

HALLS, HOUSES AND HUTS

Buildings at Ribe Viking Centre



Bo Ejstrud
Peter Goddixsen
Sandra Henry
Caroline Persson
Dominic Tomasi
Anders Thomsen

Edited by Bo Ejstrud

Ribe Viking Centre & University of Southern Denmark
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Bo Ejstrud, Peter Goddixsen, Sandra Henry, Caroline Persson, Dominic Tomasi, Anders Thomsen:

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FOREWORD

With this report on the houses at Ribe Viking Centre we can present the second experimental report written in cooperation between the Viking Centre and the University of Southern Denmark. Much worthwhile knowledge has been accumulated at the Centre, but never before described in writing. The cooperation started working with flax and linen (Ejstrud *et al.* 2011). But in fact it was the houses which originally sparked the idea for this work. In 2009 director Bjarne Clement took me for a tour around the Viking Centre. It is generally an interesting experience for an archaeologist to see artefacts in a “living” context. But it was in hearing about the houses and their maintenance that I first realized the importance of the knowledge that the centre hold. Any archaeologist who has ever done *post-hole archaeology* – and that would cover more or less every Danish archaeologist, at least – will probably realize the potential importance of the observations we present in this report. Seeing houses in full scale, and not just the post holes, must be an eye opener to anyone who has ever visited an archaeological excavation.

The results are hopefully interesting to other than archaeologists, though. These are interesting houses to visit, but the details of their construction are easily missed during a visit. The text is therefore not aimed particularly at archaeologists, but can hopefully work as a general guide to these buildings and their construction.

If nothing else, the unusually wet year of 2011 made for ideal conditions for examining the quality of buildings. This was a year when even modern house constructions were tested, and the insurance companies were busy. Due to other obligations, however, we had to start this project relatively late in the year. If nothing else, then the delay had the advantage that the project could take place partly outside the tourist season, and we could examine and document the houses in ways that would otherwise have been difficult. Unfortunately the finishing and editing of this report was then further delayed, not least by the fact that I had a job outside the University before everything was ready. But unfinished business calls for rounding off, and here we are.

The group of authors consists of carpenters Anders Thomsen and Peter Goddixsen from the Viking Centre. Together they represent more than 30 years of experience building and maintaining the houses at Ribe Viking Centre. From the Maritime Archaeology Programme I participated together with students Sandra Henry, Caroline Persson and Dominic Tomasi. Unlike the flax project, this project did not involve much experimental work as such, but has had the character of documenting an on-going –and long going- experiment. The work therefore mainly involved interviews combined with our own observations. Being two different groups of professionals working together, we were able to ask questions -and give answers- that the other party had never anticipated, and this alone made the project worthwhile.

The enthusiasm, professionalism and welcoming attitude of the staff at Ribe Viking Centre also make it a special pleasure to work there.

Sønderskov, 17 January 2014

Bo Ejstrud

Director, PhD
The Museum at Sønderskov

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1. INTRODUCTION

Ribe Viking Centre is a visitor centre recreating an experience of the Viking Age in full scale. It is structured around three main areas with several large and small buildings, and every attempt has been made to make the setting as authentic as possible. The tools and clothes used are based on actual finds wherever possible, and the houses are constructed directly from archaeological excavation plans.

But the transition from archaeological plan to actual houses is not a simple one. In fact few archaeologists can work for long on a typical North European settlement excavation without being struck by the very wide stretch between what professionals call a “house“, and what that house would have looked like originally. In an excavation, houses are mostly present in the form of postholes; as dark patches in the subsoil, and the interpretation of a settlement site is mainly an exercise in pattern recognition. The patterns we see are the remains of holes that were mostly dug and then promptly filled again to support the posts which formed the bearing structure of a house. Postholes were temporary means to an end, and would possibly not even have been perceived as part of the house by the people who lived in it. There is therefore a long stretch from the archaeologically excavated house to the original.

This is just one of the reasons why historical centres are important. With entire houses and villages being reconstructed, they fill the void between what archaeologists call “houses“ -but really are not- and those elaborate structures in which actual people lived their lives many years ago. The potential and importance of these centres in dissemination of knowledge of the past is difficult to understate. They play a significant role in the local tourist industry, as well as serving general educational purposes, and do so in a way which the archaeologist’s postholes in the field can not. This is an important way to demonstrate what archaeologists are actually talking about when they talk about houses.

But there is also a potential feedback from these houses to the archaeologist’s work in the field and behind the desk. While the immediate professional perception of the prehistoric house may be through its postholes, everyone involved is naturally aware that the original was something more. But there is little direct evidence for that *more* in the field. In Danish archaeology most field archaeologists will use the rule of thumb that an oak post will last for about 30 years in the ground, when trying to estimate the development and duration of a site, or explain the site to visitors. This is a practical rule of thumb, but what actually happens to posts when they are dug into the ground? It is not uncommon to see traces of repairs in excavated houses, where some -but not all- posts have been replaced. Obviously not all timbers in a house held exactly 30 years, or even the same time as the other timbers in the same house. And before the repair stage there is the entire construction of the house. It is possible to imagine a multitude of building practices from any set of postholes, but the only way to know whether these constructions are any good is to build them in full scale, and use them for their intended purpose as houses over a long period of time.

Archaeology can therefore learn much from modern house reconstructions, if they are made with care and in constant dialogue with the known archaeological finds. The houses at Ribe Viking Centre are constructed in close cooperation with archaeologists and other experts, and - with one exception- they have been built directly from archaeological plans. With the Centre opening in 1992, a vast experience with these buildings has accumulated over two decades. Experience which gives us important information on these reconstructions, but also inform archaeologists on the interpretation of post holes in the field.

Project design

The houses at Ribe Viking Centre are potentially informative for tourists and professionals alike. The main purpose of this project has therefore been to gather, document and discuss the experiences obtained at Ribe Viking Centre after two decades working with and around Viking Age house replicas. Obviously many choices have been made in constructing these houses, and it is interesting to see how specific practical solutions have worked over a longer period of time. Not less interesting are the changes that have been made to the houses due to practical experience, as well as the natural processes which necessitate constant maintenance.

This report is therefore not the product of a designed research project per se. It is the documentation of a many years of practical work around these houses. This obviously sets the premises for the report: It is not based around a single scientific question, but is rather a systematic gathering of the practical experiences with scientifically based house reconstructions. Such a design is not necessarily a limitation. A house is in fact a very practical thing, and its study cannot be left to academia alone, but must also be done by practical people, in the closest possible to real life situations that we can get in a modern world. The role of scientists has been to enter a dialogue with the practitioners, asking qualified questions on the practical solutions, and holding them up against their scientific background.

The structure of the following is therefore a systematic description of each house at the Viking Centre. First their archaeological background is described. Then their construction is described in as many details as we found relevant for each building. Later alterations and additions are also described. Alterations are interesting as they are improvements to the original design, which have been deemed necessary by the staff at the Viking Centre. We have strived to cover the technical solutions used in each house, but obviously have prioritized the level of information for each house, not last to avoid redundancy. It has been a goal that practical builders could follow the details in the constructions, without making the following into a builder's manual. It has also been important to discuss the results thoroughly, relaying the experiences made by the Viking Centre. This discussion is not just an academic exercise. It has been very marked how the carpenters at the Centre held often strong opinions about the masterpieces which these houses are. Also that their opinion was based not only on practical preconceptions and experiences, but even the thorough research which has been a core value of the activities at Ribe Viking Centre.

To establish a common vocabulary, chapter 2 is a broad discussion of the art of reconstructing an archaeological house, followed by a detailed glossary of the terms used in this work. We have found that the vocabulary differs somewhat between authors, and that this can be quite confusing, as often special expressions are assumed to be common, without really being it. The houses are then described and discussed in chapters 3-5, while chapter 6 is a more general discussion based on our findings though this report. Chapter 7 is a short summary and conclusion for the work.

The houses at Ribe Viking Centre

The buildings are probably the main feature structuring the experience of visitors to Ribe Viking Centre, although the effect of these buildings being populated by a relatively large staff of "Vikings" can probably not be understated. It is a lively place to visit, and the visitor aspect of the Centre is worthwhile an investigation in its own right.

The houses at the centre are physically organized in three main sections, each representing a distinct part of the Viking Age in the local area, and based on actual excavations (Figure 1). Apart from these three areas, there is also an archery range and a 'modern' area with café, administration and a playground. The administration and café is housed in *Lustrupholm*, a former

manor and a beautiful building in its own right, the east wing of which dates back to 1774. Housing the administration there is no public access, apart from the café. During the Middle Ages, the manor was owned by the bishop of Ribe, and it is first mentioned in the historical records in 1233. The Viking Centre is therefore placed on lands with a respectable time depth, with continuous settlement extending back to just a few centuries after the Viking Age.

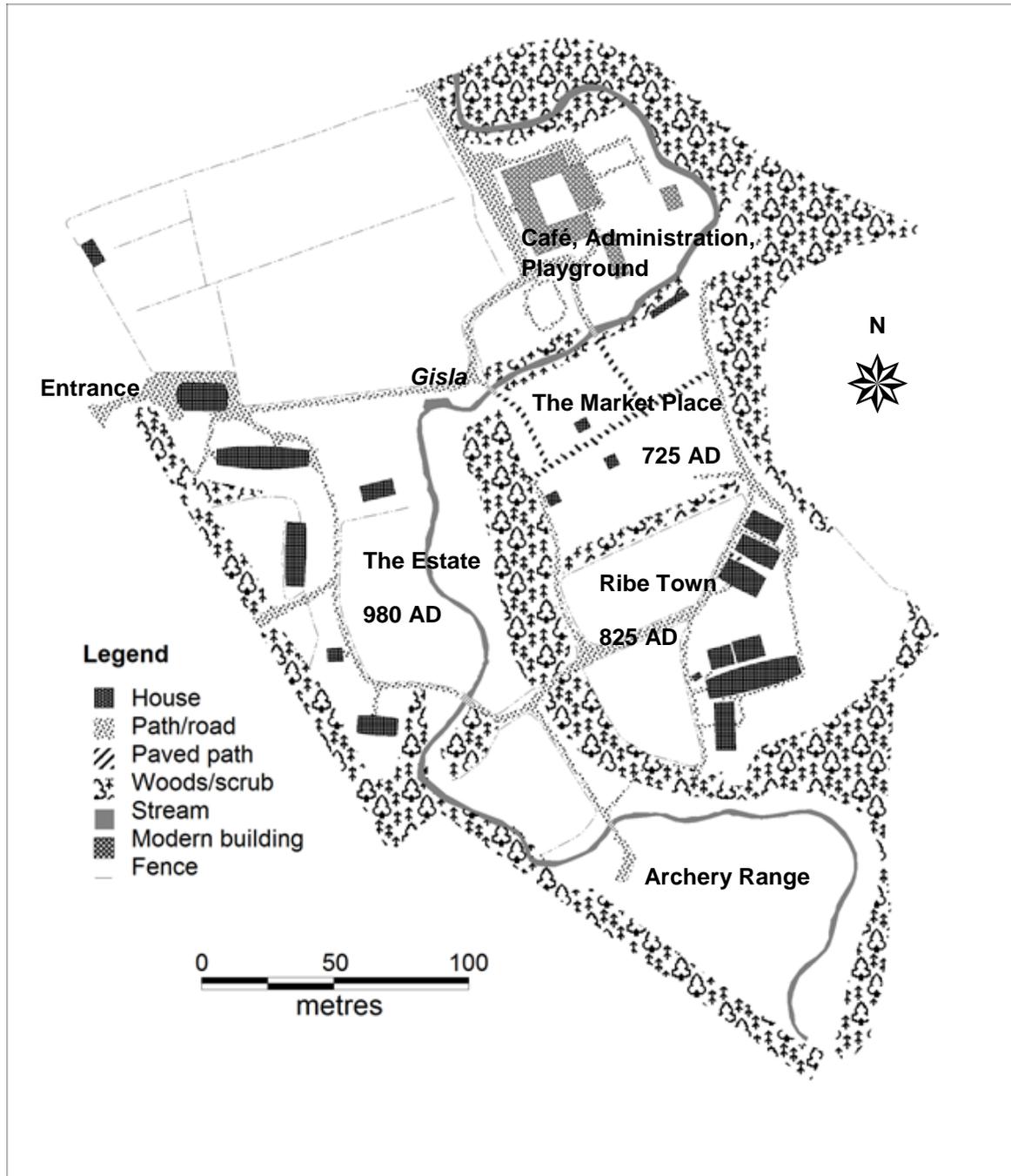


Figure 1. Ribe Viking Centre. General outline.

Starting at the entrance, an area designated “The Estate” represent a high status farm AD 980, and is based on excavations from Gammel Hviding, just outside Ribe. This area consists of six buildings, and is organized as a working farm with livestock and fields. It was in this area that the flax was grown for our previous experiment (Ejstrud *et al.* 2011).

In the north-western corner of this area, but otherwise without any connection to it, is the Viking Centre’s boat *Gisla* moored in a small stream, which crosses the area. This boat is a

replica of an early 12th century boat from the reclaimed Lammefjord on Zealand. There are plans to expand this area, making it into a harbour front, based on finds from other North European towns.

Crossing the same small stream south of the estate, one enters the archery range, where longbows and arrows are available to the visitors. Here the falconer also demonstrates her skills. No buildings are found in this area, and it will not otherwise be discussed here. It may be noted, though, that due to the very wet weather experienced during 2011, it was decided to drain this area during the fall, as water had made it virtually inaccessible at times during the summer season.

Both the estate and the archery range are situated low in the landscape. As discussed later this has caused some troubles for the buildings, and the need to drain out the archery range may be a good illustration of the cause of the problems in this area.



Figure 2. The archers and the falconer are found at the archery range. (Photos: Ribe Viking Centre)

Moving up from this low-lying area, one gets into “Ribe Town”, which represents the early town with buildings dated to AD 825. Activities here include various crafts, especially wood working, but also open the possibility to engage in different traditional games, which may have been played even a thousand years ago.

The earliest Ribe was not a town, but a seasonal trading site. This is shown in the area “The Market Place”, which represent the situation around 725 AD. Following the results from the excavations of the earliest Ribe, the town is divided into narrow plots of land, organized around a wood-paved road. This area works as a market place during the summer, and the annual Viking Market at Ribe is the largest of these events in Northern Europe.

2. RECONSTRUCTING HOUSES

Reconstruction and replica

This report is a description and an assessment of the buildings at Ribe Viking Centre. The main intention is to present the experience accumulated by the staff at the Viking Centre over the past two decades working with and in these houses. Emphasis is on the construction of the houses, while aspects of their use are hardly taken into account. This could be another interesting project.

Throughout the text we will describe the houses as ‘reconstructions’. But this word is used in a general meaning of rebuilding a house. Formally these houses should be considered replicas, not reconstructions, if we use the established vocabulary of experimental archaeology. It is misleading to talk about reconstruction of houses which are only known from archaeological post holes. They cannot be constructed again. We can arrive at a hypothetical, or sometimes conjectural, building, which is one possible representation of the original house. It is also important to recognize, that there is variance in the strength of the evidence behind any specific building project, meaning that there is also a gradient between replica and reconstruction (Schultze 2012). It is not an absolute distinction.

