VISUALISING CASTLES

Representations in 3D of castles in the Duchy of Holland during the period of 1300-1700

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How 3D modelling can contribute to understanding Dutch castles in the regions of Delft, Haarlem and Zoetermeer.

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0 Acknowledgment

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1 Introduction: castles in 3D

The primary avenue of archaeological inquiry concerns the study of material cultures and how they develop, evolve and change over time. When one considers the study of material cultures one would generally think of ceramic vessels, ‘art styles’ and ‘ritual objects’. The structures past societies constructed are, however, also a form of material culture as structures like artefacts reflect the culture that developed them.

The study that focuses on the examination and investigation of historic structures is generally identified as ‘construction history’. Within the sub discipline of construction-history, researchers seek to understand how and why past structures were constructed the way they were as a means of attaining a greater understanding of the cultures that constructed them.

Some of the most significant historical structures in the Netherlands are the medieval castles that were built throughout the Netherlands in the medieval period. In the Netherlands, castles have been studied through archaeological, historical and art-historical approaches. These approaches have thus far resulted in the conclusion that castles developed in numerous ways. One of the limitations on construction-historical research on Dutch castles is the fact that only the foundations of many of the Dutch castles remain. As a result, archaeological research can only yield us a limited amount of information about these structures.

3D modelling may, however, alleviate this deficiency when applicated in conjunction with other sources. This thesis will approach the Dutch castles by combining archaeological data, historical texts, past paintings and drawings to arrive at a comprehensive visualization of what these castles probably looked like based on the sum of sources available to us.

This thesis aims at visualising four largly demolished castles in order to study the construction history of each building. Currently, there is little information on how the general construction history of castles developed. With this research it is possible to study the construction history castles, and create a comparison. With such a comparison, new new information on how the construction of castles developed through time can be acquired.

In this thesis, the focus will be placed upon the castles that can be dated to the 1300 and 1700 as few castles are known as 1200-1300 is generally agreed upon as being the period during which castles first appear throughout the Netherlands. The first drawings of Dutch castles appear from 1300 and onwards making the period between 1300 and 1700 ideal for the study of the construction history of Dutch castles.

By modelling the building sequence of several castles, a comparison can be made of the construction history. To make a meaningful comparison the compared structures must be similar to one another in one or more dimensions. This implies that the castles we compare need to be similar in terms of status of the inhabitants, region, age and function. By comparing these with one patterns and correlations can be discerned.

Discovering such a new general pattern within the construction history of Dutch castles would provide us with greater insight with regard as to how the Dutch castles developed as they did.

1.1 What are castles?

Although castles have long been subject to archaeological- and historic research, the exact definition a castle remained undefined until 1996 (Besteman and Sarfatij 1977, 166). At this date, a description is formed, which is both useful and largely agreed upon by archaeologists (Janssen *et al*. 1996, 15). Jansen describes a castle a defensible structure that is or can be utilized as living accommodation. (Janssen *et al*. 1996, 15).

The term defensible is always subject to change, as new developments in the ways through which warfare was conducted resulted in changing meaning to what constitutes defensible and what does not (Janssen *et al*. 1996, 15-16). When the term castle is mentioned in this research, the description of Janssen is used.

Castles are thought to be constructed and inhabited by persons of nobility (and their servants) (Bult 1988, 126). Such persons possess a high social economic status, as the right to fortify structures was a privileged to nobility (Bult 1988, 126). This is the reason why researchers assume that the social economic status of the main inhabitants of sites is crucial to determine whether a medieval structure is a castle or not (Bult 1988, 126). Members of nobility needed an income high enough to cover their expenses, which came from farms, lands, and taxation rights the members of nobility possessed (Bult 1988, 127)

Yet where can we expect to find castles? The location of such structures is assumed to be either near waterways or roads or in the middle of the land, which is the property of the noble inhabitants (Bult 1988, 127; Voskuil 1979, 21-22). Both choices are expected to be related to the function of the castle. If the structure is near roads or waterways, the castle can oversee, control and tax them. When the inhabitants of the castle possess land for agricultural exploitation, the structure is located in the middle of the land, for the task of overseeing it (Voskuil 1979, 21). A third explanation is that castles were located near the boundaries of political entities in order to defend those boundaries from outside enemies.

Castles are not a uniform type of structure as their appearance is subject to a certain degree of variety (Janssen *et al.* 1996, 15). The variations in shape allow no generalisation on how an “average” castle appeared. There are, however, common elements that form the essence of what does and does not constitute a castle such as a moat and towers. A common lay out is a moated island, or a terrain surrounded by a wide ditch. In general a hall- or tower is positioned into one of the corners of this terrain, with an entrance at the opposing side. Yet the shape of these elements differs from castle to castle. A comparison in the general construction history can be made, be creating four castles in 3D. The aim of such a comparison is to observe if there is a common sequence in the construction history of four castles in the same period and region, created by families belonging to nobility, and constructed with the same purpose in mind.

Within Dutch medieval archaeology, the term moated sites is often used when castles are discussed. There is an ongoing debate on the description of this term. According to Janssen a moated site is a building which is defensible and has living accommodations (Janssen *et al.* 1996, 96). The moat on would render such a building defensible.

Bult on the other hand describes moated sites as all buildings which is surrounded by a moat (Bult 1987, 22). The level of agrarian, defensible and living

accommodations, which these buildings possess, can only be determined by extensive research.

A moat needs to possess a certain width to be considered defensible, and not just for the functional use of water availability. This width is circa 4-5 meters (Bult 1988, 126). A moat with such a width is a hindrance for agrarian functions, but is considered defensible (Janssen *et al.* 1996). Furthermore, a moated site often has an agrarian function, which is why in general, a farm in close proximity (Janssen *et al*. 1996, 96; Bult 1988, 126). Yet what about the term castle outside the Netherlands?

1.2 Castles outside the Netherlands

The Dutch term for castle differs in other countries. In places close by such as Germany, England and Belgium, the term has similarities, yet differs in meaning. The German term is for instance is made of two parts, a Turmhaus, or tower house by Bleyl (Blely 1973, 4). When a tower is connected or part of a larger structure, the term Turmburg is used (Knappe 1991, 14). Then the researcher Albrecht argues that castles developed from halls during the 11th-12th century (Albrecht 1995, 47).

The German term for castles refers to a tower, designed as living accommodation. When the tower is part of a larger structure, or is surrounded by walls, the term Turmburg is used.

Within Belgium, there are two definitions of a castle. Within Flanders, Van Hemelrijck made a typology based on chronology, yet no real description is given (Van Hemelrijck 1950, 118). The description of Doperé and Ubregts on castles and especially towers offers a description. Doperé and Ubregts describe a tower as a square, rectangle, circular or polygonal towers, in which different rooms are placed on top each other (Doperé and Ubregts, 1991, 93).

In Wallonië, Belgium, towers are described as the aspect of displaying dominance and status, defensibility, and living accommodation (Genicot *et al.* 2002, 223). Towers are in general built in Roman style, and decorations were introduced as late as the 14th-15th century (Genicot *et al.* 2002, 223). The presents or absence of other buildings, such as outer walls, gatehouse or additional structures is not of importance for the terminology. These castles were designed as a hiding place, and the defensible elements were designed to withstand a short lasting siege (Genicot *et al*. 2002, 223).

Furthermore, these towers appear to be quite similar in terms of dating, design, and size to Dutch castles (Genicot *et al.* 2002, 223). One of the most prominent changes however is the use of natural stone in Belgium, rather than the bricks, used in castles from Holland (Hermans 2013, 29).

The term for castles in England and Scotland differs from the previously mentioned descriptions. Simpson describes a castle tower as a Hall-house, in which rooms are placed above each other to increase the defensibility (Simpson 1961, 232). Cruden on the other hand describes a continuity between early towers, keeps and tower houses (Cruden 1960, 103-104). Until the 17th century, towers were the common type of castle in Scotland (Cruden 1960, 104). The construction of larger castles was in the hands of the restricted by royal decree (Hermans 2013, 32). This was in part caused by the wars of independent, which gave the English

monarch extensive power in Scotland and a deterioration of the economic situation (Cruden 1960, 104; Simpson 1959, 10).

The English term for castles does not offer a clear description on the building itself. While in Belgium and Germany, towers are the aspect on which a structure is characterised in descriptions. In England and Scotland there appears to be no clear description what elements such a structure possesses.

1.3 Duchy of Holland

Most castles in the Netherlands are found throughout the region of Holland as Holland was one of the most economically developed parts of the Netherlands in the terms of trade and production of economic value during the period from 1400 and onwards. This period of economic development was accompanied by the development and construction of several castles throughout the region with most of these castles having been dated from 1300 to 1700 It is believed that castles were one of the most significant means through which the nobility displayed and reinforced its status and prestige.

In the Netherlands, Holland nowadays is a province, yet in the past it was an Duchy that shows a high amount of economic development in terms of trade and production during the period from 1400 onwards (Israel 1999, 2-14). The period of interest on which this research in this region focusses ranges from 1300 until 1700. During this period, castles are one of the most critical means through which the nobility displayed its status. Furthermore, castles are an integrated part of the settlement pattern within regions, and are positioned at the top of the social hierarchy of agrarian settlements (Bult 1988, 126).

Since the period from 1300 to 1700 was a period that saw many political and economic developments such as the transition from the Netherlands as part of a larger kingdom into an independent republic as well as its associated conflicts such as the Eighty Years War (1568-1648). One could thus expect that the many political and economic developments that defined this period are also reflected by the castles we find throughout Holland.

Land in Holland belonged to several owners, such as the count of Holland, whom received the right of the royal regalia to the lands between the rivers IJssel and Lier in 985 (Koch 1970, 55). This right made the count of Holland an important figure, yet several parts of land had local rulers as owners because they were already in a process of reclamation and some even had settlements (Bult 2014, 128; Henderikx 1987, 46). During the 1300-1700 period, this situation had changed.

Local nobility needed land as a status symbol (Bult 1988, 127; Voskuil 1979-21-22). This status symbol included having a residence, which was “defensible” (Janssen *et al.* 1996, 17).

During this period, “defensible” describes a building, which has the following elements (Janssen *et al.* 1996, 16):

- A moat, at least four meters wide;
- Towers;
- A drawbridge;
- Walls made of stone or brick with a thickness of 40 cm or more;
- In addition, castles usually had a large central tower, keep or hall.

While the land was formally given to local nobles by the count, the procession of land by both urban citizens and local religious institutes were increasing in this period (Neefjes 2018, 45; Rijksdienst voor cultureel erfgoed 2018, 7). In addition, local farmers often possessed the lands they worked on.

These elements made the structure appear defensible, yet in reality, several of these elements have been outdated since the introduction of gunpowder as cannons could easily penetrate the often relatively thin castle walls we find throughout the castles in Holland (Janssen *et al*. 1996, 17).

1.4 The defensive function of castles

While Janssen emphasizes that castles possess a defensive function, this function decreases during the 15th century (Janssen 1981, 302). The technological evolution concerning the artillery, lead to the development of cannons that were capable of demolishing castle walls (Janssen 1981, 302). A castle, however, was still defensible enough to withstand mobile bands of raiders in the 15th century (Janssen 1981, 302). Yet, the moment a determined enemy possessed only one cannon, castle walls proved to be obsolete (Janssen 1981, 302). A 15th century cannon was capable to shoot through a wall, such as occurred to the castle of “De Haar” in 1482 (Janssen 1981, 302).

By the 17th century the purpose of castles had evolved to being either little more than a luxurious residence for nobility, or they had been repurposed in so called artillery fortresses which utilized gunpowder based weaponry to defend themselves.

In the 17th century castles either became luxurious residence for nobility, or an artillery fortress. When an owner chose for luxury, elements such as a moat, drawbridge and battlements needed to be either preserved or added, in order to be recognized as a defensible structure (Enenkel and Ottenheym 2017, 248-249). Examples of such castles are Oudegein and Rijnhuizen (Enenkel and Ottenheym 2017, 249).

When a castle needs to retain a defensive role, the structure is transformed into an artillery fortress. Thick earthen dikes/walls with incorporated round brick towers were the first means with which castle owners tried to make their possessions defensible against cannons (Janssen 1981, 302). Later defences were completely constructed out of bricks (Janssen 1981, 302). The original castle receives the purpose to house the garrison (Janssen 1981, 302). Gradually, castles develop into artillery forts, in which artillery can play a passive and active role in its defensive role (Janssen 1981, 302). A star like design of the earthen dikes and later brick walls enables the defensive and offensive use of canons (Janssen 1981, 2). An example in the Netherlands is Loevenstein (Janssen 1981, 302).

Land was a symbol of status during the period of interest (Bult 1988, 127; Voskuil 1979, 21-22). These families constructed houses and buildings that were defensible on the purchased land, in order for recognition and to emphasizing nobility (Bult 1988, 127). People that did not possess the status of nobility did not have any defensible features, such as moats or towers attached to their houses (Janssen *et al.* 1996, 96).

During the first half of the 17th century, the change of hostilities within Holland dropped, and the war with Spain was coming to an end (Meischke 1981, 270). For

castles, the period of 1610-1650 was characterized by restoration and maintenance (Meischke 1981, 270). Yet, castles were not restored according to their older building-style (Meischke 1981, 270). Instead, the modern architectural style of the period was applied, which could consist of a Gothic and/or Classical or a combination of both elements (Meischke 1981, 270). This indicates that the images of castles dating from the period 1610-1650 often do not indicate to original castle, but a restored version (Meischke 1981, 270).

1.5 The issue with castles

While castles in Holland are an area of great interest, researching them is hampered since a vast majority of castles are partly, or entirely destroyed. Frequently, the foundations of the castles are all that remains and sometimes just only the moat is what was left of the site. Since only the foundations of the castles remain, researchers have to resort to the study of past paintings and drawings to gain insight as to the appearance of the castles.

The introduction of 3D modelling in archaeology allows the partly- or entirely visualisation of destroyed structures. This method proved to be useful for presenting what is already known (Box and Draper 1987, 74). An example to the benefits of 3D is the presentation of the interpretation of the appearance of a structure (Hermans 2013, 48). This new method of visualisation can be used to display changes in the architectural appearance of a structure. In combination with historical data, it becomes possible to trace what kind, the nature of and the date that changes in a structure occur, and compare different buildings with each other. Changes in the structure may be discerned in ground plans. In addition, changes in castles can be depicted on paintings and drawings. These two sources allow us to draw a more complete image of the historic structures.

One issue with regard to this methodology pertains the reliability of the paintings and drawings of the castles. Images of castles are often created on purpose for collectors (Hermans 2013, 42). Currently, we are unable to ascertain as to how accurate and how veracious these drawings and paints are to the castles they depict. To ascertain the degree of accuracy of the drawings and paintings, we approach the archaeological record and use it as a foundation to build a reliable digital model. The paintings of the castles can be used to estimate the dimensions of the windows and the roofs of the castles, while the publications provides information pertaining to the specific features that castles may have possessed.

This raises the question of how reliable paintings and drawings are for research. A method to detect what the level of correlation between the ground plans and paintings/drawings is to create the building in 3D. By comparing the information both sources offer, the contradictions between sources can be visualised and observed. It becomes possible to compare which painters created reliable representations of castles.

1.6 Comparing models

While the archaeological information is displayed alongside paintings and drawings in 3D software, how can comparisons between castles be created and how to detect correlation? If the paintings and drawings are reliable, the ground plan, elements as the shape of walls and towers correspond on both sources. If both correspond, it becomes possible to observe what the paintings and drawings display what is missing on the ground plan.

It occurs that a wall or a roof does not connect to the outlines of buildings displayed on the ground plan. The greater the number of such in corrections, the lower is the level of accuracy in the paintings/drawings. Such a comparison gives an indication on the amount of accuracy paintings and drawings provide within Holland from 1300 until 1700.

In addition to observing correlation, 3D can be used for comparing the castles with each other. Such a comparison could visualise a common pattern in the construction history of these buildings. For instance, what architectural changes occur to a castle throughout time?

For a good comparison, the historical data of several castles are not enough. The ideal approach would constitute the comparison of visualizations of castles with the available historical and archaeological data. While these comparisons can be made using ground plans, paintings and drawings the issue with reliability, and the fact that many paintings/drawings are created on order are reasons to doubt the objectivity of these latter sources.

Ground plans on the other hand give an accurate and precise description of the foundations, and often with measurements of the situation in real life. The variables for the height of a building are difficult and often impossible to interpret based on the ground plans. This means that the archaeological data is incomplete for a visualisation and comparison. To deal with the lack of height dimension from the archaeological data, the general height of castles will be implemented as a standard. The general height of castles in South Holland is described in a PHD study of Hermans (Hermans 2013).

With the use of 3D modelling the information of both paintings/drawings, and the ground plan of a building can be implemented. Another feature that 3D modelling offers is the ability to change heights of objects, and implement textures.

The use of 3D modelling can be beneficial, yet there are a number of disadvantages that need to be taken into account. The visualisations that are produced are plausible images of the past. A realistic image would imply that the primary source is the real and intact building. As only the foundation is still present and sources as images and historical text are necessary, a model is considered plausible. By implementing the archaeological and historical data, a model can be considered to achieve a higher level of accuracy. The element of height needs to be implemented, yet to gain a plausible estimation of the height; the general height of case studies need to be taken into account.

The main issue with a model of castles is the large amount of variations in both shape, terms and function (Janssen *et al.* 1996, 17). Castles have a number of traits in common, such as elements that make them defensible, and the layout of the living quarters. Castles change through time. These changes can be visualise in 3D, to reveal parts of the construction history of castles.

To detect what architectural changes occur, observing and creating an overview of different stages of castles is necessary. This can be created by adding colours to the model. Historical data offers insight to additional information on the construction history of castles. When several castles are visualized, a comparison between them can be made. By comparing the castles with each other, it becomes possible to detect if the construction history displays a common architectural development. In order to make a comparison between castles, the selected

structures must come from the same period (1300 until 1700) and region. The region that is chosen for this comparison is the surrounding region of Delft, Zoetermeer and Haarlem in Holland. The three cities are located within the same region of Holland, which was a single political entity during the period of 1300-1700.

1.7 The research questions

The goal of this research is to observe how the construction history of comparable castles relate to each other. This is done by means of 3D modelling. The possibilities which 3D offers are firstly the combination of archaeological, historical-, and historical art sources into one visualisation of the construction history. Secondly, to detect what the correspondence is between the ground plan and paintings/drawings. And thirdly, the 3D models offer the possibility to make a schematic visualisation of the construction history, which is a tool to compare the castles with each other.

The general aim of the research can only be answered if several research- and sub-questions are discussed first. These questions are:

1 What architectural changes occur in the castles near Delft, Zoetermeer and Haarlem from 1300 until 1700?
2 Can these changes be dated?
3 What do paintings and drawings offer for ascertaining the construction history of a structure?
4 How do the castles relate to each other in terms of architectural change during the period 1300-1700?

The inhabitants of each castle will be described, as the inhabitants are an important aspect of the context of each castle. The names, period of ownership and the architectural changes they established to their castles will be described. In addition, the question if the owners resided in their castles is described.

To answer these questions, the outside of the castles needs to be visualized. The interior of each castle, is an additional feature, which can be constructed, if the rooms are described in historic sources. This feature is not necessarily needed for the research questions. While this feature could have interesting results, it is a topic of considerable size, and will therefore not be included in the thesis.

By using 3D modelling, the experience and view of the outside can be displayed. Yet the interior of these structures can also contribute to the research questions. Unfortunately, while historical sources often describe architectural features, and in some instances even the rooms, this is not enough for a plausible image of the interior. The furniture is not often described in historical text. Without this element, the interior of the models would not contain enough elements for a comparison, which is needed to answer the research questions. It is possible to research into what kind and design of furniture was in use during the research period, yet it would be an assumption, which is unsuitable for a base of comparison. Therefore the interior of the castles will not be created in 3D.

Yet what of castles outside of Holland? The different terms indicates that a comparison of castles from different countries will be problematic. All terms indicate that in each country there is a difference in description and function of a castle. This implies that the historical, political and economic context of each country has to be described, and how this affected castles before any in depth

comparisons can be made. Yet to research the construction history of castles in Holland, such an in depth comparison is not required, or relevant. Furthermore, a research into the context of each country and of each castle is in itself a research topic for a new thesis.

1.8 The implementation of 3D modelling

A 3D model is in essence a simplified version of reality, and consequently incomplete (Box and Draper 1987, 74). Yet models have the ability to present, visualise and pin-point specific aspects for research (Box and Draper 1987, 74). While it is perfectly possible to create a detailed model with highly technical features and a great amount of detail, this is not the aim of the research. In this research, the use of 3D modelling is primarily combine the information of archaeological and historical sources, and for comparison. The ability to pin-point developments in the construction history and the visualisation are important tools for a comparison. Yet the combination of archaeological and historical sources into a visualisation is the greatest advantage that 3D offers.

Of course, there is the technical context of the model: where is the 3D model depicted? It is possible to create the model in GIS, yet this requires a study of the entire surrounding area. An alternative is to place the model on a modern map. This has the benefit of displaying to the reader the location of the castle. The latter option provides a better option, as it immediately displays to the reader where the particular case study is located within its context. The option of implementing a GIS map is in itself a research, which could provide new information, if all the data on the medieval landscape (including vegetation) would be available.

The case studies need to be described in historical sources, and an overview of the owners of the structures needs to be known. The castles need to be constructed/reconstructed/altered during the period from 1300-1700. In addition, dated ground plans of the structures need to be available. While there are several castles in Holland, only a small amount of castles meet all of these requirements. Four castles that meet these requirements are located in the region of Delft, Zoetermeer and Haarlem (Bult 1980; Bult *et al*. 1992; Grootveld 1993; Grootveld *et al.* 2004). The following castles will thus be utilized as case studies:

- Altena near Delft
- Keenenburg near Schipluiden
- Palenstein near Zoetermeer
- Huis ter Kleef near Haarlem

These four castles have been described in published research. These books and articles provide an overview of the history of the castles, the owners of the buildings and a ground plan. The historical sources are described in detail within these books and articles. These books and articles provide an overview of the general historical information. The original medieval archives have been used when necessary.

1.9 Reading guide

In this introduction, the issue with Dutch castles in construction history is described, as well as the possible solutions which 3D modelling offers to unravel the building history and the appearance of castles. The sources to create a model that can be considered reliable are described. In addition, the case studies are mentioned.

In the second chapter, a description of the methodology on how the models are created is given. The geology of the research area is presented. An overview of the building materials if given. The different types of windows are displayed in images. The textures implemented in the model are described. A description on how the models are created is given, and all the assumptions are described.

Each of the four case studies is described in a separate chapter. Each of these four chapters contain descriptions of the surrounding area, the history of the castle, the excavation and a list of owners. In these four chapters the ground plans, images and historical descriptions models are presented. At the end of each chapter, the models of the castles are displayed. One model displays the construction history, another displays the bricks, windows and tiles on the roof. The finished models are presented, described and the construction history is visualised.

The reliability of the sources is a topic in each of these four chapters. Simultaneously, the paintings and drawings of the castles can be compared with the resulting models. The models are primarily based on the archaeological ground plans. Together with the information of the historical images, the models will be considered to contain a high level of reliability.

The seventh chapter focusses on comparing the models with each other to detect the possible pattern in the architectural changes in the castles. The construction history of the castles is compared, and a possible common architectural change is described. In addition, the dating for such a pattern is described.

In the final chapter the conclusions of the comparisons is presented, together with an answer to the research- and sub questions. This chapter serves as a brief answer to the research questions. Two summaries, one written in English, one in Dutch is presented after the conclusion.

2 Methodology

In the introduction it is explained that the aim is to answer the research questions by creating visualisations of the case studies. The aim of the thesis is to compare castles with one another on architectural features. Yet what is known of the case studies that will be visualised? What sources will be used, and how are the 3D models created? In this chapter these questions will be answered.

The program that has been selected for this research is *Sketchup*. This 3D program, was designed to simplify the process of 3D modelling. As a result, the interface of the program relatively self-explanatory when compared to 3D programs like Blender. Creating a simple model can be realised in the spam of a day. The nature of the program allows an easy creation of square shapes and arches. At the same time, scaling models to an appropriate. This makes the program ideal for architecture.

The castles, while often possessing elements that are not entirely square, recreating these structures in this program can be done without difficulty. Historical images can be uploaded, together with a ground plan of the foundations. The only drawback to the program is that there is no possibility to add an additional database attached to the model within *sketchup*. Yet the files of *sketchup* can be exported to other programs in which this is possible.

Answering the research questions can be realised with the following method. Within *Sketchup* the ground plans and historical images are imported and scaled to the right proportions. The outlines are drawn and raised up to become walls and towers. By comparing the model with the images, details such as chimneys, rooftops and windows are created. With the use of several colours the different phases of the construction history are displayed. When the models are finished, a comparison is made to determine the similarities in construction history.

But first, a description of the research area is necessary in order to depict the general context of the case studies before the creation of the models is described. On figure 1, the research area, together with the location of the case studies is displayed. The region of Holland today consists of two provinces, South- and North Holland.

Figure 1: The location of the four case studies in the province of North- and South Holland (in yellow) (After Central Bureau van de Statistiek 2006).

2.1 Geology of Holland

Before any information on the castles can be given, one essential aspect needs to be addressed: the geology of their location. The presence of geological layers, together with developments in the soil, have a profound influence on the formation and the processes in the landscape, yet what influence does it have on the four castles? The answer is that the geological context influenced the choice of a location when a structure is raised, which is depicted on figure 2. For any castle, the geological context is a factor, which is advisable to take into account. For instance, an area with sand dunes will contain different issues and solutions for a castle than an area with peat.

When a castle is constructed, the issue of keeping the moat filled with water would occur. Simultaneously the presents of water needed to be avoided in the basement. Another issue is visibility in the landscape. Any owner would aim to construct a castle on a location, which offers the most advantages with the least disadvantages. An advantage that the geology in Holland offers is the plenty availability of water, which fills the moats of castles. An example of how human occupation was influenced by the geology is displayed at figure 2:

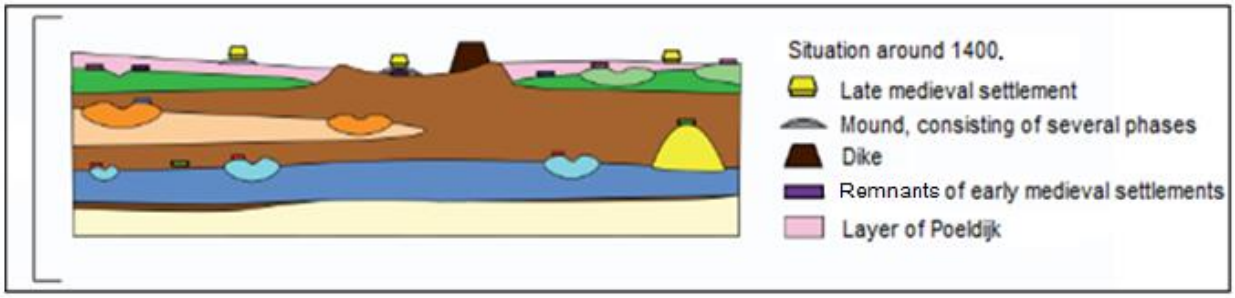

Figure 2: An example of human occupation around 1400 within South Holland (After Bakx and Bult 2013, 12).

The example of figure 2 displays several geological layers (in colour), including a peat layer (which has a brown colour) which starts to settle. Human occupation (portrayed with a yellow house) is often located on a mound, which offer protection against a flooding. Dikes are erected in regions with peat at the surface. Similar to mounds, dikes are a measurement of protection against water.

The dikes and mounds displayed at figure 2 are essential to counter the geological traits in the landscape. It also implies that people were aware of the potential dangers of placing structures at certain locations. Grounds containing peat could settle, which causes collapse of the surface, and an increase of the risk of flooding. Another potential issue are sand dunes. Building a castle on top of a sand dune has the consequence that the moats will not reach the ground water easily. And finally creating a structure in a low part of the landscape has contains the risk of a flooding or wet circumstances at the living floor or in the basement.

People living in Holland during the period 1300-1700 needed a solution for the issue of water, which could be provided by creating structures at an elevated location, or creating dikes in the region. A great number of dikes were erected in Holland around 1200 and afterwards. The creation of these dikes had the desired effect that seawater was prohibited from flooding the region. Yet, a consequence is that as a cause of the lowering groundwater table the peat loses moist and starts to settle.

Holland is a region in which the geology displays several formations and layers. A description of the largest and most common formations, and how this effects human activity is necessary to understand the choice of location of a castle.

The provinces of North- and South Holland are formed during the Holocene period in which several formations are present (Van Londen 2006, 6; Vos 2015, 257). The geological context has influence on aspects as ground water, settling of the soil, stability, fertility and vegetation. In the past, habitation in Holland generally is located on higher points in the landscape for protection against flooding (Bakx and Bult 2013, 12). For a greater protection against flooding's, since the 12th century dikes are created (Bakx and Bult 2013, 12). Castles on sand dunes are predominantly created on the coastal barriers (Bult 2000, 36). Castles could have

architectural elements in the design for flooding and/or subsidence could pose a threat to the structure. Fortunately, within the publications these elements are described, or noted when not present.

When the sea level rose around 5500 BC, the Pleistocene layers of Holland became flooded by water due to sea level rise (Vos 2015, 59). Consequently, this development let to the formation of peat, and the development of a marine area, which shifted gradually land inwards (Vos 2015, 320).

Eventually coastal barriers were formed around 5000 BC, which prohibited the water, and allowed the creation of a new formation (Vos 2015, 321). The name of this new unit is the Naaldwijk formation, which consists of three major units named the Wormer, Walcheren and Zandvoort layers:

- The Wormer formation (referred in older literature as Calais) (Vos 2015, 60). This layer is formed by sedimentation and consists of sand, with a high concentration of clay at the top (Vos 2015, 60).
- The sand layers of the Walcheren formation are located on top of the Hollandveen.
- On top of the layers of the Walcheren layer, is the Zandvoort formation (Vos 2015, 321). This formation consists of two layers: the oldest layer is Rijswijk, the youngest is Ypenburg. The formation of Zoetermeer is the following layer.

At first the region of Holland is flooded by seawater at regular periods, new layers of clay and sand are formed (Bult 2016, 11). Yet after several periods, dunes are formed which prohibit the water from flooding the region. The layer of peat which is referred to as Hollandveen develops as a result of the rising ground water. The development of dunes hinders the water from flowing away, consequently the peat layer grows.

Yet drainage by humans within the landscape prohibits the formation of peat. Because of drainage, the groundwater level starts to stagnate, which in turn effects stagnates the growth of peat. This creates a situation in which a loss of moist occurs in the peat, thus starting the settling process in which the soil declines (Bult 2016, 11). The settling of the soil makes the area lower, which in turn causes flooding, and causes the formation of a new layer (Bult 2016, 11). A schematic overview current geological units within Holland is depicted in figure 3.

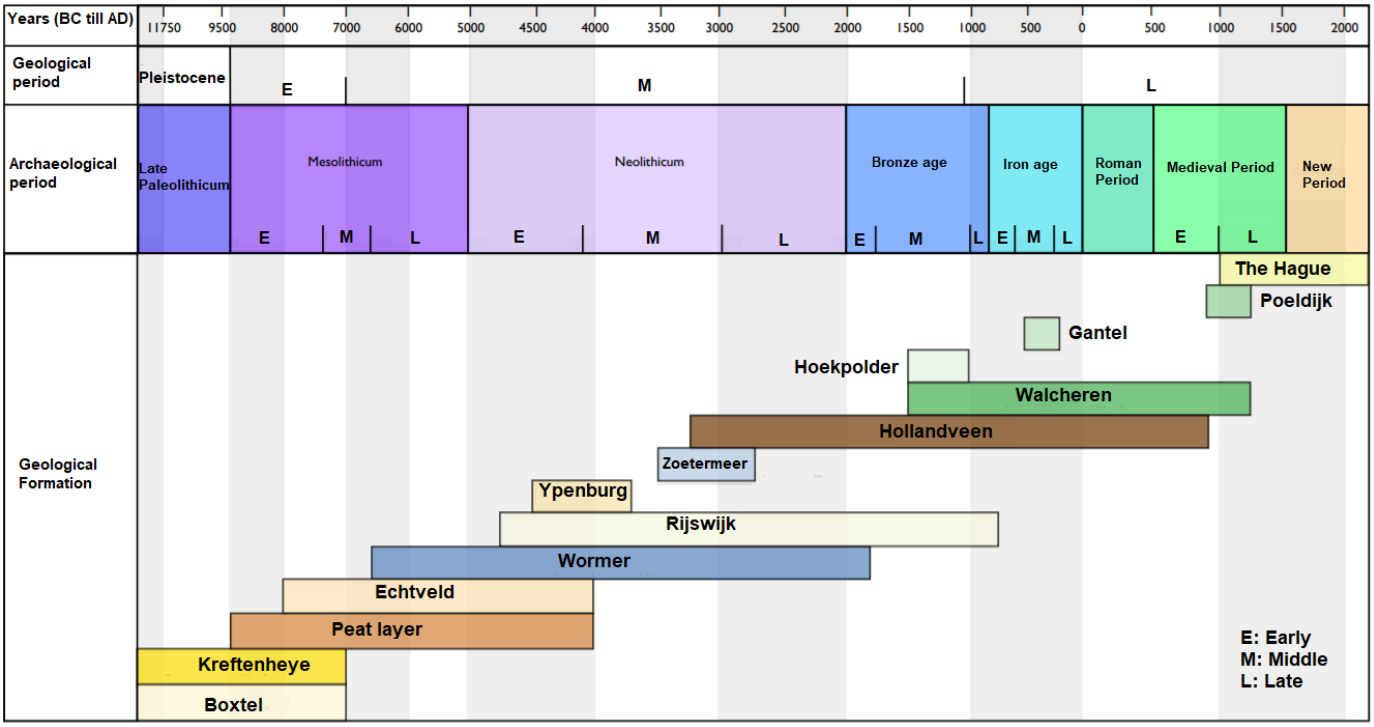

Figure 3: A schematic overview of the geological layers within Holland (After Kerkhof 2012, 11).

On figure 3, several geological layers. From the oldest to the youngest layer, the geological sequence is as described below:

- Formation of Boxtel
- Kreftenheye
- Peat layer
- Formation of Echtveld
- Layer of Wormer
- Layer of Rijswijk
- Layer of Yperburg
- Layer of Zoetermeer
- Hollandveen
- Layers of Walcheren
- Layer of Hoekpolder
- Gantel leayer
- Layer of Poeldijk
- Layer of The Hague

A flood of that scale can result in new, local geological layers, for instance the layer of Gantel, the layer of Poeldijk and the layer of The Hague (Vos 2015, 231). All these new geological units are formed at a smaller scale than the relatively large formations of the Wormer-, Hollandveen and Walcheren.

To summarise this paragraph, the landscape of Holland is shaped by its geological context. The wide availability of water presents requires that a castle needs to be elevated to avert flooding. The wide availability of water however, does ensure there are always sufficient quantities of water available to fill the moats that surround the castle.

