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Medieval latrine textiles from Rådhusgaten in Tønsberg, Norway

Abstract

This paper examines medieval textiles from the 2022/2023 excavations at Rådhusgaten, Tønsberg, shedding light on textile consumption in a Norwegian urban medieval setting. 52 textiles, predominantly wool twill, were analysed for their technical characteristics and functional significance. Many were found in a latrine deposit, suggesting secondary use as sanitary materials, offering insights into medieval hygiene practices. The finds highlight the multifunctionality of textiles in domestic life and in a harbour context. This study questions the end use of the latrine textiles and integrates textile analysis with stratigraphic data to explore textile consumption and disposal practices in the 12th to 13th centuries.

Keywords: Urban medieval textiles, latrine deposits, harbour, stripes, colours, caulking

Introduction

This paper discusses a significant assemblage of textiles unearthed in 2022/2023, during a large-scale municipal renovation project in Rådhusgaten, in the medieval town centre of Tønsberg (Norway). Rådhusgaten is one of the streets extending from the waterfront, mirroring their medieval counterparts (fig. 1). Excavations conducted by the Norwegian Institute for Cultural Heritage Research (NIKU) have yielded exceptional textile finds due to favourable preservation conditions (Bergland et al. 2025; Haugesten 2020; Halvorsen 2023; Bergland in prep.).

In total, 52 catalogued textile fragments, representing at least 57 distinct pieces, were documented, accounting for about 7% of the town's medieval textile finds (Lindh 1992; Brendalmo 1986a; Brendalmo 1986b; Brendalmo 1989; Vedeler 2000; Vedeler 2007; Nordman and Tjeldvoll 1988; Nordman et al. 1986; Tjeldvoll 1990; Jordahl 2013; Ekstrøm 2008; Ekstrøm 2010). These textiles provide valuable information about both technical and social aspects of textile consumption in the central harbour area in medieval Tønsberg. Most of the textiles were recovered from a latrine deposit, suggesting secondary use as sanitary

materials and offering insights on hygiene practices and potentially gendered use of space. The fragments indicate the diverse roles textiles played beyond clothing, the use and reuse of textiles, and their importance in domestic and maritime contexts.

This paper addresses two key research questions: the technical characteristics of the textiles and their contextual significance. The textiles were analysed for structural variations, weaving techniques, and distribution patterns to identify potential functional categories. The excavation context SL6693 serves as a case study for textile reuse in a medieval latrine. By integrating textile analysis with information from the archaeological context, this study enhances the understanding of the role of textiles in everyday activities, contributing to broader discussions on medieval urban life.

Methodology

The objective is to classify the textiles by observable structural characteristics and assess their significance within the archaeological context. We ask: (1) What technical characteristics (fibre, weave, counts, yarn, colours/patterns/finish) are present? and (2) How do

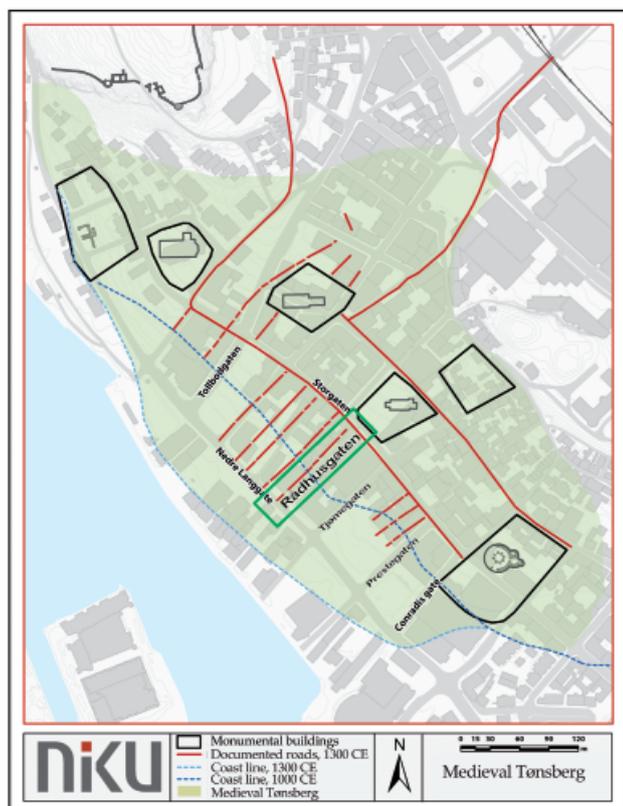
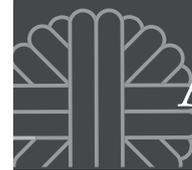


Fig. 1: Map of medieval Tønsberg and modern day Tønsberg (Image: NIKU, licence CC BY-SA 4.0)

these relate to context, reuse and function?

Textiles were grouped based on weaving technique, yarn properties, fabric qualities, and evidence of use, and/or indications of finishing treatments. The contextual section examines how the textiles correspond to the broader findings from the excavations. Most textiles (45 of 52) were recovered from SL6693, a latrine deposit rich in organic waste. This concentration was examined as a case study, with a focus on spatial distribution, fabric types, functions and textile reuse patterns. This study examines medieval textile consumption by combining technical textile analysis with archaeological context.

Technical terms

The terms woollen will be used for yarn or cloth made from wool, whereas “loft” refers to the thickness of the fabric. A lofty yarn has a low density and contains a lot of air. When discussing wool textiles, it is also relevant to define the process of “felting” versus the process of “fulling” (Walton and Eastwood 1988, 3; Emery 1994, 22–24). A “felt” refers to fibres that are not interworked but have been adhered and matted

together into a fabric. When the finish process of a fabric involves matting, shrinking and thickening like a felt, it is termed “fulling”, and the textile is described as “fulled” (Emery 1994, 20–24).

In this paper, “braid” is defined as oblique interlacing (Emery 1994, 62–69). “Whipcord braiding” corresponds to the Norwegian term “slyngning”. “Cords” are usually plied and cabled from multiple elements (Walton and Eastwood 1988, 12, 23). “Ribbon” refer to a narrow, flat-woven fabric, with its own warp, weft and selvages. Textile strips that have been cut from a woven fabric, folded with the raw edges turned in, and sewn, will be referred to as “tubes”.

Yarn measurements are taken from within the fabric. Loose spun yarn refers to twist angle up to 10°, medium refers to a twist angle of 10° to 25°, and tightly spun yarn have a twist angle between 25 to 45° (Emery 1994, 11–12; Walton and Eastwood 1988, 11).

