

Visual Textiles: A Study of Appearance and Visual Impression in Archaeological Textiles

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Does it matter how textiles look? A study of appearance is also a study in the language of form. In modern archaeology and sociology, studies of the language of form in textiles and clothing have been a means not only of understanding processes of communication between groups and individuals but also of examining the origin and function of a certain fabric.¹ Sometimes, the appearance of a fabric seems just as important in signalling social status as the form or shape of a garment.

Traditionally, technical research in textiles has concentrated on aspects such as raw materials (for example, flax or wool), twist direction of the yarn, weave, thread count, and characteristics such as weaving faults and different kinds of borders. This method has been used to classify archaeological textiles into types. Unfortunately,

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- 1 Linda B. Arthur, ed., *Undressing Religion: Commitment and Conversion from a Cross-Cultural Perspective* (Oxford: Berg, 2000); Ruth Barnes and Joanne B. Eicher, eds., *Dress and Gender: Making and Meaning in Cultural Contexts*, Cross-Cultural Perspectives on Women 2 (Oxford: Berg, 1992); Joanne B. Eicher, ed., *Dress and Ethnicity: Change Across Space and Time*, Berg Ethnic Identities Series (Oxford: Berg, 1999); Inga Hägg, *Kvinnodräkten I Birka: Livplaggens rekonstruktion på grundval av det arkeologiska materialet*, Archaeological Studies, Uppsala University Institute of North European Archaeology 2 (Uppsala: Institutionen för Arkeologi, 1974); Inga Hägg, Gertrud Grenander Nyberg, and Helmut Schweppe, *Die Textilfunde aus dem Hafn von Haithabu*, Berichte über die Ausgrabungen in Haithabu, Bericht 20 (Neumünster: Wachholtz, 1984); Inga Hägg, "Friesisches Tuch," in *Textilsymposium Neumünster, 4-7.5.1993: Archäologische Textilfunde—Archaeological Textiles*, ed. Gisela Jaacks and Klaus Tidow, North European Symposium on Archaeological Textiles (henceforth NESAT) 5 (Neumünster, Germany: Textilmuseum Neumünster, 1994); Dani Cavallaro and Alexandra Warwick, *Fashioning the Frame: Boundaries, Dress, and Body*, Dress, Body, Culture series (Oxford: Berg, 1998).

many of us have found that the standard technical analysis² is insufficient to describe the visual effect of what we see in the material. Differences clearly visible to the eye are not discernible through the standard analysis. Archaeological textiles contain something more that eludes the established recording methodology.³ Textiles with different weaves can have more in common visually than textiles made in the same weave.⁴ It is therefore necessary to ask how we can describe some of the visual similarities and differences in archaeological textiles that cannot be explained by standard technical terms, and to discuss what these can tell us.

It can be argued that the human way of experiencing visual impression is based not only on our sense organs, but also on a cultural “way of seeing.”⁵ This means that we will never be able to see the fabric the way its users and producers did. However, by putting our visual experience into a broader perspective of historical context, handicraft knowledge, and fibre science, we may after all see differences and similarities compared with our own time.

An evaluation of similarities in style will always rely on an element of subjectivity. This is true whether the objects are Renaissance paintings, Iron Age swords, or medieval textiles. Differences in style cannot always be measured, but they can be described. For example, the perceived thickness and density of a fabric may diverge from measured values due to factors such as fibre type, the twist of the yarn, or finishing processes.

In this study, four researchers from four different countries have come together to see if we share a common experience of visual characterisation in archaeological textiles. We will identify some factors that can help to explain the appearance of a textile and discuss why and how textiles can be grouped by visual criteria. We will present a set of terms based on visual phenomena and use them to describe the visual character of archaeological textiles from three different Nordic medieval towns. We will then see how these terms can help us to group the textiles and to compare them geographically and chronologically. To do this, we also have to consider how the textiles were made and how different working processes affect a fabric.

We hope that the descriptions of a textile’s visual impression in combination with technical data may provide information that will increase our knowledge about

- 2 Penelope Walton and Gillian Eastwood, *A Brief Guide to the Cataloguing of Archaeological Textiles*, 3rd ed. (London: Institute of Archaeological Publications, 1988).
- 3 Lena Hammarlund, “Handicraft Knowledge Applied to Archaeological Textiles,” *Nordic Textile Journal*, 2005, 87–119.
- 4 *Ibid.*, 87–109; Kathrine Vestergård Pedersen, “Stofproduktion i Nordeuropa 1100–1500: En analyse af tekstilfund fra Lödöse og Lübeck samt en diskussion af forholdet mellem tekstiler, vævetyper og produktionsformer” (master’s thesis, University of Aarhus, 2004), 99–100.
- 5 Michael Baxandall, *Painting and Experience in Fifteenth-Century Italy: A Primer in the Social History of Pictorial Style* (Oxford: Oxford University Press, 1988), 34–38; Anne Hollander, *Seeing through Clothes* (Berkeley: University of California Press, 1993), 349–50; Pierre Bourdieu, “Habitus,” in *Gotik: Arkitektur, Skolastik, Habitus*, Erwin Panofsky and Pierre Bourdieu, Kulturklassiker Klim (Århus: Klim, 2002), 145–72.

a finished fabric, including its appearance and tactile properties. We see this study as a starting point and hope that further testing and developing will produce a method of visual grouping that will open new possibilities for the study of archaeological textiles.

TEXTILE APPEARANCE AND VISUAL IMPRESSION

The first thing that catches the eye when you look at a fabric is its surface. But what do you see? There are many factors that influence the appearance and visual impression of a textile. To understand what we actually see, it is important to know more about these factors and how they interact. We will now discuss how thread systems, yarn, weave, and other factors influence our way of seeing and describing a textile.⁶

Thread systems

The spaces and angles between the threads in warp and weft can vary. The degrees of regularity, parallelism, or straightness of the thread systems are factors that may affect the character of a textile. This phenomenon may be connected to different types of looms. The looms that are considered to have been in use in the Nordic countries during the medieval period are the warp-weighted loom and the horizontal treadle loom.⁷ The warp-weighted loom has no reed or batten, and this may affect the thread systems.⁸

Straight systems. A straight thread system is characterised by threads with about the same amount of space between them and, in addition, a fairly right angle between warp and weft. Straight thread systems often give the textile a regular and even appearance, especially in combination with evenly spun yarn. For twill textiles, straight thread systems create straight diagonal lines.

Irregular systems. Irregularities in the thread system can disturb the weave texture and give a fabric a restless surface. Irregularities occur when warp and/or weft threads

6 Lena Hammarlund, "Tekstilenes fjerde dimensjon: håndverkerens kunnskap og redskap," *SPOR: fortidsnytt fra midt-norge*, 1997, no. 2:26–29; Lena Hammarlund, "Textiliernas fjärde dimension: Hantverkarens kunnskap och redskap: En studie av romerska tuskaftsvävar från Mons Claudianus" (research report, Swedish Research Council for the Humanities and Social Sciences [HSFR], project D-nr F517/95, 1998), 10–12; Hammarlund, "Handicraft Knowledge," 106–7.

7 Marta Hoffmann, *The Warp-Weighted Loom*, Studia Norvegica 14 (Oslo: Norsk Folkemuseum, Universitetsforlaget, 1964), 5–22, 333–36; Hammarlund, "Handicraft Knowledge," 107.

8 William D. Cooke, Kate Banks, and Lena Hammarlund, "Fabric Width Control and Sett in Warp-weighted Loom Weaving," *Archaeological Textiles Newsletter*, no. 35 (2002): 2–6. A reed is an instrument used to keep the warp threads aligned and evenly spaced. The warp threads pass through the reed, which is fastened in another loom part called the batten. The batten is also used to beat in the weft.

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have a variable spacing, which can be observed as more open sections alternating with denser areas in the warp and/or the weft.⁹ Irregularity in thread systems can create curving diagonal lines in twill fabrics.¹⁰

Yarn

Features of the yarn that affect a fabric include such elements as diameter, twist, and movement.

Diameter. When dealing with archaeological textiles, the yarn diameter is measured and an approximate value is obtained, mostly given in millimetres (mm).¹¹ During research on archaeological textiles, Lena Hammarlund found that it is useful to divide yarns into seven thickness categories: very fine (up to c. 0.3 mm), fine (c. 0.3–0.45 mm), fine-medium (c. 0.45–0.6 mm), medium (c. 0.6–0.8 mm), medium-coarse (c. 0.8–1.0 mm), coarse (c. 1.0–1.2 mm), and very coarse (1.2 mm and higher).¹² If, for example, the term “fine yarn” is used in the text, this denotes a yarn with a small diameter; similarly, the term “coarse yarn” refers to yarn with a large diameter. Speaking in general, “finer” yarns include the yarn categories fine to medium, while “coarser” yarns include the categories medium-coarse to very coarse. (No very fine yarns have been recorded among the examined textiles.)

When the terms finer and coarser are used in relation to each other—for example, a finer warp and a coarser weft—this indicates the relative thickness of the yarns.

Two phenomena important for the visual impression must be mentioned here, both of which concern the yarn diameter: finer versus coarser yarn in a textile, and the ratio of diameters in warp and weft. Both these factors affect the texture of a fabric. With fine yarns in both warp and weft, the yarn contours may merge together with the weave, and the fabric surface may be regarded as an entirety. If the yarn has a larger diameter, the yarn’s contours may dominate and give the textile another character, and the weave may be more distinct. If the yarn diameters are about the same in warp and weft, it will affect the fabric appearance in a different way than if the yarn diameters vary—for example, a finer warp and a coarser weft (see the description of tabby, below).

Twist. The hardness or looseness of the yarn twist affects a fabric.¹³ If the warp

9 Hammarlund, “Handicraft Knowledge,” 107.

10 Lena Hammarlund and Kathrine Vestergård Pedersen, “Textiles Appearance and Visual Expression: Craft knowledge applied to archaeological textiles,” in *NESAT IX*, ed. A. Rast-Eicher and R. Windler, forthcoming.

