Rethinking Iron Age loom weights in the Netherlands

An assessment of context, function and shape

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1 Introduction

There is much discussion on the archaeological evidence of textile production in (Dutch) prehistory. This is mainly due to the fact that prehistoric textile remains are poorly visible in Dutch archaeology, since perishable textiles are often not preserved in our acidic soils. Therefore, we only have access to more indirect evidence for textile production, from textile tools like spindle whorls and loom weights.

Participating in an excavation of a Linearbandkeramik settlement in the summer of 2013, we encountered several Iron Age and Roman features in the same area. The first day of my participation, a large but shallow Iron Age pit was excavated. In this feature, a row of 15 Early Iron Age conical loom weights was discovered. This was the first time I was implicated in the discussion of the function of (triangular) loom weights. This intrigued me and made me decide to dedicate my MA thesis on this controversy and give a thorough explanation on the function of so called loom weights.

1.1 Problem Orientation

Loom weights have been found all over the world and there are clear regional distinctions in shape and size, but a few types like conical weights seem to be used repeatedly in most regions. In the European Iron Age, a new type of loom weight is introduced with a flat triangular shape and perforations through the corners and regularly through the centre of the weight. The introduction of this new type of weight is reason for a big discussion. Most archaeologists do agree with a function as loom weight, since this type of weight seems to replace the Bronze Age conical or pyramidal type of weight, but there are also archaeologists that are more hesitant and argue that a function as net sinker or spanner for hides would be more credible for these objects.

The problem with currently available literature on (triangular) loom weights is that it is very limited and often dated. Meanwhile, this literature is repeatedly re-used and copied in recent articles and books without the authors giving a more critical look on the discussion that exists behind this category of objects.

Therefore, my aim for this research is to give a fresh look on the object category of Iron Age triangular loom weights as we know them now. A combination of literature and material study should give new insights on the functional aspects, development and distribution of loom weights during the Iron Age in the Netherlands.

1.1.1 Broader Significance

Loom weights were used to keep tension on the warp threads in a type of loom called the warp-weighted loom. These objects are less perishable in contrast to the warp-weighted loom which was entirely made of wood. Therefore, loom weights are one of few objects which give a distinctive indication for textile production in prehistory.

The things that stood out when gathering literature about loom weights, was the difference in approach on loom weights between authors, especially the articles concerning the triangular shaped objects from the North-Western European Iron Age. There are authors that are generally extremely cautious in using the word loom weight, who often tend to put it between quotes or use it together with the terms net-sinker or just prefer to just call it a weight. Other authors do not seem to be aware of the discussion on their function or ignore the whole discussion by using the term loom weights without any remark. The articles that do mention the ongoing discussion, give a concluding remark on the fact that more research on this subject should be done. Furthermore, the weights are often only observed within their own category. The complete archaeological context of the weights is often not taken into consideration, while it could give us so much more information about the function and overall activities at settlement sites.

From the iron Age on, several types of textile appear. The clothing created from this textile became an important platform to emphasize identity. The story of men dominates throughout prehistory, while females are less visible in archaeology. However, females are the ones thought to have made these textiles (e.g. Grömer 2016, 269; Díaz-Andreu and Lucy 2005, 1-2). By examining the remains of textile production in the Iron Age, I could add something to the story of females throughout prehistory.

1.2 Aims and Research Questions

As stated before, the aim of this research is to reconsider the object category of triangular Iron Age loom weights, therefore I would like to determine what aspects define a loom weight by doing an extensive assessment of previous literature and a material study on Iron Age loom weights from the Netherlands. With my research, I hope to be able to construct a view on the function of loom weights, make a typochronological overview of the changes in shapes and make an overview of the distribution of these objects within the Netherlands and the context in which they were found.

My approach to this problem will consist of multiple steps. The first step will be to organize all the data that is currently available on Iron Age loom weights in the

Netherlands. This literature study will not solely focus on Iron Age loom weights in the Netherlands, since our current borders did not exist. These borders do not have any relevance, since people treated the landscape in a way that is different from our modern constructs. The second step will be to expand this data with own research on loom weights from multiple Dutch case studies. The current knowledge, combined with the insight I gain with the material study will give me the information to answer my research questions. The main research question of this study will be "What defines a loom weight?" In order to structure my research, the main research question will be examined within two categories, which determine the functional parameters.

- *Function.*

Which are the characteristics of a loom weight (shape, perforations, decoration, weight etc.)? Are there regional variables, is there a development through time (typochronology)?

- *Context.*

In what contexts do we find Iron Age loom weights? Can the context give additional information about a possible function?

1.3 Theoretical Framework

When handling and discussing an archaeological object linked to textile production, one is likely to have to deal with the whole chaîne opératoir of textile production. Not only to understand how the loom weights could have been used, but also to make an inventory of the remains that textile production leaves behind in the archaeological record. In literature, the presentation and processing of textile tools have at times been executed without a thorough discussions regarding their usage.

There has been an enormous amount of research on loom weights, from all over the world. Lots of studies on Middle Eastern and Mediterranean weights can be found, however, the research on North-Western Europe is rather insufficient. One of the first to address the find of Iron Age triangular weights is K. Wilhelmi. He used the theory by G. Loewe to make a schematised drawing explaining the function of the weights. The extensive theoretical background of research on triangular Iron Age loom weights will be discussed in chapter three.

1.4 Methodology and Theories

The methodology for this research will consist of a combination of literature study and material study. This combination is necessary in order to give a good overview of the extend of the category and will help to answer the research questions. From literature, information will be gathered on (Dutch) loom weights and the discussion that exists around this category of objects. Loom weights are often recorded as a single find only, except when a complete set is found. Often the context of the single finds is poorly documented and there is no extra attention for signs of textile production. Therefore, I will make my own dataset with loom weights that have already been documented and new objects from case studies. The combination of the literature study and the material study will be sufficient to answer my research questions and therefore supplement the information that is currently available. The material in this study will be approached on a practical level in an attempt to combine the variations of context, function and shape.

1.5 Outline

The first two chapters will have an explanatory function, for one cannot comprehend the controversy around Iron Age loom weights without the necessary background information. The first chapter (2) is introductory on textile production and the evidence of that which can be found in the archaeological record and the discussion which revolves around their function. The next chapter (3) will give an overview of the previous research on triangular loom weights, both literature studies and experimental archaeology will be highlighted.

My own research will be explained within the next three chapters. These chapter will all focus one of the research questions. In chapter 4, there will be an introduction on all the case studies I shall be using for my research. The focus of this chapter lies on the **context** in which the triangular loom weights were found. Subsequently, chapter 5 will take a closer look onto the characteristics that determine the **function** of a loom weight.

The last chapter (6) will be the conclusion and consist of a discussion of the results. The discussion will revolve around the main themes of this thesis; context and function. Based on the previous chapters an answer to the main research questions will be formed.

2 Textile production in Archaeology

The following chapter provides an overview of archaeological evidence for the numerous stages of textile production that are left behind in the archaeological record. The primary focus of this chapter will lie on the production of textiles made from wool on a warp-weighted loom. In part 2.1 the general requirements for textile production are reviewed. Part 2.2 deals with the accumulation of fibres to compose the thread. In part 2.3 the process of spinning will be explained. In part 2.4 the mechanics behind weaving are explained. Furthermore, the functional aspects of the warp-weighted loom are explained. Finally, this chapter is concluded with part 2.5 where an enumeration of the archaeological evidence for textile production is given.

2.1 Textile Requirements

Textile work is rather complex, since it requires a great deal of resources and tools for the various stages of production (fig. 2.1). The sequence of textile production begins with the choice of raw material, which will be transformed until a final product is obtained. The transformation starts with the raw fibres that must be prepared, spun into yarn, woven into a solid piece of textile and finished. Each of these procedures requires a specific set of tools and skills (Gleba and Mannering 2012, 5).

By means of landscape archaeology, the organization of resources within Europe has been researched. For obtaining the raw materials, suitable areas for cultivation of e.g. flax and dye materials or a pasture for sheep were of foremost importance. Textile work required a lot of space, and thus there must have been places equipped for looms or the processing and storage of fibres within settlements. Another important aspect of textile production is specialised knowledge, which was significantly from the Iron Age onwards, when particular methods of patterns and weave types appeared. Also, trade was necessary to obtain non-local dye materials (Belanová Štolcová and Grömer 2010, 9-10).

A great deal of information about tools used in Bronze Age and Iron age textile production is available from archaeological excavations. Tools that predominantly survive within the archaeological record are the ones made of clay, like spindle whorls, loom weights, as well as a few weaving tablets. Some bone and metal materials, like needles, shears or weaving swords are preserved too (Belanová Štolcová and Grömer 2010, 10). Other remains could consist of discarded unfinished or defective products, unused raw material as well as the products themselves. Sporadically, installations, such as dyeing vats, can be recognised but this is almost exclusively in wet conditions. Raw materials and unfinished or defective products are almost never encountered, it is likely that these have been re-used (Gleba and Mannering 2012, 4-5).

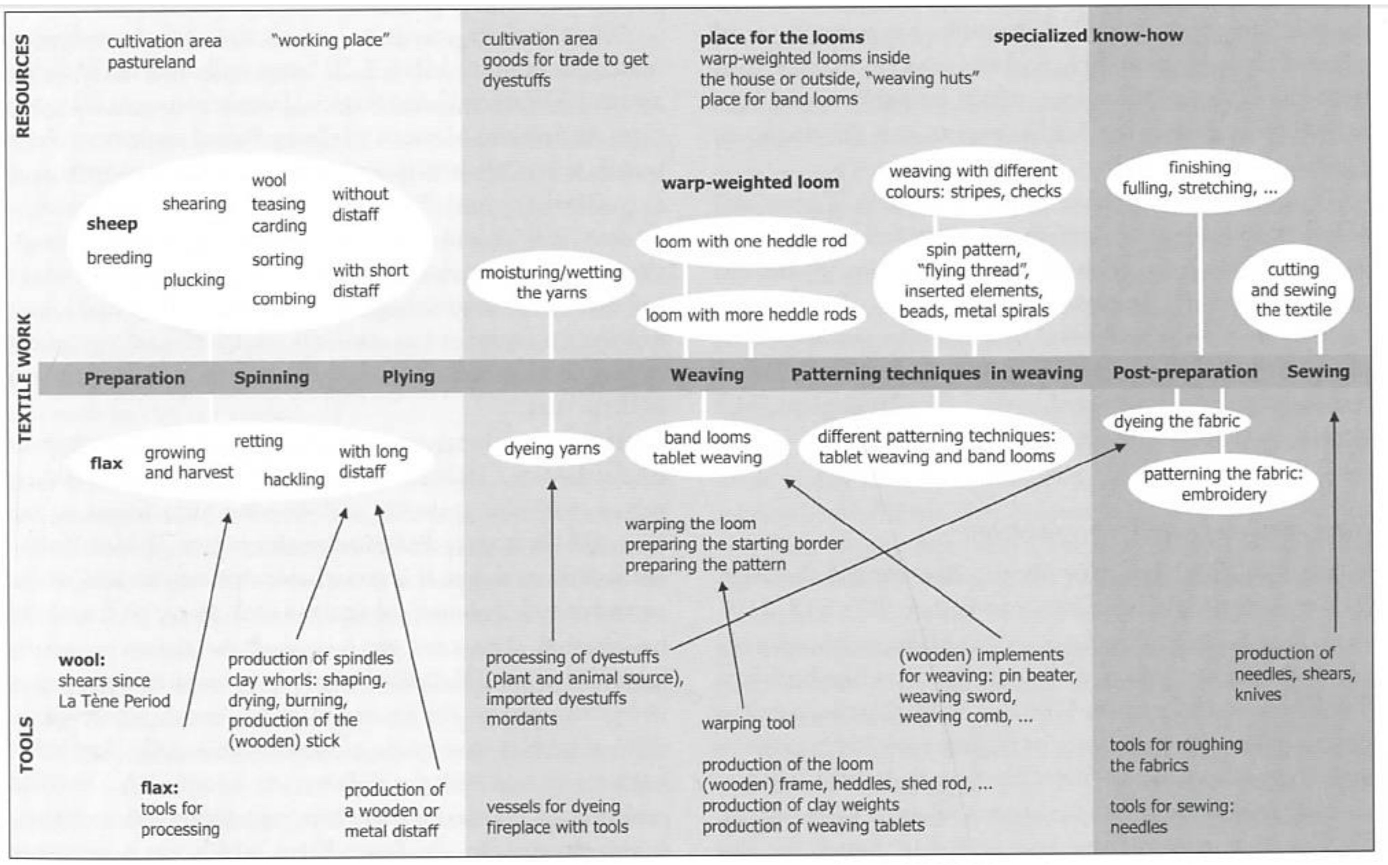


Fig 2.1. Scheme of textile techniques, resources and tools (Belanová Štolcová and Grömer 2010, 9).

2.2 Obtaining the Fibres

The major animal textile fibre of antiquity and main focus for this study is sheep's wool. Wool has properties that differ considerably from plant fibres (Harris 2010, 106-7), which account for its widespread use soon after its adoption during the Neolithic. Wool has the ability to felt, which is caused by its fibres' scaly surface. Another property of these fibres is that they are kinky; when spun or felted the mass of wool contains little air pockets making wool an excellent insulating material, as opposed to linen or other vegetable fibres. The kinks also tend to catch on each other, and on everything else, allowing wool to be spun in two quite diverse ways (Barber 1994, 36): the fibres can be combed to lie parallel, producing a hard, strong yarn, called *worsted*; or the fibres can be carded to lie in all directions, producing a soft, spongy, elastic yarn called *woolen* (like typical modern knitting yarn). The woolen yarn depends on the kinks and the spin to hold it together (Barber 1991, 20). During the Iron Age, twill weave became the predominant type of weave in most of

Europe. One of the main requirements for this type of weave was that the fibres had to be rather elastic. Wool fibres stretch more easily than plant fibres, making the fabrics made of them more elastic and suitable for twill weave (Gleba and Mannering 2012, 6; Grömer 2016, 69).

Wool must be extracted from the animal, which could be accomplished by plucking or shearing (Barber 1991, 21). Plucking is an older method, solely used on primitive breeds of sheep whose fleece moulted. More developed sheep breeds don't possess the ability to mould and therefore their fleece has to be cut off, a process accomplished with the help of shears or a knife. Shears first appear during the Iron Age and are made of iron (fig. 2.2). This can be explained by the fact that bronze was not suitable for making shears since it was not springy enough (Grömer 2016, 68). Before the Iron Age, sheep were likely sheared with knives. Since knives were used for a variety of other functions, it is impossible to prove the application of a knife solely for shearing (Gleba and Mannering 2012, 6-7).

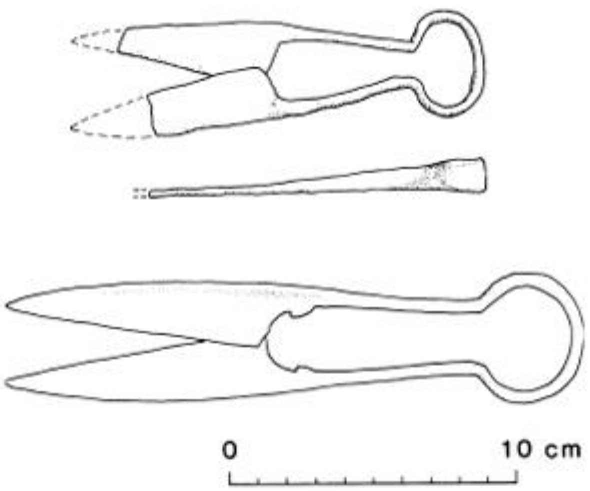


Figure 2.2 Wool shears (Gleba and Mannering 2012, after Wild 1988, 7).

Wool can be spun immediately after it has been plucked or shorn from the animal, though it is usually first prepared by combing to remove impurities (Barber 1991, 21-2; Belanová Štolcová and Grömer 2010, 11). In most cases, wool was spun unwashed, since lanolin grease, which is naturally present in the sheep's coat, helps in the process. An additional advantage of combing is that it also arranges and straightens the fibres and separates any long hairs from the wool. For this purpose, combs with long teeth made out of wood, bone or horn were used. Few examples have been found in the archaeological record (Gleba and Mannering 2012, 7-8).

2.2.1 The Composition of the Flock

There are general deviations within the distribution of age and sex visible in the bone material of a flock that could tell us something about their primary use in the past. Sheep are known to have been used for their meat (and hides), milk and wool. It is likely that a flock was used for multiple purposes at the same time, but since the animals were killed for their meat and hides, but had to be kept alive for continuing supplies of wool and milk this would not be entirely compatible (Grömer 2016, 55).

When the primary use of a flock is for its **meat**, the animals would be slaughtered within a couple of years, keeping only a small portion of the flock (mostly ewes) for breeding purposes. The optimal point to slaughter a sheep for its meat, is when it has just reached its full size (Grömer 2016, 55; Payne 1973, 281). This keeps the required caretaking and fodder at a minimum, while it maximises the amount of meat per animal (Barber 1991, 26). For the purpose of **milk**, the male is rather otiose. Only a few males are required to impregnate the ewes each season, to start the production of milk. A flock used primarily for its milk will mainly consist of adult ewes, with only a few rams kept for breeding. Therefore, most male individuals will be slaughtered at a young age (Payne 1973, 281), to limit the amount of caretaking and fodder, while most female lambs are kept to replace elderly individuals (Barber 1991, 26). A rather significant difference is visible in flocks used for their **wool**. The best quality wool is grown by castrated rams (wethers), followed by the fleeces of ewes and the poorest quality wool is produced by still intact rams. A flock used primarily for its wool is therefore expected to consist primarily of wethers, a large number of adult ewes both for breeding and wool, and a small quantity of rams to maintain the flock (Barber 1991, 26-7; Grömer 2016, 56; Payne 1973, 281).

Table 2.1. The consistency of a flock depending on its function (after Barber 1991, 27).

		Age pattern		
		Ewe	**Ram**	**Wether**
Use	**Meat**	Some yearlings, some old (for breeding)	Mostly yearlings, a few old (for breeding)	None
	Milk	Old	Mostly yearlings, a few old (for breeding)	None
	Wool	Old	A few old (for breeding)	Old

In order to maintain long-term stability, a flock was probably used for multiple purposes (Greenfield 2005, 28). Table 2.1 shows that at least some combinations are possible. It is easiest to combine meat and milk production (where ewes are maintained for their milk and breeding, but most male are slaughtered young for their meat), or milk and wool (where both sexes grow old for their wool, but most males are being castrated and the ewes being used for both milk and wool). The only way to efficiently combine meat and wool, is to eat poor quality mutton (Barber 1991, 26-7).

In theory, if the use of wool was the sole purpose, or of any importance at all, it should show in the composition of the flock in respect to the division of age and sex. The presence and determination of wethers is unfortunately less explored, since this would irrefutably prove the use of a flock for its wool. For there is absolutely no point in keeping wethers for the purpose of meat or milk. It is theoretical possible to distinguish wethers by the skeletal remains, but animal bones in archaeological research are often only identified by species, only occasionally dividing them in an age and sex distribution (which often still excludes wethers) (Barber 1991, 27).

2.3 Spinning

Once obtained and prepared, the fibres can be converted into thread. This is achieved through spinning, a process which consists of drafting (drawing out and twisting) the fibres (Grömer 2016, 75). Spinning does not necessarily have to leave any traces in the archaeological record, since a thread can be spun by hand without the use of any tools. In this case, the fingers are used to draw out and twist the fibres. Though, there are two disadvantages to this method. Overall, the fact that you can only twist the thread a couple of times with each movement of your fingers, makes it a very burdensome process. Besides that, more problematic is the fact that the thread must stay under constant tension; the moment you let go of the thread it will rapidly untwist or get tangled (Barber 1991, 42). This is unavoidable, since the thread will eventually become longer than one’s maximum arms reach. The only way to make the twist permanent, is by wetting or plying (Grömer 2016, 80).

A solution to both problems was to be found in the spindle. A spindle usually consists of a stick (the spindle) and a pierced whorl, through which the stick is entered. The spindle whorl can be secured on the top or the bottom of the spindle (Keith 1998, 501, after Crowfoot 1931). Except for the fact that twirling a thread with a spindle is much faster than doing this by hand, the spindle could also be used as storage where the already finished thread could be kept under tension (Barber 1994, 37; Grömer 2016, 76). While spindles were often made of wood, the whorls were made of variable materials, like clay or stone. This is demonstrated by the find of metal spindles in Central Europe and wooden spindles and whorls found in Northern Italy (Belanová Štolcová and Grömer 2010, 12).

A thread can be spun in two directions, which produce different structures. After the spinning, the thread may directly be used for weaving or the twist could be made permanent by plying it (Barber 1991, 42). Plying is when two or more threads are spun together to make a stronger and more durable yarn (Grömer 2016, 80), this is usually done with larger and heavier spindle whorls (Ingenegeren 2010, 43).

In prehistoric Europe, the low-whorl type spindle was commonly used, in which the whorl was attached to the lower end of the spindle rod. The spindle had a hook or dent on one end to attach the thread and to keep the yarn from slipping off the spindle shaft (Gleba and Mannering 2012, 9).

2.3.1 Spindle Whorls

Complete spindles are almost never preserved within the archaeological record, only the less perishable spindle whorls remain (Grömer 2016, 81). This makes the find of a complete spindle (fig. 2.3) at the wetland settlement site of Arbon Bleiche 3, in Switzerland exceptional. The more frequently found spindle whorls are considered to be the most common archaeological evidence for spinning.

Fig 2.3. A complete spindle from Arbon Bleiche 3 in Switzerland (Grömer 2016, 81).

A spindle whorl provides weight and tension to spin the fibres into a thread. To accomplish this, the whorl must be a symmetrical, centrally pierced object. The majority of the whorls are made of fired clay, but wooden, bone and stone whorls are also known. In the Netherlands only whorls made of fired clay are known (Ingenegeren 2010, 44). The earliest finds of spindle whorls date to the beginning of the Neolithic period. A variety of whorl shapes are known, but they are not subjected to drastic shape variations since the shape drastically affects the functional aspects (Grömer 2016, 81-3). By a degree, the differences in whorls can be explained by the fact that whorls with different qualities (like diameter, thickness and weight) were required for different types of yarn (Ingenegeren 2010, 45). Spindle whorls are practically impossible to date unless they have a datable context or a specific decoration scheme (Gleba and Mannering 2012, 9). There is evidence from the La Tène Period for the reuse of broken pottery as spindle whorl. These potsherds were adapted into a circular shape and perforated in the centre. These whorls were functional and efficient (Belanová Štolcová and Grömer 2010, 13).

The fact that no other types of spinning tools have been found, does not exclude that other spinning methods could have been used (Ingenegeren 2010, 44). The presence of spindle whorls is not needed to prove the processing of yarn into textile, but its presence can endorse the presumption of textile production in the area. The combination of spindle whorls and loom weights is considered to be a solid base to assume textile production (Grömer 2016, 62).

2.4 Weaving

Once the fibres have been spun into a thread, this yarn can be woven into a piece of textile. There are various techniques to create a textile, not all of which require a loom. The earliest textile techniques consisted of manipulating yarn to create a web-like structure (Gleba and Mannering 2012, 9-10; Grömer 2016, 92).

Weaving demands the use of two distinct groups of parallel threads. One set, the **warp**, is kept under tension during weaving, while the second set, the **weft**, is passed over and under the threads of the warp, in a perpendicular way. The looms fundamental function is to keep the warp-threads under tension during weaving (Hodges 1995, 133). There was a variety of weaving techniques available to prehistoric people (Grömer 2016, 92). The simplest form of weaving, tabby, is produced by weft threads passing over and under the warps threads in a repeating pattern (fig. 2.4, left). In more complex twill weave, the weft threads pass over and under warps in a predictable pattern, each row going one warp thread out of the way (fig. 2.4, right), this creates a diagonal effect (Gleba and Mannering 2012, 12).

In remains of Dutch prehistoric clothing, different production methods could be recognized. Besides weaving on a warp-weighted loom and band weaving, the use of the techniques sprang, braiding and knotless netting could be distinguished (Ingenegeren 2010, 51). For this study only the warp-weighted loom is of importance.

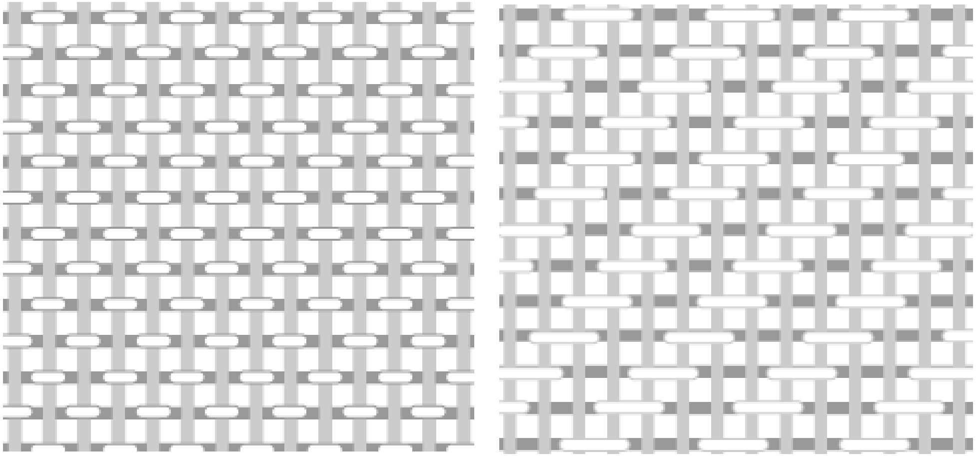


Figure 2.4. Weaving patterns; tabby (left) and twill (right) (en.wikipedia.org).

2.4.1 The Warp-Weighted Loom

A warp-weighted loom exists of two vertical beams and a horizontal beam (**cloth beam**), whence the **warp** threads start (**heading band**) (fig. 2.5). The tension on the warp threads is kept by bundling them onto **loom weights**. The warp bundles could be fastened to an intermediary rod (**shed bar**) or a thread that was attached to the weights or directly to the weights (Hodges 1995, 133-4; Ingenegeren 2010, 51; McIntosh 2009, 199).

The warp-weighted loom distinguishes itself from other types of looms by its composition. The textile is organized in such way that the warp threads are hanging lengthwise and the tension is kept by means of weights (clay or stone) attached to the bottom, while the other end is secured to the top of loom itself (Hodges 1995, 134).