Context: latrine deposits and household waste

The textiles all come from layers dated to the 1100–1200s CE (Bergland et al. 2025). Layer SL6693, a latrine deposit inside building SA3864 (at least 4.2 × 2.4 m), containing most of the textiles, moss, faecal matter and insect remains. The presence of large concentrations of insect eggs suggests that the layer remained undisturbed *in situ*. The deposit extended beyond the excavated area. The latrines are unusually large for Norwegian medieval towns. It might have served as a public latrine, potentially associated with the harbour, belonging to an inn, or to multiple households (Bergland et al. 2025, 90–92).

A radiocarbon date places the deposit around 1221–1282 CE. Other finds from the layer include everyday objects, some of which may contribute comparative dates, such as a comb (1200–1400 CE), pottery sherds (1150–1350 CE), shoes (1225–1350 CE), fragments of baking stones, sausage skewers, and wooden objects. The variety of artefacts suggests that this area may have also served as a general waste disposal site. The presence of large amounts of faecal matter raises the possibility that waste from other latrines in the vicinity was also emptied here (Bergland et al. 2025; Ulriksen 2002; Molaug 2024).

One suggested interpretation for textiles in a latrine context is that some of them might be from sanitary pads, while the moss may have functioned as toilet tissue. Textiles may also have been used for wiping and could be disposed of for other reasons as well. Textile finds were concentrated in the northeastern section of the latrine, suggesting a spatial pattern, perhaps linked to use or gender. However, there were no visual division preserved to prove that the



Name	Thread count (warp/weft)	Thread	Twill weave	Context	Colour
F401891	12/6	z/s	2/1	SL6693	Red
F402534	12/10	z/z	2/1	SL6541	Yellow/green
F402530	13/7	z/s	2/1	SL6541	
F402528	13/11	z/s	2/2	SL6541	Black
F402027	6-8/?		2/1	SL11301	Black
F401909A	12/10	z/z	2/1	SL6693	Brown
F401909B	12/10	z/z	2/1	SL6693	Red
F401909C	20/16	z/s	2/1	SL6693	Golden/Yellow
F402301	10/10	z/z	2/1	SL6693	
F401897	10/8	z/s	2/2	SL6693	
F401929	10/8	z/z	2/1	SL6693	Green
F402299A	6/3	z/s	2/2	SL9051	
F404098	12/8	z/s	2/1	SL6693	Striped; Brown, black, light brown
F401937A	14/6	z/s	2/2	SL6693	Green
F401937B	12/9	z/s	2/2	SL6693	Green
F404096	12/12	z/s	2/1	SL6693	Dark brown
F404116	4-6/?	z/z	2/1	SL6693	
F404123	12/8	z/z	2/1	SL6693	
F404126		z/z	2/2	SL6693	
F404120	8-9/5-6	z/z	2/2	SL6693	
F404122	10/8	z/z	2/1	SL6693	
F401913	10-12/?	z/z	2/1	SL6693	Green/Yellow
F401931	10-11/?	z/z	2/2	SL6693	Green
F401901	10-12/?	z/z	2/2	SL6693	Red
F401915	10-12/8	z/s?	2/2	SL6693	Yellow
F401917	12/8	z/s?	2/2	SL6693	Green, brown
F401893	14/12	z/z	2/1	SL6693	Brown, black
F404097		z/?	2/1	SL6693	
F401923	12/12	z/z	2/1	SL6693	Black
F401903	6-8 /4-5(6-8)	z/s?(z/z)	2/2	SL6693	Striped; yellow, brown, black
F401935	9-10/?	z/s	2/1	SL6693	Green / Red
F401927	10-12/?	z/z	2/2	SL6693	Green / Yellow
F401921	10/8	z/s?	2/2	SL6693	Green
F401911	12-14/?	z/s	2/2	SL6693	Green
F401933A	12/10	z/s	2/2	SL6693	Striped; green, brown, black
F401933B	8/6	z/s	2/2	SL6693	
F401933C	12-14/?	z/z		SL6693	
F401895	12/8	z/s	2/2	SL6693	Black
F401919	12/8	z/s	2/2	SL6693	Green
F404150	5/6	z/s	2/1	SL6693	

F404152A	14/8	z/s	2/1	SL6693	Striped; Light brown, dark brown
F404152B	6-8/6	z/s	2/2	SL6693	Dark brown
F404108		z/s	2/2	SL6693	
F404099		z/z	2/2	SL6693	
F404124	13/7	z/z	2/1	SL6693	Light brown
F404101		z/s	2/2	SL6693	
F404105		z/s	2/2	SL6693	
F404154	12/10	z/s	2/1	SL6693	Brown
F404156	6/9	z/s?	2/2	SL6693	Brown
F404127	6-8/?		2/1	SL5188	Black
F404120	8-9/5-6	z/z	2/2	SL6693	

Table 1: Twills from Rådhusgaten in Tønsberg, Norway

spatial distribution may reflect a physical or social division of space (Bergland et al. 2025, 90–92) and no documentary or pictorial evidence has yet been identified which suggests that this was a convention of the Medieval era.

Five textile samples from the latrine context were submitted to the laboratory for analysis of blood residue, hormones and insect eggs. Initial laboratory testing of these textiles suggests there may be traces of blood on them. So far, the laboratory has only reported on the insect sampling from one of the textiles, F401923 (fig. 2). The stomach contents of flies and fly larvae (Diptera) found on one of the textile fragments (PT401923) were extracted. Through isotope analysis, it was concluded that the insects had likely fed on human blood (Bergland et al. 2025, appendix 12.6).

Beyond the 45 textiles from SL6693, five other contexts produced textiles: SL11301, SL9051, SL5188, and SL3369 each contained a single find, while three textiles came from SL6541. SL1130, dated to before 1164–1266 CE, contained latrine waste, wood shavings and caulking material (FI402027). SL9051, SL3369 and SL6541 were levelling layers, with construction and household waste and urban fill material such as wood shavings, faecal matter, leather, and ceramics and animal bones. Two coarse textile fragments (F402299), both woven into a fabric with a net-like structure, were found in SL9051. SL3369 contained the braided fragments of F404158. SL6541 gave the find F402530, a fragment sewn into a tube, and F402529 and F402034 which both contain medium-density textiles that could be fragments of clothing. F402528 is a smooth and well balanced black-brown 2/2 twill with a 41 cm long hem. The hem is folded double on the longest and best-preserved fragment, but there are only raw edge

on the other fragments, probably because the fabric was torn at the folded edge. Thread density is 13/11 threads per cm, z-spun in one direction and s-spun in the other direction. F402034 consists of a slightly hairy, possibly napped, 2/1 twill with thread density of 12/10 threads per cm. The yarn is z-spun in both directions. The fabric was yellow-green when excavated.

