1620) and his Principles. Stevin was a Flemish mathematician and military engineer. He was active in a great many areas of science and engineering, both theoretical and practical. He also translated various mathematical terms into Dutch making it one of the few European languages in which the word for mathematics, *wiskunde* ('the art of what is certain'), was not derived from Greek via Latin. According to Pirlet (2012:9/10) Stevin was, born in Brugge, Flanders (now Belgium) around the year 1548, to unmarried parents, Anthonis (Anton) Stevin and Cathelyne vander Poort. While in his twenties, between 1571 and 1577, Stevin left his native town of Brugge. After having extensively travelled through Europe, in his thirties, in 1581, he moved to Leiden. In 1583, at the age of 35, Stevin entered the University of Leiden. In 1592, as Sarton (1934:244) mentions, Stevin was put in charge of the Waterstaet (waterways) in Delft. In January 1593, upon the recommendation of *stadhouder* (governor) Maurits van Nassau, he was appointed by the States-General *castrametator* (quartermaster general) of the Dutch armies, a position which he held until the time of his death.

## 3.2 Simon Stevin

Stevin, as De Mare mentions (2003:23/24, has been attributed different traits of character by different authors. "A charitable and sober and humane man" (Romein-Verschoor, 1938). "A refreshing way of tackling problems", "Hard working and clear thinking" and "A good-natured and funny guy" (Struik, 1958), "Quite opportunistic, cold-rationalistic and with pragmatic rationalism" (Van Berkel, 1995), "A very utilitarian view"

(Ottenheym, 1989).

Stevin is a *vernufteling*, as De Mare (2003:24) describes, which means he had a sense of ingenuity. De Mare (2003:24) mentions that Hooft[1] invented this term that refers to representatives of the "practical, outside of the universities operating engineering sciences, as a translation of "engineer" a familiar concept at the time. Stevin also distinguishes himself from the humanist scholar who is characterized by universality, who gained knowledge through the study of antique books and refined existing knowledge.

Yet Stevin was, as De Mare mentions (2003:24), characterized as one of the new generation of scientists. Stevin was a pragmatist who did not surrender to philosophical speculations. Stevin hardly referred to ancient philosophers.

In 1580 Stevin published a series of texts, as De Mare (2003:22) mentions, first with the publishing firm of Christopher Plantin than later in Leiden (again through Plantin). These texts were didactic works on mathematics: arithmetic geometry as mechanics (especially statistic), astronomy, hydrostatics, locks, perspective, the organization of the camp and fortifications. Another work was the *Thiende* the decimal notation system introduced for fractures. Stevin also published on accounting, public affairs, logic, *bourgeois* life and set a twelve-tone music system. Moreover he published a defense of the special position of Dutch as a scientific language.

His ideas were laid down, as with other architects and mathematicians, in principles (treatises) and had an influence on the construction (design and planning) of forts in the Netherlands and forts and settlements of the VOC in Asia. Stevin developed a city design in which he has been influenced by ideas of an ideal town according to the principles of the Italian *Renaissance*: the application of arithmetic units and strict

[1] Pieter Corneliszoon Hooft (1581 -1647) Knight in the Order of Saint Michael was a Dutch Historian, poet and playwright from the period known as the Dutch Golden Age.

symmetry and Dutch engineering and fortification works from the sixteenth and seventeenth centuries. Stevin mentions in his Ideal Plan for a City, how he would design a city: the most suitable form would be a rectangular with a division in rectangular blocks of plots, houses, courts and markets. All these had to be in a symmetrical order. There should be a clear positioning of functions and their positioning in the plan. All places should be easily accessible especially by water or by a network of perpendicular streets. The military buildings were constructed like forts with fortification walls, canals, locks, dikes and bridges. Stevin's plan for a town had a central river or canal which formed the primary axis of the ground plan which ran from one side to the other: from the sea to the land behind through the settlement. One side of the settlement (the short side) was parallel to the coastline. On both sides of the town were gates and on the seaside the quays of the inner harbour. On the second axis, which ran at a right angle to the first one, are the most important social and public buildings, including the centre of government, situated. Both axes represented the organizational side of the town. The first one running through the settlement for transport while the other one for its social and public functions.

### 3.2.1 Stevin's views on theory and practice

Some authors claim that Stevin thought, as De Mare (2003:23) mentions, that a practice without theory is impossible while a practice with theory can exist. "Stevin preferred a theory which is fit for practical use" (Van Berkel, 1995). Practice or in his terminology *de daet* was guiding for the theory *de spiegeling*." Stevin emphasized that the usefulness of his theories on military art and architecture tried to optimize by listening to the opinion of people from the military and building practice" (Van den Heuvel, 1995B)

His work lacks philosophical speculations, as De Mare (2003:24) mentions, and "barely refers to classical philosophers" (Kox, 1980). Stevin does not develop any naturphilosophy

of his own as Galileo and Descartes. Yet he was characterized as one of the new generation of scientists. Stevin is a pragmatic who did not surrender to philosophical speculations.