In our case, the houses at Ribe Viking Centre lean heavily towards the replica side of things. In fact, Holger Schmidt coined the problem precisely in the first sentence of the preface to his 1994 book: “*The following is an attempt to describe houses that does not exist, [...]*” (Schmidt 1994: 7). The current report is an attempt to describe houses that do exist, at Ribe Viking Centre, but these houses are the present expression of houses that has not existed for more than a millennium. Schmidt continues to state, that “*there will always be doubt the construction and layout of these houses above ground, i.e. the most interesting part*” (Schmidt 1994: 7).

Various approaches to this problem have been seen. In some cases this has involved burning down house replicas, and then comparing their excavation to the original archaeological finds. This may happen by design (Rasmussen 2007) or by accident (Tipper 2012). On a less drastic method, one may try to compare the (few) remaining timbers to the archaeological excavation plans (e.g. Schmidth 1994; Schultze 2012 to mention but a few). But in North European archaeology we mostly have to make do with the postholes in the ground. This is also the case at Ribe Viking Centre.

When in the following we therefore discuss the joinery of wood at the upper part of houses, we do not consider whether these exact joins were used around Ribe during the Viking Age. We will describe and discuss whether and to which extent the chosen solutions are viable. Whether they were in fact used at Gl. Hviding or in Ribe a millenium ago we cannot say. We can say how the technical solutions chosen at Ribe Viking Center have held up over the last two decades, and therefore whether they were good solutions among the many imaginable.

These houses are replicas. They are very well made replicas based on a substantial research effort. We think of them as being among the most convincing of the many Viking Age house replicas in Scandinavia. But considering the ontological status of the basic data, the research and the practical building process, it is wise not to forget that what we describe in the following pages are not Viking houses. The “*most interesting part*” of the original material is long gone. Being full-scale replicas, the houses at Ribe Viking centre are still most interesting in themselves.

House terminology

Terminology on house construction varies somewhat across the literature. To facilitate the descriptions in the following chapters, it is therefore practical to establish the terminology that we use in this report (Figure 3).

Bearing structures

The larger houses of Danish prehistory from the early Bronze Age through the Viking Age and into the Middle ages are virtually all based on a *three aisled* structure. The roof weight of the roof is carried by the walls, together with pairs of roof bearing posts, here called *arcade posts*. They are dug into the ground, and connected across by a *collar tie*. On top of these posts rest the *arcade plates*, which runs longitudinally on each side, and help to carry the weight of the roof. A vertical post between the collar tie and the top of the roof is called a *king post*, while two such posts supporting the structure further down the roof are called *queen posts*.

Roof

The roof ridge may be carried by a *roof plate*, running the length of the house. Resting against the roof plate, the arcade plates and and down to the wall plates are *rafters*, while horizontal *battens* on top of these form the structure on which the roof is secured. The roof may be covered in wooden shingles or with sods but mostly thatch is used at Ribe Viking Centre.

Walls

The walls may be made with wattle and daub, with vertical staves or horizontal planks (“boles”). On top of the wall is the *wall plate*. The walls may be supported by external *buttresses*, which lean against the wall, or against the wall plate. Opposite sides of the walls may be connected by a crossbeam, also called a *tie beam*.

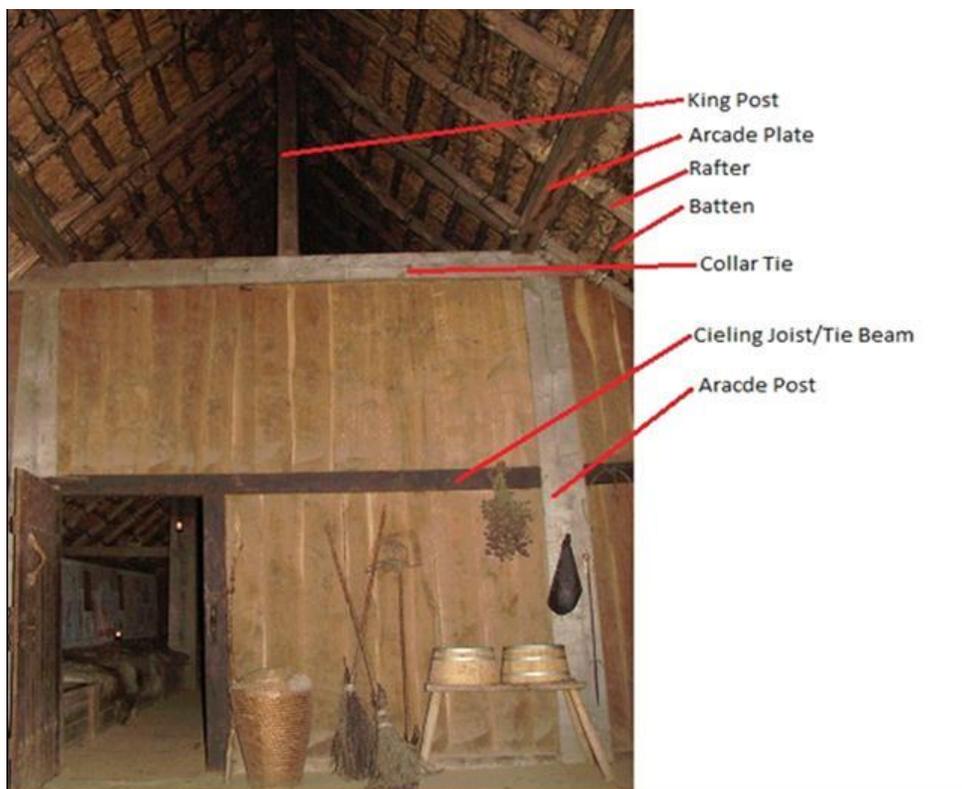


Figure 3. Terminology used in the description of the houses.

3. THE ESTATE, AD 980

The Estate is based on archaeological finds from *Gammel Hviding*,¹ 9 kilometres south-west of Ribe. It comprises of six buildings, one of which is the ticket sale and entrance to the Centre. One building is a later addition, taking up the supposed functions from the entrance building. The area is run as an active farm with cattle, sheep, geese and chicken, as well as fields with a variety of crops, which were grown during the Viking Age.

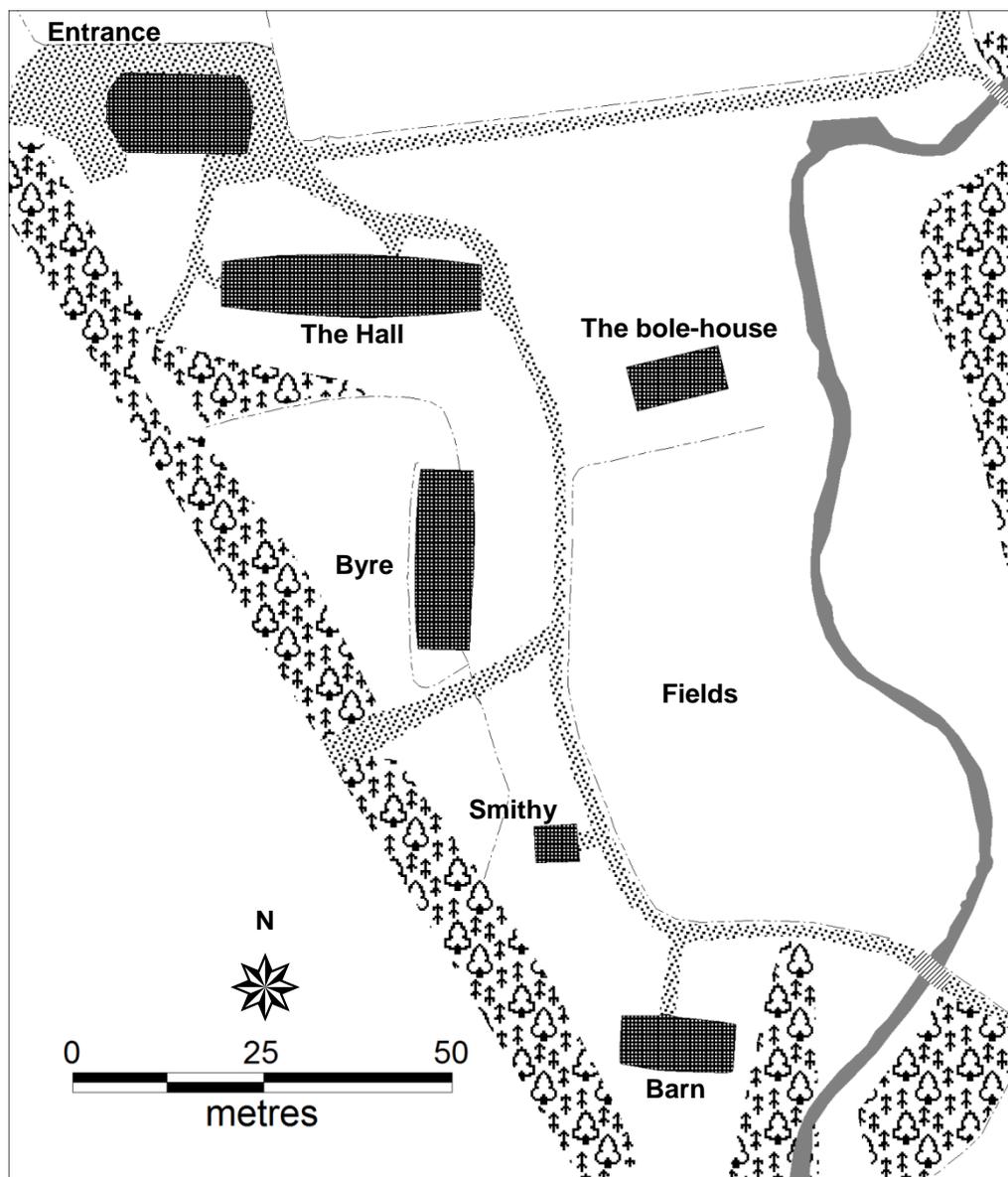


Figure 4. The Estate area. Scale 1:1000.

¹ The Danish word "Gammel" means "Old", and is normally abbreviated "Gl." in place names. The ending -ing in "Hviding" is generally held to indicate an Iron Age settlement from the centuries before the Viking Age.

This part of the Centre is placed in a low-lying area, which previously formed a wetland area around the now regulated stream. Before building here it was therefore necessary to remove 1.2 m of the peaty topsoil, and replace it with sand. While excavating the peat a thick vegetation layer with wood was uncovered, and archaeologists were called in to examine the site. But it was found that the wood was a natural deposit, and no archaeological work was needed. The houses were then constructed on top of the new layer of sand.

Being the first “proper” houses built at Ribe Viking Centre, the houses at the Estate were drawn by architect Holger Schmidt, and therefore based on his vast knowledge of Viking Age buildings (e.g. Schmidt 1973; 1990; 1991; 1992; 1994; 1999). Before this only the three small sunken huts at the Market Place had been built by the Centre’s staff, in collaboration with the archaeologists in Ribe.

Archaeological background

The archaeological interest at Gl. Hviding started with excavations inside and around the Romanesque church. Placed in an isolated and rather off-centred position within its parish, the church is made from tuff, which was imported from the Rhine area and typical for the Romanesque churches in South-western Jutland. Before renovating the church’s floor in the early 1960s, archaeological excavations revealed that this had been a much more elaborate building with twin towers, which had collapsed, most likely during the 16th century (Krogh 1964). The church was under construction for a century from the mid-twelfth century, after the Viking Age. Among the results of the excavation, however, it was found that the church was built on older cultural layers. Iron Age burials had apparently also been found just outside the churchyard in earlier years, and Viking Age pottery was found in the fields west of the church. There were therefore several indications that earlier settlements had preceded the building of the church, and that certainly the settlement had been somewhat denser than what the impression is today. Historical sources from the early modern period onwards tell that this was the primary embarkation point for goods being shipped from Ribe, although there are no earlier sources stating that this was also the case in previous periods.

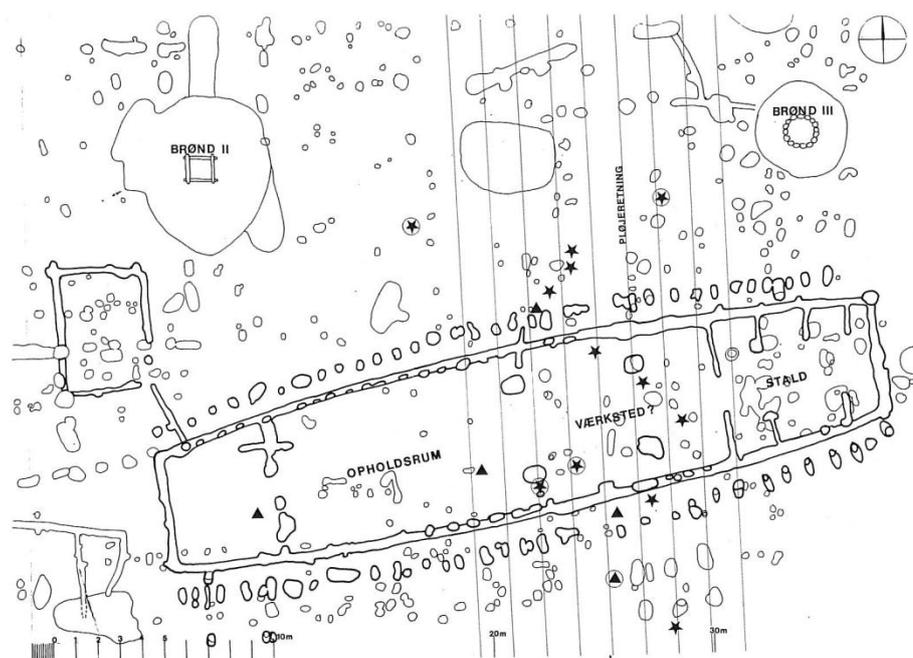


Figure 5. Plan drawing from Gl. Hviding, showing The Hall (Ill. from Jensen 1986).

In the following years aerial photography was tried several times at Hviding until finally in 1985 the outline of a large Viking Age house could be seen clearly in the field (Jensen 1986). This is the house which we call “The Hall” below. During successive campaigns during the mid-1980s and again during the early 1990s, a settlement was found, and the farm to which the hall had belonged was excavated.

Knowing that there had been an earlier metal find in the plough soil, the Museum chose to excavate the topsoil in thin layers, each of which were surveyed with a metal detector (Jensen 1986). While normally the top soil is simply stripped off a site without being examined, this method led to the find of several metal pieces. Among these were 18 pieces of lead. This included an amulet, four weights and 13 irregular pieces, which was scrap from pewter casting. They were found in the same general area, and, as the subsequent excavation proved, in the entrance area of the large hall. This led the excavators to interpret this part of the house as a separate room between the byre and the dwelling room. Without the metal finds there would have been no indication of functional divisions in the house apart from the traces of the byre. Another important result was that the horizontal movement of artefacts in the plough zone is relatively limited. The lead bits could still be ascribed to one house. Apart from few isolated attempts, this result has not generally led to systematic examinations of the plough soil in Danish archaeology. In this case it was only tried because air photos clearly indicated the position of the house beforehand. Under the present doctrine of Danish field archaeology, it would be very difficult to imagine plough soil excavations implemented more generally.

