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**Essays in Honour of Ingvild Øye on her 70th Birthday**

Irene Baug, Janicke Larsen and Sigrid Samset Mygland (Eds.)

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# A Western Norwegian Log Building Technique. Log Constructions in Bergen in Relation to Other Medieval Towns and Still Standing Medieval Buildings in Rural Norway

Building traditions have long been of interest to architects, archaeologists, historians and other scholars. One sub-topic has been the log houses of the Middle Ages. In the Viking Age, constructions with vertical roof-bearing timbers (stave constructions) were predominant in Norway. The log building technique appears in the transition to the Middle Ages (c. 1050-1100). The oldest trace of corner notching or log building technique (Norw. 'laft') in Norway is the grave chamber in the Gokstad burial mound from around AD 900 (Bonde 1994, 140). This is, however, a very simple corner notching. From that period, there are also some log built wells. Log built houses appears somewhat later. Among the still standing pre-industrial buildings in Norway (before AD 1850), we can trace regional differences in building techniques (Vreim 1936-1937, 33-64; Munksgaard 2010, 70, 88). In the east, where there has been good access to long straight timbers of good quality, the log buildings are predominant. In the west, where access to good building material has not been so good, corner notching is dominant in houses for residence and in high status buildings. In other buildings, stave constructions are used.

In the following article, I will focus on some of the technical aspects of the log buildings from Bergen and how they position themselves in the archaeological data. Is it possible to distinguish a West-Norwegian 'log construction technique' in medieval Bergen? If so, does this technique appear to be innovative or old-fashioned compared to similar archaeological findings from the larger excavations of other medieval towns and preserved rural medieval buildings? At the centre of attention are the structural elements of the buildings that may illuminate differences in construction customs in the western and eastern regions. Elements that are not relevant in this matter (e.g. foundation, the use of Norw. 'mefar' etc.) are thus excluded. As basis for the following discussion, a short retrospective on the research history will be useful.

## A long-standing interest

Research on construction techniques based upon an archaeological material is still a young discipline; however, built upon an old and long-standing tradition where remaining buildings and written sources have been the main source material – also when it comes to building techniques of the Middle Ages. As the first person in Norway, sociologist Eilert Sundt in 1862 approached this topic from a professional point of view. In 1890, antiquarian and archaeologist Nicolai Nicolaysen published an article on the topic in the Norwegian history journal 'Historisk Tidsskrift'. Although he could have based his publication on the first archaeological investigations from Oslo, he mainly based it on written sources and analogies from still-standing buildings. In the early 20th century, cultural historian and leader of the Hanseatic Museum, Johan Chr. Koren Wiberg examined parts of the ground on which Bergen is built. On this basis, he presented his views on the extent of the city and the layout and function of the buildings (Koren Wiberg 1908, 1929).

In the following years, architects and scholars from the fields of ethnology and history, but no archaeologists, shed light on buildings from the Middle Ages (cf. Vreim 1938, 1966; Stigum 1944, 1946, 1947; Lorentzen 1952; Christie 1974; Fett 1974, 1989; Reimers 1976, 1982, 2001; Hauglid 1980; Reimers and Anker 1981; Berg 1989). However, before 1960, the lack of larger archaeological excavations in the medieval towns forced scholars to still base their work primarily on written sources and analogies from still-standing or younger buildings.

A large fire devastating the northern part of Bryggen – 'the Wharf' – in Bergen in 1955 marked the start of a series of large-scale archaeological excavations in European medieval towns (Herteig 1985), including Oslo (Fett 1974, 1989), Trondheim (Christophersen and Nordeide 1994) and Tønsberg (Wienberg 1992). The comprehensive archaeological material from these excavations, documented in its original context, provided a far better basis for studies of the medieval towns and their building traditions. Parts of it were published in the following years. As regards finds from buildings, some scholars have concentrated on the construction types and the use of materials (Christie 1974; Fett 1974, 1989; Reimers 1976, 1982, 2001; Reimers and Anker 1981; Christophersen and Nordeide 1994; Høgseth 1998), while others have investigated the function and use of the different buildings and their social organisation (Christophersen 1999; Moldung 2000). In relation to my master thesis (Olsen 2002), I examined buildings and artefact finds that could be related to log buildings in Bergen before c. 1700. The results that regard building types, their function and social organisation were published in *Viking* in 2004 (Olsen 2004).

## The source material

The term 'log building' is in the following used in a broad sense and includes the building construction as a whole. This means that in addition to the interlocking of horizontal logs in the corners, 'notching joints' (Norw. *lafteknuter*), features such as sill beams, roof constructions etc. are also discussed.