### 3.3 The principles (treatises) of Simon Stevin

De Mare (2003:25) suggests that three issues were related to Stevin's architectural principle (treatise): *Onderscheyt vande ordeningh der steden Byvough der stedenoirdening, vande oirdening der deelen eens hvis Met `t gheene daer ancleeft*. (Designing Cities). One of the issues was the ideal city in relation to practice. The city map was a rectangle with sets of squares, which were separated by a triple channel scheme. Most authors emphasized the simplicity, clarity and the convenience for the tailored shape of the city in the Dutch swampy lands. It also pointed out the basic shape of the square which served as a module in the plan. In the four corners and the centre were a number of localized features, such as markets, churches, a trade fair and a city hall, a school and a prison. On the one hand there was the opinion that Stevin in his drawing retook the old pattern of the chessboard that was already practiced by the Greeks and Romans. There are reminiscences of Dürer's[2] town and other rectangular cities of that time. On the other hand, authors frequently emphasized that Stevin's design anticipated the later twentieth-century town planning, given its formal and planned settlement functions, accessibility and traffic.

The planning and construction of settlements (forts and towns), as Van Oers (2000:78) describes, in the Netherlands were influenced by Simon Stevin. The treatises of Simon Stevin could have had an influence on the construction of settlements in Asia. In 1594 Stevin published a paper on how to build fortresses: *De Stercktenbouwing* (The Art of Fortification). The treatise *Wisconstighe Ghedachtenissen* (Thoughts on Mathematics)

[2] Albrecht Dürer (1471-1528). A German painter, printmaker, engraver, mathematician, and theorist from Nuremberg/ Germany.

was published in 1605-1608 by Simon Stevin. A part of this treatise was named *Huysbou* (House Building). One of the chapters which was originally intended for *Huysbou* was titled: *Materiae Politicae* (Political Subjects). In 1617 the treatise *Castrametatio: Dat is Legermeting* (Camp Measurement) was published. In 1649 after his death his Ideal Plan for a City was published in *Onderscheyt vande oirdening der steden* and *Byvough der stedenoirdening, vande oirdening der deelen eens hvis Met `t gheene daer ancleeft.* (Designing Cities).

### 3.3.1 De Stercktenbouwing

Stevin published in 1594 *De Stercktenbouwing* an architectural theory on fortifications that combines both Italian and Dutch designs. In which he redesigns military fortifications, with a geometric basis, to be adapted to the projectile orbits of the new firearms instead of the old crossbow

Stevin gave in *De Stercktenbouwing* guidelines, as Van den Heuvel (2004:40) mentions, in on the construction of fortresses. There were according to Stevin two kinds of fortifications: fixed fortifications and temporary fortifications in the open field. According to Stevin the fortresses were to be constructed of brick walls although this was unpractical in the wet and swampy Dutch landscape. Walls of earth were easier to build, lighter and cheaper. These were more resistant to the impact of bullets. In the practice of the Dutch fortifications a system developed that was much more focused on the landscape of the Netherlands. In this paper Stevin also gave much attention to the use of water as a defensive system.

A faculty, as Van den Heuvel (2004:40) describes**,** was established in 1600 at the University of Leiden to make engineers more acquainted with fortifications in the open field. The faculty was named of *Duytsche Mathematique* (German Mathematics). The commission to establish such a faculty was given by Prince Maurits. The students were

taught in geodesy[3] and building of fortifications. After the students were familiar with the elementary principles of arithmetics[4] and practical geometry[5] they had to measure and draw regular and irregular polygon (multi corners) figures. They were then sent on fieldtrips to practice and to learn how to place the polygon figures with the help of beacons in the open field. When they had acquired enough knowledge of land-measurement, they had to make models of wood or clay of bastions and entrenchments in miniature size.

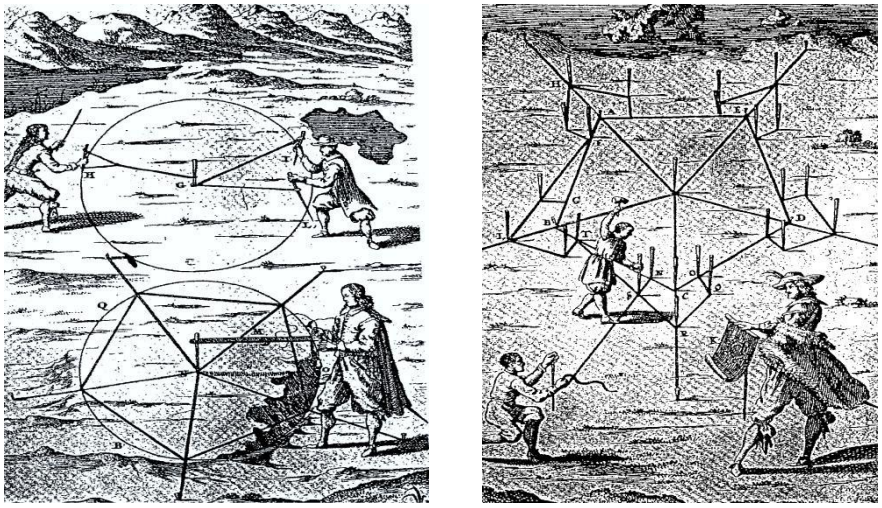

Figure 3.1a and 3.1b: Marking out fortifications in the field using surveyors' poles, Ropes and vanes to produce circles (1a) and pentagons (1b).
Source: Van Oers (2000:74).

### 3.3.2 Wisconstighe Ghedachtenissen

The treatise *Wisconstighe Ghedachtenissen* (Thoughts on Mathematics), as Van den Heuvel (2005:149) mentions, was published in 1605-1608 by Simon Stevin. A part of this treatise was named *Huysbou* (House Building). The principle (treatise) the *Huysbou* is about architecture and urbanism. In this work Stevin presents a number of plans of houses and cities. In his designs of houses he maintains an equilateral[6] symmetry. Stevin places functionality over decoration. The designs for cities, which Stevin describes in this work, are rectangular and surrounded by fortress walls. They are primarily focused

[3] Scientific discipline that deals with the measurement and representation of the Earth.
[4] The most elementary and oldest branch of mathematics.
[5] Is a part of mathematics concerned with questions of size, shape, relative position of figures and the properties of space.
[6] All sides are equal.

on civil functions. The military requirements in the work are of subordinate importance. This is in contrast to his designs in *De Stercktenbouwing*.