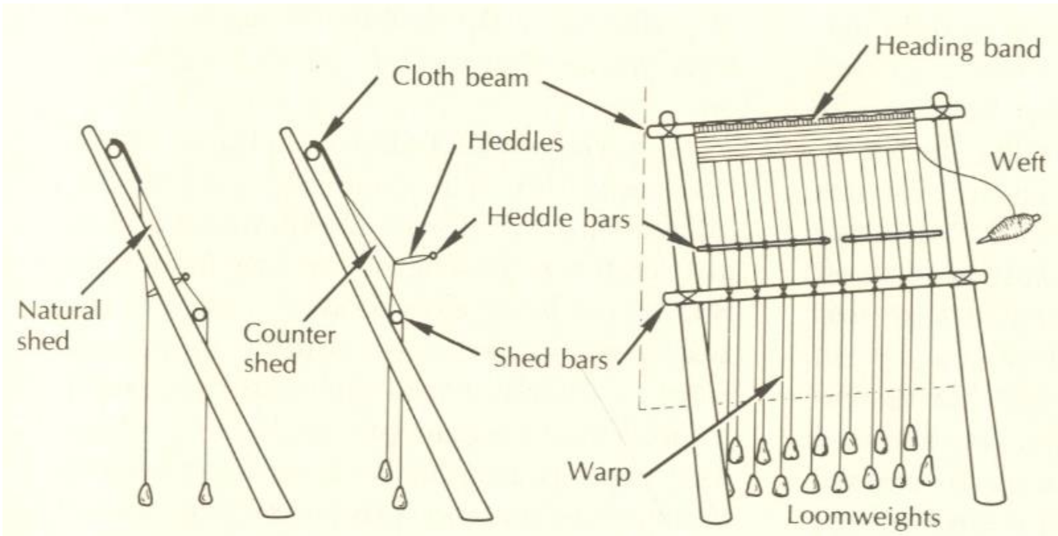


Fig 2.5. Warp-weighted loom (Barber 1991, 111, fig. 3.27).

A **heddle** was used to change the **shed** of the loom. Distinct types of weaving techniques existed throughout prehistory in the Netherlands. Tabby makes use of two sheds; the natural shed and the counter shed. It is woven on a simple warp-weighted loom with a shed bar and one heddle bar, like the one in figure 2.5 (Hodges 1995, 135). Loom weights were attached to the two sheds to keep them in place. Every second warp thread is attached to a loom weight in the natural shed, and the other warp threads are attached to loom weights in the counter shed. The loom weights in each of the two sheds are positioned side by side (Mårtensson *et al* 2009, 377). With the addition of more sheds it was possible to create a more complex, diagonal pattern, like twill (fig. 2.3). Twill required two or more heddle bars (Ingenegeren 2010, 51).

For the insertion of the weft thread in the warp, a shuttle was used on which the weft thread was wound. When the weft was placed, it had to be beaten in place by a weaving sword. All these objects, were typically made of perishable materials like wood and have therefore not been encountered, but could have been preserved in wetter conditions (Ingenegeren 2010, 51).

The warp-weighted loom can be operated in several ways, depending on weaving techniques and personal preferences. For instance, one can principally use loom weights of different weight in one setup if the tension is distributed evenly among the warp threads (Mårtensson et al 2009, 379-80).

2.4.2 Loom Weights

Common archaeological evidence for weaving consists of loom weights. These loom weights are generally the only component that remains of a warp-weighted loom. It is important to notice that the absence of loom weights cannot preclude weaving activities. Other weaving techniques, such as the horizontal loom, backstrap loom and vertical loom (Barber 1991, 80-1), were solely constructed of perishable organic materials which are rarely preserved in the archaeological record. While ethnographic studies have told us a lot about the function of the warp-weighted loom, they give little information on the function of the loom weight itself since the weights have changed noticeably since prehistory (Mårtensson *et al* 2009, 373).

Various archaeological experiments executed by textile craftspeople have established that the weaving on a warp-weighted loom is influenced by the weight of the loom weight. A certain amount of weight is necessary to stretch the warp on the loom (Belanová Štolcová and Grömer 2010, 17). This so-called warp tension is largely defined by the diameter of the thread and limits how many warp threads can be attached to a single loom weight. In general, a large diameter yarn needs more tension than a smaller diameter yarn (Mårtensson et al 2009, 378).

Apart from the weight, other variables visible in loom weights are the thickness and shape. Mårtensson *et al* (2009, 374) explain this diversity in terms of geographical, cultural and chronological factors. Even though loom weights are common finds in archaeological contexts in the Near East and Europe, there are very few publications addressing the archaeological context of loom weights and their function (Miszk 2012, 120).

2.5 Evidence for Textile Production

The problem with archaeological evidence for textile production is that the end product, the textile itself, is often not preserved. Direct archaeological evidence for wool production are preserved pieces of spun wool or textile remains, loom weights and spindle whorls which are to be seen as indirect archaeological evidence (Gleba and Mannering 2012, 5).

The only significant evidence to be found in the Netherlands are the tools used to make these textiles, therefore indirect evidence. Spinning and weaving equipment are common finds. Scarcely, traces of the actual textiles survive, but this solely happens in water-logged conditions or when buried against a metal object. Many (settlement) sites have presence of clay loom-weights, which were often not fired, merely being dried, making them very fragile (Leahy 2011, 445-6).

There are two situations in particular that can explain the in-situ deposition of loom weights. The first case occurs when the set of weights was actually in use on a loom when destroyed (either on purpose or by natural causes), causing the weights to drop in a row corresponding to the loom itself (Barber 1991, 101; Hamerow 2006, 18-9). When loom weights are found in a row, and particularly when the ends of the row are marked by post holes, it is possible to make a fairly accurate estimation of the width of the cloth that could have been woven on the loom. The second case occurs when a loom is dismantled by its owner and stored away when it is not actually in use or only the cloth beam was stored away to work on a different piece of textile (Barber 1991, 102-3; Leahy 2011, 445-6). This is often a more likely explanation for a row of loom weights found in situ. Examples of in situ loom weights are amongst others known from the site Hafnerbach (Belanová Štolcová and Grömer 2010, 17). Last but not least, besides the in-situ deposition of weights, we often encounter stray weights in dump heaps and rubbish pits (Barber 1991, 102). These are more of a mystery to us, but should not be seen as uninformative.

When loom weights are found in clear association with other textile working tools, like spindle whorls (for instance within the same settlement site or feature), archaeologists perceive a connection between them. Usually, no textile remains have survived at these sites (Belanová Štolcová and Grömer 2010, 10).

Besides the indications mentioned above, one would expect to detect wear traces on the loom weights caused by threads on the rather soft material of the clay loom weights. Curiously, Ingenegeren (2010, 54) remarks that wear traces are seldom mentioned in the Netherlands. She considers that this lack of wear traces can be explained by the fragmented state in which the weights are often discovered. From literature, we know that wear traces do occur on loom weights in other parts of Europe. In Danebury (UK) loom weights made of soft chalk show distinctive wear traces (Brown 1984, 421).

Indirect indication for textile production can also be searched in the presence of faunal remains found within the same settlement site where production tools were encountered. There is a clear distinction visible between sheep farming for meat or wool, which can be observed by looking at the ratio of female versus male sheep and their slaughter age. Although, it should be considered that the flock might have been used for more than one purpose. Besides that, there is still discussion about zooarchaeological evidence for sheep since sheep and goat remains are difficult to distinct and bone material decays easily in most regions in the Netherlands. This means that the absence of faunal remains does not exclude the presence of any sheep.

The resources and objects that we know were being used during the *chaîne opératoir* of textile are sheep for their wool, shears or knives for obtaining the wool, weaving combs to clean the wool before using it, a spindle and a spindle whorl to spin the thread, in some cases dye materials, eventually a loom and loom weights for weaving the actual textile, a weaving sword to increase the density of the product and needles to finish the final product. The following objects are preserved in the archaeological record; spindle whorls and loom weights are commonly found and faunal remains are often preserved. However, the more fragile (wooden) weaving equipment like weaving combs, the spindle and weaving swords are only found by great exception, usually in waterlogged conditions.

As a concluding remark, it is important to understand that the occurrence of these objects could be evidence for textile production at a site, especially when multiple objects are found within the same site. Nonetheless, the absence of any of these objects does not exclude textile production at a location.

3 Previous Research

The first use of the term loom weight in association with a triangular weight is unclear, but until present time the term is often used with caution in literature. An overview of relevant previous research on this subject will be given in this chapter.

3.1 Research History

Since 1967, German archaeologist Klemens Wilhelmi has been working on a preliminary compilation of triangular shaped loom weights. In his 1977 article, based on distribution maps made by T. Champion (1975, 133) and C. Reichmann (1979, karte 5)[1], Wilhelmi made a combined map (fig. 3.1) which, he states, 'shows the distribution of this widespread technical phenomenon during the North-Western European Iron Age'. He even goes as far as comparing the distribution of triangular loom weights with the distribution of characteristic La Tène phenomena like glass bracelets and *fibulae* (Wilhelmi 1977, 180-2).

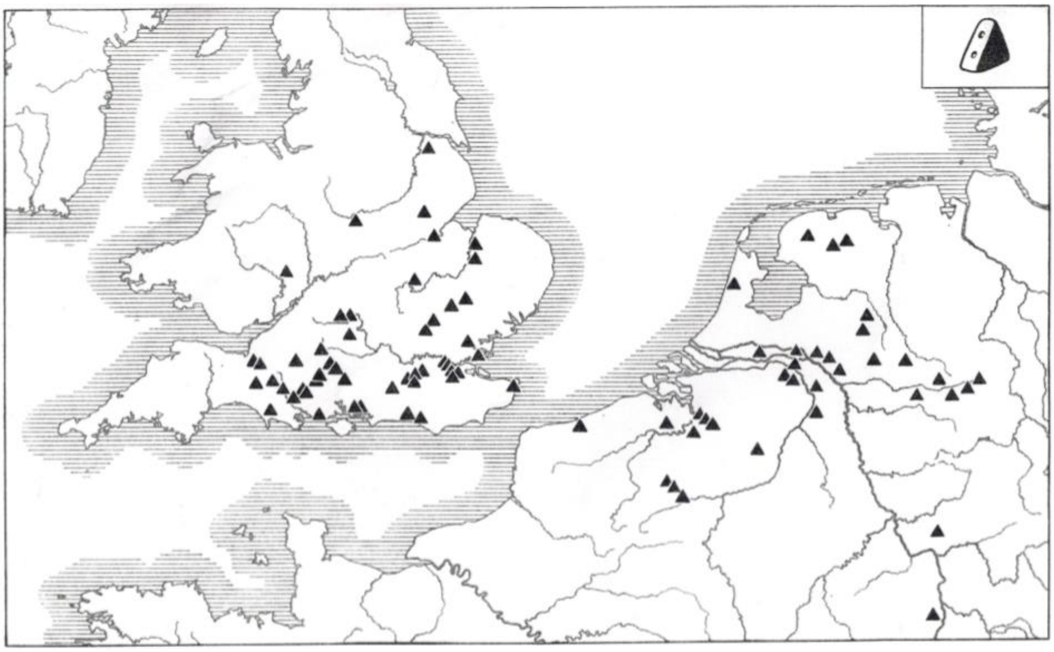


Figure 3.1. Distribution map of triangular loom weights in North-Western Europe (Wilhelmi 1977, 181).

Remarkably, T. Champion was not per se interested in the phenomenon of triangular loom weights itself. In his article, he is comparing the distribution of several elements of the British Iron Age (e.g. settlement types and pottery styles) with the other

[1] Wilhelmi used an unpublished version of Reichmann's dissertation, since this was officially published in 1979, two years after Zur Funktion und Verbreitung des dreieckige Tongewichte der Eisenzeit by Wilhelmi was published.

side of the Channel in order to prove interaction within this region (Champion 1975, 133). Reichmann uses the triangular loom weights in a similar way; he compares the distribution of triangular loom weights to the distribution of sling-shots, a certain type of interment and vertically double perforated knob handles (Reichmann 1979, 435-9).

In the 1970's German archaeologists Loewe and Wilhelmi are trying to establish a clear description of the triangular objects, their distribution and its function. Based on finds of spindle whorls and (triangular) loom weights at the German sites Bracht, in the municipality of Kempen-Krefeld and Weeze-Baal in the municipality of Geldern, Loewe (1971, 35, footnote 66) creates a scenario in which he describes how he thinks the triangular weights were used.

"I imagine the use of triangular weights like this: a bundle of warp threads is pulled through two adjacent holes; once it tightens, it is possible to adjust the weight to any desired height due to the interrupted movement. It (the weight) is secured through the third hole with a thread onto a rod which is attached to the loom, so that it cannot swing and 'step out of line'. When a piece is woven, and rolled up (onto the heading beam), you can simultaneously lift the rod and the weights, and the warp is wound, so far, that there is possibility for a subsequent piece of textile and when the rod is put down again the whole thing is kept in place again by the weights. In case of several repetitions in this simple process and corresponding length of the warp, that might have been stored under or behind the loom, it is possible to manufacture fabrics of considerable length on a vertical loom (see the 'blocks' in guy lines and rigging in ships that are functioning according to the same principle)."

In his 1977 article, Wilhelmi (1977, 182) accepted this assessment of function by Loewe and construed this into a schematized drawing of a triangular loom weight in use (fig. 3.2). Wilhelmi notes that the difference with other types of weights came primarily from the fact that these weights held the warp in such a way that the cloth could be rolled up easily during the process of weaving. This gave the triangular weights an advantage over earlier types of weights. Wilhelmi remarks that there are variations in size and (later) in the number of perforation in the loom weights, but the general type is quite widely distributed in Northern Germany as well as in Britain. He considers these objects to be part of the square grave complex of the Iron Age.

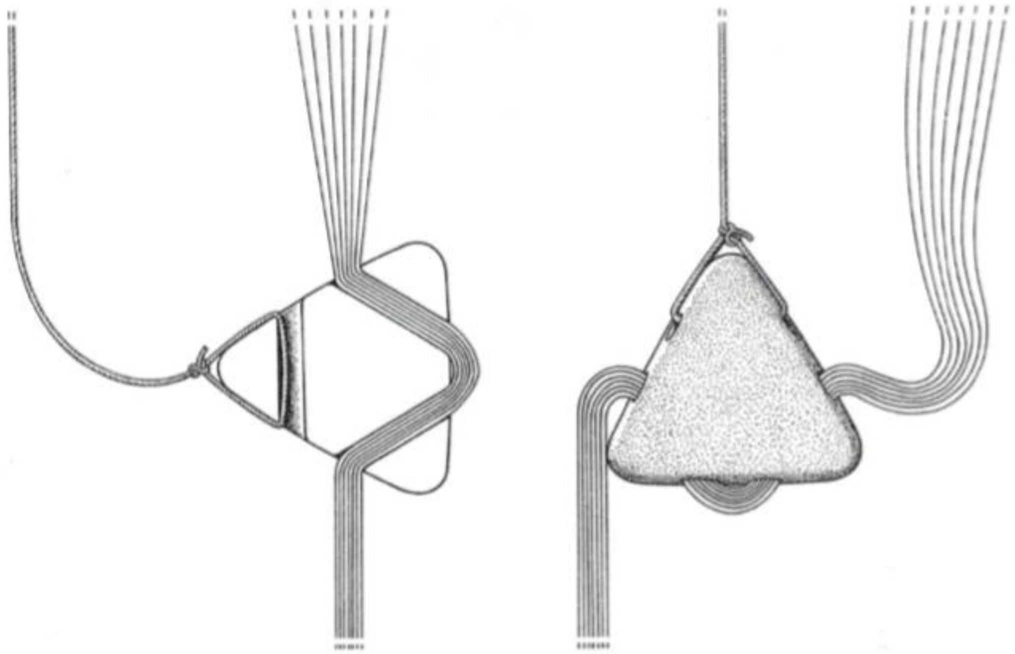


Figure 3.2. Schematized overview of the function of triangular loom weights according to Loewe (Wilhelmi 1977, 182 after Loewe 1971, 35, footnote 66).

One of the first Dutch archaeologists to address the function of the triangular weights is Verwers (1972, 117-8). He mentions the find of 120 chunks of baked clay, on which perforations could be observed on the flat sides. In two or three cases these fragments belonged to triangular objects that had thee perforations on the corners of the objects. Verwers notes that these objects are 'generally considered to be loom weights'.

Loewe was one of the first to publicly mention that the triangular loom weights are not a regional phenomenon. To show that triangular weights occur throughout the whole Niederrheinarea, Loewe (1971, 35, footnote 66) refers to drawings in Modderman's article '*De Spanjaardsberg; voor- en vroeghistorische boerenbedrijven te Santpoort'* (1961, 237-8, figure 24.8, 25.7).

Modderman divides the occupation of the Spanjaardsberg in 6 distinct phases. Based on the type of decoration of the pottery (roughened, combing and finger impressions) these all belong to the Iron Age (Van den Broeke 1980, 110). At this site, multiple fragments of triangular loom weights were found. Modderman (1961, e.g. 228) uses the definition loom weight and net sinker simultaneous. He treats the subject in a way that seems to be common in (Dutch) archaeology, by avoiding a direct discussion and mentioning both options. This makes it somewhat remarkable that, according to Modderman, the find of a spindle whorl together with a fragment of a loom weight were indications that there might have been textile production at this site (Modderman 1961, 235).

The fragments of loom weights have been found in contexts belonging to the first until the fifth period. The report also gives an overview of the skeletal remains found during the excavation. During all of these periods remains belonging to sheep/goat have been found (Modderman 1961, 228-238). It is somewhat remarkable that this is not considered by Modderman himself, because it gives more support for an indication that there could have been textile production at this site. Unfortunately, no further information on the skeletal remains is given. The age of death and the ratio between male and female sheep/goat can give us more indications on the function of these animals in this area.

In 1987, Dutch archaeologist P.W. van den Broeke is one of the first archaeologists to address the change in shape of Iron Age weights in North-Western Europe by attempting to make a typochronological overview on the development of the shape of loom weights for the southern Netherlands (fig. 3.3).

He states that for the whole of North-Western Europe it can be stated that clay weights, either net sinkers or loom weights, have never had a triangular shape prior to the Middle Iron Age and always had fewer than 3 holes. Normally, we see a rectangular, truncated pyramidal or conical artefact, with one hole in the top. In the southern part of the Netherlands, the triangular, flat loom weight makes its first appearance in the first half of the Middle Iron Age. Also new is the phenomenon of three holes through the corners of the weight. This triangular type represses the earlier shapes and predominates from the Late Iron Age, up to the Roman Era (Van der Sanden 1987, 38).

The moment of introduction seems to be rather early in the Dutch province of Noord-Brabant and potentially the southern part of Gelderland. Although the triangular weight is known to have a broad distribution, there are no examples known from sites in Northern Belgium in the first half of the Middle Iron Age. This is remarkable since the pottery assembly shows great similarity in this time. Lede, in the eastern part of Vlaanderen, a site that has been dated in the Middle Iron Age phase E(/F), yielded 18 loom weights, with anything except a triangular shape and with only one perforation. Even on earlier Middle Iron Age sites (phase F-G) in Northern Belgium (Lamine, Remicourt) we only see the older type of weights. There are types of weights that Van der Sanden does not describe, but these are scarce (Swaef and Bourgeois 1986, 41; Van der Sanden 1987, 38).

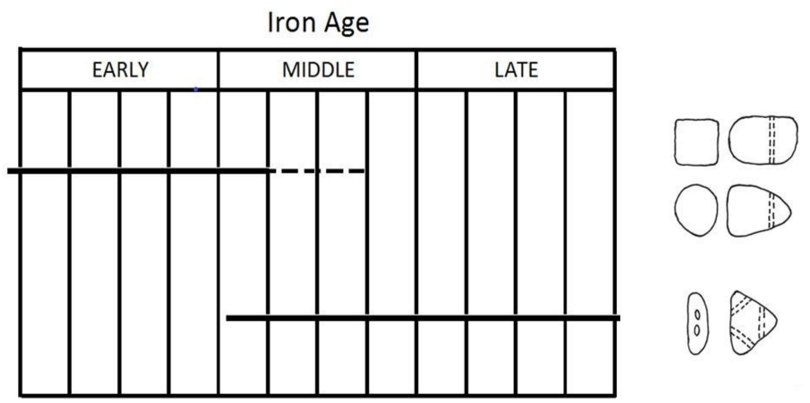


Figure 3.3. The presence of several types of weights during the Iron Age in Southern-Netherland (after Van den Broeke 1987, 38).

Two Dutch authors who oppose the generally accepted assessment of function by Wilhelmi, are Ufkes and Essink (2001, 73-4). They base this opinion on the fact that according to them the diameter of the perforations is extremely narrow, leaving space for only a few warp threads. This means that you would need an unnecessarily large amount of loom weights to compensate for this. Also, lacing up the warp threads though more than one hole, would cause irregularities in the tension on the threads. Based on this, they decided to refer to the objects as weights, instead of loom weights, following the example of Taayke (1996, II 48, III43, IV 119: 'Tongewichte'). Remarkable about the article, however, is the fact that they use no references to any sources to support their observations.

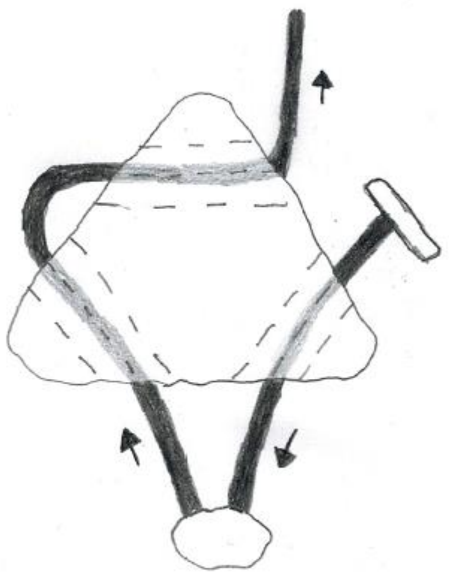
Nonetheless, Ufkes and Essink continue their argumentation with the examination of an almost completely intact weight from a site in Houten. This weight had no traces of wear and the fact that it was slightly baked made heavy use as pulley unlikely. The triangular shape of the weight made a function as net sinker unlikely, since this would cause the weight to get stuck in water plants easily. Furthermore, the presence of round, conical and pyramidal weights with one perforation would make the triangular weights otiose. These other types of weights from the Iron Age and Roman Era have been found in context like a *grubenhaus* or with multiple weights in a row, indication that a loom would have stood there. In their opinion, this proves that the triangular weights with three perforations must have had a different function (Ufkes and Essink 2001, 74).

Ufkes and Essink end their argumentation with the remark that the triangular weights found at other sites should be re-examined to look for any wear traces and possibly extra perforations. Maybe a comparison between the different contexts between sites could tell us more about the actual function of these weights.

Taayke (1992, 164, 187; 1995, 48, 64; 1997, 43, 57, 119, 127), who made an inventory of all the local pottery in the Northern Netherlands in the period between 600 BC and AD 300, refers to every type of loom weights as 'Tongewichte', which is German for clay weight (this term is also used by Wilhelmi). He describes how he was able to distinguish four different types of clay weights within this period: flat triangular shaped, with three perforations in either the narrow or the flat sides of the weight, conical or truncated pyramidal shaped, with a perforation in the top of the weight and ring shaped. In the first part of his dissertation (1992, 187) he refers to conical and ring-shaped weights with one perforation which have been dredged up in lakes and therefore he claims that a function as net sinker has been likely. Taayke does not give any remark regarding the function of the triangular weights.

A few years later in an article from 2007, Ufkes (2007, 79) refers to an article written by Friedrichs, in which Friedrichs (1998, 243) argues for a use as stretcher in the preparation for hides (fig. 3.4). For this method, a rope would be put through one of the perforations. The end of the rope would be fixated outside of this hole with a button or a wooden pirn. Then the rope is tied onto a static object, before lacing it through the next hole. The other end of the rope is attached to the object that must be stretched, in this case a hide. By pulling the rope, the stretcher could be tightened. When performed with four stretchers, you could generate a lot of tension on the hide. Friedrichs used an actual Iron Age loom weight to perform an experiment how the object would endure the tension. He observed that the stretchers could handle around 6 kg of tension, provided that the ropes were laced up through the perforations in his specific way. This would leave irregular wear traces in the perforations.

Figure 3.4. Schematic drawing of a weight used as a stretcher (after Friedrichs 1998, 243).



3.2 Experimental Archaeology

In 1987, Ingrid Schierer executed an archaeological experiment on warp-weights that were found in Gars-Thunau, a district in Lower Austria. At this site, a total of 36 weights were found. Schierer (1987, 29-45) built a wooden implement to perform several experiments aiming to find out if there was a loom situated at this place, if the weave could be discovered form the position of the weights and how the loom was destroyed. This thesis aims to discuss if the presence of loom weights can prove the presence of a loom at the specific location and to give a briefer overview of the post depositional processes that occur after a loom is out of use. In 2005, she republished her research in English, this article essentially repeated the basic facts from her previous research.

In 2009, a combined work by Linda Mårtensson, Marie-Louise Nosch and Eva Andersson Strand focussed on understanding the shape of loom weights[2]. They performed experimental archaeology with a reconstruction of a warp-weighted loom. Their primary parameter was to investigate the function of loom weights. They used different loom setups in weaving tests, to see how the thickness and weight influenced the function of the loom weights. They used multiple sets of loom weights, which were a reconstruction of items found in Bronze Age Troy. One experiment was conducted with loom weights that had different weight, but identical thickness and one experiment was conducted with loom weights that had an identical weight, but a different thickness (Mårtensson *et al* 2009, 381-3). They concluded that the weight of a loom weight must provide the correct tension for the warp-threads and the thickness of the loom weights preferably had to correspond, or be slightly wider, than the total width of the fabric to be produced (Mårtensson *et al* 2009, 382, 388).

All the experimental archaeology focuses on one primary aspect of the loom weights, like shape or the depositional processes, but there is no one who combines all these aspects and gives a recap of all the results in order to end the discussion on the function of loom weights. Furthermore, experimental archaeology strongly focuses on loom weights found in the Mediterranean area or the Near East, examples from North-Western Europe simply lack.

[2] This experiment was earlier published in 2007, in 'Technical report Experimental Archaeology. Part 3 Loom weights' by the Centre for Textile Research of the University of Copenhagen. In this article only the experiments regarding the thickness of the loom weights and their influence on the function were mentioned. Therefore, only the more extensive article from 2009 is mentioned here.

3.3 Conclusion

The research on triangular Iron Age loom weights is far from complete. This does not mean that it has not been tried to extensively research this subject, but the evidence has never been strong enough to get a unanimous acceptation of their function. The textile production tools have been given attention but they have not been brought together in a systematic way, and were at most a sub-topic in reports. Often only one aspect (function, context or shape) of the loom weights was researched, a study combining these three categories is still lacking. This is where I will position my research.

4 Context - Iron Age Loom Weights in the Netherlands

Iron Age loom weights are rather common finds in Dutch archaeology. This chapter shall focus on the context in which loom weights are found and the conditions one would expect to substantiate that these objects had a function as loom weight. The amount of loom weights found within the Netherlands was so extensive, that a selection had to be made. The areas of Voorne-Putten and Oss shall be used as case studies. An overview of all the individual sites where triangular loom weights were found shall be given and the most complete loom weights have been drawn per case study (appendix 1 and 2). The conditions at these case studies shall be compared against a number of other Iron Age sites.

4.1 My Hypothesis

The context in which you would expect a weight, functioning as loom weight to be found, is within a settlement area, in or close to a house plan and eventually disposed of in a waste pit. Though a loom could be transported, it is not expected to have been used outside of a settlement area. Within the settlement area you could also expect to find skeletal remains, that establish the presence of sheep. Though the preservation conditions of the area could throw a spanner in the works, in the case that archaeozoological remains are found you would expect at least a reasonable percentage to belong to sheep. The absence of any archaeozoological remains, however, is of no consequence.