11 For example, see Jane Batcheller, “Goat-hair Textiles from Karanis, Egypt,” in *The Roman Textile Industry and its Influence*, ed. Penelope Walton Rogers, Lise Bender Jørgensen, and Antoinette Rast-Eicher (Oxford: Oxbow, 2001), 38–47; and Else Østergård, *Woven into the Earth: Textiles from Norse Greenland* (Aarhus, Denmark: Aarhus University Press, 2004), 233–52.

12 This categorisation has been developed during work with Roman period textiles from Egypt and medieval textiles from Trondheim, Norway, and Lödöse, Sweden.

13 Irene Emery, *The Primary Structures of Fabrics* (Washington, DC: Textile Museum, 1980), 11–12.

yarn is single-spun (that is, not plied), it generally must have a hard or very hard twist to avoid breakage. Weft yarns may be more variable in twist, ranging from hard or very hard to medium or loose; in fact, the twist on weft yarn may be so loose that the twist angle is not visible. If a hard-twisted warp is combined with a hard-twisted weft, the fabric will have a certain appearance, sometimes with a bubbly surface or a hard character. If, however, a hard-twisted warp is combined with a weft yarn with a looser twist, the appearance will be different, and sometimes the fabric will have a woolly and soft character. Both the amount of twist and the twist combination in warp and weft are very important for the appearance of a fabric and also for its tactile properties.¹⁴

Movement. Yarn movement can also be seen as an irregularity on the surface of a fabric. It affects the fabric in different ways and may create a restless texture. Yarn movement can be described as an undulation, primarily caused by yarn torsion. The fibres' resistance to being twisted causes torsion, which works counter to the spin direction, and the yarn elevates, making bubbles or humps. Movement can be seen as either two- or three-dimensional. In a more openly spaced textile, the bubbles may fall sideways, and the movement is then seen as two-dimensional. In a denser textile, the bubbles will stay elevated, going up and down, and this movement is seen as three-dimensional.¹⁵ (Crepe fabric provides a good example of three-dimensional movement.) These phenomena influence tabby and twill textiles in different ways (see below, under "Weave").

Weave

Tabby and twill, the two predominant weaves, can contribute noticeably different appearance and properties to a textile.

Tabby. In a tabby weave, each weft thread passes alternatingly over one and under one warp thread.¹⁶ When the textile structure is relatively balanced (that is, the warp and weft threads have similar size and spacing), a fabric may have a distinct tabby character. An unbalanced structure will give the textile another character, visually perceived as a warp- or weft-faced tabby, sometimes with a slight rib effect.

A tabby's appearance is also affected by the fineness or coarseness of the yarn in combination with the thread spacing. If the yarn is coarse and the threads are well spaced, the textile may have a gridlike appearance. If the yarn is very fine or fine and the textile has a high thread density, the surface may be seen as an entirety, and the tabby character will disappear. A distinct rib effect may occur in the fabric when a much coarser yarn (or two threads together) is used in the warp or the weft direction.

14 Hammarlund, "Tekstilenes fjerde dimensjon," 26–28; Hammarlund, "Textiliernas fjärde dimension," 6, 10–12; Hammarlund, "Handicraft Knowledge," 88–89.

15 Hammarlund, "Handicraft Knowledge," 107.

16 Dorothy K. Burnham, *A Textile Terminology: Warp and Weft* (London: Routledge & Kegan Paul, 1981), 139.

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A much coarser warp in relation to the weft yarn may create ribs in the warp direction, and vice versa. Different kinds of bubbly surface, such as a crepe character, may also occur in tabbies.¹⁷

Twill. In a twill weave, each weft thread passes over two or more adjacent warp threads and under the next one or more, or under two or more adjacent warp threads and over the next one or more. The sequence shifts over by one warp thread with each successive weft thread, forming diagonal lines.¹⁸ For twill fabrics, the prominence of the diagonal lines is important for the character of the fabric. The twist direction of the yarn, *s* or *z*, in combination with the *S* or *Z* diagonal of the twill, creates lines that are more or less prominent or distinct.

For 2/2 twill (that is, twill in which the threads pass over two and under two), a reversible weave, the lines have a *S* slant on one side and a *Z* on the other, and consequently the lines are more prominent on one side, less on the other.¹⁹ For 2/1 twill (in which the threads pass over two and under one), an irreversible weave, the surface texture is different from front to back: Warp threads dominate on one side and weft threads on the other. In general, the diagonal lines are more prominent on the warp-faced side.

The choice of yarn twist direction in combination with the slant of the diagonal lines has a clear influence on the fabric's appearance. For finer fabrics, the slant of the twill lines may disturb the weave character. Very flat or steep diagonal lines will merge together with the horizontal or vertical threads and make the surface look as an entirety.

The character of a twill fabric may also depend on what element the eye perceives in the diagonal lines: whether it is the warp threads, the weft threads, or a combination of these.

Balance

In textile terminology, the word "balanced," when used to qualify a textile, indicates that the weight and spacing of the warp threads are approximately the same as the weight and spacing of the weft threads.²⁰ In this study, the expression "a balanced appearance" is used for a textile that is *perceived* as balanced, even if the thread count and yarn diameters are not equal in both thread systems. A balanced fabric differs visually from a warp-faced and also from a weft-faced fabric, and a balanced appearance often gives a more distinct weave texture than a warp-faced or a weft-faced fabric.

17 Hammarlund, "Handicraft Knowledge," 96, 108.

18 Burnham, *Textile Terminology*, 154.

19 G. H. Oelsner, *A Handbook of Weaves* (1915; repr., New York: Dover, 1952), 20–24.

20 Burnham, *Textile Terminology*, 1.

Fibres on surface

We have also used the words “smooth,” “woolly,” and “hairy” in our descriptions. A smooth appearance means that no fibre ends can be seen on the surface. Sometimes, these textiles give a hard and stiff impression. On a woolly fabric, fibre ends can be seen on the surface, and they may be slightly entangled. These textiles convey softness, and the fibres often give a sensation of fineness. On a hairy fabric, fibre ends are also seen on the surface, but they give a coarse and prickly character and are seldom entangled.

The terms smooth, woolly, and hairy can also be used to describe and differentiate warp and weft yarns in a textile. For example, the warp yarn may be described as smooth and the weft yarn as woolly, or both yarns may look the same and be described as hairy.²¹

Fabric thickness and density

Fabric thickness and density also influence how we perceive a textile. Thickness can be described in terms of fineness or coarseness, and density with such words as “open” and “dense.”²² Factors such as fibre type, the twist of the yarns, the weave, and finishing processes may cause the perceived thickness and density of a fabric to diverge from measured values.

Thickness. During our visual evaluation of the textiles, six different thickness categories were distinguishable; fine, fine-medium, medium, medium-coarse, coarse, and very coarse. (No very fine textiles have been recorded.) For example, if the term “a fine textile” is used in the text, this denotes a textile with a fine/thin appearance. In the same way, the term “a coarse textile” refers to a thick textile and has nothing to do with roughness. Speaking in general about finer or coarser textiles, “finer” textiles include the categories fine to medium, while “coarser” textiles include the categories medium-coarse to very coarse.

Density. For the textile density, we looked at the amount of space between the threads. The visual categories distinguishable were medium-dense, dense, and very dense; none of the textiles could be classed as “open” in density.

TEXTILES FROM NORDIC MEDIEVAL TOWNS: A CASE STUDY

In an attempt to group archaeological textiles according to their visual appearance on the basis of the factors described above, we examined 229 textile pieces from excavations at archaeological sites in three Nordic medieval towns: Lödöse, Sweden (66 pieces); Tønsberg, Norway (96 pieces); and Turku, Finland (67 pieces). In the

21 Hammarlund and Vestergård Pedersen, “Textiles Appearance.”

22 Hammarlund, “Handicraft Knowledge,” 115–17.

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three centuries between 1150 and 1450, Nordic towns developed and changed, as did the pattern of trade. In this period, textile production also changed, with innovations in both tools and manufacturing systems. Is it possible that changes in textile production can be visually traced in the textile finds?

Textiles from excavation DC in Lödöse, Sweden

Lödöse is situated in the western part of Sweden by the Göta älv (river) between Gothenburg and Trollhättan. Lödöse is mentioned in written sources from the twelfth century to the fifteenth century, when the town was moved further down the river near to the present Gothenburg. During these centuries, Lödöse was the only Swedish harbour to the west and thus had great importance for both the kingdom and the trade system. Lödöse had about 1,500 inhabitants, several clerical institutions, and the king's castle, Lödösehus.²³

The site area, named DC, was excavated in 1974.²⁴ The excavation covered only about 15 square metres but comprised 2.5 metres of layers and twelve building phases with twenty-one remnants of buildings.²⁵ The site was situated in the central part of medieval Lödöse, just northeast of the castle. This area was relatively well excavated, and street lines and building sites are known. Traces of leather and signs of metalworking and coin stamping²⁶ allowed the site to be interpreted as a workshop area with close connections to the castle. The textiles recorded in the excavation date from c. 1100 to 1350, mainly from c. 1200 to 1300. Dating is based on relative and absolute dating by dendrochronology. The textiles are now stored in Lödöse Museum.

Textiles from the Baglergaten 2-4 excavation, Tønsberg, Norway

Tønsberg is situated in the southeastern part of Norway and is usually regarded as the oldest town in Norway. It was first mentioned in medieval written sources of the 1130s as one of the six Norwegian towns.²⁷ The medieval town of Tønsberg was especially active and growing from the second half of the twelfth century until the

23 Kristina Carlsson and Rune Ekre, *Gamla Lödöse*, Riksantikvarieämbetets och Statens historiska museers rapport, Medeltidsstaden 21 (Stockholm: 1980), 5–18; Rune Ekre, Carl Hylander, and Rolf Sundberg, *Lödösefynd: ting från en medeltidsstad* (Uddevalla, Sweden: Stödföreningen för Lödöse Museum, 1994), 16–21.