2.2 Building materials

Apart from the geology, the available building material and techniques are essential to explain why a structure was created in a particular manner. Castles have been constructed for several centuries in Holland. During this period, the material of which castles are constructed underwent several developments (Hermans 2013, 92). Several general building materials can be found in castles dating from 1300 until 1700, such as wood, bricks, loam and natural stone (Hermans 2013, 92-94). Natural stones are a type of material that is commonly used in early castles, yet it does still appear in castles dating from 1300 until 1700 (Hermans 2013, 94). Natural stones do not occur in de Holocene parts of the Netherlands and had to be imported. That makes the material expensive. Natural stones were only used as architectural decoration around windows, doors and sometimes as a façade of important buildings.

The introduction of the bricks as a building material started in the Roman period, but the knowledge of making this construction items was lost in the northern parts of Europe and was not earlier reintroduced than around 1200 (Hermans 2013, 93). Bricks are a product of heated clay, which is why it is identified as a form of ceramics. Bricks were more expansive as building materials than wood, yet had several advantages for those who could afford it (Hermans 2013, 93):

- When brick was first introduced, the ability to follow the newest architectural changes of by the owner, displayed wealth and increased status.
- Buildings of bricks did not possess the same danger to fire as wooden buildings.
- Bricks, while expansive, were less costly than natural stone.

The bricks of the 13th century were quite large in comparison to later bricks (Hermans 2013, 55). Bricks become an important building material for castles in the 13th-14th century (Voskuil 1979, 21). In the 15th century, several castles, constructed out of brick can be found all across the Netherlands (Voskuil 1979, 21). Yet a gradual development occurred, in which brick production improved in terms of cost, size, quality and speed of manufacture (Hermans 2013, 55). This development last until the present day, with the introduction of mass-produces bricks. The reduction of size over time has the benefit that bricks, in combination with historical sources can be used for relative dating (Hermans 2013, 57). As a general rule, the larger the bricks in the masonry the older that part of the structure is (Hermans 2013, 55). A weakness in this rule is reuse of bricks, which can be avoided by measuring the sizes of the bricks, and calculate a general size.

Until the moment there is mass production, each brick is unique and differs slightly in size (Berends 1989, 4; Hermans 2013, 55). As figure 4 displays, there are several types of bricks, classified by their relative size (Joost, de Vree 2018).

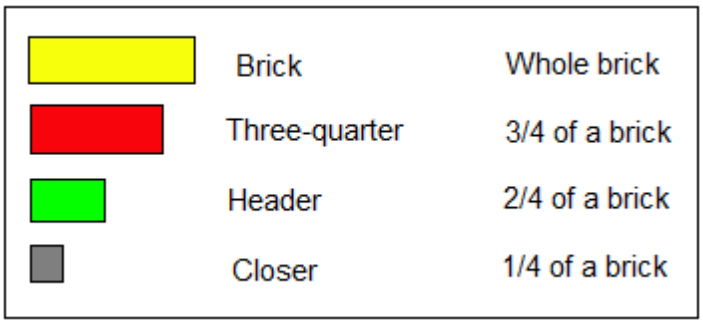

Figure 4: The typology of bricks, based on size (After Joost de Vree 2018).

As figure 4 depicts, a full brick has the dimensions of 4 x 2 x 1 (length, x width x thickness). The largest unit is the full sized brick, which is identified in Dutch by the word *strek* (which is in English simply a classified as a brick). Another unit is the three-quarter brick that possesses a size of ¾ of a regular brick (in Dutch: *driekwart klezoor*). Next in terms of size is the header, which is the name given to bricks with have half the length of a regular brick. The smallest unit known which is of importance bears the name closer (in Dutch *kwart klezoor*).

Bricks are used to create brickwork, in which bricks and mortar are used to create masonry. In the Dutch castles of in the period from 1300 until 1700 brickwork is set in bonds. There are four types of bonds that are of importance within the period of 1300 until 1700 which are depicted on figure 5 (Hermans 2013, 58).

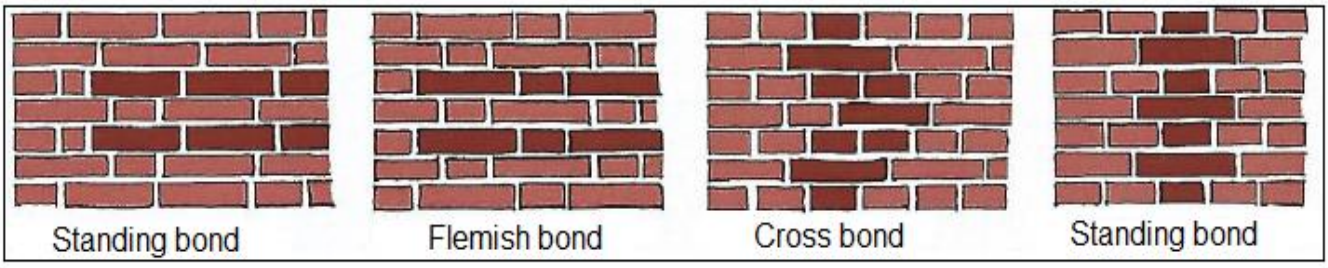

Figure 5: Overview of the four major bonds (after Hermans 2013, 58).

On figure 5, the four important types of masonry bonds for walls are depicted. Flemish bond was the predominant bond in use in Holland before circa 1325 (Hermans 2013, 94). In 45% of the castles, Flemish bond is present in the older parts of the castle (Hermans 2013, 94). Cross bond comes into use approximately around 1550 (Hermans 2013, 58). Apart from these four bonds there are several other variations of these bonds. There is a type of bond, the wild bond, in which there is no structure in how the bricks are ordered (Hermans 2013, 58).

Another change in the use of bricks is from 1300 until 1650, in which closers were placed at corners (Hermans 2013, 58; Van der Hoeve 2012, 20). After 1650, three-quarter bricks gradually replace these closers (Hermans 2013, 58; Van der Hoeve 2012, 20). Hernams mentions that in his research 45% of the encountered castles, Flemish bond type of masonry appeared (Hermans 2013, 94). Because of this percentage, the moment when the masonry of a structure is unknown, the texture of Flemish bond will be used as an assumption on the models.

Apart from bricks, the roofs construction possessed a covering of tiles. These tiles experienced an ongoing process of development and alteration. The materials to create tiles are either naturel stone, for example slate, or from heated clay (ceramic). The use of loam or plaster to seal tiles to features such as chimneys to each other was common practice during the period 1300-1700 (Rijksdienst voor archeologie, cultuurlandschap en monumenten 2018, 3). In the figures 6 to 9 examples of the tiles in use around 1300 until 1700 are displayed.

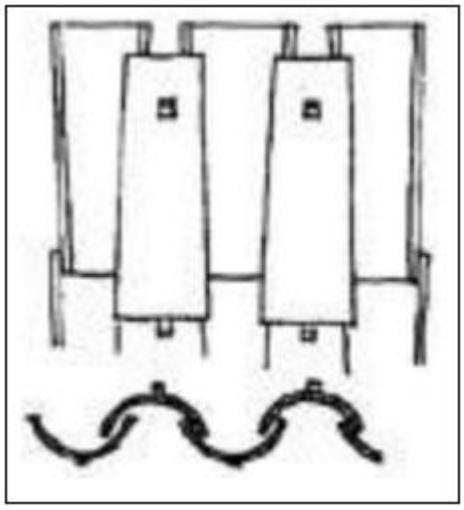

Figure 6: The earliest tile that is of importance for this research is the so called "Monniken en Nonnen" type, displayed on this image (after Joost de Vree 2018).

Figure 6 displays the "*Monniken en Nonnen*" type of tile (after Joost de Vree 2018). This type of tile was in use during the 15th century, and is still available today (Polman and van Rooden 2008, 1). In the period from 1300 until 1700, this type of tile is still in use, yet is most likely to appear on older, structures. It is unlikely that this type of tile was present on top of the main castle towers, as this type is not considered to display wealth and status, which other types of tiles do.

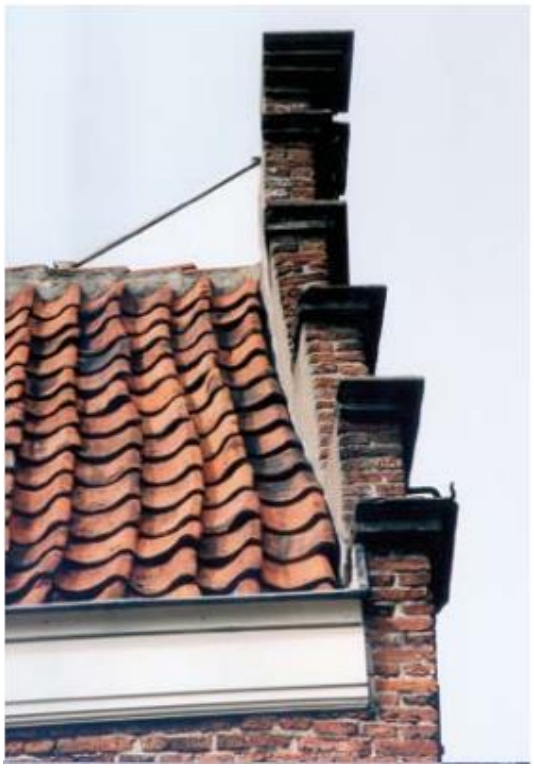

Figure 7: In 1466 a new type of tiles came into use in Holland, the "Zwolse Quakpan", whose design quickly became known in Dutch as the "gegolfde holle pan" which is depicted on the image (Polman and van Rooden 2008, 2).

The tile depicted on figure 7 is the "*gegolfde holle pan*" type, which offered the same amount of protection against the weather as the previously described "*Monniken en Nonnen*" tiles (Polman and van Rooden 2008, 2). Yet this design allowed a single tile to cover twice the surface of the "*Monikken en Nonnen*" tiles, consequently needing les tiles to cover the roof (Polman and van Rooden 2008, 2). This meant that the amount of weight pressing on the roof was reduced, while keeping the maximum protection (Polman and van Rooden 2008, 2). This type of tiles is common use in the period from 1300 until 1700 (Polman and van Rooden 2008, 2).

On figure 7, the roof appears to be a crow stepped gable design (www.Kwaad.net 2004). This design begins to appear in Holland around 1600 (www.Kwaad.net 2004). The steps of this type of roof have a perpendicular triangular shape pointing inwards, towards the roofing (Agnete Olsen 1981, 161). The function of this triangular shape appears to collect rainwater.

Figure 8: These slate tiles, which are formed into a scale like style (Boeder and Tolboom 2010a, 1).

When the shape of the tiles has a scale like appearance, such as on figure 8, the Dutch term "*Rijndekking*" is used a description (Boeder and Tolboom 2010a, 1). Slate tils are expensive and display a high social economic status (Boeder and Tolboom 2010a, 2). The roof of towers and halls of the main castle can be assumed to have been covered with late tiles. The "*Rijndekking*" tiles appear in the southern- and western parts of the Netherlands (Boeder and Tolboom 2010a, 2).

Figure 9: Two different forms of square slate tiles (After Boeder and Tolboom 2010b, 1-3).

The square slate tiles at display here are described in Dutch as "*Maasdekking*" (After Boeder and Tolboom 2010b, 1-3). This design is common in the northern- and eastern parts of the Netherlands (Boeder and Tolboom 2010b, 2). At the right side of figure 9 is a version with chamfered corners of this type of tiles, which is described under the term "*lamme koppe*" (Boeder and Tolboom 2010b, 3).

Figure 10: An example of a flat roof tile (Hupperetz, 2004, 86).

A type of roof tiles, of which figure 10 is an example (Hupperetz, 2004, 86; Polman and van Rooden 2008, 2). The design of square ceramic flat roof tiles follow the pattern of slate tiles (Polman and van Rooden 2008, 2).

One final type of roofing is organic roofing, in which organic material, such as hay (Polman and van Rooden 2008, 2). This type of roofing was in use until the 14th century, as it was cheap (Polman and van Rooden 2008, 2). When fires in cities arose in the middle of the 14th century, this type of roofing was forbidden (Polman and van Rooden 2008, 2). On figure 11, the implemented texture for organic roofs is displayed.

Figure 11: Hay texture for roofs of organic material (mx.depositphotos.com, 2015).

Apart from the building materials, several architectural features prove to be useful for dating. One such element is the “Arkeltorens” found at corners of larger towers

(Hermans 2013, 59). The shape of these towers is either round, or has several sides (Hermans 2013, 59). The placement of a single Arkeltower is rare, while two or four Arkeltowers is a common amount (Hermans 2013, 59). These towers appear sporadically in the 13th century, became a common feature in the 14th century, to fall out of use after 1575 (Hermans 2013, 60).

2.3 The windows

A feature of importance are the windows. With a window, the entire frame, containing the glass, the windowsill, and the facades are described. The first evidence of windows in Dutch castles are the presents of windowsills, which appear during the 12th century (Janse 1971, 33-34). The high nobility (which stood high in the hierarchical order) such as the count of Holland, could afford windows (Janse 1971, 36). With this in mind it is no surprise that structures belonging to the count of Holland possessed the newest types of windows. Several types of windows appear from 1300 until 1700 in Holland. The most common types of windows are described in the following figures.

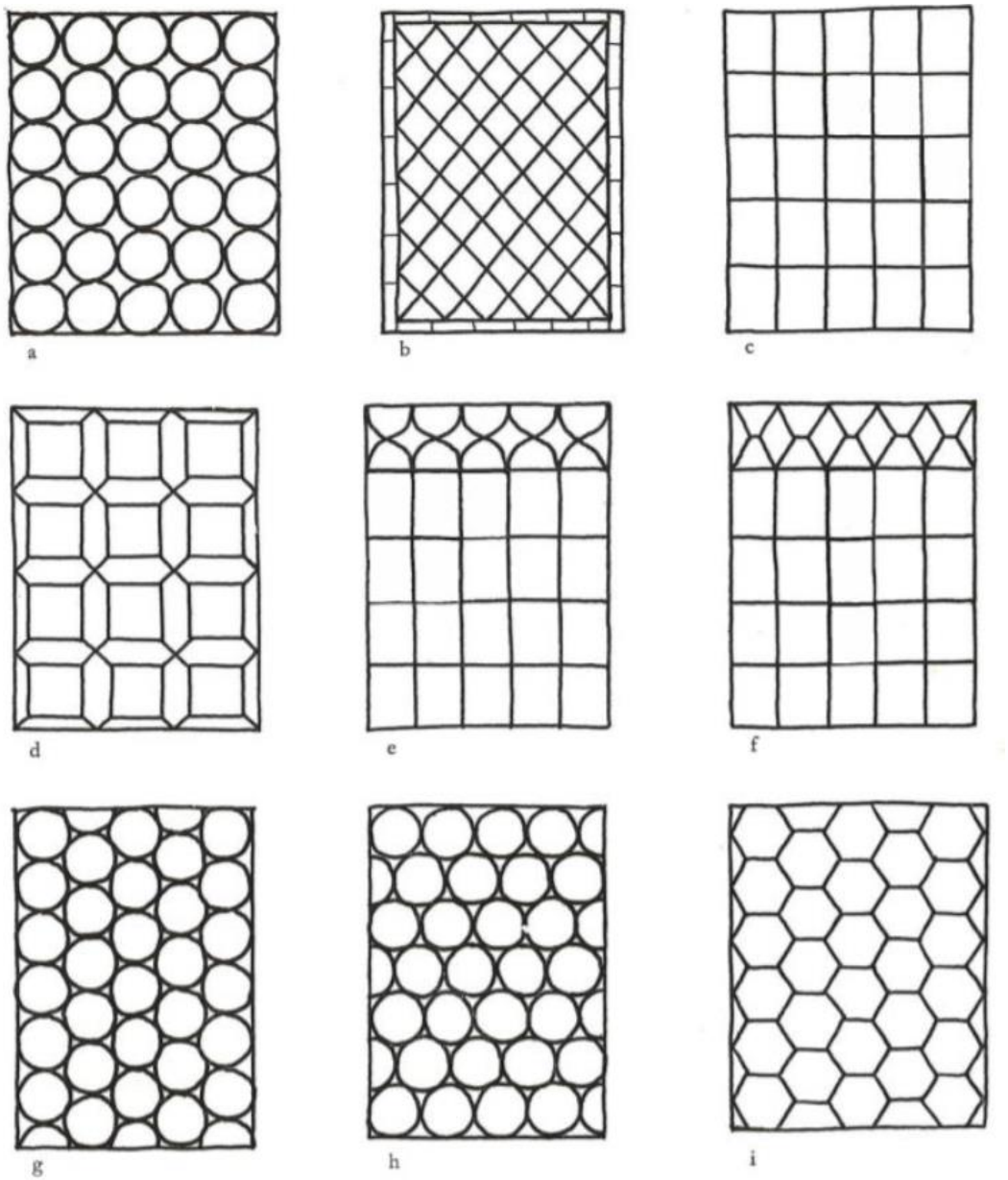

Figure 12: Several types of pattern, which can be found in glass windows (Janse 1971, 12).

Throughout time, several different forms of glass windows develop, which are displayed on figure 12 (Janse 1971, 12). At the top of this image is the shapes of the early round and the geometrical of the glass windows is displayed (an and b). Image c first appears around 1550. Around 1650, the geometrical pattern, displayed on image b gradually disappears. After 1650, complex shapes (d, e, f, g, h and i) begin to appear.

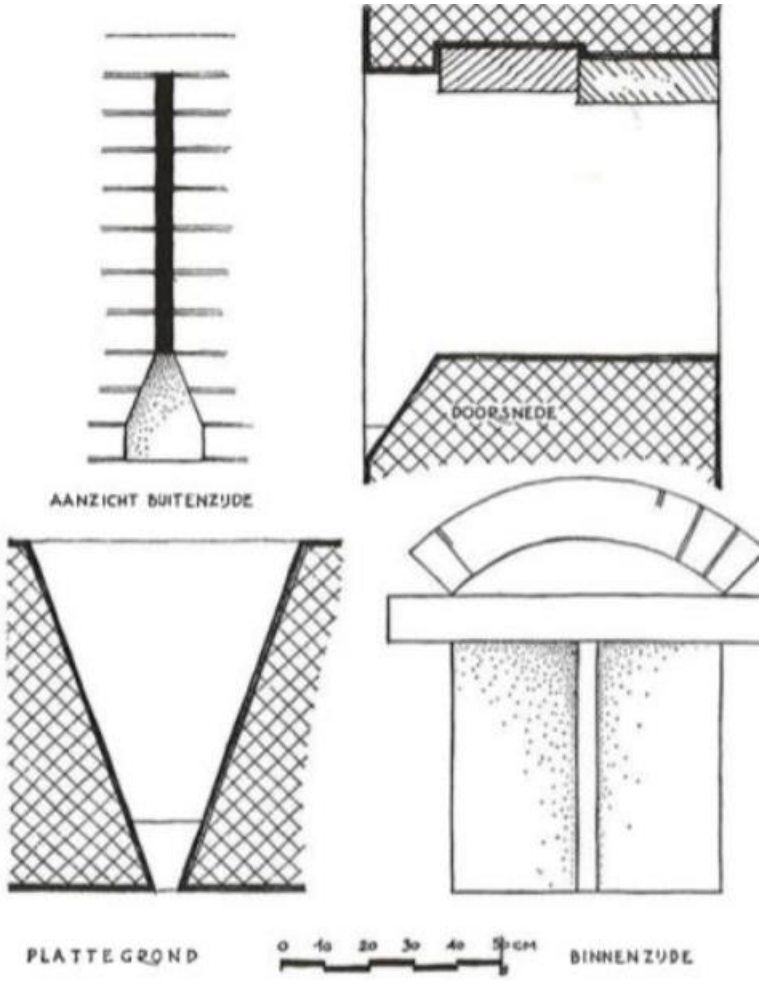

Figure 13: The Embrasure type window (Janse 1971, 33-34).

On figure 13 the 14th century Embrasure type window is displayed, which is one of the oldest types of windows in castles (Janse 1971, 33-34). This type of window was suitable to observe the surrounding area, while significantly reducing the risk of drawing enemy fire (Janse 1971, 33-34).

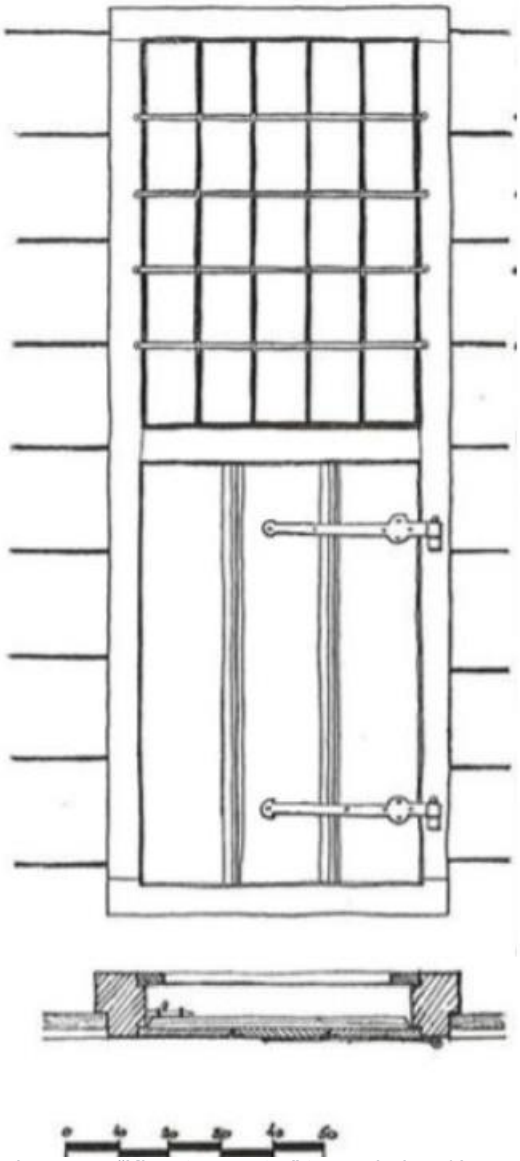

Figure 14: "Kloostervenster" type window (Janse 1971, 51).

Figure 14 depicts a "*kloostervenster*" type window, which dates in the period of 1300-1700 (Janse 1971, 44). This type of window is sometimes referred to as "*Half kruiskozijn*".

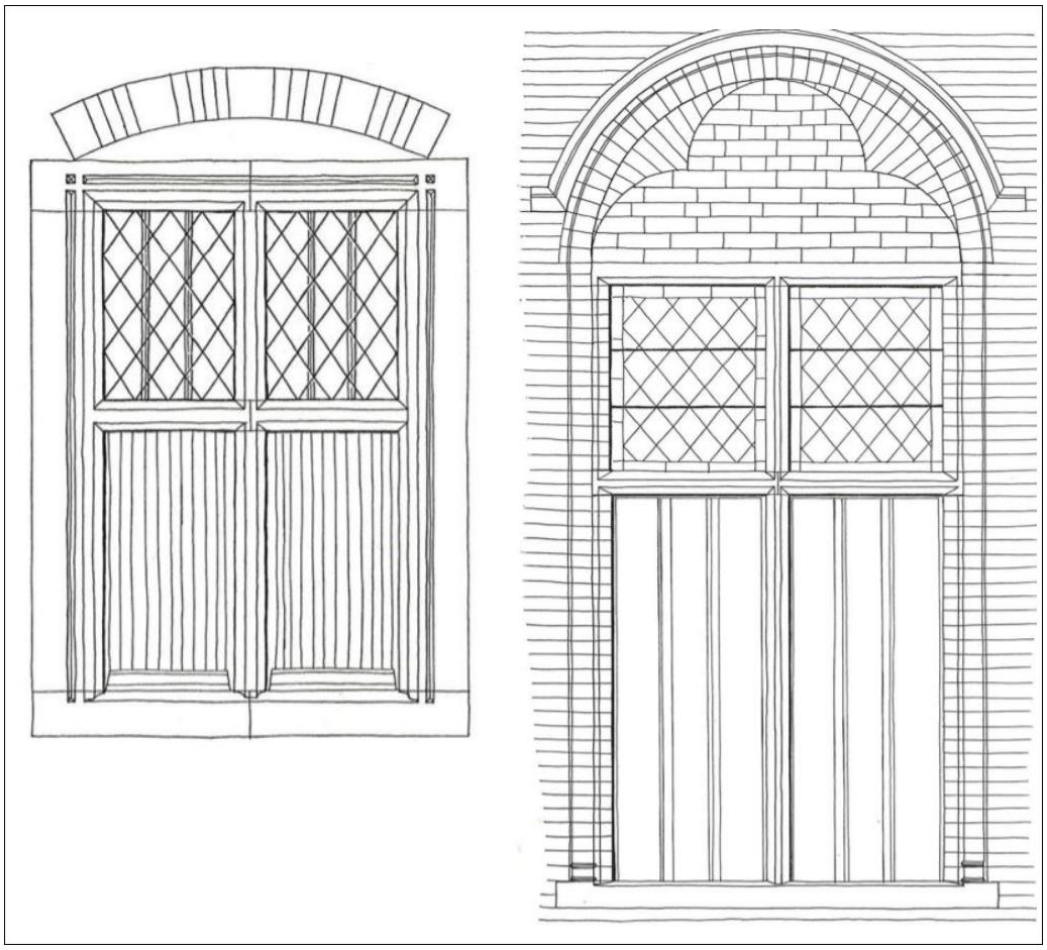

Figure 15: Two different forms of the "kruiskozijn" or cross-window (Janse 1971, 37-38).

Figure 15 displays a type of "*kruiskozijn*" window, which in general possesses stone frames (from 1652 wooden frames) and a profiled window frame head (Janse 1971, 38-39). Despite these common features, there is an extensive variety within this type of window (Janse 1971, 38-39). The first appearance of "*kruiskozijnen*", or cross frame windows is impossible to date, yet at 1300 cross frames were common features of buildings (Janse 1971, 46). The first brick frames of this type of window begin to appear around 1400 (Janse 1971, 39-40). This type of window was in use during the period of 1300 until 1700, which implies the presents of cross frames in the case studies (Janse 1971, 46). Around 1700 the use of cross frames lessens gradually, yet until 1790 it is still applied in the Maasland area (Janse 1971, 44).

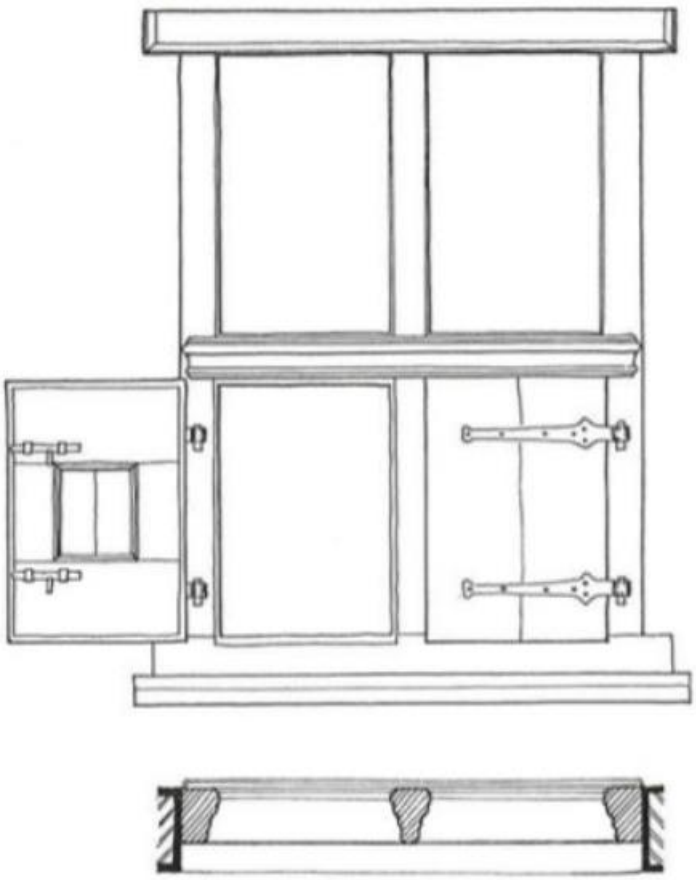

Figure 16: A different type of cross-windows with wooden frame (Janse 1971, 47).

Another common form of the cross-window is depicted on figure 16. This variant possesses a wooden frame and lids (Janse 1971, 38-39). The presents of wooden frames are first described in historical sources in 1652 (Janse 1971, 54).

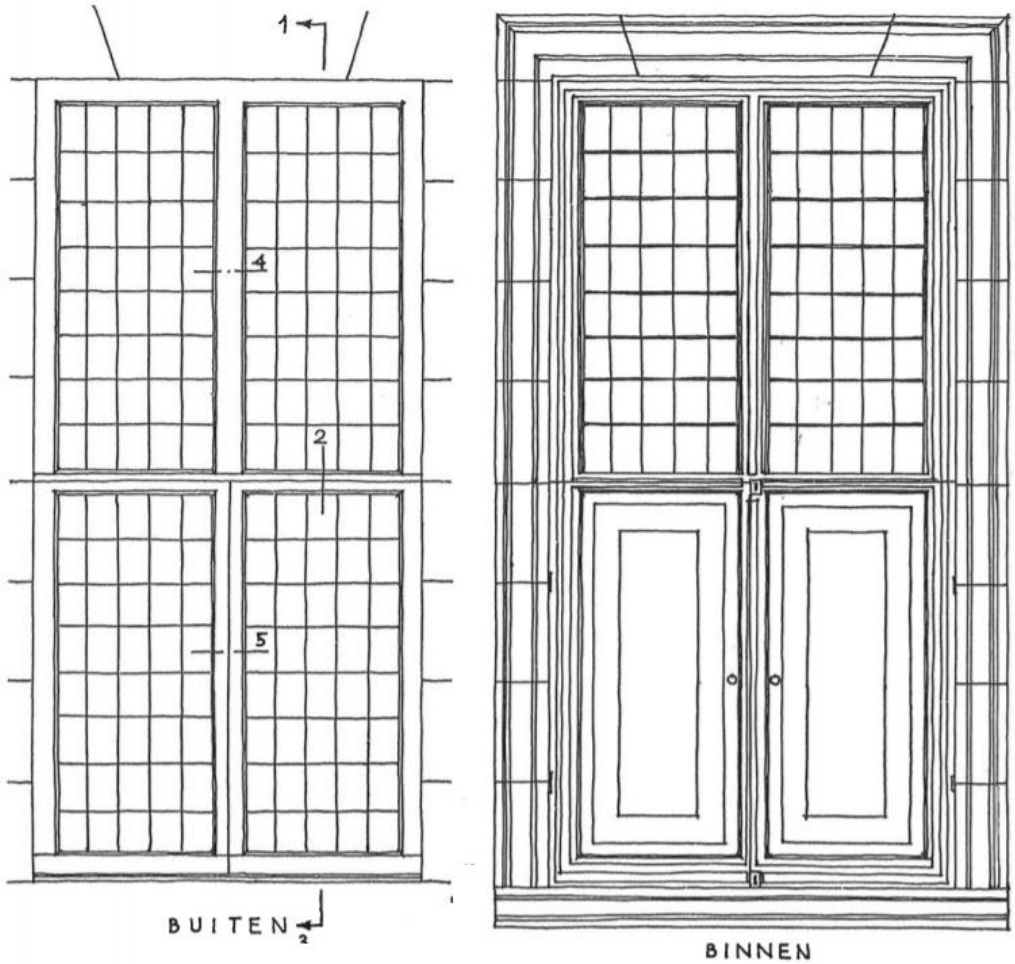

Figure 17: Cross-windows, specifically placed on large structures (Janse 1971, 63).

Figure 17 depicts cross-windows, which appear solely on large structures, such as castles (Janse 1971, 54). These large windows are constructed out of wooden frames, which offer no support for the structure (Janse 1971, 54).

The windows types depicted on figure 12 to 17 will provide information, reference points and point of reference to date the separate phases of the construction history of the buildings. When the ground plan cannot provide information on the construction history, the windows, depicted on the images will be useful sources of information to identify phases of the structure. The assumption which has to be made is that the windows depicted on the image are reality.

There are several images of windows types available. Yet with all the images of these windows, there are several issues. The first issues is that the majority of the images display the window upward, which causes a misfit of the perspective when the images are attached on the model. Another issue is the fact that the majority of the images has a black-and-white colour setting.

Yet all these issues could be overcome, were it not for a final problem: on all the images modern materials are present in the background. Often, paint and plastic surround the window, and removing these elements distorts the image to a degree that it becomes unsuitable for the model.

It is for this reason the windows are reconstructed in the models themselves, using textures that are available in the default setting. While this method takes a larger

amount of time, than simply attaching images of windows would, all the issues will be avoided.

While the used program, *Sketchup* contains several textures for materials, a number of specific images needed to be added. In particular, the different bonds of masonry throughout time. In several figures the implemented textures which were necessary will be described.

2.4 Brickwork and other implemented textures

The images of masonry bonds were exported out of the article of Orsel, who photographed several masonry bonds present in Leiden (Orsel 2007, 6). All these images are sized, to exclude modern materials present. The colour of the images was altered in the models, in order to match the description of the present bricks.in the images below, the original colour of the bricks, is displayed.

Figure 18: The textures of the brickwork (Orsel 2007, 6-19).

In the work of Orsel, an overview of bonds in brick is presented, which originate from buildings in Leiden, which is in part depicted on figure 18 (Orsel 2007, 6-19). Image A depicts a brick wall with northern bond, dated around 1200 (Orsel 2007, 6). Image B depicts a standing bond from the period 1453-1473 (Orsel 2007, 16). Image C depicts cross bond masonry, dated around 1463 (Orsel 2007, 16). Image D depicts cross bond of around 1588 (Orsel 2007, 18). Image E depicts a sign of the mason, and appears to be cross bond, dated around 1588 (Orsel 2007, 5). Image F depict cross bond dated around 1683 (Orsel 2007, 19). The image A, B and C depict masonry before the research period of 1300-1700. This is purposely done, as in all the castles, elements predate 1300, which still need the proper texture.

G Cross bond dated around 1683.

H Cross bond, dating around 1668-1670.

I Standing bond dating around 1749.

J Standing bond dated around 1751.

K Standing bond dated around 1790.

Figure 19: The textures of the brickwork (Orsel 2007).

In the work of Orsel, several other images of brickwork, of buildings in Leiden, are depicted, which is in part depicted on figure 19 (Orsel 2007). Image G depicts cross bond dated around 1683 (Orsel 2007, 18). Image H displays cross bond dating roughly from 1668 until 1670 (Orsel 2007, 20). Image I depicts standing bond, and dates around 1749 (Orsel 2007, 20). The standing bond on image J depict high quality and slightly older brick wall, dating roughly from 1751 (Orsel 2007, 17). Lastly, image K displays standing bond around 1790 (Orsel 2007, 17). There are

several images of masonry, dating after 1700. These images are used for changes in the castle, dating around 1700.