Other indications could come from the material found. The presence of other weaving tools (e.g. spindle whorl) would be an indication for textile production at the site, which makes it plausible that there was a loom present. Furthermore, since a loom comprises of a large number of loom weights, the find of multiple objects within the same area would give an indication of its function. However, loom weights do not necessarily have to be found in greater numbers. It is reasonable to assume that broken weights were reused for something else or disposed over a large timespan, which meant that they ended up in different waste pits, apart from each other. The only condition in which you would find a complete set of loom weights together, is when a loom was abandoned and collapsed as a whole or left while it was rolled up for storage purposes. This hypothesis will be tested on a number of case studies.

4.2 Case Study Voorne-Putten

The first sites for case study come from the area of Voorne-Putten, which can be seen in figure 4.1. Since 1968 many Iron Age sites have been discovered in the district of Voorne-Putten, which consists of the former islands Voorne and Putten (Wind 1970, 242). In appendix 3 a detailed map of this area can be found with the location of the individual sites that are mentioned in the paragraphs below.

Figure 4.1. The area of Voorne-Putten placed within the Netherlands (after Van Trierum 1992, 15).

Over the years, construction of housing, ditches and land consolidation in the area of Voorne-Putten has unveiled 40 new occupation areas. Most of these sites contained single farmhouses (Van Trierum *et al.* 1988, 23). Many of these sites have been excavated by the Bureau Oudheidkundig Onderzoek van Gemeentewerken Rotterdam (BOOR). Through this research, three phases of habitation have been discerned: phase 1, c. 725-525 BC (Early Iron Age), phase 2, c. 425-200 BC (Middle Iron Age) and phase 3, c. 200-25 BC (Late Iron Age) (Van Trierum 1986, 67-69).

4.2.1 Abbenbroek-Bern 17-22

During a ground survey at Abbenbroek, a triangular loom weight was found. The area was disturbed due to broadening and deepening of a ditch for the purpose of land consolidation. Iron Age artefacts - pottery, bone and wood - were found in the dug-up earth and at the disturbed side of the ditch. Although the context of the material is lost, the survey gave the archaeologists the reason to assume that there was an occupation layer within this area. The high concentration of artefacts was probably caused due to the disturbance of a waste ditch (unpublished day notes BOOR).

Three wood samples from the settlement were collected from the profile of the ditch during the ground survey. The posts dated 105 ±45 calBC (GrN 11095), 261 ±76 calBC (GrN 11365) and 281 ±63 calBC (Grn 11366), suggesting a dating of the site in the Late Iron Age (Van Trierum *et al.* 1988, 37). Van Trierum (1986, 61) mentions that this date was endorsed by the fact that the occupation traces (posts, manure, bone and pottery) were situated on top of and within the Dunkirk I deposition. In the meantime, it is agreed that the Dunkirk depositions were no sufficient means of dating (Berendsen 2005, 53-4), so therefore this observation must be approached with some reservation.

A total of 10 bone fragments of sheep/goat were recovered from the site, with a minimum number of individuals of 2. This was determined by the find of two mandibles, which gave an age of death around 3-4 and 4-5 months. This number of fragments is too low to say anything about the reason for slaughter (unpublished day notes BOOR).

4.2.2 Bernisse 10-172

During archaeological research, preliminary to the construction of a bus lane, in 1995, a Middle Iron Age settlement site was discovered. The discovery of pottery, bone, posts and manure indicated the presence of a well-preserved farmstead, therefore more extensive research on the site was performed later that same year (Goossens 2002, 31).

The excavation plan (appendix 4) shows a farmstead from the Middle Iron Age, a ditch system from the Middle and Late Iron Age and a recent ditch. Based on the location, the ditch system was made after the farmstead was no longer in use. The area was probably used as farmland by then (Goossens *et al.* 2002, 40). The house plan has an east-western orientation. An outer row of slanting posts suggests that the roof of the house had to be supported in order to stay up. The western part of the house plan has been affected by erosion during the Iron Age. The plan of the house consists of two parts; a main building measuring 16.5 by 6 meters, and an extension to the east measuring 9.5 by 5 meters. Based on the spread of the find material, both parts have been in use at the same time. If the extension had been built later, waste was to be expected under the floor level. This was not the case (Goossens *et al.* 2002, 33-5).

The distribution of finds throughout the site shows multiple concentrations (appendix 5). A triangular loom weight (fig. 4.2) and a spindle whorl were found outside of the house plan (Van Heeringen 1992, 151). Within the hallway and living area there are almost no objects. These objects could resemble secondary trash or that the activities took place outside of the house plan (unpublished day notes BOOR).

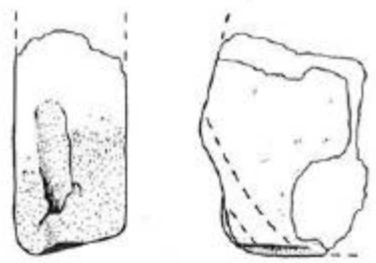


Figure 4.2. Fragment of a loom weight, scale 1:3 (after Goossens *et al.* 2002, 53).

The main building is a longhouse, which is partially both 3-aisled and 4-aisled. The badly eroded part would have been the living area; it is notable that no evidence for a fireplace has been found. The erosion is thought to have been caused due to severe floods in the Middle Iron Age. This would explain why there are so little finds in this part of the house plan. The extension diverges from the main building in size and in the fact that it is only 2-aisled, it probably had a function as stable. It is remarkable that this part of the building contained a wooden floor, made of twigs (Goossens *et al.* 2002, 35-9).

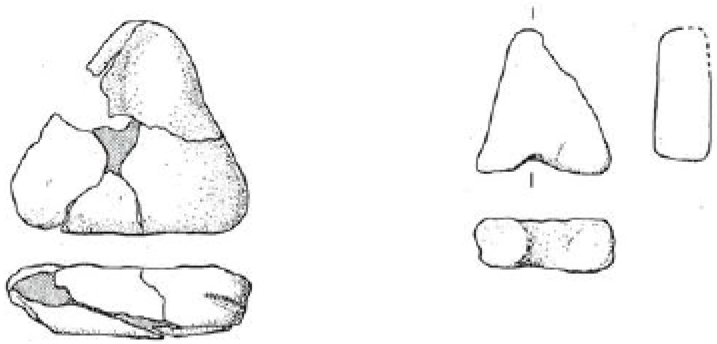


Figure 4.3. Triangular objects, scale 1:3 (after Goossens *et al.* 2002,53).

They also encountered an object that was described as 'an unfinished loom weight without holes' (fig. 4.3, left). It was suggested that the object accidentally ended up in the fire and was not usable anymore and therefore thrown away. A similar object was found at the site Heemskerk-Kerkweg (Van Heeringen 1992, 151). The triangular object is relatively small and shows no signs of perforations. They also encountered a second triangular object (fig. 4.3, right), of which the function is unknown. This object has a striking cavity at the base. It is unclear whether these objects belong to the category of weaving tools (Goossens *et al.* 2002, 52).

The archaeozoological remains at Bernisse have been examined. One of the main goals was to define the spatial distribution, to see how the floods influenced the distribution of bone material. The main categories of zoological remains consisted of cow and sheep/goat. The slaughter pattern shows great similarity with surrounding sites within the area of Voorne-Putten. Fragments of the jaw, and especially the teeth, were most suitable to determine the age of death (table 4.1) (Goossens *et al.* 2002, 47; Van Dijk and Esser 1996, 9).

Table 4.1 Determination of age for sheep/goat by dental elements (after Van Dijk and Esser 1996, 9).

Months	N
3 - 24	5
9 - 24	2
21 - 24	1
< 24	1
> 3	1
> 9	1
> 18	2
> 21	7
Total	20

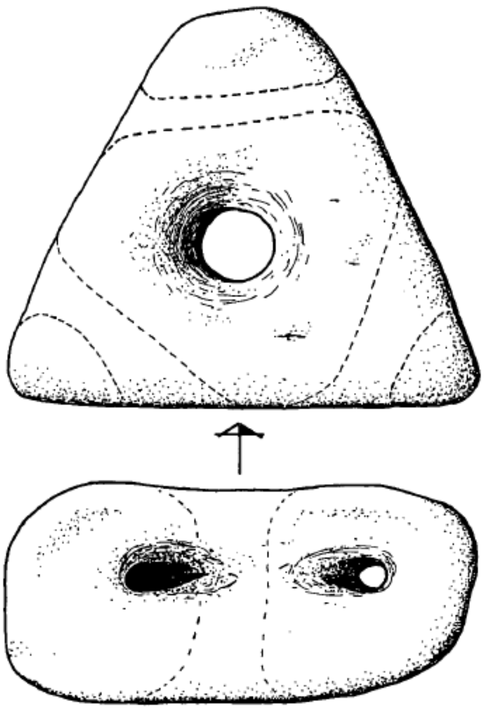
About 60 percent of the sheep/goat were slaughtered before the third year of their life, the other 40 percent was slaughtered between their third and fourth year (Van Dijk and Esser 1996, 9; Goossens *et al.* 2002, 47). This slaughter pattern is similar to that at the site Rockanje 08-52, which shall be discussed later on. This pattern has certainly not solely been for meat production, the large amount of sheep/goat older than 21 months are an indication for the use for milk and wool production (Goossens 2002, 47). Van Dijk and Esser (1996, 10) interpret the large amount of sheep/goat over 21 months as a way to naturally conserve the herd.

4.2.3 Rockanje

While constructing a sewerage system in 1968, the first signs of the rich archaeological record of Rockanje come to the surface, with the discovery of the Iron Age settlement site of Rockanje 08-06. A few decennia later, due to the construction of a residential area in 1990 in Rockanje, four Iron Age settlement sites were discovered, named Rockanje 08-52, 08-53, 08-54 and 08-55. All the settlement sites were located on top of separate peat moor raises in the landscape (Hessing 1991, 341). A coring campaign to determine the condition of the sites, revealed two more settlement sites, named Rockanje 08-56 and 08-57. Research determined that the sites all measured between 30-40 meters in diameter (Van Trierum 1992, 77). The location of the individual settlement sites within the area can be found in appendix 6.

4.2.3.1 Rockanje 08-06

During the construction of a sewerage system at the Late Iron Age settlement site of Rockanje, in 1968, an occupation layer was discovered at a depth of 1,8 meters below surface. An emergency excavation, by means of a pit of 6 x 24 meters, unveiled part of an Iron Age house plan (Wind 1970, 242; Trimpe Burger 1968, 19). Copious quantities of pottery were found in and surrounding this house plan, including dishes, saucers lids, punctured plates, tripods, loom weights and spindle whorls (Wind 1970, 242-55). During the excavation of the house plan, (fragments of) 16 triangular loom weights were found (unpublished daynotes BOOR). Wood, presumably belonging to a threshold, has been dated to 85 ±67 calBC (GrN-6401) (Lanting and Van der Plicht 2006, 356; Van Trierum 1992, 81).



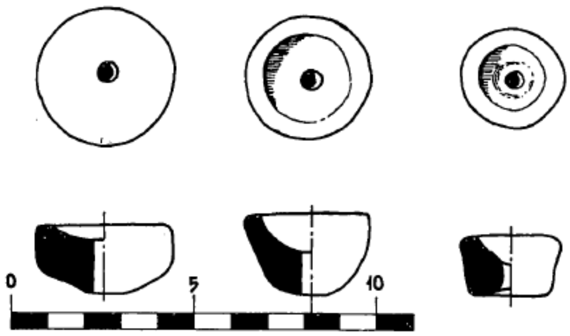


Figure 4.4. Baked clay weights (left) and three spindle whorls (right) (Wind 1970, 255).

Wind (1970, 255) gives a detailed description of the 16 -partially fragmented- loom weights. He describes them as equilateral triangular objects, with sides of approximately 13 cm and a depth of approximately 5 cm. In the centroid of the triangle, a perforation has been made of approximately 1½ cm diameter. The corners of the weights are also perforated (varying from 0.8 to 1 cm diameter) perpendicular to the central perforation. Wind describes the quality of the objects as extremely poor, comparable to the tripods found at the site. The colour of the fabric is light yellow.

Besides from the description of the objects, Wind (1970, 255) also gives his opinion on the function of these objects. He compares the objects found in Rockanje to a Belgium site called 'De Panne' which shows great similarity, especially in pottery. The fact is that, remarkably, triangular weights found at 'De Panne' lack a central perforation (Rahir 1928, 51). This leads Wind to the conclusion that only the holes in the corners of the weights are essential to the function as loom weight. Furthermore, the lack of fish remains leads Wind to conclude that a function as loom weight seems to be the most plausible. The loom weights (fig. 4.4., left) have been found together with spindle whorls (fig. 4.4, right) which have a diameter of respectively 3.8, 3.3 and 2.8 cm.

The archaeozoological remains at the site indicates the presence of a considerable number of sheep/goat at the site. This number is not specified, but since it is only mentioned for this category it is likely that the number was higher than to be expected. There is no data on the slaughter age of the animals, but according to Wind (1970, 257-8) it is a good indication that textile could have been produced at the site.

4.2.3.2 Rockanje 08-52

During the construction of a new neighbourhood in 1990, a complex of multiple farmsteads was discovered in Rockanje. Later that same year, the farmstead named 08-52 had to be excavated because it was threatened to be demolished by the approaching building activities. The house plan measured 21 meters in length and was 5.5 meters wide. Part of the stable had been disturbed, but some construction elements were preserved deeper in undisturbed ground (Van Trierum 1992, 77-78).

The house is 3-aisled and consists of a stable, a hallway with two entrances to the house and a living area with a fireplace (appendix 7). An outer row of slanting posts suggests that the roof of the house had to be supported in order to stay upright (fig. 4.5), this construction is similar to that of Bernisse 10-172. There are 12 cattle stalls in the stable, with some of the partitioning basketry still present. Along the gangway knee rail fencing was still visible, in a way comparable with those found in Spijkenisse 18-50. Van Trierum thinks it is likely that there has been a partition wall between the living area and the hallway (Brinkkemper 1991, 13; Van Trierum 1992, 78).

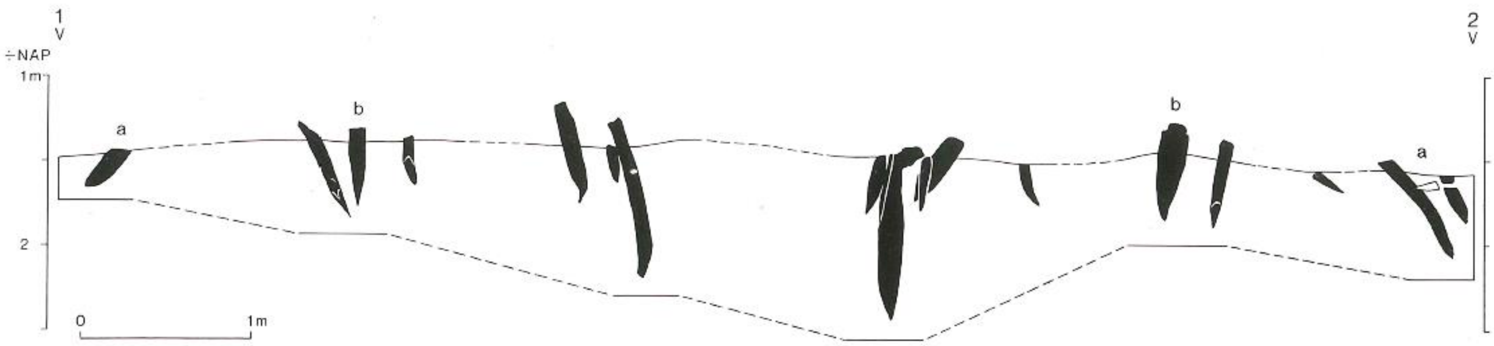


Figure 4.5. Section of the house plan. Scale 1:50 The position of this section within the house plan can be seen in appendix 6 (Van Trierum 1992, 77).

a. Slanting posts installed to support the construction of the roof
b. The posts of the house plan

In and around the house, multiple cooking grates, spindle whorls, 15 (fragments of) loom weights (fig. 4.6) and tripods were found. Tripods are objects that are thought to have been used for the extraction of salt (Van den Broeke 1986, 101). Van Trierum (1992, 81) made a distribution map of these objects within the house plan, which can be seen in appendix 8. There seem to be two concentrations of objects. One concentration is almost exclusively found within the living area of the house. The other concentration is almost entirely located outside of the house, around the southern entrance. It is thought that this place was in use as a dumping ground for material from the fireplace and other household waste. The loom weights are found both in- and outside of the house plan.

The farmstead has been dated in the Late Iron Age, based on the typological features of the pottery found (Lanting and Van der Plicht 2006, 326). According to Döbken, Guiran and Van Trierum (1992, 277), the circumstances at Rockanje 08-06 form a good parallel for those at Rockanje 08-52.

Just outside of the northern stable wall, located between two slanting posts, an inhumation of a young man was found. He has been buried in an extended position. Research indicates that he died between his 25th and 35th year of life and is estimated to have been 1.74 meters in length (Lanting and Van der Plicht 2006, 356).

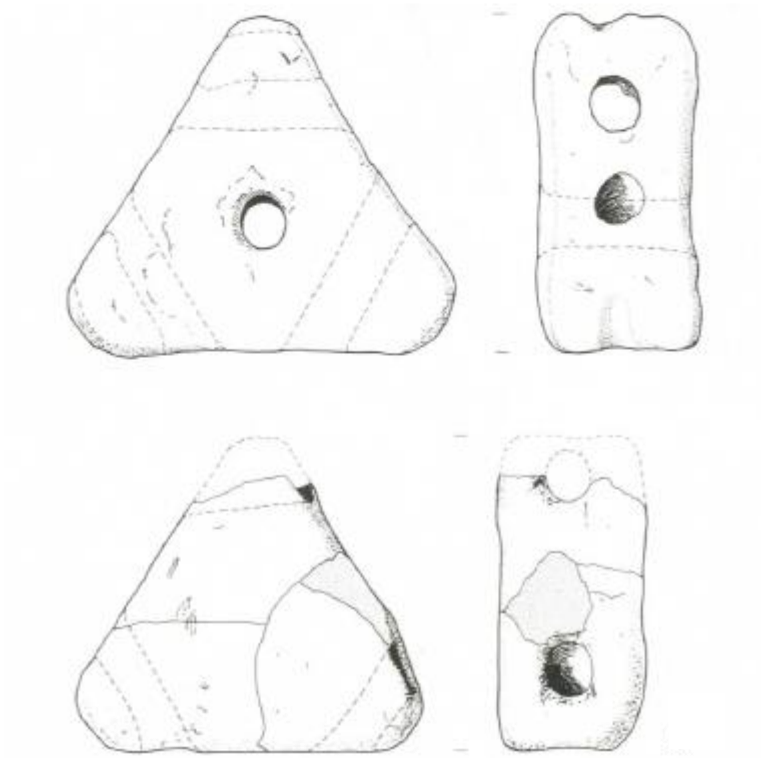


Figure 4.6. Loom weights from Rockanje 08-52, scale 1:3 (Van Trierum 1992, 79).

The livestock at the site consisted of cattle, sheep/goat, pigs and horses. Compared to the surrounding area, the substantial number of sheep/goat remains stands out (Van Trierum 1992, 80). The slaughter pattern at this site is similar to that at the site Bernisse 10-172 (Van Dijk and Esser 1996, 9). The slaughter age shows that the animals were not solely used for their meat. If the milk production was the primary use, more lambs would have been slaughtered before the age of one (table 4.2). The data seems to suggest that the sheep/goats at Rockanje 08-52 were kept for their wool (Van Trierum 1992, 80). Van Trierum suggests that the considerable number of loom weights and spindle whorls, endorses the use of sheep for their wool.

Table 4.2. Rockanje 08-52. The mortality rate of sheep by age, according to epiphyseal fusion (n=56) (Verhagen and Esser 1992, 10).

Months	Percentage (%)
0-10	14
10-24	11
24-36	42
36-42	19
> 42	14
	100

4.2.3.3 Rockanje 08-53

With the construction of a ditch, a new Late Iron Age house plan was discovered (08-53). Pottery, bone, posts and manure were discovered in the slope of the canal and in the soil heap a bone weaving comb (fig. 4.7) was found. The house plan of the farmstead was excavated in 1992 (Döbken *et al.* 1992, 277). Furthermore, in 2000, the stratigraphy of the soil in the area was mapped by means of a coring campaign (Moree *et al* 2002, 102). The geological context strongly resembles that of Rockanje 08-52 (Döbken *et al.* 1992, 277).

The excavation revealed two overlapping house plans, with cattle stalls, (side)-posts, basketry, manure, pottery, nine loom weights, bone and stone. The location contained the remains of two 3-aisled houses, with an east-west orientation. The house plans overlap entirely, so they must have been built after one another. The oldest of the house plans, which measures approximately 12 x 5 meters, consists of a living area with a fire place and a stable area with at least seven stalls. Two opposite entrances were found in the long sides of the farm. There is a ditch around the entire building (Brinkkemper 1994, 1; Moree *et al.* 2002, 102).

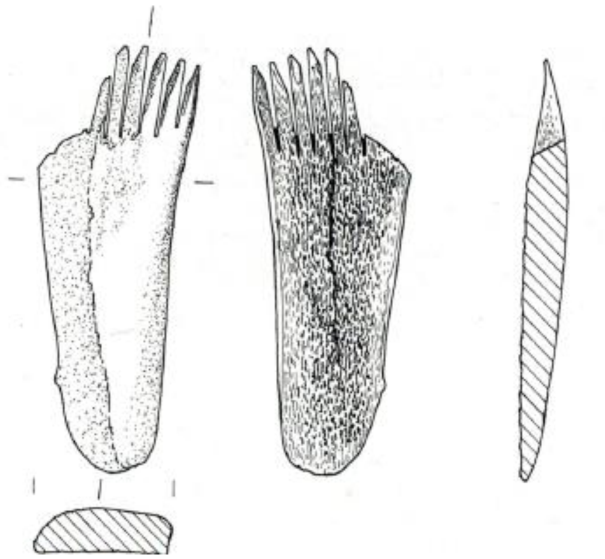


Figure 4.7. Weaving comb found at Rockanje 08-53 (Van Trierum 1992, 80).

The youngest house plan, of which the western limitation is not quite certain, measures at least 17 x 5.5 meters. Here there is a clear distinction between the living and stable area as well. There is a discussion on the number of stalls in the stable, because they were unable to distinguish if there were any entrances in this area, but the number of stalls is estimated to be fourteen. Moree *et al.* (2002, 102) believe that the find of multiple spindle whorls, loom weights and the weaving comb are evidence for textile production at this location.

The archaeozoological remains indicate the presence of sheep/goat at the site. This number is not specified, but a total of 5 long bones is mentioned which were used to determine the slaughter age. Three of the total of five long bones show a slaughter age before the age of 3 (Esser *et al.* 1994a, 8). This data is not extensive enough to say anything reasonable about the reason for slaughter.

4.2.3.4 Rockanje 08-54

With the construction of a sewerage system in 1991, a settlement site from the Late Iron Age was discovered (Döbken *et al.* 1992, 277). Though the building activities had already demolished part of the site, an excavation by means of a test pit unveiled a corner of a house plan and part of a farmyard. Outside of the house plan, within the farmyard, a fireplace was discovered (Brinkkemper 1993, 1). The conditions at the site closely resembled those at Rockanje 08-52. The find material comprised pottery, a fragment of a loom weight, spindle whorls, tripods, a big fragment of a fire grate, a metal fibula, bone, posts and manure (Döbken *et al.* 1992, 277; Moree *et al* 2002, 102).

The archaeozoological remains indicate the presence of at least 11 sheep/goats at the site of Rockanje 08-54. This minimal number of animals is not extensive enough to determine an exact reason for slaughter. The bones indicate that 83 percent of the sheep/goats were slaughtered before their third life year. This is considered to be the optimal slaughter age. Notable are three long bone fragments from juvenile animals, which could indicate that several animals were slaughtered within their first year, possibly for the consumption of lamb meat (Esser *et al.* 1994b, 7-8). A high percentage of animals slaughtered before the age of 3, might indicate an emphasis on meat and milk at the site (Van Dijk and Esser 1996, 9). An emphasis on wool production is not visible from the archaeozoological remains. However, it does not exclude the use of sheep for their wool, since most sheep gave at least one full coat before they were slaughtered (Esser *et al.* 1994a, 7-8; Payne 1973, 281).

4.2.4 Spijkenisse 18-30

During an emergency excavation performed by BOOR in 1973, three concentrations (WYI, WYII and WYIII) of pottery fragments were found at a short distance from each other. Therefore, this area was interpreted as a dwelling place. The material of Spijkenisse 18-30 (WY III) comprised of an extensive concentration of pottery, three rather small and almost identical loom weights (appendix 1) and wooden posts. Four complete pots could be reconstructed from the pottery shards. Except for a few postholes, no evidence for a house plan has been found. All the material has been found close to the surface, meaning that it has been preserved above the groundwater level. The three concentrations all belong to the same period, dating in the Late Iron Age (Hoek 1973, 19). This site has been dated based on the find of bone material, but the bone had deteriorated so much that there was not enough collagen left to perform a second dating. This makes the dating of the site rather unreliable (Lanting and Van der Plicht 2006, 358).

The zoological remains contained two fragments of cattle and one fragment of sheep/goat (Prummel 1991, 264). Reasonably, the number of fragments is too low to say anything substantial about the reason for slaughter.

4.2.5 Spijkenisse 18-50

Research of an Iron Age dwelling site in Spijkenisse, revealed part of a 3-aisled Middle Iron Age farmstead (fig. 4.8) that had been used as a stable (Lanting and Van der Plicht 2006, 358; Van Trierum 1992, 73). The rest of the house plan was damaged by recent disturbance. The find material comprised of pottery, a bottom shard that is thought to be a loom weight, a fragment of a glass bracelet, posts and manure.

Several stalls are recognisable within the stable, with knee rail fencing along the aisle. Furthermore, they encountered material from a fireplace, but it is unclear whether the fireplace was actually located at this place. It could easily be material from a cleared fireplace located anywhere else. The farmstead was approximately 5.7 meters wide and was at least 3-aisled (Van Trierum 1992, 73).

The house plan shows great similarity with the Late Iron Age house plan of Rockanje 08-52. Based on the typological characteristics of the pottery found, the house plan can be dated to the Middle Iron Age. ^{14}C-datings performed on two posts from the house plan, confirm this dating (134 ±49 calBC (GrN 11063) and 294 ±60 calBC (GrN 11064)) (Lanting and Van der Plicht 2006, 358; Van Trierum 1992, 73).

Lanting and Van der Plicht (2006, 358) place a critical note at the dating of post GrN 11064. In the ^{14}C report it is mentioned that this concerned a slanting post. It is unclear whether this is the third post mentioned in figure 4.8, but in that case this post wouldn't be part of the house plan in any way.