24 Carlsson and Ekre, *Gamla Lödöse*, 54; Kristina Carlsson, *Stratigrafi i Gamla Lödöse*, Lödöse—Västsvensk medeltidsstad 1:3 (Stockholm: Almqvist & Wiksell, 1982), 4.

25 Kristina Carlsson, *Tre kvarter i Gamla Lödöse: Kronologi och funktion* (Borås, Sweden: Centraltryckeriet Åke Svensson AB, 1998), 23, 48–53.

26 Rune Ekre, "Nya bidrag till Lödösemyntningens historia," in *Skårvor och fragment: Kring medeltid i Älvsborgs Län*, ed. Christian Aarsrud (1991; repr., Vänersborg, Sweden: Älvsborgs länsmuseum, 1994), 292.

27 Eli Ulriksen, "Utkantens håndverkere og arbeidere: En aktivitetsanalyse av Nordre bydel i middelalderens Tønsberg," *NIKU Temahefte*, 1996, no. 3:4.

end of the thirteenth century, but declined after 1319.²⁸

The textiles in this study were found during an excavation in an area in the northeastern part of Tønsberg called Baglergaten 2-4. The 724-square-metre site was excavated during 1981–82. In the Middle Ages, this part of town consisted of dwellings and handicraft workshops. The excavation revealed that blacksmiths and shoemakers had worked here. There are fifty-two buildings, one passage, and a dumping area near the wall of a small church dedicated to St. Peter. The church was built during the last quarter of the twelfth century. When the cemetery was extended in the beginning of the fourteenth century, part of the built-up area was destroyed.²⁹

Ninety-six textile pieces, dating from 1175 to 1350, were discovered at the site. More than half of the fragments were found in latrine and garbage contexts dating from 1250 to 1325. The textiles are stored in the Museum of Cultural History, University of Oslo.

Textiles from the Åbo Akademi excavation, Turku, Finland

Turku (Åbo in Swedish) holds a special position among Finnish towns by being both the largest and the oldest medieval town in the country. Turku Provincial Museum conducted an excavation at the Åbo Akademi main building site in 1998. The excavation was remarkable in Finnish urban archaeology because of its size: The excavated area was 1,300 square metres.³⁰ What makes this excavation unique for Finnish research in archaeological textiles is the quantity of textiles preserved—up to one thousand pieces, which are now stored in Turku Provincial Museum.

Our study included the sixty-seven fragments that had undergone conservation and were ready for examination at the time we made our survey. These were from some of the oldest layers. Textile remnants from the northwestern part of the excavation area were found in heterogeneous cultural layers that include a lot of organic material, such as wood chips, leather, bones, and raw wool. The material may represent backyard activities of leather and textile working along with remains of manure and litter. The other textile concentration is situated in the northeastern part of the excavation and is clearly a manure deposit containing a lot of organic material.³¹ It is obviously a backyard associated with cattle and sheep sheds. All of

28 Jan Erik G. Eriksson, “Tre norske middelalderbyer i 1970-årene. Fornminnevern og utgravningsresultater. Hamar, Oslo, Tønsberg,” in *Riksantikvarens rapporter 12*, ed. Øyvind Lunde (Øvre Ervik, Norway: Alvheim og Eide, 1986), 70–91.

29 Jan Brendalsmo, “Innberetning over de arkeologiske utgravningene I Baglergaten 2-4, Tønsberg, 1981–82” (report in the archives of the Museum of Cultural History, University of Oslo, 1986), 37–48.

30 A. Pihlman, “Excavation of the Site of Åbo Akademi University in the Urban Archaeology of Turku,” in *Kaupunkia pintaa syvemältä*, ed. Liisa Seppänen, *Archaeologia Medii Aevi Finlandiae* 9 (Turku, Finland: Suomen keskiajan arkeologinen seura, 2003), 74.

31 Heini Kirjavainen, “Medieval Archaeological Textiles in Turku,” in *Centre, Region, Periphery: Medieval Europe Basel 2002, 3rd International Conference of Medieval and Later Archaeology*, ed. Guido Helmig, Barbara Scholkmann, and Matthias Untermann (Hertingen, Germany: Folio Verlag Dr. G. Wesselkamp, 2002), 2:346.

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the deposits are dated to the end of fourteenth century and to the first decades of the fifteenth century.³² Dating is based on relative and absolute dating by dendrochronology.

Towns and textiles

The towns of Lödöse, Tønsberg, and Turku are all regarded as important medieval trading centres and are among the oldest Nordic medieval towns. The excavations from Lödöse and Tønsberg revealed remains mainly from the second half of the twelfth century to the first half of the fourteenth century, while those from Turku date from the second half of the fourteenth century. Traces of handicraft activities were found in all the excavated areas.

Table 5.1 shows that the textiles from Lödöse and Tønsberg are similarly dated, with the majority coming from the period 1220–1300. Only a few textiles are dated to the period 1300–50, and almost as few from 1100–1220. One-third of the textiles from Lödöse and half the textiles from Tønsberg are not dated. The textiles from Turku are all dated to the period 1350–1400, and are therefore of a more recent origin. (A catalogue of the textiles appears at the end of this paper as table 5.14.)

PRESENTATION OF VISUAL GROUPS

We began the study of textile samples in Lödöse in 2004. The research group—three medieval archaeologists and one handweaver with archaeological textile experience—began by laying out the textiles on a table and grouping them by their visual appearance. To understand and describe what made a group unique, we had to search for and formulate its specific characteristics. We repeated the same procedure with the textiles from Tønsberg and Turku, adding new groups in the process. After finishing the visual grouping, we recorded and incorporated technical data (such as weave, thread count, and dating) to identify geographical, technical, and/or chronological patterns.

Most of the studied textiles are made of wool, a few from goat, and some from unidentified fibres. Most are now brown in colour, varying from light brown to brownish black; the brown colour is probably derived from the preservation in the ground. Reddish tones supplemented by possible dyeing treatments can sometimes be seen.

Textiles with a felted surface

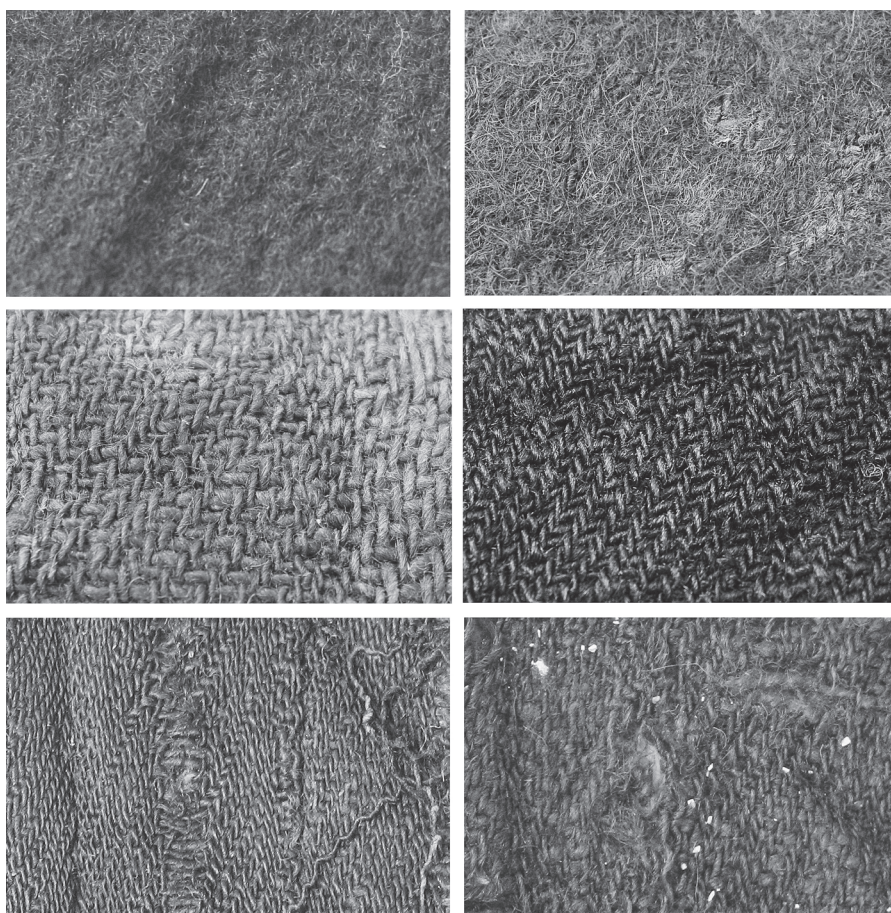
Groups 1 and 2 consist of woven textiles with a felted surface. The groups differ in

32 E. Saloranta and Liisa Seppänen, “Rakennevaiheraportti,” in *Arkeologiset tutkimukset Åbo Akademin tonilla (Turku 1/7/4) vuonna 1998* (unpublished excavation report, Turku Provincial Museum, 2000), 29–84.

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thickness, density, and finishing processes. Group 1 is finer, very hard-felted, compact, and even. Group 2 consists of coarser and not so heavily felted textiles, sometimes with a nap.