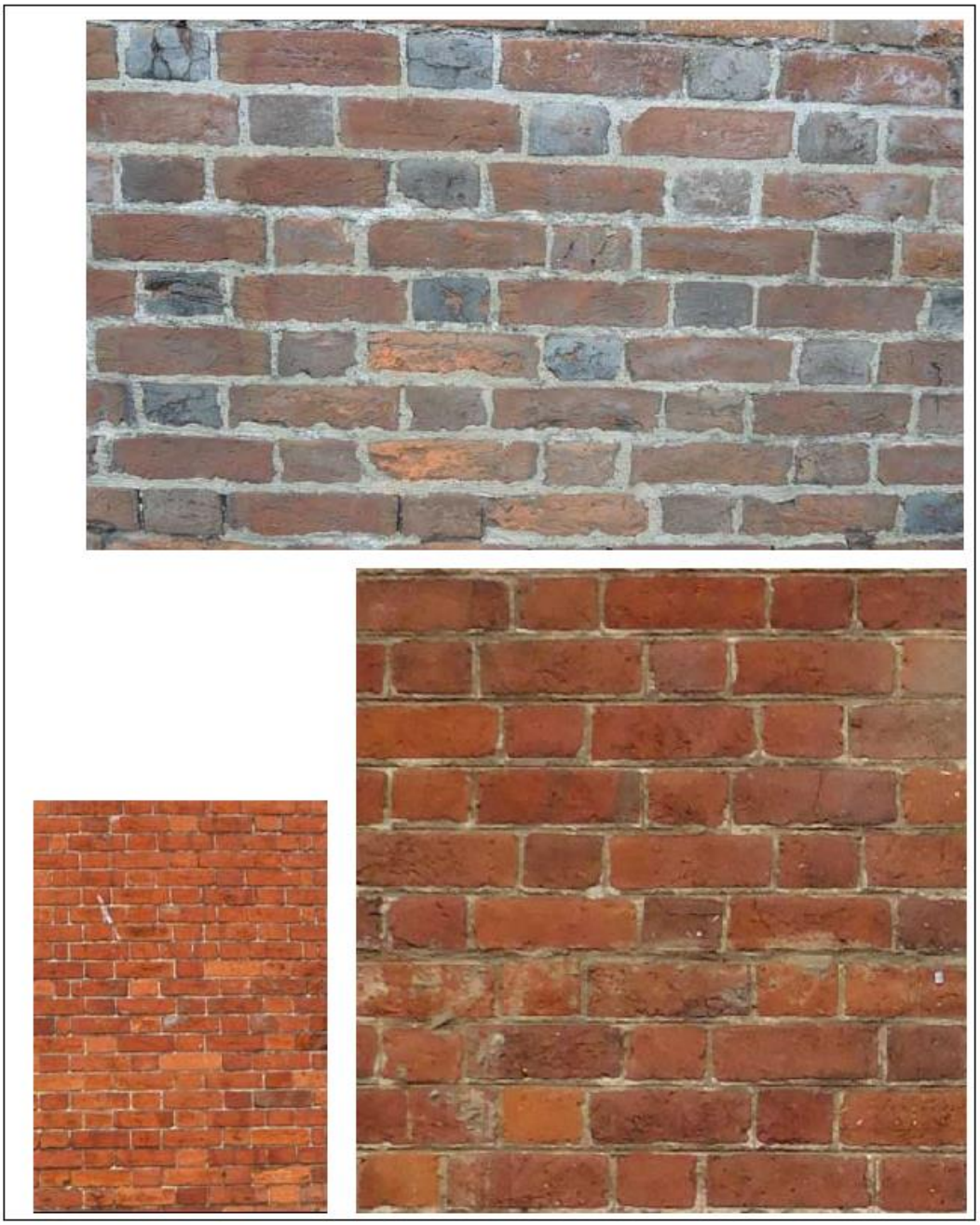

Figure 20: Three images of Flemish bond, from grey red to pinkish red to full red colour (After www.canterbury-archaeology.org.uk 2015; after www.freepedia.co.uk 2019).

On figure 20, the top image displays Flemish bond in a greyish-red colour (www.canterbury-archaeology.org.uk 2015). At the bottom left of figure 20, Flemish bond with a red colour is presented (www.freepedia.co.uk 2019). Bottom right a Flemish bond with a pinkish red colour is displayed (www.canterbury-archaeology.org.uk 2015).

Apart from images of masonry, the images of tiles were used for the roof. Textures of the two type of slate tiles are present in the default set of textures that *sketchup* offers. The commonly used "*Hollandse dakpan*" which was introduced in 1466, is present at the Keenenburg, Palenstein and Altena (Bult *et al*. 1990, 2-11; Bult 2004, 5; Westenbroek and Domburg 1993, 59). At Huis ter Kleef, it appears only

schist tiles are present, as these are mentioned in historical sources, and no ceramic tiles have been found (Vink 1995, 17). In figure 21, the image of the "*Hollande Dakpan*" which is implemented in the model is presented.

Figure 21: "Hollands Dakpannen" (Polman and Rooden 2008, 1).

The texture used for the "*Hollandse dakpan*" type of tile is depicted on figure 21. This type of tile is commonly present after 1466, yet as it is less expensive as slate or schist tiles, it is expected that these tiles are present on any structure except the main castle building.

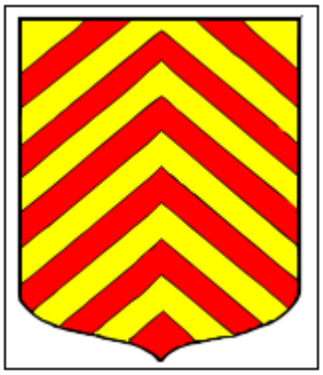

Figure 22: The emblem of the house of Egmond (Egmond online). This symbol was depicted on the windows of Palenstein.

Figure 22 displays the emblem of the House of Egmond. In a discussion with Grootveld, the emblem of the owner of Palenstein was depicted on the windows of the castle.

Figure 23: The texture of a medieval road (Pixabay 2019).

The location of at least one castle is directly facing a street. In order to display a reliable image, a texture of a medieval road, as seen on figure 23 is implemented in the models.

Figure 24: Keperbond, present as a floor in the castle of Huis ter Kleef (After Werkspot 2009).

In figure 24, the bond type of Keper is displayed. In a discussion Numan mentioned that this type of bond is used for floors, and is present on the inner court of Huis Ter Kleef.

2.5 How to create the models?

Now that the building materials and added textures have been described, it is essential to present an overview of the working of the program. The models are created in *Sketchup*. This 3D program is used by the general public for numerous purposes, for instance architectural, engineering and interior design purposes.

The program, while relatively straightforward allows the implementation of ground plans, paintings and drawings. The implementation of images such as ground plans and paintings/drawings is described under the term import. The program allows the measuring of objects in cm. In *Sketchup*, inches are the default measurements, yet the ground plans use measurements in meters. In the models, the settings for unit measurements will be switched to meters.

In *Sketchup,* the toolbar displays several tools for creating simple shapes. By using the rectangular tool, a rectangle is created, the marker tool creates length markers, and the erase-tool erases shapes, etc. these tools are useful to create symmetrical shapes. Yet many archaeological features do not follow a perfect symmetrical shape. For this, the implementation of the line tool is used.

The line tool creates a simple line, by clicking the mouse button. One click to start the line, and one to mark the ending. Connecting lines form a merge into a single feature. A particular useful tool is the marker tool, which allows measurements of lines. These lines can be both vertical and horizontal. By drawing these lines over the ground plans, rooms, walls, towers and pits become editable features. These lines can be drawn both vertical and horizontal. There is no database connected to these features such as in a GIS environment.

These features are at first flat, yet length can be given to them by using the raise tool. It is possible to raise structures to precisely the right height, which is useful in case this information is available. Raising a feature can be done by either console command, or by moving the cursor up to the desired height. By pressing CTRL, a duplicate of the feature can be made, which is a suitable option for creating new levels on the model.

It is possible to add textures and colours to the features. This attribute will create a more natural outlook on the model. In addition, shadows and light can be added for a natural display of light.

Each model of a case study is created in a separate file. Placing all the data in a single file makes it difficult for the average computer to manage the 3D process. In addition, the risk of losing all the data increases if all the data is placed in a single file. All the case studies will be stored on a disk which is implemented in this research.

Each case study has a ground plan present in the archaeological report. In the program, the separate ground plans are imported, and placed horizontally. The ground plans provide an overview of the excavated architectural remains. Furthermore, a ground plan is accompanied by a scale bar. The orientation and the scale bare present on each ground plan will be taken into account as the scale of the actual model. This is done, in order to achieve a high level of correspondence with the actual archaeological information.

After a ground plan is set and scaled to the correct proportions, the paintings and drawings are imported. These images provide information on the shape of the roof, and how many rooms there are in the structure. The images are placed vertically in the program. By creating view lines to features on the structure, that are present on an image, the perspective can be assumed. Using only one image, can result in a model, yet multiple images provides additional sources as reference points, which provides less room for assumption in the models.

After all the required images are imported, the outline is drawn on the ground plan. When the outline of the structure is completed the walls can be raised. Unfortunately, while two story buildings in a castle is common, three story buildings are less numerous and four stories are rare (Hermans 2013, 91). This information is essential for the height assumptions. In a PHD thesis, Hermans calculated the

height of castle features over several periods of fifteen castles (Hermans 2013, 91).

According to the data that Hermans provides, an average height of the main castle towers of 14 meters is to be expected (Hermans 2013, 91). This is the average height from the ground level, to the eave (the beginning) of the roof, (Hermans 2013, 91). Consequently, the average height of the actual roof construction is unknown. Furthermore, there is a great amount of variation, both in heights as well as in the number of present floors (Hermans 2013, 91). This makes it impossible to calculate the height with certainty if no drawings or paintings are available of a castle. It seems that castle towers were at least 14 meters high, yet the roof height of the constructions are an unknown factor. It is therefore assumed that the tower will have reached a maximum height of 20 meters, and a minimum of 18 meters.

While these heights are an assumption, there is no option available that is based on more solid evidence. As the roof construction is lost, and technical drawings of the castles are not available, the depiction that the images provide are the only reference point. Consequently, the models will have minimal height of 18 meter, and a maximum of 20 meter. It is entirely possible that the castles had a different height in reality, yet there is no accurate way of ascertaining this actual height.

After the creation of the outline, the walls will be visualized. It is at this stage that the paintings and drawings become the reference point on the structures appearance. The amount of vertical lined windows gives an indication on the number of floors. The roofs are shapes according to the visualization that the paintings and drawings provide. It is possible that the paintings and drawings do not display the real situation. Briefly comparing the shape of the roofs and construction techniques/building style(s) will counter this issue.

There is one assumption with the windows, which is that it is assumed that every structure had at least one window. The reason behind this reasoning it that structures need light, which windows can provide.

2.6 Transparency

During the creation of the models, the greatest challenge is displaying academic transparency. 3D models are powerful means of creating ideas of the past. While 3D models can contain high quality graphics, which improves the outlook on the models, this has little value for the implementation of the research. All the data, measurements and textures in the models need to clarified and evidence based. While the ground plans and archaeological reports contain hard evidence, this is incomplete information. Furthermore, the data from the paintings, drawings and literature is indirect information on the actual situation. Lastly, because the actual buildings are no longer complete, as some of the information is lost to us.

The solution to these issues is both describing and visualising assumptions. For every feature of the models, a description of the available evidence and/or sources is necessary. By tracing back, the lost features in either literature or data, the creation of a well-founded plausible image on the past is realised. Since the actual castles are no longer complete, assumptions within the models are unavoidable. By using a red colour as texture in the visualisation of all the assumed features, it becomes clear to any reader what the known and unknown elements are within the model.

One of the uncertain features is the texture of the model. The texture in the models needs to display the building material that was in use at the specific period in time. By researching what the available building material was, it can be determined what the texture should be.

In the models, the different stages of the construction will be visualised. The castles are visualised by the using colours to indicate the different phases of each castle through the 1300-1700 period. This implies that every castle will have two models in the thesis: The first model is a colourful version, which functions to display the construction history. The second model displays the structures with the building material (masonry and roof tiles).

The masonry and roof tiles in themselves are indications of the construction history. Yet can it be expected that the public recognize these indications? The use of colours in the model will add clarity for the readers to a far greater degree than the textures can.

It is important to note that while all the available evidence and references are implemented, the height in the models is still an assumption. The only method that assures a conclusive result is by measuring the actual building, which is not available at any of the case studies. The rooms of the first floor can be created, if the inner walls of the structure are visible on the ground plan. The rooms above the first floor are speculation, and implementing them does not contribute to answering the research questions.

While castles can be created is a simple manner, each feature should be accounted for by means of evidence. This evidence contains the ground plans, historical descriptions, paintings and drawings. The models need to present information of the construction history, which will be visualized by means of different colours.

In addition, a separate model of each castle, with the appropriate building material as texture will be presented, to provide a plausible image of the structure in the past. Now that the background information is described for each case study, it is time to present the models of each castle within the third chapter.

For a comparison, four cases were selected. The choice for this number has two reasons. Firstly, to provide a reliable overview. Secondly, because of the issue that only a few castles in Holland possess the requirements for solving the research question(s). In addition, the amount of four case studies over a limited period and one region ensures a representative overview of the development on this type of castles. There are multiple requirements needed to create a 3D model of the case studies. These requirements are:

- An archaeological description.
- Paintings and drawings.
- A ground plan.
- A historical description.
- Architectural developments/expansions/changes in the structure.

The case studies, (Altena, Keenenburg, Palenstein and Huis ter Kleef) all possess these attributes.

2.7 Summary

In this chapter, building materials, textures and methodology are described. The 3D program provides a simple and straightforward method of replicating structures

in 3D. The description of the masonry bonds, the images of the roof tiles and the display of different window types is presented, will provide the necessary background information to create a plausible and a scientific 3D model of the castles. The description of the added textures provides the missing data for the outlook, which the program itself does not offer.

The nature of *Sketchup*, the program I have utilized for modelling has been previously explained at paragraph 2.5. The straightforwardness of this program allows for an efficient construction of the model, which can be edited, and displayed with great ease.

In the following four chapters, each of the case studies will be described. It is necessary to create a complete overview of the context of each case study. In order to provide this overview, the research history, the owners of the castles, the geological context and the remains of the structure are described in these chapters.

3 Altena

The excavation on the site of Altena was initiated in 1969 and continued until 1993 (Bult 2004, 8). The excavation was later resumed and finished in 2014. The site, located at the Voorhoornsdijkse polder near the medieval town of Delft contained six phases, which dated between 1250 and 1761 (Bult 1980, 3; Bult 2004, 8).

3.1 The surrounding region

Altena is situated in the Holocene part of the Netherlands. The geology consists of several layers situated on top of each other. Figure 2 displays an example of such a landscape, and how it affected human occupation. The layers which were encountered during excavation were the layers of Wormer (previously described as Calais IV) and the layer of Gantel (previously described as Duinkerke I) (Zagwijn and Van Staalduinen 1975; Vos 2015, 257-8). The Gantel layer dated back to 500 BC, and on top of this layer a vegetation horizon has formed (Bult 2014, 24). This vegetation horizon is referred to as "*woudlaag*" or woodlayer, and was formed during the Roman period and Early medieval period (Zuidhoff *et al.* 2006 82). On top of this layer the 13th century material, which served as landfill (Bult 2004, 13). Structures belonging to Altena are constructed through the woodlayer (Bult 2004, 13). 40 cm of the top layer has been disturbed in recent times (Kerkhof 2012, 17).

Altena is located near the city of Delft, at the end of the "*laan van Altena*". The reclamation process of this region was started as early as the Merovingian period (Bult 2014, 128). During the Carolinian period, further investments in the landscape occurred (Bult 2014, 128).

The city of Delft, near which Altena is located, is first mentioned in 1157 (Niermeyer 1944, 20). Delft received the right to be a city in 1246 (Niermeyer 1944, 56). The "Hof van Delft", was one of the largest territories (Koch 1970, 55). The term "Hof" describes an agricultural unit, which functioned as centre of cultivation (Niemeyer 1944, 27). The owner of the land was the count, yet peasants cultivated it (Bult 2011, 23). The lands on which Altena itself was located belonged to the "*Vrijenban*" which was first mentioned from 1206-1215 (Koch 1970, 55). These lands were free of duties towards the count, hence the name "*Vrijenban*" (Bult 2011, 25).

The "Hof van Delft" disintegrated during the year 1251, with the transfer of the Curtis of the "hof van Delft" to the praemonstratenzer order which owned the local monastery Koningsveld (Bult 2011, 141). The count absolved serval duties for the inhabitants and nobility could possess land in the "hof van Delft" (Bult 2011, 141). This is the context in which the castles of Altena was created around 1250.

3.2 History of Altena

The first mention of Altena itself occurred in the year 1347 (Westenbroek 1992, 11). Altena was sold in 1347 to the lady of Cruiningen (Westenbroek 1992, 16). It is unclear if this lady was either Elizabeth of Heenvliet or Aleida of Borselle (Westenbroek 1992, 16). The husband of Elizabeth, Adriaan, lord of Cruiningen, was actively involved in the region of Delft (Westenbroek 1992, 16). Because of this fact it is likely that Elizabeth was the owner of Altena instead of Aleida (Westenbroek 1992, 16). In either case, the owner possessed a high social economic status (Westenbroek 1992, 16). It is unclear if a person of a high social economic status inhabited Altena itself, or that the owner had farmed/leased out his possession.

Altena has been described as a residence of nobility, and has been sold and purchased several times (Westenbroek 1992, 19-21). Eventually, Goeswijk van der Poel, a nobleman became the owner of Altena (Westenbroek 1992, 22). During the 14th-15th century political conflict, named *"De Hoekse- en Kabeljauwse twisten"* Altena is confiscated and officially described as "defensible" (Westenbroek 1992, 22). In the document in which the confiscation is described, Altena is mentioned as the residence of Goeswijk van der Poel (Westenbroek 1992, 22). In light of this, we may interpret that Altena constitutes a castle at this point in time. Yet no building of this earliest version of Altena was excavated (Bult 1980, 5). In figure 25 and 26 the relevant phases of the ground plans for the model are displayed.

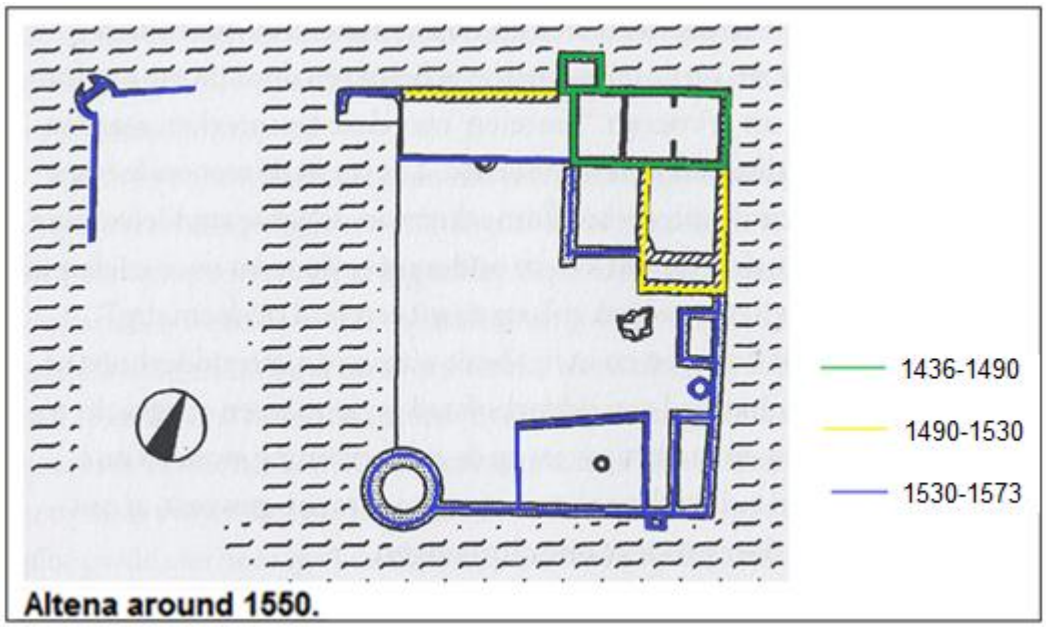

Figure 25: The ground plan of Altena around 1550 (After Bult 1980, 5).

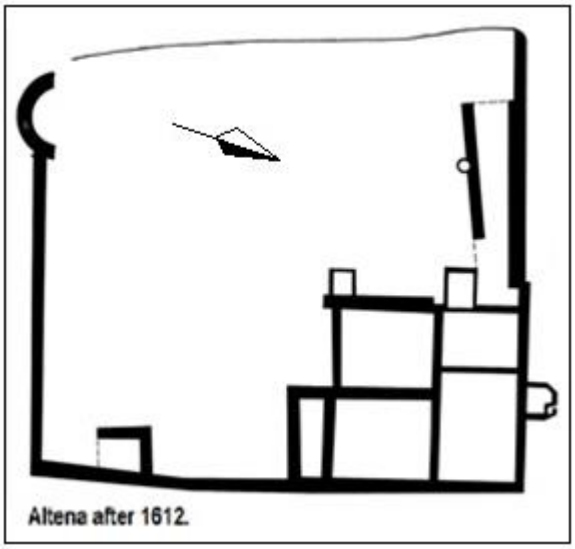

Figure 26: The ground plan of Altena after 1612 (After Bult 1980, 5).

Altena was altered several times from 1436 until 1572 (Bult 2004, 5). The first of the alterations appear in 1435 with the construction of a moat and a hall containing a tower with a staircase (Bult 2004, 5). The owner of Altena at this period was Gerrit Gerritsz. van Egmond (Bult 2004, 5).

In 1490, Gerrit van Nijeveld reconstructed Altena, when he took possession of the castle (Bult 2004, 5).

The effects of the war between Spain and the Dutch Republic are visible in the history of Altena. Prior to 1572, the owners had converted Altena in a luxurious house, which was demolished shortly after this date (Bult 2004, 6). Because the nearby city of Delft feared the nearing enemy Spanish troops, ordered all "defensible" buildings (such as Altena), surrounding the town to be demolished (Bult 2004, 6). In 1612, Altena was rebuild, using partly the walls of the ruin of 1572 (Bult 2004, 6; Bult 2007, 33).

Altena served as a residence for the Van Almondes family after 1612, who portrayed their coat of arms upon the windows (Bult 2007, 33). The main building was restored, the moat was deepened/dredged, a new bridge was constructed at the east side of the structure and a new staircase in a hexagonal tower in the middle of the northern front of the main building was added (Bult 2004, 6; Bult 2007, 33). After 1612, Altena became at first a noble countryseat, later on it was rented to rich or important people and finally as a tavern yet the status deteriorated until it was abandoned in 1740 (Bult 2004, 6).

Altena served the purpose of residence for wealth people, to be converted into a tavern around 1680-1730, and later it served as a "*rederijkamer"* (an organisation/club for poetry) (Bult 2004, 6; Bult 2007, 33). The ground plan of the castle of figure 26 depicts a version of the last phase of the structure. After 1740, Altena became a ruin, which was demolished in 1761 (Bult 2004, 6).

The castle can be considered a moated site, according to the term of Bult. There are defensible elements present, such as the moat, and the towers. Yet the walls are too thin and the moat to shallow to have any actual defensible value.

On the basis of the excavated foundations and the historical information available, a chronological overview has been created. The overview in table 1, describes the various owners responsible for the architectural changes we discern in Altena over time. The dates at which the individuals in charge of Altena renovated or restructured Altena are also presented.

Table 1: An overview of the owners of Altena whom are responsible for changes towards the castle.

Owner	Year	Type of construction
Goeswijn van der Poel	Before 1421	Unknown.
Gerrit Gerritsz van Egmond	1435	Brick-built hall and tower.
Gerrit van Nijeveld	1490-1530	Additions to the hall.
Van Almonde	1530-1572	Several additional buildings.
George de Bije	After 1612	Rebuild the main structure and a brick-built hall

3.3 The excavation

The excavation of Altena started in 1969, continued until 1993 and was resumed and finally finished in 2014. The area of research was excavated because the area was selected for the construction of a factory of the *"Koningklijke Gist- en*

Spiritusfabriek", now called the DSM Anti-infection (Bult 2004, 2). Intentionally, the excavation focused on the main terrain and the surrounding moats (Bult 2004, 4).

The excavation uncovered the castle of Altena (Bult 2004, 4-6):

- The pre-castle phase from 1250-1435. The excavation revealed a parcel, surrounded by a ditch/moat of 3.5 m wide. No traces of a building have been recognized. The possibility that the buildings were constructed out of wood offers an explanation for the lack of structures. While stones, or "*kloostermoppen*" have been found, the presents of several pits filled with manure points towards a farm, rather than a castle. Yet in a document dated 1421-1424, Altena is describes as a "*woning*", which in the same text is used to describe fortified housed. The pits are filled and the terrain is levelled at the end of the 14th century.

- The second phase dates from 1435-1490. During this period, Gerrit Gerritsz van Egmond ordered the construction as a rectangular hall made of brick at the north eastern part of the terrain. The house had a size of 30 x 37 meter, and was surrounded by a moat. The house contains a hall with the size of 7 x 14 meter and walls with a thickness of 60 cm. The orientation of the house is east by west. A brick-built hall, containing the staircase, and a cesscellar in its basement which was attached to the north western corner was present. The moat possessed a width of 12 meters. The previous ditch/moat was filled and a structure was erected at this location. Furthermore, the excavation revealed several building materials such as brick, and slate tiles, which were present on this part on Altena.

- The third phase is dated around 1490-1530. During this period attachments to the existing castle gave Altena an L shape. The person who order the construction was most likely Gerrit van Nijeveld. Attached to the hall, an addition was erected along the eastern moat, with measurements of 7.5 x 7.5 meter. A round cesspit was created in this period.

- During the period of 1530-1572, Altena reached its maximum size. During this period, the van Almonde family resided on Altena. In this period the hall received an additional wall. The earlier cesspit was partly demolished. There are several new structures in the period 1530-1572. Along the northern wall an additional building was constructed. A polygon cesspit was created, against the eastern wall. In addition, a building was constructed and at the southern wall with two levels. And finally, a round brick-built hall was created at the south western corner. All these buildings seem to have different starting dates for construction.

  Altena was surrounded by walls and the buildings faced the open space on the court. An outer terrain was transformed into a bailey with a size of 35 x 15 meter. The bailey contained a round brick-built hall, with walls to the side. Yet these walls did not surround the entire terrain. The moat did surround the entire bailey.

- The last phase of Altena dated from 1612 -1765. George de Bije rebuild the castle, and is mentioned as such in a testament dated at 1613. The old hall with its additional buildings was reconstructed and adjusted to become a single structure. The old tower with the staircase was replaced with a new tower. At the eastern side of the terrain, a drawbridge was constructed, with a small building next to the bridge.

3.4 The images

The designers Roelant Roghman and Abraham Rademaker have made images of Altena, depicting Altena at dates postdating 1612 (Kloek 1990, 33). The depiction of Roghman dates from 1646-1647 and de Haen from 1729 (Kloek 1990, 33; www.Nederlandse Kastelen Stichting.nl 2018).

Figure 27: The image of Roelant Roghman, which faces Altena from the north-eastern corner and dates from 1646-1647 (After Kloek 1990, 33; After www.Kastelen Zuid Holland.nl 2003).

Figure 27 displays Altena after its reconstruction of 1612. The image displays the main structure, together with the brick-built tower containing the staircase. The Drawbridge and the building next to it are depicted. On figure 27, large cross-windows are present. On the top of the north side of the roof, a window of the "*kloostervenster*" type appears to be present. Both types of windows are in use during the period 1300-1700, yet the large windows appear during the 17th century (Janse 1971, 38-39).

Furthermore, a round window appears on the main structure. On this location, an outline of a former door is visible, which has been sealed off. Chimneys appear, together with decoration on the brick-built hall in the form of arches. These archers are described as "*Boogvriezen*", unfortunately these elements could not be dated (Hermans 2013, 60). The first of these arches appears around the 12th century, it disappears somewhere in the 18th century (Haslinghuis and Janse 1997, 91). The shape of the roof follows the crow-stepped gable design, which appears around 1600 (www.Kwaad.net 2004).

Figure 28: The images of Altena in 1729 by Abraham de Haen, facing the castle from the North side (After www.Kastelen Zuid Holland.nl 2003).

Figure 28 displays several elements, which appear on figure 27. The main structure, the brick-built hall, the windows and the arches on top of the tower appear.
This image displays that the roof on the east side of the structure is wider than the opposing side. The drawbridge seems to have been replaced.

Despite all of this information, many elements of Altena remain unknown. The masonry remains outside of our grasp. The decoration that covered the castle prior to 1572 is also unknown.

3.5 The model

There are four models of Altena. The castle of Altena was constructed around 1250. The castle of Altena was first destroyed in 1573, and subsequently rebuilt in 1612. The foundations of the castle of 1573 are reused for the castle of 1612, with a few additional elements. On figure 25 and 26, the ground plans are displayed. Yet only the images of Altena created after 1612 can be considered reliable.

No images of the Altena castle prior to 1573 are available to us. The primary outlines and shapes of the castle as described in historical sources as well as the remains of the early foundation allowed for the creation of a model as to what previous appearance Altena might have had prior to 1573. Because of the lack of reliable images, this model lacks several details as windows and chimneys. On the other hand, the model does display a great amount of information about the construction history of Altena. On the figures, 30 and 31 the model prior to 1573 is displayed.

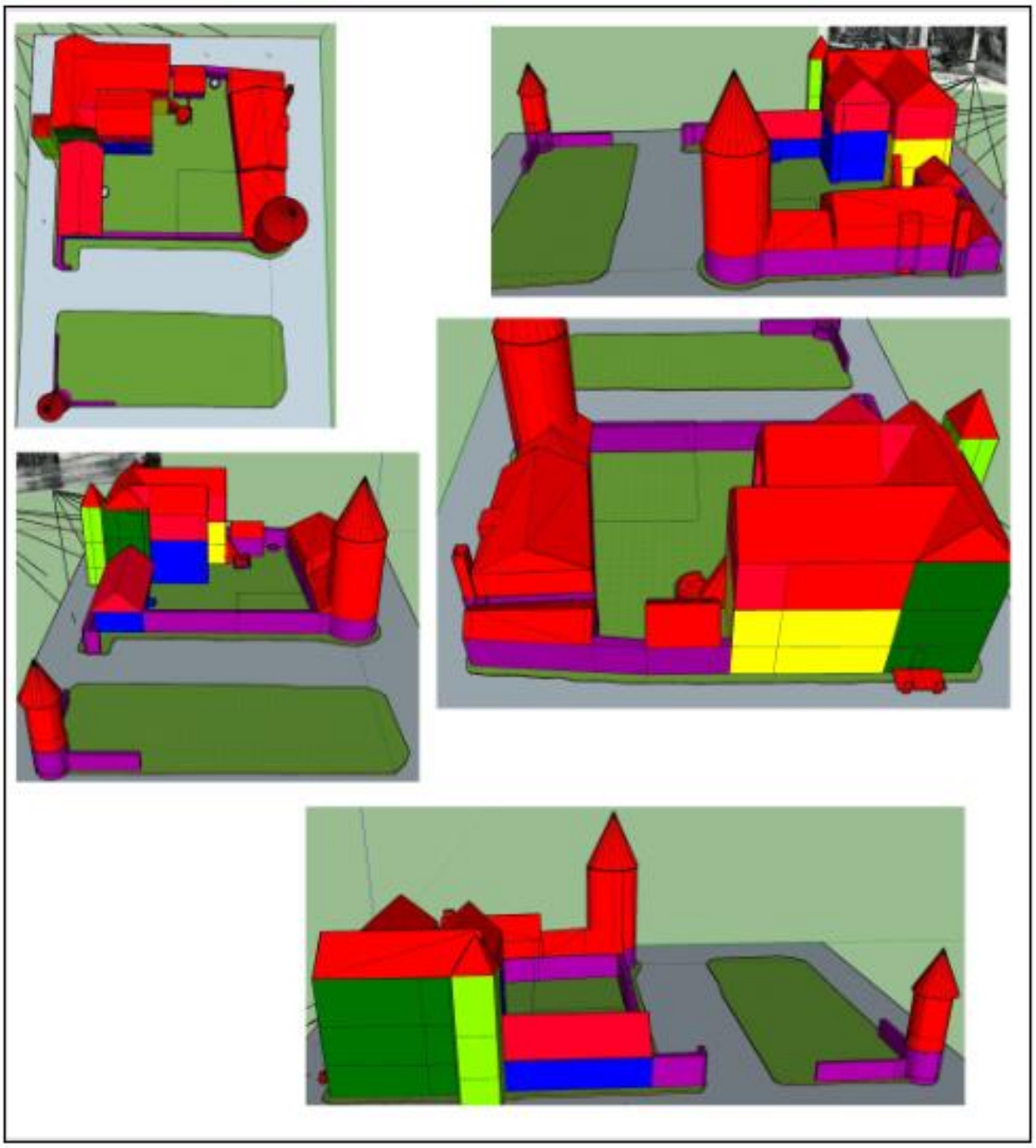

Figure 29: The Castle of Altena prior to 1573 (Bult 1980, 5). The colours display the different phases in the construction history of Altena.

The rectangular hall, depicted in a dark green shade on figure 29 is the oldest part of Altena, and likely to be constructed by Gerrit Gerritsz van Egmond. The dark green part of the castle dates to 1435 (Bult 2004, 5). Attached to this structure is a brick-built tower, containing a staircase, displayed in a light shade of green.

An addition to the brick-built hall is a structure, depicted in yellow. This part of Altena is constructed from the period in which Gerrit van Nijeveld made changes to the castle around 1490 (Bult 2004, 5). The blue parts indicate the next phase in the construction history, during which the Van Almonde family possessed Altena. The changes that were made to the castle between 1530 and 1573 can be attributed to this family (Bult 2004, 5). The blue and yellow additions turn the oldest part of Altena into a large square structure.

The final phase in the construction history of Altena prior to 1573 occurred from 1530 until 1573 in which the Van Almondes still own Altena (Bult 2004, 5). After the additions to the main tower, additional buildings, towers and walls were created, attached to the existing structures.

On figure 29 several features are displayed in red, which indicate assumption. The shape of the roofs cannot be asserted without reference points, which is why all these elements are depicted in red. The height of the main brick-built hall is estimated at the general height of 14 meters. Yet it is uncertain if all the attached structures to the main tower had a similar height.