My main source material is the archaeological material from Bryggen in Bergen, originating from the excavations at Bryggen, Svensgården and Rosenkrantzgate (Fig. 1). The buildings date from the beginning of the Middle Ages (c. AD 1100) to the time of the great fire that struck in 1702, destroying almost the entire town. Of the around 600 documented buildings, 27 can be termed definitely or probably log-built, whereas 390 of the approximately 3,600

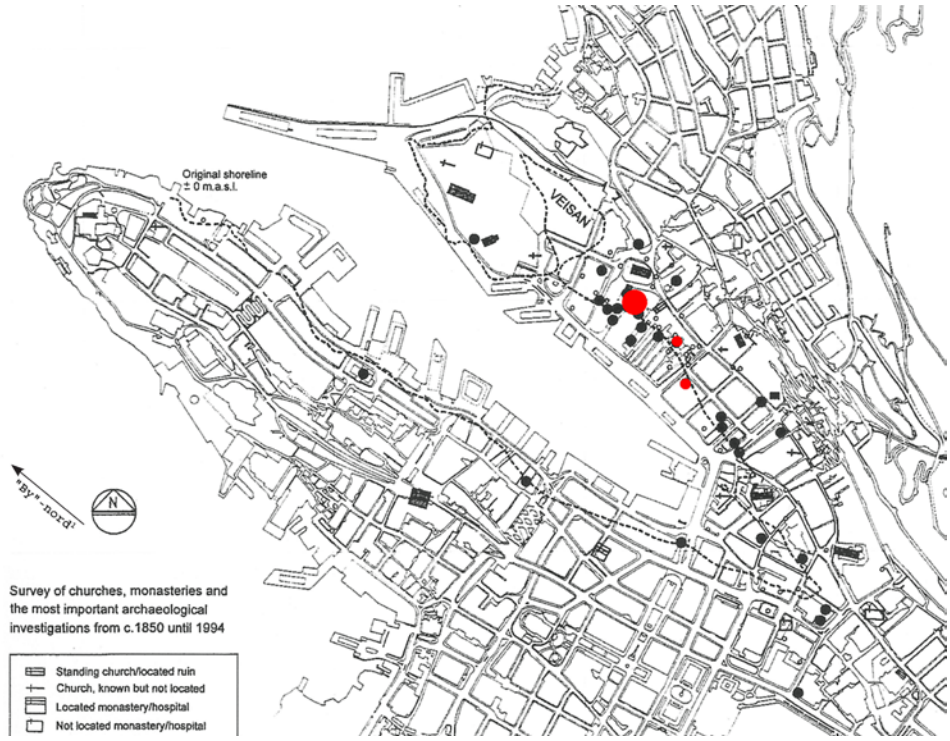


***Figure 1.*** *Map of Bergen with its most important archaeological excavations. Excavations with log buildings are marked in red (Modified after Øye 1997, 447).*

documented building finds or finds of other larger wooden objects could be related to log buildings. Altogether 134 of these were part of the in situ excavated buildings, while 256 had been re-used in other contexts.

A few finds are dated by means of dendrochronology (tree-ring dating); however, the dating of buildings and building finds is primarily based on the fire layer chronology established by archaeologist Asbjørn Herteig (1985, 21) and modified by archaeologist Gitte Hansen (1998, 123) (Fig. 2). Throughout its history, Bergen was struck by nine larger city fires (as well as a number of smaller fires) – i.e. in 1120, 1170, 1198, 1248, 1332, 1413, 1476 and 1702. New buildings were raised on the remains of the old ones, which resulted in several stratigraphic fire layers. In this fire layer chronology, the time span and the accumulation of layers between two fires represent one period, starting with material deposition and the accumulation of layers following one fire and ending with the next one. The fires are numbered I–VIII, where the latest fire in 1702 is denoted number I (Herteig 1990, 1991). The nine periods that make up the chronology are numbered in an opposite sequence to the fires, where period 8 is framed by fires I and II, period 7 by fires II and III, and so forth. Some of these periods are additionally separated into phases based on replacement and annexes/additions to buildings and other structures. Thus, we are left with quite a chronological fine-masked history of building constructions.

| Fire | Dating | Period |
|---|---|---|
| 0 | 1955 | |
| | | 9 |
| I | 1702 | |
| | | 8 |
| II | 1476 | |
| | | 7 |
| III | 1413 | |
| | | 6 |
| IV | 1332 | |
| | | 5 |
| V | 1248 | |
| | | 4 |
| VI | 1198 | |
| | | 3 |
| VII | 1170/71 | |
| | | 2 |
| VIII | ca 1120 | |
| | | 1 |

***Figure 2.*** *The Bryggen fire layer chronology.*

The in situ excavated buildings can be given an exact date in relation to the fire layer chronology. Dating is more challenging when it comes to reused logs and planks found in secondary contexts. These objects may have had their original use in the same period as they are found, or they might just as well have been used in the preceding period and then reused as for example landfill after the last fire. Thus, in principle, the reused material could also have had its original use in an even earlier period; yet, this is considered to be less likely (pers. com. architect Egill Reimers). The dating of the archaeological material is also supplemented by contemporary written sources, which directly or indirectly illuminate building types and building techniques.