With metal finds and a large building, together with the later corroborating evidence from the large Romanesque church, and the even later historically documented position as embarkation beach for Ribe, the Viking Age settlement at Ribe was interpreted as the estate of a local magnate. In fact later investigations have revealed even richer metal finds and similar houses from the contemporary site Råhede, which is situated so close to Hviding that it must have been an immediate neighbour. The many metal finds at Råhede could be due to more active use of the metal detector, though (Feveile 2011). Also the large house that was found at Gl. Hviding may not have been as rare as it seemed when the site was first excavated. Nonetheless we will maintain the established name used at the centre, considering this a high status estate, and naming the main building a ‘hall’. Anyone seeing it will also recognize that this is a large building.

The Centre’s replicas of these houses follow the outline of each house, but not the general layout of the farm. Adaptations to the local landscape have been made, and the houses distributed differently in the area than the originals were in Hviding.

The Hall

The longhouse in Ribe Viking Centre is 35 m long and 8 m wide at the centre, the gables having a width of 5.5 metres. The house has curved sides and high gables, with the shingled roof also being curved along the top. The walls are supported with external buttresses, which are set against walls of wide oak staves.

The whole building required 160 logs of oak for its construction. The house was made with green wood and seeing that oak can shrink more than 5% while drying, consideration for eventual shrinking influenced how certain parts were constructed so that no gaps, especially in the outer walls and the roof would appear in the years after construction. Even though it was thought that parts of the house would twist and warp over time due to shrinkage this is not the case. The fact that all the parts are fastened together reduces the effect of twisting immensely because one piece holds the other in place and helps it maintain its shape.

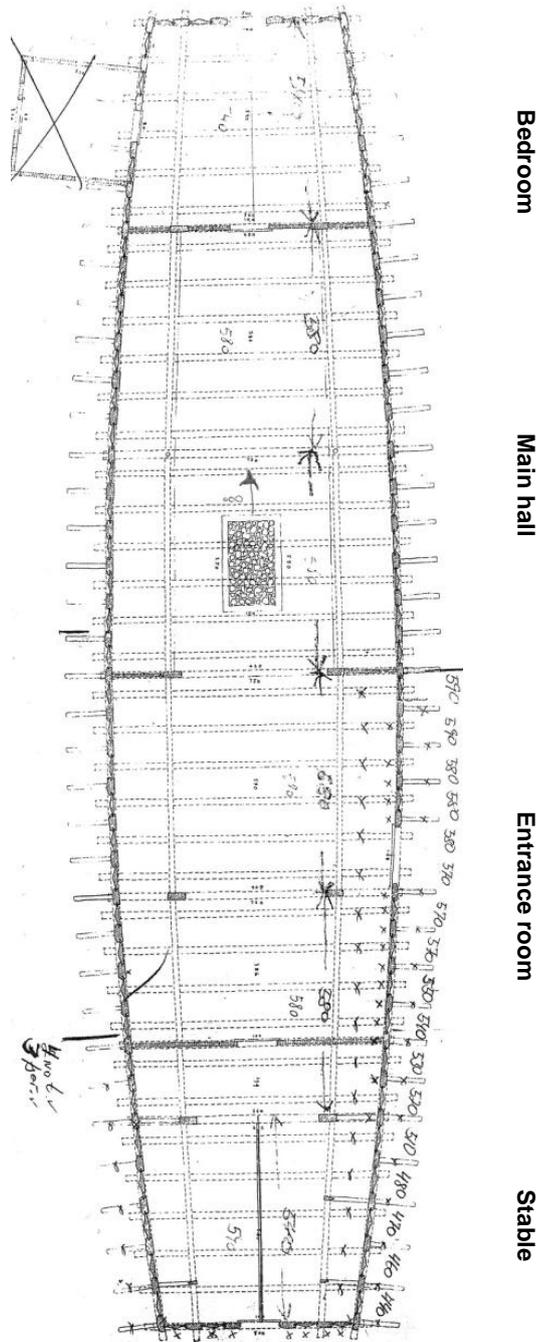


Figure 6. The original drawing by architect Holger Schmidt. North is to the right. Note how an entrance room towards south was originally envisioned from the 'bedroom'. From the archives of Ribe Viking Centre. 1:200.

Bearing structure

The inside of the longhouse consists of four pairs of free standing roof bearing posts or 'arcade posts'. The arcade posts are all placed at a depth of 1.5 m into the ground, and have quite massive dimensions of 45×15 cm. These posts are connected to one another along the top by a collar tie. It is common in longhouses for inner bearing structures to have a king post placed in the centre of the tie beam which is then butted up against the underside of the roofs ridge. However, in this long house, no king posts are present, and the roof ridge stands unsupported. It must be mentioned that not all the weight of the roof is placed on the inner structure seeing that the walls are made from thick vertical oaks staves which play an important role in bearing the roofs weight. Houses

that have their walls made from wattle and daub depend a lot more in their inner bearing structures to support the roof's weight. Running atop the arcade posts are two horizontal arcade plates that run for the entire length of the house.



Figure 7. The Hall seen from NW.

In the central room a different style of bearing structure is present. Instead of having two arcade posts to support the arcade plates there is a tie beam roughly at its centre of the hall that cuts the lateral axis of the house and rests on the wall plates of the outer walls. On this tie beam two queen posts are used to support the two longitudinal arcade plates found on either side of the roofs interior; the same timbers that are supported by the aisle posts. These queen posts are held in place with a mortise and tenon joint and held in place by a dowel. This construction gives a very large span without arcade posts obstructing the room.



Figure 8. Deterioration of an arcade post. Up to 4 cm of material has vanished from each side, but they are still massive.

The arcade posts are dug very deep into the ground, and have seen considerable deterioration, up to 4 cm on each side. Due to their massive dimensions, there is still plenty of material left in them, and a risk assessment done in 2011 showed that they will still support the house for many years, but that gradual replacement is advisable.

House Exterior

The walls

The longhouse's walls are constructed from oak staves that have been placed in the ground at a depth of 90cm. They are joined to one another with a distinctive tongue and groove joint. Every second stave has two grooves running from top to bottom where the adjacent plank can be inserted. The stave that slots itself into the groove is therefore held in place on each side by the grooves of the adjacent staves. This construction has been inspired by a 12th century wooden stave church from Vänga, Sweden. Choosing between different known walling systems (Figure 9), the architect's argument was that the Hall was a high status building, and that it should be given the most intricate wall type known at the time.

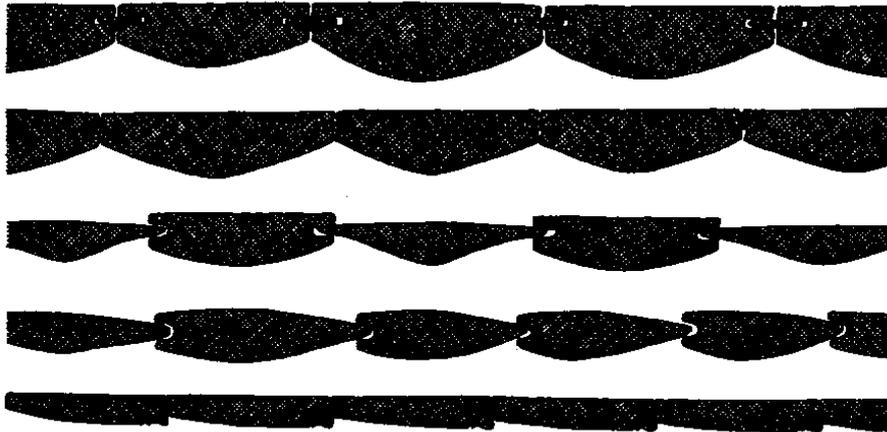


Figure 9. Known wall constructions from stave churches in Sweden and Norway. For the Estate, number three was chosen. (After Schmidt 1994: 115).



Figure 10. Deterioration of the wall planks below ground on the south side of the hall.

Without specific knowledge on the wall type this was a reasonable choice. One could argue, though, that the known stave walls are all found in churches, which may also reasonably be reckoned as high status buildings, belonging to a somewhat higher being than a locale magnate somewhere in SW Jutland. Therefore there is probably no social tie inherent in these construction methods. After almost 20 years of use, we can now realize the weakness of the chosen construction. The two tongues are very thin, only a couple of centimetres thick, and this makes for a frail construction, especially as these staves are dug into the ground, and not resting on a bottom sill as is the case with the stave churches.

This weakness became very apparent when maintenance work on the house commenced in 2011. The narrower ‘tongue’ planks were deteriorated to the point where they had vanished in places. Only the thicker central part of the plank remained in the soil (Figure 10). The walls are now gradually being replaced by a sturdier type (as Figure 9, top).

Running along the top of all the staves is a wall plate with a groove cut on its underside into which the tapered tops of all the staves has been inserted. The wall plates are made from different lengths of wood joined together by simple scarf joints. Each stave is fastened to the wall plate by the use of a wooden dowel that penetrates both the wall plate and the stave (Figure 11).



Figure 11. Wall plate scarfed and joined to staves by groove and dowel. One dowel has loosened.

The south side of the house consists of 69 staves and has no entrance. The north side of the house consists of 66 full staves seeing that on this side of the house there is a door which takes up the width of three staves. Three shorter staves can be found above the door. Both gables have eight full length staves and a door that has a width of three staves.

When constructing this long house a traditional pulley was used to place the heavy timbers into the desired position but on one occasion a 360 kg plank accidentally fell. After realising the danger involved in using ropes for such heavy materials it was decided that it would be better to use a chain and a more modern rig for lifting the beams.

External buttresses

As well as vertical staves the outer walls of the longhouse consist of external buttresses which are used for stabilizing the walls of the building from the outward force of the roof (Figure 12). External buttresses are evident on many of the excavated houses and were placed in the ground at one end and fitted against the wall plate seeing that this is where the main outward force from the roof is concentrated. In the long house in Ribe however the external buttresses have been inserted

into prepared slots found up high on the actual staves (Figure 13), and do not make contact with the wall plate. This was the design of the architect, who had recently reconstructed a similar house at Fyrkat, although with the buttresses supporting the wall plate directly. Apparently he wanted to experiment with the design. Having the external buttresses placed in this position is not nearly as effective as having them butted up against the wall plate, and in effect they are more there for aesthetics than for increasing the structural integrity of the building. When the long house was first built the external buttresses could be easily pulled out of their slots by hand but with time the weight of the roof has put them under more pressure and many of them are now held more firmly in place, while others are still very loose.



Figure 12. External buttresses

The builders involved in the building the hall at Ribe still holds different views about when the external buttresses were placed. Some maintain that they were part of the initial construction, but others maintain that the houses were generally built without them. They were then later installed when the outward force of the roof became evident in the upper parts of the walls. One could also hold the view, that in the earlier period of Viking longhouse construction they were not part of the initial construction but upon realising the effects of the weight of the roof they were eventually installed and later became the standard when houses were being newly built. They may also be connected to roof design, although they seem to occur of different styles of houses. They occur too regularly in Viking Age finds not to be part of the design, although many houses seemingly worked fine without them.



Figure 13. External buttress slot. This buttress could easily be removed, so has no structural function in the building.

The roof

The roof of the longhouse has a curved ridge and both sides are bow-sided or convex and have narrow eaves. The roof is entirely covered with shingles, about 5000 (Figure 14). The reason shingles were used to cover the roof is because there is more than enough evidence that they were used in roofs during this period. At Gl. Hviding itself two shingles were found in a well, and a single shingle has been found at Trelleborg (Jensen 1986; Schmidt 1994: 124).



Figure 14. The shingled roof

On average one man can make seven shingles in a day having the wood already on site and an axe in hand. Each shingle is 1m long, except the last ones placed at the bottom edge of the roof which are only half length since they are only overlapped at the top. Each shingle is held in place by a single dowel. The reason a single dowel was used, was to allow for movement of the shingle caused by the shrinking of the wood. Having a shingle held in place by more than one dowel would hinder any movement and result in cracks and possible leaks. As the builders of the house put it: *“The wood must be given the freedom to work”*.

The current problem with the shingled roof is that some of the shingles are starting to bend. This bend occurs with the shingles that have not been cut along the grain. Of the circa 5000 or so shingles about 400 were entirely shaped with an axe and were therefore cut with the grain of the wood. As for the other shingles, they were cut with a saw; this causes bending and warping over time. Although some shingles were cut with a saw and others with an axe, the exposed side of all the shingles was finished with an axe to give a more traditional look to the roof. It is only by looking closely on the underside of the shingles that one could distinguish between those cut with an axe and those cut with a saw.

House Interior

Partition walls

The longhouse is divided on the inside by three partition walls thus dividing the house into four separate rooms. One room is a stable one is an entrance hall, one is the main hall and one is a bedroom. All the partition wall are made from oak staves like those used for the outer walls and are held together using the tongue and groove joint technique. The difference with the tongue and groove technique used on the inside of the house is that each stave has a tongue and a groove unlike the outer walls that had either two grooves or two tongues per stave.

Floor

The floor is compressed clay apart from the bedroom found at the east end of the house which has a floor made from (number) large oak planks. The idea of putting large oak planks as a floor was taken from an actual find in York from the Viking period.

Roof (inside)

The roof is made with a number of rafters, over which horizontal battens have been placed. The battens have been penetrated by the dowels used to hold the shingles and are visible on the underside of the roof. The main longitudinal plates act as a support for the roof's rafters. Both battens and rafters have been cut square and straight which is of importance for a shingled roof. Any irregularity underneath the shingles will mean the shingles not fitting together as they should and may even be visible on the outside. When building a thatched roof on the other hand the battens and rafters can be round and even have an irregular shape for the thatch fills the gaps created by irregularities and flat smooth outer surface is easily achieved.

In the bedroom section of the house a diagonal cross brace is visible on both sides of the roof which helps stabilize the roof from any sway caused by the wind and increases the roof's overall structural integrity.



Figure 15. Underside of shingled roof

Rooms

As already mention the longhouse is divided into four separate areas by three partition walls. These areas consist of the stable, the entrance hall, the main hall and the bedroom.

Stable

The stable at the western end of the house is reconstructed with the archaeologically documented stalls. It also has an upper floor made from uncut lengths of wood that run from one side wall to the other. Two longitudinal beams support these lengths of timber and are each supported by two vertical posts as well as being partially inserted into a square cut in the arcade posts that are found in the byre.

It is imagined that the upper part would have been used to store hay. In the early Viking period byres were integrated into the inhabitants living quarters but in the later period the byre became a

separate building, the Ribe Viking Centre has both examples. As this stable is quite small, one may speculate which animals were housed here in the main building, and which ones were kept in the separate byre. Without direct evidence this question cannot be solved. No animals are actually held in the stable of the reconstructed Hall; the space being used for storage.

Entrance room

Next to the byre is the entrance hall which is an open room and was once part of the main hall. Seeing the main hall proved to be too big an extra partition wall was installed not only to reduce the size of the main hall but to prevent cool air entering seeing that the north facing entrance to the house once lead to directly to the main hall. Now the north facing entrance leads to the new entrance hall. This is the area where the metal working activities were discovered in the original find.

Within the entrance hall there is a ladder which leads to the upper part of the byre where the hay would be stored. An oven can also be found situated in the corner.

Main hall

This added partition wall leading from the entrance room to the main room has two entrances but no doors. The entrances of these partition walls have been designed to hold leather or cloth flaps which would be used to block out any drafts. The staves from the section of the partition wall between the two doors are not placed in the ground but are placed into a groove found on a ground sill.

Two benches are found on each side of the main hall running along the walls for the entire length of the hall. They are wide enough to allow benches and tables to be positioned there, and they can also be used to sleep on.