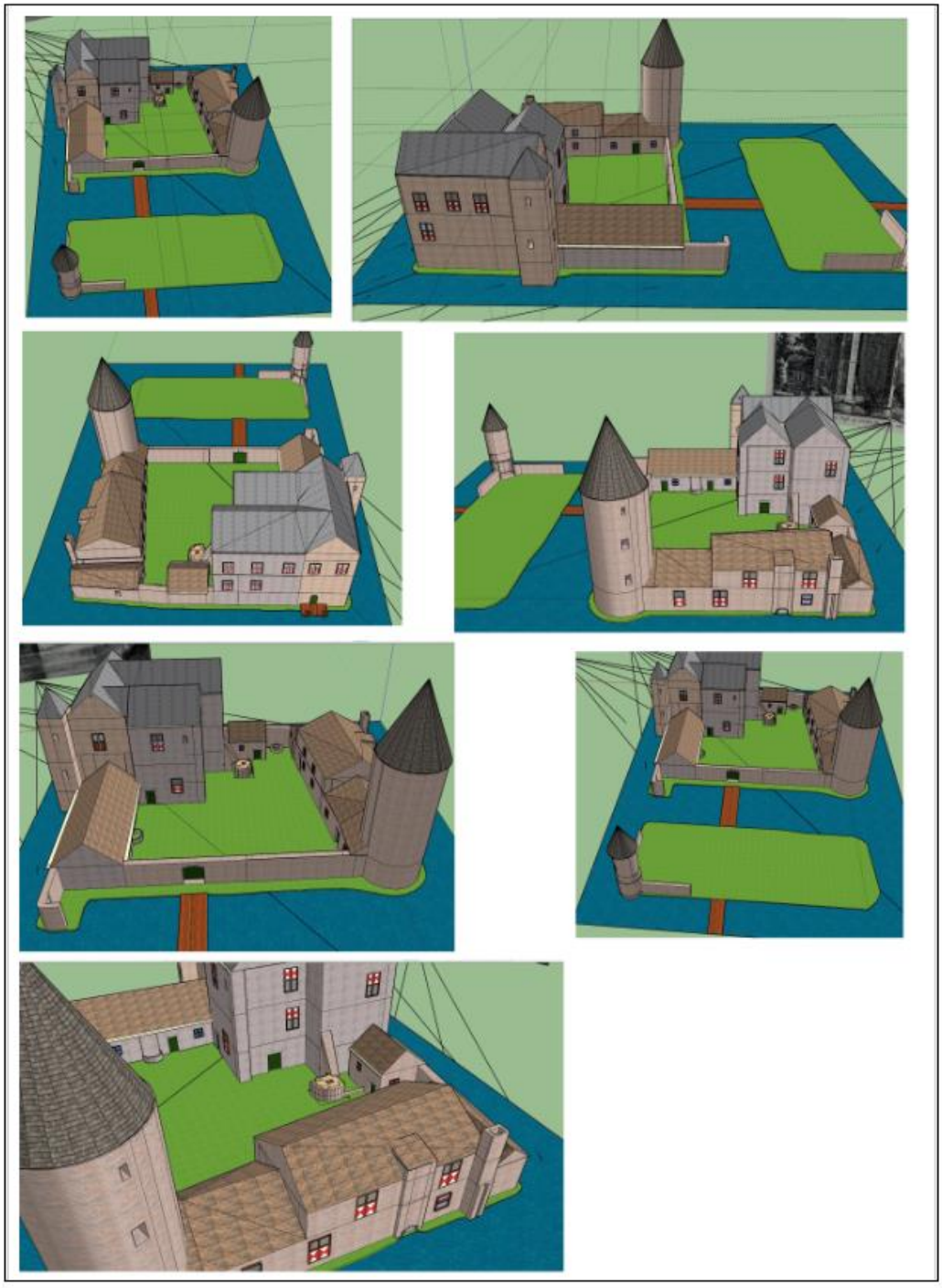

Figure 30: The dated masonry is applied to the model of Altena prior to 1573.

On figure 30 the plausible image of Altena is displayed. Altena is demolished in 1573 to prevent Spanish troops from using the castle. Around 1612 the castle was rebuilt. The rebuilt structure possesses two images, which are depicted in figure 31.

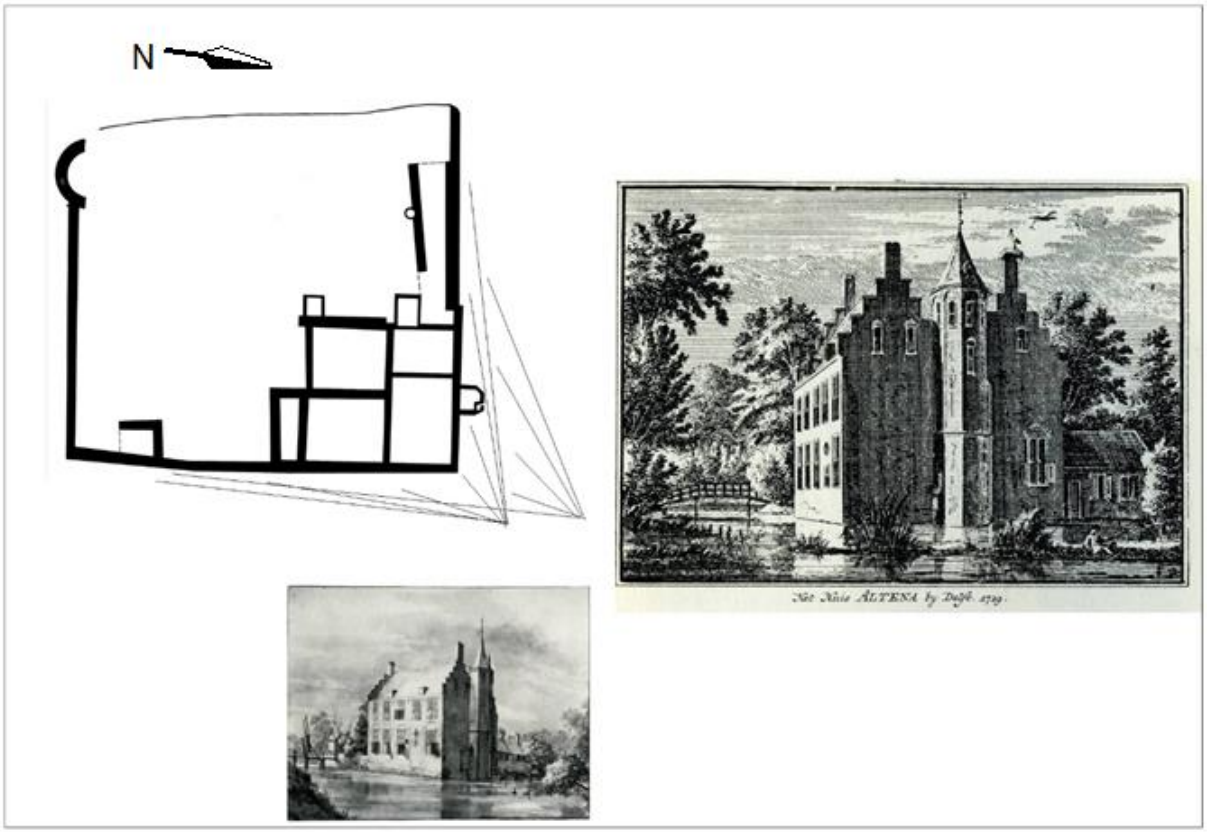

Figure 31: The ground plan and images of Altena after 1612 (After Bult 2004, 5; After Kastelen Zuid Holland 2003).

The images of Altena on figure 31 display an irregularity concerning the roof. On both images the two parts of the roof appear to be of equal height, yet the position of the brick-built hall attached to the structure, suggests that the two parts are not of equal height.

When the model was created, the two parts of the roof had an equal height. Consequently, the shape of the roof did not correspond with the position of the tower, as depicted on both images. After adjusting the height of the roof, this issue remains unsolved. After studying the images, a plausible explanation could be that the two parts of the roof each possess a different height. When this was implemented in the model, the shape of the roof did correspond with the position of the tower. By elevating the most southern part of the two roofs, the shape displayed on the images was created.

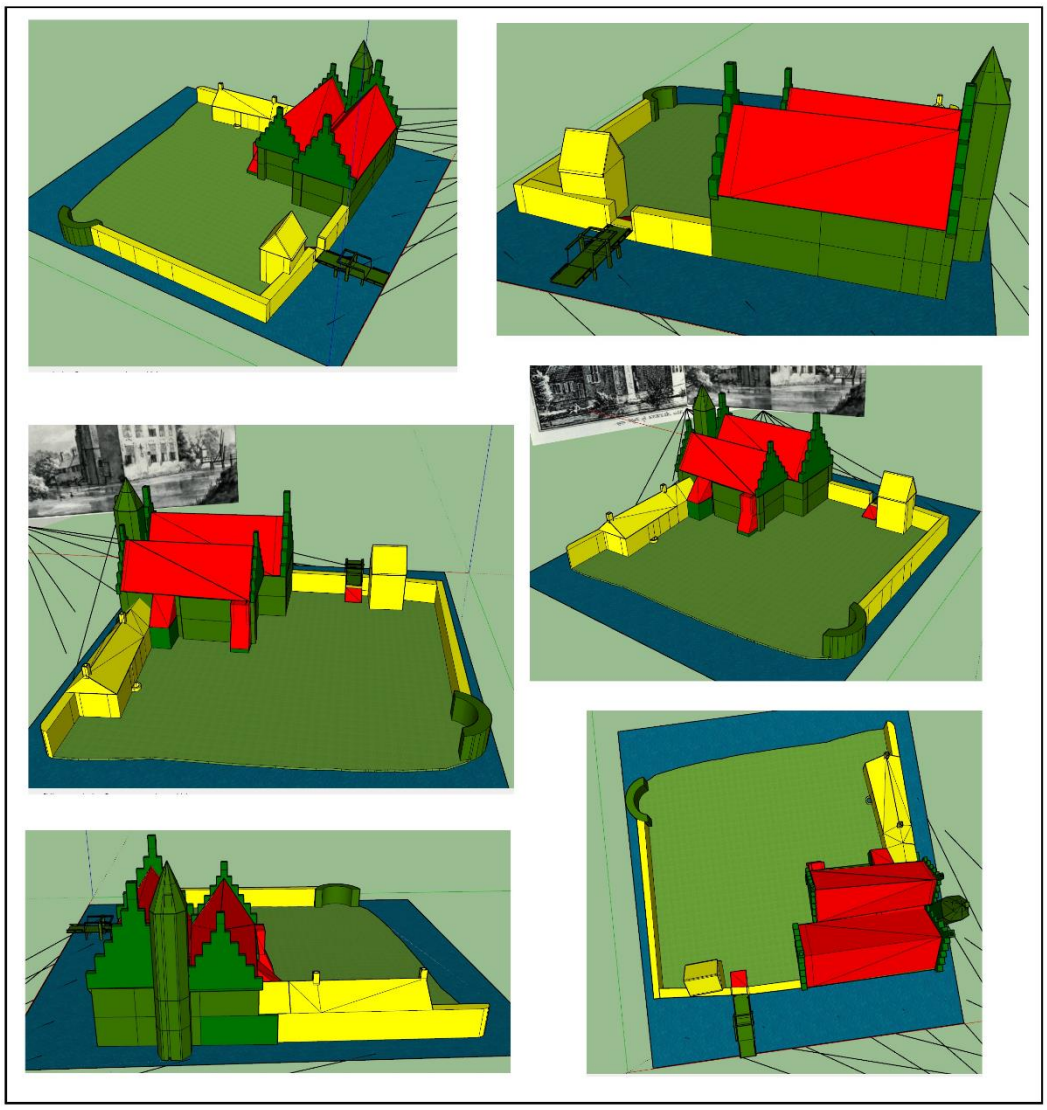

Figure 32: The model of Altena after 1612 (After Bult 2004, 5; After Kastelen Zuid Holland 2003). The different colours display the various stages in the construction history.

The colours on figure 32 display only two stages, and the assumptions. Green displays the oldest part of Altena. After 1612, the castle was rebuilt, and the main buildings of the structure prior to 1573 was restored by George de Bije (Bult 2005, 5-6). This part is represented in green. The tower attached to the main building is assumed to have been constructed at the same time that the main structure was being restored (Bult 2005, 5). The outer wall and several outer structures are depicted in yellow, to indicate that these features were constructed after the main structure is completed. The timeframe during which the yellow features were constructed is in the early 17th century.

The colour red indicates assumption. The shape and height of the roofs of the main structure, are assumptions (Bult 2004, 5; Kastelen Zuid Holland 2003). In addition, the shape of two cesspits along the wall is an assumption. The roof of the tower attached to the main building is not an assumption, as this roof is depicted on the images.

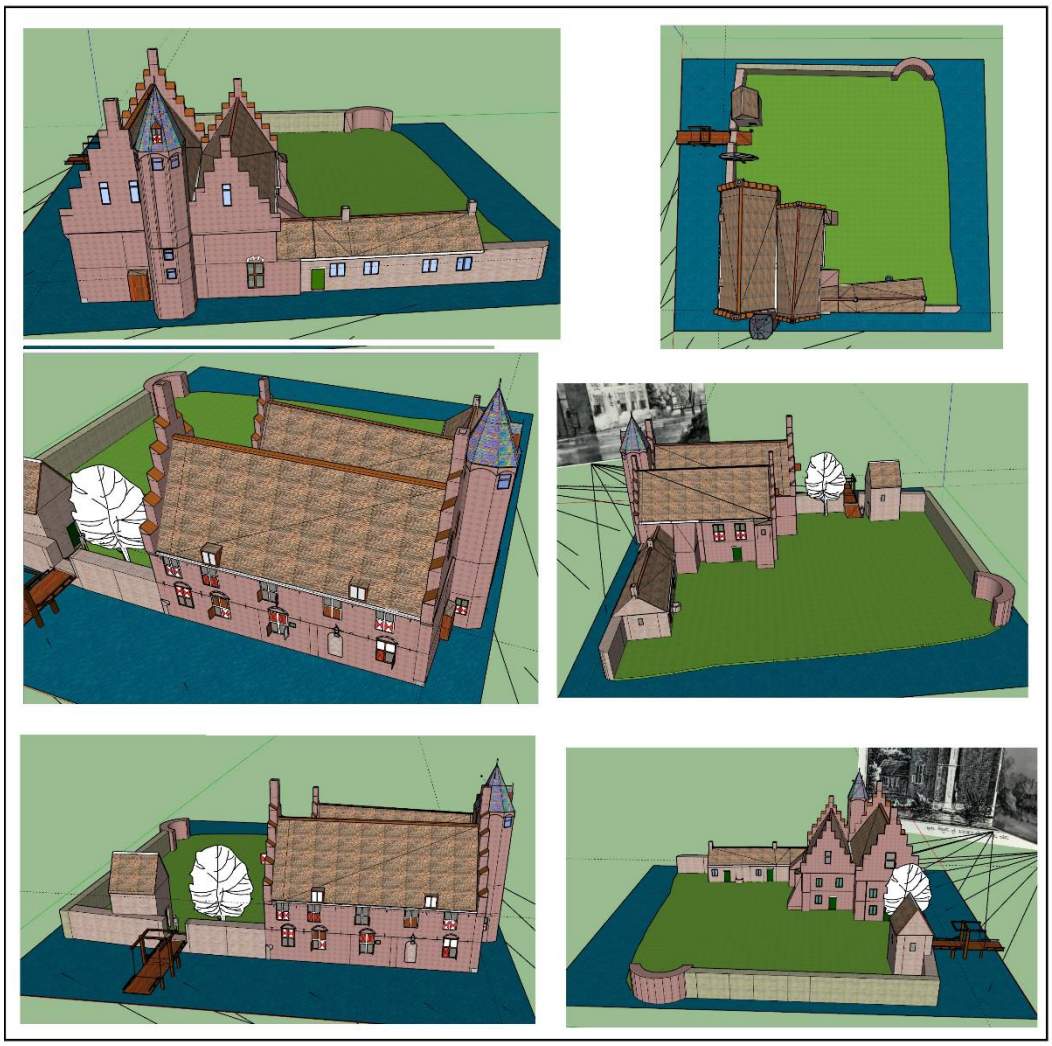

Figure 33: The textures of the dated masonry are applied to the model of Altena.

There are relatively few phases in the construction history, compared to the model of Altena prior to 1573. A possible explanation could be that after 1612 Altena was abandoned in 1740 and demolished in 1761 (Bult 2004, 6). In addition, the function of Altena has changes several times, which caused the status of the structure to deteriorate (Bult 2004, 6). These two reasons provide an explanation why there are only two phases in the construction history of Altena after 1612. With the masonry attached to the model, Altena would have appeared presuming as is depicted on figure 34.

The images, in combination with the ground plan provide enough information to create a plausible image of structures in the past. The model depicted on figures 30 and 31 displays that without the use of images, it is possible to create a 3D model, which can be of use to determine the construction history of a building.

3.6 Summary

The castle of Altena underwent several changes in ownership throughout time. Furthermore, the castle received architectural additions and/or changes throughout time. With the ground plan, the archaeological evidence, the images and the historical text, two models of Altena are created. These models display the architectural changes throughout time, and visualise the changes the owners made over time.

4 Huis ter Kleef

The research history of the castle, which bears the name Huis ter Kleef, started in 1973 and lasted until 1975. The excavations were resumed in 1990-1994 (Numan 1995b, 61-62). This castle, located at the Kleverlaan in Haarlem is described to be an “impressive” structure, which met an unfortunate fate (Vink 1995, 8).

4.1 The surrounding region

Huis ter Kleef is constructed on a layer of sand, which was deposited around 3800 BC (Numan 1995a, 36). The forming of dunes ended around 3200 BC, and after this day, clay was deposited (Numan 1995a, 36). Over time, the influence of the sea over this area lessened, which consequently allowed peat to grow in this area (Numan 1995a, 36). Huis ter Kleef was located on a higher dune in this peat area (Vink 1995, 8).

The castle is located on the west flank of a dune, which ensures a soil suitable for building a brick-built hall (Numan 1995a, 36). In addition, the water level at this location is adequate to ensure that groundwater fills the moat, yet not penetrates the basement (Numan 1995a, 36). Furthermore, the location on the beach barrier offered a natural protection against flooding (Numan 1995a, 36).

Huis ter Kleef is located near the city of Haarlem, and in the immediate surroundings of the village of Schoten (Vink 1995, 8). While today, Schoten is a part of the municipality of Haarlem, originally it was an independent village, and Huis ter Kleef belonged to this territorial unit (Vink 1995, 8). Both Haarlem and Schoten are located on a sand dune (Vink 1995, 8). In the region, the Delft was the most important canal, which was constructed to remove water from the soil (Vink 1995, 9).

The close proximity of Haarlem meant that routes towards the city pass close to Huis ter Kleef (Vink 1995, 10). One of these routes was the “*Kruisweg*” and the “*Middenweg*”, which were important routes towards Haarlem (Vink 1995, 10). With the close proximity of the roads, it appears that Huis ter Kleef could have a tactical purpose yet the structure possessed too few military qualities (Vink 1995, 10).

Schoten was one of the territories, which are described as “*ambachten*” (Vink 1995, 10). An “*ambacht*” is a jurisdictional territory as well as a political unit in Holland (Vink 1995, 10). The title of Schout gives the authority to control an “*ambacht*” (Westenbroek 1993, 9). The owner of such a unit was the count, yet rights were often given to other nobles (Vink 1995, 10). The right of an “*ambacht*” made a person the “*ambachtsheer*” or lord of the territory, which included the right to the income of the territory, and obliged said person to act as judge (Vink 1995, 10). While the ambachtsheer was a judge, the right to judge crimes in which execution was a possibility belonged to a higher authority (Vink 1995, 10-11).

Apart from the ambacht Schoten, there were six smaller of these units near Huis ter Kleef, which were Noord-Akendam, Schotervlieland, Zanen, Schoterbosch, Hogerwoerd and Zuid Akendam (Groesweek 1981, 23; Vink 1995, 11). Between the 15th and 16th century, Schoten and Huis ter Kleef possessed a jurisdictional relation (Vink 1995, 11). From the 16th century, Huis ter Kleef and its surrounding lands belonged to Zuid-Akendam, who were in possession of the same owner (Vink 1995, 11).

4.2 History of Huis ter Kleef

Historical documents first mention the presents of the castle, belonging to Pieter van Rolland, at the end of the 13th century (Vink 1995, 14). After him, the ownership changes to Willem the Bastard and Willem de Cuser (Vink 1995, 14). In the year 1339, the count of Holland decided that Huis ter Kleef is to be inherited within the family of the count (Vink 1995, 14-15).

Willem the Bastard and Willem de Cuser became the owners in the period 1328-1329 (Vink 1995, 13). A different document dictates the year 1335, in which the land and all houses (which could include the castle) were in the possession of Arnoud de Wilde (Vink 1995, 13). In 1346, documents emphasize for the first time that 16 morgen of land were included in the ownership of Huis ter Kleef (Vink 1995, 13). The 16 morgen included the territory of Schoten, in which the owner of Huis ter Kleef received jurisdictional powers by default (Vink 1995, 13).

When the entire territory of Holland became possession of the count of Burgundy in 1433, there seems to be no change in status, rights and attachments of Huis ter Kleef (Vink 1995, 16). Huis ter Kleef became the possession of Walraven of Brederode during the year 1494, and from this date, the house belonged to the wealthy, family Brederode who belonged to the class of high nobility (Vink 1995, 16).

The castle is at first described as “huse te Schote”, before it is named “huise Cleve” in 1503 (Vink 1995, 11-12). A possible explanation of this differentiation in the name of the same building can be found in the fact that around 1503 Huis ter Kleef was owned by the sisters Margaretha and Catharina van Kleef (Vink 1995, 12).

The Brederode family possessed nine similar territories such as Huis ter Kleef in Holland, and numerous other possessions outside of Holland (Vink 1995, 17). With several possessions and castles at their disposal, the presents of the family in Huis ter Kleef is likely to have been minimal (Vink 1995, 17). Henderik of Brederode lost Huis ter Kleef from 1563 until 1566, due to a numerous amount of debts (Vink 1995, 19). The duke of Alva, commander of the Spanish forces in the Netherlands forfeited Henderiks possessions, which includes Huis ter Kleef (Vink 1995, 17).

During the Dutch-Spanish war (1568-1648), Huis ter Kleef was in the possession of the court of Holland (Vink 1995, 20). The court paid for all the maintenance at the house in the year 1569, yet the effect of the war forced the castellan to abandon Huis ter Kleef (Vink 1995, 20). Huis ter Kleef served as a military headquarters for the Spanish army during the siege of Haarlem, from 1572-1573 (Vink 1995, 20). After the capture of Haarlem, at the hands of the Spanish forces in 1573, the Spanish commander, Don Frederik destroyed Huis ter Kleef by means of explosives (Vink 1995, 20). Henderik of Brederode regained possession of the ruin of the castle in 1573. The castle was never rebuilt.

It is worth to note that the condition of the castle is neglected in historical documentation, as documents keep referring to Huis ter Kleef as if it were still intact when it is in a state of ruin for several decades (Vink 1995, 12).

Table 2: An overview of the owners of Huis ter Kleef whom are responsible for changes towards the castle (Vink 1995, 16; Groesbeek 1981, 3).

Owner	Year	Type of construction
Pieter van Rolland?	1250	Hall
Willem de Curser and Coenraad van Oisterwijc	1275-1325	Kitchen
Willem de Curser and Coenraad van Oisterwijc. From 1403 Margaretha ter Kleef.	1325-1425	Inner court
Willem de Curser and Coenraad van Oisterwijc. From 1403 Margaretha ter Kleef.	1375-1425	Inner court
Walraven of Brederode	1475-1500	The Northern tower and a tower containing stairs on the inner court.
Walraven of Brederode	1475-1500	Tower containing stairs

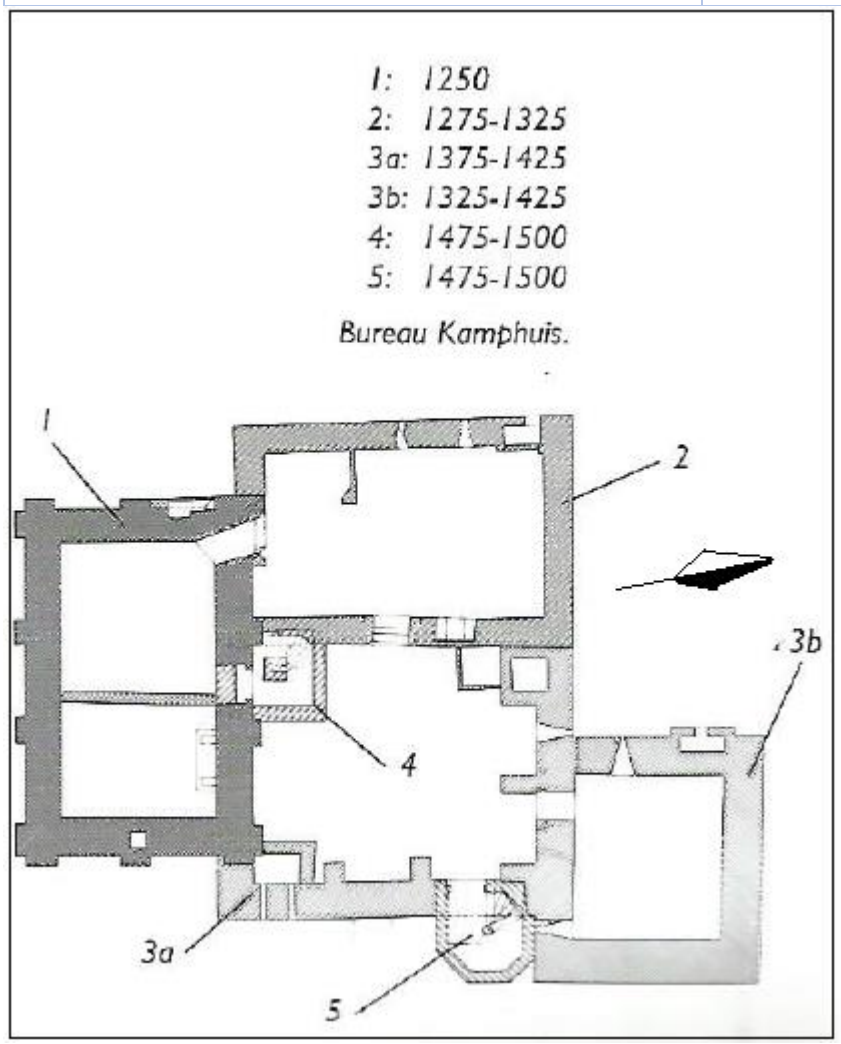

Figure 34: The ground plan of Huis ter Kleef, with the dating's of the five phases of construction (After Kamphuis and Viersen 1995, 40).

The excavated foundations, in combination with the historical information of the owners, table 2 was created. Table 2 described the various owners responsible for architectural changes in Huis ter Kleef, while figure 34 depicts the various architectural changes in the castle. In addition, the dating's of when these persons ordered the construction are presented. The person Coenraad van Oisterwijc is

the father of Willem de Curser, and could be held in equal terms of responsibility as his son for any changes occurring from 1275-1325 (Groesbeek 1981, 3; Vink 1995, 16).

While Huis ter Kleef remains in ruins to this day, the importance of the house and its attachments to the land remain intact (Vink 1995, 21). The house of the Castellan was left standing, yet there is no evidence that points towards a reconstruction of the main castle (Vink 1995, 24). Despite this, the historical documents continuously disuse the word ruin and keep referring towards Huis ter Kleef as if the castle were still intact (Vink 1995, 24).

While the castle was inherited by the family of the count of Holland, and the wealthy Brederode family, the building itself was plain, the unstructured distribution of rooms and the hazard way in which adjustments were carried out (Vink 1995, 15). The earliest mention of the building describes Huis ter Kleef as a brick-built hall, created in 1290, possibly by Pieter van Rolland (Vink 1995, 16). The archaeological evidence partly supports this claim as the evidence suggests a start of the construction of the castle during the period 1250 - 1300 (Vink 1995, 16). Yet it remains uncertain if Pieter van Rolland alone is responsible for the construction of the tower (Vink 1995, 16). Furthermore, the masonry on the foundation suggests construction took place in two separated phases (Kamphuis and Viersen 1995, 38). Based on the design of similar towers, believe that the tower of Huis ter Kleef to be three stories tall (Kamphuis and Viersen 1995, 38).

During the 14th century, the construction of a second building on the eastern side of the main building was realized (Vink 1995, 16). Either Willem de Cuser or his father, Coenraad van Oisterwijc, constructed this secondary building, described in historical documents as a kitchen (Vink 1995, 16).

Huis ter Kleef can be considered as a moated site, according to the term of Bult. It possesses elements such as a moat, and the presents of the battlement. Yet these elements, especially the battlement are not designed for actual protection, and would suggest a decorative function. Huis ter Kleef appears to be specialised in providing living accommodation rather than actual defensibility.

4.3 The excavation

The excavation of Huis ter Kleef started in 1973, as a result of the memorial of the siege of Haarlem (1572-1573) (Numan 1995b, 61). The north tower and wall were excavated (Numan 1995b, 61). A floor was uncovered during these excavations (Numan 1995b, 61). During the excavation of 1990-1994, the structure at the northern wall was identified as the kitchen (Numan 1995b, 61). The pottery of the castle primarily dates back to the 14th century, yet brick-built building blocks of the earliest castle were also uncovered (Numan 1995b, 61-62).

During the excavation of 1990-1994, the bailey was mapped with an ohmmeter, to detect structures in the ground without actually uncovering them (Numan 1995b, 63). This device mapped a gatehouse of 5.50 x 5.50 meter (Numan 1995b, 64). The terrain had a size of 36/56 x 75 meter in total and did not seem to have a military function based on the lay out (Numan 1995b, 65).

From 1990-1994 the entire castle was uncovered (Numan 1995b, 65). Five phases of the construction history were uncovered (Numan 1995b, 65; Kamphuis and Viersen 1995, 40):

- 1 The hall, which dates from 1250.
- 2 The Kitchen, dating from 1275-1325.
- 3 An inner court, dating from 1325-1425. This phase was later divided in 3a (1375-1425) and 3b (1325-1425).
- 4 The northern tower dating from 1475-1500.
- 5 A tower containing stairs 1475-1500.

The first structure was the initial tower, which served as a house on an island, and can be considered "defensible" (Numan 1995b, 66). The measurements inside the tower are 5.55 x 10 meter (Kamphuis and Viersen 1995, 38). The walls have a thickness of 1.30 m (Kamphuis and Viersen 1995, 38). The masonry points towards several phases in which the hall is constructed, instead of a rapid construction (Kamphuis and Viersen 1995, 38). The masonry appears to be Flemish bond (Kamphuis and Viersen 1995, 38).

The castle has several oddities. The door of the hall is placed at a height of 75 cm, which is quite low for a defensible structure (Kamphuis and Viersen 1995, 38). Against the outside wall, "*linsen*" (a reinforcement to the wall) are placed (Kamphuis and Viersen 1995, 40). "*Linsen*" are a common element in England and France during the 11th and 12th century, yet on 13th century Huis ter Kleef this element seems a bit outdated (Kamphuis and Viersen 1995, 40). A final strange feature is the lack of a basement (Kamphuis and Viersen 1995, 41). This can be explained by the fear of the inhabitants for water damage, as a flooding was still a risk in the region (Kamphuis and Viersen 1995, 41).

The tower was located on an island, and later a moat was created (Numan 1995b, 66). The island could have accessible by means of a bridge, yet no traces of such a structure belonging to have been found (Numan 1995b, 67). A door was present in the middle of the hall (Numan 1995b, 67). 17th century clay pipe fragments have been found in this tower, which means that the site was disturbed in this period (Numan 1995b, 67). Numan suggest that the ruin of the castle has been used as quarry for building material (Numan 1995b, 67).

The kitchen area was created around 1275-1325 (Kamphuis and Viersen 1995, 40). This building had a measurement of 6 x 11.20 meter (Kamphuis and Viersen 1995, 42). Attached to the kitchen was a cesspit (Numan 1995b, 68). Against the northern wall, three heart fires were discovered (Numan 1995b, 68). In the western wall a shaft for a latrine was encountered, which possessed a size of 70 x 130 (Numan 1995b, 68; Kamphuis and Viersen 1995, 42). The size of the shaft indicates the existence of at least two latrines (Kamphuis and Viersen 1995, 42). It is likely that these latrines were places at separate levels (Kamphuis and Viersen 1995, 42). This point towards the kitchen being a two level structure (Kamphuis and Viersen 1995, 42).

Considerable efforts to maintain the masonry on the brick-built hall and the kitchen (Kamphuis and Viersen 1995, 42). It is possible that during the winter, the frozen water reached a high level, and thus creating destruction on the lower walls (Kamphuis and Viersen 1995, 42). The constant effort to restore the masonry points towards regular maintenance of the castle.

The inner court was a terrain, which was already raised before 1325-1425 (Numan 1995b, 68). The outsides court facing the moat was walled (Numan 1995b, 68). This wall was built without attachments against the existing structures, which consequently means that is was added later (Numan 1995b, 69). The terrain was at first completely open, yet later it received a pavement of yellow-pinkish stone with a size of 20/21 x 9/10.5 x 4/5 cm (Numan 1995b, 69). In all the structures, shards of slate were discovered (Numan 1995b, 69). These shards were once part of the roof (Numan 1995b, 69). At the eastern corner, a gate house was situated, which was sealed off somewhere between 1500-1573 (Kamphuis and Viersen 1995, 44). Remains of a bridge have been excavated (Kamphuis and Viersen 1995, 44).

The northern brick-built hall at the northern corner dates from 1475-1500 (Kamphuis and Viersen 1995, 44). The measurements of the interior of the tower are 5.33 x 5.95 (Kamphuis and Viersen 1995, 44). A basement was present in this tower (Kamphuis and Viersen 1995, 44). Attached to the northern tower is a second tower, containing a staircase (Kamphuis and Viersen 1995, 46).

4.4 The images

There are several images of Huis ter Kleef available. Unfortunately, the majority of the images display Huis ter Kleef in a ruined state. The figures 36 and 37 display the images used for the creation of the model.

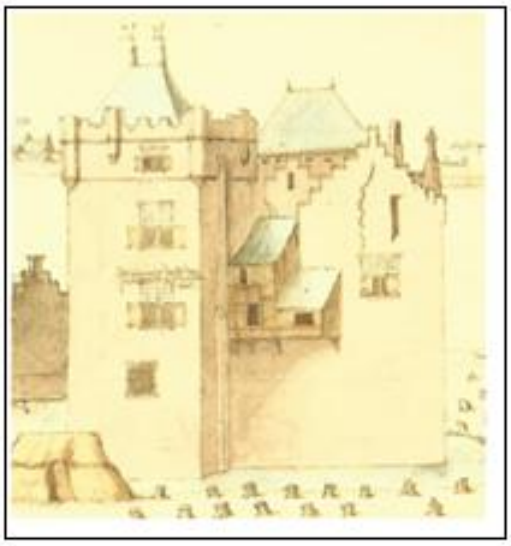

Figure 35: The historical image, known as the "Pseudo Saeredam" of Huis ter Kleef (After Vink 1995, 14-15). The historical image visualized Huis ter Kleef between the middle of the 15th century and 1573 (Vink 1995, 16).

Figure 35 displays Huis ter Kleef before it is demolished after 1573 (Vink 1995, 20). On the image can be seen several architectural elements such as the windows, the shape of the roof and the decoration. In a discussion with Numan, he describes the wooden structure attached to the wall as an "*Overgang*" and was used as a toilet. Above this wooden attachment, the shape of the roof of a tower in the inner court is visible. This tower contained a staircase (Vink 1995, 16; Groesbeek 1981, 3).

The windows appear to be cross-windows. In the tower on the foreground, four windows are placed above one another. This indicates four levels inside the tower. From 1500 this type of window is a common feature. As the tower in the foreground, and the building to the right date from 1325-1425 and 1275-1325

according to image 15, it appears that these windows are a result of a construction after 1425.