For my comparative analysis, I have used archaeological material from Oslo and Trondheim. As I have not had the opportunity to investigate the excavated material or primary documentation myself, I base my discussion on publications from some of the larger excavations. These are presented by architect Tryggve Fett (1974, 1989) and archaeologists Axel Christophersen and Sæbjørg Walaker Nordeide (Christophersen 1994, Christophersen and Nordeide 1994). For the remaining log buildings from rural southern Norway, I rely on the work of architect Arne Berg (1989; 1990; 1991; 1993; 1995).

## Sill beams – a symbol of status or inherited from the stave buildings?

Sill beam (Norw. 'svill') is a term used to describe the lower log in each wall (Fig. 3). It is often larger than the rest of the logs, and can have a different cross-section. It has a dual function: it forms a stable foundation for raising the building and it gives the building a grander architectural appearance at its base. This is especially striking when the sill beams are trapezoidal (Berg 1989, 46-47). The sill beams in the material from Bergen can be divided into five main categories, presented in Figure 4: sill beams with a round, flat-oval, oval, rectangular or trapezoidal cross-section. Some of the rectangular sill beams have been bevelled at the sides, so that they have an almost octagonal appearance. It has been possible to determine the cross-section of the sill beam in 23 of the 27 buildings. Of

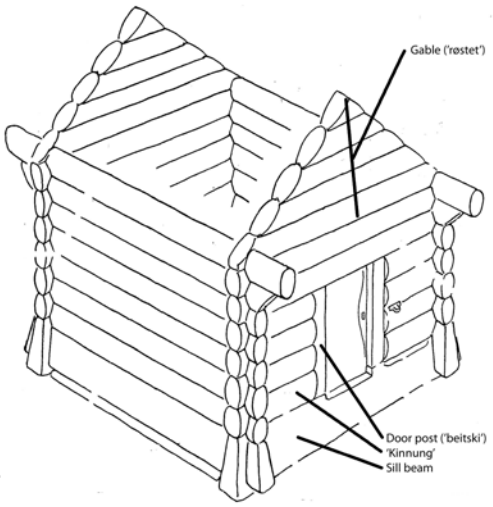


***Figure 3.*** *A log built building with the denomination of some of the construction elements discussed in the article (Modified after Berg 1989, 32).*

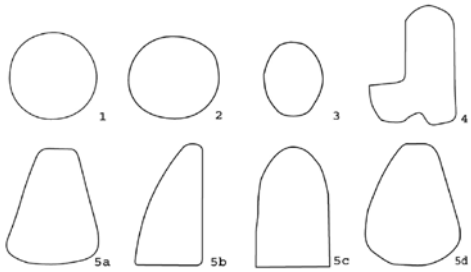


***Figure 4.*** *Sill beams with examples of different cross-sections: 1. round, 2. flat-oval, 3. oval, 4. rectangular, 5a.-d. trapezoidal.*

these, three houses have a combination of sill beams with different cross-sections, whereas 12 had round, one had flat oval and five had trapezoidal sill beams.

The rounded sill beams, which made up the largest group, were used throughout the entire period of investigation (Fig. 5). The one building with flat oval sill beams dates to period 5 (1248-1332). The trapezoidal sill beams are represented from period 3 to 5 (1170/71-1332). Yet, if we include sill beams found as reused material, the picture changes somewhat (Fig. 6). Of 28 such sill beams, only six had a round cross-section, while 20 had trapezoidal and two had rectangular cross-sections.

However, it may be that the more unusual trapezoidal sill beams are over-represented in the documented material, in contrast to the more modest round sill beams. Rounded sill beams in the reused material in secondary contexts are present in period 3 to 6 (1170/71-1413), while the sill beams with trapezoidal cross-sections are dated to period 4 to 6 (1198-1413). As Figure 6 shows, the trapezoidal cross-section became more common in later periods. As

| Period | Totalt | Round | Flat-oval | Trapezoidal | Combination of sill beams with different cross-sections | Uncertain |
|---|---|---|---|---|---|---|
| 2 | 1 | 1 | | | | |
| 3 | 6 | 4 | | 2 | | |
| 4 | 5 | 4 | | 1 | | |
| 5 | 11 | 5 | 1 | 2 | 2 | 1 |
| 6 | 2 | | | | 1 | 1 |
| 7 | 2 | | | | | 2 |
| **Total** | **27** | **14** | **1** | **5** | **3** | **4** |

***Figure 5.*** *Temporal distribution of sill beams from Bergen, based on cross-section.*

| Period | Totalt | Round | Flat-oval | Trapezoidal | Rectangular | Uncertain |
|---|---|---|---|---|---|---|
| 2 | | | | | | |
| 3 | | 3 | | | | |
| 4 | 3 | 1 | | 2 | | |
| 5 | 3 | 1 | | 6 | 1 | 1 |
| 6 | 9 | 1 | | 10 | 1 | 1 |
| 7 | 13 | | | | | |
| **Total** | **28** | **6** | **0** | **18** | **2** | **2** |

***Figure 6.*** *Temporal distribution of sill beams from re-used material, based on cross-section.*

discussed earlier, we cannot ignore the fact that some of the sill beams that were reused in one period were originally made and used in the preceding one.