One of the chapters which was originally intended for *Huysbou* was titled: *Materiae Politicae* (Political Subjects). Stevin expressed, as Van den Heuvel (2005:185) mentions, his ideas in this chapter on locating all administrative power of a city in one single building. He added that all the governing bodies of the city had to be housed in a palace or *Vorstelyck Huys* (Regal House). Stevin also gave several reasons, why he wanted this stately house to lodge all the officers with their wives and children. One of those reasons to Stevin, as Van den Heuvel (2005:185) describes, was to reduce travel time as well as to save money.

The paper *Huysbou* contains as well, as Van den Heuvel (2005:200) mentions, all kinds of information: it was about the selection of the site where to build a city and on the lay-out of cities. It was also about the lay-out of churches and prisons, as well as of the galleries in front of the house on both sides of the street and the mirror-sided expansion of the town. It also contained, as Van den Heuvel (2005:200/201) describes, information how to keep water fresh, about locks, harbours, water breakers, how to keep smelling canals fresh and how to make diked lands higher in order to prevent the flooding of towns and villages while ensuring that they stayed fertile.

### 3.3.3 Castrametatio

The treatise *Castrametatio: Dat is Legermeting* (Camp Measurement) of Simon Stevin, as Van Oers (2000:78) describes, which was published in 1617, was about composition of an army camp. Principally concerned with the lay-out of an army camp on site. It also contained a description in which way temporary army camps should be designed for sieges. Stevin combined the theoretical examples of the Classical Antiquity, as Van den

Heuvel (2004:41) mentioned, with the experiences of the Eighty Years War[7]. From these experiences, Prince Maurits developed a camp model which was modern for its time. First the Prince had designs made of the lay-out of the camps in the fashion of the Romans but after many complaints from his officers for the too small housing he decided to redesign his camps according to the rectangles of Polybius and other authors of the rectangles of Polybius[8] and other authors of the antique Greek and Roman periods.

The model was empirical[9] in its approach and flexible in design which made it possible for an encampment to be constructed anywhere. All required shelters were set up in squares with a total length of three hundred Dutch feet[10]. Next the width was adjusted to the requirements of the commanding officer or army encampment. The squares were then drawn on scale and moved around on a drawn roster within lines which ran parallel to each other. In between these lines there was space for streets which had a width of fifty Dutch feet. When it was deemed necessary the squares could be made wider or narrower. It was especially the detail for logistics and order which were so characteristic for the designs of Simon Stevin. As Van den Heuvel (2004:42) describes, the longer the army stayed the bigger the camp got and could even grow to become a city. After the army entered the camp it was enclosed by moats (water filled) and bastions at regular intervals. The bastions were placed at each corner of the camp. They extended slightly outside the line of fortifications so there was a better view of the surrounding countryside and along the length of the wall. *Castrametatio* (Camp Measurement) contained lists of everything, up till the last nail, what should be in an army camp. It contained instructions to keep order in the camp, about hygiene, the sale of beer,

[7] The Eighty Years War (1568-1648) was fought because the Northern Netherlands (present day the Netherlands) revolted against the Spanish Habsburg Kings to gain their independence from Spain.

[8] Greek statesman and historian (c 200-c 118 BC). Polybius wrote 40 volumes on the rise of Rome of which only 5 remain in their entity. In some volumes Polybius wrote about wars which were fought by Rome and how they were fought.

[9] Empirical means information gained by means of observation and experiment.

[10] A foot is called a voet in the Dutch language. The most commonly used was the Rijnlandse voet. Which is 0.098596 m2 or 1.0163 sq f.

gambling and the distribution of places where salespersons should sell their goods. The Polish architect Adam Freitag  the author of the *Architectura Militaris or Fortification* of 1630 made a difference between temporary camps for one or a couple of nights, camps for sieges and camps which grew into a city. His book was inspired by *Castrametatio* (Camp Measurement)  by  Simon Stevin. This design, according to Van den Heuvel (2004:43), most likely had an influence on the design of the first VOC settlements overseas.

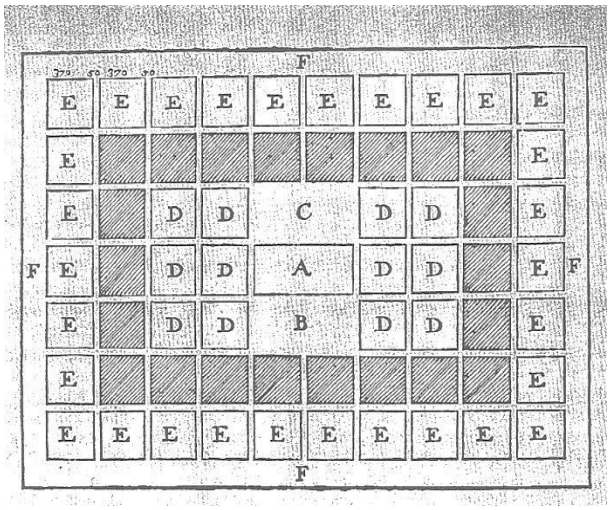


Figure 3.2: Stevin's ground Plan
Roman Army  Camp
Source: Van Oers: (2000:80).