A hearth is found in the middle of the room. Directly above the hearth in the roof there is an opening to allow the exit of smoke form the fire. Although the main hall was made smaller it is still the biggest room in the building. Both the partition walls in the main hall have integrated arcade posts and tie beams.



Figure 16. The interior of the main room. The effect of the windows is very clear in this picture. So is the level of smoke in the building.

The Sleeping Quarters

The bedroom is the fourth room in the long house and has the special feature of having a wooden floor. Nine oak planks are placed side by side and run from the gable to the partition wall. The wooden floor was inspired from an actual find in York from the Viking period. The west entrance to the house leads directly to the bedroom. Two beds are found here and are placed lengthways up against the northern wall. Looking up it is possible to see the two cross braces in the roof. This is also a service area without public entry, so that a few modern facilities can be hidden here (mainly electricity for service functions).

The Doors

This long house has three doors, one found in each gable wall and one more found in the north facing wall. The south facing wall has no entrance. The doors consist of four vertical planks held together by two horizontal battens which are fastened by wooden dowels. The doors swivel on two wooden pegs. The bottom peg is placed into a hole the doors sill and the top peg is inserted into a carved piece of wood attached to the adjacent stave. Such doors were inspired from actual finds in Hedeby.



Figure 17. The inside of the west gable door. This picture also gives a good impression of the dimensions of this imposing building.

Repairs and alterations

Some alterations have been made to this longhouse since its construction. As already mentioned an extra partition wall was placed within the main hall which caused the creation of a new entrance hall. Initially the main hall proved to be too big and drafty and a new partition wall seemed to be the best option. The southern section of this partition wall has sunk a little bit which was made worse when the sub surface section of the staves was revealed in order to see the extent of the wood rot that has caused great damage in recent years. The circulation is still found to be sub-optimal, through, and smoke is not circulated fast enough out of the building.

Another important alteration was the installation of windows (Figure 18). The house itself was too dark to work in and so decision to cut out small section from some of the staves was made. Cut through the staves in the finished house, the windows are high and narrow, and of similar but not exactly same dimensions. A salvaged wattled gable from Hedeby has a window 32×48 cm and it is assumed that houses during this period had small windows that were widely spaced from one another making the inside of the houses quite dim.



Figure 18. One of the windows on the south facing wall. The opening can be closed with a plate.

The external buttresses have more pressure placed on them now at the time of construction. Initially these external buttresses could be removed from their slots by hand but many are now held firmly in place. They are in the process of being replaced, due to rot at the ground end.

Also the wall staves are gradually being replaced due to rot. As explained above, the new staves are of a different design, and the house will gradually change its appearance over the coming years.

The Bole House

There are two houses at the Viking Centre with the bole wall construction, the small smithy and the bigger house simply called the bole house. They are both based on excavated house foundations on the site of Hviding, at site known as house LII and house LVI. The characteristic feature of the bole house is the horizontal beams in the wall construction. The beams are supported by vertical posts, spaced with approximately 1.80 m distance (this measurement comes

from the Bole House replica). The origin of the name (also known from “bulwark”) is that the lower part of the tree trunk below the lowest branch is known as the “bole” (“bul” in Danish). The vertical planks were therefore cut from the “bole” of the tree.

The original use of the bole house in Hviding is uncertain. At the Viking Centre, the reconstruction is used as for accommodating people camping at the centre during the season. It has a hearth, benches to sleep on and some shelves hanging on the wall for storage. In the excavation at Hviding, no sign of a hearth in the Bole House was found, nor was there any other inclination of what the house originally was used for.



Figure 19. The Bole House, north facing wall, showing the vertical posts supporting the horizontal planks. The piles of earth surrounding the posts come from the soil sample test procedures.

The architect's plan

The Bole House is based on the excavation in Hviding in 1995 (house LII). Holger Schmidt also did the drawings for this house. The proposal was first sent to the Viking Centre in April 1996, where Schmidt sends drawings as well as a description of his works. The traces of a house consist of postholes and other traces in the ground, which Schmidt bases this reconstruction on. He acknowledges the difficulty in the reconstruction as the traces of building has completely disappeared and he is left with studying the posthole pattern. The house is approximately 50 square meters, with the excavation plan showing it around 4.5 m wide and 10.92 m long. The roof bearing posts are placed 30 cm outside of the gable walls, according to the excavation plan. With a house length of approximately 11.5 m, the use of collar ties and king posts to further support the roof construction is a plausible solution. Schmidt also says that the reconstruction proposal gives double support posts for the bole walls, which should be dug down 60 cm. Double posts is something known from “several Viking Age house sites” (Schmidt 1996, letter in the Centre’s archive).

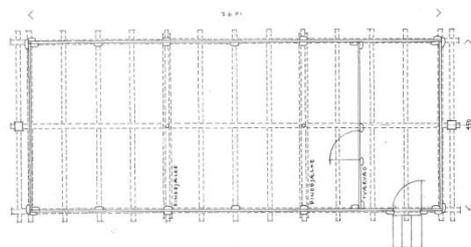


Figure 20. The original drawing by the architect of the Bole House. South is up. Scale 1:200.

The traces from the excavation also give the information that the house was entirely timber built with a simple rectangular shape, something indicating the later Viking Age. There was an inner wall in the house, and the entrance was placed on the north-western wall, leading into the hallway made by the inner wall. The bole planks should by Schmidt's recommendations be 4 cm thick, and as wide as the timber allows for. The drawing shows the stave-built upper parts of the walls, but other solutions would also be possible.

In the beginning of May 1996, the excavation director of Hviding, Claus Feveile, had seen the plan from Schmidt and had some concerns about the drawings. The main concerns were that Schmidt's drawings were based on average measurements of the distances between the posts and that the inner wall had been moved, so the architectural drawing was not the same as the excavation plan. Feveile put the excavation plan on top of the architectural plan to show the dissimilarities. Another thing that Feveile questioned was that since there were no traces of double posts on the Hviding LII site, why would there be on the reconstruction? His idea is that were they to make an excavation of the site at RVC in 40 years, the results should be the same as the Hviding excavation (within limits of the possible), or else it would be odd calling it a reconstruction.

The summer season made a break in the correspondence, as the staff of Ribe Viking Centre had visitors to show around and a great Hall to man, so in January 1997 the bole houses are again looked into. Holger Schmidt was invited to the Centre to look at the houses and to answer some questions, among other the changes that Claus Feveile had suggested. One example was that the staff at the Viking Centre wanted the inner transverse wall of the Bole House should go all the way up to the roof and not be a half-wall. They also had some concerns about the high threshold, because they meant that it was only troublesome and they would like to change it. The visit was made according to the correspondence, and seems to have been satisfactory. The inner wall in the actual house is still a half-wall, but Schmidt made some changes in the plan to better fit the actual excavation plan.

Construction

It was decided to stick to the plan of using double posts for the supporting system. When building the walls, the inner vertical posts are placed first, dug into the ground and eventually fastened to the wall plate in the bearing construction. Then the horizontal planks are laid in from ground and up, and the top plank fits into a notch in the wall plate. The planks are of different width, and the width does not have to be the same on the two ends of the different planks, dependent on the natural width of the plank. After the planks are in place, the outer posts are placed against the inner posts, so they end up opposite each other, making a pair. The posts are not fastened to the planks, but to the wall plate, using treenails. Vertical posts are dug into the ground for support. By experience, the horizontal planks also need to be dug slightly into the ground to give room for shrinkage in the timbers. Unlike the walls, the upper parts of the gables on the reconstructions are stave built, i.e. with vertical planks.

There are seven pairs of vertical posts supporting the walls on the south and the north side (Figure 22). The posts are fastened to the wall plate by treenails (c. 1.5 cm thick) on the upper part's reduction and to benches on the lower part. The house is divided into two rooms, a narrow hallway and a main room. The inner half-wall between the hall and the main room is built by posts N/S 2(cf. Figure 22). On the wall there are vertical bearing posts only on the hallway side, not on the main room side. There are two crossbeam structures with collar ties and king posts, connected with the wall bearing posts 3 and 5. They are fastened to the wall posts by two different techniques, as the N/S 5 fastening is a repair.



Figure 21. The main room of the Bole House, showing the benches, the inner support posts, the sheep wool caulking between the wall planks, and the wall separating the hallway from the main room. The hearth is also visible, as is the spark protection above it. Modern fire precautions must also be taken.

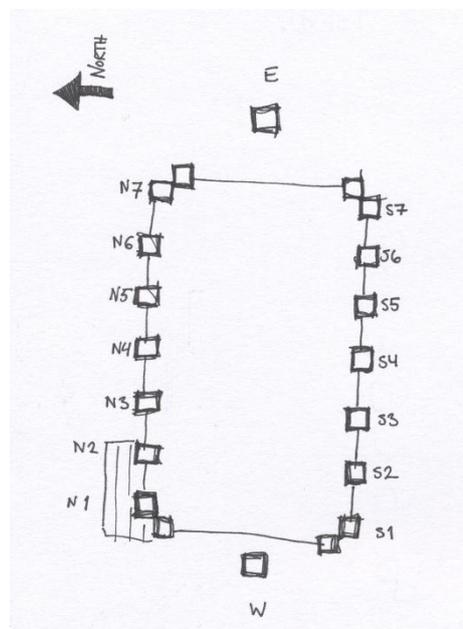


Figure 22. Field sketch of the Bole House and the reference numbers used in this text. Not to scale.



Figure 23. Left: The fastening of the collar tie, inner support and wall plate at N3, being the original fastening as devised by the architect. Right: The repair at N5, where the somewhat frail construction has been covered by a wooden “box”.

The wall plate measures 19 cm in width along the whole house. There are small diagonal holes in the wall plate for drainage of rainwater. The bench height is 30 cm and goes along the walls of the main room, i.e. the northern, eastern and southern walls. The height from the benches to the collar ties is around 160 cm. From the benches to the wall plate on the different sides of the main room, the distances are quite similar to the collar ties: Eastern wall: 160.5 cm on both N and S side. Inner wall: N: 160 cm S: 161 cm. This shows that though there are some differences on the northern and southern side of the house (especially around the posts of N/S 5), it has not gone terribly lopsided during the years.

The central roof bearing posts at the ends of the house are placed outside the house. The distances from the walls differ slightly, especially above ground level. When measurements were taken in approximate waist-height, the western post was 35-36 cm from the wall and the eastern post was at a 30.5-32 cm distance. The arrangement with external roof bearing posts at the gables can also be seen at the Byre, just a few metres from the Bole House. Both are based on interpretations of the original excavations drawings at Hviding. Why this was done originally is quite a mystery to us. There seems to be no immediate advantage of the construction with an exposed post. The Centre staff sees it -tongue-to-cheek- as a possible example of experimental building from the Viking Age.

The western end consists of the wall posts N1 and S 1 in the corners, 8 planks until the wall plate in bole construction, and 13 planks above the wall plate in stave construction. The top triangle just below the thatched roof is a wattle to let more light in; an alteration which was done after the house was built. The plank widths of the bole construction are around 20-25 cm. These planks are narrower than on the other walls. The bottom two planks were replaced in 2010.

The eastern wall consists of the wall posts N7 and S7, and the construction on the inside of the house ends with the benches. There are 4 planks of the bole construction, measuring from the ground up, 35 cm, 51 cm, 54 cm, 37 cm and the wall plate's 19 cm. The gables are constructed from 13 planks in stave construction, much the same as the western wall, with a width of around 30 cm each (variation between 20-38 cm). The upmost top before the roof is again wattle. Between the bole planks there is caulking of tarred sheep's wool.

The southern wall consists of 4 planks of bole construction and the wall plate. The planks measure (from ground up) 34 cm, 49 cm, 50 cm, 37 cm and the wall plate of 19 cm. In between the planks there is tarred sheep's wool caulking. Close to the eastern wall there is a window cut out, measuring 119 × 53 cm. The window closes with two shutters with handles. The use of

windows has been debated at the Centre, but it is found practical to get more light in the house (Figure 25).



Figure 24. The eastern end of the Bole House with the free standing roof bearing post.



Figure 25. The extra light coming from the window on the southern wall. In the background is the eastern wall while the northern wall has shelves for storage. Note also the stove built upper gable of the eastern wall.

The northern wall also consists of 4 planks in bole construction plus the wall plate. The measurements of the planks are, from the ground to the top, 29 cm, 53 cm, 40 cm, 48 cm and wall plate 19 cm. The door is between posts N1 and N2, cut out from the upper and lower bole planks. The door measures 131 cm x 80 cm. The threshold height (i.e. what was spared from the lowest bole plank) is 28 cm. We found that painting the low opening was a very practical precaution, although many a head has still hit the upper door sill over the years.

Figure 26. The door posts on the outside of the northern wall, also showing the untreated posts of N 1 and N 2 together with the wooden entrance and the threshold, which continues from the bottom bole plank.

The inner wall's upper door post, and the door posts of the outer door have all been painted yellow, with a decoration on the upper post in red, green and tar. The yellow and red paints come from ochre mixed with oil and eggs.



The roof is thatched. The roof plate is joined to the king posts of the cross beams in a flat mortise and tenon joint. The roof consists of square rafters and naturally shaped, debarked battens horizontally lain over the square posts. The square rafters measure 9.5 cm x 9.5 cm and are placed at 80 cm distance. There are 11 rafters each on the north and south side, together with the diagonal ends of the western and eastern walls. There is also one extra pair of roof bearing posts outside of the western and eastern wall.

The round naturally shaped horizontal battens have a diameter of between 4 and 7 cm, and are spaced at an approximate distance of 24 cm. The variations are due to the crooked timbers. The horizontal posts are tied to the vertical with a piece of raw hide, in what looks like a knot of the constrictor hitch family. The roof straw is laid out in bundles, spread out thick and evenly, and sewn onto the bearing construction (the horizontal posts) using an oversized iron needle and thin tarred hemp-mixture rope. If there are two people working together, one on the outside and one on the inside, the work is done with a straight iron needle in a fashion reminiscent of the dress making scene in Disney's Cinderella. The workers pass the oversized needle to each other and watch out so they are not in the needle's way when it returns. If the thatcher works alone, the needle needs to be bent in order to work only from the outside. The distance of the stitches is approximately 18-25 cm. The roof top is covered with turf. Even so, there is a leak from the top of the roof on rainy days.

The floor is made of clay. In the autumn of 2011 the workers at Ribe Viking Centre are experimenting with maintenance of the clay floors, mainly in the town houses. There is a saying among the historical centres that a clay floor cannot be maintained, only replaced, but the workers at the centre are testing the removal of the top layer of the clay, mixing that with fresh clay and sand, and add it anew. Time will soon tell if this is a good way of maintaining instead of replacing a clay floor completely.

The hearth is built up on the floor underneath the crossbeam on posts N/S 5. The outer part is a wooden frame, measuring 93 cm x 160 cm x 12 cm. It is filled with stones, with a top layer of clay to protect the wood from the flames, and on top of the clay there is a stone circle for the fire, the outer part measuring ca. 78 cm in diameter. Suspended above the hearth there is a spark protection made out of a wooden frame with a scraped but otherwise untreated hide. This construction has proved useful during the centre's time, and can be found in all houses with a hearth. There are a few stories told at the Centre on how this simple device has proven effective.