In the material from Oslo, rounded sill beams dominate throughout the examination period, while rectangular sill beams were utilized only in the oldest phases. The sill-beams with trapezoidal cross-section occur about the same time as the rectangular pass out of use (c. 1100) (Fett 1989, 51). In Trondheim, a sill beam with a trapezoidal cross-section is documented from the 16th century. According to Christophersen (1994, 164-165), the remaining beams were round or oval. Archaeologist Harald Høgseth (1998, 57) has in addition demonstrated hexagonal, oval and pear-shaped sill beams in the material extracted for dendrochronology. Nevertheless, we must presume that round sill beams was the most dominating type. In the remaining medieval buildings in the countryside, the trapezoidal cross-sectioned sill beams are predominant.

Trapezoidal sill beams are either deemed as an intentional architectonic effect, or inspired by the stave buildings. With the exception of a barn, all the remaining medieval buildings are high status buildings such as Norw. 'loft' (two story hoses), 'stover' (living quarters) and 'bur' (small stock house). These have trapezoidal cross-sectioned sill beams, regardless of its location in western or eastern Norway. This supports the sill beams' function as an architectonic expression and as a symbol of status on these types of buildings.

The investigated archaeological material from the towns represents a larger diversity of building types, from plain storage housings of lower quality, to buildings where a great deal of work is obviously invested in the end result and where the building was to reflect the owner's status. The trapezoidal sill beams are more common in the archaeological material from Bergen than in Oslo and Trondheim. However, this may not necessarily mean that there were more high status buildings in Bergen than in the other two towns. Analyses of the buildings' functions show variation in house types, as well as varying quality and status of the buildings (Moldung 2000; Olsen 2002, 114-133). Among the log buildings in Bergen, both 'stover' and 'langloft', as well as larger and rougher storing houses, are documented (Olsen 2002, 131). The larger amount of trapezoidal sill beams in Bergen, therefore, may represent a building customs that to a larger degree than the other two towns has kept elements from the stave buildings.

## The notched joints – traces of craftsman conservatism in Bergen?

Two main forms of notched joints or corner notching were represented in the material from Bergen (Fig. 7): 'findalslaft' ('findal' meaning 'old' or 'old times') and 'raulandlaft' (named after a well-known house in Rauland in the county of Telemark were this notching technique is used). There are also some types of notched joints that do not fit into any of the main categories. 'Vagenov', for instance, which is considered the oldest and least developed type, is in Bergen mainly found in foundations and falls outside the scope of this article.

### *'Findalslaft' and 'kinning' as indicators of influences from the east*

The 'findalslaft' joint is characterised by a deep upper cut, and by the neck of the notch being in the lower half of the log. This is a more developed corner notching than 'vagenov', providing a joint that is more stable and less likely to become skewed. However, 'findalslaft'

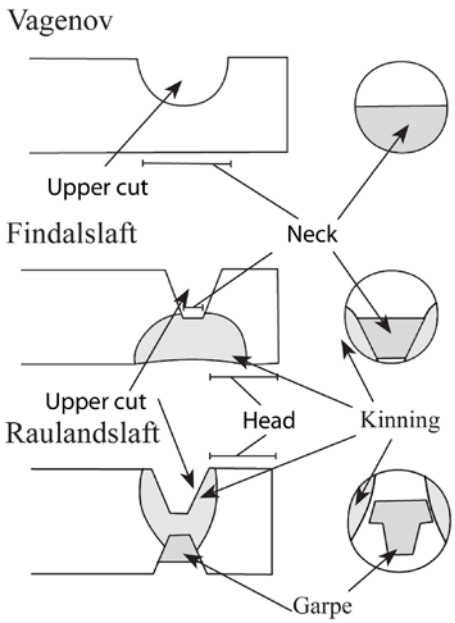


***Figure 7.*** *'Vagenov', 'findalslaft' and 'raulandslaft' and the different parts of the notched joints.*

has a major weakness relating to the neck of the notch only being in the lower part of the log. This makes it possible for the upper part to break off.