SL5188 was an activity layer above the wooden decking of the medieval main street, beneath Storgaten. It contained caulking material, F404127, though this is a bit removed from the harbour. Textile caulking material could come from buildings as well. F404127 consisted of several fragments of a very lofty and wrinkled black-brown, 2/1 twill low-density fabric sewn into tubes with widths varying between 1.5 and 4 cm (Bergland et al. 2025).

Findings

All the textiles contain animal fibres, primarily wool, though some possibly incorporate animal hair. The preservation of textiles in archaeological contexts is closely tied to the environmental conditions of the deposited layers (Wild 1988; Peacock 2014). The excavated deposits consisted of heavily saturated, acidic, and compact urban layers, which are typical of medieval towns (Rytter and Schonhowd 2015; Halvorsen et al. 2022). Under these conditions, protein fibres tend to survive better than cellulose fibres (Gleba and Mannering 2012, 2; Gillis and Nosch 2007).

Most of the textile finds are woven fragments, with a total of 52 woven fabrics identified (Bergland et al. 2025). These textiles fall within the common parameters of textiles found in Norwegian medieval urban contexts (Hammarlund et al. 2008; Øien 2007; Schjølberg 1998; Vedeler 2007; Kjellberg and Hoffmann



Fig. 2: F401923; showing a balanced 2/1 twill, with thread count 12/12 threads per cm, and z-spun yarn in both warp and weft (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)

1991; Thomassen 2024; Øye 1988). All identifiable woven textiles, except from one tabby weave, are variations of twill: 25 are woven in 2/1 twill, and 25 in 2/2 twill (table 1).

Two groups of weaves could be distinguished among the textiles: Those with a somewhat balanced ratio of warp to weft threads and those with a significant imbalance. This imbalance is primarily due to differences in the quality of yarn used for the warp and weft, though weaving techniques, technological aspects, and traditional craft practices may also be considered (figs. 2–3).

When examining a simple woven fabric, it is generally only possible to determine the warp and weft directions if a selvage is present. However, in many



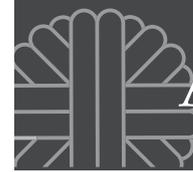
Fig. 3: F401937; an example of an unbalanced 2/2 twill, with smooth z-spun warp and thick, loosely s-spun weft, 14/6 threads per cm (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)

of the textiles analysed, the distinct characteristics of the yarn provided strong indications of which threads were used for the warp and which for the weft. Warp yarn must withstand greater tension and weight than weft yarn. The weaving technique and warp tension also contribute to a generally higher thread count in the warp. A warp-weighted loom would likely require an even stronger warp yarn compared to warps used on a horizontal loom. The type of loom and the intended textile would determine key parameters of the warp yarn, such as its strength and elasticity (Hammarlund 2004; Mårtensson et al. 2006). Factors such as fibre type, thickness, spin direction, twist, and elasticity all play a role in how a textile is designed (Hammarlund et al. 2008; Bender Jørgensen 1986). This is reflected in the unbalanced textiles, where the warp threads have a higher thread count than the weft threads.

All the woven textiles analysed contain single-thread yarns. Almost without exception, the warp yarn is hard, smooth, and shiny, with a consistent z-spin, designed to endure heavy tension. The weft yarns are either s-spun or z-spun, with some textiles featuring a combination of z-spun warp and s-spun weft, while others have both warp and weft in z-spun yarn. In most fragments, warp yarn thickness ranges from 0.5 to 1.5 mm.

Greater variation is observed in the weft yarn. In the 19 cases where the weft is also z-spun, its thickness is comparable to that of the warp, resulting in relatively balanced fabrics, rarely showing more than a two-thread imbalance per centimetre. The material suggests a slight predominance of 2/1 twill (11 instances) woven with z/z-spun yarn, while only six 2/2 twill fabrics share this characteristic. Although the sample size is small, this variation may indicate a preference for certain weaving qualities in different textile types and applications.

For comparison, only six fabrics woven in 2/1 twill feature a thicker, loosely s-spun weft, whereas 20 textiles overall contain thick, loosely spun s-spun weft yarn. When the weft is s-spun, it often has a low spin angle, has a loftier texture, and is more likely to create an unbalanced thread count between warp and weft. Only four fabrics with an s-spun weft have a relatively balanced structure, with weft yarns similar in thickness to the warp. Additionally, six fabrics contained weft yarns that were too loosely spun to determine whether they were z- or s-spun. However, these six textiles share visual characteristics with the other s-spun weft fabrics. They also display a significant imbalance in thread count between warp and weft, reinforcing a common structural feature among them. The weft yarn thickness varies considerably but generally falls between 1.5 and 4 mm.



Fabric qualities

Thread count refers to the number of threads per centimetre and serves as an indicator of fabric density, flexibility, and fineness (Bender Jørgensen 1986; Hammarlund et al. 2008). It can provide insight into potential uses, as higher thread counts might correspond to finer, more labour-intensive textiles, while lower thread counts with coarser threads may suggest more utilitarian fabrics (Øien 2007; Vedeler 2004; Vedeler 2007). Additionally, significant imbalances in thread count may indicate distinct fabric groups with specific functions.

Thread thickness and density are crucial factors in determining fabric quality (Hammarlund et al. 2008). The coarsest textiles generally have the lowest thread counts. Four textiles in the collection have thread counts ranging from three to six threads per centimetre. These relatively open, net-like fabrics likely served utilitarian purposes, possibly related to packaging and transport. F402299B is the only plain-weave fabric, measuring 12 × 2 cm, with a net-like structure, only 3–4 threads per centimetre, and a yarn thickness of 2–3 mm. The fabric is sewn together into a tube using a S2z twisted thread. Another open, net-like fabric is F402299A. This is a 2/2 twill with 3/6 threads per cm and a weft thickness of up to 4 mm. F404150 is a loosely woven fabric featuring a lofty weft of varying thickness (1–4 mm) and a thread count of approximately 5/6 threads per cm. F404116 is an open-weave fabric, with 1 mm thick yarn, and a thread count of 4–6 threads per cm.