Group 1: Hard-felted textiles (fig. 5.1; table 5.2). Group 1, the larger of the two groups, represents finds from all three sites. It consists of textiles in different weaves and with different combinations of twist direction. This shows that the technical



Figs. 5.1–5.6: Examples of textiles from visual groups 1–6. Fig. 5.1 (top left): hard-felted textiles; Turku, no. TE2019. Fig. 5.2 (top right): coarser felted textiles; Turku, no. TE5047. Fig. 5.3 (middle left): coarser twill textiles with curving diagonal lines; Turku, no. TE2051. Fig. 5.4 (middle right): coarser twill textiles with straight diagonal lines; Turku, no. TE2014. Fig. 5.5 (bottom left): finer, shiny textiles with a hard and stiff appearance; Tønsberg, no. TS5097. Fig. 5.6 (bottom right): textiles with an irregular surface; Tønsberg, no. TS5367. Photos: 5.1–5.4, Heini Kirjavainen; 5.5–5.6, Marianne Vedeler.

choices made during the spinning and weaving processes do not affect the final appearance of textiles in this group. The different technical choices seem instead to be connected to place or period. Fabrics similar to the textiles in group 1 have been identified as parts of clothing, such as decoration bands from Oslo.³³

Description: Finer, hard-felted textiles. The yarn and weave are no longer visible, as fibres have formed matted entanglements on the surface. The textiles are very dense, because felting is accompanied by shrinkage. These factors give the fabrics a very compact and even appearance. Dyed textiles are common. The group comprises seventeen pieces.

The examples from Lödöse and Tønsberg are woven in twill, mostly in 2/1. At Turku the weave is tabby. The combination of twist direction varies: The Lödöse and Tønsberg textiles all have a z/s twist combination, while s/z is common in Turku. The thread count varies from 9/9 to 18/16 threads per centimetre with no clear differences between the sites. The thread count ratio is also similar for all the sites; most common is a ratio near 1:1, that is, with about the same thread count in warp and weft. The majority of the textiles date from the periods 1220–1300 and 1350–1400.

Group 2: Coarser felted textiles (fig. 5.2; table 5.3). *Description:* Coarser felted textiles, some with a nap. The textiles are not so hard-felted as those in group 1, probably due to the coarseness of the raw webs, and therefore they are less dense and compact. The group comprises eight pieces.

The textiles in group 2 come from Lödöse and Turku. Both of the Lödöse textiles are woven in 2/1 twill, and five of the six Turku textiles are in 2/2 twill. The combination in twist direction varies; the textiles from Lödöse are z/s, whilst in Turku several combinations occur. The thread count varies from 6/6 to 14/7 threads per centimetre. The ratio for Lödöse is twice as many warp as weft threads; for Turku it is more common to see the same thread count in warp and weft. The textiles date from the periods 1220–1300 and 1350–1400.

Coarser textiles with diagonal lines

The textiles in groups 3 and 4 are all twills, with prominent diagonal lines. Most are woven in 2/2 twill with z/s twist direction, and they often have more warp threads than weft threads. Textiles in group 3 are mainly from Tønsberg, while those from group 4 are more commonly from Turku. The curving diagonal lines found in group 3 may be due to irregularities in the thread systems that may occur when weaving on a loom without a reed, probably a warp-weighted loom. But curving lines may also occur if a fabric has been woven with an open-spaced weft and then shrunk in the finishing process. The straight diagonal lines in group 4 could be a result of a reed's function of keeping the warp threads parallel when weaving on a horizontal treadle loom. But straight diagonal lines may also originate in a warp-faced or densely

33 Marianne Vedeler, "Klær og formspråk I norsk middelalder," *Acta Humaniora*, no. 280:151–54.

beaten fabric woven on a warp-weighted loom.

Traces of seams found on some of the fragments suggest that they were used as clothing. In some cases, however, the warp density in combination with the fabric density indicates a possible use as sailcloth. Fabrics similar to those in group 3 were used to make a medieval tunic from Guddal church in Norway and a stocking found in Tønsberg, radiocarbon dated to the tenth century.³⁴

Group 3: Coarser twill textiles with curving diagonal lines (fig. 5.3; table 5.4).

Description: Coarser twill textiles with curving, prominent diagonal lines. The curving lines result from irregularities in the thread systems. The prominence of the lines is due to the hard-spun warp yarn in combination with sufficient space between the weft threads to allow the warp to contract and make it look as if the warp were lying on top of the fabric surface. The phenomenon is strengthened by differences in warp and weft. The warp yarn is finer, more even, and harder spun in comparison to the much coarser and uneven, knobby weft. The group comprises twenty-three pieces.

This kind of textile was found at all three sites, but most pieces in this study are from Tønsberg. In general the weave is 2/2 twill. The combination in twist direction is mostly z/s. Thread count varies from 7/4 to 14/9 threads per centimetre, but the highest counts are rare. In general the textiles have more warp than weft threads per centimetre. They are dated from 1175 to 1400.

Group 4: Coarser twill textiles with straight diagonal lines (fig. 5.4; table 5.5).

Description: Twill textiles of medium-coarse to coarse thickness and relatively dense. The diagonal lines are prominent and straight due to straight thread systems and/or the finishing process. The warp yarn is finer and harder spun in comparison to the weft, and both warp and weft look even. The group comprises twenty-nine pieces.

The textiles are found at all three sites. In Lödöse and Tønsberg they occur in both 2/1 and 2/2 twill, in Turku only in 2/2 twill. Twist direction is mostly z/s, with only two exceptions, both from Turku. The thread count varies from 7/7 to 15/9 threads per centimetre, and the thread count ratio varies from an equal ratio to twice as many warp as weft threads. In Turku, a ratio near 1:1 is more common. The textiles in group 4 date from all the designated time periods. Comparing all the groups from the three sites, this group is the most homogenous according to the technical data.

When the visual description and the technical data are examined together, it emerges that group 4 has much in common with group 2 (above). The similarities between the groups may indicate that that group 2 and group 4 textiles were of the same type of loom stage fabric (that is, at completion of weaving but before finishing), but that different finishing processes were used to create fabrics with different appearances and properties.

34 Marianne Vedeler Nilsen, "Draktmaterialet fra Guddal: Funksjon og visuell kommunikasjon" (master's thesis, University of Bergen, 1992), 27–31.36 Vedeler, "Tekstiler funnet under utgravninger i Tønsberg 1959 til 1986" (report in the archives of the Museum of Cultural History, University of Oslo, 2000), 3–13 (especially 3–6, 8–9, 12–13).

Groups with other distinct visual characteristics

Groups 5 to 8 each had a distinct appearance, as follows.

Group 5: Finer, shiny textiles with a hard and stiff appearance (fig. 5.5; table 5.6). Group 5 is the largest group of all, with fifty-six textile pieces. In spite of variations in weave, thread count, and thread count ratio, the textiles have a very similar appearance. This kind of textile is common in Lödöse and Tønsberg, but none appear among our textile samples from Turku. Only three pieces are dated after 1300, to the period 1300–50. Many textiles in this group are pleated and have been identified as fragments of clothing.³⁵ In this study pleating is not used as a criterion for visual grouping. It seems, however, that this kind of finer fabric represents a fashion often connected with pleats.

Description: The fabrics vary from fine to medium thickness with a dense appearance; fabrics classified as fine are the most common. In general, the textiles have an easily recognisable weave and are woven in plain twill with straight diagonal lines. But sometimes the weave is not so easily recognised, as for fabrics woven in broken-reverse twill or if the textiles are fine, with a steep slanting of the diagonal lines. Warp and weft yarns look alike and are very even. The appearance of the textiles is shiny, smooth, and even, and they give a hard and stiff visual impression. With a very few exceptions, the colour of the textiles is now brownish-black or black. The group comprises fifty-six pieces.

These textiles are relatively common in both Lödöse and Tønsberg and are generally woven in 2/1 twill. The combination in twist direction is mostly z/s. This group contains textiles with the highest thread count, from 14/8 to 32/16 threads per centimetre, and they have the broadest variation in thread count ratio. The textiles date from all the designated time periods except 1350–1400.

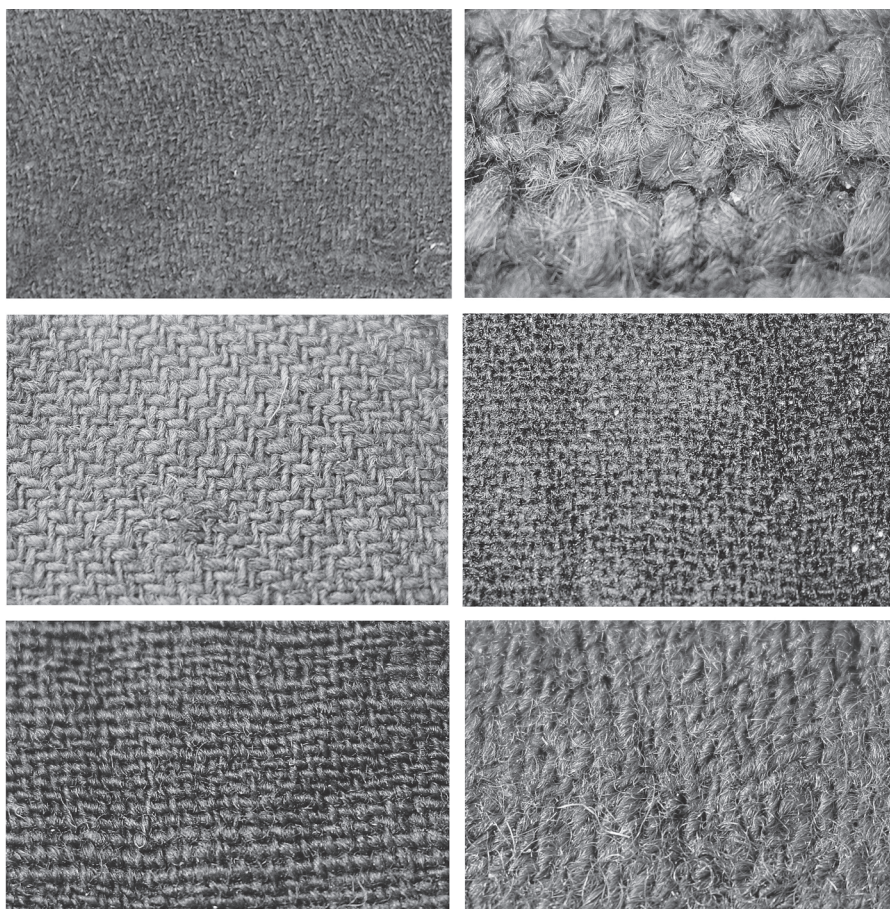
Group 6: Textiles with an irregular surface (fig. 5.6; table 5.7). Textiles in group 6 are registered only in Lödöse and Tønsberg. The irregular surface most likely derives from variable spacing of the warp and/or weft threads together with yarn