In the material from Bergen, 'findalslaft' first appears in re-used material deposited in period 2, c. 1120-1170/71. 'Findalslaft' was used in all the in situ excavated buildings where the type of notched joint could be determined. Based on this material, it appears that the 'findalslaft' technique was in use until 1413. A timber with a 'findalslaft' joint has also been found from period 7 (1413-1476), but whether this timber was originally used in that period is uncertain. In period 6 (1332-1413), however, the 'findalslaft' was so well represented that it must reflect an actual use on the site. This is very interesting because the 'findalslaft' technique was previously believed to have gone out of use after the Black Death (1350).

The most common shape of the neck was inverted trapezoidal, with a straight edge. In addition, timbers have been documented with the upper edge of the neck chamfered or with a Norw. 'barke' (Fig. 8). The notch with a neck with a right upper side – type I – is the type that Berg (1989, 36) describes as the purest form of 'findalslaft' joint. It is also the predominant type in the material from Bergen, and the only type documented in the in situ excavated buildings. Type II is similar to type I, but stands out in that the two top 'corners' of the trapeze are cut so that the neck is shaped like a hexagonal cross-section. This type was only documented in periods 5 and 6 (1248-1413). It accounted for approximately 10 per cent of the total (11 of 107) during these periods. Berg (1989, 37) believed it was the result of influence from chopping techniques where the neck is in the middle of the cross-section of the log, i.e. 'raulandslaft' and the hexagonal notch. A type III notch has a pentagonal cross-section, so that the top of the neck forms a 'ridge'. This type is known from still-standing buildings, but, in the material from Bergen, it was only represented by two logs, both from period 6 (1332-1413).

The design of the neck of the notch has not been reviewed in the material from Oslo and Trondheim. A comparison is thus difficult. Judging from images and illustrations one may, however, see that the purest form of 'findalslaft' (type I) is part of the material from Trondheim (Christophersen 1994, 160). Here, an example of type IV, where the neck has a 'garpe' on top, has also been documented (Berg 1989, 39). This type has not yet been documented other places than in Trondheim and Bergen. Among the remaining medieval buildings, type I, II and III are common. The material from Bergen is not noticeably different from the other medieval cities. The few finds of type IV that have been found in Bergen and Trondheim are interesting, though hard to interpret. Perhaps they are traces of an exchange of knowledge or craftsmen between the two towns?

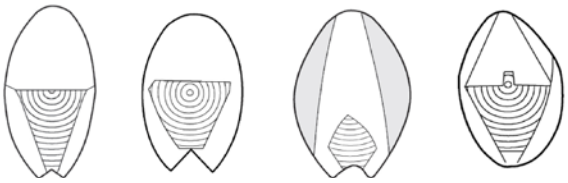

***Figure 8.*** *'Findalslaft' and thedifferent shapes of the neck. From the left: Type I-IV.*

For the notched joints to be tight fitting and stable, the neck of the one log had to be adapted to fit exactly the upper cut in the log below. The adjustment between the straight edges of the cut and the rounded surface of the log was made using Norw. 'kinning' or flange. The flange was only at the neck, while the 'kinning' could be both at the neck and in the upper cut. The flange could also have 'kinning'. I have divided them into two main types (flanges and 'kinning'), each with several subtypes based on differences in shape (Fig. 9). The main type A consists of logs with 'kinning', which forms an oval surface. Logs of the other main type, type B, have a flange instead, cut into the log at right angles.

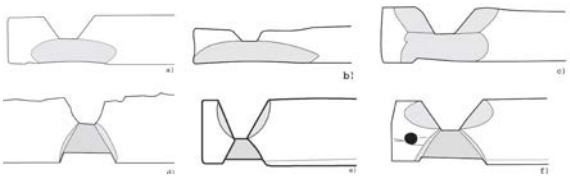

***Figure 9.*** *The different types of 'kinning' found in the material from Bergen: a) type A1a, b) type A1b, c) type A2, d) type B1, e) type B2, f) type B3.*

In the material from Bergen, logs with 'kinning' are most common (type A). In most cases, the 'kinning' is ended before the end of the log (types A1a and A2), but extends beyond this (type A1b) in some cases. Among the excavated buildings, two had type A1a logs, while two had logs with A1a, A1b and B2. In the re-used material, the groups that only had 'kinning' at the neck and limited to the extent of the log are the most dominant. Logs where the 'kinning' extends beyond the ends of the logs are documented in period 3 (1170/71-1198) and periods 5-6 (1248-1413). The last group of logs in category A, logs with 'kinning' both along the neck and at the upper cut, is documented in period 3 (1170/71-1198) and periods 5 to 6 (1248-1413). Main type B logs have a flange instead of 'kinning' at the neck. In addition, the notch may have 'kinning' beside the upper cut, at the flange, or in both places. The subtype with 'kinning' at both the upper cut and the flang seems to have been most common.