Two long narrow embrasure type windows are present which date to the 14th century (Janse 1971, 33-34). This would indicate that the tower in the background and the building in front of it were created before or in the 14th century. The dating of these two parts ranges from 1250 to 1325, which fits the dating of the windows on figure 35 (Janse 1971, 33-34).

On the roof, a grey colour tile is used, which is most likely slate. Apart from the tiles, the crow-stepped gable design is present on the roofs in figure 35. In the discussion with Numan, this type of tiles was described as "*Rijndekking*".

The decorative towers at the side of the tower in the foreground seem to represent Arkeltowers. Arkeltowers date from the 13th century until 1575 (Hermans 2013, 60). According to figure 35, this tower was constructed at 1325-1425, which does fall in the period in which Arkeltowers appear.

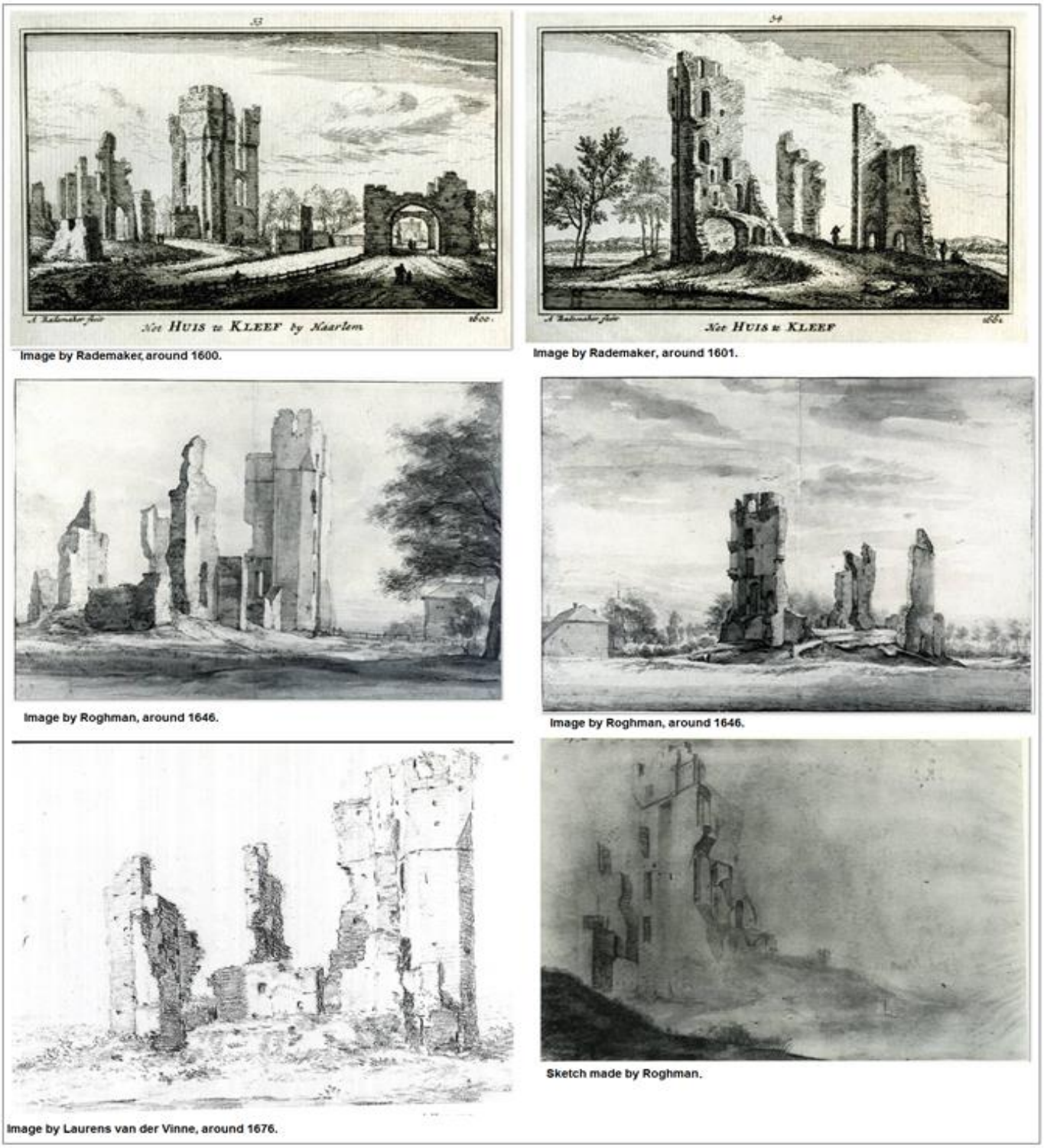

Figure 36: The images of the ruin of Huis ter Kleef (After Kamphuis and Viersen 1995, 41-50: www.Kastelen in Nederland.nl 2019).

The images on figure 36, from top left to bottom right depict (Kamphuis and Viersen 1995, 41-50; www.Kastelen in Nederland.nl 2019):

- First image by Abraham Rademaker depicting Huis ter kleef at 1600. This image was created around 1720 (Kamphuis and Viersen 1995, 48).
- Second image by Abraham Rademaker of Huis ter kleef around 1600 (Kastelen in Nederland 2019).

- Third image by Roelant Roghman is dated around 1646 (Kamphuis and Viersen 1995, 50).
- The fourth image is created by Roelant Roghman and dates around 1646 (Kamphuis and Viersen 1995, 50).
- Laurens van der Vinne created the fifth image in 1676 (Kamphuis and Viersen 1995, 41).
- The sixth image is an undated sketch by Roelant Roghman (Kastelen in Nederland 2019). While it appears likely that this sketch has the same date as image three and four, it is uncertain if it can be dated to 1646.

The six images on figure 36 all display Huis ter Kleef in a state of ruin. The still recognizable brick-built hall does appear to possess four levels, such as figure 35 suggests. These images are of use for the assumption to the height. The remaining brick-built hall appears to have a considerable height if three four were present. It can be assumed that the tower possessed a length of 20 meters high, (which includes the roof structure). The remaining walls of the other structures suggest that these buildings could have reached a height of around 15 meters.

According to the historical documents, a window in the kitchen was replaced in 1523-1524 (Vink 1995, 17). Historical documents refer to the roofs, which contains tiles made of slate (Vink 1995, 17). Because of all the historical images and written sources, together with the archaeological data, Kamphuis was able to create reconstructions of the different building phases of Huis ter Kleef. The reconstructions are depicted at figure 37.

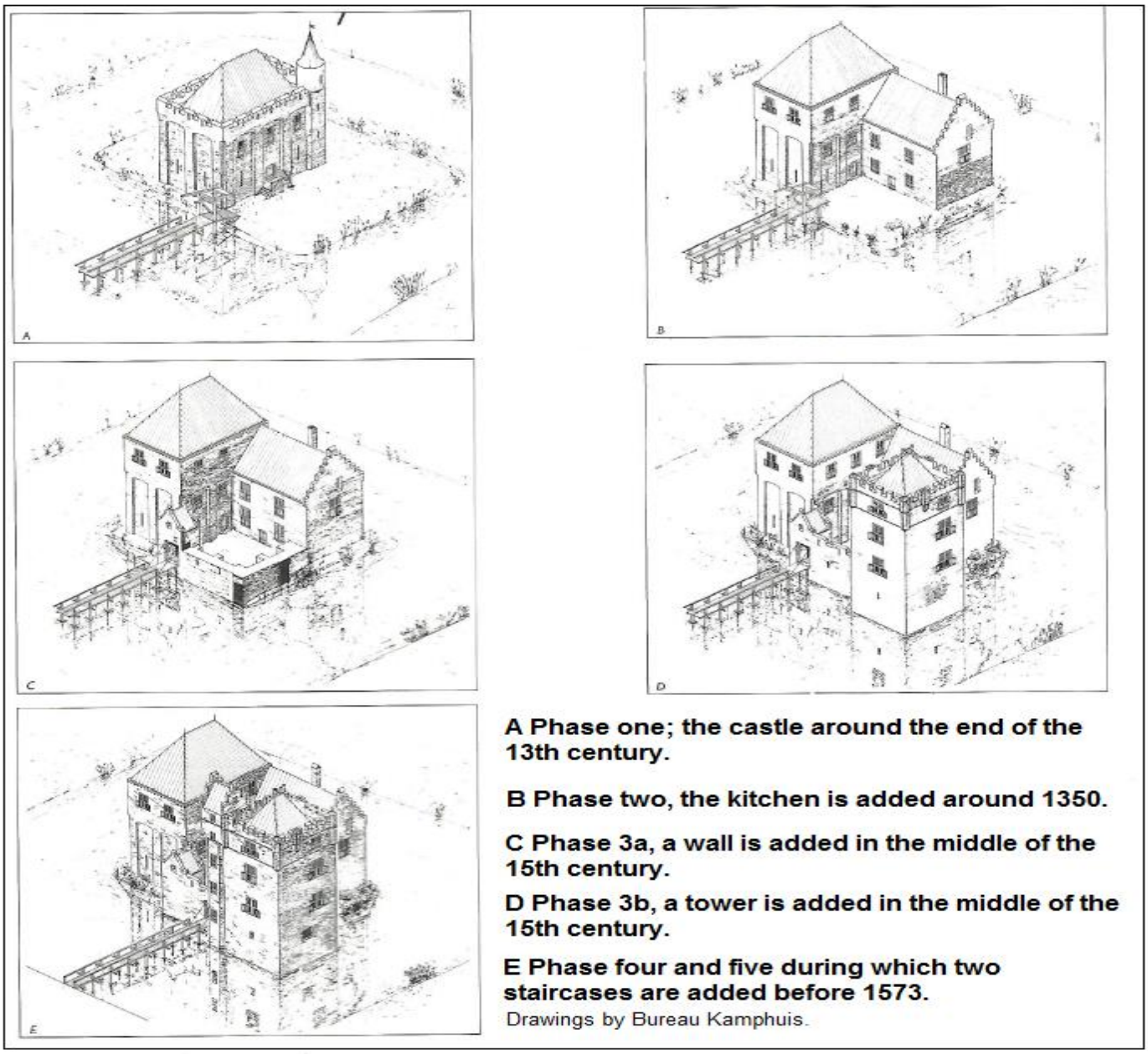

Figure 37: The five building phases of Huis ter Kleef (After Kamphuis and Viersen 1995, 39). This visualization provides useful information for the front of the castle.

On figure 37, image A, there is a round tower present, which contained a staircase (Kamphuis and Viersen 1995, 38). The remnants of this tower is in the masonry of the square hall and the foundations. On E, an inner tower, which is present according to figure 35 is left out.

Even with a large amount of archaeological and historical data, there are several elements, which are still missing. The Flemish bond masonry of Huis ter Kleef was damaged, subsequently repaired and ultimately damaged again by demolishment and the reuse of building material. It is unknown where exactly these damaged areas are, which is why they are not present in the model. Furthermore, the colour of the original masonry is difficult to reconstruct.

4.5 The model

The reconstruction of Huis ter Kleef is based on the archaeological remains and historical images. The images on figure 37, drawn by Kamphuis visualize how Huis ter Kleef developed over time (Kamphuis and Viersen 1995, 39). On the two figures below, six different images with their perspectives and the ground plan are displayed.

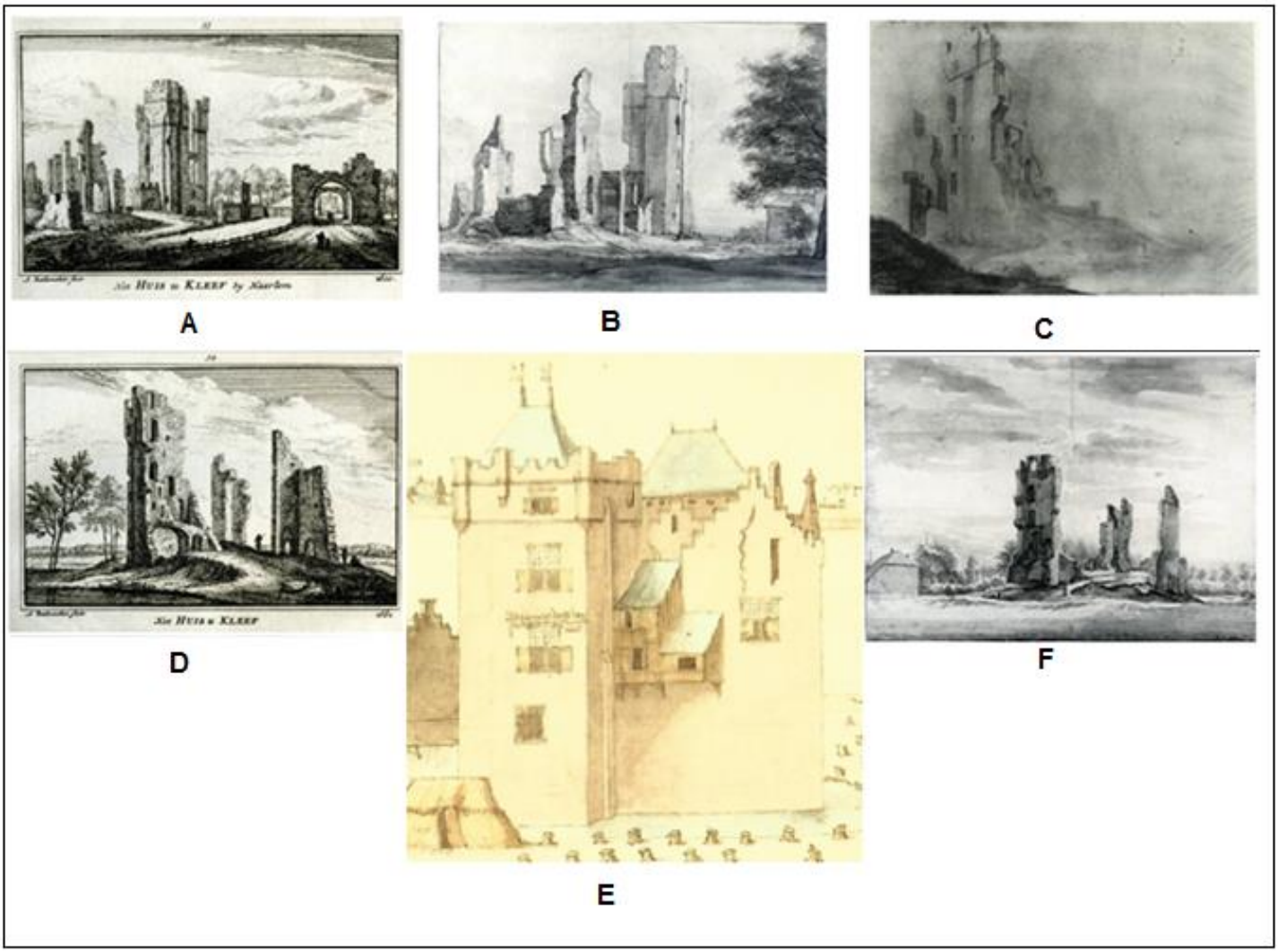

Figure 38: The images of Huis ter Kleef (Kamphuis and Viersen 1995, 41-50; Vink 1995, 14-15).

The number of images in figure 38, in combination with the location of their perspective did not allow for a clear overview in a single image. Instead, the ground plan and the location of the perspectives of each image is depicted on figure 39.

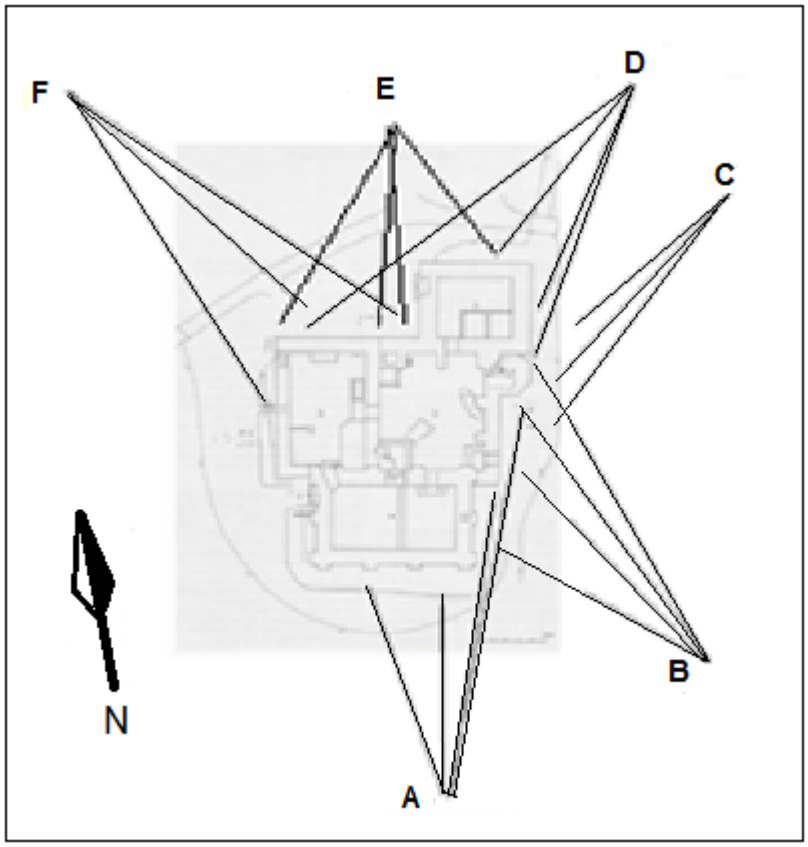

Figure 39: The ground plan of Huis ter Kleef together with the location of the perspective each image of figure twenty-seven displays (Temmink 1995, 2).

As figure 38 displays numerous images, it is possible to create a detailed model of Huis ter Kleef. In addition, the images allow for a representation of the construction history for nearly the entire structure. Yet only one image depicts Huis ter Kleef before it was demolished. This implies that details such as which windows were present need to be assumed.

Figure 39 displays, one corner of the castle, which is not depicted, which means that a part of the model has to be assumed. Numan personally mentioned that a significant number of glass shards were excavated at this location. This points towards the presence of at least one window at this location, yet in a Marquette of the castle, which Numan created three windows, one for each floor level are present. In the model this assumed number is implemented in the model

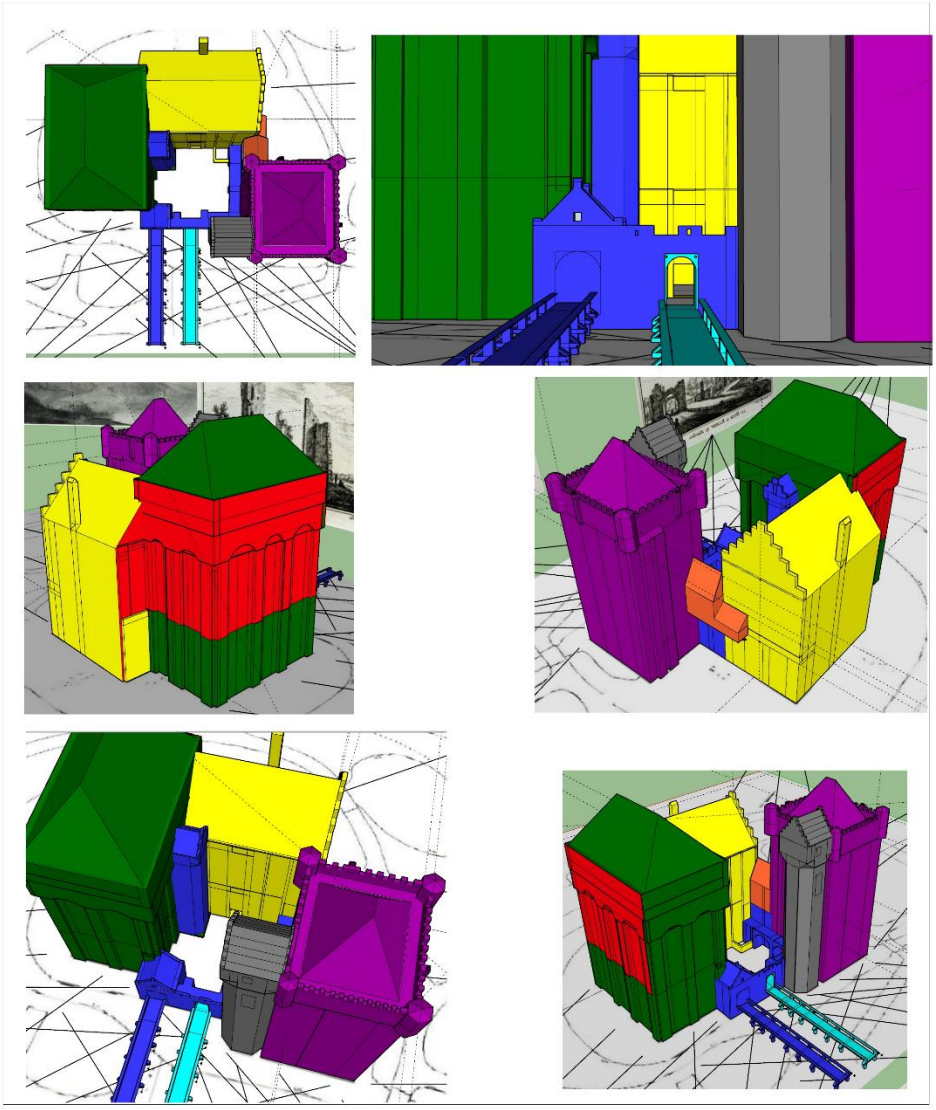

Figure 40: the model of Huis ter Kleef, the construction history of the castle is depicted with the use of colour. The castle stands on an artificial island in a moat.

Figure 40 portrays the different phases of the castle. The green colour identifies the oldest phase of the castle, which manifests itself as the large square tower. The first tower was constructed around the end of the 13th century, possibly by Pieter van Rolland, yet it is unclear what kind of roof the first tower possessed (Kamphuis and Viersen 1995, 38-39). The roof that is used in the model is based on an image that was made prior to the demolition of the castle (Vink 1995, 14-15).

Attached to the brick-built hall is the first addition to the castle, the kitchen (Kamphuis and Viersen 1995, 38-39). The kitchen is depicted in yellow. The kitchen was constructed around the year 1350 by Willem de Curser and Coenraad van Oisterwijc (Kamphuis and Viersen 1995, 38-39).

The colour blue displays a wall at the border of the island upon which the castle is located. This wall was erected during the middle of the 15th century by Willem de Curser and Coenraad van Oisterwijc (Kamphuis and Viersen 1995, 38-39). Wooden poles provide evidence of a bridge and a gate. The gate and bridge have been visualized on the basis of this evidence (Kamphuis and Viersen 1995, 38). Yet at some point after the beginning of the 15th century, the old gate and bridge

were replaced by Willem de Curser and Coenraad van Oisterwijc (Kamphuis and Viersen 1995, 38-39). The bridge and gate that replaced these features, are displayed in a lighter shade of blue. The dating of the gate and bridge is between the beginning of the 15th century and 1573 (Kamphuis and Viersen 1995, 38-39).

A second brick-built hall was created during the beginning of the 15th century by Walraven of Brederode (Kamphuis and Viersen 1995, 38-39). This brick-built hall is constructed on top of the previously described wall. Next to the tower, a structure is placed on top of the wall. This structure, depicted in orange is also visible on the only image prior to the demolition in 1573 (Vink 1995, 14-15).

The brick-built hall containing the staircase is depicted in grey. This tower is attached to the purple tower, as an addition to the structure. The dating of this staircase is prior to 1573, and was added by Walraven of Brederode (Kamphuis and Viersen 1995, 38-39). The perspective of the image prior to 1573 does not display the staircase. Yet on all the images after 1573, the staircase is visible (Kamphuis and Viersen 1995, 41-50).

The corner that is not visible on any of the images has a red colour, to indicate that this part of the model is assumed. While this only concerns a small part of the model, and the foundation reveals an indication of the shape of the structure, it remains uncertain how this corner looked in reality. In addition, there are in comparison to the Keenenburg, few chimneys and windows, which is caused by the lack of images prior to 1573 (Vink 1995, 14-15). It is possible that there are additional structures attached to the castle, but we presently have little to no concrete evidence in support of such additional structures can be found in the archaeological and the historical records.

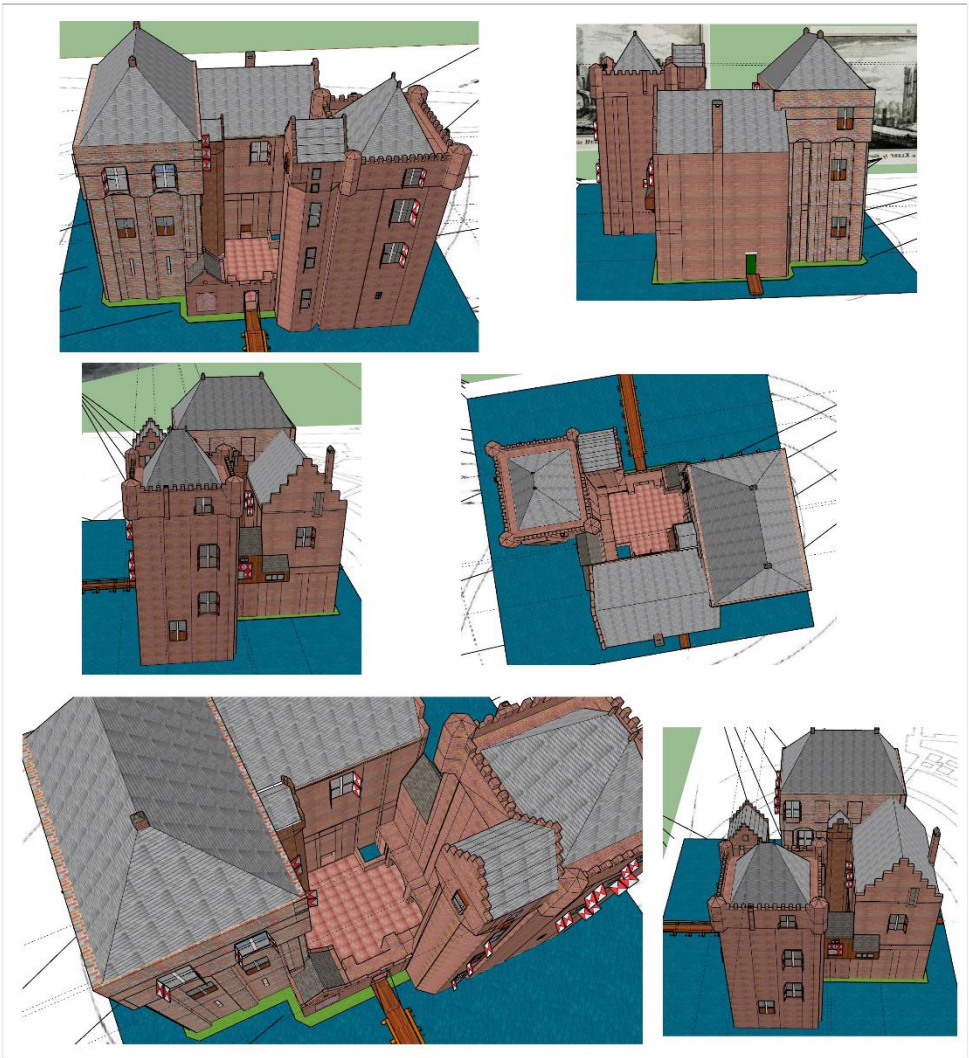

Figure 41: The dated masonry textures are applied to the designated areas on Huis ter Kleef.

Figure 41 displays the dated masonry textures, applied to the right parts of Huis ter Kleef. The model is a plausible visualisation of how the demolished castle appeared in the past. The historical images correspond with the archaeological ground plan to such a degree that the creation of the model was possible. The overall construction history of Huis ter Kleef can be modelled, yet the details of the castle remain largely unknown. This implies that the model cannot display a high amount of detail, thus providing only a brief image of the past, and not an in depth visualisation.

4.6 Summary

The castle of Huis ter Kleef underwent several changes in ownership throughout time and was located on an important route towards Haarlem. In addition, the architectural additions and/or changes are well described in historical text. With the ground plan, the archaeological evidence and the images a model could be created. While the damage to the masonry and the explosive end of the castle were issues, the creation of the model provides a plausible image of what the castle would have looked like throughout time.

5 Keenenburg

Within Schipluiden, a small village near Delft, a castle known as the Keenenburg is located. This castle was excavated from 1960-1990.

5.1 The surrounding region

The Keenenburg is located near the city of Delft. The geological context, in which the Keenenburg Is situated, is defined by several different stratigraphic layers. The oldest layer that is of interest has been identified as the Wormer layer, overlain by a peat layer, that has been identified as Hollandveen (Bult 2016, 12). On top of the Hollandveen, the Gantel layer and the layer of Poeldijk are present (Bult 2016, 12). The layer of Poeldijk is formed in the 12th century (Bult 2016, 12). A benefit, which this offers for the Keenenburg, is that water is permanently available in the moat, yet the ground is stable enough to construct the walls of the castle on it (Bult *et al.* 1990, 3).

The region in which the Keenenburg is located contains a layer of peat in the geology. At the moment the peat settles, the risk of flooding's increases (Bult 2016, 11). This issue occurred several times in the region in which the Keenenburg is located (Bult 2016, 11). To avoid this, issue the builders of the Keenenburg chose a location, which was elevated in the surrounding landscape to protect the structure, yet still allow water in the moat (Bult 2016, 11). This was the ridge of a former gully, which was silted up with sand and sandy clay (Gantellaag). Due to the inversion in the landscape, this sedimentation became a higher point in the landscape.

Originally, the territory of Schipuiden belonged to Hof van Delft. The area around the Keenenburg was donated in de 11th century by the Count of Holland to the Church of St. Maarten in Utrecht. Before 1294 the area known as St Maartensrecht, in which the Keenenburg is located, is the possession of Arnout van Dorp (Bult 2016, 15).

5.2 History of the Keenenburg

The family van Dorp possesses the Keenenburg until 1411, in which Philips van Dorp dies without an heir and Philips the Blote gains his possessions in Schipluiden (Bult 2016, 15). Phillips (re)constructs the Keenenburg. Yet it remains unclear if Philips van Dorp had already constructed a castle at the same location (Bult 2016, 16). The historical sources do mention the sale of brick and slate tiles, which indicate a brick-built structure, created of expensive building materials (Bult 2016, 16). Philips the Blote inhabited the Keenenburg before 1417, as a courier was sent from The Hague to his castle in Schipluiden to summon Philips to the court of the count (Bult 2016, 16). The family de Blote possessed the Keenenburg until 1469/1471 and was succeeded as owner of the Keenenburg by Otto van Egmond (Bult 2016, 17). In the 16th century, his grandson (who bears the same name) manages to expand the property (Bult 2016, 17).

During the 16th century, Otto van Egmond, who manages to expand his territory in Schipluiden to 88 morgens, possesses the Keenenburg (Bult 2016, 15). Van Egmond managed to secure the position of sheriff, clerk, and bode-ambt in 1583 (Bult 2016, 11). Furthermore, van Egmond secured 4662 morgen of land in Schipluiden and Maasland (Bult 2016, 15). Finally, he received the right to appoint vicars and headmasters of schools (Bult 2016, 15). The possessions of van Egmond created a situation, in which he had a significant amount of influence in

day-to-day-, as well as long-term political and jurisdictional affairs within Schipluiden and Maasland (Bult 2016, 15).

Because of the hostilities in Holland between the Spanish monarch, and the Dutch prince William of Nassau, the Keenenburg was deliberately destroyed in 1573 (Bult 2016, 15). It is assumed that Otto ordered the destruction of the outer bailey, yet refrained from destroying the entire Keenenburg (Bult 2016, 17). At the moment the hostilities ceased in the region around Delft, Otto van Egmond started rebuilding the Keenenburg (Bult 2016, 17). The original outer bailey, was however, never restored (Bult 2016, 17).

Following the death of Otto's son, Jacob van Egmond in 1618, the family van Zeventer managed to secure the possession of the Keenenburg (Bult 2016, 17). After several owners, Willem Hendrik van Steenberch renovates the Keenenburg in 1769 (Bult 2016, 17). The Keenenburg is finally demolished in 1798 (Bult 2016, 17).

The castle can be considered as a moated site, according the term that Bult uses. The moat, battlements, towers and bridges give the Keenenburg a defensible character. Yet the castle lacked the thick walls, and the large windows and relatively few battlements suggests that the actual defensive worth was limited.

With the excavated archaeological remains, and the available historical information concerning the Keenenburg, a list of owners who were responsible for different phases in the construction history, could be created. Table 2 described the various owners responsible for architectural changes in the Keenenburg.

Table 3: An overview of the owners of the Keenenburg whom are responsible for changes towards the castle (Bult 2004, 16-17).

Owner	Year	Type of construction
Arnout van Dorp	After 1294	First structures.
Philips van Dorp	Before 1411	Begins construction of the brick-built hall.
Philips the Blote	1411	Finishes construction of the brick-built hall, and attachments. Constructs the hall in two seperate phases
Otto van Egmond	1573	Partly demolishes the castle.
Otto van Egmond	1579	Rebuilds the Keenenburg, creates a new outer bailey.
Otto van Zeventer	1636-1646/1647	A kitchen is added.
Willem Hendrik van Steenberch	1769	Restores the castle.

5.3 The excavation

Between 1960 and 1990, the foundations of the Keenenburg were excavated (Moerman 1976; Bult *et al.* 1990, 1-2). The earliest mention of the Keenenburg is in the year 1294. The earliest dating of the medieval occupation of the site may be dated to the second half of the 12th century (Bult *et al.* 1990, 3). The terrain of the Keenenburg is divided into two areas: the main structure and the bailey (Bult *et al.* 1990, 2-3). On figure 42, the ground plan of the excavated castle is presented.