### 3.3.4  Ideal Plan for a City

In his Ideal Plan for a City published, in *Onderscheyt van de oirdening der steden* and *Byvough der stedenoirdening, vande oirdening der deelen eens hvis Met `t gheene daer ancleeft* (Designing Cities), in 1649 after his death. In his Ideal Plan for a City Stevin had developed a city design in which he was influenced by ideas of an ideal town according to the principles of the Italian *Renaissance*: the application of arithmetic units and strict symmetry. As well as by Dutch engineering and fortification works from the sixteenth and seventeenth centuries.

Stevin mentions that: the choice of a specific site to build a settlement depended on certain aspects: It should be able to defend properly, the soil had to be fertile and it

should be located at the estuary of a large navigable river which was essential for trade purposes.

### 3.4 Translation

The English translation of 1604 in manuscript form of the Art of Fortification (*Stercktenbouwing),* of 1594 in James Catalogue at Trinity College Library, Cambridge, United Kingdom has, as Schukking (1964:34/35) mentions, never been printed. This rare 106-page document, most of which in old writing[11], has been found not to be serviceable for the interpretation of Stevin's original text for the non-Dutchmen. This book has been translated not only into English but also in French and German.

The French translation of 1634 by Albert Girard [12] occurring in the *Oeuvres Mathematique* (Mathematical Works) (Work XIII) is, as Schukking (1964:35) mentions, presumably the only one. It in any case the best known. It was used by Mallet[13], as Schukking (1964:35) describes, for the extract in his *Traveaux de Mars* of 1671 (Works of Mars) and was translated back into Dutch again by Smallegange[14], as Schukking (1964-35) mentions, in *Den arbeid van Mars* 1672, afterwards also by Brialmont[15].

Wauwermans[16], however, has, as Schukking (1964:35) mentions, consulted the original Dutch text. The German translator anticipated the French: as early as 1608 the first edition by Gothard Arthus of Dantzig[17] was published at Frankfort-on-the Main; an improved but probably identical reprint, also as regards the dedication appeared in 1623. Perhaps this early translation can be regarded as a result of the respect for Speckle[18], who for Stevin was such an important predecessor and example. The French, it must be

[11] With the exception of the title page, the tabulated classification of the contents, the notes in the margin and the captions and legends of most of the figures, the entire manuscript has been written in the old Gothic script.
[12] Albert Girard (1595-1632). French mathematician and musician.
[13] Alain Manesson-Mallet. (1630-1706). French engineer.
[14] Mattheus Smallegange, (1624-1710). Dutch historian, genealogist and translator .
[15] Henri Alexis Brialmont (1821-1903). Dutch –born Belgian military engineer. One of the leading fortifications engineers in the 19th century.
[16] Lieutenant-General Henri Emmanuel Wauwermans. (1825-1902). Belgian writer. *Etude sure la bibliographie de l'Architecture Mlitaire Flamande.*
[17] Gothard Arthus of Dantzig **(** Dantzig (1570-1630?). German historian.
[18] Daniel Specklin (1536 -1589). German fortressbuilder, engineer and cartographer.

admitted, were not so much in need of Stevin's book: since 1594 or 1600 they possessed Errard's [19] Fortification.

The question why an English translation was so soon made, as Schukking (1964:35) mentions, is not difficult to answer. For in 1604, the year which the manuscript bears, there were still a fair number of English troops in the service of the Republic; the siege of Ostend, in which also commanders and engineers were involved, had just come to an end and until 1609 Britain was to keep the fortresses of Flushing and Brielle occupied. Likewise, it may appear from the History of the Royal Engineers that in those years and even earlier, the English themselves must have been acquainted with the art of fortification in the style of the Italians and their followers Stevin and Speckle.

This is proven by the old town of Berwick, possibly the only town in England which has kept its bastioned fortifications, but also the above mentioned history, which in addition to important data on the construction of these fortresses in the years 1559 to 1563 contains the names of English engineers who were contemporaries of Stevin. Among them is Captain John Paperill, who served as an engineer in the siege of Ostend in 1601-3 and in that of Juliers in 1610. In addition to this engineer, as Schukking (1964:36) mentions**,** his compatriot Raeff Dexter is especially known, and is praised by the authors of the former siege as "the best and most daring of all among the engineers". Could not either of these two, after returning home, influenced by what they had experienced in the besieged fortress have taken an initiative for the translation which had all the features of having made by an expert.

Not only has this engineer translated the Dutch text, as Schukking (1964:35/36) mentions, which was clear to him into English, but – apart from minor licences in style and choice of words which, naturally, he could permit himself – he also made

[19] Jean Errard (1454-1610). French engineer.

improvements among other things by curtailing Stevin's argumentation. The principal of these is no doubt, as Schukking (1964-36) describes, the extra picture of Stevin's bastion included as 9th figure, "Added by the Translator for the better expressinge of the authors meaninge" (added by the translator for the better expression of his meaning). It would seem to us that there was reason for this; in any case, it made for easier reading of the book.

The translation of 1604 does not, as Schukking (164:36) mentions, include the aforementioned dedication of the book to Hendrick van Brienen[20], the end note of chapter 1, on folios 6 and 7, and the "conclusion" on folio 91.