It has been a tradition in Norway to have the 'kinning' as small as possible, resulting in as much as possible being hidden by the next log (Berg 1989, 27). In Sweden, however, it is common to let the 'kinning' stretch out over the short end of the log. In the archaeological material from Trondheim, there are several examples on such outstretched 'kinning', which can be

viewed as influences from the east (Christophersen 1994, 163). Based on the illustration in Fett (1989, 54), we see that the 'kinning' also in Oslo could stretch far out. This is also found in Bergen, but to lesser extent. This variation is most likely the result of influence from the east, but can also be explained by a more lenient chopping technique in less elaborate constructions. A further investigation of this is challenging, however – partly because the finds represent secondary usage of the material, where it is difficult to understand the buildings' status, and partly because the original material has been discarded.

## *The 'raulandslaft' – notched joints where the neck is in the middle of the log's cross-section*

The 'raulandslaft' joint is characterised by the neck being in the middle of the log (Fig. 10). In addition, it has a 'garpe' underneath the neck that makes the cross-section different from the 'findalslaft' joint. This makes it more stable and solid. The upper cuts are usually carefully adjusted to fit around the 'garpe'. Because of the neck's being in the middle of the log, a 'raulandslaft' joint would have both an under and an upper cut.

***Figure 10.*** *Log with 'raulandsaft'.*

Only two logs with 'raulandslaft' joints are documented in medieval Bergen. This type of joint is documented for the first time in a re-used log from period 6, phase 2 (1332-1413), meaning it must have been known here no later than the mid-1300s. The other log dates to period 7 (1413-1476). The archaeological material from period 7 and 8 is, however, more badly preserved than the material from the earlier periods. The fact that we only find two logs with "raulandslaft" is therefore probably not representative of the full extent of the use of 'raulandslaft' in Bergen in the late Middle Ages and the transition to modern time. In buildings erected after the fire of 1702, 'raulandslaft' joints were the most common type of notch.

It has not been possible to document 'raulandslaft' in Oslo and Trondheim, but this is likely due to the conditions for preservation and what periods or finds have been documented. In rural areas, the 'raulandslaftet' is only used in about 10 per cent of the buildings older than 1350. After the time of the Black Death, the techniques with the neck in the middle of the log became dominant.

To sum up: If we compare the material from Bergen, Trondheim and Oslo and the preserved medieval buildings in the rural parts of Norway in relation to types of notches in general, then 'vagenov' is predominant in Trondheim and Oslo in the periods prior to the oldest documented log buildings in Bergen. 'Findalslaft' subsequently seems to be the most widespread notching technique, but lasts longer in Bergen (to the fire in 1476) compared to the countryside where the technique goes out of use around the time of the Black Death. There might be different reasons for this. The craftsman milieu in Bergen may have been more conservative than in other places. Due to its eastern origin, it may also have taken longer time for the 'raulandslaft' technique to be established in the west. Lastly, it might also be that 'raulandslaft' first was applied in high status buildings, while 'findalslaft' still was used in building with lower status, also on the countryside. However, these buildings are not preserved today.

## Doorposts and 'kinnunger' as an indicator on Western Norwegian construction customs

A log building is most stable when all the logs in the walls extends unbroken from one corner to the next. The moment some of the logs are being cut, for example to create a door, this increases the risk of the logs sliding out of position. To solve this, doorposts (Norw. 'beitski') are inserted (Fig. 3). They were attached to the last full log at the bottom and the first full log above the opening. The cut-off wall timbers, Norw. 'kinnunger', were then attached to the doorposts (Fig. 3). The joint between the 'kinnunger' and the doorpost has been executed in two ways – the doorposts either had a groove where the pointed 'kinnunger'could be inserted, or the 'kinnunger' could have a groove in it, into which the doorposts were inset (Fig. 11). In the material from Bergen, 'kinnunger' with pointed ends dominated. They were used in five buildings (1170/71-1332). One of the in situ excavated buildings may have had 'kinnunger' with grooves. Among the secondary, re-used material, 'kinnunger' with pointed ends dominate.

There are only preserved doorposts from two in situ excavated buildings in Bergen. The doorpost from the first house is fairly narrow and rectangular (8 x 16 cm). The second building was re-used as foundation and the excavated doorposts were only 60 cm high. If these were the original doorposts, only reduced in height, they have been oval, about 15 x 18 cm. Doorposts found in a secondary context are omitted, because they may not be linked to log buildings. The doorposts were attached to the sill beams in two different ways. In seven of the buildings, they have been inset into the sill beam, while one case has been documented where the doorpost has 'straddled' the sill beam. Among the secondary, re-used material, there are 16 examples of doorposts that have been inset into the sill beams.