Seven textiles were grouped as low-density textiles, with thread counts ranging from 6–9 threads per centimetre, though exhibiting greater variation in density and structure. A common characteristic of these fabrics are thick, lofty wefts, with warmth, softness, and flexibility, which suggests they may have served as utility textiles as blankets, insulation or padding. F402027 and F404127 are both fullled fabrics, which are hemmed and folded, and sewn into tubes. F402027 was probably used for caulking or sealing. Both fabrics are woven in 2/1 twill, while the remaining five in this group are 2/2 twill. F404156, F404152B and F401933B have unbalanced fabrics, with 8-9/6 threads per cm, featuring a thick, loosely spun weft. F401903 is a more complex, striped fabric, combining two distinct qualities. The warp thread count is 6–8 threads per centimetre, with the darker stripes woven maintaining this density, using the warp yarn quality. The lighter stripes are made from a thicker, more loosely spun yarn, reducing the density to 4–5 threads per centimetre. This fabric has been interpreted as a thicker utility textile, possibly for interior use, such

as a blanket. F404120 features a variation in thread count, with 8–9/5–6 threads per cm. The weft yarn is approximately 3 mm thick, while the warp is only 1 mm. This textile could have functioned as a utility fabric or belonged to a thicker garment.

The group for medium-density fabrics includes 33 textiles with thread counts ranging from 10 to 14 threads per cm, a common density in the Norwegian Middle Ages (Vedeler 2007; Kjellberg and Hoffmann 1991). Some of these fabrics exhibit a significant imbalance in thread count. The likelihood that a fabric originates from clothing increases with thread count. Several of these textiles are likely remnants of clothing, particularly those showing signs of dyeing, surface treatments such as napping or fulling, and seams. Relative balance in thread count, along with the use of hard-spun and durable weft yarns, can also indicate textiles originally used for clothing. The possible clothing fragments are F402034, F402528, F401909, F402301, F401929, F404123, F404122, F401913, F401931, F401901, F401893, F401923, and F404154. Some of the medium-density fabrics are equally likely to originate from utility textiles as from clothing. These include textiles with high warp thread counts but lower, loosely spun weft thread counts, some of those showing signs of seams or dyes: F401897, F401937, F404096, F401915, F401917, F401935, F401921, F401933A, F401895, F404152A, and F404124. Within the group for medium-density textiles, there are also textiles that have been folded and sewn into tubes, including F404098, F402530, F401911 and F401919. Additionally, some fragments appear to have been woven as ribbons rather than repurposed, such as F401891, and potentially F401933C. This will be investigated further later on.

Only one fabric in the collection might be categorised as a high-density fabric. F401909C, with 20/16 threads per cm, has a high likelihood of being a clothing fabric. This interpretation is further supported by the textile's golden colour, suggesting it may have been a high-status garment or a decorative piece.



Fig. 4: F401905 is a 16 cm long braid from SL6693 (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)



Fig. 5: F401891 is a woven, red ribbon, 1 cm wide and 19 cm long, tied in a slipknot and finished with a tassel or elaborate bow (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)

Braids, cords, ribbons, textile strips and tubes

Among the textiles examined, two braids have been identified. F404158 looks to be made by whipcord braiding with multiple groups of threads. There are several fragments, likely from the same object. The colour is light-medium brown. The braid appears to be made up of 4–6 intertwined bundles of 1–2 mm thick, single s-spun threads. F401905 is a much better-preserved braid (fig. 4). Although not stratigraphically related, the two finds share comparable textile qualities, and both might be whipcord braiding. F401905 is a 16 cm long and 1 cm wide circular braid, with a knot at the top. The braid consists of five groups; each composed of four to six threads. F401907 consisting of 12 fragments of very loose s-spun wool threads, might also originate from a braid. The colour was green during excavation but now appears black. F401891 is a woven red ribbon from SL6693, made up of two fragments, approximately 1 cm wide and 19 cm long combined (fig. 5). The ribbon is tied in a slip knot, with remnants of a tassel at the end. It has 12 warp threads and 6 weft threads per cm. The z-spun warp yarn is about 1 mm thick, while the weft yarn is loosely s-spun and 2–3 mm thick. The weave structure is 2/1 twill with a warp-rib effect, and in some areas, the ribbon is heavily fullled. This ribbon might have been woven on a rigid-heddle loom.

There are several tubes and textile strips, varying in structure, weaving techniques, and potential function.

Some tubes are folded and hemmed woven fabrics. One such example is F402530 from SL6541, which is blackish brown in colour and loosely woven in a soft 2/1 twill. The fragment was folded into a tube, measuring about 1 cm in width, though no visible evidence of seams remains. The thread density is 13/7 threads per cm, with s-spun weft.

Similarly, F404127 from SL5188 includes several fragments of blackish brown, fullled 2/1 fabric with visible evidence of seams. Three of these fragments were hemmed and sewn together to form tubes measuring 1.5 cm, 2 cm, and 4 cm in width. The largest fragment features a single hem along one long side. The fabric appears very coarse and fullled, though a thread density of approximately 6–8 threads per cm can still be observed. It is interpreted as remnants of a utilitarian textile, possibly boat caulking or another practical application.

The woven tubes and textile strips seem to have served both functional and decorative purposes, though their exact function remains unknown. One such example is F401927, a 35 cm long textile strip woven in 2/2 twill. When excavated, it was green, though it has since faded to light yellowish-brown. One surface appears fullled, and the textile is cut lengthwise, with a possible single hem along one side. At one end, the textile splits into two separate 15 cm-long textile strips, each measuring approximately 1 cm wide. The fabric is evenly and densely woven, with 10–12 z-spun threads per cm.

F401911 consists of a 21 cm long tube sewn from a 2/2 twill fabric. It was initially recorded as green, but it now appears medium brown. The fabric is folded, with the raw edges tucked inside, and is sewn with coarse overcast stitching (Emery 1994, 236). The thread density is 12–14 threads per cm, with a loosely s-spun weft. The sewing thread is two-ply, S2z approximately 2 mm in diameter. In addition, four smaller fragments with evidence of seams (2–4 cm long) have been preserved.