The reason that the ideas of Simon Stevin were not totally implemented is that they were, as Schukking (1964:37) mentions, to expensive for the limited financial means of the republic. The ideas of Samuel Marolois[21] and Adam Freitag were implemented. Indeed, the financial means of the Republic were only just sufficient to apply this very inferior system for the many fortresses they had to build or improved in those years. Prince Maurits will certainly have realized that the design according to Stevin's system with its double walls, revetments[22], very large bastions and three fold-flanks[23], would have made financially impossible demands. Only a century later this system, though of course in a somewhat modified form, was to find application, as appears from the fortresses built under the supervision of Vauban[24] and Coehorn[25] and their contemporaries.

### 3.5 Treatises about Architecture from the Italian Early and High Renaissance

[20] Hendrick van Brienen (1540-1620). Burgomaster of Harderwijk. Member of the nobility of the Veluwe.Councillor of the Court of Gelderland and for many years deputy for Gelderland in the States General and in the Council of State.
[21] Samuel Marolois (1572-1627). Engineer.
[22] In military engineering they are structures, again sloped, formed to secure an area from artillery, bombing, or stored explosives.
[23] To protect the flank.
[24] Menno, Baron van Coehorn (1641-1704). Dutch soldier and military engineer. He made a number of influential weaponry innovations in siege warfare and fortifications techniques.
[25] Sebastien Le Prestre, Seigneur de Vauban and later Marquis de Vauban (1630-1707), commonly referred to as Vauban, was a Marshal of France and the foremost military engineer of his age, famed for his skill in both designing fortifications and breaking them.

In the Italian Early (1400-1479) and High (1490-1520) Renaissance Italian architects wrote treatises about their views of the ideal city. These treatises influenced Dutch engineers and architects. The following architects wrote some of these treatises:

### 3.5.1 Leonardo Bruni[26]

Leonardo Bruni in his *Laudatio Florentiae urbis* (Praise of the City of Florence) (1407), as Eaton (2002:41) states**,** was the first to describe a city as an objective space. Bruni viewed Florence as the perfect city since it represented the city-state which was, in his eyes the ideal form of government. The city surpassed all others in splendour, ornament and cleanliness.

### 3.5.2 Leon Battista Alberti[27]

Leon Battista Alberti**,** as Eaton (2002:49) mentions, in his *De Re Aedificatoria* (On the Art of Building), written in 1452 and published in 1485, that without order there can be nothing commodious, graceful and noble. Alberti explained the types of buildings that suited various functions within society, as well as their positioning and visual ploys that expressed social hierarchy. Alberti, as Rosenau (1959:36) states, dealt with various aspects of the town made a complete ordered listing of buildings, the property for the principal citizens, the middle groups and the common people. Taking Vitruvius[28] work as its point of departure, as Eaton (2002:49) describes, but elaborating upon it, a set off utilitatian and aesthetic principles were established which formed the basis of the ideal order. Although Alberti mingled medieval and Renaissance ideas about civic design in his inclusion of both winding and straight streets. Alberti offered detailed advice and guidelines on how to achieve fine building in keeping with the canons of his period. Explaining that "the principal ornament to any city lies in the siting, lay-out, composition and

[26] Leonardo Bruni (1370-1444). Italian humanist, historian and chancellor of Florence. Bruni is supposed to have been the first modern historian.
[27] Leon Battista Alberti (1406-1472). Italian architect, philosopher, painter, musician and sculptor.
[28] Pollo Vitruvius (c. 80C-70 BC-after c. 15 BC).Roman architect.

arrangement of its roads, squares and individual works; each must be properly planned and distributed according to use, importance and convenience. For without order there can be nothing commodious, graceful and noble". Still continuing medieval traditions, as Rosenau (1959:36) mentions, Alberti is mainly to be remembered as a predecessor of modern functional tastes thus forming a link between the Middle Ages and the contemporary scene. His desire for naturalism in painting and his emphasis on simplicity and moderation, and what he owned to the Vetruvian tradition are characteristics of his age.

### 3.5.3 Antonio di Pietro Averlino (Filarete)[29]

Antonio di Pietro Averlino, as Eaton (2002:50) describes, proposed the first complete ideal city to be built in the Renaissance in his *Trattato d' Architettura* (Treatise on Architecture) written during the period 1457-1464. Filarete did not redesign an existing city he designed a new one. Its radial lay-out was created by the superimposition of two squares within a circle and sixteen radial routes. This is the first known example of the use of the radial plan at this time, and the cluster of squares at the heart of the design is not very satisfactory form a visual point of view. A single building would have worked better and, in fact, Filarete had announced his intention to place a tower in this spot originally (which reminds us of that occupying the central position in certain illuminations of St Augustine's cities). Central observation towers were later to be projected in a number of military schemes during the sixteenth century (for example by Maggi[30] and Castriotti[31]) and we find the echo into the design of the Panopticon[32] at the end of the eighteenth century. For Filarete this would have resolved the aesthetic issue but would not have represented the power structure, and the ambitions of his patron, in a suitable manner, which might be the reason for his abandonment. He thus placed three

[29] Antonio di Pietro Averlino (1400-1469). Averulino known as Filarete (Greek for lover of excellence). Italian sculpturer and Architect.

[30] Annibale Maggi Da Bassano (d. 1509). Italian architect of the Renaissance period. He designed and help build the loggia del Consiglio in Padua in 1493 and was the architect of the house of San Giovanni degli Specchi.

[31] Jacopo Fusti Castriotti, (1501-1563). Military architect.