35 Karin Gjøel Hagen, *Solplissé: En reminisens av middelalderens draktutvikling? En komparativ studie i plisserte stoffer fra Birka, Vangsnes, middelalderens Trondheim, Uvdal og Setesdal*, Varia 25 (Oslo: Oldsaksamlingen, Institutt for arkeologi, kunsthistorie og numismatikk, Universitetet i Oslo, 1992), 12–15; Anne Kjellberg and Martha Hoffmann, “Tekstiler,” in *Dagliglivets gjenstander*, ed. Erik Schia and Petter Molaug, De arkeologiske utgravninger i Gamlebyen, Oslo 8 (Øvre Ervik, Norway: Akademisk forlag, 1991), 13–81; Margareta Nockert, “Medeltida dräkt i bild och verklighet,” in *Den ljusa medeltiden: Studier tillägnade Aron Andersson*, ed. Aron Andersson, Museum of National Antiquities, Stockholm Studies 4 (Stockholm: Statens historiska museum, 1984), 191–96; Ellen Schjølberg, “12th century Twills from Bergen, Norway,” in *Textiles in European Archaeology: Report from the 6th NESAT Symposium, 7–11th May 1996 in Borås* [NESAT 6], ed. Lise Bender Jørgensen and Christina Rinaldo, GOTARC Series A, vol. 1 (Göteborg: Göteborg University Department of Archaeology, 1998), 209–13; Marianne Vedeler, “Plisserte tekstiler fra middelalderens draktplagg,” *Occasional Papers, University Museum of Cultural Heritage* 1 (2002): 219–25; Marianne Vedeler, “Pleated fragments of clothing from Norway,” in *Priceless Invention of Humanity—Textiles: Report from the 8th NESAT Symposium, 8–10 May 2002 in Lodz, Poland* [NESAT 8], ed. Jerzy Maik, Acta Archaeologica Lodziensia 50/1 (Lodz: Lodskie Towarzystwo Naukowe, 2004), 61–65.

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movement, probably caused by high shrinkage. The variable spacing of the threads may occur when weaving on a loom without a reed. The few dated fragments are from the period 1220–1300. The variable thread spacing combined with the early dating could indicate that the fabric was woven on a warp-weighted loom.

Description: Textiles of medium and medium-coarse thickness, often dense. They have an irregular surface texture that makes the threads very hard to follow in the



Figs. 5.7–5.12: Examples of textiles from visual groups 7–12. Fig. 5.7 (top left): textiles with a surface seen as an entirety; Tønsberg, no. TS5404. Fig. 5.8 (top right): very coarse tabby textiles; Turku, no. TE50423. Fig. 5.9 (middle left): textiles with a regular twill character; Turku, no. TE2021. Fig. 5.10 (middle right): textiles with a regular tabby character; Turku, no. TE50427. Fig. 5.11 (bottom left): tabby textiles with a rib character; Turku, no. TE50424. Fig. 5.12 (bottom right): textiles with a woolly, soft expression; Turku, no. TE50419. Photos: 5.7, Marianne Vedeler; 5.8–5.12, Heini Kirjavainen.

fabric. It is thus difficult to recognise the weave. The textiles have no prominent diagonal lines or straight thread systems. There is a small difference in diameter between warp and weft threads; the warp is slightly finer and harder spun. The group comprises seven pieces.

The textiles are found in Lödöse and Tønsberg. They occur only in 2/1 twill, and twist direction is z/s. The thread count varies from 8/6 to 16/12 threads per centimetre, and the thread count ratio is close to 2:1. They are dated to the period 1220–1300.

Group 7: Textiles with a surface seen as an entirety (fig. 5.7; table 5.8). *Description:* Textiles of medium thickness. The weave is hard to recognise, due to a combination of factors such as yarn, weave, and thread count. These interact in such a way that the surface texture is seen as an entirety, with no clear diagonal lines or weave. There is no difference, or at most a very small difference, in the diameters of the warp and weft threads. Where there is a difference, the warp is somewhat finer than the weft. The group comprises thirteen pieces.

This kind of fabric is rare in Lödöse and Turku. It occurs only in 2/1 twill, and the twist direction is z/s, except for the one example from Turku, which is z/z. The thread count varies from 7/8 to 16/8 threads per centimetre. For about half of the textiles the thread count ratio is close to 1:1, for the other half, toward 2:1. The dating is generally uncertain.

Group 8: Very coarse tabby textiles (fig. 5.8; table 5.9). Although the textiles in this group represent only Lödöse and Turku in this study, this kind of textile is also known from several other excavations in Tønsberg.³⁶ It is well known as a textile used for transportation or packing all over Northern Europe.³⁷ One of the Turku samples from this group was sent for fibre analysis to York Textile Research in Archaeology, England, where it was identified as dark brown goat hair.³⁸

Description: Very coarse tabby textiles. They can have a gridlike appearance, because of the open space between the threads, but dense textiles with a distinct tabby character are also represented. The yarn is two-ply, and coarse fibres can be distinguished. The group comprises five pieces.

The weave in this group is tabby. The thread count is low, and the twist direction varies. The textiles date from all the designated time periods.

Groups registered only in Turku

Textiles of the kinds in groups 9, 10, 11, and 12 were registered only in Turku. Each

36 Vedeler, “Tekstiler funnet under utgravninger i Tønsberg 1959 til 1986” (report in the archives of the Museum of Cultural History, University of Oslo, 2000), 3–13 (especially 3–6, 8–9, 12–13).

37 Susanne Möller-Wiering, *Segeltuch und Emballage: Textilien im mittelalterlichen Warentransport auf Nord- und Ostsee*, *Internationale Archäologie* 70 (Rahden/Westf, Germany: M. Leidorf, 2002), 161–69.

38 Penelope Walton Rogers, “Report on fibres in cordage TE 50423 from late medieval Turku, Finland” (report in the archives of the Turku Provincial Museum, 2001), 1; Kirjavainen, “Medieval Archaeological Textiles,” 348.

of these groups is very homogenous according to the technical data. The groups also have some similarities in their visual description. Groups 9, 10, and 11 all have straight thread systems, while groups 9, 10, and 12 all have the same description of the yarn. Two groups consist of even and regular fabrics. Groups 10 and 12 have parallels in Lübeck dated to the fifteenth century.³⁹ Because the Turku samples represent a later time frame than those from Lödöse and Tønsberg, could these groups point toward a change in production, with new fabric types and use of the horizontal treadle loom?

Group 9: Textiles with a regular twill character (fig. 5.9; table 5.10). *Description:* Twill textiles of medium thickness with straight diagonal lines. The fabrics are even and regular with straight thread systems. Warp and weft yarns look alike. The colour is now dark brown. The group comprises six pieces.

Only 2/2 twill textiles are represented, but with a varying twist combination. The thread count has a small span, and five of the six pieces have a similar thread count ratio, near 1:1.

Group 10: Textiles with a regular tabby character (fig. 5.10; table 5.11). *Description:* Finer tabby textiles. The textiles look well balanced, with straight thread systems that give the textile a clear tabby character. Warp and weft yarns look alike. The textiles appear to be even and regular with a good drape. The group comprises six pieces.

Tabby textiles with a varied twist combination are recorded. Again the thread count has a small span, and the textiles have a similar thread count ratio, near 1:1.

Group 11: Tabby textiles with a rib character (fig. 5.11; table 5.12). *Description:* Tabby textiles of medium thickness. The warp and weft yarn ratio differs. The weft is much coarser than the warp, creating a rib effect in the weft direction. The thread systems appear straight. The textiles are smooth and shiny, and they have a hard and stiff look. The colour is now dark brown to brownish-black. The group comprises four pieces.

This group contains only tabby textiles, all with *s/z* twist. The thread count has a small span, and the textiles have a similar thread count ratio, 1:1 or close to it.

Group 12: Textiles with a woolly, soft expression (fig. 5.12; table 5.13). Only two pieces of this kind were identified. However, as this kind is known from other excavations in Lödöse⁴⁰ and Turku,⁴¹ we decided to treat these two textiles as a group and provide a description.

Description: Textiles of medium thickness with a woolly and soft appearance, probably due to fibre type in combination with a light fulling. There is enough space between the threads to allow a two-dimensional yarn movement, but the weave is still recognisable. Warp and weft yarns look alike. The fabrics now have a yellow-

39 Vestergård Pedersen, "Stofproduktion," 62–65.

40 Hammarlund, personal observation.

41 Kirjavainen, personal observation.

Lena Hammarlund, Heini Kirjavainen, Kathrine Vestergård Pedersen, Marianne Vedeler

brownish tone. The group comprises two pieces.

The samples are both tabby, one *s/z*, the other *z/z* twisted. The thread count has a small span, and the textiles both have a thread count ratio of about 1:1.

The remainder

Fifty-three textile pieces were not sorted into any of the groups. Most of them are very worn, and some are also very small and therefore difficult to place in any group. This group also contains some odd or unusual textiles that have been too few or unclassifiable to qualify as a group.