F401919 consist of a corner combining two perpendicular textiles, 21.5 cm long and 1.5 cm wide, and 7 cm long and 2 cm wide. The fragment might be from a utility textile and is heavily fullled in some areas. The raw edges are hemmed at the back, possibly folded twice. The fabric has 11–12 warp threads per cm, 1 mm or less thick, and the weft is 8 threads per cm, 2 mm or more thick, and loosely spun. Two different sewing threads were used: a 2 mm thick, S-plied thread in the longer textile, matching the fabric colour, and a 1 mm thick, black, single-strand z-spun thread in the shorter textile. This textile was green when excavated but now appears light-medium brown.



Caulking material

A few textile fragments have been identified as *drev* (norwegian), a type of caulking material traditionally used to seal boats (Rodum 2013). However, they might also be sealing from between wood beams in buildings. One example is F402027 from SL11301, which consists of two lightly twisted and felted strings of animal hair and wool, each approximately 20 cm long. Another textile interpreted as caulking is F404127 from SL5188, which consists of several fragments of blackish brown, fullled 2/1 fabric with evidence of seams. Some of these fragments appear to have been hemmed and sewn together into tubes of various widths (1.5 cm, 2 cm, and 4 cm). The heavily fullled texture suggests that this fabric may also have been used for caulking.

Fragments of loosely s-spun wool threads, varying in diameter from 0.3–0.8 cm, were found in F401907, possibly originating from a cord. The fragments had a greenish hue, but they now appear dark brown. The threads vary in diameter from 0.3–0.8 cm. F401925, consists of a folded bundle made from animal hair. A twisted strand of the same hair was found wrapped around or near the rest of the hair. This cord measures 9 cm in length, is 1.5 mm thick, and is loosely S-plied of z-spun threads. The construction of this cord resembles that of F401899, which was found in the same layer.

Seams

Evidence of seams may indicate that textiles are the fragments of clothing (Vedeler 2007; Vedeler 2004). However, very few of the textiles in this material display evidence of seams indicative of advanced sewing techniques. In total, 13 fabrics show evidence of seams, but all of these originate from from hemming of raw edges, folded tubes, or fabrics sewn together (possibly as repairs). These could just as easily belong to utility textiles as to clothing items (Pritchard 2003). Except for a few small wedge-shaped fabric pieces, there are no textiles that exhibit clear cutting patterns that could be linked to a specific garment shape. The deposit contexts should be considered here, as most of these textiles were likely secondarily used and cut up, before being discarded.

F402528, from SL6541, is possibly a fragment of clothing. It consists of cohesive fragments that appear to form a hem approximately 41 cm long on a black-brown fabric. The fabric is woven in a smooth and balanced 2/2 twill. The longest and best-preserved fragment has a double fold, while the other fragments display a single indented raw edge—likely due to tearing along the folded edge. The thread density is approximately 13/11 threads per cm. The yarn is

single-stranded, about 0.1 mm thick, z-spun in one direction, and s-spun in the other. The raw hemline is approximately 0.4 cm wide. The outer hem edge, where the raw edge is folded in, is about 1.2 cm broad. There is an impression left by stitching, with intervals of approximately 0.5 cm, although no sewing thread has been visibly preserved.

Another sample interpreted as potential clothing, or other fine decorative textile is F401909 from SL6693. This sample consists of three small fragments. Fragment A has a potential selvedge preserved on one side, measuring approximately 4 cm in length. Fragment B forms a corner, between a selvedge and a sewn edge. F404098 consists of eight cohesive fragments of 2/1 twill fabric that have been folded and sewn together. At least one fragment appears to have been sewn into a tube, and the others may either be tubes or remnants torn from a folded edge. The raw edge is sewn down on the back using coarse overcasting stitches, spaced approximately 0.5 cm apart, and visible on both sides of the fabric. The sewing thread is approximately 2 mm thick, and s-spun and Z-plied (Z2s). The fabric is dark black-brown, with one fragment preserving a 2 cm wide strip of lighter brown yarn. The thread density of the fabric is 12/8 threads per cm, with a 1 mm thick, z-spun warp yarn, and approximately 1.5 mm thick, s-spun weft.

A light brown fragment, F401893, woven in 2/1 twill, with a seam in black brown, very loosely spun wool, has traces of possible repair stitching, or what may be decorative stitching (fig. 6). It has a narrow-hemmed edge along one long side, but no visible stitches. The surface is smooth and dense. There are approximately 14 × 12 threads per cm, both directions z-spun. The sewing thread is 1–4 mm thick. Impressions and stitch marks from black yarn are visible on the surface and along the edge of a torn short side.



Fig. 6: F401893 is a 2/1 twill, with repair stitching or maybe decorative stitching in a hairy black-brown sewing thread (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)



F404152 consists of two connected fragments. The larger fragment is an open-weave 2/2 twill fabric with a coarse, lofty texture. The warp is a hard, z-spun approximately 1 mm thick, in a 2/1 twill with a thread density of 6–8 threads per cm. The weft is loosely s-spun, measuring 2–4 mm in thickness, with a thread density of around six threads per cm. The fabric is dark brown in colour. The smaller fragment features warps and wefts in different colours. The warp is light brown, z-spun, with a thread density of 14 threads per cm. The weft is a variety of dark browns, s-spun, with a thread density of approximately 8 threads per cm. On one short side of the fragment, there is a 2 cm wide section where both the weft and warp are dark brown. This may indicate a woven stripe. The fabrics were originally joined by a thread, twisted from both light and dark fibres, suggesting that they were sewn together (fig. 7).

An L-shaped fragment, F401935, woven in 2/1 twill, with approximately 9–10 threads per cm, features a



Fig. 7: The fabrics in F404152 are woven in 2/2 twill and 2/1 twill and sewn together with a thread twisted from both dark and light yarn. One fabric has a dark brown colour, and a coarse, lofty texture. The other fragment has a smoother surface, and more colour effects, with a light warp yarn, and weft in alternating light and dark stripes (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)

single folded, hemmed edge. All other edges are torn. The fabric was yellow-green when excavated but is now a dark reddish brown. The warp yarn is hard z-spun, approximately 1 mm thick, but the weft is somewhat looser and s-spun.

F401895 consists of two interlocking fragments of brown-black woven 2/2 twill with indentations where there may have been a seam. Parts of an edge are sewn down in a simple hem with rough hemstitches. The sewing thread is loosely z-spun and sewn with two parallel threads, 2 mm thick. The hem is 1.2 cm wide. The warp yarn is hard and shiny, z-spun, 1 mm thick, and there are approximately 12 threads per cm. The weft yarn is lofty, loosely s-spun, with a thickness of approximately 1.5–2 mm and a thread density of 8 threads per cm.