[32] The Panopticon is a type of institutional building designed by English philosopher and social theorist Jeremy Bentham (1748-1832) in the late eighteenth century. The concept of the design is to allow a watchman to observe (-opticon) all (pan-) inmates of an institution without their being able to tell whether or not they are being watched.

important squares in the centre of the city: one contained the cathedral and the prince's palace, representing religious and secular power, while the other two were devoted to the market and the merchants. Filarete was also concerned by the provision of water and replaced every secondary road by a waterway in this thorough programme which included a mint, banks, baths, schools, prisons, a ten-storey house of 'Vice and Virtue' complete with lecture rooms and brothel, a hospital and cottages for artisans. While very practical in many ways, his design becomes more fanciful at times: his suggestion of a labyrinth to surround the entire city definitely borders on the dystopetian[33].

### 3.5.4 Francesco di Giorgio Martini[34]

Francesco di Giorgio Martini, as Eaton (2002:53) mentions, completed his *Trattato di Architectura* in 1495. The fifth book contains his theories about the modernization of medieval systems of fortification and a proliferation of plans for fortified cities. It opens the path for the increasingly military approach of the ideal-city designers during the next century. Despite its functional aspect, the Sienese author has a highly anthropomorphic[35] vision of his ideal: the fortress is identified with the head, the temple with the heart, the central tower with the stomach or navel, the defensive towers with the superior and inferior extremities and the crescent-shaped gateway with the phallus.

### 3.5.5 Leonardo da Vinci[36]

Leonard da Vinci, as Eaton (2002:54) describes, made several proposals concerning city design in the late fifteenth and early sixteenth centuries. His concern was primarily technical and functional although at least one scheme leaves room for speculation about his

[33] Is the idea of a society, generally of a speculative future, characterized by negative, anti-utopian elements, varying from environmental to political and social issues.

[34] Francesco di Giorgio Martini (1439-1502). Italian painter of the Sienese School and a sculptor and a visionary architectural theorist. As a military engineer he executed architectural designs and sculptural projects and built almost seventy fortifications for Federico da Montefeltro, Count (later Duke) of Urbino, for whom he was working in the 1460s, building city walls as at Iesi and early examples of star-shaped fortifications.

[35] Described or thought of as having a human form or human attributes.

[36] Leonardo da Vinci (1452-1519). Painter, sculptor, architect, musician, scientist, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist and writer.

social considerations. Working at a period when plague decimated the populations of the Italian peninsula (Milan lost one third of its inhabitants in the epidemic of 1484-1485). He experienced a profound disgust regarding the promiscuity and lack of sanitation in the medieval city which he perceived as anarchic and chaotic. The connection of filth with chaos and hygiene with order is a recurrent theme in utopian thinking and will be echoed over the centuries.

The designers of ideal cities invented them, as Eaton (2002:11) mentions, in the conviction that they belonged to an elite capable of understanding the nature of these original patterns and hence of attuning the city as closely as possible to their perfect harmony. Hence the noun: 'ideal' describes that which is presented as the absolute model, a standard of perfection, whereas the adjective 'ideal' whose source is the Latin *idealis*, defines that which is conceived and represented in the spirit, the implied meaning being: that which achieves all the perfection that can be imagined or hoped for, that which cannot be improved upon.

It has been attempted to show, as Rosenau (1959:56), mentions how the *Early Renaissance* freed the concept of town-planning from the medieval, chiefly religious and symbolic interpretation. This was even further challenged during the High *Renaissance*, when, however the concept of unity of the town tended to disappear; the emphasis was then on the individual contribution, based on clarity and accuracy of observation and formal considerations and symmetry.

### 3.6 Dutch Architecture and Town Planning according to the ideas of Simon Stevin

There was a great influence of Simon Stevin's treatises on design and planning of settlements. In his Ideal Plan for a City, published in *Onderscheyt van Oirdeningh der steden*

and *Byvough der stedenoirdening, vande oirdening der deelen eens hvis Met `t gheene daer ancleeft*. (Designing Cities) in 1649 after his death, Stevin had developed a city design in which he was influenced by ideas of an ideal town according to the principles of the Italian High *Renaissance*: the application of arithmetic units and strict symmetry and Dutch engineering and fortification works from the sixteenth and seventeenth centuries.

Stevin's design had an orthogonal (rectangular) street pattern, as Van Oers (2000:11) de-scribes, with buildings for military and civil use. The military buildings were constructed like forts with fortification walls, canals, locks, dikes and bridges.

Stevin mentions, in his Ideal Plan for a City, how he would have designed a city: the most suitable form would be rectangular with a division in rectangular blocks of plots, houses, courts and markets. All these had to be in a symmetrical order. There should be a clear positioning of functions and their positioning in the plan. All places should be easily accessible especially by water or by a network of perpendicular streets.

Stevin's plan for a town had a central river or canal which formed the primary axis of the ground plan which ran from one side to the other: from the sea to the land behind through the settlement. One side of the settlement (the short side) was parallel to the coastline. On both sides of the town were gates and on the seaside the quays of the inner harbour. On the second axis, which ran at a right angle to the first one, were the most important social and public buildings, including the centre of government, situated. Both axes represented the organizational side of the town. The first one running through the settlement for transport while the other one for its social and public functions.

### 3.7 VOC settlements

The choice of a specific site to build a settlement depended, as Van Oers (2000:160/

161) describes, on certain aspects: it should be able to defend properly, the soil had to be fertile and it should be located at the estuary of a large navigable river which was essential for trade purposes. Because there were mostly swampy areas this also gave the Dutch an advantage over other nations because of their engineering skills. Other nations had to build their settlements on higher grounds but the Dutch could build their cities right at the seaside.

A settlement had two distinct axes at right angles of each other: a dominant axis, a canal or river, along which the direction of the development of the entire settlement took place and a secondary one along which the important buildings, spaces and elements were build.