THE POSSIBILITIES OF VISUAL GROUPING

We have presented a set of terms to describe different visual phenomena that characterise textile appearance and visual impression. It must be emphasised that the number of textiles in many of the visual groups is small, and that the purpose of this study is to show the potential of the method and not to draw any specific conclusions. Nevertheless, it emerges that grouping by appearance can be a useful method of comparing textiles with one another. A variety of visual groups, with different kinds of fabrics, appeared in the studied areas. At first seven groups were discerned in the Lödöse material, then one more group was added from the Tønsberg material. The Turku material added four additional groups.

The results of the visual grouping of textiles from three different Nordic contexts show that the appearance of a fabric does not always correspond to the technical differences in weave or twist direction of the yarn. To understand appearance and visual impression, we have to take a variety of different factors into account. A typical example of this is group 5. The textiles look homogeneous in spite of different weaves and variations in twist direction. The specific appearance of the fabric is due to factors in the yarn; evenly spun, hard-twisted, and shiny, in combination with a certain thread count ratio. In other groups, there is a correspondence between the technical description and the textile appearance, as in the very coarse tabby textiles of group 8. Here it is the weave in combination with the coarse two-ply yarn that determines the appearance.

The method has also been shown useful when dealing with a larger amount of technically homogenous textiles. The Lödöse and Tønsberg material consists of a large number of 2/1 twills with twist direction *z/s*, but we have been able to discern several visual groups: group 4 (coarser textiles with straight diagonal lines), group 5 (finer, shiny fabrics with a hard and stiff look), and group 6 (textiles with an irregular surface of medium and medium-coarse thickness). These three visual groups also fall into three different thickness categories. Information of this kind is potentially useful when further investigating archaeological textile material, studying properties and use. Three of the groups specific to Turku—groups 10, 11, and 12—are all

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woven in tabby, with somewhat varying twist directions and of finer or medium thickness. Here we have a very good example of how tabby textiles may differ in appearance and visual impression.

The method also reveals small discrepancies between Lödöse and Tønsberg. Group 7 (textiles with a surface seen as an entirety) seems to be common in Tønsberg, but rare in Lödöse. Also, group 3 (twill textiles with curving diagonal lines) seems to be common in Tønsberg but rare in Lödöse.

Our work with identifying and understanding the basis for the visual description for each group has also raised the question of the type of loom used in the weaving process. Group 6 (textiles with an irregular surface) shows a variable thread spacing, which points toward the use of a loom without a reed, probably a warp-weighted loom.

Groups 1 to 8 are all represented in the Lödöse material. Except for groups 2 and 8, the same groups are also found in Tønsberg. The distribution of textiles in the groups differs somewhat between these sites. Lödöse has a higher percentage in groups 1, 4, and 6, while Tønsberg has a higher percentage in groups 3, 5, and 7. The greatest variety in fabric kind is found in Turku, in ten groups out of twelve. Textiles from Turku dominate in seven groups, 1, 2, 4, and 9–12, all of them quite small except for group 4. The tabby textiles in groups 10, 11, and 12 are characteristic of Turku textiles, and so are the twill textiles in group 9.

By combining technical descriptions with an evaluation of textile appearance and visual impression, a more complex picture of archaeological textile material can be reached. The combination can help us to understand how different factors in the construction of the textile are related, how a textile is the sum of all its phases from raw material to finishing processes, and hopefully also give information about textile production and changes in production techniques. It can also lead to an improved understanding of which fabrics were desirable and in use, providing an overview of fashion over both space and time.

Table 5.1: Distribution of the textile samples by number and percentage according to towns and time periods

Period	Lödöse	Tønsberg	Turku	Total
1100–1220	9 (13.7%)	9 (9.4%)	—	18 (7.9%)
1220–1300	29 (43.9%)	30 (31.2%)	—	59 (25.7%)
1300–1350	6 (9.1%)	9 (9.4%)	—	15 (6.6%)
1350–1400	—	—	67 (100%)	67 (29.3%)
Not dated	22 (33.3%)	48 (50.0%)	—	70 (30.5%)
Total	66 (100%)	96 (100%)	67 (100%)	229 (100%)

Tables 5.2–5.13: Technical description of the textiles by group

Each of these tables shows the number of textiles with various characteristics from each site. The percentage figures indicate the proportion of each site's samples represented by that group's textile type. Thread count is given as threads per centimetre. For twist direction and minimum–maximum thread count, a slash separates warp and weft. For the thread count ratio, a colon separates warp and weft.

Table 5.2: Technical description of the textiles in group 1

Group 1	Lödöse	Tønsberg	Turku
Number (% from site)	6 (9.1%)	2 (2.1%)	9 (13.4%)
Weave	2/1 twill = 5 2/2 twill = 1	2/1 twill	tabby
Twist direction	z/s	z/s	s/s = 1 s/z = 6 z/z = 1 z/s = 1
Min–max thread count	10/8–18/16	12/10–14/10	9/9–18/14
Thread count ratio	1.25:1–1.12:1	1.6:1–1.4:1	1.75:1–1:1
Period	1100–1220 = 1 1220–1300 = 5	1220–1300	1350–1400

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Table 5.3: Technical description of the textiles in group 2

Group 2	Lödöse	Tønsberg	Turku
Number (% from site)	2 (3.0%)	—	6 (9.0%)
Weave	2/1 twill	—	tabby = 1
2/2 twill = 5			
Twist direction	z/s	—	s/z = 1
z/z = 2			
z/s = 3			
Min-max thread count	14/7	—	6/6-12/8
Thread count ratio	2:1	—	1.66:1-1:1
Period	1220-1300	—	1350-1400

Table 5.4: Technical description of the textiles in group 3

Group 3	Lödöse	Tønsberg	Turku
Number (% from site)	3 (4.5%)	19 (19.8%)	1 (1.5%)
Weave	2/2 twill	2/1 twill = 1 2/2 twill = 18	2/1 twill
Twist direction	z/s	z/z = 1 z/s = 18	z/z
Min-max thread count	7/4-10/6	7/4-14/9	7/5
Thread count ratio	1.75:1-1.33:1	2:1-1.22:1	1.4:1
Period	1220-1300 = 2 ? = 1	1100-1220 = 3 1220-1300 = 2 1300-1350 = 1 ? = 13	1350-1400

Table 5.5: Technical description of the textiles in group 4

Group 4	Lödöse	Tønsberg	Turku
Number (% from site)	7 (10.6%)	7 (7.3%)	15 (22.4%)
Weave	2/1 twill = 6 2/2 twill = 1	2/1 twill = 3 2/2 twill = 4	2/2 twill
Twist direction	z/s	z/s	z/z = 1 z/s = 13 zzS/z = 1
Min-max thread count	8/6-15/9	8/8-12/9	7/7-14/7
Thread count ratio	1.71:1-1:1	1.66:1-1:1	2:1-1:1
Period	1100-1220 = 1 1220-1300 = 2 ? = 4	1100-1220 = 1 1220-1300 = 1 1300-1350 = 2 ? = 3	1350-1400

Table 5.6: Technical description of the textiles in group 5

Group 5	Lödöse	Tønsberg	Turku
Number (% from site)	20 (30.3%)	36 (37.5%)	—
Weave	tabby = 1 2/1 twill = 15 2/2 twill = 3 Other = 1	2/1 twill = 33 2/1 variant = 2 2/2 twill = 1	—
Twist direction	z/z = 3 z/s = 17	z/z = 1 z/s = 35	—
Min-max thread count	16/10-32/16	14/8-29/12	—
Thread count ratio	2.28:1-1:1	2.62:1-1.21:1	—
Period	1100-1220 = 6 1220-1300 = 5 1300-1350 = 1 ? = 8	1100-1220 = 4 1220-1300 = 15 1300-1350 = 2 ? = 15	—

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Table 5.7: Technical description of the textiles in group 6

Group 6	Lödöse	Tønsberg	Turku
Number (% from site)	4 (6.1%)	3 (3.1%)	—
Weave	2/1 twill	2/1 twill	—
Twist direction	z/s	z/s	—
Min-max thread count	14/7-16/12	8/6-12/7	—
Thread count ratio	2:1-1.33:1	1.71:1-1.33:1	—
Period	1220-1300 = 2 ? = 2	1220-1300 = 1 ? = 2	—

Table 5.8: Technical description of the textiles in group 7

Group 7	Lödöse	Tønsberg	Turku
Number (% from site)	1 (1.5%)	11 (11.5%)	1 (1.5%)
Weave	2/1 twill	2/1 twill	2/1 twill
Twist direction	z/s	z/s	z/z
Min-max thread count	13/10	7/8-16/8	9/8
Thread count ratio	1.3:1	2:1-1:1.14	1.12:1
Period	?	1300-1350 = 1 ? = 10	1350-1400

Table 5.9: Technical description of the textiles in group 8

Group 8	Lödöse	Tønsberg	Turku
Number (% from site)	4 (6.1%)	—	1 (1.5%)
Weave	tabby	—	tabby
Twist direction	ssZ/ssZ = 3 zzS/zzS = 1	—	ssZ/ssZ
Min-max thread count	3/3-3/4	—	2.5/2
Thread count ratio	1:1-1:1.33	—	1.33:1
Period	1100-1220 = 1 1220-1300 = 1 1300-1350 = 2	—	1350-1400

Table 5.10: Technical description of the textiles in group 9

<i>Group 9</i>	<i>Lödöse</i>	<i>Tønsberg</i>	<i>Turku</i>
Number (% from site)	—	—	6 (9.0%)
Weave	—	—	2/2 twill
Twist direction	—	—	z/z = 4 z/s = 2
Min–max thread count	—	—	10/9–12/10
Thread count ratio	—	—	1.5:1–1.11:1
Period	—	—	1350–1400