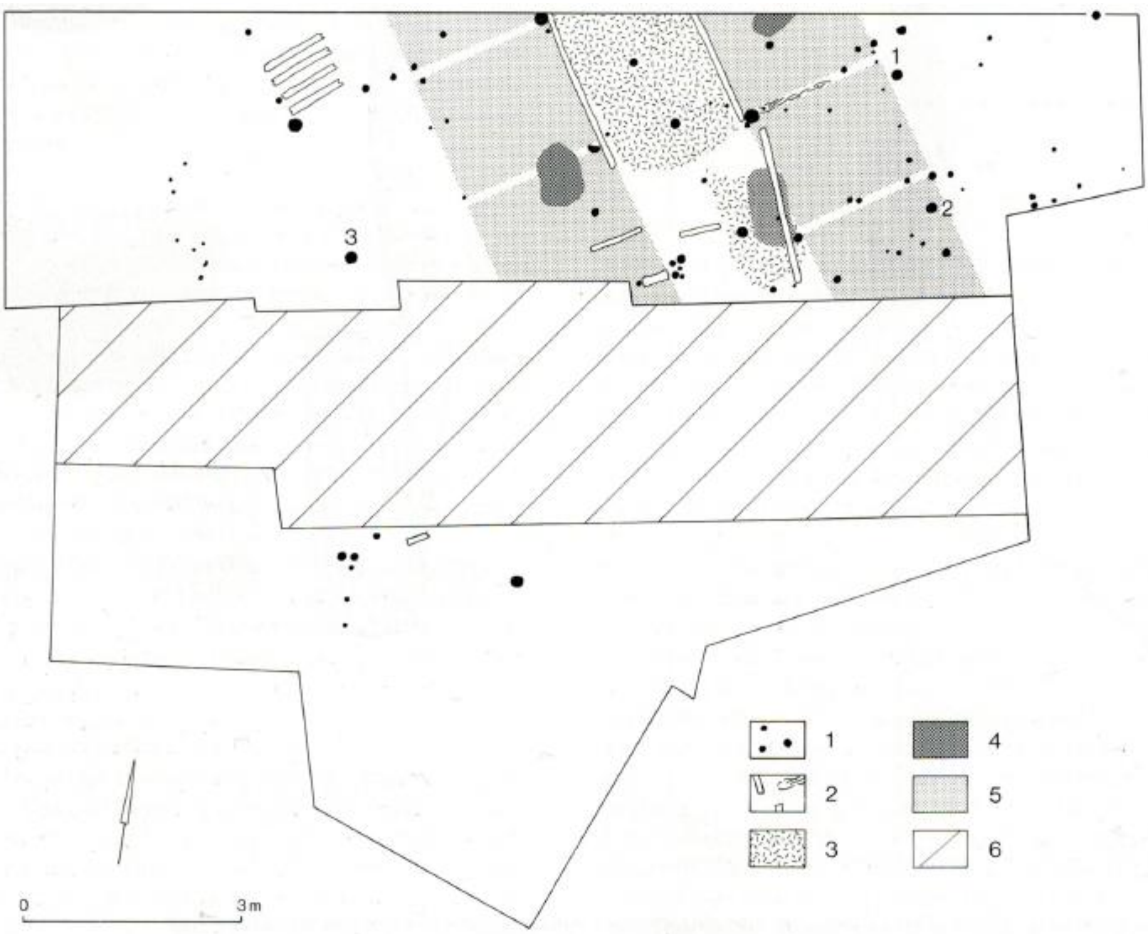


Figure 4.8. Excavation plan of the Middle Iron Age farmstead of Spijkenisse 18-50. Scale 1:100. Legend: 1. Standing posts; 2. Basketry and fallen posts; 3. Manure; 4. Hearth material (charcoal and ashes); 5. Reconstruction stables; 6. Disturbance (Van Trierum 1992, 72).

The archaeozoological material comprised remains of dog, pig, cattle and sheep/goat; 17 pieces were not identified (Prummel 1992, 144; Van Trierum 1992, 73). There is no exact data on the slaughter pattern at this site, since Prummel (1991, 246-248) only made an assessment of all the sites in the area of Voorne-Putten combined to establish the slaughter pattern. Individual data is not available. Roughly taken, the percentage of sheep which were slaughtered within their first year was approximately 35%, within their second year was approximately 25% and within their third or fourth year was approximately 40% (about 20% each year). Prummel concludes her assessment of the sheep remains with the conclusion that the age data of sheep were very incomplete. Therefore, no conclusion on the kill-off patterns for sheep in this phase can be drawn.

4.2.6 Concluding Remarks Voorne-Putten

During the Iron Age, Voorne-Putten was largely covered with peat. Stagnations of the peat growth in the Early Iron Age, result in occupation of the area. Houses were built on the elevations in the landscape, while the depressions probably provided some drainage of the peat. Settlement sites from the Early, Middle and Late Iron Age have been found. The majority of these sites consisted of a single farmstead, which were probably inhabited for several decades (Prummel 1991, 235; Prummel 1992, 131).

The case studies from Voorne-Putten belonged to the Middle and Late Iron Age. Analysis shows that the sites in the area of Voorne-Putten which contained loom weights were all located within a settlement area. The only site that did not contain an actual house plan was that of Abbenbroek-Bern 17-22. Though no tangible evidence is provided, the material found by means of a survey gave the researchers strong reason to believe there was an occupation area located at this site.

Only in the case of Abbenbroek-Bern 17-22, it is entirely unclear from which context the loom weight came. At all the other sites, the loom weights were found within or in proximity to a house plan. At Bernisse 10-172, a single loom weight was found right outside of the extension of the farmstead. The 16 loom weights at Rockanje 08-06 were found in and outside of the house plan. The distribution of the 15 loom weights at Rockanje 08-52 is clearly visible in appendix 7, which shows that the weights were almost exclusively found in and around the living area of the farmstead. There is no description of the context for Rockanje 08-53 and 08-54, only that they were found in relation to the house plans. There is no way to tell if the loom weights from Rockanje 08-53 belonged to either one or both farmsteads. Since there were only a few postholes found in Spijkenisse 18-30, it is not possible to tell whether the 3 loom weights were found in- or outside of the building. The weight from Spijkenisse 18-50 was found near or within the stable area of the house plan.

There were no case studies belonging to the Early Iron Age, this means that none of the Early Iron Age sites (e.g. Spijkenisse 17-30 and 17-35) in Voorne-Putten contains any traces of loom weights (Van Trierum 1992, 38-56). Remarkable is the fact that at both Early Iron Age sites, remains of sheep were found. We have no proof that these sheep were used for anything other than their meat or milk.

The archaeozoological remains at the majority of the case studies at Voorne-Putten were not sufficient enough to give a decisive answer on the reason why the animals were slaughtered. The most extensive data is available for the sites Bernisse 10-172 and

Rockanje 08-52. Both sites show a remarkable similarity in data[3]. About 60 percent of the animals were slaughtered before the third year of their life, the other 40 percent was slaughtered between their third and fourth year. This suggests that the animals were kept for their wool. It is thought that the sheep at Rockanje 08-54 were kept for the purpose of their meat and milk, since a high percentage of the animals was slaughtered before the age of 3. However, this is based upon a minimum number of 11 individual animals. Furthermore, Esser *et al.* (1994a, 7-8) emphasises that it is not possible to exclude the use of sheep at this site for their wool, since most sheep gave at least one full coat before they were slaughtered.

One problem with archaeozoological material is the use of the category sheep/goat. The analysis of adult mortality patterns, has largely been depending on the problematic evidence of postcranial epiphyseal fusion. As Halstead and Collins (2002, 545) state: 'Archaeozoological analyses of mortality patterns for the combined category sheep/goats risk masking important contrasts in management between these species or worse, creating an illusory composite picture which is valid for neither species'. Research has shown that it is possible to make a morphological distinction between sheep and goats (Hallstead *et al.* 2002; Prummel and Frisch 1986). Based on the article by Prummel and Frisch (1986, 568-77), Prummel determines that none of the bones showed the features that are characteristic for goats. Therefore, she assumes that the bones listed as sheep/goat were actually of sheep, and that goat was absent in this area (Prummel 1991, 238).

Though the archaeozoological data in the area of Voorne-Putten combined with the find of multiple spindle whorls, a weaving comb and loom weights makes it easy to assume that the weights were solely used for textile production, other options should also be taken in consideration.

The Iron age sites of Voorne-Putten were situated in the fresh water delta of the Meuse. Prummel (1991, 259-60; 1992, 134-5) provides evidence for the presence of fish remains at numerous Iron Age sites in the area of Voorne-Putten. The species of fish that were found, are sturgeon (*Acipenser sturio*), thin- or thick-lipped grey mullet (*Liza ramada* or *Chelon labrosus*), perch (*Perca fluviatilis*) and bream (*Abramis brama*). All these types of fish are known to spawn or (seasonally) live in fresh water areas, like that in Voorne-Putten. These fish are known to have been caught with (drag)nets, where weights could have been

[3] It is good to notice that different methods of determination were used for these sites. At Bernisse 10-172 age of the animals was determined by dental elements and at Rockanje 08-52 this was done by means of epiphyseal fusion.

used as net sinker. It is notable that none of the case studies in Voorne-Putten where loom weights were found provided any proof for fishing by the presence of fish remains.

Other indications that could support the use of the weights for textile production come from the presence of other loom weights or weaving tools. Both Rockanje 08-06 and 08-52 show a large number of (fragments of) loom weights found in and around the house plan. This could indicate that there was a loom present at both sites, which probably has been dismantled. The cluster of farmsteads at Rockanje (08-52 until 08-54) shows a remarkable number of weaving tools. Here, loom weights have been encountered together with numerous spindle whorls and a weaving comb.

My concluding remark about the case study of Voorne-Putten is that based on all this data it cannot be excluded that these weights were used for anything else than textile production, but based on the context of all these weights it is likely that textile production was at least one of its main functions.

4.3 Case Study Oss

The archaeological research in Oss and its surroundings has been going on since the 1970's and is undeniably connected to Leiden University (Pruijsen and Van As 2012, 19). The area is known for its rich archaeology, with many Iron Age settlement sites. Iron Age loom weights from the areas Oss-Schalkskamp and Oss-Horzak shall be examined (fig. 4.9).

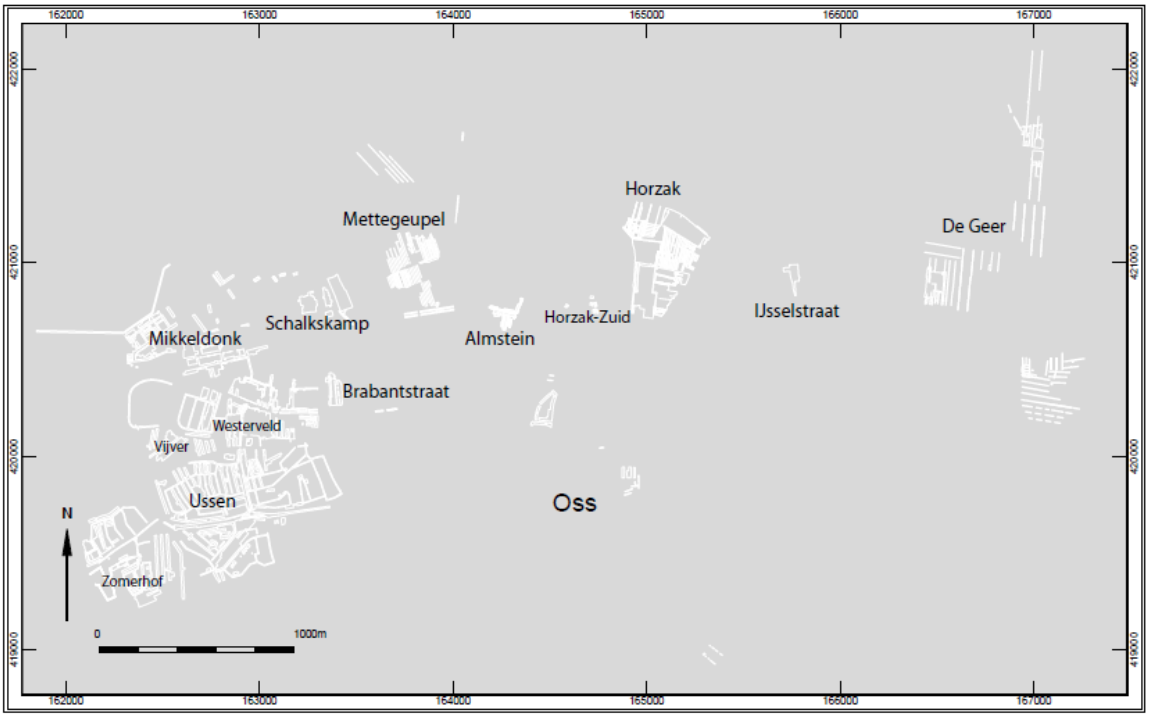


Figure 4.9. The excavation sites in the area of Oss (Pruijsen and Van As 2012, 19).

4.3.1 Oss-Schalkskamp

The area of Oss-Schalkskamp has been excavated extensively. The first occupation of the area occurred in the Early Bronze Age, with little to no presence during the Middle Bronze Age until the Middle Iron Age. There is a period of intense habitation from the second half of the Late Iron Age which continued in the Roman Era (Brusgaard *et al.* 2015, 345-6). Due to the large amount of data it was possible to determine that it was an enclosed settlement, surrounded by a 2 meter wide ditch. The excavation of the settlement revealed three house plans, several pits, granaries and wells (Jansen and Fokkens 2010, 72). With the 1991 campaign, an enormous amount of (fragments) of triangular loom weights were encountered in a Late Iron Age ditch. There are 13 weights that are distinctively triangular, with only some corners broken off. Furthermore, there are two clusters of about 70 fragments of weights that are in an extremely fragmented state. For most of these fragments it is impossible to give an approximation of their original shape, but their composition is equal to the 13 triangular weights. All weights are from either feature 1006.23 or 1007.70. Drs. R. Jansen from Leiden University explained that after the allocating of the feature numbers, it was determined that both features were part of the same ditch system. This ditch system contained an enormous amount of waste, consisting of pottery, sling pellets, loom weights and La Tène glass bracelets (Fokkens *et al.* in prep).

Whilst the ditch system was already filling up with waste, an iron forging-hearth was established (Arnoldussen and Brusgaard 2015, 115). Amongst the finds were 203 fragments of slag, pottery, a fragment of a *tuyere* and chunks of burned loam. Since there was about 55 kilograms of pottery found, a use as furnace has also been suggested. The large amount of broken weights could be explained by the fact that the weights were produced at this location and weights that broke in the furnace would be tossed away in the direct neighbourhood.

4.3.2 Oss-Horzak

The area of Oss-Horzak has been excavated over an extended period of time. Traces from the Middle Bronze Age on have been discovered and from the Iron Age on, the area has been occupied more extensively. Furthermore, traces from the Roman Era and the High Middle Ages have been encountered. During the campaigns of 1998, 2001, 2004, 2005, 2006 and 2007, triangular Iron Age loom weights were encountered. Unfortunately, no data concerning the contexts of these weights has been published yet. The little data below has been extracted from unpublished day notes by Leiden University.

During the 1998 campaign a triangular weight was encountered in a well with a width of at least 4 meters (Feature 65, also known as WA001) which was dated in the Early/Middle Iron Age. The feature had two different fills; on the inside a dark grey fill with a lot of charcoal and on the outside a light grey fill with dark grey spots that resembled sods. The inner fill contained a lot of bone material and Iron Age pottery (unpublished day notes Leiden University 23 June and 4 July 1998).

With the 2001 campaign 10 fragments of triangular weights were encountered in a Late Iron Age pit (fig. 4.10) with a depth of 90 centimetres (Feature 67, also known as KL034), which also contained copious amounts of pottery, (burned) bone material (also teeth), 16 sling-shots, several whetstones, a spindle whorl and two fragments of a purple La Tène glass armlet (of which one was burned) with a decoration of yellow paste. The dental fragments were determined to belong to cattle, pig and horse (Bruineberg 2004, 67). Due to many twigs that were found within the bottom fill of the pit, Drs. R. Jansen suggested in the day notes that the pit was supported with wattle. Based on the material found, this pit was dated in the Iron Age (unpublished day notes Leiden University 9, 10, 11 and 12 July 2001). Research by Bruineberg (2004, 67-8) suggests that this pit and a neighbouring pit, which contained massive quantities of pottery, were part of a Late Iron Age yard. This yard would also consist of several postholes and three granaries. She suggests that the house plan belonging to the yard is probably just located outside of the excavated area.

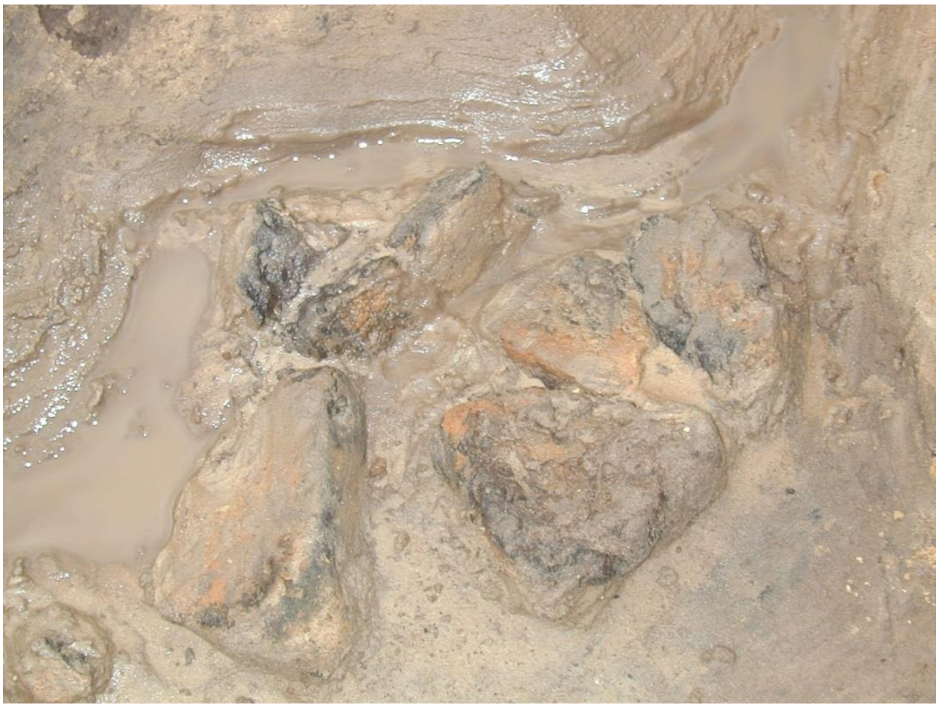


Figure 4.10. Four of the ten triangular weights found in 2001 (photo taken in the field).

Two triangular weights, finds 431 and 445, were encountered in a well (WA036) during the 2004 campaign. During the 2005 campaign, a triangular weight (2279) was found near/in a Late Iron Age house plan (H047). During the 2006 campaign, 3 triangular loom weights were found, one (V4732) conical was found with cremated remains (R032) which also contained (the remains of) an Early Bronze Age ceramic pot. Find 5296 of this same campaign was a triangular loom weight found in a well (WA057) and find 5716 was a triangular weight found in a ditch (G002E). A lot of weights were encountered during the 2007 campaign, which all came from ditch G001.

4.3.3 Concluding Remarks Oss

All the triangular weights found at Oss-Schalkskamp came from a ditch system that contained an enormous amount of waste, consisting of pottery, sling pellets, loom weights and La Tène glass bracelets. This 2 meter wide ditch was part of an enclosed settlement, where evidence for three house plans, several pits, granaries and wells was encountered.

Since no data about the context of the triangular loom weights of Oss Horzak has been published yet, no drawings or detailed site description are available. However, the little data available from unpublished day notes has shown that triangular loom weights from Oss are found within features that are generally presumed to belong to a settlement site.

4.4 Other Examples Known From Literature

Although Voorne-Putten and Oss have shown to be comprehensive case studies, these areas do not have to be representative for the conditions in the rest of the Netherlands. A few other examples shall be taken into account, since the context of these weights is noteworthy and of influence for the argumentation of this thesis.

4.4.1 Valkenburg, Limburg

With an excavation of a Roman settlement site in 1985, a cemetery, Roman roads, remains of multiple buildings with a military purpose and traces of civic buildings were encountered. In a Northern branch of the river Rhine, a collection of objects was found that are thought to have been used for catching fish. It concerns 11 round disks with one perforation and 3 triangular flat disks with three perforations created of softly baked clay (fig. 4.11). They are thought to have been used as net sinkers. The weight of the triangular object varies enormously, with the lightest weight around 175 grams and the heaviest weight around 300 grams (Bult and Hallewas 1987, 13, figure 11). Bult and Hallewas emphasize that since the weight of the objects varies strong, it is highly unlikely that the weights have been used as loom weights. Since the triangular weights have been found in the same context as the round weights, Bult and Hallewas (1987, 14) assume that they had the same function.

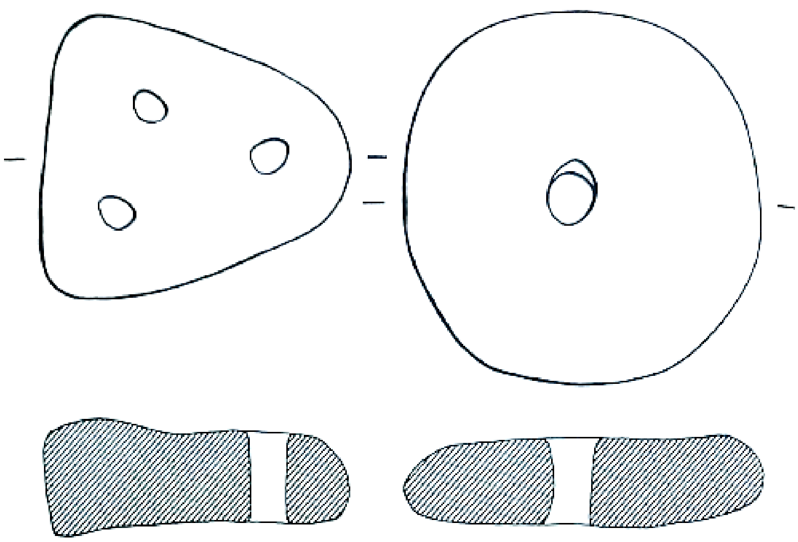


Figure 4.11. Net sinkers found in Valkenburg (Bult and Hallewas 1987, 12).

4.4.2 Cannerberg, Limburg

The Cannerberg, located in the Dutch province of Limburg, is a settlement site that has been in use for a long period of time. The first habitation is known from the Late Bandkeramik culture as early as 5.000 BC and continued during the Late Bronze Age, Iron Age and the Roman Era (Van Wijk and Meurkens 2016, 53).

In a shallow Iron Age pit, 15 conical loom weights were encountered (fig. 4.12). The feature had an oval shape, measuring 2.5 x 1.65 meters and was 15 centimetres deep on average. The 15 largely complete weights were located in the North-Western segment of the pit. The weights were forming a row and most of them seem to have been partially burned. Van Wijk and Meurkens (2016, 233) remark that the weights seem to mark the location of a loom. Other finds from the feature consisted of a small quantity of pottery and a complete quern, of which the lower part was made of vesicular lava and the upper part was made from quartzite pebble. Based on analysis of the pottery and the shape of the loom weights found in this pit, the feature was dated in the first half of the Early Iron Age.

Figure 4.12. Pit 1732 with a row of loom weights in situ (Meurkens 2016, 233).

Meurkens (2016, 233) notes that this is a remarkable pit, of which there are no comparable cases known in the Netherlands. However, in Hafnerbach, Austria, a comparable pit with a row of loom weights in situ, dating to the Hallstatt period, has been excavated (Belanová Štolcová and Grömer 2010, 17).

Two possible interpretations regarding the function are given by Meurkens (2016, 233). The pit could have been a kind of sunken-floor hut (also known as *Grubenhaus*), which are interpreted as small workplaces with a lowered floor level. Though, there are a few problems regarding this interpretation; no clear postholes have been found giving an indication for a building and, more importantly, in the Netherlands there are no sunken-floor huts known from the Iron Age. Striking though, is the fact that the Hafnerbach loom mentioned earlier, is also thought to have been located in a pit (Preinfalk 2003 16). The other possible interpretation as suggested by Meurkens (2016, 234) is that the finds are a deposition, possibly ritual. In the Netherlands, Early Iron Age depositions of multiple loom weights are known to Meurkens from Udenhout and Twello, where in both cases the weights were haphazardly deposited in small pits. However, it remains unclear how we should interpret such depositions.

Due to a high fragmentation and poor preservation conditions in the decalcified grounds, no information about bone material from the Iron Age is available (Van Wijk 2016, 110). Therefore, no indication for the presence of sheep could be given.

4.4.3 Udenhout, Brabant

During a test trench campaign in 2011 at the settlement site of Udenhout-Den Bogerd in the Dutch municipality of Tilburg, fourteen Late Bronze Age/Early Iron Age conical loom weights found together in a pit with a depth of 36 cm (fig. 4.13). Three of the weights were of such poor condition that they could not be reconstructed (Verbeek and Mostert 2012, 62) the other 11 weights were in good condition. This pit also contained 5 Iron Age potsherds. Two were rims, of which one was roughened. One of the rims and a side sherd were burned. Verbeek and Mostert (2012, 41) assume that the weights were evidence for weaving of flax or wool within the settlement and part of a deliberate deposition, since the weights were still in such good condition.

Figure 4.13. The context of the loom weights from Tilburg-Udenhout (Verbeek and Mostert 2012, 41).

Within the cluster of features where this pit with weights was found, they also encountered an Iron Age side building, and 5 granaries and a part of a side building dated to the Iron Age/Roman Era (Verbeek and Mostert 2012, 34). At a nearby cluster of features, they discovered two Iron Age wells, a Middle Iron Age funerary monument, 3 granaries, multiple side buildings and numerous parallel ditches with ditches crossing in perpendicular way (Verbeek and Mostert 2012, 30-2). The funerary monument did not have a central grave, but the filling of the ditches contained bone material of an adult individual (Verbeek and Mostert 2012, 44). This site seems to have been occupied from at least the Early Iron Age on.

During the test trench campaign, no faunal remains were encountered. However, due to the small percentage of the area that has been thoroughly researched, the presence of any livestock at the site cannot be excluded. A new campaign set out by Archol, in 2015 revealed a Bronze Age house plan. Unfortunately, no results of that campaign have been published yet.

4.4.4 Twello, Gelderland

During an excavation at 'De Schaker' in Twello a pit (S8.292) was found containing one pyramidal loom weight, with a perforation on the narrow side and fragments of two weights, of which one was conical and one pyramidal (Meurkens 2014,152) [4]. Aside from the loom weights, pit S8.292 contained an enormous amount of pottery, fragments of weights and stone tools. According to Meurkens (2014, 255), the large amount of material has to be the result of an intentional deposition. Sherds of at least 21 individual pots were encountered in the pit. About 16% of the sherds had been secondarily burned. Pits with substantial amounts of pottery and other household tools are found more often in the Early and Middle Iron Age. They are often interpreted as a ritual when the house was abandoned, and all the household utilities were left behind. The weights were found within a cluster of other features, containing a granary, 25 pits and some small clusters of postholes. The majority of these pits had straight sides, which indicates that they were used for storage purposes. These features seem to resemble the edge of the property.