In the material from Oslo, two in situ excavated log buildings had traces of doorposts. These were dated to 1100-1200. Both had cavities that indicate that the doorposts must have been inset into the beam (Fett 1989, 77). Among the remaining buildings in the rural parts of Norway, only doorposts inset into the logs under and above the doors are documented. In the material from Oslo and Trondheim, 'kinnunger' are not commented in particular. Berg (1989) has nevertheless conducted a careful review of the material from the countryside. Here, both types are documented, but the most frequent one is the doorpost being inserted into the 'kinnunger'.

Berg considers 'kinnunger' inset into the doorposts as the oldest type and as heritage from the stave buildings. This is also the most common type in Bergen. However, in the inner and eastern parts of the country, the technique with the doorposts inset into the 'kinnunger' becomes more and more

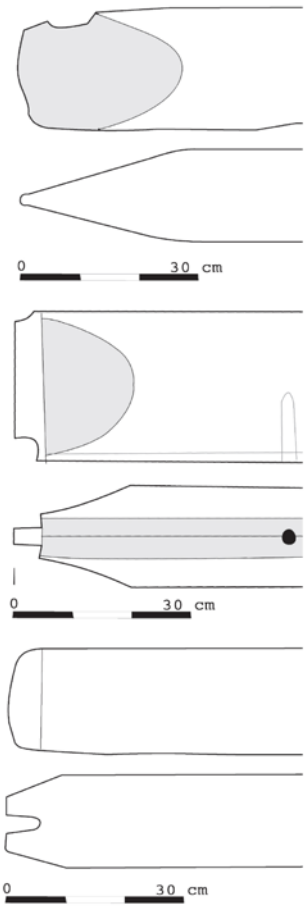


***Figure 11.*** *Different types of 'kinnunger'.*

common with time. This might have been a better solution in log buildings that sag when they dry and must have 'mefar' to be tight.

The material from Bergen might best be explained by the craftsmen keeping the tradition from stave buildings longer, and that 'kinnunger' in this matter contribute to the image of a Western Norwegian log building tradition in the Middle Ages.

## Roofs – an area of collar rafter roof ('sperretak') and an area of side purlin roof ('åstak')

Archaeologically, the roof is the part of the building we know the least about, but finds of logs from gables (Norw. 'røstet') indicate that the houses have had gable roofs. This seems plausible also based on the assumption that the roofs would be constructed so that they would lead water in the best possible way to eavesdrops or passageways. Adjoining outbuildings and annexes, however, probably had simple sloping roofs. A gable roof could be constructed as a collar rafter roof (Norw. 'sperretak'), a side purlin roof (Norw. 'åstak') or a combination of the two (Fig. 12). Traces of a collar rafter roof could be a horizontal supporting beam, Norw. 'beter' (a single crossbeam, high on the wall, across the building), traces of such, or logs with traces of rafters. These crossbeams would prevent the walls from being pushed apart. Notches in the timbers in the gable could be traces of a side purlin roof. Unfortunately, logs with traces of rafters can also indicate a side purlin roof with side/aisle rafters.

In Bergen, one horizontal supporting beam has been found in an in situ building. In addition, another 16 logs with traces of rafters have been registered, dating to the period from 1170/71 to 1476. Some crossbeams have also been documented, which can also indicate the use of collar rafter roofs. None of the in situ excavated buildings from Bergen have traces of side purlin roofs, but notches in some logs from a gable, found as re-used fill material, tell us about the use of such roofs. Logs from gables also indicate the use of a combination of side purlin roof and collar rafter roof.

The gable timbers can also provide hints about the angle of the roofs. The angle at the end of the timbers indicates that the angle of the roofs varied from 29° to 49°. These angles do not vary over time. The angle of the roof affects what type of roofing can be used. Turf roofs should preferably be no steeper than 33°, while a roof of wooden planks or wood shavings could be steeper.

In a comparative perspective, all the preserved medieval log houses from rural settings have gable roofs. In Oslo and Trondheim, there are only traces of this type of roofs (Fett 1989, 71; Christophersen 1994, 164). In the material from Oslo, a log with possible traces of rafters has been found. This might be an indication of a collar rafter roof. There were also traces of roofs with a centre purlin in an in situ burned down building from the 12th to the 13th century (Fett 1989, 71). In Trondheim, two logs from a gable show a side purlin roof (Christophersen 1994, 164). When it comes to roofing, we learn about turf roofs in 'Håkonarsaga' in 1218 (Helle 1982, 212), and both turf and wood shavings are mentioned in the city law of 1282 (Norske Middelalderdokumenter, 176). In Oslo, a red orange fire layer has been found, indicating burnt turf (Fett 1989, 73). Most of the still standing log buildings from the Middle Ages have turf roofs today, but this does not necessarily mean that this also was the case in the Middle Ages, as the roofs are the part of the building that most often are in need of repair.