Repairs and alterations

The carpenters of the centre believe that the bole planks in this house might be too wide. The more realistic measurements in the Viking Age are likely to have been about 30-40 cm wide and 7.5 cm thick. This is based on considerations on how a split log is best utilized. It might not be a coincidence that the western wall, which has the narrowest planks, is the wall with the least amount of tarred sheep wool caulking. If the bole planks had been narrower, they would warp less when the wood dried. On the other hand, the bole planks from Vordingborg are rather wide, and this is the reason why wide planks are suggested here too.

The repair of the collar tie fastenings at N/S 5 is due to a living-and-learning experience. The architect drawing showed a construction that does not give the best strength when it comes to the characteristics of the wood. The square cut half way through the collar tie gives two breaking points, and this was what happened at the N/S 5 fastenings. Eight or nine years after the house was built, the wood cracked. The experience was made and the town houses have another, more robust solution.

To replace some of the outer support posts will soon be necessary in the bole house. This became obvious when we dug holes around most of the posts to look at the deterioration, which will be further described towards the end of this chapter. The posts on the south side are much worse off than the posts on the northern side of the house, so the south side should be the starting point. Luckily the construction makes for easy replacement. One of the posts is taken out; they are only fastened with two treenails in the wall plate, so it should be easily done. The bottom plank could also be replaced quite easily by just being taken out from underneath. Then a new support post is put in place to replace the old. The eastern roof bearing post is almost as good as new, but the western should be looked into. It has still much bearing wood left, but seems to deteriorate faster than its eastern counterpart. It will not be as easily replaced as the other posts, however, and the question for the Centre is of course whether there will be a 'Viking' way to replace it? One should not neglect the value of being able to do such tasks during the tourist season. Otherwise maintenance with more modern equipment must be undertaken off-season.

Another thing the carpenters have noticed in the Bole House is that the collar ties are under strong stress. The roof is very heavy and the pressure makes the collar tie bend.

Wear and tear

When digging sampling holes around the wall posts, it became evident that there was a noticeable difference between the south and the north side. The north and east posts have all been better preserved than the south and west posts (Figure 27). The western post has a more "expected" form of decay, placed just at the surface of the ground, but the deteriorated part stops a few decimetres down and the shape become fuller again (in contrast to the pointy wear in the Hall, and even on post S3). The eastern post has no wear at all. It was very solid, which is strange as the sample showed very dry soil. The sandy soil of the sample may well have been left over from the top soil, but the sample was not taken noticeably higher than the other samples, so there may be a difference at the depth of the sandy soil as well. There may also have been some contamination of the sample in sand falling down from the uppermost layer.

No samples were taken from the posts N1 and N2 due to the door construction being in the way (cf. figure 22). That being so, there will be no direct linear reference to the difference of the posts S1 and S2, which is why we let S1 be still. The results speak clearly enough, however, that there is a difference in the soil moisture and that has influenced the wear of the posts. With this in mind, there are questions to be asked in consideration of the soil type the Viking Age people would prefer. The Ribe Viking Centre used to be wetlands, but now there is a 1.20 m layer of

sand on top of that. The excavated areas were placed on sand. The only odd thing with the moisture picture is the eastern post, so there may be other mechanics at work as well.



Figure 27. The post S3 was one of the most worn posts of all on the Bole House. The contrast of the wear on the northern side of the house (here post N3) was striking in some cases.

Something well worth thinking about, however, is the direction of the wind. The wind and the rain in south-western Jutland are two things never far away. One side of the house must be more exposed to the wind and the rain, which normally comes from the west. The changes in moisture might be the villain here. The wood wears more if the environment around is changing as opposed to being more stable. The northern and eastern side could be protected from these shallow but yet significant changes by the western and southern side of the house. This is the case for the thatched roofs, where according to the carpenters the northern side lasts up to 5 years longer than the southern side. The only explanation is that the southern side of the roof gets more wind, rain and sun, and thus get wet and dry quicker and with more changes than the northern, protected side.



Figure 28. The difference in wear of the western (left) and eastern (right) posts. Though the western post's pit is dug deeper in these pictures, the difference in the soil is clearly visible, with the eastern hole being significantly moister.

The Byre

The Byre at the Ribe Viking centre is ??? wide at its widest point and ??? long. The walls are made from wattle and daub and have an average height of 1.95 m, the roof being thatched. The byre has two entrances, one on the north facing gable which leads directly to the outer pen and is solely for the animals (Figure 30). The other entrance is found at the centre of the eastern wall.

The idea of having a separate byre was a development of the Viking period, before developed byres were usually integrated into the inhabitants living quarters. An example of an integrated byre can be seen in the Hall.

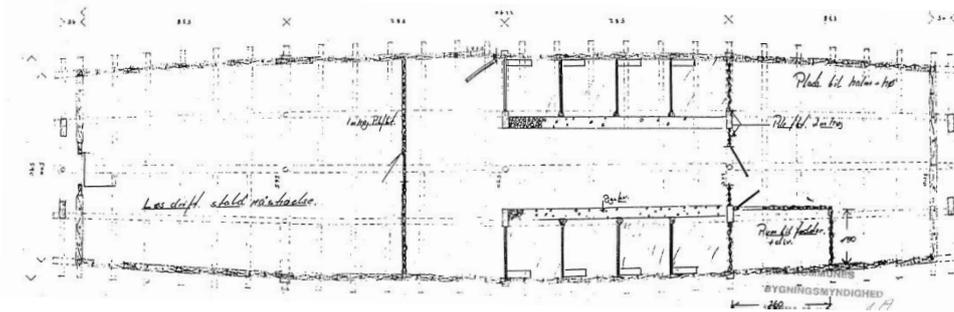


Figure 29. The original plan by architect Holger Schmidt. North is to the left. Scale 1:200.



Figure 30. Outer part of byre with the two entrances.

Construction

Bearing structure

The byre has four sets of arcade post of which two set are placed on the outside of the building. Each set of aisle posts is 42 cm wide and 14 cm thick and are placed at a depth of 1.20 m into the ground. A collar tie connects the aisle posts along the top on which a king post is placed at its centre; the king post is butted up against the roofs ridge plate. Two arcade plates running for the entire length of the building are inserted into right angled slots found at the top outer corners of each arcade post. Although a large part of the bearing structure consists of aisle posts there is one exception. Running perpendicular to the longitudinal axis of the house and placed on the outer walls above the animal enclosure a ceiling joist is present on which two queen posts are positioned. On top of these queen posts a tie beam has been placed at the same height as those found on the aisle posts and just like the other tie beams a king post is present. The absence of aisle posts within the animal enclosure allows the livestock to move more freely.

The decision to place two sets of aisle posts outside was based on actual post hole finds from the Viking period but the reason for their unique positioning is still debated. It could have been an attempt to achieve more inner space or a means to prevent the animals making contact with such

an important part of the bearing structure or simply the product a builder's creativity. The exterior aisle posts are placed at a distance of 30cm from the gabled walls. The real disadvantage of having exterior aisle posts is exposure to rain which quickens the presence of wood rot.



Figure 31. Bearing structure with queen posts situated on a cross beam above the animal enclosure.

Walls

The walls of the byre are made from wattle and daub. The technique of wattle and daub is very simple and reliable even in harsh weather conditions found in northern Europe. The technique works as follows: vertical staves are placed in the ground and horizontal withies are woven between these staves forming a wattle structure to which daub mixture is applied. In this byre the staves are placed at an average of 45cm apart with their top end inserted into prepared slots on the underside of the wall plate and each fastened by a treenail. The staves are placed into the ground. The daub in this byre used to cover the wattle wall is made from clay, straw and sand but animal dung can also be added to the mixture. In this mixture the clay acts as a binding agent which holds the mix together, the sand gives the mixture its bulk and stability which is then reinforced with the straw.

The longitudinal walls have an average height of 1.95 m and all the walls including the gabled walls have an average thickness 18 cm. The gabled walls at both ends have their top section made just from wattle, this allows for the passage of air which serves to aerate the building both for the animals and hay found within. Aerating the building for the sake of the animals is important to have clean air and to reduce the smell created from excretion. Having an aerated building is also very important where hay is stored for it prevents the build-up of humidity which could lead to self-combustion if allowed to accumulate.

The two gabled walls are more exposed to the wind, sun and rain making them subject to re-daubing whenever wear becomes evident. Another method of protecting the exposed gables can be seen on the south facing gable where a straw mat has been placed right across the wall (Figure 32). All the outer walls in the byre are kept out of direct contact from the cows. The east facing wall also has a fence put up so that the livestock cannot make contact with in whilst outside and the north facing gable has vertical wooden staves that serve the same purpose.



Figure 32. Straw matt used to protect the gabled walls against the elements.

The daub is effective in protecting and preserving the underlying wattle structure which it covers but like in the longhouse, the wooden staves found below the soils surface have been exposed to wood rot. 12 years after its construction the rot problem had to be challenged which will be discussed in more detail later in this chapter.

The roof

The roof of the byre is a thatched gable roof. The ridge of the roof has been covered with square pieces of turf from end to end in order to seal it and prevent leaks. One interesting feature of this roof is the way in which its gabled edges are finished. Along the most outer rafters on each side an extra plank of wood has been attached, the plank is wider than the rafter and therefore gives the end rafters extra height. The thatch placed over this section of the roof slopes slightly upwards and serves to channel the rain run off to the sides of the house. It also is more aesthetically pleasing, see Figure 33 below.



Figure 33. The end rafter with extra lath of wood attached causing the thatch to bend upwards.

The 16 pairs of rafters have been cut squared like those in the long house. As for the 2×26 horizontal battens they are simply unworked lengths of wood with the bark still present. The reason the rafters were worked to have a square cross section was simply the choice of the architect and serves no particular purpose on a thatched roof. A thatched roof has the advantage of taking the shape of the below lying rafters and battens thus giving a smooth outer appearance regardless of underlying unevenness. If one looks at the Hall with its shingled roof one can understand the importance of smooth and evenly cut rafters and battens. Any irregularities in the rafters and battens would mean the shingles being badly positioned and would not only be aesthetically displeasing but would also create open gaps between the shingles allowing rain to seep in and drafts. The rafters and battens on the byre are held together with the use of strings made from raw hide while the thatch is also tied on with lime bast.



Figure 34. Square cut rafters tied to uncut battens with strips of animal hide.

Interior

The interior of the byre has four bays and can be divided into four separate areas. One area is where the animals are housed which is situated to the right when entering the byre from the eastern entrance. The second area is an open area and is where people entering the house first find themselves and here there is also a small animal pen which can hold more livestock. The third area which is found on the left when entering the byre is used as another area which has 9 separate stalls to house more livestock and above this stable area there is another level where hay is stored. After the stable area has been passed there is a wattle door that leads to the final section of the building which is used as a store area, especially for hay. All these sections of the buildings are discussed below in more detail.

The animal enclosure

This area of the building is where the livestock can be placed during the night and get shelter from the rain and cold. Of the two entrances into the byre one is strictly for the livestock and is found in the north facing gable of the building, it leads to the outer pen where the livestock have more space to roam around, see Figure 35. The other entrance is open for the public.



Figure 35. Outer entrance to the byre's animal enclosure.

The animal enclosure uses the outer walls of the building for two of its four sides, that is most of the north gable and a section of the west facing outer wall. The sections are protected by wooden staves, to prevent the cattle from rubbing against the wall. The other two walls that make the enclosure are made from wood. One of these walls runs parallel to the east facing wall and forms a thin corridor area where hay can be placed and used as a trough for feeding the cattle.

Figure 36. The feeding aisle on one side of the cattle enclosure.



The south facing wall of the animal enclosure is a waist high wooden wall which runs from the west facing outer wall and joins the other waste high trough wall at 90 degrees. It has a double gate in it that allows access to the interior enclosure. The reason a double gate was selected was that when open there would be a wide enough space to allow the access of a cleaning machine. Having livestock enclosed in a relatively small area allows for the rapid accumulation of manure and using a modern machine is the quickest and most efficient means to tackle this issue.

The entrance area

This is what is first encountered when entering the building from the eastern entrance. The double gates leading into the animal enclosure can be found here as well as a small animal enclosure situated directly opposite the entrance. Access to the second floor of the stable area is also accessible from here by means of a ladder.

The stable area

The stable area of the byre consist of two levels, the bottom level having nine separate stalls, five on the right side and four on the left and an upper level where hay is stored. Just like in the long house the floors of stalls are cobbled and are slanted towards a gutters that run along the sides of the central aisle which is made from compressed clay. The stalls themselves are made by a series of separators about 90 cm high each. Each separator is placed between two longer pieces of worked wood which have the function of supporting the main beams of the upper level where the hay is stored.



Figure 37. Individual stalls placed centrally in the house.

The hay storage area above is made from a placing unworked and relatively thin lengths of wood across the underlying beams. On top of the unworked lengths of wood small planks of wood are placed so that a person retrieving and stacking the bales of hay will have a smooth surface to walk on.

The Store room

The final bay of the byre is separated from the stable area by a wattle wall, the door too is made from wattle. Seeing that this section of the byre is used to store hay the wattle walls and door serve to allow the movement of air which reduces the build up of humidity. Within the storage area there is also an inner chicken coop which the chickens can access by means of a small entrance that leads to the outside. There is also an area where the geese are housed.

Alterations

The byre has a total of six small windows that were made after construction was completed to allow for more light. Three of these windows are found on the east side of the house and three are found on the west side of the house, they are 20cm high and 40cm wide and are all situated in the southern section of the house, no windows are found in the animal enclosure. They were simply made by cutting a rectangular section out of the wall and then making a frame with four planks cut to size to fit the newly cut sides. The window frames are simple openings without glass, and can be opened and closed with the use of a fitted piece of wood. (Figure 38)



Figure 38. One of the six windows found in the byre.

Wear and tear

The wall plate especially above the eastern doorway has been noticeably pushed out of place due to the outward force caused by the roof see fig below. According to the Centre's staff, thatch has an average weight of 30 kg per square metre so it easy to imagine the forces involved by the weight of such a roof. The use of external buttresses on each side of the longhouse were used to tackle such a problem and in turn helped maintain the structural integrity of the building and possible collapse. Having a reconstructed example of a building without external buttresses is a great way to compare techniques and possibly grasp the reasoning behind different buildings form the Viking period. One must also remember that similar structures have been erected for thousands of years before the Viking Age and the use of external buttresses. Therefore they may be of significance.

The sub surface section of the exterior aisle posts on the south side has been exposed and examined. Wood rot is present and the extent of deterioration is up to 3 cm on all sides of the aisle posts. This is the result of 14 years of exposure, another 14 years and the aisle posts will be deteriorated right through. One of the main reasons why the deterioration has been so rapid is due to the absence of a roof at the gabled ends of this building. The eaves of the roof plays a huge role in protecting the sub surface section of wooden staves and aisle posts by acting as kind of a shelter from the rain and slows down the spread of wood rot. On closer examination of three different buildings, that is the longhouse, the byre and the barn (which will be discussed later) it is clear that the bigger the eaves of the roof the less the extent of wood rot. Simply increasing the size of the eaves proves to be a very effective method against wood rot and was overlooked during the starting stages of the long-running building project in Ribe.