At an earlier excavation called 'Achter 't Holthuis', performed by ARC bv, an Early Iron Age dwelling place was encountered just 30 meters to the west from the cluster of features at 'De Schaker'. Although Meurkens (2014, 156) uses no reference to any literature, he presumes it to be highly likely that these new features are part of the Early Iron Age dwelling place found by ARC bv in 2006.

In the publication by ARC bv, the find of an Early Iron Age barn (outbuilding number 2, fig. 4.14) and granary (number 15) are described (De Wit 2012, 52-9).

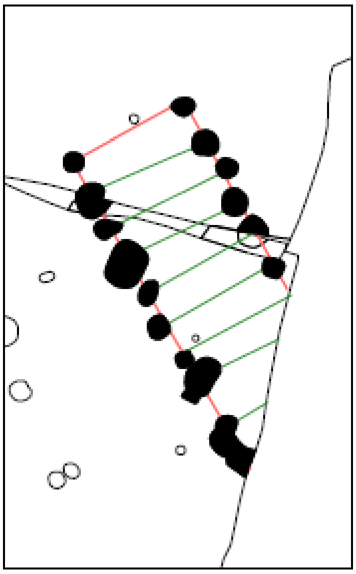


Figure 4.14. Outbuilding 2, Early Iron Age barn (De Wit 2012, 55)

The barn was dated based on 35 pottery fragments found in the postholes (Hermsen 2012, 147). The barn has a NW-SE orientation, is one-aisled and consists of at least 9 heavy upright beams. The measurements of the barn are at least 3 by 7,5 meters. During excavations in 2007, 2008 and 2011, in the southern part of the research area, ARC encountered multiple outbuilding in relation to house plans dating to the Early Iron Age (De Wit 2012, 37). Therefore, De Wit thinks it to be likely that a house plan which would belong to this outbuilding is located right outside the research area. The barn is thought to have been in use as stable, since no stable areas could be districted within the house plans (De Wit 2012, 389-90).

[4] There are 14 weights that are called loom weights in the text (see Meurkens 2014, 152), but are later on multiple times referred to as only weights. This highly creates the impression that these weights are just normal weights and were accidentally referred to as loom weights.

The granary is located to the western part of the area researched in 2006, in between these two structures a number of pits have been found, of which one contained over 50 Early Iron Age sherds (De Wit 2012, 138). The barn is located to the far east of the research area, which matches the description by Meurkens (2014, 156).

During the multiple campaigns at Achter 't Holthuis', remains of Iron Age loom weights and a spindle whorl have been found in pits. Which indicated that there was active textile production at the site (De Wit 2012,261-3). Unfortunately, no Iron Age faunal remains have been found to support the presence of sheep at the site.

4.4.5 Wijnbergen, municipality Doetinchem, Gelderland

At a well-preserved Iron Age settlement site at 'De Kap' in Wijnbergen, 10 triangular loom weights were found (fig. 4.15). Their context is not entirely clear since they were found in a cultural layer directly above the other features in the pit (Ufkes 2007, 82). The concentration of weights was of such poor condition that they had to be removed all together and dissected in a lab to directly conserve them with Paraloid resin.

The weights are not equilateral but seem to have an upper side. All, but one weight (fig. 4.16, far right), are thought to have had 3 perforations. Since the weights are in such fragmented state, their original shape and weight is unknown. Ufkes (2007, 82-4) estimates that the weight might have been around 1200 grams and observes that the measurements of the objects are much alike.

Figure 4.15. Triangular loom weights from find 616 at Wijnbergen (Ufkes 2007, 83).

Archaeozoological research on the Iron Age faunal remains at the site was not conclusive. The conservation of the bone material was of such poor quality that it was not possible to determine to what species the remains belong. Therefore, it is not possible to say anything about the presence of sheep at the settlement site (Buitenhuis 2007, 133-4).

At the same settlement site, two concentrations of Early Bronze Age loom weights were encountered. In total, 9 conical weights were found, all objects with a single perforation slightly above the centre of the weight. Six of the weights were found together with a complete Barbed-Wire beaker and the sherds of two other beakers (Ufkes 2007, 79). The three other weights were encountered only 2 meters to the west. In both cases, no feature could be distinguished.

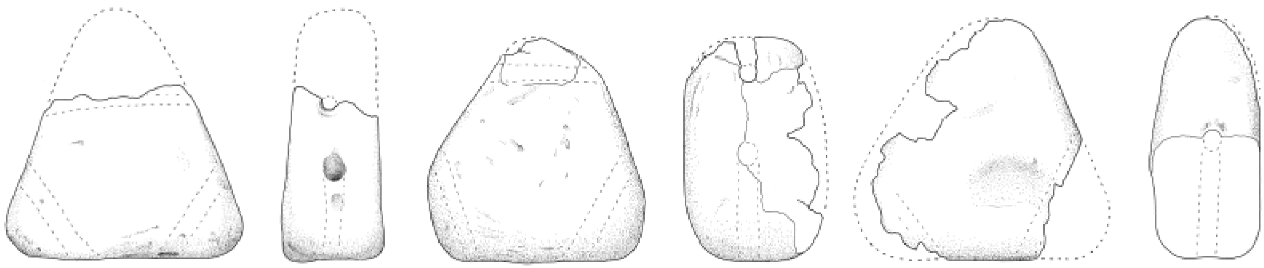


Figure 4.16. Three reconstructed triangular loom weights from find 616 (after Ufkes 2007, 85).

As already noted in chapter 3, Ufkes is not convinced that the Iron Age objects were used as loom weights. His arguments include the fact that the diameter of the perforations is rather small, and therefore considered too narrow for the warp threads. Furthermore, he considers the lacing up of warp threads through more than one perforation, will cause irregularities in the tension on the threads. Furthermore, he also points to the 'lack' of wear traces on these weights.

4.5 Experimental Archaeology on the Context

Although the context in which loom weights are found can give us a lot of information, the arrangement in which the weights themselves are found is also of significant importance to us. This is demonstrated by an archaeological experiment performed by Ingrid Schierer in 1987[5]. In 1982, during an excavation at Gars-Thunau, Austria, 36 disc-shaped loom weights were found in situ. In average, the weights had a diameter of 8,5 to 9,8 centimetres and an eccentric hole. The majority of 31 weights were found in a row measuring circa 1 meter and another 5 weights were found 10 centimetres deeper in an undisturbed layer. Finds from the same context, like a sieve vessel, allowed the weights to be dated to the Bronze Age (Schierer 1987, 29).

[5] Out of great interest, she republished some of the results again in English in 2005.

In order to perform the experiments, she copied the Gars-Thunau weights and built a wooden implement corresponding to ethnographic examples and the width of the row measured in situ (fig. 4.17). The goal of the experiment was to record the pattern in which the weights fall down, during several ways of destruction plausible for a loom (Schierer 2005, 101-3). She performed the experiments with the common patterns known from prehistory; tabby and twill weave.

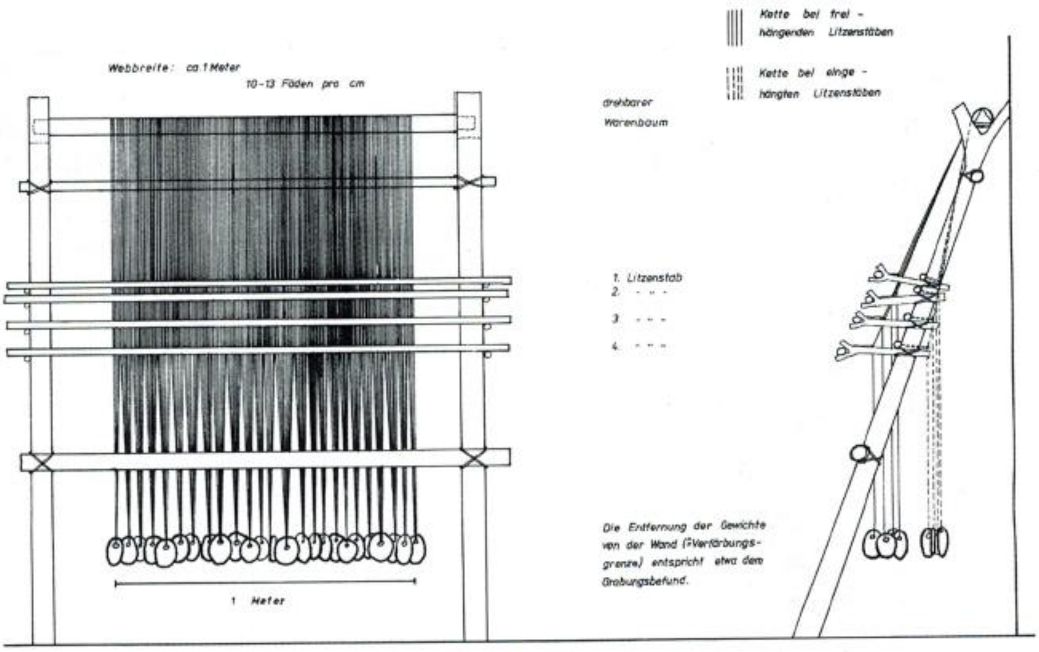


Figure 4.17. Drawing of the loom, built for the experiments (Schierer 2005, 102).

The experiments consisted of overall destruction of the loom and/or the fabric (by burning or cutting the threads), pushing against the loom until it fell over in multiple ways, unwinding of the cloth so that the weights were to touch the ground and rolling up of the cloth with the weights still attached. Though Schierer (1987, 48-9; 2005, 103) acknowledges that it is only an attempt to reproduce the conditions of natural decomposition, it allowed her to make a few statements.

Schierer (1987, 50-65; 2005, 103-5) concluded that in the case of Gars-Thunau it is highly likely that there had been a functional warp-weighted loom at that exact location. The pattern in which the weights were found suggested that the loom had been in use for twill weave and was destroyed in one stroke, as is the case with a fire.

4.6 Concluding Remarks on the Context

Multiple cases have shown that loom weights are usually encountered in a settlement context, inside or close to a house plan. The weights are often disposed of in a waste pit, which are fairly common features in the Bronze and Iron Age. It is suggested that some of these pits were part of depositional practices, for instance when a building was abandoned (Gerritsen 2003, 97-8). These pits differ from regular waste pits, because they contain massive quantities of pottery, fragments of grinding stones, charcoal and often spindle whorls or loom weights. However, based on the case study there are no clear indications that this was the usual practice with Iron Age loom weights.

Other indications come from material found in same context. Provided that the bone material has survived, there are often faunal remains of sheep found within these settlement sites. There is also a significant number of sites where they encountered other weaving tools (spindle whorl).

As suggested in my hypothesis, loom weights are often found together. It is estimated that sets of loom weights on average contained between 6 to 30 loom weights, even though sets up to 80 weights have been found (Mathiassen and Leilund 2008, 132-3). There are cases in which a single weight was found, but these weights often seem to have been discarded since they were damaged. However, there are no cases known in which triangular weights were found in a row corresponding to the case in Cannerberg. The weights often seem to be deposited in a pit or scattered around the house plan, as for instance is the case in Rockanje.

5 Function - The Characteristics of a Loom Weight

In the Netherlands, loom weights represent the only archaeological remains of warp-weighted looms. The function of the warp-weighted loom is well known from ethnographic studies. Meanwhile, the function of the loom weights has not comprehensively been investigated. The problem here, is that this cannot be deducted directly from ethnographical data, since loom weights in prehistory were different from those used in the twentieth century AD (Mårtensson *et al.* 2009, 373).

The problem with weights is that they can be used for many purposes. Therefore, the difficulty lies in demonstrating that these objects were indeed used for textile production rather than another purpose (Barber 1991, 92-3). Andersson Strand (2010, 2) emphasizes that in order to obtain valuable information about the function, qualities and limitations of tools, we have to test them by means of experimental archaeology. Especially, since functional research by means of literature study is rather difficult since archaeologists generally do not publish the exact details of the objects. Often there is only a description of the shape and an indication of the total number of objects found. Details about the measurements, perforations and weight commonly lack. This chapter reviews the functional elements of a loom weight.

5.1 Determining the Characteristics

In order to decide which characteristics determine the function of a loom weight, basic knowledge of weaving technology is vital, it is not sufficient to look at archaeological evidence only. Therefore, results of archaeological experiments concerning textile production with loom weights shall be reviewed too.

As shall be discussed later, Mårtensson *et al* (2009, 396-7) established that the weight and thickness of loom weights are the defining functional parameters for the operation of the warp-weighted loom. Ingenegeren (2010, 55) was one of the first to make an enumeration of the variables that influence the (triangular) weights' function in the Netherlands. Since the weights that Mårtensson *et al.* (2009) used in their studies only had one perforation, this was not considered to be a variable. With Iron Age loom weights in the Netherlands, the number of perforations varies considerably. Therefore, this variable should be analysed.

The major functional parameters for loom weights are the context, weight, thickness, perforations and shape. I will not elaborate on the context again, since this already has been examined meticulously in chapter 4. The rest of the functional parameters shall be discussed in this chapter.

5.2 The Weight

An experimental study was designed by Mårtensson *et al* (2009, 378) to obtain a better understanding on the functional aspect of the weight of loom weights. This experimental research was part of the *Tools and Textiles - Texts and Contexts* (TTTC) research program, directed by archaeologist Eva B. Andersson (PhD) and historian Marie-Louise Nosch (PhD).

Their research focussed on textile tools from the eastern Mediterranean area, dating to the Bronze Age. In previous experiments (by Mårtensson *et al* 2007), it was established that the weight of loom weights influences weaving on a warp weighted loom. The height of the loom weight as well as its diameter partly defines its weight. In general, a thin yarn requires less tension and a thick yarn needs more tension. By tension, the weight per warp thread needed for optimal weaving is meant (Andersson 2003, 27-29).

Mårtensson *et al* (2009, 378) define the theoretical basis of warp tension as follows: since diverse types of yarn need different tensions, this restricts how many warp threads can be attached to one loom weight. If the yarn need 20 g tension per warp thread, and the loom weight weighs 500 g, the weaver attaches 25 warp threads to this loom weights. If, however, the weaver uses a yarn that requires 50 g tension, only 10 warp threads can be attached to the loom weight.

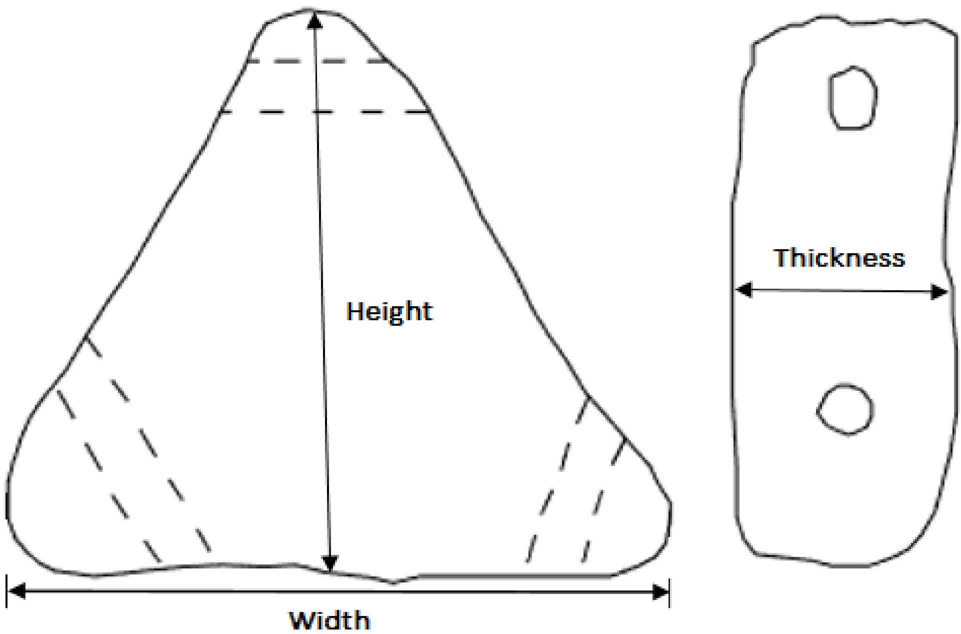


Figure 5.1. Figure demonstrating what is meant by height, width and thickness in a triangular loom weight.

The combination of height, width and thickness (fig. 5.1) of a loom weight define its weight. In addition, the weight can be influenced by the material of which the loom weight is constructed. However, height and material are of minor importance during weaving. The weight's main function is to keep the warp threads stretched and in place. The required tension depends on factors as the anticipated density of the fabric and the thickness of the yarn used (Barber 1991, 104).

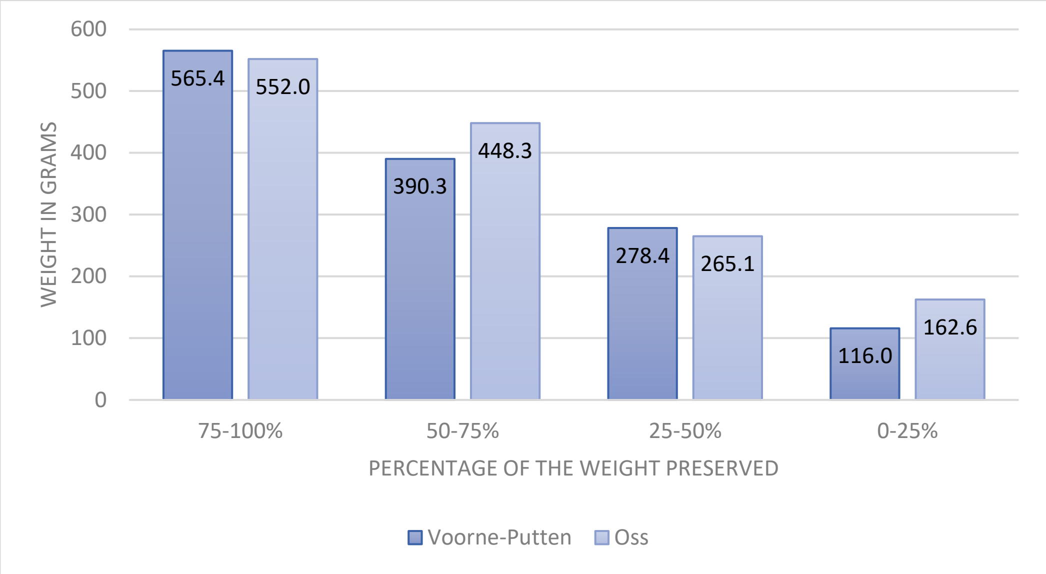
Principally, thin threads need less weight than thicker threads. Mårtensson *et al* (2009, 378-82) performed a study focussing on the influence of the weight and thickness of loom weights on the fabric produced. Two systematic weaving tests demonstrated that the weight of a loom weight is an important functional parameter for the operation of the warp-weighted loom. The weight must provide the correct tension for the warp threads. Even the difference between 11 grams tension and 18,5 grams tension per warp thread has a strong impact on both the weaving process and on the resulting fabric. The weaver's selection of the correct loom weight and the correct weight distribution on the warp threads is crucial for the quality of the fabric.

The weight clearly defines the use of the object. An example can be seen with small weights found in Hungary from the Starčevo-culture which belong to the Linearband-keramik culture. These weights are too small and therefore too light to weave flax, but they are heavy enough for a twining warp (Rast-Eicher 2005, 123-24).

So now it could be agreed upon that differences in weight within a set of loom weights seems to undermine the function. To the contrary, research shows that a great variation in weight is not insurmountable to weaving on the warp-weighted loom, although it does not make textile production any easier (Barber 1991, 95). Hoffmann (1964, 42) investigated modern Scandinavian used of the warp weighted loom and found that women simply tied proportionally more warp threads to the heavier weights, and fewer to the lighter ones. Theoretically, a set-up with weights of varying weight can be used, in which case the warp threads need to be redistributed in differing amounts over each weight (Mårtensson 2003 in Thorin 2012, 8).

The weight of loom weights is known to greatly vary from 150 to 1000 gram or more, however, the clear majority of the weights varies between 500 and 700 grams (Hoffman 1964, 20). With the loom weights from Voorne-Putten and Oss we see a great variation within the weight of the objects (appendix 9 and 10). This can be explained due to incompleteness of the majority of the weights; they miss a noticeable percentage of their original shape (and therefore weight). The average weight per case study, based on the percentage preserved, has been established in table 5.1.

Table 5.1. The average weight of the loom weights used in the case studies.



Left out of the calculation of average measurements of table 5.1 are the conical weight and the three triangular weights from Spijkenisse 18-30, which seem to deviate from the average; not only in their weight, but also in their size. The weights seem to be at least 25 percent smaller (and therefore more lightweight) than other loom weights from Voorne-Putten. The composition of the weights seems to be identical (fig. 5.2). The only obvious visual difference seems to be that the third weight has a central perforation and the others do not. The most remarkable thing about these weights, is the fact that their weight is practically identical; -from left to right- the weights weigh 139, 134 and 137 grams. It is highly likely that the weights were of identical weight while in use.

Figure 5.2. Triangular loom weights from Spijkenisse 18-30 (own photograph).

5.3 The Thickness

The choice of loom weights influences the fabric (Andersson Strand 2010, 2). Hence, Mårtensson *et al.* (2007) brought attention to the importance of thickness of loom weights. Thickness in combination with the weight can be used to calculate how wide the warp was spaced and indicate the type of fabric that could be constructed with it (table 5.1). The height of the weight is not that essential during weaving since the loom weight is not as constrained in this direction (Mårtensson *et al.* 2009, 378).

Table 5.2. Schematic overview of the use of loom weights for each type of fabric (Mårtensson *et al* 2009, 390).

	Thick yarn	Thin yarn
Open fabric	Heavy, thick loom weights	Light, thick loom weights
Dense fabric	Heavy, thin loom weights	Light, thin loom weights

When two sets of loom weights would have the same weight but a different thickness, the set that was less thick could have been used to set up a narrower warp compared to the other set. The same number of threads would be used per weight, making the final fabric narrower and denser. Compared to the Bronze Age conical weights, the rather thin triangular weights could be hung closely next to each other, making it possible to have more threads in the same area, making the fabric denser. This transition can clearly be seen in textiles from the Middle Bronze Age, which have an inferior density compared to Hallstatt Period textiles (Belanova-Stolcova and Grömer 2010, 17).

This knowledge provides a methodological framework for archaeologists to approximate the possible fabric from any given loom weight, as long as the weight and thickness are preserved. Furthermore, it allows us to analyse textile production more closely on sites where textiles are not preserved (Mårtensson *et al.* 2009, 373).

With the loom weights from Voorne-Putten and Oss we see a great variation within the thickness of the objects (appendix 9 and 10). Only the weights of which the original thickness could be determined are considered. The thickness of the weights from Voorne-Putten deviates from 4.4 up to 6.3 centimetres, but seems to have a mean of circa 5.2 centimetres. The miniature weights of Spijkenisse 18-30 were excluded in this average.
The thickness of the weights from Oss deviates enormously, compared to Voorne-Putten from 3.9 up to 10.7 centimetres. The average seems to be around 5.3 centimetres.

5.3.1 Experimental Archaeology

The importance of the thickness of loom weights was demonstrated by an archaeological experiment by Mårtensson *et al* (2009, 382-4). Four tests were conducted to examine how the thickness of a loom weight influences the weaving and the fabric. The main purpose was to achieve a better understanding of the influence of a loom weight's thickness on the weave. For this purpose, two different sets of 22 ceramic loom weights were made. These loom weights were specifically designed to test these two parameters and no reconstructions of any specific archaeological type. The loom weights all had an identical weight of approximately 275 grams, but the loom weights in one set had a thickness of 4 cm and the loom weights in the other set had a thickness of 2 cm.

Each set of weights was positioned side by side and at the same level in a loom. This had a practical consideration: if the loom weights hang in a disorderly way at multiple levels, the upper weights could damage the warp threads. Besides, when loom weights are not hanging side by side, the warp threads will get disorganized. During weaving, this would cause the loom weights to tangle the warp threads attached to them (Mårtensson *et al* 2009, 382-4). Problems with tangling loom weights in a reconstruction setup are also described by Carington Smith (1992, 690).

Two sets of tests were performed. In the first test, two identical warps were constructed on two warp-weighted looms, each with a 34cm wide starting border. The only variation was the weights different thickness, test C used the 4cm thick loom weights and test D used the 2cm thick loom weights. The resulting fabric of weaving test C was a more regular fabric than the fabric in test D. Weaving test D only became regular when a width corresponding to the total width of the row of loom weights was reached. Secondly, based on these findings, two new setups were tested (E and F). In this case, both setups had a total width in which the loom weights were slightly wider than the starting border (Mårtensson *et al* 2009, 382-6).

The concluding remarks regarding this experiment were that it is preferable to use loom weights with a total width which is identical to or slightly wider than the width of the fabric to be produced. The experiments established that there is no advantage in attaching an abundant amount of warp threads to one loom weight. The weavers concluded that 30 warp threads per loom weight is an absolute maximum, since more will make it difficult to setup the loom and distribute the warp threads evenly in the fabric, which has a negative output on the final product (Mårtensson *et al* 2009, 382-4).

5.4 The Perforations

Loom weights often vary immensely between different time periods and locations, but one feature that they often have in common, is that they are all pierced with one or more perforations, in the centre or at the top (Hoffman 1964, 20). The triangular Iron Age weights we encounter in the Netherlands during the Iron Age often have multiple perforations though the corners of the weights (appendix 9). The number of perforations has shown to vary from 2 to a total of 4 perforations of which 3 are though the corners and one thought the centre of the weight.

An exception can be found in a triangular weight described by Ufkes and Essink (2001, 73-5), found in Houten. This weight has 4 perforations (fig. 5.3), of which one perforation was placed oddly though the surface of the weight into a perforation in the corner. The diameter of this fourth perforation measured only half of the diameter of the other 3 perforations. Ufkes and Essink emphasize that no other examples of such perforation are known from the Netherlands; therefore, we could only speculate about its purpose. However, there are two cases of double perforations known for the English hillfort site of Danebury where both holes are placed parallel. Poole (1984, 403), assumes that the extra perforation was wrongly positioned and therefore subsequently altered.

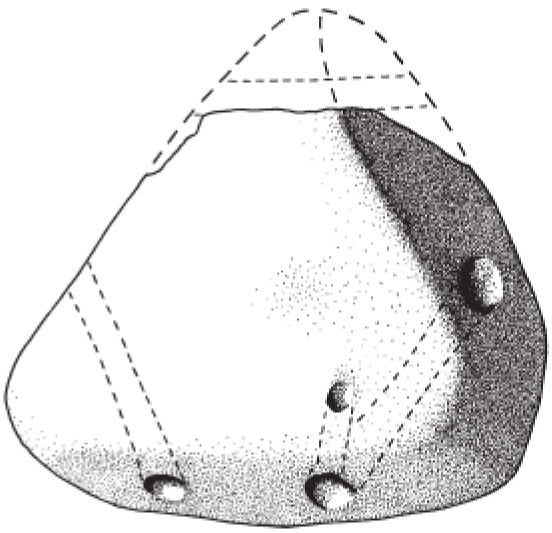


Figure 5.3. Triangular loom weight from find 659, in Houten, scale 1:2 (Ufkes and Essink 2001, 75).