Colours

Colours may provide a great deal of information about both the textiles and the people who owned them (Fett 1991; Andersson 2006; Jahnke 2015; Heller 2021). Which colours could be achieved would have depended on availability of dyestuffs, technical expertise and specialisation, craft traditions and social traditions, trade networks and economics (Pedersen 2009; Barber 2007; Cardon 2007; Munro 2003). The fairly well-preserved textiles reflect a relatively rich colour spectrum. The field archaeologists wrote a short note on the colours they observed during excavation. Some colours have since oxidised. Only a few textiles, mainly those with coloured stripes, were photographed during the excavation. Several textiles still display visible colours and patterns.

Red is observed in three textiles: the woven ribbon F401891, in addition to F401909 and F401901. Three textiles appear yellow green: F402034, F401913 and F401935. Seven fabrics are described as green: F401937, F401931, F401927, F401921, F401911, F401919, and F401907. Yellow and golden colours are observed in F401909C and F401915. Blackish brown tones are seen in five textiles: F402528 I, F402027, F401923, F404127, and F401895. There are also four fabrics with a striped effect: F404098 (dark and light brown), F401903 (yellow, brown, green), F401933A (green, now light and dark brown) and F404152A (brown stripe). Three fabrics appear to have different colours in the warp and weft: F401929 (green), F401917 (yellow-green, light and dark brown), and F404152A (light and dark brown). Several textiles that now appear brown may originally have been dyed in more vibrant colours.

F401903 comprises four likely connected fragments of a thicker, striped 2/2-twill. Described as striped with yellow, brown, and green when collected, it now looks



Fig. 8: F401903 consists of fragments of a 2/2 twill decorated with what was probably yellow, brown, and green stripes (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)

light medium brown and dark black-brown (fig. 8). The fabric has an unbalanced structure, with a hard z-spun warp, 1.5 mm thick, with a density of 6–8 threads per cm. The wefts consist of two types of yarn: there are light stripes of loosely spun, lofty yarn, approximately 2–4 mm thick, with 4–5 threads per cm. There are also dark stripes of z-spun yarn, approximately 1.5–2 mm thick, with 6–8 threads per cm. The warp and dark weft may be from the same yarn, but the weft appears more loosely spun. The wider light stripes appear darker in colour than the narrower ones. This fabric was likely part of a thicker utility textile. The largest fragment has the following stripe pattern:

- Wide, light brown stripe: 1.4 cm
- Dark stripe: 0.5 cm
- Light stripe: 0.5 cm
- Dark stripe: 0.5 cm
- Light stripe: 2 cm
- Dark stripe: 1 cm
- Light stripe: 0.4 cm
- Dark stripe: 0.5 cm
- Interrupted light stripe: 0.3 cm

Five fragments of woven textile, F401933, are likely from two or three different fabrics. The largest fragment is decorated with four stripes (fig. 9). The pattern alternates between black-brown and light brown stripes. The fabric is woven in 2/2 twill. The warp is dark brown, hard z-spun with approximately 12 threads per cm, and a thread diameter of 1 mm. The weft is slightly looser s-spun, with a diameter of 1–2 mm, and thread density approximately 10 per cm. The textiles were originally described as green but now appear to be various shades of brown.

Processing

For most of the fabrics, it is hard to say if the surface has been processed after weaving. Fulling can be the natural result of wear in wool textiles; this may indicate use patterns on textiles. Most of these textiles displays wear and tear, which, together with the deposit context, may indicate that they were used and reused several times over. A few fabrics have a texture that may indicate processing after weaving. One possible interpretation of the loose, lofty s-spun weft yarn is that these were napped or fulled.

F402034 may show evidence of having been napped. This is a 2/1 twill with a slightly hairy surface. It is possible that the fabric was originally napped or had a more refined finish than what has been preserved. The thread density is approximately 12/10 threads per cm. The yarn is z-spun in both directions. The fabric appears light-medium brown but was initially observed as yellow green. F404150 consists of 11 smaller fragments of an open-weave lofty fabric, likely to have been woven in 2/1 twill. The thread density is approximately 6/5 threads per cm, although the thread thickness varies significantly, ranging from 1–2 mm in the warp to 1–4 mm in the weft. The warp is tightly z-spun yarn, and the weft is a loosely spun yarn. Several fragments are heavily tangled with what appears to be unspun wool. This could indicate that the fabric was either napped to create a raised surface



Fig. 9: F401933A is a 2/2 twill featuring four dark black-brown and light brown stripes. The fabric appeared green when it was excavated (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)



Fig. 10: F402301 is an example of a wedge-shaped rag (Image: Gorm Seljeseth, NIKU, licence CC BY-SA 4.0)

or woven using minimally spun wool, possibly to produce a warm blanket or a thick utility textile.

F404154 is a triangular, medium brown textile fragment woven in 2/1 twill. The fabric is evenly and tightly woven, with lofty yarn, possibly indicating that the surface was napped. The thread density is approximately 12/10 threads per cm. The yarn is about 1 mm thick, z-spun in one direction and s-spun in the other.

A fragment cut into a trapezoidal shape, F402301, is possibly a remnant of a wedge (fig. 10). The widest side measures 6 cm at what appears to be a selvedge. The fabric is a tightly woven 2/1 twill with a thread density of approximately 10/10 threads per cm. The yarn is z-spun and 1–2 mm thick. The surface is lightly full.

Another fragment of woven fabric, F401929, with a sewn down edge, may have full during use. The fabric is woven in 2/1 twill, approximately 10/8 threads per cm. The yarn is z-spun, approximately 2 mm thick. A 4 cm long edge is preserved and folded down with a S-plied, z-spun sewing thread, secured using 0.5 cm long running stitches. The fabric was green when excavated and has one thread direction appearing darker than the other. F404123 is a fragment of full, woven fabric. The exact weaving technique cannot be determined, but a twill variant is probable.

A triangular woven fragment in 2/2 twill, F401931, has a somewhat lofty surface. Initially recorded as green, it is now uniformly dark brown. All the edges are cut off. The thread count is 10–11 z-spun threads per cm.