As for the vertical staves situated within the main walls of the building they too have become the victims of wood rot. Although the daub used to cover the underlying wattle structure is very effective in protecting the wood above the surface, below the surface the wood is still subject to a wet and damp environment. The fact that the byre is used to house animals means that excretion is ever present. The wet conditions created by excretion greatly contribute towards the presence of wood rot and deterioration in the subsurface sections of the wattle structure. The vertical staves are prone to more deterioration than the aisle posts found in the byre and presence of animal excretion is not the only reason. The vertical staves used in the wattle and daub walls as well as being a lot thinner than the aisle posts has preserved of sap wood which has a quicker deterioration rate than heart wood. The wooden staves used in the walls are made by radially

splitting a relatively thin log of wood which is the reason for their triangular cross section. Being radially split means that widest part of these staves was once the outer section of the parent log, which mainly consists of sapwood.

Resolving such a problem required the use of a modern method which worked as follows: Concrete was used to fill the area below the vertical stave that had the rotten part cut away. An iron plate was then placed vertically into the concrete which was then screwed into the vertical stave (Figure 39). Having the stave now held in place by an iron plate fixed in concrete proved to be a successful solution in facing wood rot but it also contradictory to the Viking Centre's rule of keeping things "authentic". This is a simple question of the running costs of maintenance; and the fact that this would never be visible to any visitor.



Figure 39. Showing iron plate attached to newly cut wooden stave at one end and inserted into concrete at the other.

The Smithy

The architect's plan and the excavation

"The Smithy" is based on house LVI of the excavation in Hviding 1995. The excavation gives evidence of this having been a pit house, since the floor level was found approximately 50 cm below surface. According to the archaeologists (quoted by Holger Schmidt) there seems to have been a 30 cm layer of topsoil, which means that there is evidence of the floor level being dug down with 80 cm. The traces of the house in the excavation measured 3.5 x 4.78 m and had three large posts each in the eastern and western gables of the house. The posts were dug down by approximately 50 cm below floor level, but there was a difference between the eastern and western wall. The western wall showed the posts inside the foundation, where the eastern wall posts were in line with the foundation. According to Holger Schmidt this would have complicated the construction of the house. His theory is that it was done because of the door being placed on the eastern side where the posts were better supported. Because of the size, the shape and the complex construction, Schmidt preferred to date the house to late Viking Age.

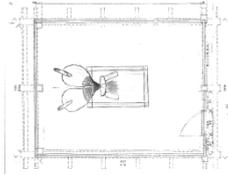


Figure 40. The architect's original drawing of the smithy. 1:200.

The reconstruction plan is done in bole technique, because it is the most probable construction of the house. The eastern wall is different from this by the door opening being stave built, which actually seems like the most logical solution. The planks are fastened to the outer side of the western posts, but to the inner side of the eastern posts, leaving only the eastern wall with visible supporting posts. The roof is supported by the wall plates and central supporting posts in the two gables.



Figure 41. The smithy seen from the roof of the barn.

Construction

The smithy is a small bole house, without any crossbeam support inside. The walls have no outer posts supporting the walls, as is the case with the Bole House, but only narrow support posts on the inside.

A small embankment surrounds the house, but is not piled up against the walls. This is the earth dug up during construction of this sunken hut.

The bole construction consists of five planks on the western and southern wall, while the northern wall has four planks. On the eastern wall there are some narrower planks, along with one very narrow plank that seems to be a repair, which makes the total number of planks seven. The gables have the stave construction on top, like the Bole House, but unlike the other houses, the smithy lacks the wattle opening at the very top of the wall. The stave construction has 14 staves on each side. The eastern wall also has the door, which is accompanied by one stave next to the door posts.

The height from floor to the wall plate differs partly because there is an uneven scarfing in the corners, where one piece sits on top the other, so the two gables are slightly over 10 cm higher

than the two long walls. The wall plates have diagonal draining holes, just as the Bole House and the Hviding Hall. The average heights (floor to wall plate) is as follows:

S wall: 137 cm, N wall: 141 cm, E wall: 150 cm, W wall: 148 cm.



Figure 42. The inside of the Smithy's southern wall, showing the narrow support posts of the bole planks. Note also the wall plate being thicker than the other planks and that the wall bears the markings of blacksmiths or visitors.

The height of the wall plate differs as well, 15 cm on the roof bearing wall plates of the north and south walls, 14 cm on the stave bearing wall plates of the western and eastern walls. The eastern and western wall have a roof bearing mid-post, the eastern wall on both inside and outside of the wall, where it's just on the inside of the western wall. There are two vertical wall posts each on the inside of the southern and northern walls, though not as thick as in the bole house.

All fastenings on the wood work seem to be treenails. On the eastern wall, however, the construction itself is interlocked where "tenons" of the northern and southern planks protrude through cut holes in the gable planks. On the western wall the planks are fastened by treenails only.

Figure 43. The eastern wall with the tenons protruding from the northern wall's bole planks. The picture also shows the narrow plank (second plank from above) put in after the shrinkage of the wood gave a large opening between the planks. The grass embankment surrounding the Smithy can also be discerned behind the house.



The width of the bole planks differ more in the Smithy than in the Bole House. This is

probably because of the different number of planks in each wall. The northern wall's measurements are 40 cm, 32 cm, 39 cm, 27 cm. The eastern wall, which includes one repair plank, measures 15 cm, 27 cm, 17 cm, 29 cm, 36 cm, 3 cm and 27 cm. The southern and western walls each have five bole planks, but the measurements differ still. The southern bole planks measure 28 cm, 22 cm, 30 cm, 27 cm and 25 cm, where the western planks have the measurements 37 cm, 34 cm, 31 cm, 23 cm and 20 cm. All the measurements are given in order from floor to the wall plate.

The stave built gables also show a variation in measurements, but seems to be most usual in the width of 20-30 cm, with some common exceptions.

The floor is a mixture of earth and soot. In the middle of the room the hearth or the forge is placed in a comfortable working height. Small anvils stand on wooden stumps. The smithy is usually manned during opening hours and proper blacksmithing work is done. The soot and charcoal on the earth floor come from using the Smithy, although it has its own decorative feel to it.

The roof is thatched, made by the same principles as the other houses. Between the vertical rafters the distance is 84-85 cm. The distance varies more between the horizontal posts, but 20-25 cm is usual. The vertical posts have fastenings of raw hide, but the straw has been attached to the horizontal posts by a variety of string materials.

There is only caulking with sheep's wool in the southern wall, and one small piece of wool in the northern.

Wear and tear

Even in this case the bole planks are too wide, in the view of the carpenters. They should also have liked to build the house with overlapping planks instead of the side-by-side bole planks. The reason for this preference has to do with the drying tolerance of the wooden planks. As it is now, the caulking with sheep wool has been done only where the distance is too big between the planks. Another trace from the shrinkage of the wood can be seen in the narrowest planks of the Smithy walls, which have been put there after the wood dried. A usual approximation is that wood shrinks with 8 % when it dries, and because of the fastening system of the planks in the Smithy, the option to lift up the planks is not feasible.

The technique of bole planks is a rather wasteful technique by modern standards, especially with wide planks. The log is radially split and a big part of the piece goes to waste to make a plank.

The grass embankment surrounding the house was designed to keep the earth away from the planks, and so preventing unnecessary deterioration of the wood. However, when it rains, this grass hill makes the rain water form puddles next to the house wall instead. One solution might be to fill in the distance from the wall, another to make a drainage system from the space between hill and wall, away from the house, and for the sake of visitors maybe also away from the road.

The use of the original house is not certainly a smithy. There has been some discussion whether it could have been a small church as well. The placement of the smithy, as well as any other fire hazard, would have been planned in the Viking Age as well as when the first towns were being founded. The smithy would have been placed at a distance from the other buildings, and with the wind in consideration, where it was at all possible. Even in the modern time, the Viking Centre is aware of the fire hazard, and the raw hides which act as spark protection for the ceiling are changed when needed.

The interior is of the carpenters' own design. The forge consists of a wooden base filled with stones, with clay on the top. The opening, where the bellows air joins the fire, is made from soapstone, which is a rather expensive solution, but examples of both soapstone and clay have been found from Viking Age excavations. Another interesting question is whether the blacksmith in the Viking Age built up a forge, or if instead the smith was dug down to come closer to the hearth. The latter example has been seen ethnographically. Even here it's important to remember, and the carpenters also stress this, that what seems natural to the modern day person might not have been natural for the persons living in the Viking Age. The same goes for the need of anvils. From the Middle Ages small anvils have been found, but the use of a well-shaped stone might have been just as useful if the iron needed to go to the objects. However, a smithy on the Hviding farm might not have been a poor smithy.

The roof has been attached to its horizontal support beams by a variety of strings of elm and willow bast and raw hide. All of these varieties are now rather decayed. The foundation in wood, the threshold and the lower piece have also decayed and is ready for replacement. The replacement will be more difficult than on the Bole House, because of the fastenings of the planks being interconnected in the walls.

A big discussion within reconstruction circles is the question of the chimney, or the outlet of the smoke. A popular theory about the holes on the side, which is usual for letting in more air, has not much practical use for letting smoke out. The carpenters told a story about how, when it was dark outside and the hearts were burning in one of the houses, they could see how the smoke escaped from every little crack and space between the planks. To really trust experiments with smoke within a Viking Age house, the fire should be watched to be kept at a good, steady temperature. The door should not constantly be opened and closed either. In short, it would be a difficult experiment to conduct during opening hours at the Viking Centre, or any centre that is open for visitors.

The Barn

The barn is 13.90 m long and 5.70 m wide. The walls are just made from wattle and there are two entrances. The roof is thatched and is hipped with four sloping sides. It is used to store hay, and a wagon.



Figure 44. The barn seen from north.

The carpenters' plan

The barn is the only house at Ribe Viking Centre not based directly on an archaeological find. There was another house connected to the farm at Hviding, but that house is used as an entrance and ticket sale to the Centre, and is completely modern inside. To run a full farm, as is done at The Estate, the Centre felt that a barn was necessary, and therefore the decision was made to make another building, this time in a more free form, using only eye and experience. Therefore no plans existed of this house. It is the carpenters' own vision of a Viking house. To put it in context with the other scale drawings in this chapter, we measured it in the field.



Figure 45. The barn as measured by the team. No plan previously existed of this house. 1:200.

Construction

The bearing structure

The bearing structure of the barn consists of three pairs of arcade posts. There is a collar tie connecting the each set of arcade posts post at the top in the middle of which a kingpost can be found which supports the roof's ridge. Two arcade plates which rest on the tie beams are placed directly above the wall posts and run the entire length of the building.



Figure 46. An inside view of the barn, showing the roof bearing structure.

Typical for this building the timbers are cut relative rough, making a marked contrast to the finely hewn timbers of the other buildings at The Estate. Considering the use of this building, this design choice makes sense, but is in fact also a reaction to the other buildings being felt too “neat” and in a design ‘ruled by the ruler’.

The walls

The walls of this building are made from wattle in the same way the underlying wattle walls of the byre are made. Vertical staves radially cut from relatively thin logs of wood are placed at an average distance of 10-20 cm apart and then withies are weaved in and out of these vertical

staves. At each corner of the building there are corner posts which are square cut and wider than the vertical staves. Two additional posts made in a similar fashion are found between the doors frame and the west end. The fact that the walls are not covered with daub comes with a good reason. Being a building which has a main purpose of storing hay it is of utmost importance that the air has a chance to pass through. The reason for this is that hay if stored when it is still green or if it gets wet or even damp before being stored it can self ignite. The heat which may lead to self combustion is caused by both chemical and biological processes and it is therefore very important that the area is well aerated to avoid such incidents taking place.

The roof

The roof of the barn is thatched with hipped ends. The ridge of the roof, like that of the byre has been covered with turf from end to end in order to seal it and prevent leaks. As mentioned it is very important that humidity does not build up inside the hay shed for it can lead to the self combustion of hay. The eaves of the roof are not even the whole way around the building and ranges from 57 cm to 90 cm in some places. As already mentioned, the protruding eaves acts as a very effective means in slowing down the deterioration process at the base of the walls. It was fourteen years ago that this building was constructed and so far there has been an average deterioration of 1 cm at the bases of the buildings corner posts. Compare this to the exterior aisle posts of the byre that were also placed in the ground 14 years ago and now have deterioration at a depth of 3 cm. The immediate conclusion could be that even large eaves can slow down wood rot up to three times, and at least it can be seen as one of the main anti-rot techniques available during the period. Whether it was used we can hardly tell.

On the underside of the roof the rafters and battens are visible. They have not been worked and are still round and also have traces of bark on them: they were simply cut to the appropriate length and installed. The rafters that run from the wall plate to the roof's ridge are known as common rafters and the rafters that run from the wall plate to the hip rafters (that is the four corner rafters) are known as jack rafters.

One extra feature of this roofs underlying structure is the way it is constructed above the doorways. There are two double door entrances in this barn that are situated directly opposite one another so that a hay cart or can pass through one door, be filled up with and the exit from the other door. Allowing the cart to pass through the building by means of two opposite facing doors eliminates all the complications of reversing, turning and positioning the cart when loading takes place. Above the doorways the roof has been lifted in an arched like fashion to give more freedom of movement to those entering the building.

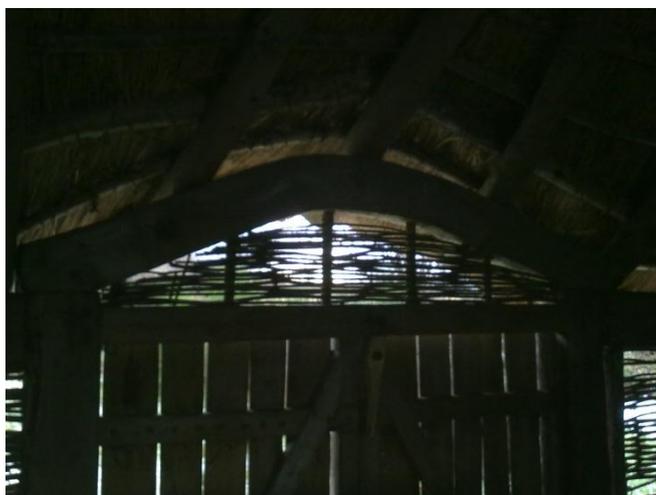


Figure 47. The roof structure atop the northern double door.

The rafter which makes its way from the ridge to the arch is cut short and then three smaller rafters spread from this main rafter which give the arch its shape. The battens and the rafters of the whole roof are held in place by both strings of raw hide and wooden dowels. The strings stop the dowels from coming out of their holes in case a wind causes substantial upward lift in stormy weather. As for the dowels they simply hold the battens and rafters in position and stop the batten from sliding up and down along the rafters.

The doors

As already mentioned there are two double doors in the barn, one on the north facing side and one on the south facing side. Wide, high and opposite one another the doors allow for the convenient loading and unloading of hay

Figure 48. One side of the northern double door.



General discussion

The Estate is built on low lying ground. Although precautions were made by removing the peaty topsoil and replace it with more than a metre of sand, water is a problem for these buildings, and we have observed ground water standing in the inspection holes that were dug around the posts of the houses. These houses stand with their feet wet, probably more or less permanently, and at least during most seasons. We experienced a very wet summer, so maybe the ground water level may lower sufficiently to dry out the posts during warm summers. In retrospect it is not an ideal location for wooden buildings, and indeed houses are rarely found archaeologically on low-lying ground.

Using these areas for building was a question of the possible, and of using the entire space available to the Centre and its activities. It is also worth noting that these houses have functioned for two decades. They are now in need of repair, but that would go for any building after 20 years. It is also worth noting that the high water level is apparently not solely responsible for the degree of degradation seen, as there was a noticeable difference between the north and south sides of the houses. This was worth looking further into.