These multiple perforations must have been of significant importance for the function of the weights, otherwise people would not have invested the time and effort in making these extra perforations. The number of perforations is a variable on which not many authors have elaborated. Loewe (1971, 35, footnote 66) is the only one to come up with a theory to explain the presences of multiple perforations in loom weights. With a normal warp-weighted loom it is possible to extend the length of the cloth further than the height of the loom, by rolling the finished part on the cloth beam and extending the warp threads (Barber 1991, 106). With a normal warp weighted loom this would mean that you had to manually move all the loom weights down the warp threads and secure them again. Based on the theory by Loewe the perforations of the triangular loom weights would have made this process less time consuming.

One of the first authors to mention the discrepancy in perforations in triangular Iron Age loom weights was Wilhelmi (1977, 180). He compared two sites in Germany, Sünninghausen and Bad Lippspringe, where triangular loom weights were found. One of the main differences between loom weights from these sites is the fact that the weights from Bad Lippspringe have a perforation in the centre of the weight. Wilhelmi observes that these central perforations show up in Haps, Germany and 'De Panne', Belgium and seem to branch out to the west, including southern England, containing almost entire North-Western-Europe. According to this observation by Wilhelmi, one could expect the number of perforations to be corresponding within a settlement.

In order to test the theory by Loewe, Wilhelmi (1977, 183) used the triangular type of loom weight without a central perforation from Sünninghausen to perform a small scale archaeological experiment in collaboration with the Textilmuseum Neumünster. He gave the assessment of function as explained by Loewe (chapter 3.1) to work with and they concluded that a warp-weighted loom can be worked in a way similar to the description by Loewe. Notable, however, is the remark he makes about the staff members of the Textilmuseum Neumünster, which he describes 'do not possess the experience needed for the critical assessment of this technology'.

A fascinating difference is visible in my case studies. The weights from Oss exclusively have 3 functional perforations, while the weights from Voorne-Putten show a disunity between weights with 3 and 4 perforations. However, there is one weight, Oss-Schalkskamp_9, that has an outset for a fourth perforation through the surface which stops about half way through the weight. This perforation itself is useless, but it does not influence the function of the weight in any way. Two other weights from Oss show abnormalities in one of their perforations. Weight Oss-Schalkskamp_13 has 3 perforations, of which one is fashioned in a perpendicular way compared to the other two. Last, weight Oss-Horzak 11617_1 has an outset for a perforation that has a crooked orientation and stops half way through the weight. However, this weight still seems to have been used, since one of the perforations of this weight shows wear traces.

At least 14 of the 47 weights from Voorne-Putten show a central perforation with an average diameter of 1,7 centimetres (appendix 9). There are only 12 weights where I could establish the total amount of perforations, since a lot of weights are broken. One of these weights is a pottery bottom with one perforation, of which I highly doubt it had a function as loom weight therefore, this weight will be left out of my consideration. Of the remaining 11 weights, four have 3 perforations and seven have 4 perforations. Within

Rockanje 08-52 and Spijkenisse 18-30, examples with different quantities of perforations were found.

There are few requirements that the perforations must comply with, in order to have been used as loom weight. Contrary to spindle whorls, for instance, loom weights do not need to have a central placed perforation, a perforation practically anywhere in the object will achieve the desired result (Barber 1991, 52). The only requirement of significant importance is the diameter of the perforation and whether it is sufficient enough for the amount of threads that has to be pulled through. Even then, a small perforation could have functioned to pull an intermediary thread through, while the bigger perforations were large enough to hold an entire bundle of warp threads (Ingenegeren 2010, 56).

The diameter of the perforations of my case studies are an average of 1,3 centimetres for the weights form Oss and 1,5 centimetres for the weights from Voorne-Putten. Only the corner perforations were considered in this average, since not all weights possess a central perforation. Furthermore, the central perforations seem to have a larger diameter on average.

A different aspect of the perforations of the weights that could give us an indication of the function are wear traces. Remarkably, there is almost no research on wear traces on loom weights; at most you will find a short mention of traces within publications. One clear demonstration of the use of these objects is to be seen in wear traces along the corners and flanks of the objects. This is not per definition evidence for the exclusive use of the weights as a loom weight, but at the very least it shows that the holes were used for lacing up some sort of rope. The majority of the triangular Iron Age loom weights are made out of baked clay, which is fairly soft, so the use of any kind of rope through the holes, around corners or flanks could easily leave wear traces. Furthermore, the direction of the wear traces could potentially give us an indication of the way rope was laced through the weight and therefore confirm or exclude a certain type of use. However, many kinds of use would leave traces and this does not mean that any object without these traces could not have been used as a loom weight.

Remarkable, is the fact that wear traces on triangular loom weights are practically never mentioned in the Netherlands. It is unclear how this absence can be explained, but I think it to be highly likely that wear traces are often not recognised as such or not considered to be of any importance. In England, at the Iron Age hillfort site of Danebury, again no examples of wear traces have been found on triangular weights. According to Poole (1984, 403) the lack of wear traces on the total of 62 triangular clay weights, could be explained by the fact that most are incomplete fragments.

Figure 5.4. Detail of wear traces on the corner and perforation of weight Rockanje 08-52 164_1 (left) and the perforation of Oss-Schalkskamp_10 (right) (own photographs).

The case studies of Voorne-Putten and Oss, seem to be of high importance, since the triangular weights from both settlement sites show multiple examples of wear traces (appendix 9 and 10). The shape of the perforations gives a good indication for wear. The more oval a perforation, the more the hole has been worn out by the use of the object. An example can be seen from a weight from Oss-Schalkskamp and Rockanje 08-53 (fig. 5.4) In Voorne-Putten a remarkable amount of 7 weights show wear traces along the corners and perforations are often elliptically worn (appendix 1).

5.5 The Shape

In the Netherlands, loom weights from the Bronze Age are not often found. Common forms throughout the Bronze Age are the ring shape with a central perforation and conical weights with one piercing in the top. From the Early Iron Age on, we encounter truncated and elongated pyramidal and conical shapes. These weights are often found in groups of multiple items and resemble the shapes found in the Bronze Age. The significant difference is that the depth of the weight is smaller (Ingenegeren 2010, 56-60).

With the Middle Iron Age, we see the introduction of a new type of weight. This triangular weight is standing out, not only because of its new shape, but also because of its multiple perforations. In general, the triangular weights have at least three perforations through the corners (Van der Sanden 1987, 91; Van Heeringen 1992, 239). This type of weight was in use until the Roman Era (Ingenegeren 2010, 56), but seems to completely disappear during the Late Roman Era (Willems 1986, 194).

The presence of triangular loom weights is scattered over England, the Netherlands, Belgium, France, and Germany (Champion 1975, 132; Rahir 1927, 51; Blin *et al* 2003; Wilhelmi 1977, 180). For the whole of North-Western Europe, we know no examples of triangular loom weights with three perforations that have been found dating before the Middle Iron Age. The usual type of weight throughout North-Western Europe is elongated or truncated pyramidal and conical shaped, with a single perforation in the top. From the Middle Iron Age on this type appears and from the Late Iron Age onwards this type of weight seems to displace the other type of weights (although they do not disappear completely) until the Roman Era (Van der Sanden 1987, 38).

There is no discussion about the function of pyramidal and conical weights as loom weights, since rows of these weights have been found in situ (indicating the location of a loom). Furthermore, these weights have been found together with other textile working tools (Ingenegeren 2010, 54). No examples of in situ weights can be given for the triangular weights, but the weights are often found in a clear association with spindle whorls (e.g. Wind 1970, 255; Bruineberg 2004, 67).

5.6 Concluding Remarks on the Function

In chapter 4, the context of the triangular weights from the case studies has already been reviewed extensively. In this chapter, the other functional parameters necessary for a loom weight have been established. There are multiple hypotheses for the use of the triangular weights, like net sinker and stretcher. Each of these functions would require a specific set of functional parameters. For example, net sinker, must be well fired so as not to disintegrate in the water (Rahmstorf 2015, 8). Although net sinkers were likely made in a kiln within the settlement, you would expect these objects generally to be found at the bed of an old waterway or near the presence of a waterway. In hardly any case, it would be beneficial to bring a net sinker back into the settlement, therefor they are thought to normally have been stored in a boat, not in the house (Barber 1991, 97, footnote 11).

Two more problematic functional parameters are the weight and thickness of a loom weight. The majority of Iron Age triangular loom weights is broken and occasionally, the original surface of the object is gone. This makes it a challenge to establish the original weight and measurements of the object.

The perforations of triangular loom weights have shown to be a rather extensive topic. There are a lot of variables to be considered: the number of perforations, the diameter of the perforations, the location of the perforations and wear traces visible within the perforations. An attempt to find patterns within the wear traces of the perforations showed to be rather difficult, since most weights are damaged. Furthermore, this only proves that a rope of some sort was laced up through the perforations. Additionally, we only have the scenario as described by Loewe (1971, 35, footnote 66) as drawn up by Wilhelmi (1977, 182). No other suggestion on the operating of triangular loom weights has been done since then.

Since triangular weights first appear in the Middle Iron Age, this was expected to be the major functional parameter. Within the Netherlands, there are no major regional variations visible in the shape. While triangular weights dominate from the Middle Iron Age until the Roman Era, we still come across conical or ring-shaped weights. An attempt to expand the research area to the whole of North-Western Europe has shown to be more of a challenge. There a language barrier, with sources published in French, German and Czech. Furthermore, the amount of data needed in order to make a solid comparison is often insufficient and not easily accessible.

An overall problem with triangular weights seems to be that information given in publications concerning their basic characteristics is often inadequate. This makes comparisons between tools from different sites difficult. As Thorin (2012, 2) emphasizes, this causes it to work as an obstruction for the development of new methods and theories to understand the functional and practical aspects of these types of tools.

With the functional parameters listed in this chapter and chapter 4, the function as loom weight is not per definition established. Though, due to the large amount of weights found within settlement sites in direct relation to spindle whorls and often with proof for the presence of sheep in the direct area, a function as loom weight is highly likely. With the insights created by this chapter, the argumentation used by opponents of a function as loom weight can now largely be refuted. I will discuss further on this in the conclusion, which will be the next chapter.

6 Conclusion

Since textile remains scarcely survive in most of Europe, we need other ways to approach textile production in prehistory. The presence of spinning and weaving equipment, like spindle whorls and loom weights, is often considered to the best evidence for textile production in the Netherlands. An assessment of the *chaîne opératoir* of textile production has been made to establish which resources and objects were necessary. This showed that the presence of sheep, shears or knives, weaving combs, spindle whorls, loom weights and needles are good indicators for textile production. A combination of these resources makes the presence of textile production more plausible.

The conical and pyramidal weights have established their function as loom weight, with rows of weights indicating the location of a loom. With the emerging of the triangular weight in North-Western Europe during the Iron Age, questions about its functionality as loom weight arise. In order to establish what functional parameters define a loom weight it is necessary to approach textile production in prehistory through deductive research.

Few people today are aware how time-consuming the production of clothing is for the household. On a daily basis, many hours must have been dedicated to textile work, especially to spinning (Grömer 2016, 74). Barber (1991, 4) estimates that the textile production probably consumed far more hours of labour than pottery making and food production together (Barber 1991, 4). Though it would have been its main function, clothing did not only protect against the weather. Clothing is assumed to have been an important medium to communicate identity and as indicator of social status, age, gender and group membership (Grömer 2016, 454).

This research has focussed on combining the aspects of function and context of triangular Iron Age loom weights in a systematic way. Hence, the Dutch case studies from Voorne-Putten and Oss have been thoroughly examined to establish how the various characteristics determine the functional capacities of a loom weight.

Unfortunately, the weight and thickness of the triangular weights turned out to be problematic functional parameters. Most Iron Age triangular loom weights are broken, which makes it difficult to establish the original weight and measurements. Hoffman (1964, 20) defined that a clear majority of loom weights is between 500 and 700 grams. So far, his research could only establish that the average weight of the most complete triangular loom weights has shown to be part of this majority (table 5.2). Further research on a way to compute and interpret these functional parameters is desirable.

Remarkable within the case studies are the three triangular weights from Spijkenisse 18-30. These weights do deviate from the average; not only in their weight, but also in their size. The weights seem to be at least 25 percent smaller than any other loom weight from Voorne-Putten. The composition of the weights seems to be identical, making it highly likely that the weights are a set. The only obvious visual difference seems to be that the third weight has a central perforation and the others do not. Therefore, showing that for its function not all weights within a set should have the same number of perforations. The most remarkable thing about these weights, is the fact that their weight is practically identical; the weights weigh 139, 134 and 137 grams. A weight distribution as identical as this one is only necessary for pursuits in which there must be a consistent tension distributed over multiple aspects. There is absolutely no purpose for an identical weight with net sinkers and these weights are too light to have been used as spanner for the preparation of hides. The only plausible reason for someone to invest extra time and effort in making objects of identical weight is when it was of direct influence on the function. Therefore, it is reasonable to assume that these weights were used as loom weight.

Although loom weights without perforations have been encountered in Bulgaria (Barber 1991, 98), weights encountered in the Netherland always seem to be perforated. The only known Dutch examples without a perforation (fig. 4.3, left and 6.1) seem to be from weights that ended up in the fire before they were finished. These objects are often encountered in a hearth or furnace and show no sign of wear traces (Smeets 1987, 49).

Figure 6.1. A pyramidal loom weight without a perforation (Smeets 1987, 49).

With the perforations of the weight, there are a lot of variables to be considered; the number of perforations, the diameter of the perforations, the location of the perforations and wear traces visible within the perforations. The most essential requirement of a perforation for a function as loom weight, is that the diameter of the perforation is sufficient for the required amount of warp threads.

The number of perforations differ with triangular weight, we see examples with only two perforations as described by Ufkes (2007, 84-5, vnr. 616/4), or with three perforations in the corners and sometimes an additional hole in the middle, making four perforations in total. The weights from the case studies show a distinct difference between Oss and Voorne-Putten. The weights from Oss only have 3 functional perforations, while the weights from Voorne-Putten have 3 or 4 functional perforations. At least 14 of the 47 weights from Voorne-Putten show a central perforation (appendix 9).

One of the weights found in Voorne-Putten (Spijkenisse 18-50) is a re-used pottery bottom with one perforation. I highly doubt it had a function as loom weight since there is only one example and the weight has been found in the part of the house where the stable was located (Lanting and Van der Plicht 2006, 358; Van Trierum 1992, 73). This weight probably had a more self-contained function, that had something to do with the stables.

The location of the perforations in triangular weights has shown to diverge. Peculiar are the triangular weights found in Valkenburg (Bult and Hallewas 1987). These weights have perforations that are not located through the corners as we see with almost all the Iron Age weights, but through the surface of the weight in a perpendicular way compared to the Iron Age loom weights. This type of perforations makes a functional scenario as described by Loewe (1971, 35, footnote 66) as drawn up by Wilhelmi (1977, 182) rather unlikely. Since lacing up the rope through the weight in this sort of way, would make the weight hang skewed causing it to become unstable.

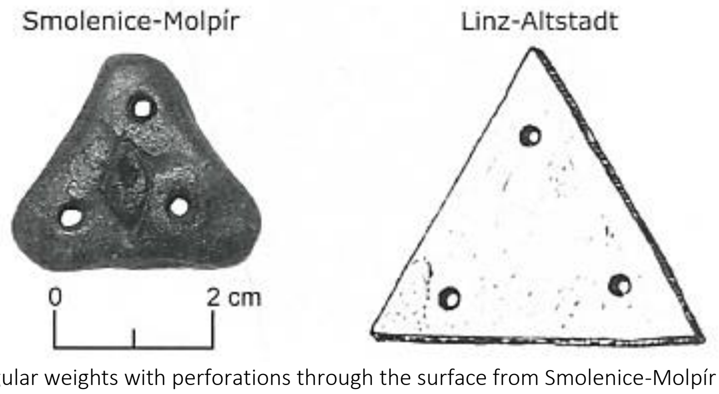


Figure 6.2. Triangular weights with perforations through the surface from Smolenice-Molpír and Linz-Altstadt (Belanova-Stolcova and Grömer 2010 ,15).

Van den Broeke (2009, 624) states that this new type of perforation was prevailing in the Roman Era. Examples are known from the Hallstatt Period settlement of Smolenice-Molpír (Dušek and Dušek 1995, Taf.67:18) and from the Roman Period in Linz-Altstadt (Karnitsch 1962, Taf. 30) (fig. 6.1). The weights from Linz-Altstadt were found next to the traces of a warp- weighted loom (Belanova-Stolcova and Grömer 2010 ,15). These weights have also been found in a context that suggested a (secondary) function as net sinker; in Valkenburg, three triangular weights were found together with 11 ring shaped weights at the bedding of an old branch of the river Rhine. Only one example of such perforation has been seen in the case studies, weight Oss-Schalkskamp_13 has one perforation which is fashioned in a perpendicular way, but the weight also has two normal perforations. Suggesting that the deviant perforation was probably more some sort of experiment.

Decoration in the form of stamps are known from pyramidal weights in the Netherlands (e.g. Groenewoudt and Verlinde 1989, 289 and Smeets 1987, 49), Stamps or inscribed characters on loom weights are known from other archaeological sites (Groenewoudt and Verlinde 1989, 289). Groenewoudt and Verlinde argue that these characters might have had the function to distinguish a set of loom weights with the same weight from other sets of weights with a different function or weight. No evidence for decoration has been found on Iron Age triangular weights in the Netherlands.

This research showed that the characteristics of which a functional loom weight should comprise are a consistent weight which provides enough tension for the required number of warp threads and at least one perforation to fasten the warp threads. While the shape can influence the convenience of the use of a weight, it is of inferior priority. The absence of any decoration in triangular loom weights showed it had no function at al.

Triangular weights appear from the Middle Iron Age onwards, no examples before that are known. Although an excavation performed by Van Heeringen (1998, 109) seemed to suggest different. A fragment of a triangular loom weight (fig. 6.2) was encountered at location 5, a settlement site in Vlaardingen which was dated in the Early Iron Age, based on the pottery found. Van den Broeke (2012, 287, footnote 27) remarks that this dating seems to be incorrect based on the pottery found. Based on the decorations on the sherds (nail impression, roughened) drawn by Van Heeringen (1998, 109), I agree that a dating in the Middle Iron Age seems to be more appropriate.

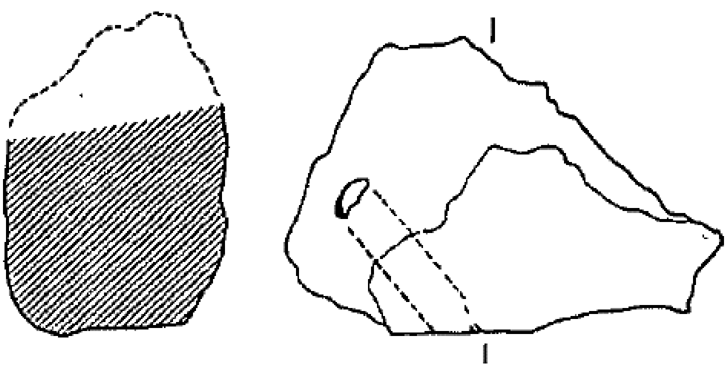


Figure 6.3. A fragment of a triangular weight encountered at location 5 in Vlaardingen (Van Heeringen 1998, 108).

There are very few examples known of conical and pyramidal loom weights in a context that suggested the location of a loom, but an even smaller number of examples from the Netherlands is available (e.g. Meurkens 2016, 233). No such examples are available for Iron Age triangular loom weight. The lack of evidence for triangular loom weights found in situ can be explained by the fact that in contrast to the other types of weights, the distribution of these weights was much smaller and the triangular weights were used for a much shorter time frame. Besides, due to the large amount of perforations the weight could easily be reused for other purposes.

While there are numerous examples of conical and pyramidal weights from the Bronze Age and Early Iron Age, there are very few examples of conical and pyramidal weights which can be dated in the Middle and Late Iron Age. However, these types of weights reappear in the Roman Era. Since we still encounter textile remains during the Middle and Late Iron Age, it is highly unlikely that there was little to no textile production during the Middle and Late Iron Age, a more likely explanation would be that the weaving technique was adjusted (Barber 1994, 81). The triangular loom weights appear during the absence of the conical and pyramidal weights and disappear gradually when these shapes reoccur, making it very viable that the triangular weights were the favourable shape of loom weights during the Middle and Late Iron Age until the beginning of the Roman Era.

Apart from the weight, the context and perforations seem to be the most important functional parameters that determine the function of a loom weight. The only regional variables visible between the triangular loom weights from the case studies, is the quantity of perforations visible between Oss and Voorne-Putten. The weights from Oss only have 3 functional perforations, while the weights from Voorne-Putten have 3 or 4 functional perforations. At least 14 of the 47 weights from Voorne-Putten show a central perforation. Based on these observations it is not possible to distinguish a typochronology of triangular Iron Age loom weights in the Netherlands, other than the one assembled by P.W. van den Broeke in 1987 (fig. 3.3).

As Barber (1994, 83) states, outdoors is not a favourable place for a loom, since this will make the textile exposed to the elements. Therefore, a type of loom was invented that could be positioned inside against the wall, taking almost no floor to accommodate the device; the warp-weighted loom. The warp-weighted loom was used from as early as the Neolithic. The loom employed clay or stone weights to stretch the warp threads. The construction was leaned against the wall and this inclination produced a natural shed (Grömer 2016, 107).

This indicates that a settlement site would be a favourable context for finding loom weights. The triangular loom weights from the case studies emphasize this hypothesis. The 47 triangular loom weights from Voorne-Putten have exclusively been found in settlement sites, often in direct association with a house plan. All sites date to the Late Iron Age, except for Bernisse 10-172 and Spijkenisse 18-50 which were dated in the Middle Iron Age based on the material found. The 13 triangular weights and over 70 fragments of weights from Oss-Schalkskamp have been encountered in a Late Iron Age settlement site and the weights from Oss-Horzak have all been encountered in features that are associated with Iron Age settlement sites, like wells, ditches, pits and a house plan.

The encounter of many loom weights together would indicate the presence of a loom or a storage of weights. Andersson (2003, 34) observed that loom weights in general are often found as single artefacts, which do not give us much information about the function. This can be explained by the fact that most loom weights found by archaeologists are those that have been discarded or reused for other purposes. Particularly, since the weights were easy to replace, since they were made out of inexpensive material.

Remarkable, is the fact that both sites Rockanje 08-06 and 08-52 from Voorne-Putten showed a particularly large amount of at least 15 (fragments of) triangular loom weights. All the weights were found in and around a house plan. This could indicate that there was a loom present at both sites, which probably has been dismantled. Furthermore, the cluster of farmsteads at Rockanje (08-52 until 08-54) each show a remarkable number of weaving tools. Here, loom weights have been found together with numerous spindle whorls and at Rockanje 08-53 they even encountered a weaving comb. The combination of the loom weights, spindle whorls and a weaving comb is robust evidence for textile industry in this settlement area.

The presence of a loom has been demonstrated at the Tisza Vallen in Hungary (Barber 1994, 83-4). In one house plan a heap of weights was found beside a pair of heavy postholes near one wall. These posts had no detectable function in holding up the roof or walls, they are thought to have formed the supports for a vertical warp-weighted loom. This loom was set up facing the doorway, so that it had the best light during the day and set near the fireplace so there would also be light in the evening. Remarkably, the excavation plan of Rockanje 08-52 (appendix 7) shows many features and postholes within the house plan that could indicate the location of a loom. Unfortunately, no such thing was recognized during the excavation and there is no data available on the similarity and depth of the various features, making it difficult to prove this hypothesis.

Van den Broeke (2009, 624) remarks that triangular weights were not exclusively found in settlement sites. He calls attention to Roman triangular weights from Valkenburg which were encountered in an old branch of the river Rhine. Although these objects found at the bedding of an old waterway are triangular weights, they differ from the Iron Age triangular weights in the direction of their perforations, making the circumstances of their context of little value to this argumentation.

The context in which triangular loom weights have been found has proven to be of immense importance to give additional information about the function. This enabled me to prove that triangular loom weights are mainly found at settlement sites, either discarded as refuse or as part of a functioning loom. Analysis of these settlement sites showed the presence of sheep and spinning and weaving equipment and proved a direct relation between the loom weights and house plans. Proving that weaving was one of the household activities performed at these settlement sites.

The research on triangular Iron Age loom weights is far from complete. It might never be possible to prove if the weights were used as described by Loewe in his assessment of the function. However, the examination of both the objects and the context from the case studies enables me to refute most -if not all- arguments of the opponents of a function as loom weight and prove that these objects show a large number of characteristics that are purely necessary for the function as loom weight. Therefore, I am convinced that the triangular weights were primarily used as loom weight.

7 Abstract

Loom weights have been found all over the world and there are clear regional distinctions in shape and size, but a few types like conical weights seem to be used repeatedly in most regions. In the European Iron Age, a new type of loom weight is introduced with a flat triangular shape and perforations through the corners and often through the centre of the weight. The introduction of this new type of weight is reason for a big discussion.

The generally accepted hypothesis on the function of triangular loom weights comes from Loewe (1971, 35, footnote 66), in which he describes how the triangular weights with three perforations were used to secure a bundle of warp threads, making it easier to fabricate longer pieces of textile and rolling the textile up for storing purposes. This presumably gave the triangular weights an advantage over the earlier conical and pyramidal weights. However, some archaeologists disapprove of this assessment of function, they presume a function as net sinker or spanner for hides is more likable.

Hence, I used a combination of literature study and two Dutch case studies to thoroughly establish what defines a loom weight. These and numerous other excavations have been examined in order to establish in what context triangular loom weights are encountered. The case study of Voorne-Putten dates to the Middle and Late Iron Age. Analysis of the context of the 47 triangular weights shows that the sites were all settlement sites. The 13 triangular weights and over 70 fragments of weights from Oss-Schalkskamp have all been encountered in a Late Iron Age settlement site and the weights from Oss-Horzak have all been encountered in features that are associated with Iron Age settlement sites, like wells, ditches, pits and a house plan.

Furthermore, this thesis examined and established what characteristics a loom weight should comprise of. The most important functional parameters showed to be a consistent weight and perforations. There were no major differences visible between the triangular weights from the case studies. In both cases, weights showed wear traces along the corners and numerous perforations were worn oval. The only noticeable discrepancy is that weights from Oss have 3 functional perforations, while the weights from Voorne-Putten show a disunity between weights with 3 and 4 perforations. Since there are no major regional variation visible in the shape, it was not possible to make a typochronology.

Research showed that these objects show a large number of characteristics that are purely necessary for the function as loom weight. Therefore, I am convinced that the triangular weights were primarily used as loom weight.