Table 5.11: Technical description of the textiles in group 10

<i>Group 10</i>	<i>Lödöse</i>	<i>Tønsberg</i>	<i>Turku</i>
Number (% from site)	—	—	6 (9.0%)
Weave	—	—	tabby
Twist direction	—	—	s/z = 2 z/z = 2 z/s = 2
Min–max thread count	—	—	10/9–14/12
Thread count ratio	—	—	1.16:1–1.09:1
Period	—	—	1350–1400

Table 5.12: Technical description of the textiles in group 11

<i>Group 11</i>	<i>Lödöse</i>	<i>Tønsberg</i>	<i>Turku</i>
Number (% from site)	—	—	4 (6.0%)
Weave	—	—	tabby
Twist direction	—	—	s/z
Min–max thread count	—	—	11/11–15/11
Thread count ratio	—	—	1.36:1–1:1
Period	—	—	1350–1400

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Table 5.13: Technical description of the textiles in group 12

Group 12	Lödöse	Tønsberg	Turku
Number (% from site)	—	—	2 (3.0%)
Weave	—	—	tabby
Twist direction	—	—	s/z = 1
z/z = 1			
Min-max thread count	—	—	7/7-10/8
Thread count ratio	—	—	1.25:1-1:1
Period	—	—	1350-1400

Table 5.14: Catalogue of the textiles in the study

Group	Site	Museum no.	Weave	Warp per cm	Weft per cm	Twist	Date, circa
1	Lödöse	DC4917 a	2/1 twill	18	16	z/s	1180-1210
	Lödöse	DCB4165 c	2/1 twill	12	10	z/s	1250-1300
	Lödöse	DCB4197	2/1 twill	10	8	z/s	1250-1300
	Lödöse	DCB4341	2/1 twill	12	10	z/s	1250-1300
	Lödöse	DCB4372 a	2/1 twill	12	10	z/s	1250-1300
	Lödöse	DCB4193 a	2/2 twill	18	16	z/s	1250-1300
	Tønsberg	TS5073	2/1 twill	16	10	z/s	1250-1300
	Tønsberg	TS5330	2/1 twill	14	10	z/s	1250-1300
	Turku	TE2016	tabby	12	10	s/z	1350-1400
	Turku	TE2017	tabby	12	11	s/z	1350-1400
	Turku	TE2019	tabby	13	10	z/s	1350-1400
	Turku	TE2045	tabby	12	10	s/z	1350-1400
	Turku	TE2112	tabby	14	8	z/z	1350-1400
	Turku	TE5042	tabby	13	10	s/s	1350-1400
	Turku	TE5045	tabby	18	14	s/z	1350-1400
	Turku	TE50414	tabby	9	9	s/z	1350-1400
	Turku	TE50421	tabby	12	12	s/z	1350-1400
2	Lödöse	DC714	2/1 twill	14	7	z/s	1220-1300
	Lödöse	DC2151 a	2/1 twill	14	7	z/s	1220-1300
	Turku	TE2064	2/2 twill	10	8	z/s	1350-1400
	Turku	TE2066	2/2 twill	12	8	z/z	1350-1400
	Turku	TE2111	tabby	6	6	s/z	1350-1400
	Turku	TE5041	2/2 twill	9	7	z/z	1350-1400
	Turku	TE5047	2/2 twill	10	10	z/s	1350-1400
	Turku	TE50425	2/2 twill	10	6	z/s	1350-1400

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Group	Site	Museum no.	Weave	Warp per cm	Weft per cm	Twist	Date, circa
3	Lödöse	DC1089	2/2 twill	7	4	z/s	1220-1300
	Lödöse	DC2151 b	2/2 twill	10	6	z/s	1220-1300
	Lödöse	DC4165 a	2/2 twill	8	6	z/s	?
	Tønsberg	TS5371	2/1 twill	14	9	z/z	?
	Tønsberg	TS5131	2/2 twill	10	5	z/s	1250-1300
	Tønsberg	TS5423	2/2 twill	7	5	z/s	?
	Tønsberg	TS5363	2/2 twill	9	5	z/s	?
	Tønsberg	TS5366	2/2 twill	11	9	z/s	?
	Tønsberg	TS5369	2/2 twill	?	?	z/s	?
	Tønsberg	TS5729	2/2 twill	7	4	z/s	1175-1200
	Tønsberg	TS5506	2/2 twill	7	5	z/s	?
	Tønsberg	TS5507	2/2 twill	10	5	z/s	?
	Tønsberg	TS5410	2/2 twill	10	7	z/s	?
	Tønsberg	TS5412	2/2 twill	10	5	z/s	?
	Tønsberg	TS5413	2/2 twill	10	4	z/s	?
	Tønsberg	TS5362	2/2 twill	9	5	z/s	?
	Tønsberg	TS5727	2/2 twill	10	6	z/s	1175-1200
	Tønsberg	TS5728	2/2 twill	10	8	z/s	1175-1200
	Tønsberg	TS5527	2/2 twill	8	4	z/s	?
	Tønsberg	TS6161	2/2 twill	10	7	z/s	?
	Tønsberg	TS4754	2/2 twill	7	4	z/s	1250-1300
	Tønsberg	TS4855	2/2 twill	8	6	z/s	1300-1350
	Turku	TE2051	2/1 twill	7	5	z/z	1350-1400
4	Lödöse	DC299	2/1 twill	8	6	z/s	?
	Lödöse	DC367 a	2/1 twill	10	6	z/s	1220-1300
	Lödöse	DC2152	2/1 twill	12	8	z/s	1220-1300
	Lödöse	DC4463	2/1 twill	10	7	z/s	?
	Lödöse	DC5044 a	2/1 twill	15	9	z/s	?
	Lödöse	DC5186	2/1 twill	12	7	z/s	?
	Lödöse	DC5400	2/2 twill	10	10	z/s	1170-1220
	Tønsberg	TS5136	2/1 twill	10	6	z/s	c. 1300
	Tønsberg	TS5411	2/1 twill	8	8	z/s	?
	Tønsberg	TS5414	2/1 twill	?	?	z/s	?
	Tønsberg	TS5649	2/2 twill	11	7	z/s	1200-1250
	Tønsberg	TS5138	2/2 twill	11	9	z/s	c. 1300
	Tønsberg	TS5415	2/2 twill	9	8	z/s	?
	Tønsberg	TS4715	2/2 twill	12	9	z/s	1175-1200
	Turku	TE2014	2/2 twill	12	9	z/s	1350-1400
	Turku	TE2046	2/2 twill	11	9	z/s	1350-1400
	Turku	TE2061	2/2 twill	11	8	z/s	1350-1400
	Turku	TE2062	2/2 twill	11	9	z/s	1350-1400
	Turku	TE2068	2/2 twill	8	8	z/s	1350-1400
	Turku	TE2091	2/2 twill	8	7	z/s	1350-1400
	Turku	TE5043	2/2 twill	11	8	z/s	1350-1400
	Turku	TE50410	2/2 twill	11	9	z/s	1350-1400
	Turku	TE50411	2/2 twill	11	9	z/s	1350-1400
	Turku	TE50412	2/2 twill	9	8	z/s	1350-1400
	Turku	TE50416	2/2 twill	10	6	z/s	1350-1400
	Turku	TE50417	2/2 twill	10	9	z/s	1350-1400
Turku	TE50430	2/2 twill	14	7	z/s	1350-1400	

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Group	Site	Museum no.	Weave	Warp per cm	Weft per cm	Twist	Date, circa
4 (contd)	Turku	TE50431	2/2 twill	9	7	z/z	1350-1400
	Turku	TE50432	2/2 twill	7	7	zzS/z	1350-1400
5	Lödöse	DC3681	tabby	20	20	z/s	1300-1350
	Lödöse	DC2197	2/1 twill	18	12	z/s	1220-1300
	Lödöse	3220	2/1 twill	22	14	z/s	1220-1300
	Lödöse	DC3407 a	2/1 twill	32	16	z/s	1220-1300
	Lödöse	DC3409 a	2/1 twill	24	16	z/s	1220-1300
	Lödöse	DC3779	2/1 twill	26	16	z/z	1220-1300
	Lödöse	DC4911	2/1 twill	22	15	z/s	1170-1220
	Lödöse	DC4998	2/1 twill	20	16	z/s	1170-1220
	Lödöse	DC5209	2/1 twill	32	14	z/s	?
	Lödöse	DC5568	2/1 twill	20	16	z/s	?
	Lödöse	DCB5100	2/1 twill	24	16	z/s	?
	Lödöse	DCB5538	2/1 twill	26	14	z/s	?
	Lödöse	DC4988 a	2/1 & tabby	20	16+13	z/s	?
	Lödöse	DC5396	2/2 twill	28	20	z/s	?
	Lödöse	DC5408 a	2/2 twill	20	18	z/s	1120/50-1170
	Lödöse	DC5408 b	2/2 twill	20	18	z/s	1120/50-1170
	Lödöse	DC4867	2/1 twill	18	9	z/z	?
	Lödöse	DC4988 b	2/1 twill	18	9	z/s	1170-1220
	Lödöse	DC4997	2/1 twill	16	10	z/s	1170-1220
	Lödöse	DC5335	2/1 twill	16	12	z/z	?
	Tønsberg	TS5456	2/1 twill	15	11	z/s	1250-1300
	Tønsberg	TS5418	2/1 twill	22	14	z/s	?
	Tønsberg	TS5372	2/1 twill	24	12	z/s	?
	Tønsberg	TS5373	2/1 twill	23	14	z/s	?
	Tønsberg	TS5374	2/1 twill	24	12	z/s	?
	Tønsberg	TS5375	2/1 twill	23	13	z/s	?
	Tønsberg	TS5529	2/1 twill	24	12	z/s	?
	Tønsberg	TS5625	2/1 twill	24	14	z/s	1250-1300
	Tønsberg	TS5626	2/1 twill	24	13	z/s	1250-1300
	Tønsberg	TS5417	2/1 twill	20	14	z/s	?
	Tønsberg	TS5345	2/1 twill	21	12	z/s	?
	Tønsberg	TS5528	2/1 twill	23	11	z/s	?
	Tønsberg	TS5067	2/1 twill	23	9	z/s	1250-1300
	Tønsberg	TS5068	2/1 twill	20	16	z/s	1250-1300
	Tønsberg	TS4644	2/1 twill	24	12	z/s	1250-1300
	Tønsberg	TS3564	2/1 twill	23	11	z/s	1175-1200
	Tønsberg	TS3562	2/1 twill	22	12	z/s	1175-1200
	Tønsberg	TS3563	2/1 twill	21	14	z/s	1175-1200
	Tønsberg	TS4328	2/1, variant	27	12	z/z	1175-1200
	Tønsberg	TS5132	2/1 twill	18	14	z/s	c. 1300
Tønsberg	TS5133	2/1 twill	17	14	z/s	c. 1300	
Tønsberg	TS5406	2/1 twill	22	9	z/s	?	
Tønsberg	TS5097	2/1 twill	16	9	z/s	1250-1300	
Tønsberg	TS5397	2/1 twill	20	10	z/s	?	
Tønsberg	TS5398	2/1 twill	14	8	z/s	?	
Tønsberg	TS5399	2/1 twill	22	10	z/s	?	
Tønsberg	TS5338	2/1 twill	20	13	z/s	?	