Soil moisture content

The discernible differences in wood preservation between the north and south facing walls in both the hall and the bole house suggested a microclimatic difference between the two sides. When digging the holes for inspecting the underground parts of the constructions, we noticed that while the soil in north side seemed relatively moist, the south side was dryer, almost like a loose powder at the top level. To validate this observation, and to examine the extent of the difference, the soil moisture content around the bole house was examined. Soil samples were taken outside all vertical posts, except the westernmost, where the entrance hindered any digging on the north side, and the south side therefore also omitted. The soil samples were taken c. 10cm below surface level, omitting the very dry topsoil.

The samples were weighed and then oven dried at c. 110°C for 16 hours after which no weight loss could be measured, and all free water therefore had evaporated. Measuring weight before and after drying gave the moisture content in % (Table 1).

Sample	Wet, g	Dry, g	Moisture, %	Sample	Wet, g	Dry, g	Moisture, %
W	123	117	5,13	E	128	126	1,59
N1	-	-	-	S1	-	-	-
N2	-	-	-	S2	148	142	4,23
N3	114	108	5,56	S3	123	119	3,36
N4	133	128	3,91	S4	164	160	2,50
N5	135	126	7,14	S5	124	121	2,48
N6	166	160	3,75	S6	147	140	5,00
N7	127	123	3,25	S7	125	121	3,31
Total North			4,65	Total South			3,33

Table 1. Soil moisture content around the bole house.

This simple test demonstrated that the water content was indeed higher at the northern side, the difference between the two sides being 1.3% soil moisture across all samples. This is not a large absolute difference, but still makes for 40% in relative difference between the two sides. The soil samples were taken after a couple of days with relatively dry weather in early November 2011. The very low water content at the eastern roof bearing post may be because this sample have been taken slightly higher in the ground than the others, and thus possibly with intrusion from the powdery top soil. Another factor may be that the East side of the house would be relatively dry in an area with predominantly westerly winds.

Although one may note that we have only measured soil moisture content on this one day of the year, there seems to be a relation between dryer soil conditions and bad preservation of the wood. The southern -drier- sides of the houses see more degradation. This relation is actually well known for above-ground building timbers. In the recommendations by the Danish National Cultural Agency (“Kulturstyrelsen”) for preservation of the built heritage (Kulturarvsstyrelsen n.d.), treatment with pine tar is suggested for wooden roofs. It is also recommended that this treatment is repeated every 5 years for south facing roof sides, but only every 20 years for the north sides. The difference is explained with the different effects of sunlight, which is seen as the main factor in the degradation of wooden roofs. That may be, but sunlight cannot be the direct cause of the severe rot seen in the underground parts of the houses at Ribe Viking Centre. The effect here can only be indirectly linked to the sunlight. Possible suggestions could be that the higher temperatures in the ground, as indicated by the dryer soil, would induce a higher biological activity, and thus more rot. Another explanation, which we got from the roof thatcher working for the Viking Centre, is that the higher variance in microclimate on the south facing sides, with alternating dry and wet conditions, gives a mechanical degradation of the material, which then opens the way for the fungi.

From an archaeological perspective, both the national recommendations and our observations in the field would suggest, that we should expect more repairs on south sides of archaeological houses, and that we cannot conclude much on the use-life of a house based on its repairs.

General assessment of the houses

The main house in this group is *the Hall*. It is made from massive amounts of oak wood. In general it must be assumed to give a good depiction of this house type during the Viking Age. It is a successful build. In the light of this we still have a few comments on it.

It is interesting that the sawn shingles now start to show a noticeable warping, unlike those that were hewn completely by axe. This is something we also recognize from ship reconstructions, and is a testament to the technological importance of the introduction of the saw during the Middle

Ages: The axe and the saw represent two substantially different approaches to working with wood.

The observation that external buttresses should rest directly against the wall plate, rather than the walls, make this feature critical to the general outlook of the Hall. If the reconstructed angle of the buttresses is correct, and if they should rest against the wall plate, then the wall is probably the better part of a metre too high. The entire house could have been lower, which may also have given a more harmonic looking -but possibly less imposing- building. This interpretation rest entirely on the assumption that the angle of the buttresses are correct, something that is not entirely clear from the original material.

The house has been reconstructing with high gables. The argument by Holger Schmidt was that there were heavy posts in the gables, and that they must have carried a heavy structure. The original drawings are kept at *Sydvestjyske Museer*, which kindly allowed us to access the material. According to these drawings, the gable post do is fact run deeper than the wall ditch, but not by much. They are not as heavy as the other arcade posts, and by their spacing are probably just door posts. Therefore a hipped gable, as is seen in the Fyrkat reconstruction, also seems a realistic possibility (Figure 49).



Figure 49. The reconstructed house at Fyrkat. Photo: Malene Thyssen, from Wikimedia commons.

With the authors' background in maritime archaeology, and seeing the strong degradation of the underground timbers, we also cannot help but to speculate whether this house should have been tarred. We know tar was used for boats and ships; we also know that it was used on the Early Medieval churches, at least in Norway. There is no evidence for tarring in the finds. But we will discuss in chapter 7 whether even the colour of The Hall could be wrong.

In the excavation plans there are traces of at least parts of the walls being supported by inner posts. This is a normal feature of houses in this period, and can be found both in Scandinavia and England (Goodburn 1995). At the house in Hviding the pattern of inner posts is scattered and irregular, and is not connected to certain parts of the house. This feature is not used in the reconstruction, and although widely known, we have not found any suggestions for the structural function of these posts. From Haithabu we know one-aisled houses with inner bearing posts (Schultze 2008), but they are of a different construction, with spacing between the posts.

The Byre is interpreted as a purely economic building, and used for cattle and poultry. Precautions have been made to reduce wear from the cattle, as well as to protect cattle and visitors from each other. While the latter was not a consideration in the original houses, the need for protection and reinforcement against leaning and scratching animals must have been the same.

What puzzles us the most about this building are the heavy roof bearing posts situated outside the two end walls. One would imagine that they were better protected from the elements, if they were built into the wall.

Finally we find *the Barn* interesting in that it is the only house at the Centre which is not based on archaeological drawings, but purely made by eye and experience of the carpenters. The barn was constructed after building the rest of the houses at the centre. It is not least interesting that the carpenters hold this to be the most authentic of the houses, as the original Viking Age houses were built in this way and not from a drawing. This is in fact correct. Authenticity is therefore not an absolute term, but the level of authenticity in this house is then derived from the vast experience of the builders in constructing a large number of houses at the Centre. We shall also discuss this aspect further in chapter 7.

4. RIBE TOWN, AD 825

The area Ribe Town consists of eight houses in two groups, each based on original excavations in different parts of the Viking Age town.

Confident that they did not need the help, or expense, of an architect to draw up these houses, the staff decided to design and build these houses on their own, in cooperation with archaeologists in Ribe. They are based on finds from two separate locations in Viking Age Ribe, three of the houses being based on one and the same house find.

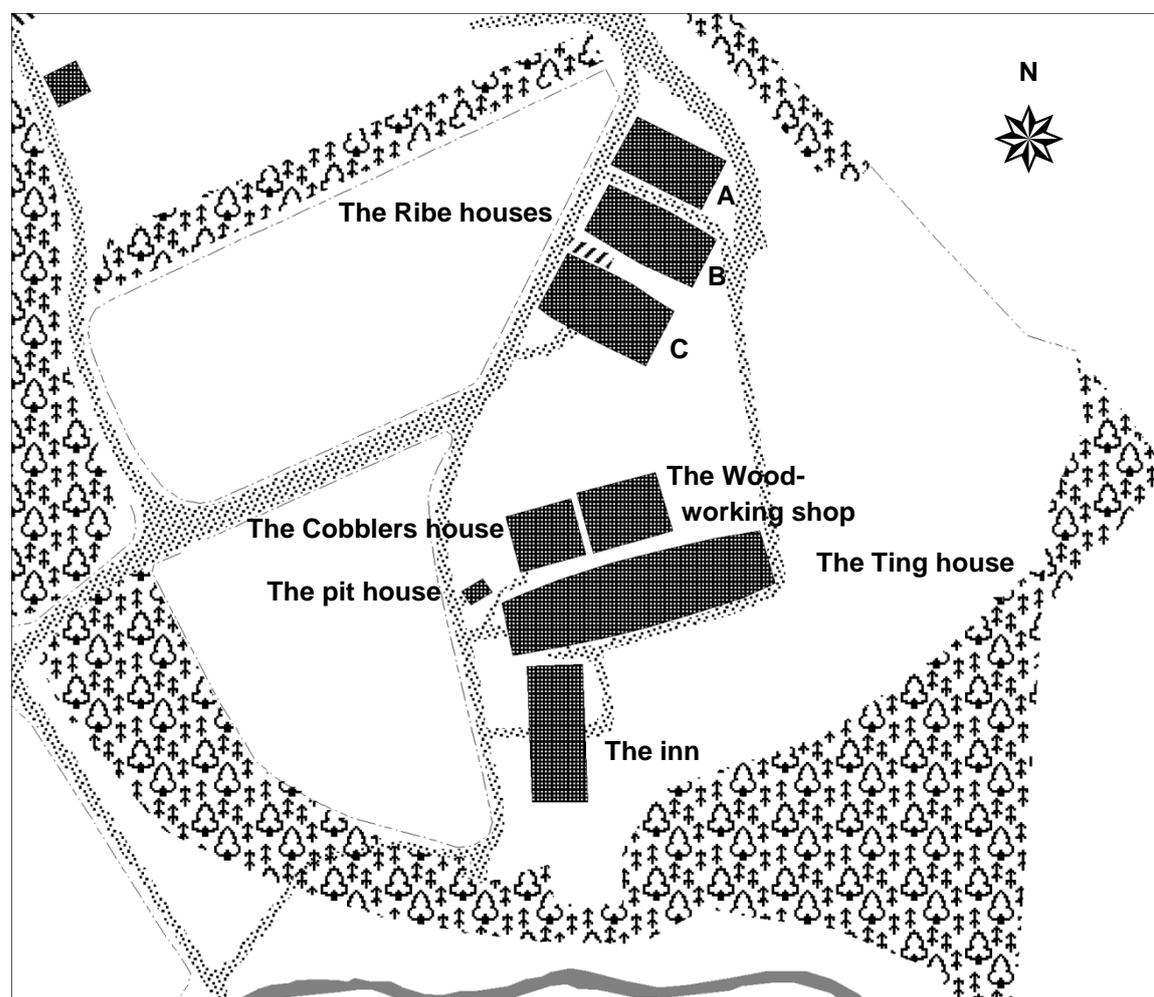


Figure 50. Ribe Town. Scale 1:1000.

Archaeological background

The southern part of Ribe Town is based on the excavations by Sydvestjyske Museer (/Claus Feveile) at ASR 926 Ribelund I, covering 1400 m². These excavations revealed the outer perimeter of the town, in the form of a ditch from the 9th century. Behind this ditch was a road

from the 8th and 9th centuries along with eight houses, four sunken huts, parts of a fence and a well. The oldest phase was originally dated to the early 9th century. Later it has been found that this phase probably belong to the second half of the 8th century. So in fact this area should probably be called Ribe Town 775, rather than 825. Not that it would make much of a difference.

We show the plan here (Figure 51). It is easy to see how the houses are not found in full, as later elements have destroyed parts (most notably a 12 m wide moat in front of a rampart, belonging to the 11th century), and because the excavation did not extend the full length of the houses.

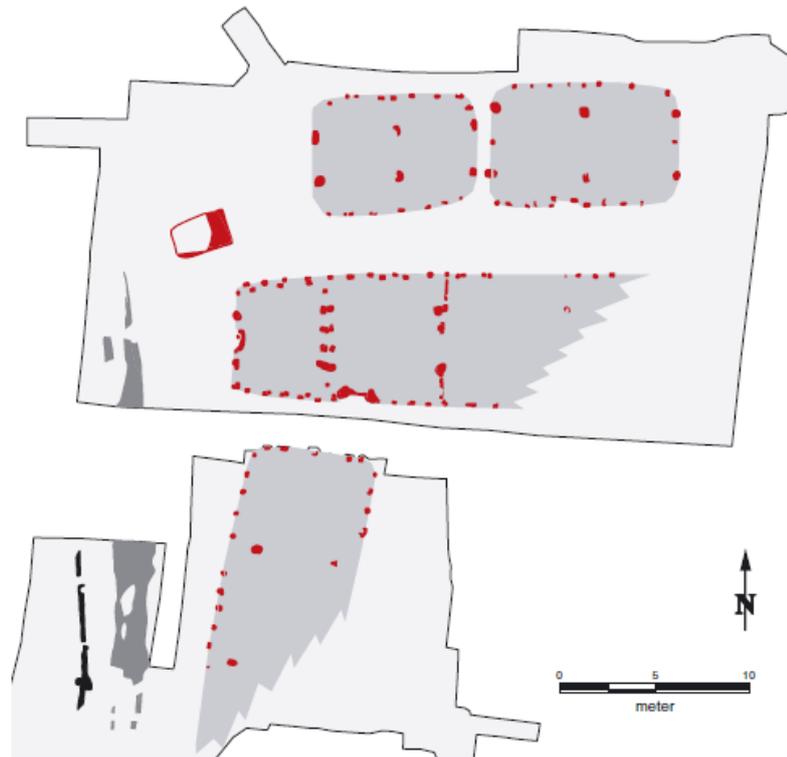


Figure 51. Ribelund I. The oldest phase, late 8th century, or just around 800 AD. (Illustration from Feveile 2006: 39) 1:400.

The other three houses in the Ribe Town area are based on excavations of one house at ASR 985 Tvedgade, very close to the original market place, but excavated some 20 years later. This was a more limited excavation of 275 m², and as it was known that this area has been heavily altered during the middle ages, there were few expectations to the excavations. Nonetheless well preserved traces of habitation did turn up. Typologically this house belongs to the 8th or 9th century, and is characterized as a ‘Haithabu-house’ with external buttresses. This means that it is a rectangular town house. Laying close to the market place it was placed on low ground, probably around 2.2-2.4 m a.s.l. This is relatively low for a permanent structure in the Wadden Sea area, and a risk of flooding must have been accepted as part of the settlement.

Although the house is characterized as well preserved, there is no indication of the details of its construction. This has given the Viking Centre the opportunity to experiment with different designs.

The Ting House

The Ting House is thought of as the meeting place in the Viking town where matters of importance can be discussed. A “ting” is the name of a public assembly during the Viking and Middle Ages. The Ting house was only partially excavated during the excavation in Ribe as the boundary of excavation did not incorporate the full extent of the house. Therefore the western extremity of the house had to be interpreted from the plans of the rest of the house. A length of up to 21 m of the house was visible during the excavation. The centre overcame this problem by duplicating the eastern end to produce a format for the western end of the house.



Figure 52. The ting house during construction. Seen from the west.



Figure 53. The Ting house in 2011. As part of the activities, children have been invited to help decorate the walls in Viking-inspired patterns.