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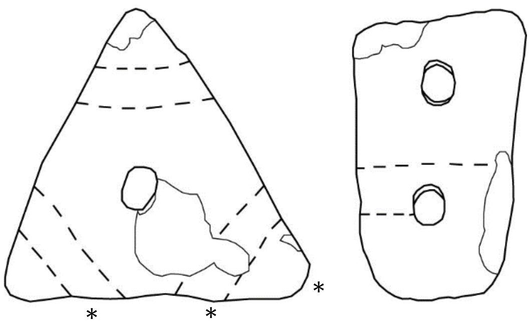
Appendices

Appendix 1. Drawings of the most complete loom weights from the case study Voorne-Putten. The standard scale of the drawings is 1:3, if a different scale has been used, it is mentioned underneath the drawing. The (*) indicates wear traces.



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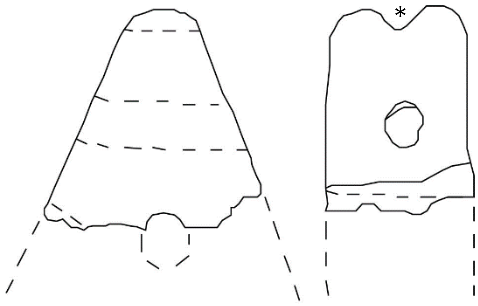

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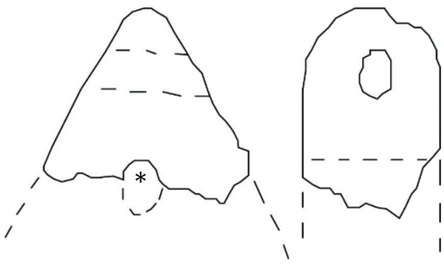

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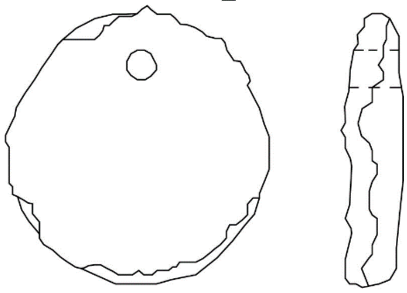

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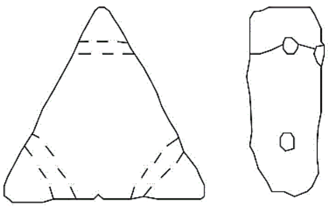

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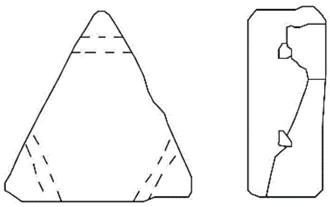

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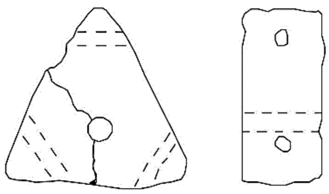

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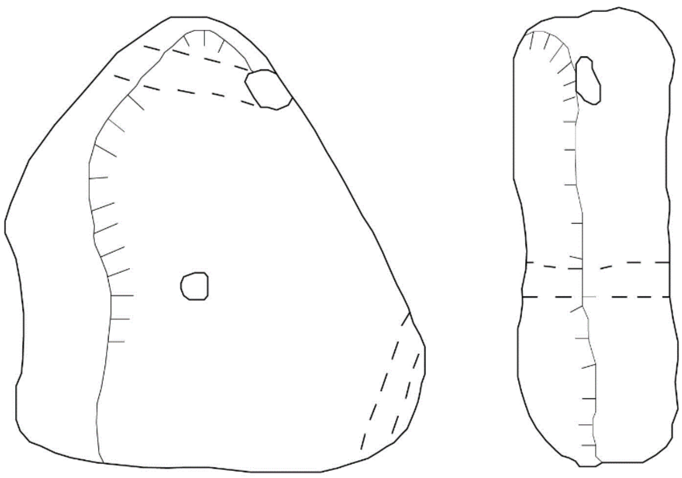

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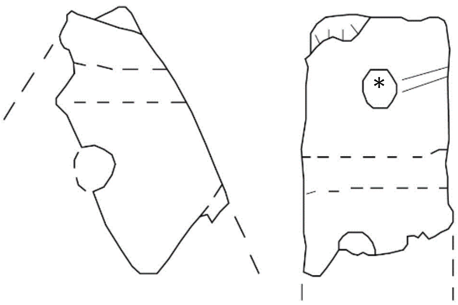
Scale 1:1



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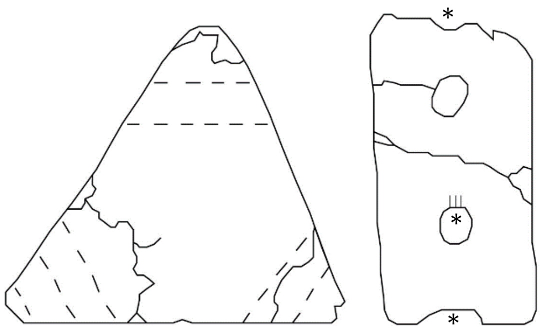

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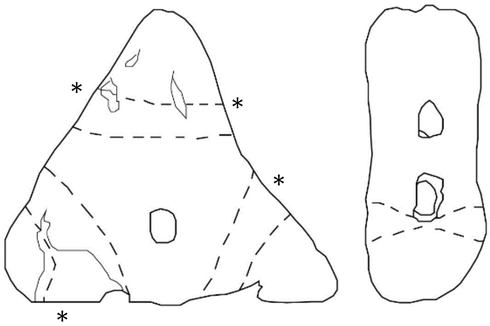

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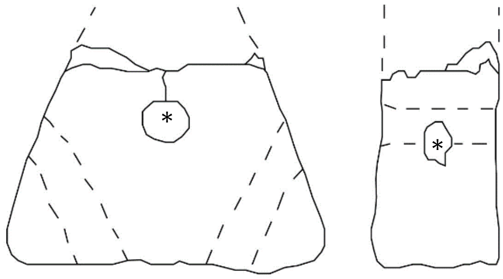

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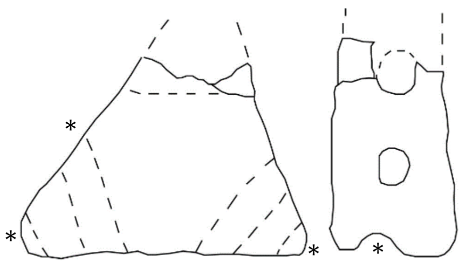

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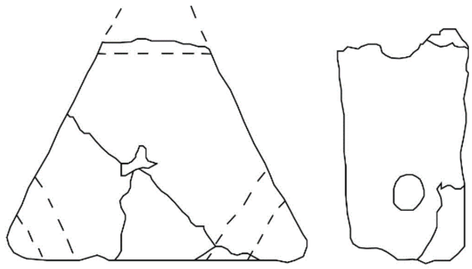

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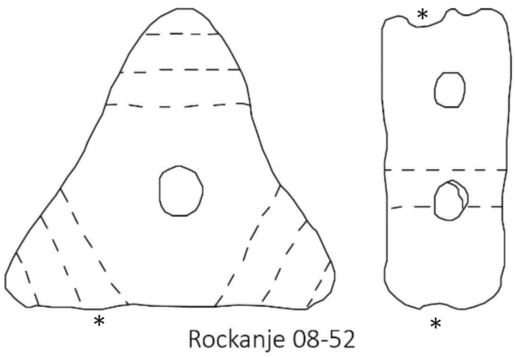

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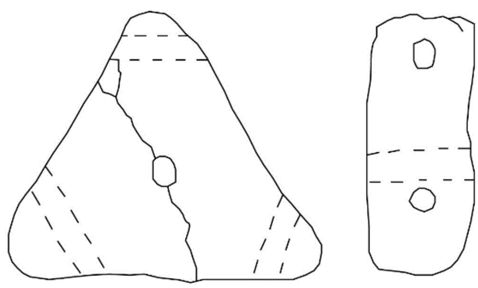

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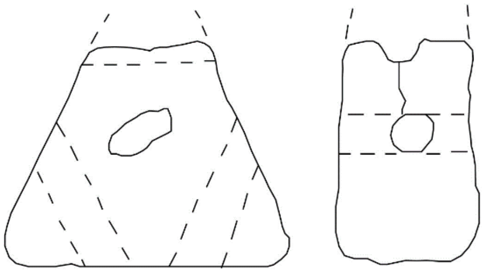

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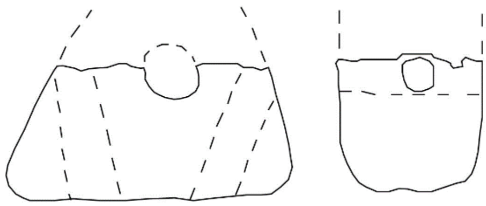

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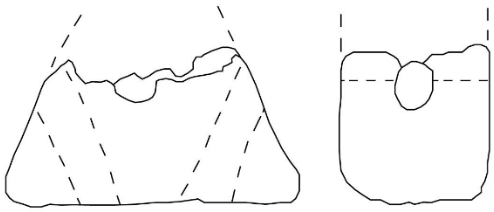

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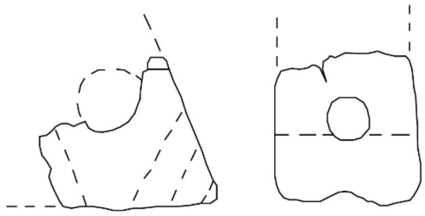

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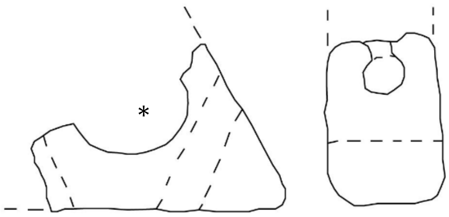

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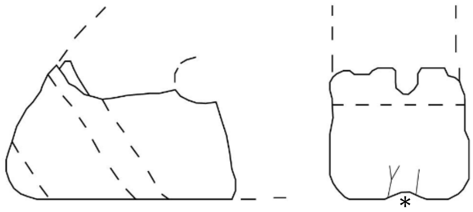

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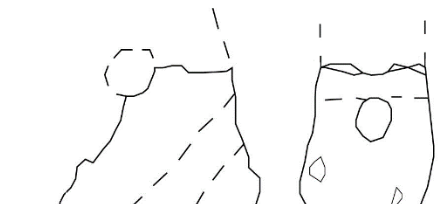

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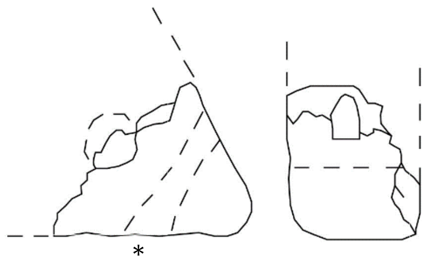

Rockanje 08-53
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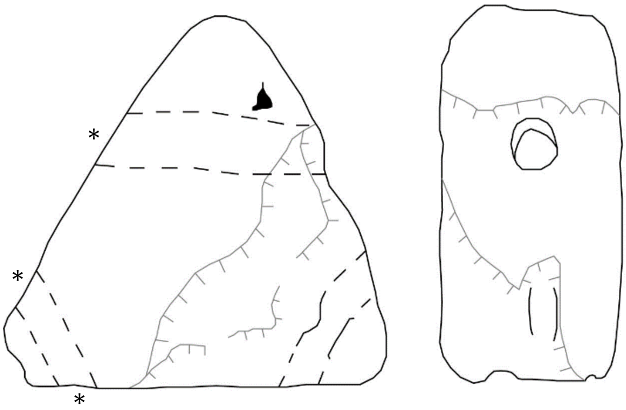
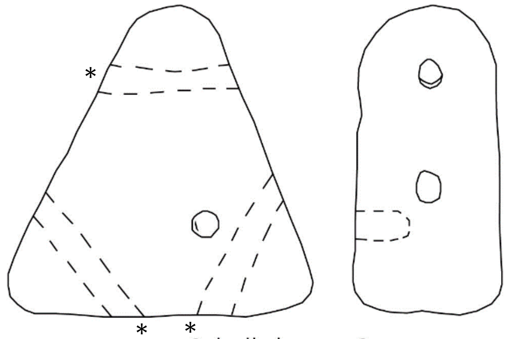
Appendix 2. Drawings of a selection of the most complete loom weights from the case study Oss. The scale of the drawings is 1:3. The (*) indicates wear traces.



Schalkskamp_8



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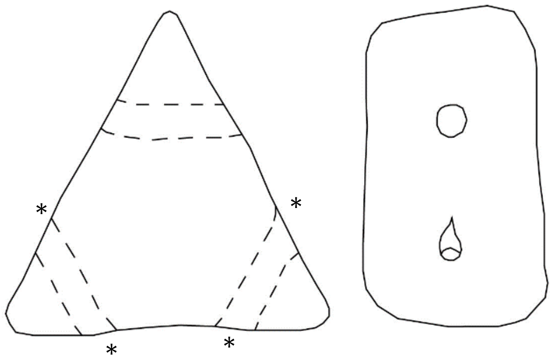
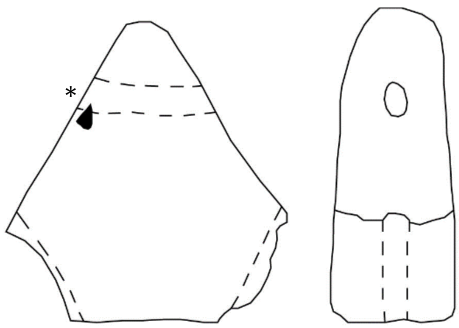


Schalkskamp_10
1006



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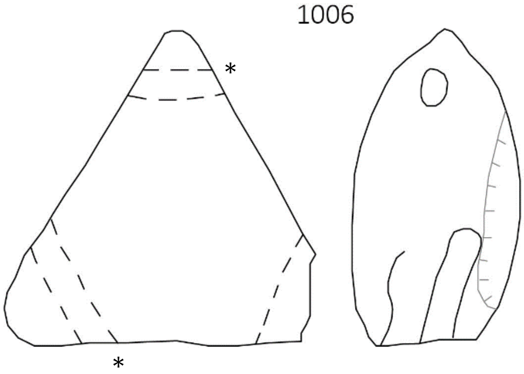

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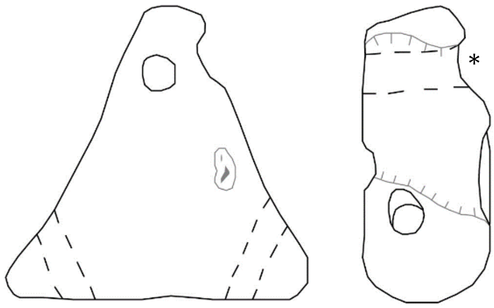

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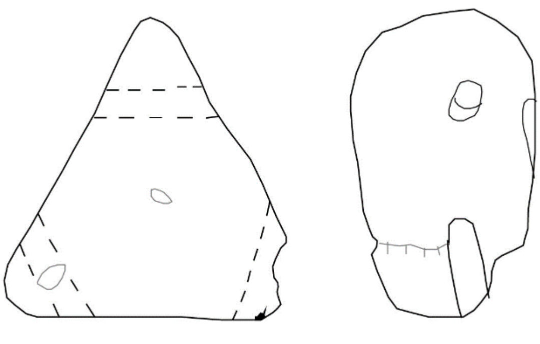
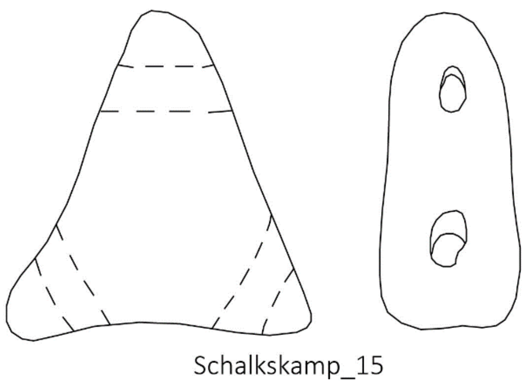
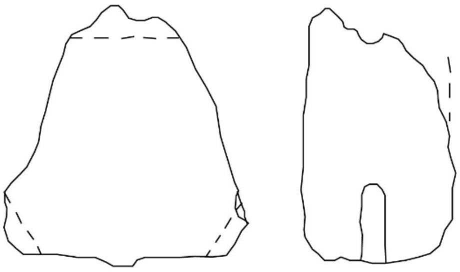


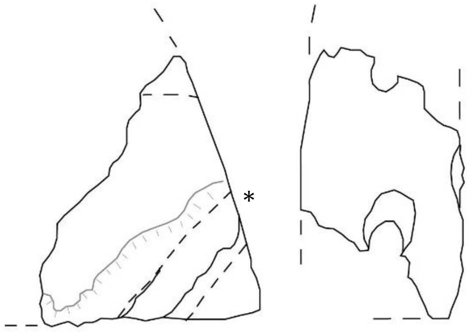
Schalkskamp_14



Schalkskamp_15



Schalkskamp_16



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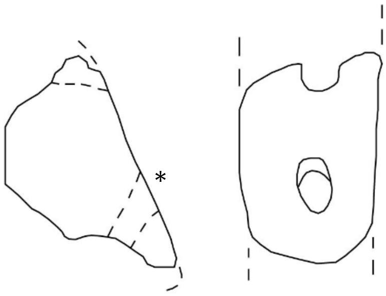
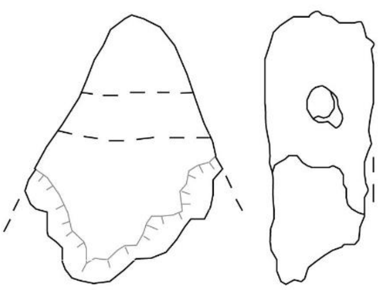
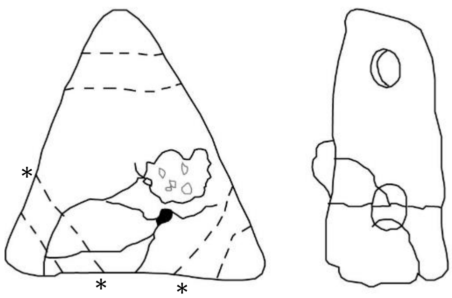