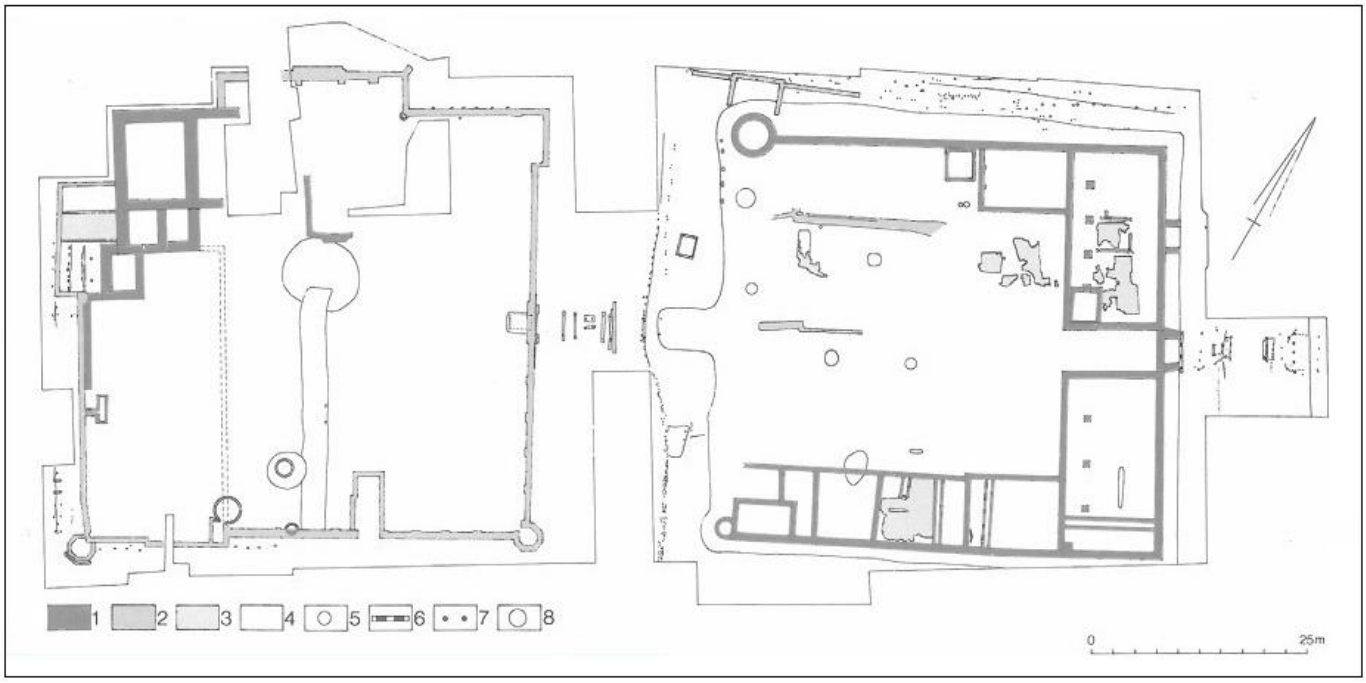

Figure 42: The ground plan of Altena (After Bult 2016, 23).

The numbers on figure 42 display (Bult 2013, 23):

- 1 15th century masonry.
- 2 Late 16th-17th century masonry.
- 3 Floors.
- 4 Moat.
- 5 Wells and cesspits
- 6 Situated wood.
- 7 Wooden poles.
- 8 Pitts.

The terrain of the main structure of the Keenenburg has a size of 44 X 44 meter (Bult *et al.* 1990, 3). It contains a square brick-built tower of 9.4 x 7.9 meters, dating from the beginning of the 15th century (Bult et al. 1990, 3; Bult 2016, 22). Behind this tower, a smaller tower with a cesspit in between its foundations and staircase to connect the ground-floor to the other stories was present (Bult *et al.* 1990, 3; Bult 2016, 22). This tower has a size of 4.3 x 4.1 meter, it has slightly larger bricks (24.5/23.5 x 12/10.8 x 5.8/5.5 cm, and it is likely that the cesspit was never used (Bult *et al.* 1990, 3). The size of the bricks in the foundation of the main tower are 23.5/2211 x 10.8 x 5.7/5.5 cm (Bult *et al.* 1990, 3).

In the second building phase, the tower with the cesspit was incorporated into an enlarged building, which became a hall (Bult *et al.* 1990, 3). The second phase of the building can be dated shortly to the first building phase on the account of the great similarities between the bricks used in the construction of the first and second phases of the structure. This suggests that the first building phase was probably never completed before the second building phase started. It is probable that Philips van Dorp started the building activity but did not finish it before he died in 1411 and that Philips de Blote changed the building plans when he assumed control of the castle (Bult 2016, 22).

Philips de Blote demolished a previous yet unknown brick building at the location of the Keenenburg (Bult 2016, 16; Moerman 2009, 32). Philips sold the brick and slate tiles from this structure to the count of Holland (Bult 2016, 16; Moerman 2009,

32). The plan of Philips de Blote shows a second room against the back of the brick-built hall and the eastern wall (Bult *et al*. 1990, 2-3). At the south side of the tower a tower which contained staircases was attached with a cesspit within the foundations (Bult *et al*. 1990, 2-3). On the images of Roghman, the top of the great brick-built tower displays four small brick-built side towers, so-called “Arkeltowers” (Bult *et al.* 1990, 4; Bult 2016, 23). These side towers do not contain any openings to fire or shoot arrows to the enemy, which could imply that these features served a decorative function only (Bult 2016, 24).

A trench, filled with rubble and bricks was created to serve as a foundation for a wall (Bult 2016, 23). This trench begun at the south western corner of the second tower containing a staircase (Bult 2016, 23). The trench proceeded towards the west and made a sharp turn to the south, to stop in the middle of the terrain (Bult 2016, 23). At the end of the trench a “*gemak*” (a toilet) was placed with its own shaft (Bult *et al*. 1990, 3).

A brick hall was attached to the tower, of which masonry the north- and south wall possesses an irregularity (Bult *et al*. 1990, 2-3). This irregularity suggests that the hall was constructed in the first phase (Bult et al. 1990, 2-3). After the death of Philips van Dorp the construction ceased (Bult *et al*. 1990, 2-3). When Phillips de Blote purchased the castle, the construction was resumed, and the irregular part in the masonry served as a point of attachment for the north- and south wall (Bult 2016, 23).

The walls of the hall, display in both the masonry of the wall and in the images of Roghman, a shape that suggests the hall was constructed in two separate phases (Bult *et al*. 1990, 3-4). A different structure, which was later added to the brick-built tower, was a kitchen (Bult *et al.* 1990, 4; Bult 2016, 24). The wooden poles, which serve as the foundation of the kitchen, provide a dendrochronological date of 1636 (Bult *et al.* 1990, 4; Bult 2016, 24). The kitchen must have been constructed between 1636 and 1646-1647 (Bult *et al.* 1990, 4; Bult 2016, 24).

At the south western- and south eastern corner polygon brick towers were erected (Bult *et al.* 1990, 4). At the south side, a long narrow building of 25.5 meter was constructed, that had an opening to the moat, which points towards the function of boathouse (Bult *et al.* 1990, 4; Bult 2016, 24). The same building yields artefacts that suggests inhabitation by servants (Bult 2016, 24).

At the northern wall, several structures were present (Bult *et al.* 1990, 4). Roghman depicts a building attached to the large square tower, which contained a staircase (Bult *et al.* 1990, 4; Kloek 1990, 115). Next to this building, is the roughly 18 meters long gatehouse (Bult *et al.* 1990, 4-5; Kloek 1990, 115). A bridge connected the former western bailey with the terrain of the main castle (Bult 2016, 24). At the moment Roghman creates the images of the Keenenburg, the outer bailey is in a state of ruin.

At the east side of the gate house, a 13-meter-long and 5.5 meters wide building of red/pinkish brick (Bult *et al.* 1990, 5). The size of the bricks is 19 x 9 x 4.5 cm, and at the outside hard yellow IJssel stones with a size of 17 x 8 x 4 cm (Bult *et al.* 1990, 5).

In the middle of the east side, a simple gate was present, with a wooden bridge, placed upon three pair of poles (Bult *et al.* 1990, 5). This bridge was replaced with another bridge, which was founded on only two pair of poles (Bult *et al.* 1990, 5).

Both bridges have the same typology, the type that needs poles for support (Bult *et al.* 1990, 5).

Apart of the court, there are the outer baileys. The earliest outer bailey was located eastwards of the terrain of the main structure (Bult *et al.* 1990, 5). The size of this terrain was 40 x 42 meter (Bult *et al.* 1990, 5). The moat separating the main structure from the bailey was 18 meters wide and 3 meters deep (Bult *et al.* 1990, 5). In the 17th century, the moat had a width of 12 meters, and was 4.8 meters deep (Bult *et al.* 1990, 5).

At the eastern side of the bailey, two large buildings were present with a size of 17.6 x 9.4 meters (Bult *et al.* 1990, 5). The buildings appear to have been created in the same phase (Bult *et al.* 1990, 5). These buildings flanked the gate of 3.8 meters wide (Bult *et al.* 1990, 5). A bridge connected the outer bailey with the outside world (Bult *et al.* 1990, 5). This bridge which was altered at an unknown date. The poles of these bridges were driven in the soil. The stability of the bridges if provided by the by the soil surrounding the poles (Bauer 1981, 254).

The size of the bricks is 25 x 11 x 5.5 cm and 22 x 11/10.5 x 5.5/5 cm (Bult *et al.* 1990, 5). Several reused stones with a size of 30/29 x 14/13 x6.5/6 cm were present (Bult *et al.* 1990, 5). Masonry recovered from the moat suggests that the two brick buildings did have a height of two levels (Bult *et al.* 1990, 5). A cesspit was present in this structure (Bult *et al*. 1990, 5). On the outside of the building, a wooden platform was constructed to fasten boats (Bult *et al.* 1990, 5). In each of the buildings, brick columns are present, of which one is attached to the wall, which points towards a two level building (Bult *et al.* 1990, 6). The masonry suggests that the columns were created in the same phase as the two buildings (Bult *et al.* 1990, 6).

The northern building possessed a roof with slate tiles (Bult *et al.* 1990, 6). Against the northern wall, a building was present with a size of 8.4 x 6.4 meter, which had slate tiles as well (Bult *et al.* 1990, 6). Next to this building was a cesspit of 3 x 2.8 meters in size (Bult *et al.* 1990, 6). The cesspit suggests that the building could have served as a kitchen (Bult *et al.* 1990, 6).

At the end of the northern wall, a round tower, with a diameter of 4.2 meter is present (Bult *et al.* 1990, 6). At the opposing south wall, a building with six rooms was present (Bult *et al.* 1990, 6). Some of these rooms were later adjustments/attachments such as a round tower with a diameter of 2.2 meter (Bult *et al.* 1990, 6). No sequence could be constructed of these rooms (Bult *et al.* 1990, 6). The absence of any tiles in the moat in front of these structures suggests that an organic material such as hay may have been used for roofing (Bult *et al.* 1990, 6). Brick gullies were present in the building (Bult *et al.* 1990, 6). The bridge which crossed the 12-meter-wide moat was constructed on four rows of oak beams (Bult *et al.* 1990, 6). The moat was considerably less wide in the 17th century.

In 1573 the outer bailey of the castle was demolished (Bult 2016, 15). A new outer bailey was placed at the north side of the Keenenburg, yet this part has not been excavated (Bult 2016, 15). An image by Pronk dating from 1727 provides an image of how this bailey during the 18th century (After www.Midden-Delfland.nl 2009).

The foundations of the structures on the court are absent (Bult 2016, 23). It is possible that these buildings were present, as the foundations for such structures are generally situated at a far lesser depth than the outer walls of the castle (Bult

2016, 23). In addition, the upper layer of the terrain had been removed to fill the moats in more recent times (Bult 2016, 23). The foundations could have been removed with the soil (Bult 2016, 23).

The outer walls of the main structure served as a barrier against the water in the moat, which is why the foundations of these walls are situated deeper than the other walls (Bult *et al*. 1990, 4). The outer walls are constructed out of hard yellow brick with a size of 18/17.5 x 8 x 4 cm (Bult *et al.* 1990, 4). The masonry of the outer wall consists of cross bond, and the earliest dating of this wall is the 16th century (Bult *et al*. 1990, 4). The attachment of the east wall on the gully filled with brick and rubble indicates that this wall replaced the previous wall (Bult *et al*. 1990, 4).

During a discussion with Moerman, two slate tiles of the castle, belonging to the "*Rijndekking*" type of roofing were presented. For this reason, the texture of "*Rijndekking*" is used on the roof of the main tower.

5.4 The images

There are three images created by Roeland Roghman in 1646-1647. There is a fourth image by Pronk, depicting the new outer bailey which is displayed in figure 43. These images display the shape of the towers, the roofs and the windows of the Keenenburg. The roofs of several buildings of the court of the main castle are displayed. While the court of the main castle contained no walls of outer structures on its western side, it is possible that these buildings were present, as the foundations for such structures are generally situated at a far lesser depth than the outer walls of the castle (Bult 2016, 23).

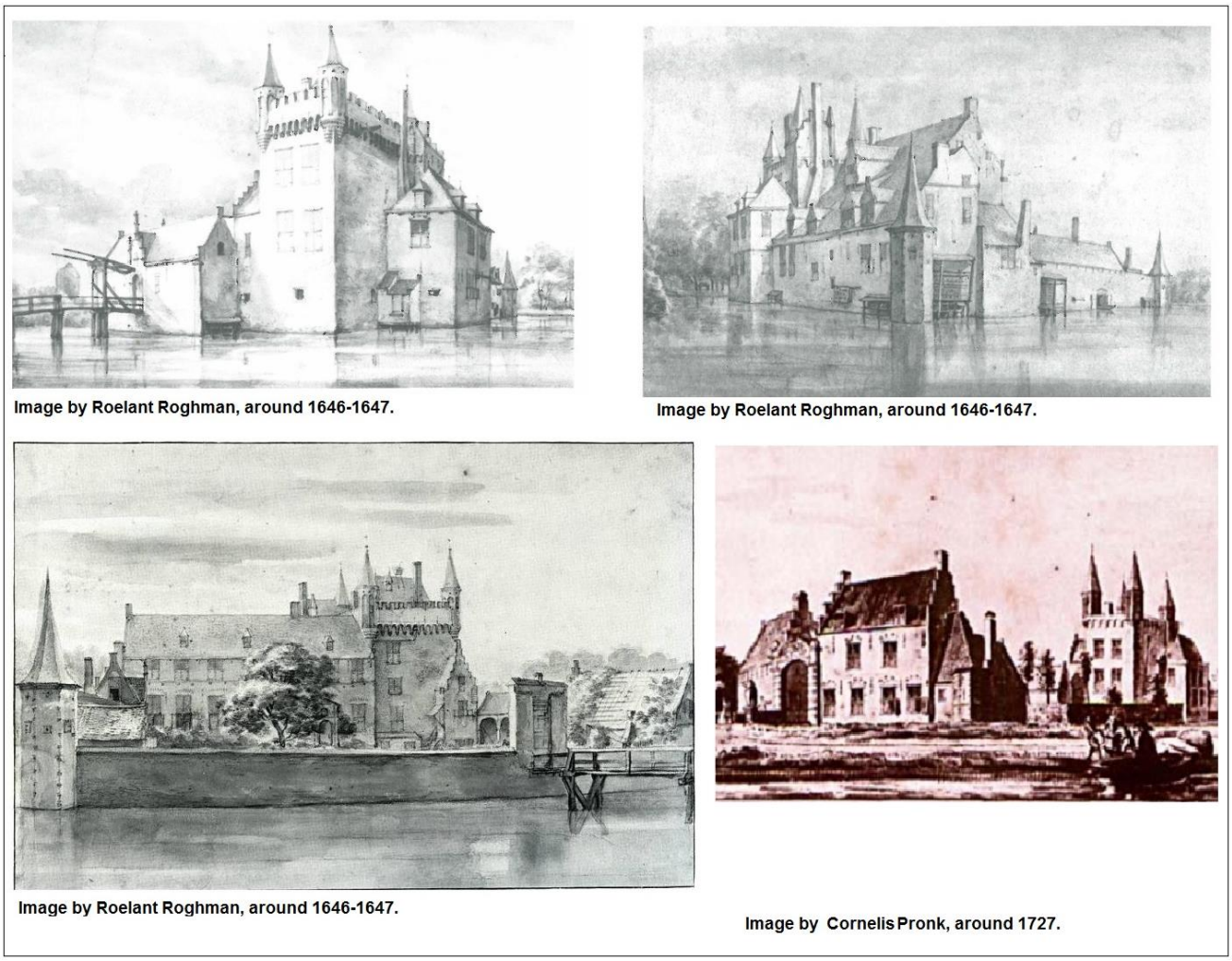

Figure 43: The images of Roelant Roghman and Pronk of the Keenenburg, (After Kloek 1990, 115; After www.Midden-Delfland.nl 2009).

The images on figure 43 from top left to bottom right are:

- Image by Roelant Roghman, facing the Keenenburg from the north west, dated arounnd 1646-1647 (Bult 2016, 17).
- Image by Roelant Roghman, facing the Keenenburg from the south west, dated around 1646-1647(Bult 2016, 24).
- Image by Roelant Rogman, facing the Keenenburg from the east, dated around 1646-1647 (After www.Midden-Delfland.nl 2009).
- Image by Cornelis Pronk of the bailey of the Keenenburg, facing the north side of the castle, dated around 1727 (After www.Midden-Delfland.nl 2009).

On all the images of figure 43, the Keenenburg, arkeltowers are depicted on the square brick tower. This is expected, as the square tower was finished after 1411, and the arkeltower is a common future in the 14th century (Hermans 2013, 60).

On the first image of Roghman, cross-windows appear to be present. This type of window was in common use around 1500 (Janse 1971, 39-40). It is possible that these windows were placed during the construction of 1411, as the approximate date when cross-windows appear is unclear (Janse 1971, 39-40). On this image, the shape of the bridge and of the roofs is of importance, as it allows for a detailed representation in the model.

Apart from the windows, the square tower appears to possess decorative arches. Unfortunately, such elements have as of yet not provided any suitable information for dating (Hermans 2013, 60). These elements do, however, provide the model with additional detail and veracity.

The second image by Roghman displays the arkeltowers, and the decorative arches, yet presents several types of windows. Several designs of cross-windows are present along with the "*kloostervenster*" type, which dates around 1500-1700 (Janse 1971, 44).

The third image by Roghman displays several cross-windows, arkeltowers and decorative arches. The gatehouse also has at last two arches to support the roof. This third image provides a depiction of the bridge, the roofs of the structures in the terrain and the shape of the roof of the polygon towers.

The image of Pronk depicts the outer bailey after the partial demolishment of 1573. Even though this building has not been excavated, this image does provide a representation of what the structure could have looked like.

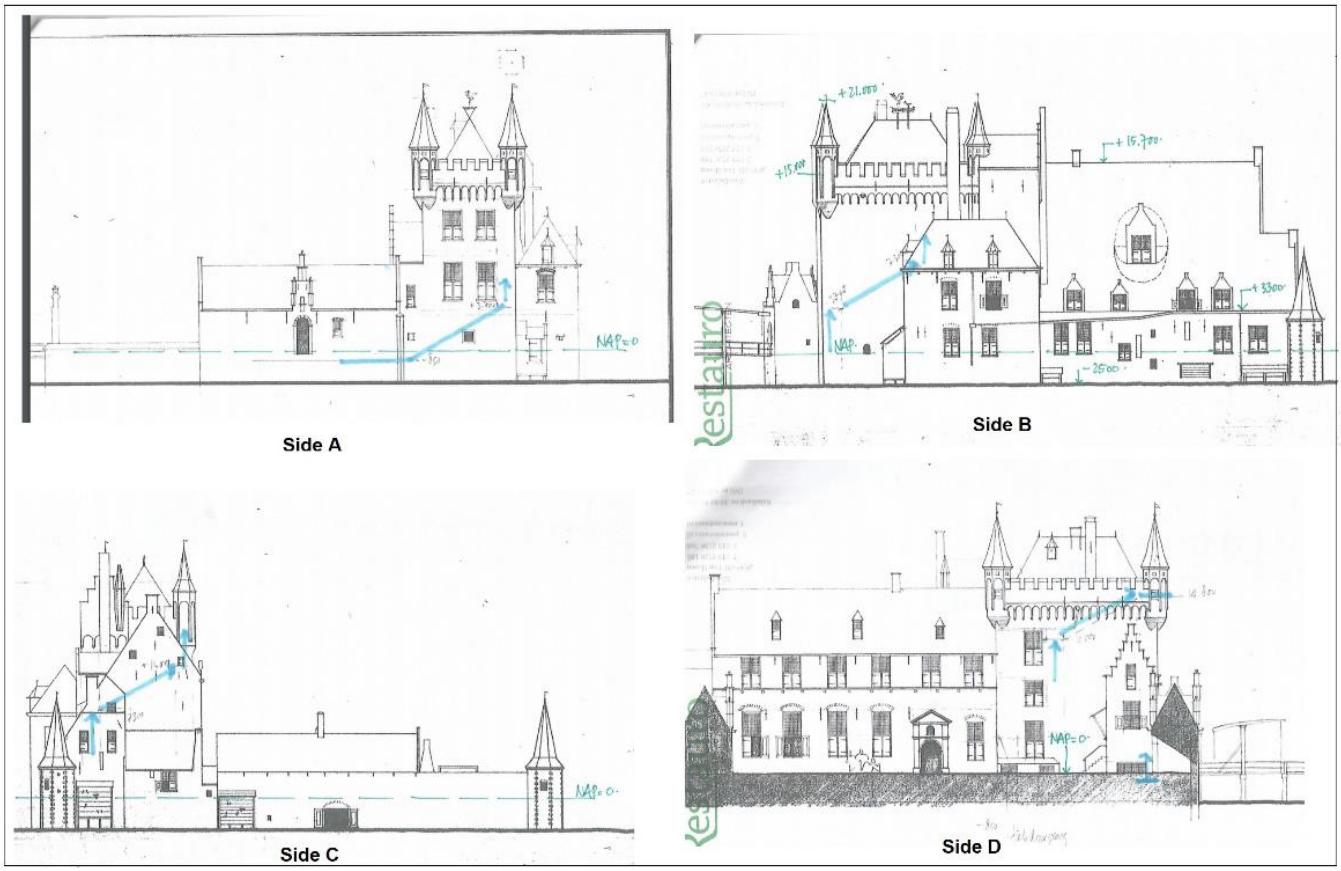

Figure 44: The four different sides of the Keenenburg (After van Velzen 2019).

On figure 44, four drawings made by Peter van Velzen are presented. These images, are created on the basis of the images of Roghman. Assumed heights are marked, which are based on the shades and perspective of the images. Side B is showing the Keenenburg from the west. Side B displays the measurements of the main tower from bottom to the top of the arkeltowers, which is circa 21 meters. The middle of the arkeltowers is situated at circa 15 meters. In addition, side B describes the walls of the Hall to measure 3 meters from bottom to eave and circa

15.7 meters for the top of the roof. The encircled window on side B indicates a feature for which no measurements could be assumed.

Side C depicts the Keenenburg from the south. On side C, the heights of the several buildings added to the hall are displayed. The lowest point measures 7.3 meters from the bottom. The windows at the right side of the roof are at a height of 11 meters.

The information on the Keenenburg enables the creation of a highly detailed 3D model. Unfortunately, the masonry of the structures on the inside of the main structure are unknown. In addition, the windows on the buildings inside the main structure are unknown, and assumptions regarding their shape must be made. Since the cross-window will be applied for when the windows are unknown in this model. In addition, only one of the two outer baileys has been excavated. Because of this lack of information, only the first outer bailey, which has its foundations depicted on figure 42, can be modelled.

5.5 The model

The two models of the Keenenburg are based on the previously mentioned images of figure 43 and 44. The images display several angles of the Keenenburg, of which the location is depicted on the figure below.

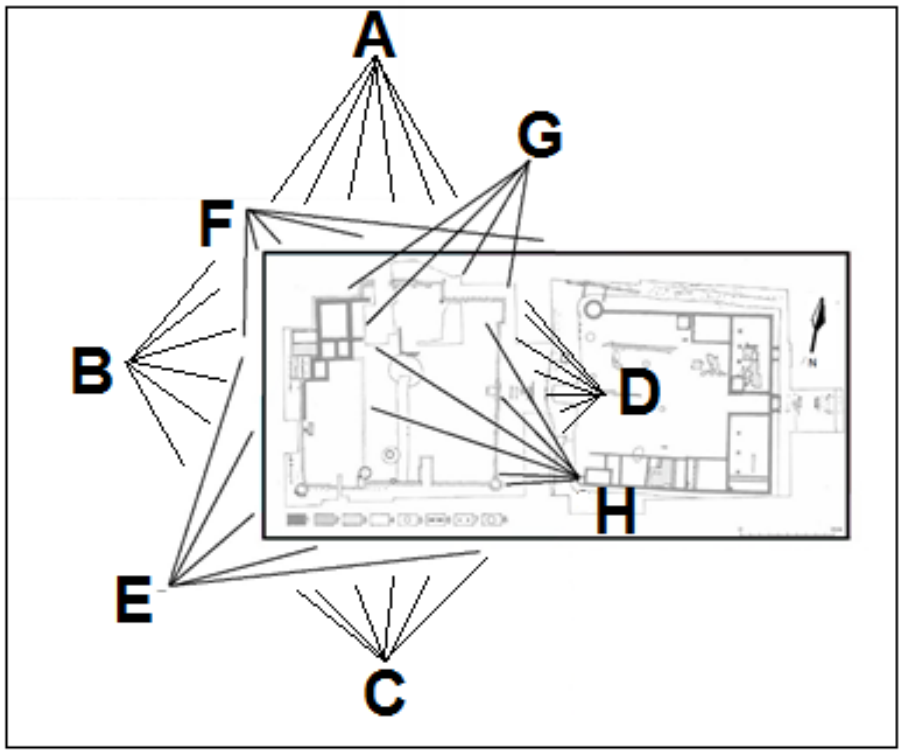

Figure 45: The ground plan and the three images by Roghman in 1648 of the Keenenburg (Bult 2015).

The location of perspective on figure 45 is displayed by view lines. The outer bailey, which the ground plan describes as a large and complex structure (or structures) is not present in detail on any of the images, yet the condition of this terrain is unknown. The letters A, B, C and D display the perspective of the images of Roghman.

On image F, a tower of the outer bailey is present in the background. The perspective from H seems to be created at the location of the other tower of the outer bailey. In addition, H seems to have an elevated perspective, which suggests that this tower was still partly standing. Image G portrays the new outer bailey, which was not excavated yet. Unfortunately, this image did not offer enough information to allow for the reconstruction of the entire outer bailey. Instead, height of the walls and towers had to be estimated. The resulting dating model is presented in figure 46 on the next page, depicted in grey.

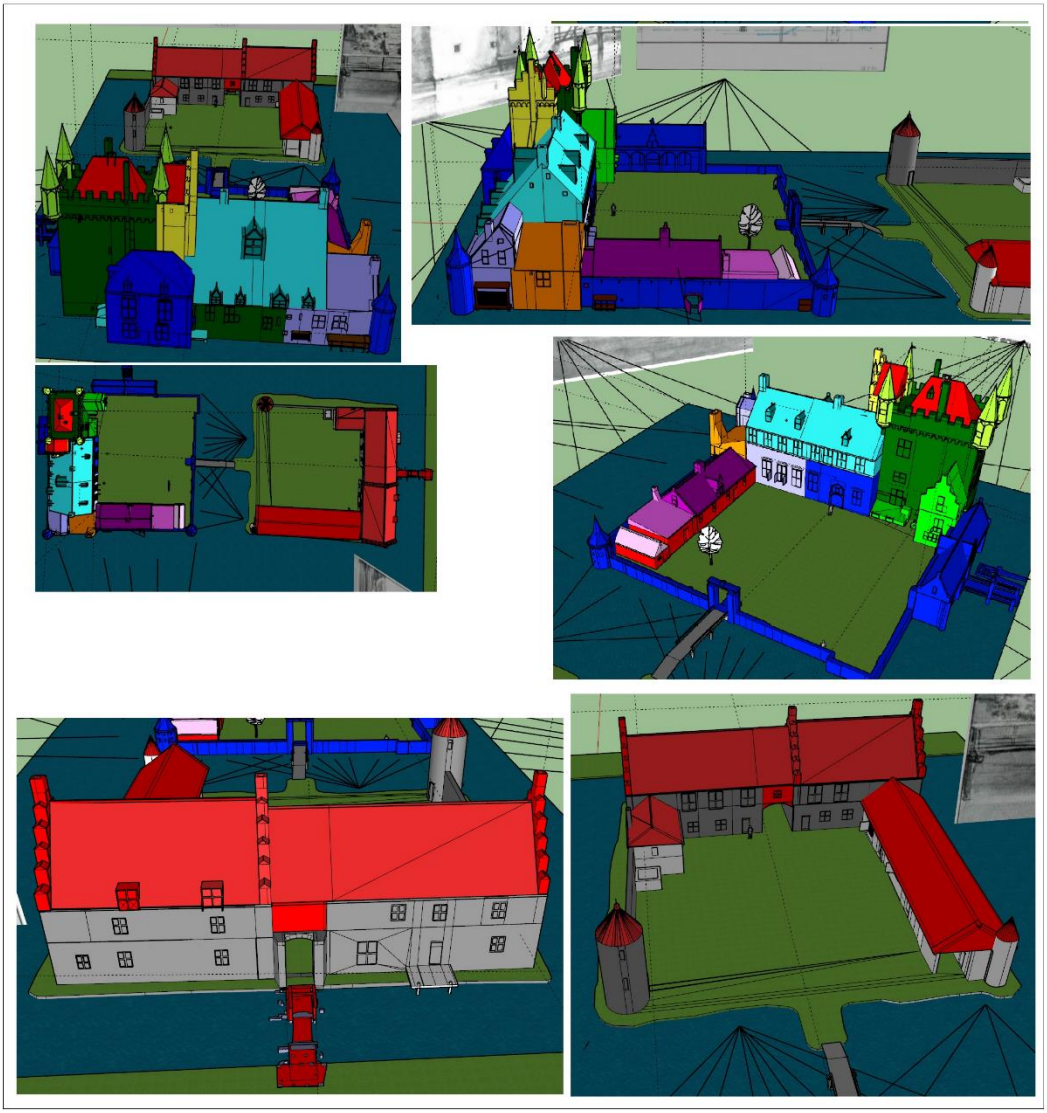

Figure 46: On this figure, the model of the Keenenburg is depicted. Dark green indicates the oldest part of the castle. Yellow indicated the second phase. Blue indicates the third-, and purple the fourth phase in the construction history. The final phase is indicated in grey. The lighter shades indicated additions to the structures.

The colours on figure 46 display the different chronological phases of the castle. The elements in dark green constitute the oldest excavated section of the Keenenburg castle. This is not the earliest structure of 1294 by Arnout van Dorp, but the square brick-built hall by Philips van Dorp and finished by Philips the Blote around 1413 (Bult 2015, 23). In 1573 the castle was partly demolished, yet before that, the second building phase, depicted in yellow was presumably created, in which Philips the Blote was the owner of the castle (Bult 2015, 24). The second phase consists of an additional tower against the rectangular hall.

The third building phase is in 1636 when Otto van Zeventer was the owner (Bult 2015, 23). This phase is depicted in blue. The fourth phase depicted in purple and dates in the 17th century. These are the main building phases. The colour red depicts structures that are not present throughout the archaeological record or historical imagery. It is likely that the foundations of these elements have been removed (Bult 2015, 22-23). The use of lighter shades of colour implies relative dating's.

Apart the main building phases, there are several additions which are relatively dated. The main castle tower has several additional towers, chimneys and decoration (depicted in a lighter shade of green), which are added after 1413. The small sideway towers, which seem to be “Arkeltorens”, which sporadically appear in the 13th century (Hermans 2013, 59-60). The Keenenburg was partly demolished in 1573, and afterwards rebuilt (Bult 2015, 24). This implies that between 1413 and 1573 these towers are constructed.

The main hall of the Keenenburg displays three phases of construction as well as additional buildings that were presumably constructed between the late 16th century and 1648. According to the images of Roghman of 1648, the main hall, appears to have been constructed in three separate phases (Bult 2015, 24). The date of construction for the second half of the main hall, which has a darker shape of blue, is unknown.

The oldest part of the Hall is depicted in blue, and according the size of the bricks in the masonry presumably dates back to the earliest construction of late 16th century. The earliest parts of the building are presumed to have belonged to a smaller building, located at the end of the cesspit near the western wall.

The vertical light blue part in the main hall indicates an undated additional floor, attached to the main hall, several additional roofs and chimneys are presents, and predicted in light blue. This part of the structure appears to have been constructed after the main hall took its final form. Moermans suggests that this particular structure may be presumed to be a kitchen on the account of the amount of chimneys linked to it.

The second floor is the final addition to the main hall and it gives the structure a presumed height of approximately 15 meters from the bottom to ‘top’ of ‘ceiling’. This addition is depicted on Roghmans images. A line appears under the second row of windows. In addition, where the first row of windows is aligned with the windows of the main tower on the same level, the windows of this second line are not aligned with the windows of the second level of the main tower. The roof of the orange part seems to mark the height of the old roof. ‘This indicates that the third floor was constructed during the structures’ final phase. The colour of this part of the structure is depicted in light yellow.

The old outer bailey is depicted in grey, because it was created at a later date than the square tower it surrounds. Yet the masonry of this outer bailey dates back to the 15th century according to figure 46, which is the same dating as the hall of the second phase. It is assumed that the construction of the hall began before the outer bailey was constructed, which is why this structure is depicted in grey rather than yellow. The lighter shade of grey depicts buildings that were later added. The exact date during which these buildings were constructed remains unknown. The shape of the roofs is an assumption, and therefor depicted in red. The newer outer bailey was presumably constructed in 1579. It has, however, not been excavated as of April 2019.

The kitchen, depicted in blue, still had wooden parts preserved, which provided a dating, by means of dendrochronology (Bult 2015, 24). The wood used for the construction of the kitchen was cut in 1636, and afterwards used for the construction of this part on the castle (Bult 2015, 24). It is the date of 1636 implies that it is unlikely that the kitchen was constructed before the main hall was finished,

yet it is possible that the second phase or the additional part are constructed simultaneously. In the period of 1636, Otto van Zeventer owns the Keenenburg (Bult 2015, 24). On figure 43 Roghman depicts two structures, which are attached to the kitchen. In the model, these additions are marked in a light shade of blue to indicate that these structures could only have been constructed after the kitchen itself was finished.

Roghman portraits the original tower, the attached hall and several other buildings. Two of these structures are attached to the main castle tower. In the model the same lighter shade of green is used as with the “Arkeltorens”. Of these buildings, the only certainty is that they were constructed before 1648. The structure attached to the tower and the hall is interpreted as a pathway to the basement. The structure at the right side with a prominent crow-stepped gable design contained staircases, which offer access to the different levels of the main square tower.

Apart from the additional buildings on the main tower. At the south western wall three buildings are portrayed on the painting of Roghman. In the model, these buildings have a purple colour to imply the fourth major phase of construction. The masonry found at this section of the Keenenburg dates from the 17th century (Bult 2015, 23). This implies that the buildings were relatively new at the time during which Roghman painted them. On the basis of chronology, we would have reason to believe that these buildings were constructed by the order of Otto van Zeventer.

It is difficult to provide relative dating of the features we identify throughout the hall as there is a distinct possibility that many of these features were added after the hall had been constructed. Concurrently, it is also possible that the windows were constructed in the first phase of the construction of the hall and that the subsequent additions were created in a similar style. The image that Roghman created does not provide us with enough evidence and/or information to allow us to provide a definite answer to halls’ chronology.