In Roman times these axes were running precisely north-south and east-west and had gates at each end. To this were added the typical Dutch features as a water filled moat around, and canals that run through, the town.

Goods with a destination inland and from overseas had to be transported over the water, through the port, and over the river of the town. The trade of crops and handicrafts was there for prosperous. Money was generated from tolls and assessments. The canals and rivers served more than one purpose other than to pass goods over: it gave a possibility, as Van Oers (2000:81) mentions, to earn a living: fishing. Another aspect, as Van Oers (2000:164) describes, was the storage and circulation of water. Underneath the pavement of the streets there was an elaborate system of sewerage canals for the discharge of refuse and sewage from the houses above.

Canals divided the settlement into four principal identical bands or strips. Every band had a principal lay-out of twenty identical building blocks. Blocks themselves were subdivided in to two times ten identical plots, with their backs to each other. A pattern

of streets and building blocks or housing plots, as Van Oers (2000:82) mentions, was part of the urban structure.

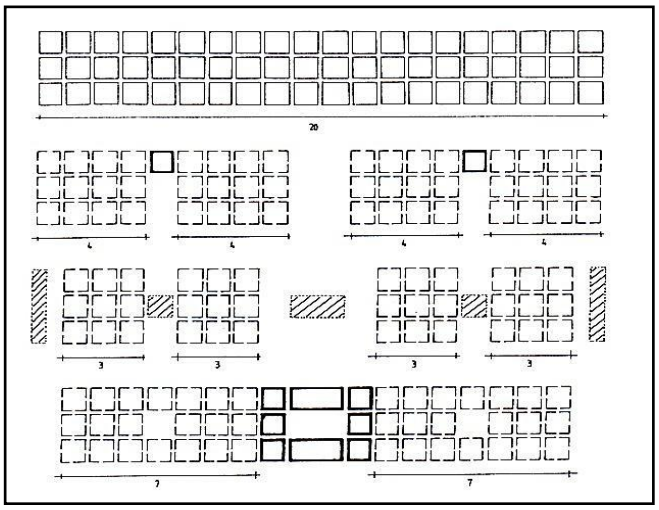

Figure 3.3: The subdivision of a settlement into four bands, these are in turn divided into symmetrical parts by special elements: buildings for social functions (churches, a college, a poor house and public spaces (markets).
Source: Van Oers (2000:82).

Special elements like churches, colleges, poor houses and markets subdivided the bands or strips in symmetrical parts. All buildings were placed symmetrically in the settlement: so is the important *Hoogschool* (High School) on the main canal with on the other side the *Stadthuijs* (Town hall) with the *Armhuijs* (House for the Poor) situated behind it. To make a social distinction between the central part of the settlement and the rest of the city there was a double row of houses built for the labourers at the edge of the town. The streets were sixty feet wide including a separate lane, according to Van Oers (2000:82), in front of the houses so people could easily enter their houses if they were not on horseback or in their carriages, of 10 feet wide on each side of the street. There remained therefore a street of forty feet wide for traffic to pass through. For the housing blocks squares of three hundred and sixty feet were chosen with the two housing plots to be built on these squares back to back.

There were two squares in the centre, as Van Oers (2000:83) describes, of the town. One was called de *Grote Marct* (Big Market) and the other one was for de *Beurze* (Exchange). On the Big Market, which was close to the centre of town, daily fresh goods were sold like: fish, poultry, dairy products, vegetables and fruit. Next to the Big

Market, in the two middle bands, other markets were placed: *Coornmarct, Beestemarct, Houtmarct en Steenmarct.* These were the markets for wheat, animals, wood and bricks.

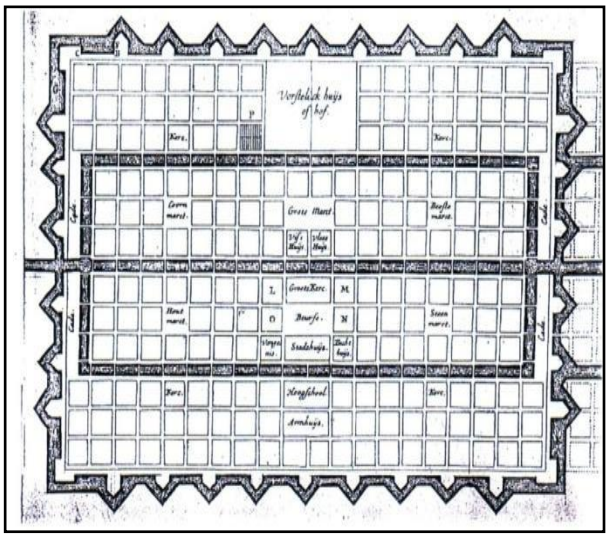


Figure 3.4: Placement of buildings in an Example of an Ideal Plan for a City
Source : Van Oers (2000:80) .

The important factor in the lay-out of the city was that it was all related to the principle of trade. Keeping that in mind the *Vorstelijck huijs* or *Hof* (Royal Palace) was placed at the side of the town. In other, less democratic, countries the royal or the noble court would be placed centrally in the settlement. An important part of a VOC settlement was the social, public and trade aspect. The social aspect was represented in buildings like the *Hoogeschool* (College) and *Armhuijs* (Poorhouse), *Vangenis* (Prison) and *Tuchthuijs* (Reformatory School). The public aspect was to found in buildings like the *Groote Kerck* (Main Church) and the *Stadthuijs* (Town hall). These buildings were all centrally located around and aside the *Beurze* (Exchange). The buildings, which represented the trade aspect of the settlement, as the *Vishuijs (*Fish House) and the *Vleeshuijs* (Meat House) were located aside the Big Market. An important part of the social network and design of the Dutch town was that there should be no sick, begging or needy people be seen in the streets.