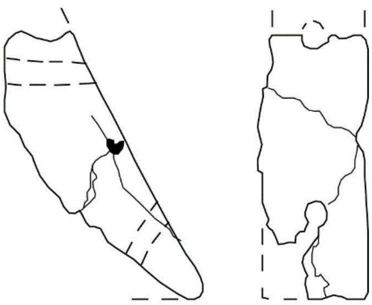
Schalkskamp_18



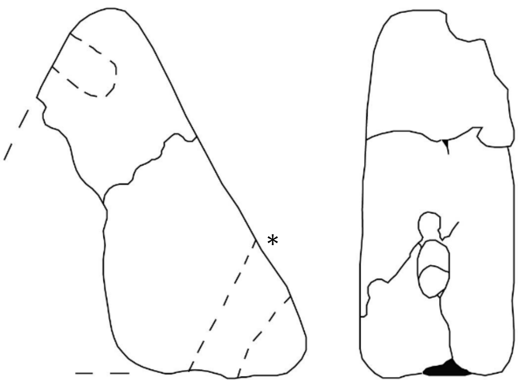
Oss-Horzak 6357



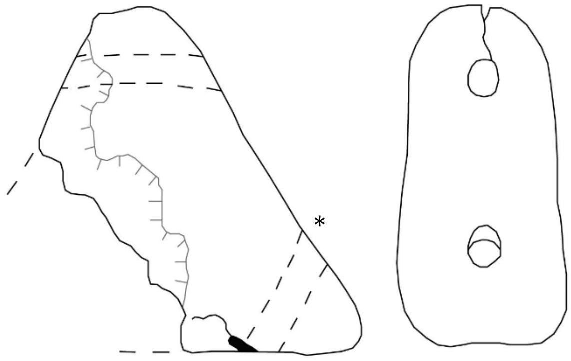
Oss-Horzak 6749



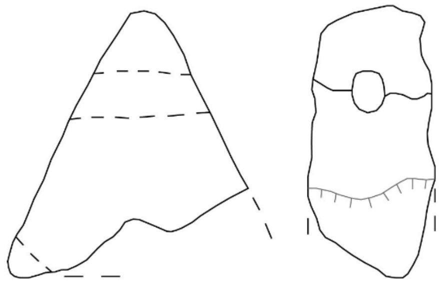
Oss-Horzak 10964



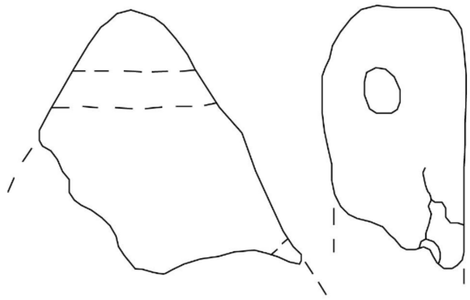
Oss-Horzak 11617_1



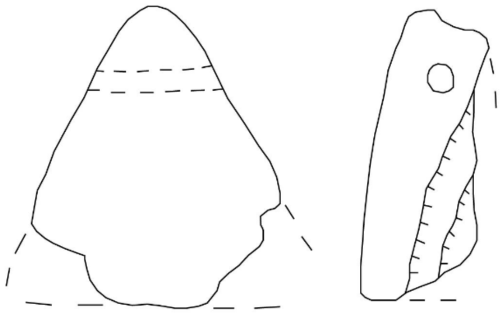
Oss-Horzak 11617_2



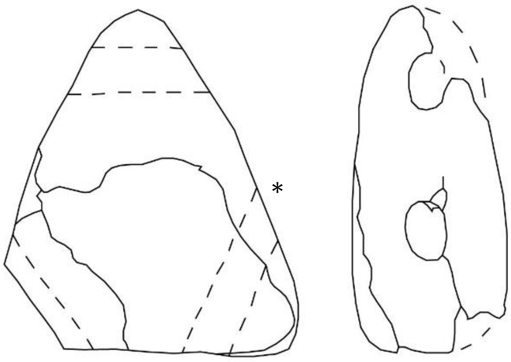
Oss-Horzak 11617_3



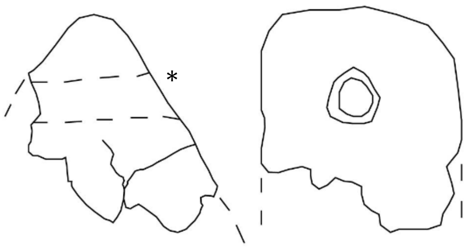
Oss-Horzak 11617_4



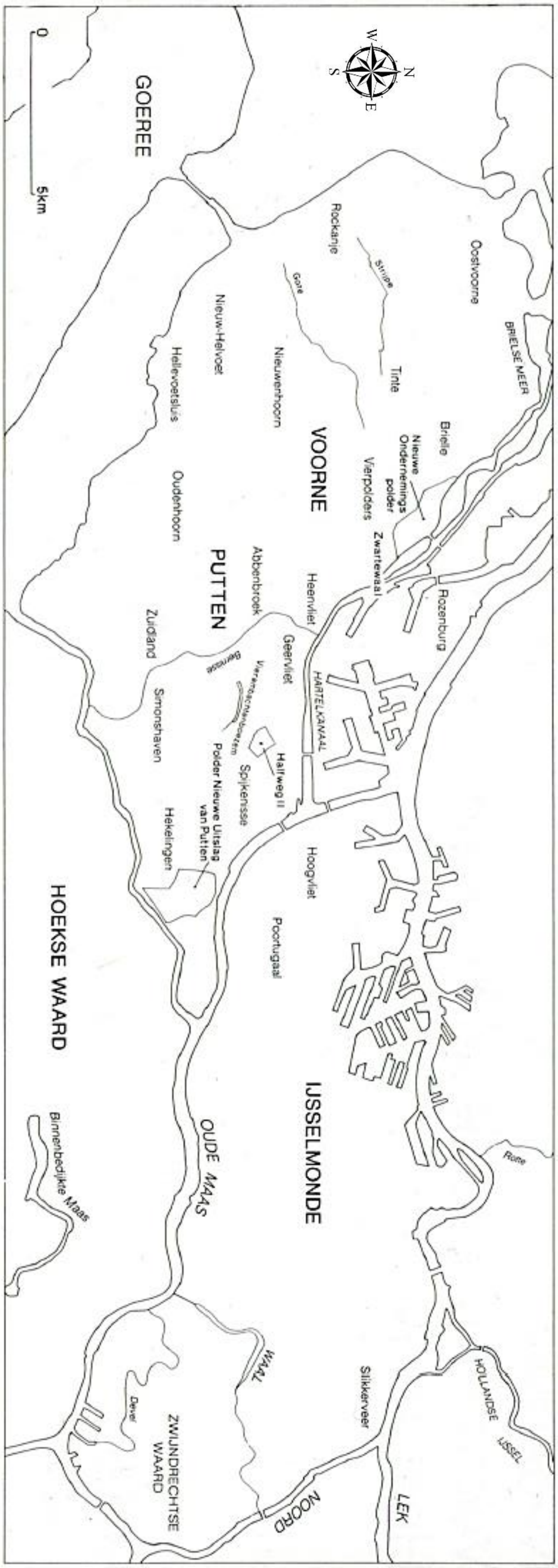
Oss-Horzak 11617_6



Oss-Horzak 11617_19

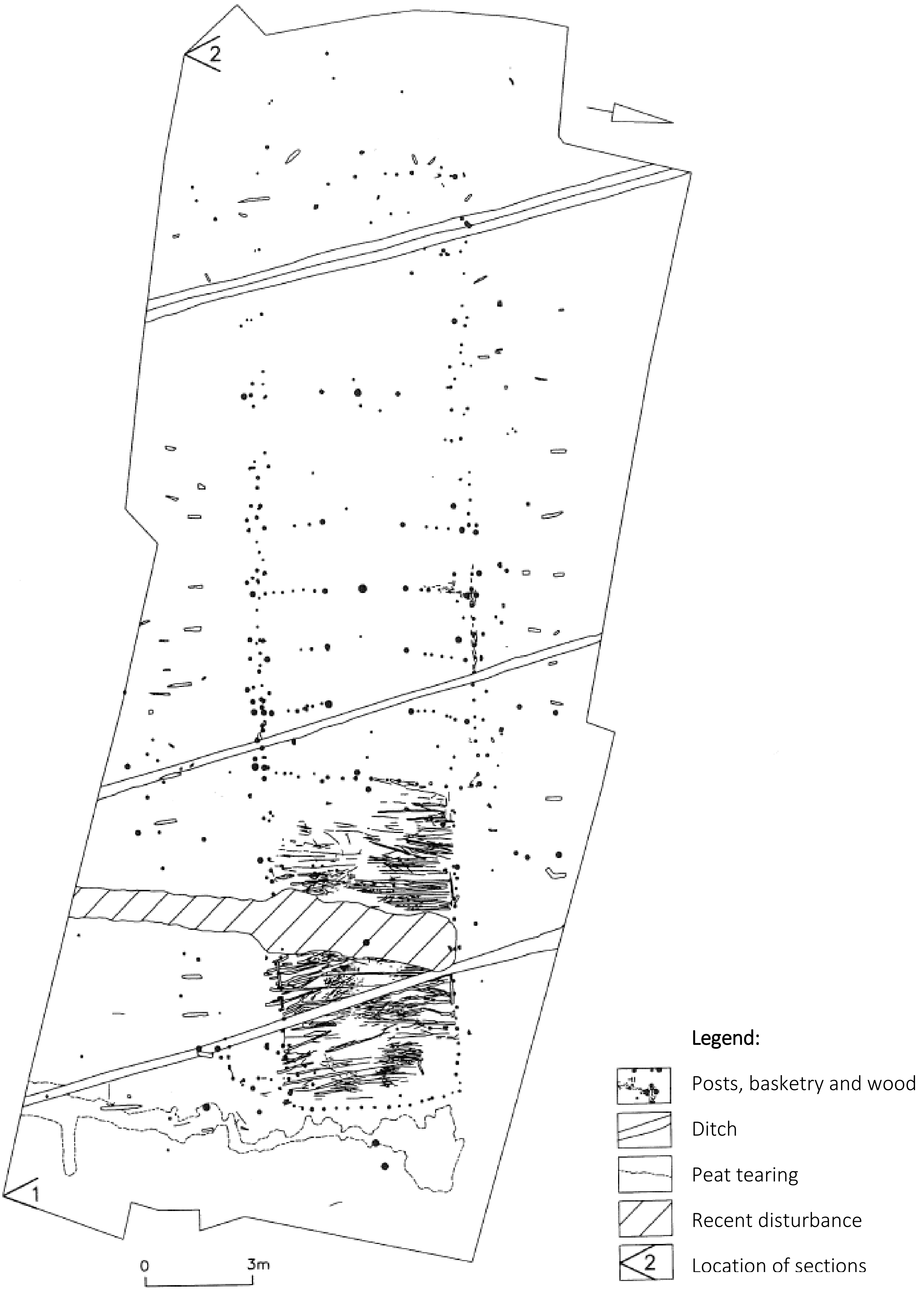


Oss-Horzak 11617_20

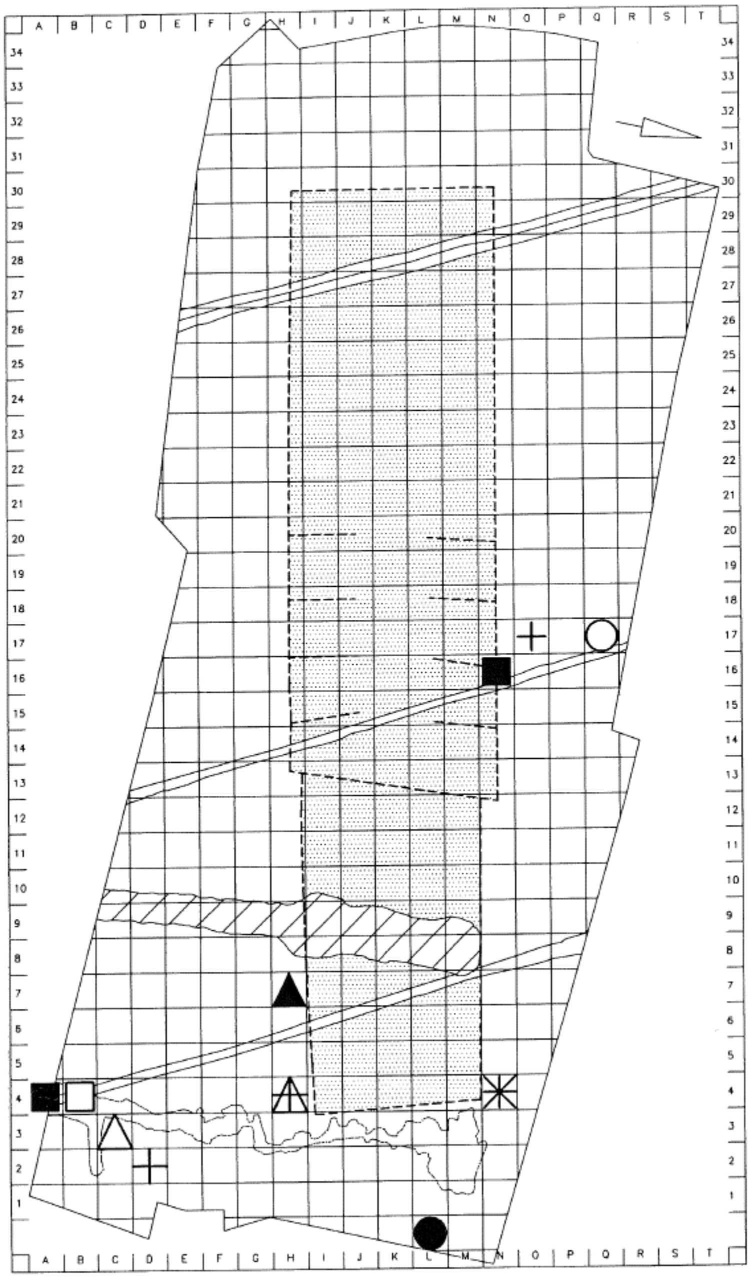


Appendix 3. Case studies within the area of Voorne-Putten (After Van Trierum 1992, 16).

Appendix 4. Excavation plan of the house plan of Bernisse 10-172, scale 1:200 (Goossens 2002, 34).



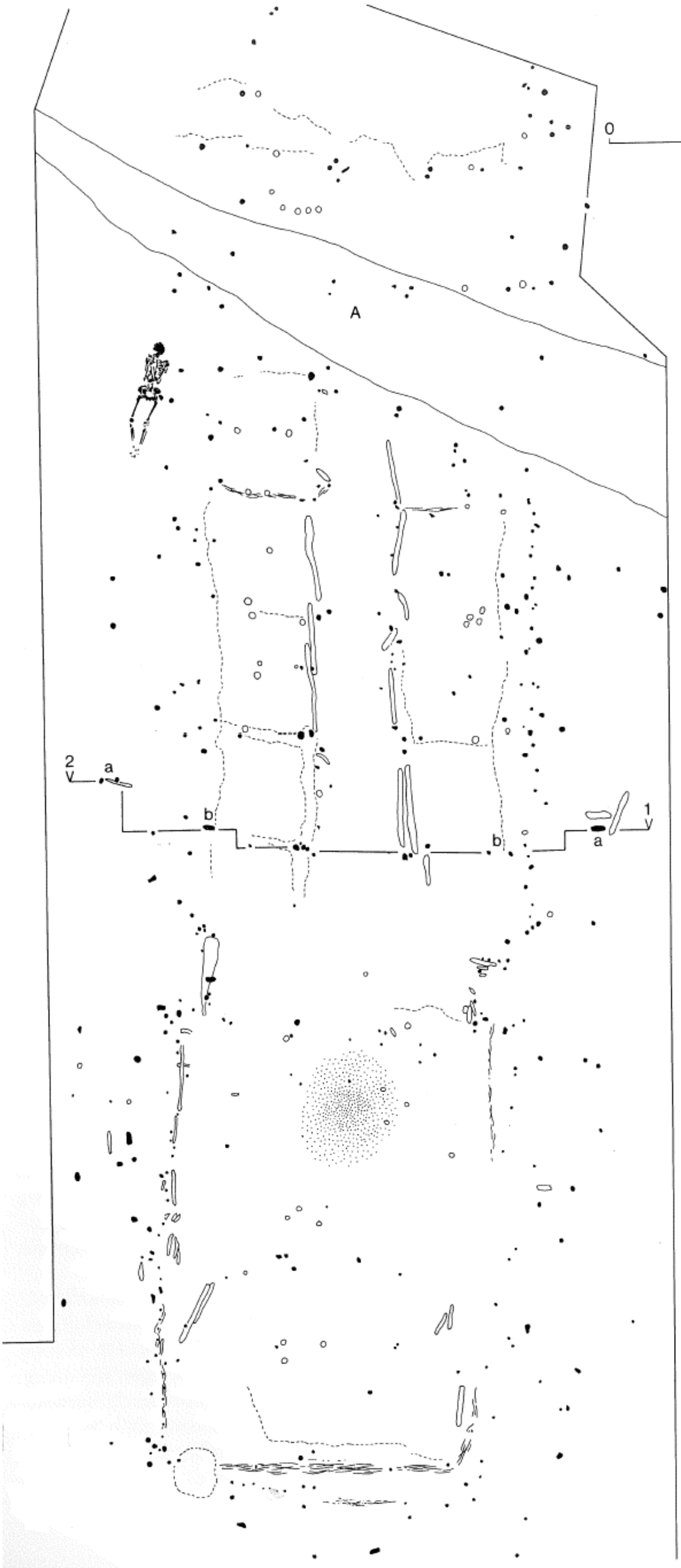
Appendix 5. Distributionmap of the objects found at Bernisse 10-172 (Goossens 2002, 56).

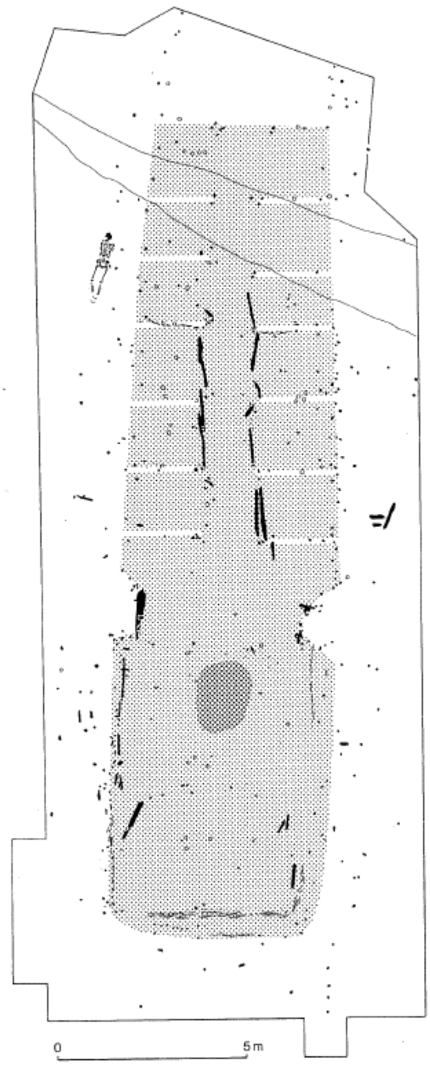


○ Fire grate
▲ Loom weight
● Spindle whorl
□ Whetstone
+ Grinding stone
■ Amber bead
✳ Sling-shot
△ Triangular object of baked clay

Appendix 6. Rockanje 08-52 - 08-57 on a contour map (Van Trierum 1992, 75).

Appendix 7. House plan of Rockanje 08-52 (after Van Trierum 1992, 76).



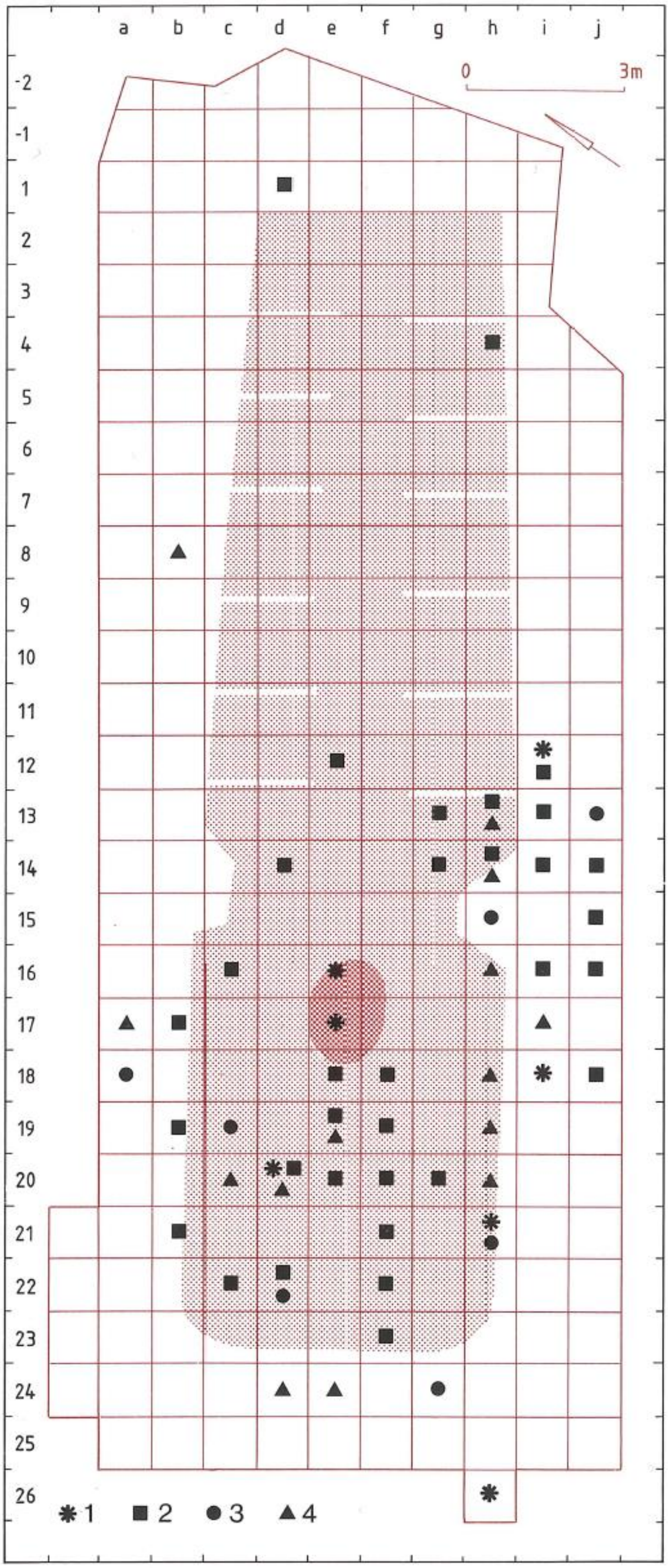


Legend:

1. Posts (up right or fallen over), basketry and postholes.
2. Features
3. Disturbance

The drawing on the right shows the entire area excavated.

Appendix 8. Rockanje 08-52. The distribution of utensils (one or more fragments or specimens) (Trierum 1992, 92, fig. 69).



Legend:

1. Cooking grate
2. Tripod
3. Spindle whorl
4. Loom weight

Appendix 9. Measurements of the loom weights from Voorne-Putten. Measurements are in centimetres, if not mentioned otherwise.

	Total	Number	Dating	Material	Weight in gram	Height	Width	Thick	Ø central perfor.	Ø perfor.	Shape	Nr. of perfor.	Wear traces	Comment
Abbenbroek-Bern 17-22	1	9999_1	LIA	baked clay	555	11.3	12.2	6.3	1.5	1.2-1.8	triangular	4	Perforation and one corner show wear	
Bernisse 10-172	1	209	MIA	baked clay	134	6.6	5.6	3.9	?	?	triangular	1	Light wear traces perforation	
Rockanje 08-06	16	1.1	LIA	baked clay	285	8.5	7.3	5.9	?	*c* 1.5	triangular	2	Wear on the corner	
		1.2	LIA	baked clay	158	8.3	7.4	5.1	?	1.3-1.5	triangular	2	Light wear central perforation	
		1.3	LIA	baked clay	99	8.6	5	5.6	?	?	triangular	3	Light wear to a perforation	
		1.4	LIA	baked clay	146	9.3	6.5	5.8	?	?	triangular	2	-	
		1.5	LIA	baked clay	151	9.2	6.8	3.5	?	?	triangular	1	-	
		1.6	LIA	baked clay	141	8	7.5	4.5	?	?	triangular	1	-	
		1.7	LIA	baked clay	83	5.9	6.4	4.4	?	?	triangular	1	-	
		1.8	LIA	baked clay	98	8.9	4.2	4.5	?	?	?	1	-	
		1.9	LIA	baked clay	63	6.2	5.2	4.6	?	?	triangular	1	-	
		1.10	LIA	baked clay	64	5.6	5.3	3.8	?	?	triangular	1	-	
		1.11	LIA	baked clay	49	6.4	4.8	3.1	?	?	triangular	1	-	
		1.12	LIA	baked clay	46	4.5	4.1	5	?	?	triangular	1	-	
		1.13	LIA	baked clay	38	5.4	4.6	2.7	?	?	triangular	1	-	
		1.14	LIA	baked clay	37	5.9	4.8	2.7	?	?	triangular	1	-	
		1.15	LIA	baked clay	26	4.2	3.4	4.7	?	?	triangular	1	-	
		1.16	LIA	baked clay	34	5.7	6.1	2.3	0.9	1.2-1.5	triangular	3	-	Miniature weight?
Rockanje 08-52	15	164_1	LIA	baked clay	604	11.1	13.6	6.2	-	1.2-1.5	triangular	3	Light wear on corner	
		233_1	LIA	baked clay	523	12.1	13.6	5.6	1.5	1.2-3.3	triangular	4	Wear on the perforations	
		248_1	LIA	baked clay	434	9	13.2	5	1.6	1.2-1.6	triangular	3	Light wear on the perforations	
		256_1	LIA	baked clay	691	11.7	13.5	5.1	*c* 1.7	1.2-1.8	triangular	4	Wear on the corners	Complete weight
		263_1	LIA	baked clay	359	7.9	11.4	5.4	-	1.4-1.8	triangular	3	Wear on the holes	

		382_1	LIA	baked clay	389	9.4	12.1	5.4	-	1.2-1.5	triangular	3	-	Lower weight, fig. 4.6
		234.1	LIA	baked clay	379	7.7	11.4	5.6	1.2-2.4	1.8-2.1	triangular	4	-	Central perforation oval
		234.2	LIA	baked clay	290	5.2	11.9	5.9	?	?	triangular	3	-	
		234.3	LIA	baked clay	304	6	12.3	6.1	?	?	triangular	3	-	
		234.4	LIA	baked clay	152	6.5	8.2	5.9	?	?	triangular	3	-	
		234.5	LIA	baked clay	84	6.5	4.8	5.6	?	?	triangular	3	-	
		234.6	LIA	baked clay	36	5.5	4.4	2.9	?	?	?	1	-	
		234.7	LIA	baked clay	26	4.1	2.6	3.5	?	?	?	1	-	
		234.8	LIA	baked clay	21	4.1	3.2	2.7	?	?	?	?	-	
		234.9	LIA	baked clay	28	4.5	4.4	3.1	?	?	?	1	-	
Rockanje 08-53	9	561.1	LIA	baked clay	454	10.6	12.8	4.4	1.2	0.9	triangular	4	-	
		603	LIA	baked clay	166	5.2	8	4.9	?	*c* 1.2	triangular	1	Wear on corner	
		85	LIA	baked clay	131	7.5	5.8	4.8	?	*c* 1.2	triangular	2	-	
		399	LIA	baked clay	42	5.9	4	2.6	?	?	triangular	1	-	
		305	LIA	baked clay	33	5	4.7	2.6	?	?	triangular	1	-	
		141	LIA	baked clay	179	10.1	6.2	4.4	*c* 4.5	*c* 1.6	triangular	3	Central perforation extremely worn out	
		104	LIA	baked clay	116	7.1	6.3	5.2	?	1.2-1.5	triangular	2	Wear on perforation	
		89	LIA	baked clay	60	7.4	4.5	4.9	?	?	triangular	1	-	
		140	LIA	baked clay	235	8.7	8.5	5.4	?	?	triangular	4	Central perforation extremely worn out	
Rockanje 08-54	1	241	LIA	baked clay	278	10.3	5.3	5.8	-	*c* 1.5	triangular	3	Wear on perforation	
Spijkenisse 18-30	3	9999_1	LIA	baked clay	139	7.6	8.7	2.9	-	0.6	triangular	3	Light wear on corner	Set of light weights?
		9999_5	LIA	baked clay	134	7.6	8.4	3.1	-	0.6	triangular	3	Light wear corner and perforations	Set of light weights?
		9999_6	LIA	baked clay	137	7.1	8.1	3.3	0.9	0.6	triangular	4	Light wear corner and perforations	Set of light weights?
Spijkenisse 18-50	1	8_1	MIA	baked clay	203	10	10	2.1	1.2	-	round	1	Light wear on perforation	Pottery bottom

Appendix 10. Measurements of the loom weights from Oss. Measurements are in centimetres, if not mentioned otherwise.

	Total	Number	Dating	Material	Weight in gram	Height	Width	Thick	Ø central perfor.	Ø perfor.	Shape	Nr. of perfor.	Wear traces	Comment
Oss-Schalkskamp	13 +	8	LIA	baked clay	841	13.5	13.7	6.8	-	1.7-2.1	triangular	3	Slight wear on the perforations	Damaged
		9 1006_23c	LIA	baked clay	616	10.6	10.7	10.7	-	0.7-1.0	triangular	4	Slight wear on the perforations	4th perforation incomplete
		10 1006	LIA	baked clay	590	11	11.5	6.3	-	0.5-1.3	triangular	3	Slight wear on the perforations	-
		11	LIA	baked clay	399	10.3	9.1	4.5	-	0.8-1.4	triangular	3	Slight wear on one perforation	Two corners broken off
		12	LIA	baked clay	605	11.6	10.1	5.8	-	1.2-1.7	triangular	3	Thread wear on the perforation	-
		13	LIA	baked clay	564	10.6	11.7	4.7	-	1.0-1.7	triangular	3	Wear on the upper perforation	Surface damaged, upper perforation though surface
		14	LIA	baked clay	435	11.2	9.4	6.8	-	1.3-1.7	triangular	3	-	Corner broken off
		15	LIA	baked clay	485	10.8	10.4	5.2	-	1.7-2.3	triangular	3	Slight to medium wear on the perforations	-
		- (16)	LIA	baked clay	397.5	9.4	8.8	5.4	-	c. 0.7	triangular	3	No obvious wear	Corners broken off
		- (17)	LIA	baked clay	262.8	9.4	6.8	5.9	-	c. 1.6	triangular	2	Slight wear on the perforations	Fragment
		- (18)	LIA	baked clay	158.8	8.4	5.1	5.2	-	c. 1.3	triangular	2	Slight wear on the perforations	Fragment
		-(19)	LIA	baked clay	528.9	12.1	10.3	5.2	-	1.7-2	triangular	3	central dent	
		-(20)	LIA	baked clay	242.4	8.8	-	7	-	c. 1.7	triangular?	1	Slight wear	
		-(21)	LIA	baked clay	1180	-	-	-	-	-	-	-	No wear visible, too fragmented	Over 20 fragments and dust
		-(22)	LIA	baked clay	2600	-	-	-	-	-	some triangular?	-	Broken, glued and broken again. No wear could be distincted	Over 50 fragments, 3 of which were corners with a perforation (c. 1 cm Ø)

Oss-Horzak (2004)	27	431	LIA	baked clay	66.4	?	?	4.3	-	0.8	triangular?	1	Fragment	Put 86, vlak 1, spoor 90, vulling 2, segment 2
(2004)		445	LIA	baked clay	57.3	?	?	?	-	?	?	2?	Fragment	Put 86, spoor 90, vulling 4, segment 4
(2005)		2279	LIA	baked clay	71.7	?	?	?	-	-	?	?	8 fragments	Put 109, vlak 1, spoor 1, vulling 1
(2006)		4732	EBA	baked clay	218	9.3	8.1	4.4	-	0.9	conical	1	Fragment	Put 157, vlak 1, spoor 21, vulling 1
(2006)		5296	LIA	baked clay	46.7	?	?	?	-	-	?	-	2 fragments	Put 164, vlak 1, spoor 170, vulling 1, segment 2
(2006)		5716	LIA	baked clay	19.2	?	?	?	-	-	?	?	Fragment	Put 165 vlak 1, spoor 217, segment 3
(2007)		6314 _1	LIA	baked clay	89	?	?	?	-	-	?	?	Fragment	Put 188, vlak 1, spoor 21
(2007)		6314_2	LIA	baked clay	38	?	?	?	-	?	?	1	Fragment	Put 188, vlak 1, spoor 21
(2007)		6357	LIA	baked clay	290	10.2	7.3	4.7	-	1.6	triangular	1 (3)	Fragment	Put 186, vlak 1, spoor 88
(2007)		6749	LIA	baked clay	303	8.5	8.6	3.9	-	1.0-1.5	triangular	3	Slight wear traces on the perforations	Put 189, vlak 1, spoor 46, vulling 1
(2007)		6775	LIA	baked clay	54.7	?	?	?	-	-	?	?	3 fragments	Put 189, spoor 47
(2007)		6849	LIA	baked clay	44.9	?	?	?	-	-	?	?	Fragment	Put 189, vlak 1, spoor 48, vulling 2
(2007)		6885_1	LIA	baked clay	389.8	9.2	8.7	>5.3	-	0.7	conical?	1	Surface broken, no wear	Put 189, vlak 2, spoor 48, vulling 2
(2007)		6885_2	LIA	baked clay	343.9	10.5	7.9	6.1	-	c. 1.3	triangular?	1	Fragment, no obvious wear	Put 189, vlak 2, spoor 48, vulling 2
(2007)		6885_3	LIA	baked clay	74	?	?	?	-	-	?	?	Fragment	Put 189, vlak 2, spoor 48, vulling 2
(2007)		6955	LIA	baked clay	115	?	?	?	-	-	?	?	Fragment	Put 196, vlak 1, spoor 10
(1998)		10964	E/MIA	baked clay	151	10.7	4.1	4.3	-	0.8	triangular	2 (3)	Fragment	Put 8, spoor 65, vulling 1
(2001)		11617_1	LIA	baked clay	568.2	13.1	8.7	5.6	-	1.1-1.6	triangular	2	Wear on the complete perforation	Second perforation not complete
(2001)		11617_2	LIA	baked clay	568.7	12.6	7.7	6.0	-	1.5-2.0	triangular	2		Put 60, spoor 67
(2001)		11617_3	LIA	baked clay	338.4	9.6	9.0	4.6	-	c. 1.6	triangular	1	Too damaged to determine	Put 60, spoor 67; Two pieces

(2001)		11617_4	LIA	baked clay	417.8	9.7	9.0	5.4	-	1.4-1.6	triangular	2	Slight wear on perforations	Put 60, spoor 67
(2001)		11617_5	LIA	baked clay	531.3	?	?	?	-	?	?	2	Highly fragmented, traces for perforations	Put 60, spoor 67
(2001)		11617_6	LIA	baked clay	388.6	11.3	9.4	3.7	-	c. 0.7	triangular	1	Very damaged	Put 60, spoor 67
(2001)		11617_7	LIA	baked clay	476	?	?	?	-	?	?	1	Fragmented	Put 60, spoor 67
(2001)		11617_8	LIA	baked clay	433	?	?	?	-	-	Triangular?	-	Fragmented	Put 60, spoor 67
(2001)		11617_9	LIA	baked clay	146.3	?	?	?	-	-	?	?	Fragmented	Put 60, spoor 67
(2001)		11617_10	LIA	baked clay	105.1	?	?	?	-	-	?	?	Fragmented	Put 60, spoor 67