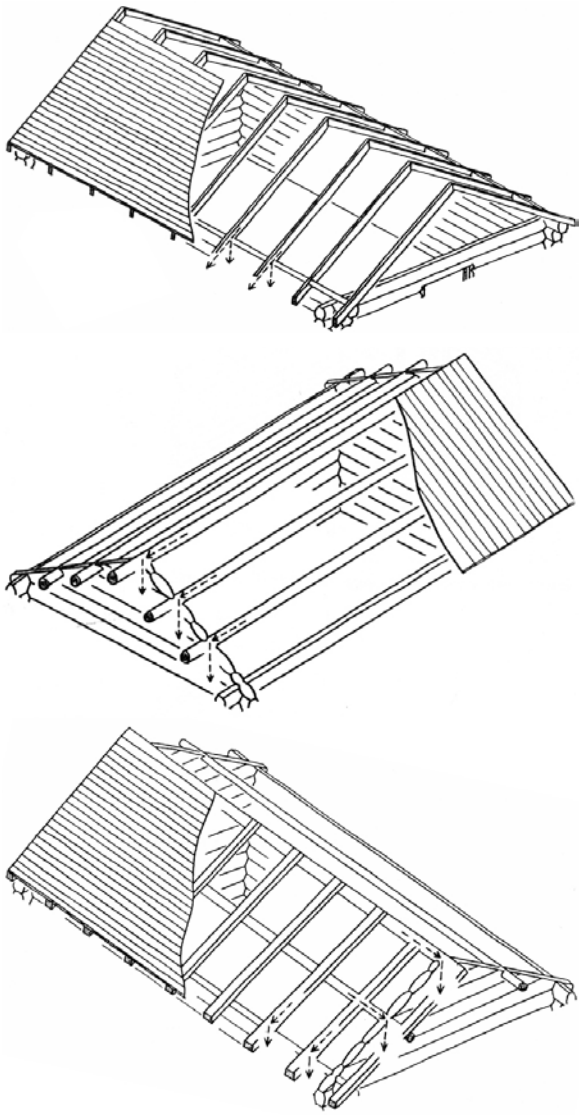

***Figure 12.*** *Different construction types of roofs. From the top: Collar rafter roof ('sperretak'), side purlin roof ('åstak'), and a combination of the two (After Godal 1994).*

In all, collar rafter roofs dominate Western Norway, while side purlin roof is more common in Eastern Norway. This is a characteristic building customs in these regions even in more modern times; thus, the roots for this distinction can be traced all the way back to the archaeological material from the Middle Ages. The reason for this might be that the western parts have kept more of the building traditions from the stave buildings, while the eastern have to a larger extent integrated the corner notching techniques.

## Concluding remarks

Among the still standing, post-medieval and pre-industrial buildings in Southern Norway, a difference between the east and the west can be identified. Stave buildings are common in the west, where log built constructions mostly are used in houses of residence and high status buildings. In the east, log built constructions are typical in all types of houses. Could the archaeological material from the medieval towns shed light upon whether this difference is traceable not only in the building finds in general, but in the building techniques of the log built buildings in particular? If so, does this technique appear to be innovative or old-fashioned?

In the preserved medieval buildings from the rural areas, the sill beams are trapezoidal. With one exception, all these buildings are of high status such as 'loft' and 'stover'. It is therefore assumed that the choice of type of sill beam was due to a wish for a particular architectonic expression. Regarding the archaeologically excavated buildings, the types of buildings are a lot more varied, including also other types of buildings than high status ones. In other words, the archaeological material provides a more complex and complete picture of the buildings in use. In Bergen, a larger proportion of trapezoidal sill beams than in Oslo and Trondheim has been found, which may indicate a building tradition closer connected to the stave buildings. This is further substantiated when it comes to the doorposts ('beitskier') and 'kinnunger'. Pointed 'kinnunger' that are inset into the door posts are considered a heritage from the stave buildings and they are more common in Bergen than among the still standing log buildings from the rural areas. Traces of roof constructions are sparse, but the few existing finds indicate that some kind of collar rafter roof has been most common in Bergen. This is still the case around AD 1850 – collar rafter roofs dominate in the west, side purlin roofs ('åstak') in the east. Also the technical construction of the log building and especial the notch joint, 'findalslaft' vs 'raulandslaft' (and other joints with the neck of the notch in the middle of the log) indicates that craftsmen have probably been more conservative in Bergen than in the rural parts of Norway. The dominance of pointed 'kinnunger' may be another indication of conservatism here.

Thus, it seems plausible that the difference between eastern and western post-medieval and pre-industrial building constructions has its roots in the Norwegian medieval towns, and that it is traceable also in the corner notching/notching joint technique itself. In this respect, the conservatism in Bergen and the fact that this east-west distinction also concerns towns is particularly interesting, as rural districts generally tend to be more conservative and towns adapt and exchange new impulses faster.

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