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Group	Site	Museum no.	Weave	Warp per cm	Weft per cm	Twist	Date, circa
5 (contd)	Tønsberg	TS5062	2/1 twill	15	8	z/s	1200-1300
	Tønsberg	TS5063	2/1 twill	21	8	z/s	1250-1300
	Tønsberg	TS5064	2/1 twill	22	10	z/s	1250-1300
	Tønsberg	TS5065	2/1 twill	18	9	z/s	1250-1300
	Tønsberg	TS5066	2/1 twill	19	10	z/s	1250-1300
	Tønsberg	TS4872	2/1 twill	22	10	z/s	1250-1300
	Tønsberg	TS6155	2/1 twill	19	10	z/s	?
	Tønsberg	TS5096	2/1, variant	29	12	z/s	1250-1300
	Tønsberg	TS5098	2/2 twill	22	13	z/s	1250-1300
6	Lödöse	DCB4825 b	2/1 twill	16	8	z/s	?
	Lödöse	DC2993	2/1 twill	16	8	z/s	1220-1300
	Lödöse	DC3462	2/1 twill	16	12	z/s	?
	Lödöse	DC3784	2/1 twill	14	7	z/s	1220-1300
	Tønsberg	TS5095	2/1 twill	12	7	z/s	1250-1300
	Tønsberg	TS5367	2/1 twill	8	6	z/s	?
	Tønsberg	TS5508	2/1 twill	10	7	z/s	?
7	Lödöse	DCB4825 a	2/1 twill	13	10	z/s	?
	Tønsberg	TS5137	2/1 twill	9	8	z/s	c. 1300
	Tønsberg	TS5400	2/1 twill	15	8	z/s	?
	Tønsberg	TS5401	2/1 twill	15	8	z/s	?
	Tønsberg	TS5402	2/1 twill	16	8	z/s	?
	Tønsberg	TS5403	2/1 twill	14	9	z/s	?
	Tønsberg	TS5419	2/1 twill	12	11	z/s	?
	Tønsberg	TS5420	2/1 twill	12	11	z/s	?
	Tønsberg	TS5370	2/1 twill	13	10	z/s	?
	Tønsberg	TS5421	2/1 twill	12	10	z/s	?
	Tønsberg	TS5404	2/1 twill	7	8	z/s	?
	Tønsberg	TS5405	2/1 twill	12	8	z/s	?
	Turku	TE50418	2/1 twill	9	8	z/z	1350-1400
8	Lödöse	DC1887	tabby	3	3	zzS/zzS	1170-1220
	Lödöse	DC2399	tabby	3	3	ssZ/ssZ	1300-1350
	Lödöse	DC2745	tabby	3	3	ssZ/ssZ	1220-1300
	Lödöse	DC3689	tabby	3	4	ssZ/ssZ	1300-1350
	Turku	TE50423	tabby	2.5	2	ssZ/ssZ	1350-1400
9	Turku	TE2012	2/2 twill	12	8	z/s	1350-1400
	Turku	TE2021	2/2 twill	11	9	z/z	1350-1400
	Turku	TE2022	2/2 twill	12	10	z/z	1350-1400
	Turku	TE2023	2/2 twill	12	10	z/z	1350-1400
	Turku	TE2024	2/2 twill	10	9	z/z	1350-1400
	Turku	TE2044	2/2 twill	10	9	z/s	1350-1400
10	Turku	TE2011	tabby	12	11	z/s	1350-1400
	Turku	TE2013	tabby	10	9	z/s	1350-1400
	Turku	TE2065	tabby	14	12	s/z	1350-1400
	Turku	TE50420	tabby	11	10	s/z	1350-1400
	Turku	TE50427	tabby	12	10	z/z	1350-1400
	Turku	TE50429	tabby	14	12	z/z	1350-1400

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Group	Site	Museum no.	Weave	Warp per cm	Weft per cm	Twist	Date, circa
11	Turku	TE2015	tabby	15	11	s/z	1350-1400
	Turku	TE2018	tabby	11	11	s/z	1350-1400
	Turku	TE5044	tabby	13	12	s/z	1350-1400
	Turku	TE50424	tabby	11	11	s/z	1350-1400
12	Turku	TE50419	tabby	7	7	s/z	1350-1400
	Turku	TE50428	tabby	10	8	z/z	1350-1400
None	Lödöse	DC1723	2/1 twill	14	8	z/s	1220-1300
	Lödöse	DCB4495	tabby	12	6	z/s	?
	Lödöse	DC295	2/1 twill	9	5	z/s	?
	Lödöse	DC998	2/1 twill	12	8	z/s	1220-1300
	Lödöse	DC1444	2/1 twill	10	6	z/s	1220-1300
	Lödöse	DC1448	2/1 twill	10	6	z/s	1220-1300
	Lödöse	DC1526	2/1 twill	19	8	z/s	1300-1350
	Lödöse	DC1590	2/1 twill	10	15	z/s	1300-1350
	Lödöse	DC3409 b	2/1 twill	24	16	z/s	1220-1300
	Lödöse	DC3733	2/1 twill	18	12	z/s	?
	Lödöse	DC4844	2/1 twill	?	?	z/s	1220-1300
	Lödöse	DCB5044 b	2/1 twill	?	?	z/s	?
	Lödöse	DC2636	2/1, variant	12	9+16	z/s	1220-1300
	Lödöse	DC3400	2/2 twill	18	8	z/s	1220-1300
	Lödöse	DC3696	2/2 twill	22	14	z/s	1300-1350
	Lödöse	DC4123	2/2 twill	10	10	z/s	?
	Lödöse	DC4165 b	2/2 twill	20	16	z/s	?
	Lödöse	DCB4321	2/2 twill	18	12	z/s	1220-1300
	Lödöse	DC4492	2/2 twill	20	20	z/z	1220-1300
	Tønsberg	TS5409	?	15	16	z/s	?
	Tønsberg	TS5285	tabby	15	6	s/s	1300-1350
	Tønsberg	TS5134	2/1 twill	19	14	z/s	c. 1300
	Tønsberg	TS5135	2/1 twill	19	15	z/s	c. 1300
	Tønsberg	TS5416	2/1 twill	20	12	z/z	?
	Tønsberg	TS5070	2/1 twill	22	10	z/s	1250-1300
	Tønsberg	TS5071	2/1 twill	22	10	z/s	1250-1300
	Tønsberg	TS5072	2/1 twill	16	10	z/s	1250-1300
	Tønsberg	TS5368	2/1 twill	12	7	z/s	?
	Tønsberg	TS4293	2/1 twill	17	8	z/s	?
	Tønsberg	TS4479	2/1 twill	19	8	z/s	1200-1250
	Tønsberg	TS5493	2/1 twill	15	8	z/s	?
	Tønsberg	TS5730	2/1 twill	11	8	z/s	1175-1200
	Tønsberg	TS5069	2/1 twill	14	9	z/s	1250-1300
	Tønsberg	TS5331	2/1 twill	18	12	z/s	1250-1300
	Tønsberg	TS5757	2/2 twill	10	8	z/s	1200-1250
	Tønsberg	TS4808	2/2 twill	10	8	z/s	1250-1300
Tønsberg	TS4809	2/2 twill	15	13	z/z	1250-1300	
Turku	TE2067	tabby	13	10	z/z	1350-1400	
Turku	TE20611	2/1 twill	8	7	z/s	1350-1400	
Turku	TE20610	2/2 twill	10	8	z/z	1350-1400	
Turku	TE2047	2/2 twill	10	7	z/s	1350-1400	
Turku	TE2069	2/2 twill	8	7	z/s	1350-1400	
Turku	TE50413	2/2 twill	8	8	z/s	1350-1400	

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Group	Site	Museum no.	Weave	Warp per cm	Weft per cm	Twist	Date, circa
	Turku	TE50426	2/2 twill	13	12	z/z	1350-1400
	Turku	TE2041	2/2 twill	11	10	z/s	1350-1400
	Turku	TE50433	2/2 twill	11	8	z/s	1350-1400
	Turku	TE5046	2/2 twill	12	9	z/s	1350-1400
	Turku	TE50422	2/1 twill	12	12	z/s	1350-1400
	Turku	TE2043	tabby	13	10	s/z	1350-1400
	Turku	TE5049	tabby	10	10	s/z	1350-1400
	Turku	TE2113	tabby	11	10	z/s	1350-1400
	Turku	TE2042	tabby	11	8	z/s	1350-1400
	Turku	TE2092	tabby	10	8	z/s	1350-1400