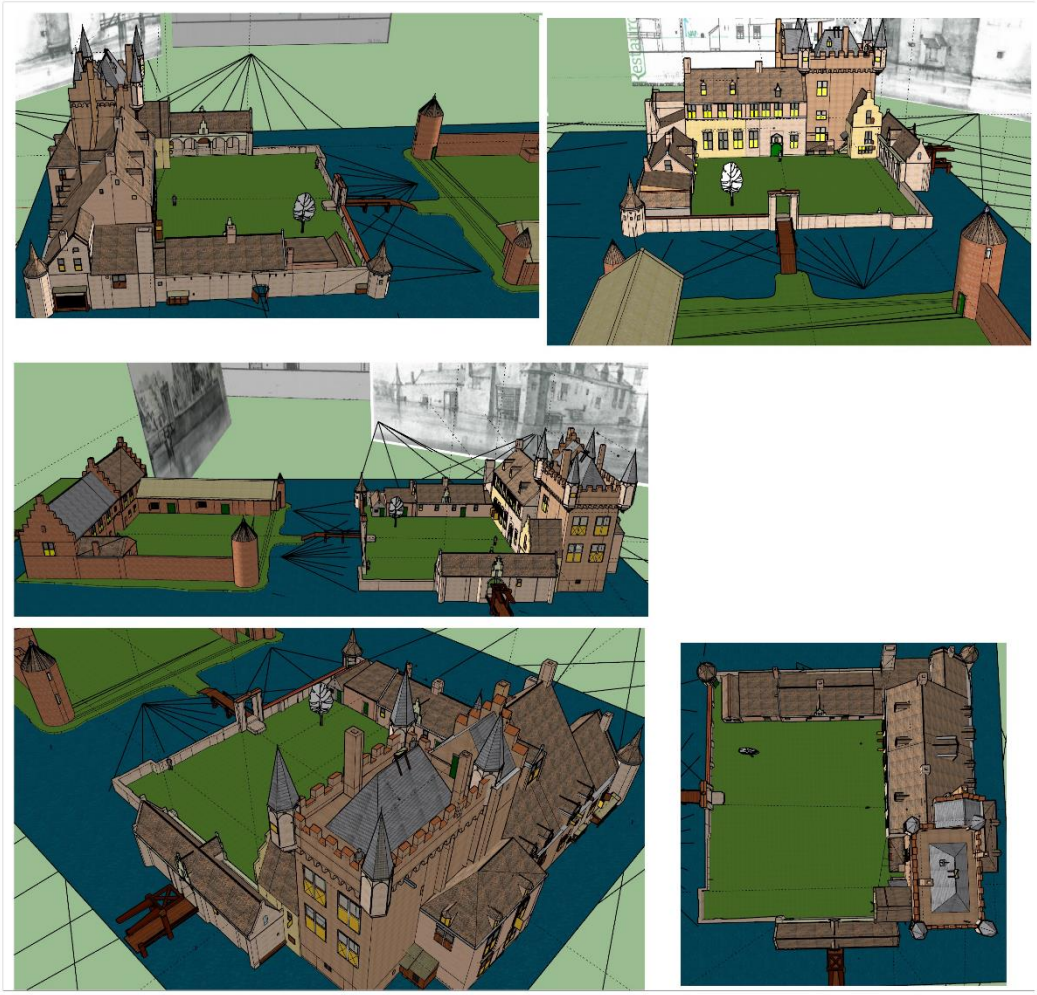

Figure 47: The dated masonry textures are applied to the designated areas on the model.

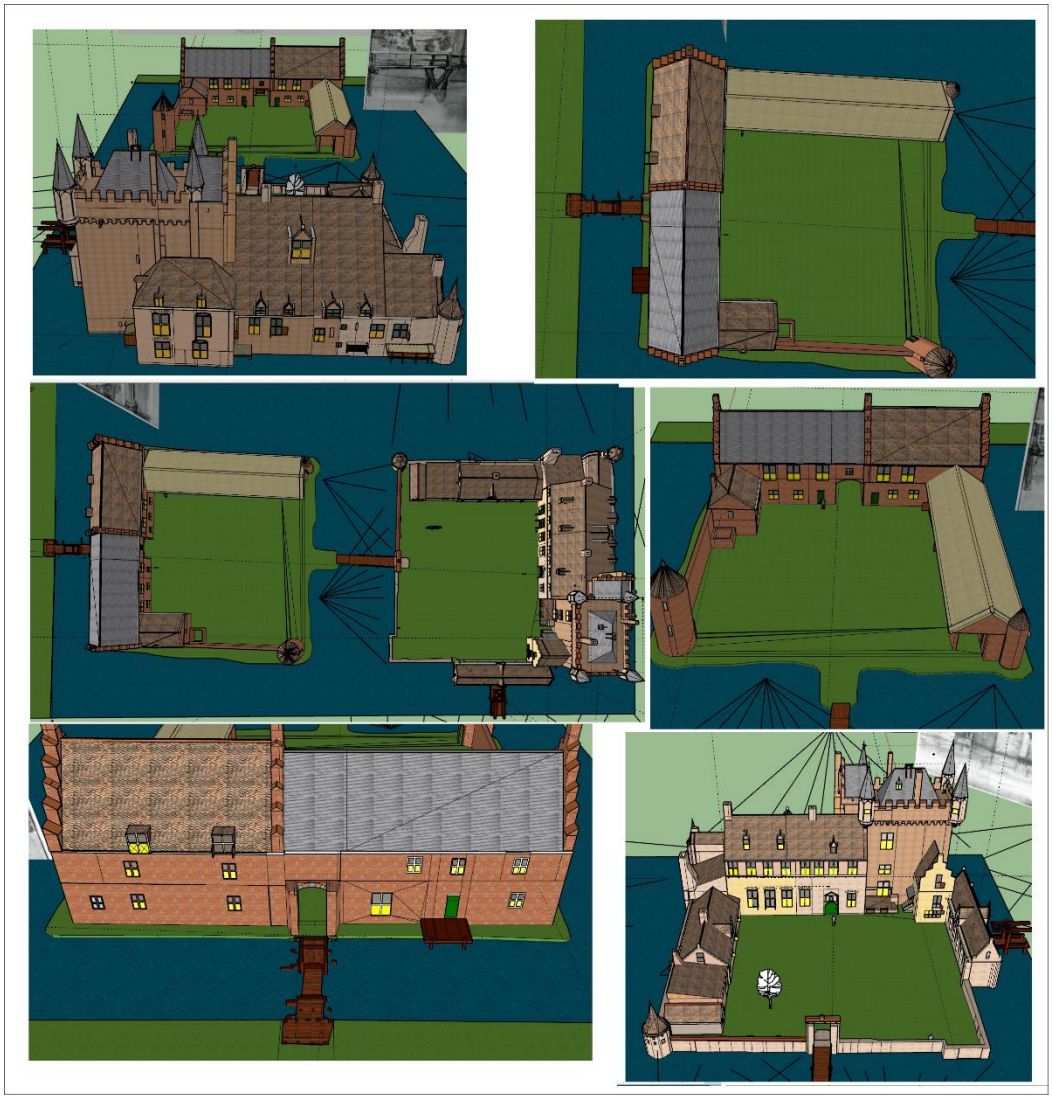

Figure 48: The front of the outer bailey of the Keenenburg is the only part of this structure, which has been depicted by Pronk.

On figure 47 and 48 the dated masonry textures are applied to the matching parts of the Keenenburg. This model is a plausible image of the Keenenburg, which offers a detailed reconstruction of the destroyed castle. In the case of the Keenenburg, the ground plan and images of Roghman correspond with each other to a degree that an accurate representation is possible. The height perspective from presumed location from which Roghman created the image, correspond with the assumed height of the model. This correspondence points towards a high level of certainty within the work of Roghman, concerning the Keenenburg.

5.6 Summary

As the Keenenburg changed from owners over time, several architectural changes occurred. By integrating the archaeological foundations, the historical background, the archaeological evidence available to us, and the depictions of Roghman, a highly detailed model could be constructed. This model does display the changes occurring to the castle throughout time. Unfortunately, one of the two outer bailey has not been excavated. The unexcavated section of the Keenenburg can regrettably not be modelled at this point as no input data is available.

6 Palenstein

The castle of Palenstein was excavated from 1984 until 1986 and again in 1992 (Westenbroek and Domburg 1993, 56). The castle of Palenstein is first mentioned in the 14th century (Westenbroek 1993, 10).

6.1 The surrounding region

Palenstein is located in the modern town of Zoetermeer, within Holland (Westenbroek 1993, 9-10). The geology of the region around Zoetermeer consists of a clay layer (Gantellaag) that was formed by sedimentation two thousand years ago as a result of the sea (www. Oud Soetermeer.nl 2019). Peat had formed on top of the (Gantellaag) clay layer (www. Oud Soetermeer.nl 2019). The peat layer that covered the Gantellaag has also been called by the name “Hollandveen” (www. Oud Soetermeer.nl 2019). The presence of peat made the initial settling of the site difficult.

The count of Holland was the owner of the lands on which Zoetermeer was founded (Westenbroek 1993, 9). This region was part of the “wilderness” prior to 1000 until the count of Holland claimed this territory (Koch 1970, 55; Westenbroek 1993, 9). During the 11th and 12th centuries the peat area underwent reclamation (Westenbroek 1993, 9).

The first mention of Zoetermeer itself dates from around 1300 (Westenbroek 1993, 9). During this period, Zoetermeer is part of the ambacht of Zegwaart as it belongs to the same church (Westenbroek 1993, 9). In addition, the taxation of “*bede emn botting*” was a paid in union to the count (Westenbroek 1993, 9). Furthermore, in times of war, both Zegwaart and Zoetermeer were obliged to fulfil the “*riemtalen*” (the number of soldiers that an *ambacht* is obliged to send) together (Westenbroek 1993, 9).

The title of *Schout* of Zegwaard and Zoetermeer was at first appointed by the count (Westenbroek 1993, 9). The right of the count to elect the title of *schout* could be gained without the consent of the count in the late medieval period (Westenbroek 1993, 9). In general, land in the *ambacht* was added to the title as a loan, which was still property of the count and the person receiving the loan was described as “*leenman*” (Westenbroek 1993, 9). After the demise of a “*leenman*” the land returned to the count, yet in the case of a “*rechte lenen*” the family of the deceased has the right to buy the loan back (Westenbroek 1993, 9). The oldest *Schout* was Florens van Brederode, who had Zegwaart and Zoetermeer as one of the *“rechte lenen*” (Westenbroek 1993, 10).

6.2 The history of Palenstein

The street on which Palenstein is located is the centre of the core of the Zegwaart and Zoetermeer *ambacht* (Westenbroek 1993, 10). In addition, the church which both Zegwaart and Zoetermeer shared is located on this street (Westenbroek 1993, 10). It has to be mentioned that the earliest church of Zoetermeer was originally located at the Zwaardslootseweg (Westenbroek 1993, 10). In 1367, the location of this church was changed to the Dorpsstraat (Westenbroek 1993, 10). This implies that between 1295-1296 and 1367 the centre was relocated (Westenbroek 1993, 10). Both Zegwaart and Zoetermeer were wealthy villages (Westenbroek 1993, 10). Palenstein being situated in between two wealthy villages implies that the status of its owner must have been significant.

The first mention of an owner of Palenstein was a knight by the name of lord Willem I van Egmond (Westenbroek 1993, 11). The date of this first mention is in 1398 (Westenbroek 1993, 12). On the 11th of February 1370, Willem I received the lands of Zegwaard and Zevenhuizen as loan from his brother, Arnoud who was lord of Egmond (Westenbroek 1993, 11). In 1372, Willem signed a letter with the title lord, implying that he received knighthood at that point (Westenbroek 1993, 11).

The economic situation of Zegwaart and Zoetermeer deteriorated during the "*Hoekse- en Kabaljauwse twisten*" (Westenbroek 1993, 14). Hostilities in the area included the plundering the region (RAZH 1572; Westenbroek 1993, 14). Palenstein received a garrison of six soldiers by order of the city council of Leiden (RAZH 1572; Westenbroek 1993, 14). This does imply that Palenstein was considered to be "defensible" (Westenbroek 1993, 14). Because Palenstein still had owners of nobility, and the structure was considered "defensible" it appears to fulfil the description of Janssen of a castle. This makes Palenstein the only castle in this reseach which is actual defensible. Because of the moat surrounding the main structure, the castle can be considered a moated site.

From the 15th until the 17th century, several persons of nobility owned Palenstein, such as Jan II van Zwieten, Johanna van Zwieten, Agatha van Alkemade, Johanna van Culemburg, Jean de Bourgogne, Johanna van Gent, Catarina van Gent, Chales Francois de Bourgogne, Anna Marie de Bourgoge, Jacob Oem van Wijngaarden, Carel Oem van Wijngaarden and Everdina Antonia Sloet (Westenbroek 1993, 21-27). Apart from having ownership over Palenstein, all the owners seem to have had possessions in Utrecht (Westenbroek 1993, 21-27). It is unclear if any of these individuals actually resided in Palenstein (Westenbroek 1993, 21-27). Palenstein has been described as a residence for nobility, yet it is often mentioned to have been rented out to either family members or other occupants with a high social economic status (Westenbroek 1993, 21-27).

Around 1750 Palenstein was put under mortgage, (this document was signed by a certain mr. William van Cleef) (Westenbroek *et al*. 2004, 19). It was sold to Joan Osy in 1750, who lived in the castle with his family (Westenbroek *et al*. 2004, 19-20). The family restored Palenstein, yet in 1790, Balduinis Osy demolished the castle, in order to construct a grand house in 18th century style (Westenbroek *et al*. 2004, 19-20). After 1830 the family rarely visited the house (Westenbroek *et al.* 2004, 21). This neglect of the Palenstein property may be explained on the fact that most of the family's possessions were situated in Belgium (Westenbroek *et al*. 2004, 21).

After 1856, the family Osy gave the ownership of Palenstein to the church in Zoetermeer, who sold it in 1887 to major Bos (Westenbroek *et al*. 2004, 21). Palenstein was partly demolished when Bernardus Brinkers, who was the founder of the Brinkers butter factory, bought it (Westenbroek *et al*. 2004, 21). The parts of Palenstein, which were not yet demolished were transformed into a shop (Westenbroek *et al*. 2004, 21). The walls were integrated in the later butter factory on this terrain (Westenbroek *et al*. 2004, 22). In 1970 the factory and all the remaining walls of Palenstein were ultimately demolished (Westenbroek *et al*. 2004, 22).

Table 4: An overview of the owners of Palenstein whom are responsible for changes towards the castle (Westenbroek et al. 2004, 10-19).

Owner	Year	Type of construction
Unknown	1325-1375	The terrain is levelled.
lord Willem I van Egmond	1398	Constructs a square brick-built hall, presumably a tower.
Willem II van Egmond	Around 1450	Constructs an attachment to the existing brick-built hall.
Jacob Oem	1643	Constructs a house on the terrain.
Joan Osy	1750	Restores the castle.

Table 4 displays the different owners who made architectural changes on Palenstein. The castle underwent some construction, yet it is unclear whether the many nobles that possessed Palenstein actually resided in the castle. If the majority of the owners did not reside at the castle, it would offer an explanation for why there is a large time gap between the construction phases.

6.3 The excavation

The excavation of Palenstein began in 1979, resumed in the years 1984-1986 and was ultimately concluded in 1992 (Westenbroek and Domburg 1993, 56; Westenbroek *et al*. 2004, 43). During the excavation, parts of long narrow halls and the main structure were uncovered, yet neither was fully revealed (Westenbroek and Domburg 1993, 55). The presumed ground plan of the excavation is depicted on figure 49 (Westenbroek 1993, 120). The earliest presence of pottery, dating from 1325 until 1375, which was likely waste brought to the terrain for levelling the ground (Westenbroek and Domburg 1993, 57).

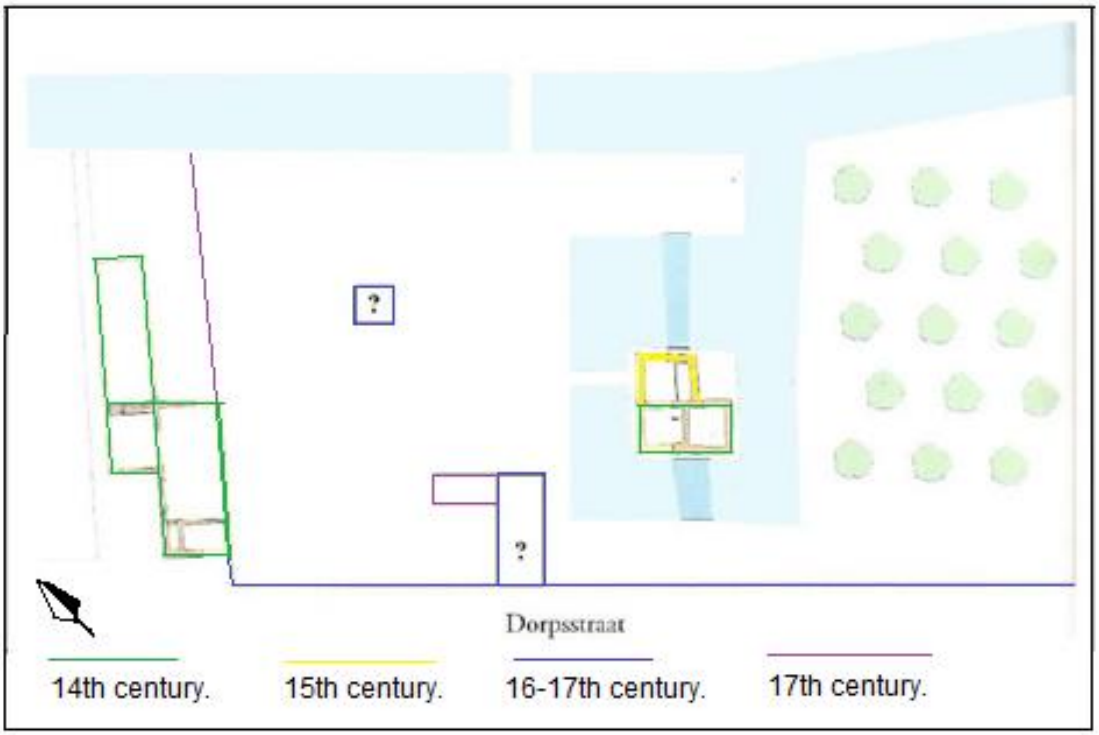

Figure 49: The ground plan of the site (After Westenbroek 1993, 120).

The first structures that were uncovered during the excavation were two long narrow halls that were constructed from brick. Foundations include two brick-built columns within the south western corner of the area, which date from the second half of the 14th century (Westenbroek and Domburg 1993, 57). These foundations are located on an artificially raised part of the terrain (Westenbroek and Domburg 1993, 57). The stones of these buildings have a size of 27 x 14 x 7 cm (Westenbroek and Domburg 1993, 57). Roof tiles were found from the castle period (Westenbroek and Domburg 1993, 57).

The removal and replacement of the previous structure occurred around the year 1400 (Westenbroek and Domburg 1993, 57). The side of this structure facing the street was in the possession of a solid foundation, which was not present at the other sides of the structure (Westenbroek and Domburg 1993, 57). The size of the stones was 23/22.5 x 11.5 x 5 cm (Westenbroek and Domburg 1993, 57). The front of this building faced the street and had a stronger foundation (Westenbroek and Domburg 1993, 57). The building was built on vertical piles in the ground, with wooden poles placed horizontally on them (Westenbroek and Domburg 1993, 57).

In the south east of the terrain, a moat and foundations belonging to the structure we identify as the actual castle have been uncovered (Westenbroek and Domburg 1993, 59). Under the foundations, a pit of 90 x 50 cm, dating to the second half of the 14th century, was present (Westenbroek and Domburg 1993, 59). The stones in the foundation indicate two separate phases of construction (Westenbroek and Domburg 1993, 59):

- Based on the stones and masonry in the foundation, the first structure may be dated to sometime between 1375 and 1400. The size of the stones consists of 24.5/23.5 x 11.5 x 5.5 cm, and the wall has a thickness of 0.80 cm.
- The masonry suggests that around 1450 an additional structure of 8 by 6 meters was attached to the existing structure. The size of the stones consists of 22 x 10 x 5 cm and was attached to the wall belonging to the first building phase. This building had a length of 8 meters and an average width of 6 meters. A well was present inside this building.

At the northern side, a moat was located (Westenbroek and Domburg 1993, 59). While only a part of the structure was excavated, yet the researchers assume that the structure has a square shape (Westenbroek and Domburg 1993, 59-60).

When Palenstein was discussed with Grootveld, he mentioned that this structure, presumably constructed by Willen I van Egmond is demolished in the 17th century. This claim is supported by the fact that this structure does not appear on any of the images of Palenstein postdating this period.

It is worth noting that the south western moat has a presumed width of 10 meter (Westenbroek and Domburg 1993, 60). The other moats presumably have the same width, because these moats were connected to several local canals (Westenbroek and Domburg 1993, 60). A possible reason for this particular size of the moat is the availability of transportation by water, from and to Palenstein (Westenbroek and Domburg 1993, 60). Evidence of renewal of all the moats continues until the 18th century, in which two additional gullies seem to have been created, and all of the moats had been connected to one another (Westenbroek and Domburg 1993, 60).

Roof tiles have been used as a material to strengthen the sides of the moat (Westenbroek and Domburg 1993, 60). Other slate tiles were present in the moat

(Bullaart *et al*. 1993, 113). The round shape of the tiles suggest a scale like roofing, which fits with the "*Rijndekking*" type of roofing (Boeder and Tolboom 2010a, 1; Bullaart *et al*. 1993, 113).

6.4 The images

There are seven images of Palenstein, and of structures on the terrain (Koopmans 1993, 48-50). Five copies of the same sketch depict Palenstein itself; two of these are later copies of Meijer's work (Koopmans 1993, 50-51). The other three images are displayed of figure 50. At first, it appears that the images Abraham Rademaker and Cornelis Pronk depict the same building. Yet the depth of the images as well as several windows do not correspond with one another (Koopmans 1993, 49). In addition, the image, created by the image of Jacobus Stellingwerf (1667-1727), who assumed the appearance of Palenstein in 1569 (Koopmans 1993, 48-49). Furthermore, the source, which the other painters used for their images, remains unclear (Koopmans 1993, 49).

These two images, display a long, narrow building, along a street and the front of a house with long narrow halls attached to it (Koopmans 1993, 51). This image is partly supported by the archaeological evidence, as the foundations of the house and the long narrow halls are present (Koopmans 1993, 51).

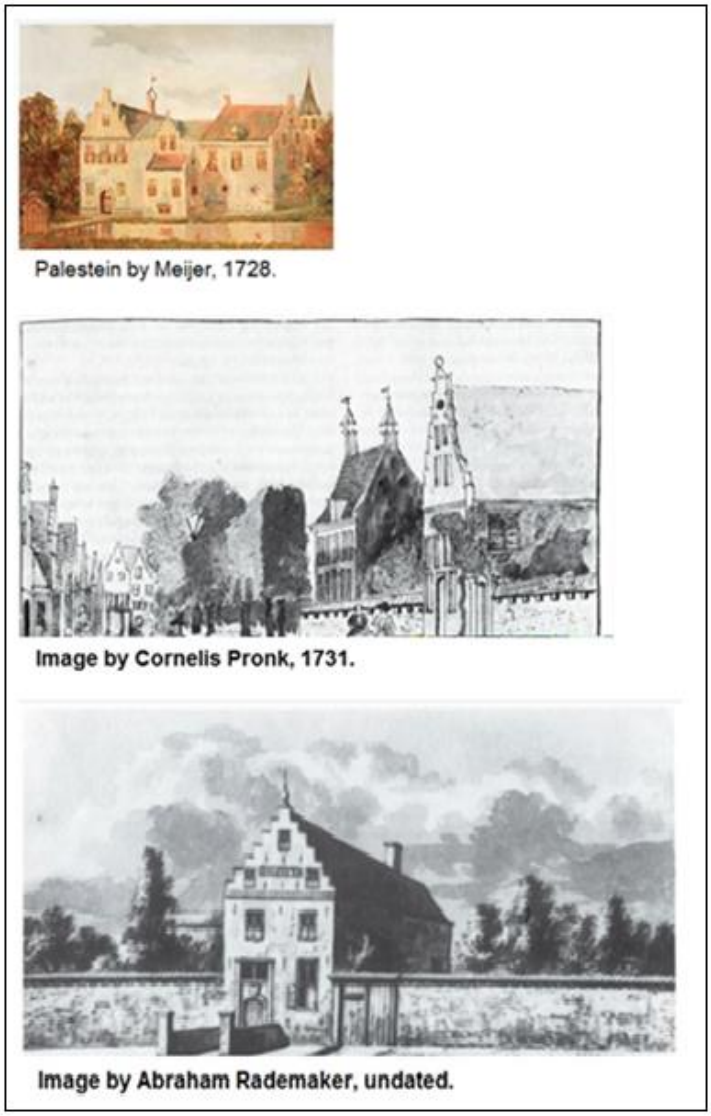

Figure 50: The two images by Cornelis Pronk and Abraham Rademaker, together with the image by J. H. Meijers (After Koopmans 1993, 50-51).

On figure 50, three images of Palenstein are presented. From top left to bottom right:

- Image by J. H. Meijers displaying a fictional representation of Palenstein, dated around 1728 (Koopmans 1993, 50).
- Image by Cornelis Pronk presenting the north western front of Palenstein, dated around 1731, (Koopmans 1993, 51).
- Undated image by Abraham Rademaker, displaying the norther structure facing the Dorpsstraat (Koopmans 1993, 50).

The images of Palenstein display the north western front of the castle. The earliest image is by Meijer, which created a fictional representation of Palenstein (Koopmans 1993, 51). The archaeological remains do not correspond with the dimensions Meijer illustrated

The image of Pronk displays the long narrow hall from the side, together with a house like structure that belonged to the terrain of Palenstein until the 17th century (Westenbroek 1993, 120). At least one round window and several square windows appear on the image, yet only one is recognizable as properly a cross-window.

The roof of the long narrow building in the foreground possesses a crow-stepped gable design, which appears from 1600 (www.Kwaad.net 2004).

The image of Rademaker depicts the front of the long narrow building, with cross-windows, yet the round window which Pronk displays is not present. Rademaker depicts decoration in the front of the wall, while Pronk does not. While the majority of the image appears the same as the image of Pronk, Rademaker copied this image from an earlier version, while Pronk did not (Koopmans 1993, 50). Both images depict a crow-stepped gable design for the roof, yet the two fronts do not have the same amount of steps. While the differences are marginal, Pronks' image possesses a greater degree of historical veracity due to the fact that Rademaker copied earlier work while Pronk did not (Koopmans 1993, 50).

While the castle of Palenstein has a detailed history on the ownership of the property, the construction history is difficult to detect from historical sources. In addition, the limited amount of images and the fact that the castle is not fully uncovered limits the creation of our model. The masonry is not known for the majority of the buildings, and the images reveal the outlook of only the structures facing the Dorpsstraat. Yet it is still possible to make a plausible model with the limited data available, and the construction history can still be presented.

6.5 The model

The castles so far had at least two images that could be used as reference point. With Palenstein, only two images can be considered to have any degree of credibility, yet both of which do not display the main structure. On figure 50, three images are present, created by Meijer, Pronk and Rademaker. On figure 51 below, the two reliable images and their perspective are presented.

Koopmans argued that the image by Meijer is not reliable (Koopmans 1993, 48-49). After comparing the ground plan with this image, no points of reference could be traced. This implies that the image of Meijer cannot be corroborated by the archaeological evidence. The images of Pronk and Rademaker display structures that can be linked/corroborated to the archaeological foundations. This is why these two images are used for creating the model and displayed in figure 52.

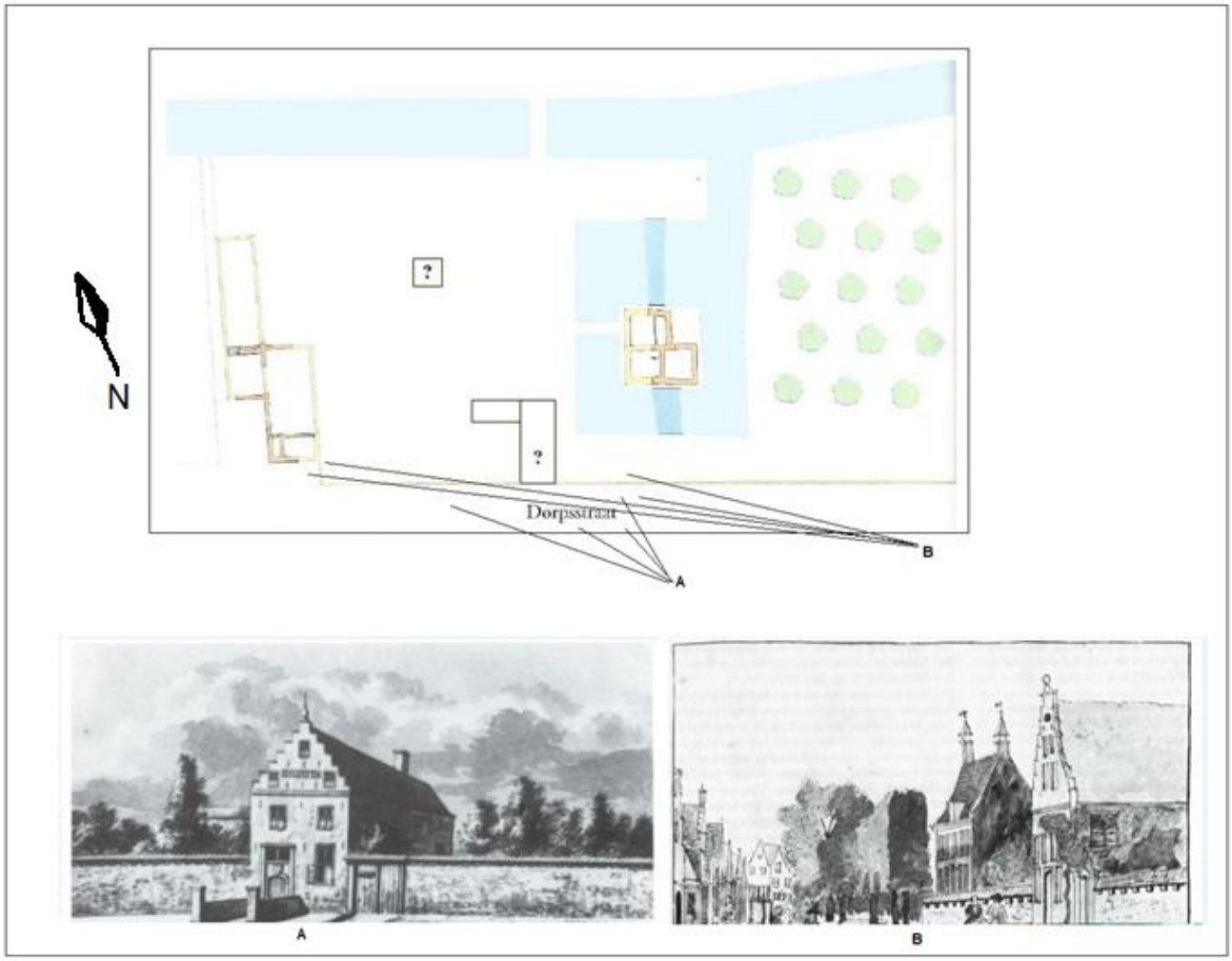

Figure 51: The ground plan and historical images of Palenstein (After Koopmans 1993, 50-51; After Westenbroek 1993, 120).

On figure 51, the perspective of two images are present. Each of the buildings is facing the street, yet the main building of Palenstein is obscured. The image of Rademaker is marked with A, the image of Pronk with B. On the image of Rademaker the oldest part, the square main structure, is not present in the background. Instead, trees line the location of this structure. This points towards the demolishment of the oldest part of Palenstein, around the 17th century.

The image created by Pronk displays a less detailed image than Rademaker, created around 1731 (Koopmans 1993, 50-51). This image presents the most reliable image of Palenstein in the past. The resulting model from the images is displayed on figure 52. The perspectives of both the image of Pronk and Rademaker are depicted on figure 51.

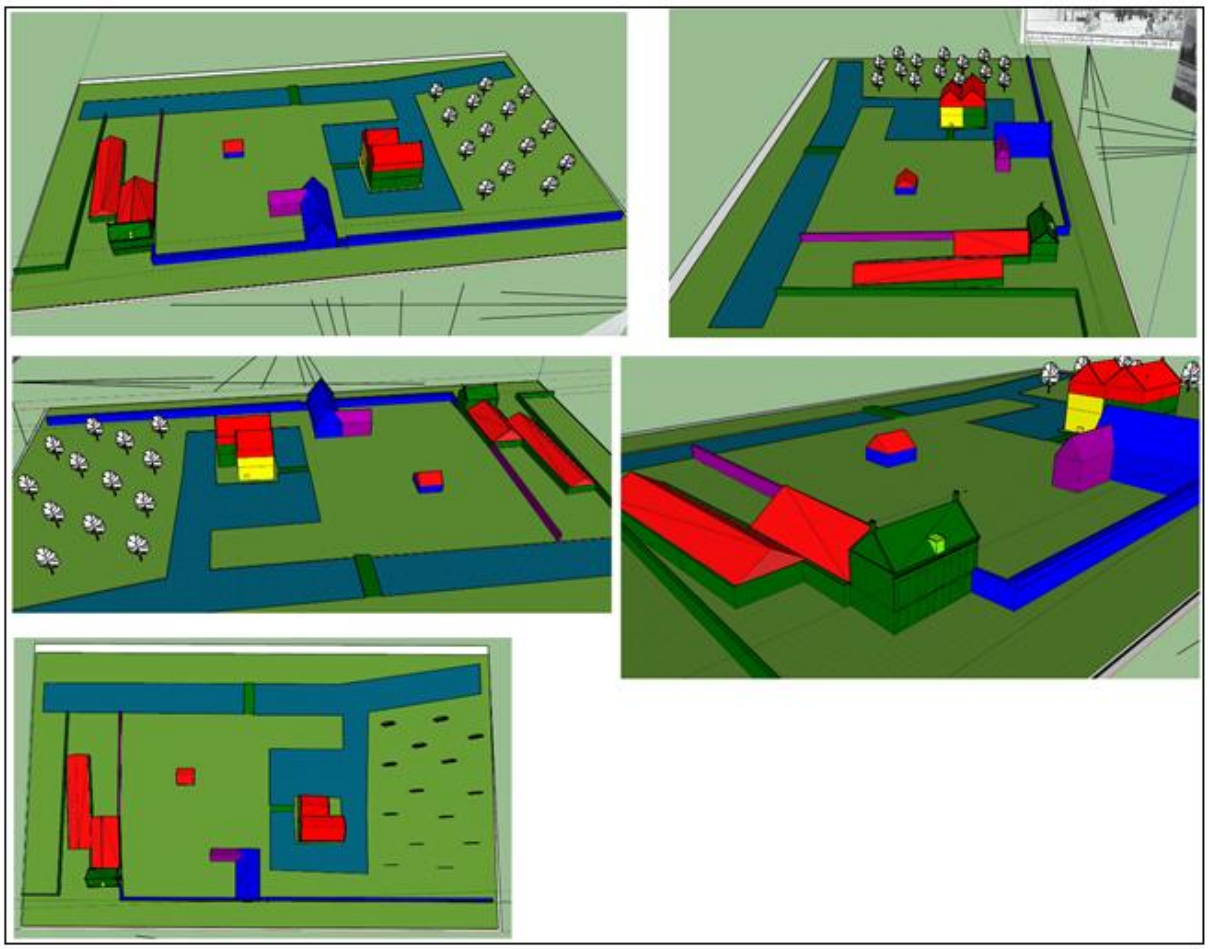

Figure 52: The model of Palenstein presents a plausible image of Palenstein in the past.