A folded triangular fragment, F401901, in 2/2 twill features a slightly curved, simple hem, with no visible evidence of seams. The hem may have been part of an opening in clothing or a utility textile. The fabric has a smooth surface, while the inside of the hem appears slightly loftier. Its colour was initially reddish-brown, but it now appears dark reddish-brown. The thread count is 10–12 threads per cm, of 1 mm thick, z-spun yarn. F401915 is an elongated, square fragment woven in 2/2 twill. Initially described as yellow, it is now

medium brown. The fabric is unbalanced, with 10–12 z-spun, 1–1.5 mm thick, glossy warp threads per cm, while the weft has eight threads per cm. The weft is lofty, 2–3 mm thick, with a low spin angle. Some areas of the fabric surface appear lofty.

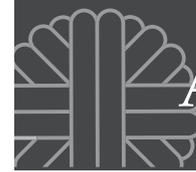
F401917 consists of two fragments of fabric woven in 2/2 twill. All the edges are torn. The surface is smooth but shows the remains of a possibly napped texture. The warp is dark brown, smooth, z-spun, with 12 threads per cm. The weft is light brown, loftier, loosely spun, at approximately eight threads per cm. Initially the colour was yellow-green, now it is a light medium brown. The difference in colour may be due to variations in the warp and weft fibres.

Discussion

The textiles' technical distribution and grouping patterns might be useful for a better understanding of life in the central harbour of medieval Tønsberg.

The predominance of wool fabrics, particularly twills, aligns with broader textile traditions observed in medieval Norway (Kjellberg and Hoffmann 1991). The presence of low-density, lofty fabrics suggests their use as padding, insulation, or blankets, supporting interpretations of textiles serving practical household or personal comfort purposes, as well as for trade and handicraft (Schjølberg 1984). In contrast, the medium to high-density textiles, often with balanced thread counts and finer structures, indicate potential use as clothing. Several fragments have traces of dyes and finishing techniques, hinting at variations in social status and access to specialised textile production.

One of the most compelling aspects of the Rådhusgaten assemblage is the concentration of textile fragments in the latrine deposit. The presence of torn, hemmed, and folded textile strips and tubes may suggest their secondary use as sanitary products or toilet tissue. This potential interpretation may provide some insight into medieval hygiene practices and the social aspect of the latrine, with the clustering of textiles in one section of the deposit potentially indicating spatial division based on gender, though other social or practical distinctions may also apply. The preliminary laboratory analyses show traces of blood in the tested fibres, and that insects in at least one textile have fed on human blood. This may strengthen the theory that some of these textiles were used as menstruation rags, though other explanations for blood on the textiles, such as wound dressings, are possible. It must be noted that we do not know if these insects fed on blood from the textiles, or blood directly from human hosts.



Many questions remain unaddressed in this case, as the use of sanitary products has not previously been developed in any depth in archaeological settings.

A comparable find is the 95 woven textiles excavated in Baglergaten in Tønsberg, mainly from a latrine area (Brendalmo 1989). The excavation focused mostly on describing the structural layout of the medieval town, and the latrine textiles were not thoroughly addressed. The oval pit interpreted as a latrine, “construction 530”, had human waste and small pieces of wool textiles in the top layers (Brendalmo 1989, 18). 90% of the textiles from Baglergaten 2–4 “were found in such a context that they must be interpreted as menstruation pads or toilet tissue disposed of in latrine areas” (Brendalmo 1989, 31). In the proceedings from the Baglergate 2–4 excavations, there is a paper thoroughly discussing the different kinds of moss in the samples from latrines (Griffin and Foldøy 1986, 3). Here as well are the mention of the textiles in the latrine as possible female sanitary products, though the question is not further addressed. The test samples from the latrine were investigated to identify several different species of moss and pollen.

Another site in Tønsberg where textiles have been found in waste layers or latrine layers is the excavation at Storgaten 24/26 (Lindh 1984, 57). These textiles are briefly mentioned as “rags, often in the form of strips torn from larger fragments. These were most likely used as toilet paper in latrines or as menstruation pads” (Lindh 1984, 57). The largest part of the textiles from Storgaten 24/26 were found in layer L248, noted as a “typical waste layer, where waste from households (...) were deposited. The concentration of textile finds might indicate that the waste is from latrines. Whether the textiles have been used as toilet paper or as menstruation pads, and what this may imply about gender distribution in the urban population, have been discussed. However, this discussion will not be addressed in this paper” (Lindh 1984, 97). The idea here is that a concentration of textiles in a waste layer might indicate that the waste is from a latrine – thus there is a sort of circular argument when it comes to discussing latrine textiles.

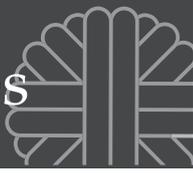
Textiles have been found in latrine contexts in Oslo as well. Kjellberg and Hoffman (1991, 49) mentions a context from Oslo, where several cut-off selvages were found in a latrine or dung heap. They mention that these could have been used for toilet paper or “other things”. In 2015, two latrine areas with very well-preserved textiles were excavated in Oslo (Nordlie et al. 2020). Molaug (2024, 103) briefly touches on the possibility that such latrine textiles might have been used as sanitary pads, as it is an established truth that

it was the peat moss *Sphagnum* that were commonly used for toilet paper (Molaug 2024).

The established truth that it was moss that were used for toilet tissue, rather than textiles, is a bit surprising. While the moss in question has excellent absorption qualities, it has a weak structure that might not be the best for wiping. Wool textiles might be a structurally better choice for wiping, though they may have lower absorption powers. The cost of textiles in the medieval economy, even as worn rags, might be the reason to choose moss for toilet tissue. From the perspective of a menstruating woman, the moss with the excellent absorption powers and the bonus of antiseptic and antibacterial qualities, would be the better choice. *Sphagnum* is otherwise known as “blood moss”, which might both refer to the use for dressing wounds and for menstruation absorption.

A combination of textiles and moss might be a logical solution (Gilbert 2025; Zankl 2021). But both textiles and the moss would need to be kept in place, if they were to function as menstruation rags. Menstruation rags may have been pinned in place, fastened to the underwear, but the use of underwear is uncertain. The preserved Lengberg underpants are identified as male, largely because historical writings indicate that female underpants were considered improper (Case et al. 2017; Nutz and Stadler 2015). Nutz and Stadler (2015) gives a brief overview of mentions of female underwear from the Middle Ages through the 1500s and 1600s. However, just because men who wrote about women’s underwear ridiculed it, did not mean that women would never wear underwear. Rules about what someone should or should not wear may indicate that the opposite is true. As Nutz and Stadler (2015) point out, the question of underwear was a question of social power and cultural taboos. Female underwear might have been perceived as shameful, maybe due to its connection to the stigma of menstruation (Ott 2018; Green 2005).