Regulations could have been issued on the form and size of the new town, as Van Oers (2000:10) mentions, even what the buildings should look like. To this date, however no

such regulations have been found in any papers of the States-General or VOC. It is not such an unconceivable idea however since everything in Dutch Society was meticulously planned.

The VOC granted other religions, as Van Oers (2000:84) describes, a relative freedom in their settlements. So in the towns of the VOC plots were reserved for churches of other religions next to the centrally located, protestant, church. Religious houses were built for the Jews, Lutherans, Anglicans and Catholics. Regulations stated that houses of worship should not be built in a pompous style so as not to attract overly attention. The whole idea behind this personal and religious freedom in the settlements overseas was really to attract other nationalities who wished to settle because there was a distinctive lack of manpower.

### 3.8 Conclusion

The personality of Simon Stevin is described by different authors as charitable and sober and humane, with a refreshed way of tackling problems, hardworking and clear thinking, as good-natured and funny, opportunistic, cold-rationalistic, as having a pragmatic rationalism and with a very utilitarian view.

Others say that his work lacks philosophical speculations. Stevin hardly refers to classical philosophers, does not develop any naturphilosophy of his own (such as Galileo and Descartes), yet he was characterized as one of the new generation of scientists. Stevin is a pragmatist who did not surrender to philosophical speculations.

Simon Stevin published several treatises. In 1594 Stevin published *De Sterctenbouwing* (The Art of Fortification), in which he gave guidelines on the construction of fortresses. The treatise *Wisconstighe Ghedachtenissen* (Thoughts on Mathematics) was published in 1605-1608 by Simon Stevin. A part of this treatise was named *Huysbou* (House Building). One of the chapters which was originally intended for *Huysbou* was titled:

*Materiae Politicae* (Political Subjects). Stevin expressed his ideas in this chapter on locating all administrative power of a city in one single building. The treatise *Castrametatio: Dat is Legermeting* (Camp Measurement) which was published in 1617, was about the lay-out of an army camp. It also contained a description in which way temporary army camps should be designed for a siege. In his Ideal Plan for a City published, in *Onderscheyt van de oirdening der steden* and *Byvough der stedenoirdening, vande oirdening der deelen eens hvis Met `t gheene daer ancleeft.* (Designing Cities), in 1649 after his death, Stevin mentions that the choice of a specific site to build a settlement depended on certain aspects: It should be able to defend properly, the soil had to be fertile and it should be located at the estuary of a large navigable river which was essential for trade purposes.

The English translation of 1604 in manuscript form of the Art of Fortification, 1594 at James Catalogue at Trinity College Library, Cambridge, United Kingdom has never been printed. This rare 106-page document, most of which in old writing, has been found not to be serviceable for the interpretation of Stevin's original text for the non-Dutchmen.

There are several treatises from the Italian Early and High *Renaissance*: Leonardo Bruni in his *Laudatio Florentiae urbis* (Praise of the City of Florence) (1407) described Florence as a model of an ideal city of justice, a city well ordered, harmonious and beautiful. Leon Battista Alberti stated in *Re Aedificatoria* (On the Art of Building) published between 1452 and 1485 his aesthetic and moral values, of his ideal city, quite clearly. Antonio di Pietro Averlino (Filarete) proposed the first complete ideal city to be produced in the *Renaissance i*n his *Trattato di architettura* (Treatise on Architecture) written during the period 1457-1464. Francesco di Giorgio Martini completed his *Trattato di architectura* (Treatise on Architecture) in 1495. The fifth book contains his theories about the modernization of medieval systems of fortification and a proliferation

of plans for fortified cities. Leonard da Vinci made several proposals concerning city design in the late fifteenth and early sixteenth centuries. His concern was primarily technical and functional although at least one scheme leaves room for speculation about his social considerations

There was a great influence of Simon Stevin's treatises on design and planning of settlements. In his Ideal Plan for a City published, in *Onderscheyt van de Oirdeningh der steden and Byvough der stedenoirdening, vande oirdening der deelen eens hvis Met `t gheene daer ancleeft.* (Designing Cities), in 1649 after his death, Stevin had developed a city design in which he was influenced by ideas of an ideal town according to the principles of the Italian High *Renaissance*: the application of arithmetic units and strict symmetry and Dutch engineering and fortification works from the sixteenth and seventeenth centuries.

VOC Settlements had a rectangular street pattern intersected by canals and surrounded by fortification walls and a water-filled moat. The sense of proportion was well balanced in the width and accessibility of the streets and the building blocks at the side of the streets. All elements in the town were fixed with a specific social and public aspect.

Secondly there was the architectural side of the city: with a fixed system of measurement of *facades*, building height and style. There was a central market, which was placed in the centre of town and there were local markets which were at the side of the centre. There was a main church, in the centre of town, and secondary churches, which were again more out of the centre of town. A settlement was there for logical and symmetrical in design.

Thirdly the city could be easily expanded, if necessary, on all sites as with the army camps in the Netherlands. Another fortification wall could be erected and another water

filled moat could be dug. In the newly open space houses and public buildings could be built. There for a settlement designed by Simon Stevin was like a do-it-yourself kit and could be constructed anywhere. A VOC settlement in Southeast Asia there for would be and will be immediately, recognizable and identifiable.