The colours on figure 52 portray the construction history of Palenstein. While all the features on the model are present in the archaeological evidence, chimney and windows are not present on the majority of the structures of the model. Without images for reference material, the shape and position of these features (which are assumed to be present) cannot be determined.

The dark green shade indicates the oldest parts of Palenstein. These parts are the main brick-built hall, surrounded by a moat, and two long narrow halls with a structure that according to the image of Pronk has the shape of a house. The masonry of the halls and the brick-built hall indicates a date between 1375 and 1400 (Westenbroek and Domburg 1993, 59). It is worth to note that the first signs of structures are found at the location of the two long narrow halls (Westenbroek 1993, 116). The long narrow hall is constructed on top of these early structures (Westenbroek 1993, 116). These structures date from the middle of the 14th century, while Willem I of Egmond constructs the long narrow halls and the brick-built hall at the end of the 14th century (Westenbroek 1993, 116-117). A window is displayed with a lighter shade of green on the roof of a structure attached to the long narrow halls. It is uncertain when this window was added.

The yellow parts indicate an addition to the main brick-built hall, dated around 1450 by Willem II van Egmond (Westenbroek and Domburg 1993, 59). The next phase in the construction history is displayed in blue. This structure is mentioned as a house according to Grootveld, yet it was never excavated. The current location is an assumption of the researchers (Westenbroek 1993, 120). It is unclear whether

the structures depicted in blue on figure 52 were finished around 1450, or if the construction started at this period in time (Westenbroek 1993, 166-177). The outer wall a square structure and the house like structure that both Pronk and Rademaker present is displayed in blue. These parts of Palenstein are created around the middle of the 15th century, and were likely constructed in the period in which Jacob Oem owned Palenstein (Westenbroek 1993, 117).

An addition to the structure both Pronk and Rademaker display is represented in a purple colour, which dates from the 17th century (Westenbroek 1993, 120). The roof of this additional structure appears on the image of Rademaker, yet an exact dating of this part of Palenstein is uncertain. A wall also appear to have been created during this phase of the castles existence. The last features are the red roofs of which the actual shape is unknown; therefore, the colour red is used to indicate these parts as an assumption.

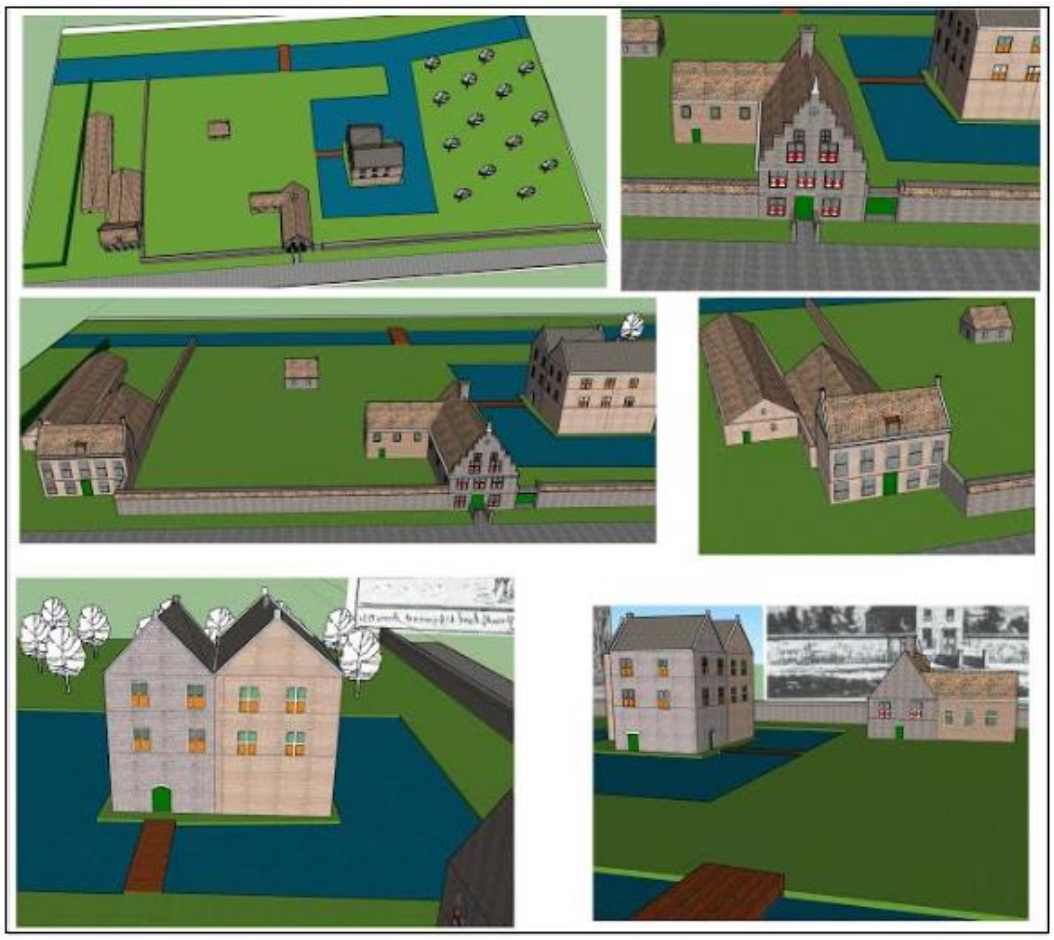

Figure 53: The model of Palenstein, with masonry textures applied to the designated areas.

While the images display some information on the construction history of Palenstein, a detailed overview cannot be retrieved from them. Figure 53 displays the castle, with assumed masonry, and the windows, yet it is clearly not as detailed as the model of the Keenenburg. This issue is not isolated from Palenstein alone, but is applicable to all partly destroyed structures. There are simply too few reference points to create a plausible model with a higher amount of detail. With this model, the archaeological data are the primary source of information, and because it makes no other assumptions apart from the roofs, the model can be considered plausible.

6.6 Summary

While Palenstein does not have images of the main structure to allow a detailed model, it is possible to create a plausible image of the castle. With the ground plan, the archaeological evidence and historical background, a rough depiction of the castle throughout time can be created.

7 Comparison and results

In the chapters 3 to 6 the plausible 3D representations of the castles were presented, yet what information do these models offer? In this chapter, the question of what other uses the models offer for researchers will be discussed. Apart from this, a discussion on the use of the paintings and drawings in researching the construction history will be present in this chapter. The architectural changes, which occurred in the castles, will be presented and compared. Furthermore, how the castles relate to each other in terms of architectural change from 1300-1700 will be discussed.

7.1 Architectural changes and comparison

The castles Altena, Huis ter Kleef, Keenenburg and Palenstein went through several architectural changes. These changes are described in table 5, together with the dating's of each phase.

Table 5: The different phases of the construction history of each castle, displayed in different colours of the models. The structures, which could not be modelled and are not present in the table.

Dating	Altena	Huis ter Kleef	Keenenburg	Palenstein
1250	Unknown structure. Cannot be modelled.	Rectangular brick-built hall.	Unknown structure. Cannot be modelled.	
1300		Kitchen.		
1350		Inner court.		
1400		Additions to the inner court.	Begin construction square stone tower.	Stone square tower/hall.
1450	Stone square hall and tower.		Finishes construction of the stone tower, and attachments.	Additions to the stone tower.
1500	Additional buildings to the square house.			
1550	Several additional buildings. A wall surrounds the terrain. Castle is demolished in 1573.	The northern tower is added.		
1573	**Demolished**	**Demolished**	**Partly demolishment**	**in disrepair**
1600			Castle rebuilt, a new outer bailey is created. The main hall is enlarged, and additions are attached.	Construction of an additional house on the terrain. A wall is created at the border of the terrain.
1650	The main structure is rebuild and a tower containing stairs is added.		Kitchen.	
1700				
1750	Demolished in 1761		Demolished in 1769	Demolished in 1970

Table 5 presents the characterisation of the different additions/changes of each castle. The table displays a general pattern. Palenstein possessed only four phases in its construction history, which is the lowest amount of phases that have been discerned among the surveyed castles. Huis ter Kleef possesses five phases and Altena possesses six. The Keenenburg has the largest amount. The causes of this difference is presumably in a detailed documentation of the castle, and the fact that structures with a longer life spam can have more alterations.

Unknown structures receive no colour, as they cannot be reconstructed in the models. Yet the oldest structure, which was excavated in all four castles is a rectangular brick-built hall, with a brick foundation. In the case of the Keenenburg, the construction of the square tower was discontinued when the owner died, and resumed when the new owner took possession of the castle.

The second phases consist of additional structures attached to the square tower/hall. These additions can be towers, square buildings, cesspits, a hall or in the case of the Huis ter Kleef a kitchen. The kitchen, which represents the second phase of Huis ter Kleef is described in historical text, which is why the function is known. An additional cesspit was also added against the kitchen during this phase. The nature of the additional structures of the second phase generally consists of one single building, attached to the rectangular brick-built hall.

Following the structures of the second phase, the third phase of the construction continues the pattern of adding structures to the older parts. Altena, receives two additional buildings, attached to the original square tower and the buildings of the second phase. An inner court is created at Huis ter Kleef, with a gate house. On the terrain of Palenstein, a house like structure was created on the terrain.

The third phase of the Keenenburg begins after the (partly) demolishment of the castle in 1573, with the reconstruction in 1579. Unfortunately, the most significant change, the new outer bailey was not excavated, and with only one image, it is impossible to create a reliable model of this structure. The kitchen, created between 1636-1646/1647, is modelled, and belongs to the third phase of the construction history.

The nature of the third phase is a maximum of two structures, which are attached or near the square tower/hall. Palenstein, with a house like addition, is the only exception, as the amount of space between the original square tower and the new building is wider than the other three castles.

All the castles experience a fourth phase in their construction history. In the case of Altena, the Keenenburg and Palenstein, the castle has fallen in a state of decline, and is restored in this phase. Huis ter Kleef was not restored, because it is constantly repaired and maintained. In fact, the inner court of Huis ter Kleef is recreated, with the old gate and wooden bridge replaces by a new gate and bridge.

Altena was altered after it was demolished. The square tower and the attachments of the second and third phase are now one single structure. The orientation of the roof is altered and the tower on the south western corner was reconstructed.

Altena and Huis ter Kleef possess a fifth phase. The Keenenburg, while having a larger amount of additional buildings, has less major changes to the castle than these two castles. In addition, the Keenenburg and Palenstein are restored in their fourth phase, and no major new additions have been created after this event.

Altena receives a new tower, containing stairs, an attachment to the restored main structure. Huis ter Kleef is the only castle which receives another additional square brick-built hall, comparable in size to the oldest tower.

With the exception of Palenstein, all castles, the inner terrain of the main structure is surrounded by buildings. This creates an inner court. Yet these walls are constructed after the main tower/hall is constructed. In the case of Altena and Huis ter Kleef this inner court is present in the third phase of construction. In the Keenenburg the terrain is walled in the second phase. Palenstein received few additional buildings, yet surrounding the borders of the terrain a wall was present, creating a walled open space.

Of the castles that have been mentioned only Palenstein can be considered defensible as this was the only castle that housed a significant garrison. Its defensibility is reminiscent of the defensibility of the Beersel castle in Belgium (Blely 1973, 41). The Beersel castle is round and encompasses three large towers. This is distinct from the square dimensions of the Palenstein castle. With regards to defensibility, the castles are, however, reminiscent to one another as both castles are surrounded by moats and are also only accessible through a single bridge. These shared elements give the castles a high degree of defensibility that is absent in the other castles that have been discussed.

While defensive elements have been incorporated throughout all of the castles only Palenstein can be identified as a defensible castle due to how the defensive elements have been integrated into its design. The purpose of the other three castles appears to have been living accommodation and general prestige rather than a wholesale defensive purpose. Castles such as Kolomont in Vlaanderen and the German castle of Rötteln are clear examples of castles where defensibility lay at the essence of the castles' design (Van Hemelrijck 1950, 118, www.Röttelncastle.de 2019).

While the castles in Belgium and Germany were generally constructed with defensibility in mind, it appears that Dutch castles rarely focused on defense or military purposes. This is evidenced by the fact that only one of the four castles I have studied appears to be 'defensible'. The lack of focus on integrating defensive elements onto the castles in Holland can be partly explained by the technological evolution of artillery (Janssen 1981, 302). Furthermore, Dutch castles generally only sought to withstand small bands of raiders until at least the 15th century (Janssen 1981, 302).

Instead, the castles in Holland appear to have been constructed with living accommodation as the primary focus. The data utilized in this study is, however, insufficient to decisively confirm this hypothesis. To conclusively answer such a question, a more extensive comparison between castles in Holland and castles outside of Holland is necessary.

When the four castles from Holland are compared to castles in England and Scotland, there are two clear similarities. In England and Scotland, the tower house is considered to be the standard, such as the examples Hallbar Tower, or the 16th-century Claypotts Castle (Hermans 2013, 32; Tower of Hallbar 2007). These type of structures primary functions are providing living accommodations, and displaying social status, according to Simpson (Simpson 1961, 234). Exhibiting

social status is also an element of great importance in Dutch castles. (Janssen *et al.* 1996, 15; Bult 1988, 126).

The second similarity between English castles and the four castles in Holland is the fact that the central towers were generally starting point, as the central brick tower was the first phase in all of the examined castles. The defensibility of castles throughout England and Scotland is, however, hard to ascertain as current research on castles throughout England and Scotland does not provide us with a clear description of their degree of defensibility. Comparison is made more problematic by the fact that there are many terminological differences about terminology, primary function, and design between these two countries. Such descriptions cannot be seen outside of their contexts as that which is quite defensible in one place given the realistic threats may be entirely indefensible in a different place.

Such differences in context make it difficult for us to ascribe a uniform definition to words such as defensible or status-oriented as these values exhibit themselves differently depending on the regional cultural, political, and possibly military context.

In light of this variation in terminology and application making conclusive hypotheses or theories with regards to comparing different castles is difficult as the necessities for such a study exceed the scope of the data and research currently at hand.

The similarities and differences of the four castles from Holland can, however, be examined based on the data and terminology available for us. This will be done throughout the next paragraph.

7.2 Results

Now that the construction history of the different castles has been compared with one another, the results are several similar developments. The table displays that there is a general pattern within the construction history of the castles. A square tower, or a hall with a foundation of brick is in general the oldest structure. The second phase consists of additions to this square tower or hall. The third phase consists of several additional structures, which are attached to the square tower, or attached to the buildings of the second phase or close to the main structure. The fourth phase differs in the sense that the entire structure is restored.

Yet opposite of these similarities, the individual differences between the castles illustrates that the function of the added buildings in each phase differs, and that the pattern is relative. Huis ter Kleef for instance is constantly restored with new buildings being added in each phase. On the other hand, Palenstein receives few additional structures, of modest size in comparison to Huis Ter Kleef. The Keenenburg has the greatest amount of structures, and is demolished in the same period as Altena, due to Spanish hostilities in the region of Delft in which both castles are located. Altena expands at a regular pace, until it is partly demolished, after which the status of the castle slowly deteriorates.

Furthermore, the nature of the architectural changes, displayed in table 5 portrays a variety of different forms. In general, however, the buildings exhibit a set of general trend where newer structures are attached to the oldest part of the castle. On the other hand, the pace of construction differs at each castle.

The different phases display a relative pattern, to which no exact dating's can be applied. The reason for the inability to add specific dates to the general pattern of the phases, as two castles, Altena and the Keenenburg start with an earlier, yet not encountered structure. In addition, the dating of the first phases has a difference of 23 to 171 years between all the castles, in the second building phase, the difference ranges from 15 to 175 years. A large degree of difference occurs in the third phase, which ranges from ranges 40 to 318 years' difference. And the phase with the greatest amount of difference in time is the fourth phase ranges to at least 50 to 325 years. The significant difference in time between the construction phases is the reason why there is no reliable way to date the earlier mentioned pattern. It appears as though the pattern only offers a relative sequence.

In addition to the archaeological phenomena, a historical pattern is evident. The majority of changes occur when the castles changes from ownership. The majority of the additions to Altena and the Keenenburg appear to have been initiated when the castle comes into the possession of different owners belonging to a different family. Huis ter Kleef is constantly in the possession of wealthy members of nobility. The constant possession of Huis ter Kleef by members of the wealthy nobility provides a possible explanation as to why the castle was continuously expanded over time. Palenstein was situated in an economical promising location, but never truly thrived as its economic potential diminished due to frequent hostilities. The owners of Palenstein did not construct many additions, compared to the other three castles. The owner of Palenstein are presumed to not have resided at the castle, resulting in a presumed negatively influence on the construction and reconstruction of a castle.

All these examples point towards the influence of either new owners or financial fortunes as being potential causes for architectural change to the castles. Nevertheless, the four castles we have identified hardly present sufficient proof for a direct cause and effect relation. Further and thorough historical and archaeological research is required to establish or disprove a possible correlation between changing ownership and architectural changes.

7.3 Discussion on the use of paintings and drawings

Apart from the construction history, the reliability of the paintings and drawings is a crucial matter. The paintings and drawings are in the cases of Altena, the Keenenburg and Huis ter Kleef a vital point of reference. It turned out to be impossible to calculate the exact level of accuracy for paintings and drawings within *Sketchup*. The program can, however, present the archaeological foundations of a structure and subsequently allow us to compare the archaeological foundations of a structure to the known paintings and drawings of the structure. The archaeological foundations allow us to ascertain the degree of veracity of the paintings, while the paintings may allow us to fill in the blanks that cannot be filled in by the archaeological foundations of the structure.

When estimating the reliability of paintings and drawings, the first general step is describing what is displayed, and if the paintings and drawings correspond with each other. The next step is assessing how old an image of a castle is and what orientation the image displays. The dating and the creator of every paintings and drawings needs to be described. In addition, a way to assess how reliable a painting or drawing is, is by researching the background of why the image was created. Several paintings and drawings of castles are created by order of the

owner. In such a case, it is possible that the creators focus was on the wishes of the owner, rather than displaying reality.

Fortunately, the archaeological foundations offer a reliable base of comparison between what the paintings and drawings display, and the empirical evidence. By finding corresponding features between the paintings/drawings and the ground plans, the reliability of the paintings/drawings can be assessed.

Presently, when at least four features on the ground plan correspond with four features of a painting/drawing on the north, south, west and east side of the structures, it can be assumed that it corresponds with the empirical evidence. The amount of four features at each side of the castle is chosen as a means to detect a correlation between the images and the ground plan and to determine the perspective of the images. However, with only one painting or drawing, the assessment is not significant. If several images, from different perspectives display the same features on the same castle, then it can be assumed to be reliable. When the models were created, finding the position of the perspective of the paintings/drawings can be difficult, even with the orientation known.

An example of several paintings/drawings displaying the same features from different perspectives is the Keenenburg and Huis ter Kleef. With the Keenenburg the images of Roghman all displayed the castle in 1646/1647, and correspond with each other and with the ground plan. This points towards the assumption that Roelant Rogmans work for the Keenenburg is reliable.

Unfortunately, not all castles were as fortunate. The images of Roghman, Rademaker and van der Vinne display Huis ter Kleef in a state of ruin, yet all display the same features. In addition, the images correspond to the ground plan, which makes them reliable sources, yet provide little information on how the castle looked like before demolishment. The difference between images is the scale. In this case, the earlier mentioned assumed general height is used for creating the models.

Altena had a different issue. Of the two ground plans, the version prior to 1573 did not possess reliable paintings or drawings. Fortunately, with the assumed height and shapes for the roofs, a representation of the construction history was possible. Yet details such as chimneys and decoration could not be added, and windows (position and type) needed to be assumed.

The ground plan of Altena after 1573 only possesses two images of Roghman and de Haen, form the north and north-east. Both display a number of the same features, such as the shape of the roof, a tower, the windows and the position of additional buildings. Yet the details on the other sides of the structure need to be assumed.

Palenstein has two reliable drawings of the north western front of the castle. Unfortunately, none of these drawings displayed the main structure of Palenstein. Because of this, there is no reference point for details such as chimneys and the shape of the roof. In addition, the shape and type of windows needs to be assumed.

In all the models, the images by Roghman display a high level of correspondence with the ground plans. This points to a high level of reliability towards the works of Roghman. Other images, such as the works of de Haen, and Rademaker also

correspond with the ground plans. The work of Cornelis Pronk corresponds with the ground plans, which indicates a level of reliability.

If the images correspond, a certain level of reliability can be assumed. When several images correspond with the ground plan, and each other, this assumption gains in reliability. 3D is ideal to make such comparisons. Overall, the level of reliability remains a factor of assumption rather than an exact measurement.

The height which painters depict, varies widely. Roghman in general depicts castles from an upward perspective. This results in an impressive and tall depiction of the castle. Pronk displays varying heights of features. On the Keenenburg, Pronk displays the Arkteltowers are a large, broad and prominent feature on a small tower, while Roghman depicts these same features as sleek and tall decorations on a high tower. With a calculation of the general height of castles in the region, this issue is avoided. Yet it displays that paintings and drawings should not be treated as automatically displaying past realities.

In addition, not all the paintings and drawings were of use, such as the image of Palenstein by Meijer. Other images give reasons for doubt of their reliability on specific details, such as with Rademaker at Palenstein. In other cases, such as the outer bailey at the Keenenburg, an area, which was not excavated was portrayed by Pronk. Another image of the earliest outer bailey of the Keenenburg, which was copied of Rademaker, displays features which do not correspond with the ground plan. This image proved to be unreliable.

To summarize this paragraph: No painting or drawing can automatically be assumed to display reality. It remains of importance to describe and assess each painting and drawing individually. Furthermore, to ascertain the reliability of these images the historical background and the correspondence towards the empirical evidence of the ground plan need to be described. Only when an image corresponds with the ground plan can it be assumed to have any reliability.

In addition, when the paintings/drawings do correspond with the ground plan, compare the features they display with each other. While the use of paintings and drawings is essential for representing a detailed image of a demolished building, it is not necessary for modelling the general construction history.

7.4 Aims and uses for the models

So far, models have been presented and described, and the methodological use of historic paintings has been explored. The future aims and uses which these models offer is described in this paragraph. The construction history is displayed and features are visualised. With all of the descriptions and images, the question of what future aims do the models possess remains.

With the amount of required information to create a reliable image of a structure of the past, the output of the models might appear rather limited. Only the construction history is displayed in the models. With a greater amount of information, other aspects such as the inner chambers and furniture might be displayed. While the interior, and any ideas of how the inhabitants of castles lived would still be an assumption, it can be a useful tool of presenting new theories.

In addition, 3D models can combine information from historical and archaeological sources, in order to gain new insights. With the models of the castles, several aspects could now be brought together, which created a clear overview of the

construction history. Apart from the construction history, the models of the castles display possible indications on the possible influence of changing ownership.

Furthermore, it is possible to calculate the walking routes through the castle, by analysing the use of space (Blake 2004, 233). This requires the implementation of several agents, with attached variables to represent human behaviour (Blake 2004, 233-234). This technique, called spatial analyses can provide new information on the use of space (Blake 2004, 233-234; Wolfgang *et al.* 2018, 182-183). Unfortunately, the technique requires ground plans to make the calculations, and while the creation of a 3D model would add to the visual presentation, it is not required.

On the other hand, apart from presenting information, the models offer limited value as a research tool. This issue is not isolated to these models. It is a rather general issue with the current 3D models. Models provide researchers the ability to visualise aspects from the past (Wolfgang *et al.* 2018, 174). Apart from structures natural processes and patterns can be created in 3D. Yet a model offers either a simplified representation or a plausible image of the past (Box and Draper 1987, 74). The entire complexity of reality simply cannot be modelled with the current software (Box and Draper 1987, 74).

Despite their shortcomings, models have been, and still are of great use for researchers (Box and Draper 1987, 74; Wolfgang *et al.* 2018, 174). Specific aspects, such as the construction history of structures, can be presented. The fact that models present information in a simplified manner is actually a benefit, as it allows theories to be visualised (Box and Draper 1987, 74).

In addition to pinpointing specific aspects, models are great tools for presenting information to the public (Ratto 2006, 1-3; Wolfgang *et al.* 2018, 174). 3D models in particular are an effective tool for the presentation and even preservation of heritage (Dell'Unto *et al.* 2015, 74; Wolfgang *et al.* 2018, 174; London charter 2009). The models of the castles will provide a plausible and reliable image, which offers the information to the general public (Ratto 2006, 1-2; Wolfgang *et al.* 2018, 174).

Yet because models can only show specific aspects well, without becoming too complicated it will never be possible to visualise all traits concerning human behaviour.

3D models possess a great amount of influence on the perception of a time period by and region of the general public (Dell'Unto *et al.* 2015, 73-74; Ratto 2006, 1-3). Because of the significant degree of influence visualized models wield when informing the broader public, veracity and historical accuracy are vital to the modelling of archaeological structures (Dell'Unto *et al.* 2015, 73; Ratto 2006, 1-3; London charter 2009). Concurrently, a model is founded on the archaeological knowledge available at the time of the models' construction. Since our knowledge of the archaeological record is constantly changing, models will need to change as well if they are to accurately reflect past realities. At the same time.

The models of the castles display at least four different phases of the construction history. There appears to be a general pattern between the construction phases of the castles, which is characterised in additional buildings to the oldest part of the structure in the first two phases. From the third phase onward the trend remains additional structures to the oldest part of the castle. Yet in the third phase only a

maximum of two buildings are added, and the amount of variation increases. The fourth phase consists of the restoration of the castle.

Adding dates to the general patterns appeared to be impossible. The difference in years between the castles varies too widely to have a meaningful dating attached to it. Furthermore, the amount of variation in the shape and function of the attached buildings does not allow to make any assumptions on a general nature. It is not possible to assume that for instance the early phase of these castles is dominated by the constructions of kitchens. What has been determined, is, that any additions of the second phase are likely to be attached to the oldest part of the castle.

Paintings and drawings offer vital information on the appearance of castles. It remains of importance to describe and assess the reliability of each painting and drawing individually. The correspondence of paintings and drawings with the ground plan is crucial to determine any reliability.

To conclude this chapter, there is a possible general pattern present within the construction history of the four castles. Yet it is impossible to date the different phases, or understanding a general nature of the constructions. To confirm the general pattern, together with uncover a possible correlation with these features, requires a similar research of a larger scale.

8 Conclusion

This thesis started with several questions on castles. The aim of this research is to observe how the construction history of comparable castles relate to each other, and this can only be answered by clearing the research questions. Below a brief answer to these questions in described.

1 What architectural changes occur in the castles near Delft, Zoetermeer and Haarlem from 1300 until 1700?
The architectural changes between the castles differ from each case. Altena near Delft starts with a square brick hall and expands with additional buildings to this hall. These additions include a stone tower, an outer wall and an outer bailey, all of which transform the castle in a luxurious residence over time. After 1573 Altena is demolished and rebuilt in 1610 after which it slowly deteriorates until it is demolished in1761.

Huis ter Kleef started as a square brick hall around 1250. The castle expands over the next 150 years, in which a kitchen, and an inner court are added, together with a square tower in the northern section. Simultaneously modifications to this inner court. The castle is demolished in 1573 and never rebuild.

The Keenenburg originates as a square brick hall around 1300 and is expanded rapidly with the construction of a stone tower, a surrounding wall, two outer baileys, and several attached buildings. This castle was demolished in 1573, and rebuilt in less than five years, during which a kitchen was added. The castle fell in disrepair and was demolished in 1769.

The castle of Palenstein, was constructed in 1400, and originated as a square brick hall. Later additions were constructed against this hall. In 1573, the house was in a state of disrepair, yet it received a garrison, which implies it was a defensible structure. Around 1600 a house like structure was added on the main terrain. The castle fell again in disrepair and was demolished in 1970.

2 Can these changes be dated?
The architectural changes in the castles usually can be dated because of the historical text describe the transaction of the building material, and the mention of constructions ordered by the owners, such as the construction of the square hall of the Keenenburg in 1411 which lasted until 1417. With this information it is possible to determine a period of 25 years in which an architectural change was made, such as the Northern tower of Huis ter Kleef (1475-1500).

Unfortunately, the difference between the dates of the construction phases of the castles made a meaningful comparison impossible. Between constructions the second phase of all the castles ranges from 15 to 175 years.

In addition, a construction is often mentioned as during the ownership of a person, and does not describe how many years it took to construct. For instance, the kitchen of the Keenenburg was created after 1636, which was described in text, but no dating was mentioned. By means of dendrochronology the date of 1636 was extracted. To summarise, historical text can provide exact dating’s, yet often provides a time period of 10 to 25 years.

The historical texts do refer to the demolishment of the castles in 1573-1600. During this period the Eighty Years War (1568-1648) was fought and castles were

demolished in hostilities, destroyed in order to keep them out of enemy hands or garrisoned. Historical text mentions the rebuilding of all castles, with the exception of Huis ter Kleef, which remains a ruin. Yet the historical texts do not mention all the additions and changes on a castle. Fortunately, a different source can provide these elements; paintings and drawings.

3 What do paintings and drawings offer for ascertaining the construction history of a structure?

Paintings and drawings of castles provide two crucial pieces of information about the architectural development of castles in Holland. The aspect which is of great importance it that paintings and drawings present a visualised image of the castles. Paintings and drawings can display to a researcher how a structure looked from a certain perspective.

In addition, paintings and drawings can provide images of several buildings, which are not mentioned in text. The paintings and drawings in combination with the historical text augment one another. The information implemented in a 3D model will result in a high level of detail within the new visualisation.

The paintings and drawings, are of great importance to create details on the models. These details contain elements such as the type of the windows, the shape of the roof and the decoration. These kind of details are important pieces of evidence for dating the castles. Consequently, the construction history of the castles can be more effectively reconstructed. Yet it is possible to create a 3D image of a castle with minimal use of paintings and drawings, such as with Palenstein and Altena. While the level of detail will be reducing, the construction history can still be visualised.

Unfortunately, there are two aspects which hinder the use of paintings and drawings. The first of these is locating the exact position of the perspective of the painting and drawings. While the ground plan offers points of reference for depicted features such as towers, buildings and walls, when there are no reference points, the amount of information that a painting or drawing can provide is limited.

Yet a painting or drawing does not have to depict reality. Painters were hired by the owners of castles to make a visualisation of the structure. In several cases the painters created a non-existent building, such as Meijer did with Palenstein. Therefor each of the paintings and drawings should not be treated as a single source of information. Several images, a ground plan and the historical text should be able to determine what image displays a non-existent building.

4 How do the castles relate to each other in terms of architectural change during the period 1300-1700?

While the four castles display great variety, there are similarities. The architectural changes within the castles of Altena, Huis ter Kleef, the Keenenburg and Palenstein from 1300 until 1700 follow a general pattern. The oldest part is often a square tower or hall with a brick foundation. Additional structures are generally attached to the initial square tower. Later additions are limited to only two buildings, yet still close by the original square tower/hall.

There is a great amount of variation in the additional buildings, which makes determining the nature of these structures impossible. The dating of individual structures is often described, or can be retrieved by dendrochronology and by

dating the size of the bricks. The different dating's between the castles display a high variation, which makes it impossible to date the phases of the general pattern.

Main question: How does the construction history of comparable castles relate to each other?
The construction history between the four castles displays a similarity in the sense that a square brick hall, and at least four phases in the construction history follow, each adding a minimal of two structures. The additional structures vary greatly in function and dating to be compared.

The implementation of 3D has allowed to combine paintings, drawings, archaeological data and historical texts into one visualisation to display the construction history. The limitations of this method are that a model is only a plausible image, as the evidence is incomplete and the actual structure is lost. Secondly, the interior is difficult to visualise as there is often no information of the furniture which was present.

On the other hand, with this method, demolished structures can be recreated and comparisons on a larger scale between structures can be realised. With additional time, a comparison of castles or other structures between different regions and countries is possible. Yet the greatest benefit which the use of 3D offers is the produced model, as this will allow the presentation of the past to the general public in a visualised manner.

9 Summary

The use of 3D modelling allows us to research and visualize the construction history of archaeological structures. In this research, 3D models of the castles of Altena, Huis ter Kleef, the Keenenburg and Palenstein were created based on archaeological evidence, historical text, paintings and drawings.

In order to understand and explain the construction history, the context of the sites needed to be described. This is why the location, geology, history, owners, demolishment, excavation and research of each castle have been written down in four chapters. At the end of each chapter the 3D models, displaying the construction history of each castle have been presented.

After comparing, the different phases of the construction history of the castles display a general pattern. Each castle has at least three different phases in the construction history. The oldest part of the castles is usually a square tower or hall. The second phase consists of additions to this structure, and the third phase consist of a maximum of two additional buildings. Due to the high level of variation between these castles, reliably dating and assessing the nature of the additions is impossible.

Only with the archaeological- and historical evidence can a castle be accurately modelled in 3D. The addition of paintings and drawings provide reference points to create a detailed model. With a higher level of detail, more information can be attained. Yet it is possible to create a model to display the construction history without these sources.

10 Samenvatting

Door het gebruik van 3D modelling is een visualisatie van de bouwgeschiedenis van kastelen mogelijk. In dit onderzoek naar de bouwgeschiedenis van de kastelen Altena, Huis ter Kleef, de Keenenburg en Palenstein zijn verschillende 3D modellen gecreëerd, gebaseerd op archeologisch bewijs, historische teksten, schilderijen en tekeningen.

De context van de kastelen is van belang om de bouwgeschiedenis te begrijpen en te verklaren. Door de locatie, de geologie, de geschiedenis, de bewoners, de sloop, de opgraving en het onderzoek van ieder kasteel te beschrijven is in vier hoofdstukken een completer beeld naar voren gekomen, waardoor de bouwgeschiedenis uitgelegd kan worden. Aan het eind van ieder van deze hoofdstukken is het 3D model van het desbetreffende kasteel gepresenteerd.

Bij het vergelijken van de verschillende fases van de bouwgeschiedenis per kasteel blijkt een patroon aanwezig te zijn. Ieder kasteel heeft minimaal drie verschillende fases. Het oudste deel van een kasteel is in het algemeen een vierkanten toren of een hal. De tweede fase bestaat uit meerdere bijgebouwen, welke tegen de toren of hal zijn aangebouwd. De derde fase bestaat doorgaans uit twee uitbreidingen aan de hoofdconstructie. Door het grote verschil tussen de kastelen is het niet mogelijk om betrouwbare dateringen te koppelen aan deze fases, ook verschillen de functies van de bijgebouwen te veel om een algemene beschrijving te maken.

Om een 3D model te realiseren is het gebruik van archeologisch bewijs en de historische tekst noodzakelijk. Met schilderijen en tekeningen is het mogelijk om de details in het model weer te geven. Meer details betekent dat het model meer informatie kan overbrengen. Het is echter niet noodzakelijk om de gehele bouwgeschiedenis van een kasteel weer te geven.

11 Archives

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16 Unpublished sources

Unpublished drawings by P. Velzen, van. Handed over by P. van Velzen, 11-03-2019.