Before the modern use of adhesive sanitary pads, sanitary belts or girdles were the common way of fastening the re-usable sanitary pads (King 2023). A solution like the menstruation girdle might explain why so many of the latrine textiles are long strips, tubes, braids or cut of selvages – some of these textiles may have been used for the fastening of menstruation rags, though there are of course several other potential uses for these fragments. Some medieval medical written sources indicate that herbal remedies must be inserted vaginally, for example to cure the lack of menstruation. This kind of remedy would also need to be kept in place, for example by strings and textile strips (Kruse 1999, 246–250).



A find from the Herjolfsnes burial site might be of relevance. A woman (grave Ikigait I), aged 30–40 years old, suffering from scoliosis, was found with little pieces of sealskin fastened with twisted wool cords over the pubic bones. Plant fibres, small hairs of sheep wool and a little bit of moss were found beneath the sealskin. This was interpreted as a bandage for the absorption of secretions, such as incontinence (Nørlund 1924, 322–332; Netherton 2006).

“Being on the rag” alludes to the rags women would wear as menstruation pads. The first known mention of such “menstruation rags” indicates that such rags were used in antiquity (Booth 2017, 128; King 2023). Two of the earliest preserved manuscripts of the Book of Isaia (Septuaginta 300–100 BCE, Codex Leningradensis 1008 CE) refer to menstruation rags, or menstruation clothing (Barstad 2025; Eidsvåg 2025). There are a few medieval mentions of menstruation rags as well, for example from the physician Bernard de Gordon, who said that menstrual cloth should be inspected by the physician to diagnose sickness (McClive 2004). A record from the 1300s mentions menstruation rags as part of a magical potion (Ladurie 1980). Menstruation rags or cloths are mentioned more often as the number of written sources increases from the 1500s onwards (Reed 2008).

Medieval women’s ability to menstruate were probably affected by fasting periods, malnutrition, pregnancies and nursing. Medieval women generally experienced more pregnancies than modern women, and as nursing also might delay periods after pregnancies, they would have had fewer menstruations. Considering how each pregnancy is followed by lochia, up to six weeks of heavy bleeding post-partum, there would still be lots of blood to dispose of (Harris and Caskey-Sigety 2014, 36–47; Delaney et al. 1988). Menstruating women with a heavy flow, or those experiencing the lochia, must have had solutions in place. It is difficult to consolidate the image of free-bleeding women (Reed 2008) with the medieval stigma of menstruation and of the high value of clothing.

Medieval nuns might have been menstruating almost as often as modern women. Monastic clothing was strictly regulated in theory, though some of the written sources indicate that privately owned lay clothing prevailed within some monasteries. The reform statutes of 1453 by Nicholas of Cusa for the Sonnenberg nunnery (Germany) give a detailed list of which clothing the nuns should have, including “if they suffer women’s infirmity, they may use linen shirts and linen cloths for as long as the infirmity lasts” (Torggler 2016, 41–55).

The shapes of the textile finds are diverse. While most of the fragments are small, torn rags, 12 of them have square or rectangular shapes that could function as pads from a modern perspective. Some of the textile strips, tubes, cords, braids and ribbons might also be fastening for menstruation rags, or combinations of rags and moss.

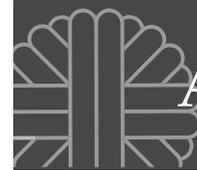
The body of textiles are too diverse to be explained as solely remnants of menstruation rags and girdles, or toilet tissue. As the latrine layer also includes other household waste, some of the textiles could have been part of general waste disposal. The variety of the textiles point to a diverse and dynamic use, and re-use of textiles beyond clothing. The rather colourful ensemble of textiles with reds, yellows, greens, black and browns hint at the value these textiles would have had, before they were at the end of their usefulness and were cut down to rather small fragments and disposed in the latrine.

From a broader archaeological perspective, the Rådhusgaten textiles show how textiles were integrated into daily life and personal hygiene. However, the textiles from Rådhusgaten are too few to base wider conclusions concerning further distribution patterns within the social town structure on. Previous excavations and research into the harbour area have unfortunately skipped a deeper technical analysis of textiles. For example, a larger excavation in Nedre Langgate in 1976 revealed 179 textiles. Half of these were not analysed, the rest was rope, thread and caulking cords (McLees 1999, 91–65; Ulriksen 2002).

Conclusion

The excavation at Rådhusgaten, Tønsberg, has revealed a small corpus of medieval textiles, offering insights into textile technology, daily life, and hygiene practices. The predominance of wool twills, varying in density and processing, reflects the versatility of textile production and usage. The presence of textiles in urban fill layers, as well as within latrine deposits, hints at the diverse re-utilisation of textiles in medieval daily life. It is interesting to note the diversity in colours and patterns in textiles, as this raises questions on the availability and social distribution of dyed textiles in the medieval town.

This study has discussed how textile fragments found within a latrine deposit potentially may have been used as menstruation rags and girdles. Little archaeological research has previously been done on medieval menstrual hygiene practices, the secondary use of textiles in latrine settings and the potential gendered organisation of latrine spaces.



The presence of caulking materials, ribbons, cords and tubes, packaging and evidence of sewing further demonstrates the multifunctionality of textiles within both domestic and harbour settings.

For future research, it would be very interesting to take a closer look at the combination of the textiles found in other latrine deposits, such as those from Baglergaten 2–4, Storgaten 24–26 and those found in Oslo. A comparative study of the qualities of the textiles in these contexts might give indications on possible uses of these textiles. Further testing focusing on hormones, DNA, traces of blood and pubic lice would be very interesting and should be considered whenever textiles are found in latrine contexts in the future.

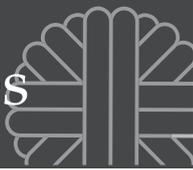
These findings emphasise the importance of textile studies in medieval archaeology, demonstrating how fabric remains can reveal details about daily habits that are often absent in historical records, as well as observations related to trade, economy and technology. Future research, including laboratory analyses and hopefully dye identification, might further refine our understanding of these textiles and their broader implications for medieval Scandinavian society.

Acknowledgments

Thanks are due to the Rådhusgaten team and the Norwegian Institute for Cultural Heritage Research (NIKU), and the Museum of Cultural History. The excavation was funded by Tønsberg commune.

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