The walls of the Ting house are wattle and daub. The wattling is carried out by inter twinning osiers, which can be of many different material often hazel, willow, juniper or birch. Willow was used for osiers in the Viking centre. The wattling involves upright stakes being placed in the ground. The osiers are then worked through and around these in a wickerwork type fashion i.e. stake 1 the willow osier goes to the outside in stake 2 it will go to the inside and it continues in this trend. On top of the wattle and daub sit the rectangular longitudinal beams. The treenails that run along the exterior longitudinal beams lock the stakes which the osiers are woven between.

The stakes rotate between a thin one, a thick one, a thin one and so on. The square ones are radial spilt timbers whilst the others are brush woods or round woods. Round corners to the houses can be seen in the archaeology record as with the above mentioned varying stake sizes.

The daub is placed upon the wattling. Daub is a clay composite. There is straw mixed in the clay, but due to modern considerations, the Centre has opted not to mix it with cow dung, which is otherwise considered very well suited for the purpose. The daub of the wall is about 10 cm in depth. The process of putting the daub onto the wattling involves hammering the clay into place to take the air out of the clay. Then one wait's a few days and repeats the hammering action removing as much air as possible. The quantity of clay used per one m² of wall is 700-800 kg of clay. The walls of the houses need repairing every year; this is done in repair patches. The gable walls need more repairing than the broadside of the house, as the broadside is more protected by the roof. The south side suffers the worst as it is the most exposed to changes between wetness and dryness.



Figure 54. Repairing of the clay wall. Fresh clay can be seen as khaki patches against the white walls.

There are seven roof bearing structures in the house. There is no exterior supporting beams on this house. The original arcade posts and cross beams are an unknown shape and size. Therefore the ones here are a modern interpretation. The dimensions decided by the builders were 1ft x 1½ ft for the arcade posts, but today they are felt to be too massive. To put the upright stakes up, there would have been a crane like structure used. Due to safety considerations, and an unpleasant experience earlier, the Viking Centre was unwilling to use this technology. The Viking Centre has also noted that in this house the distance between the bearing structures is too long and therefore the longitudinal beams are beginning to stoop. The longitudinal beams which are exposed on the exterior are thought to have been carved but this unknown.

The first bearing structure located at the Eastern gable wall contains one of the entrance doors. The upper crossbeams are bevelled to fit the shape of the roof and recessed to fit the longitudinal supporting beams of the roof. This is the common style in this house. The main joinery type here is a locked mortise and tenon joining of the beams and posts to each other. The next roof bearing structure closes of the house by a wattling division. This was done for aesthetics. A dovetail joint is used here in the lower crossbeam and is locked by treenails. The joint is broken and damaged on one side. This is believed to be due to the pressure of the roof pushing upon the wall. Also, the arcade posts on the second bearing structure are sinking slightly.



Figure 55. Damaged joint The outward force of the wall has pushed the beam out of place.

The scarfs on the arcade plate have two wedges to lock it together. This is a relatively modern scarfing method and is unknown if used in Viking times. It was done to make it safe. The rest of the bearing structure is mortise and tenon joinery. The tenon of the crossbeam extends through the exterior and is locked by two pyramidal shaped pegs as also seen in the three “Ribe Houses” described below. The king posts are treenailed into the upper crossbeams. The treenail goes straight through in the direction of gable to gable. They are fastened to the centre roof longitudinal beam by treenails but this time the treenail points from broad side to broad side. This is a common feature of all the bearing structures of the house.

The third bearing structure also has a dividing wall. This type is of vertical staves with a hinged door. This dividing wall is the entire height of the house. The staves of the wall appear deformed. This is possibly a result of humidity. The door is vertical stakes, treenailed and held together by horizontal timbers at the top and bottom. The handle has two holding supports for a gliding wooden latch. The treenails on the door are large with rounded heads. Mortise and tenon joining is used here again for the fastening of the majority of components to each other and they are all treenail locked.



Figure 56. Dividing stave wall: treenails locking staves and deformity of staves visible.

The door post on one side meets the horizontal cross beam whilst on the other the arcade post continues up to support the collar tie. Treenails occur across the horizontal crossbeam in an un-uniform but continuous manner, holding the staves in place. The walls bottom sill is penetrated by the upright roof bearing posts.

The fourth roof bearing structure is a skeleton structure in comparison to the other due to the lack of a wall. Here there are two upright posts with a collar tie. The upper collar tie is bevelled in the opposite direction than the other crossbeams. Locked mortise and tenon joints are used for the lower wall supporting cross beams, they don't pass through the centre of the structure extending from the arcade posts to the external walls on each side. Candles are placed on the beams here.

The fifth roof bearing structure is a dividing wall with a door. Vertical staves are used to create the dividing wall. The door is the same as former door but with a large gliding handle instead of a door knob. Here the upright arcade beams break the lower crossbeam and are fastened by locked mortises and tenons. The door post terminates in a tenon and fits into the crossbeam. A locked king post sits on the upper crossbeam, mortise and tenon fastened. Supporting base beam also occurs here and is cut by the upright posts. It is fasten by a holding peg with a mortise cut each side.

The sixth roof bearing structure contains a base beam with wattling dividing. The upright beams are rabbeted to receive the osiers throughout its height. This is also the case with the door posts. Here the doorstep and door are treenail fastened. The door has a vertical gliding latch in this instance. There are two horizontal supports for the latch. The level of the handle is not angled like the door of roof bearing structure three. The lower crossbeam fits the recess in upright beam. One side is more deeply recessed than the other to receive the crossbeam. The crossbeam running to the wall is tenon and mortise locked. The king post is of the same fashion as previously described.



Figure 57. Osiers sit in recessed post at the sixth roof bearing section of the Ting House.

The seventh roof bearing structure is that of the western end of the house and has all four upright beams cut the crossbeams. The upright beams are diagonally recessed with locked mortise and tenon joining for the crossbeams and the door arch. The King post is of the same fashion as previously described.

There are five longitudinal beams that run the length of the house, two wall plates, two arcade plates and a roof plate. They are made up of many timbers which are scarf joined by diagonal scarf and locked by treenails as with the central roof beam. The wall plates are all half lap joined/ double butt end joined. The Northern walls longitudinal beam has six different elements whilst

the South side has four. Treenails occur all along these exterior longitudinal beams. They lock the vertical stakes of the wattling of the external wall.

The roof on the Ting House is made of thatch. Thatch roofs are wheat otherwise but rye was used on this roof. On the exterior gable wall rye thatching is used for protection. This was a secondary repair and it is tied on. This protective feature can be seen on houses from the early 20th century. The roof is composed of ash and oak longitudinal and lateral beams. The thatch is fastened here with cow hide and lime bast. The roof framing structure is treenailed fastened. The diagonal placement of treenails prevents movement. This is applicable to all fastening. However, it is thought that the treenails are not necessary due to weight of the roof which should hold it in place. It is interesting to note that in the severe storm of 1999 many modern houses around Ribe lost their roofs whilst the Viking houses kept theirs. Forty years is the life span of a thatch roof with the possibility of lasting a hundred. Grass sods across the top of the roof are thought to be a later tradition as it is possible just to bend over the thatch. The sods are a much better solution, though. There are questions to how far the thatch should surpass the exterior planks of the roof. The wide overhang of the roof can provide protection to the walls as discussed in the “Ribe Houses” below.

There are four exterior doors in this house. The curve to the side door between the second and third bearing structure in the longitudinal beam is from the archaeology record. The curve would act to take from the height of the walls and reduce the size of the doorway. It is thought that the doors were smaller in height in the Viking days. The doors at the Ribe Viking Centre almost fit modern standard size doors. All the doors at the Viking Centre have been painted with linseed oil for protection.

Ventilation is provided by triangular opening in the gable walls, covered by wattling. They also provide light. This is an “open” house whereby there is a gap between the walls and the roof. There are a number of windows in this house but they are later additions added due to a need for light felt by the occupants of the house. Occasional leaking of the roof is viewed here at the Centre as a modern problem, even at the fireplace it is not an issue. That may be, but constant driple in selected places is not only annoying, but also clearly damaging to the floors.



Figure 58. Ventilation in gable walls.

The Wood working shop

The wood workers shop lay three and a half meters to the North of the Tinghus. This workshop is also constructed of wattle and daub walls. The workshop is composed of three roof bearing

structures. There were no external supports on this house. The supporting roof posts and beams were rectangular in shape. The supporting roof structures are pretty uniform here. They consist of the arcade posts receiving the crossbeams. They are locked mortise and tenon fastened and only the lower crossbeams run the width of the house on the gable walls. The other roof bearing structure has only horizontal wall supports from the arcade post. The upper crossbeams are all recessed to take the longitudinal roof bearing beams. This is done in a dado joinery fashion (Figure 59).

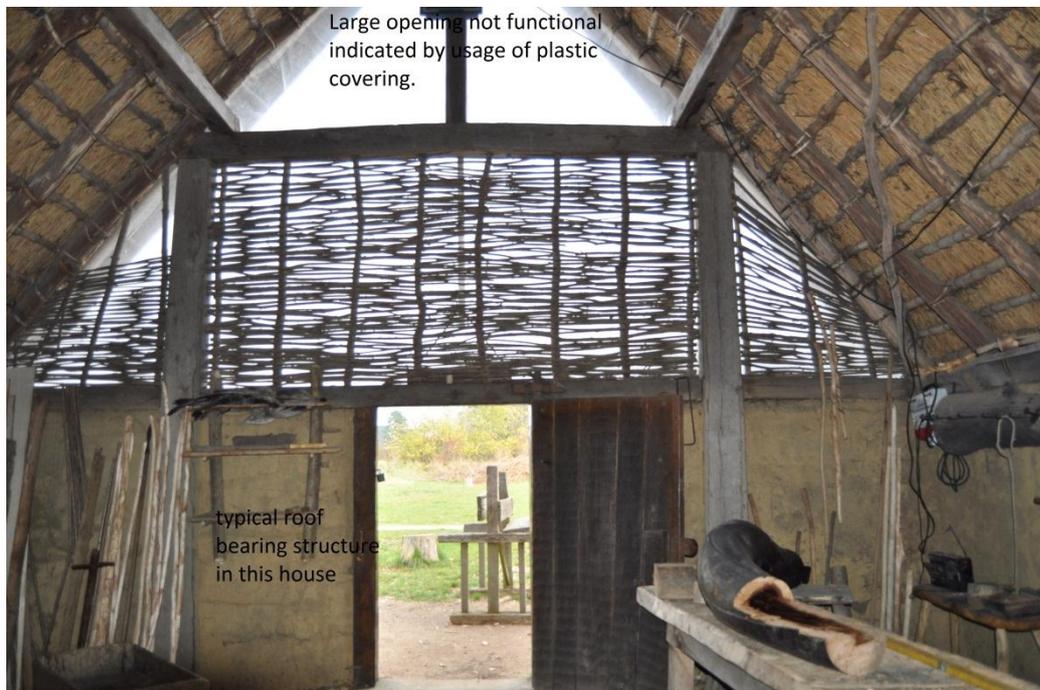


Figure 59. Interior view of the Wood worker's house. The plastic covering of the gable is in preparation for winter, and such open gables are therefore probably not an original feature, even for a workshop.

The roof here is a thatch roof of wheat and is of the same construction as that of the Thing house. The large opening in the upper gables walls of this wood working shop have a wattling partition but this open plan does not work as it is too cold and exposes the structure to weather damage. During winter it is therefore necessary to cover the gables with plastic tarpaulin. There were two doors, both of which are double doors here, one as the front entrance door and a Northern side door. This coincides with the excavation plan which shows door openings of approximately 1.75 meters. The floor of the work shop is also of compressed clay.

Originally in the Viking Centre no protection was used on the wooden components on any of the buildings. This was due to the time constraints on making tar and that it is fresh wood that is used in the construction of these houses. Seasoned wood is very difficult to work and can't be worked in the same manner as fresh wood. To work the wood as fresh wood, followed by seasoning before using it in the construction of the houses would take eight years. The problem with the use of fresh wood is that the water content of the wood acts as a barrier to the tars lipid components resulting in the tar simply sitting on the wood and not penetrating into it. However, the Viking Centre has now begun to put a tar and linseed oil mixture on the exposed exterior beams of all the houses. It is believed that this will increase the life span of the exposed exterior timbers of the houses. This is done by apply a number of coats of tar to the beams and it currently appears as if the tar is being absorbed by the wood. This is indicated by the buildup of bubbles on the wood. This wood has encountered drying since its erection in the houses (Figure 60).



Figure 60. Working shot of application of tar and linseed mixture on exterior timbers.

The Cobbler's house

The cobbler's house lies roughly three quarters of a meter behind the wood workers shop. This house is a wattle and daub construction with no exterior supporting beams. The houses roof bearing structure differs from the other houses. The difference with this house is how the collar ties do not cross above the arcade posts as seen in all the other bearing structures at the Centre.



Figure 61. The Cobblers house. Interior view showing roof bearing structure, collar ties do not connect with the arcade posts. The upstairs compartment is also visible.

This house also does not have its collar ties built into the gable wall as seen in the other houses. Here it sits approximately ten centimeters inside the gable wall. The crossbeams in this house connect with the arcade plates in a locked mortise and tenon fastening. The lower crossbeams which occur in association with the upstairs compartment structure run to the exterior walls in one instance. Where the lower crossbeam terminating tenons run to the mortised longitudinal exterior wall plates, they are locked by a single peg. Dovetail joints were also used in this house for example the longitudinal beams of the upstairs compartment are attached to the arcade posts by a locked dovetail joint.

This house has a thatched roof and it is of the same construction as the roof of the Ting house. Additional thatch protect was added to this house as the others. There is thatch covering of the upper gable walls and thatch sheathing at the base of the walls. This house is an open house. A gap exists between the roof and the broadside walls. In this house bonded rolls of thatch are used to try to reduce draught and heat loss through this opening. Further ventilation here is also a wattled triangular opening in the uppermost part of the gable walls and an opening with a silted roof covering is present above the fireplace. A hole is cut into the upstairs to allow the smoke to pass through. The floor here is a clay floor.

The Inn

There is no knowing what this house was originally used for. It is probably just a “normal” dwelling of Viking Age Ribe. But since it is used mainly for housing the leisure Vikings who stay for shorter or longer periods at the Centre every summer, it is vernacularly known as the Inn. The main deviance from a ‘proper’ reconstruction is that part of the wall on the north side is in fact a fire escape, although it is masked from the outside. This part of the wall is thin enough to break through, should an emergency arise.

The house lies at the edge of the Viking town and its length is North - South orientated which varies from all the other houses in the village. This house contains four roof bearing structures and a dividing wall. The dividing wall is a wattling partition. The walls of this house are bench lined sometimes by an upper and lower bench component. The entrance area is free of these benches. A variety of joint types is also used in this house from mortise and tenon fastenings to lap joints. There is no chimney present in this house and the fireplace sits on a height, a bench fireplace. Ventilation is provided by a wattled triangular opening in the gable wall of the house.

The floors are made of clay. The process of creating the floor involves placing wet clay on the floor. This can be mixed with cow dung and straw to hold the clay together. It is mixed with water to increase the quantity and improve workability. The floor is then leveled. This is done with boards and the level is obtained by eye. On drying of the clay its then is compressed by natural trampling. This could also be carried out by a wooden hammer. In Ribe Viking Centre they are currently attempting to repair the floors in the Village houses. It is believed that they can't be repaired properly as the damaged clay will continue to break off in large pieces. This would mean that the entire floor wears as one and that to fix problems with the floor the whole floor has to be re-done.



Figure 62. The fresh clay is applied for repair of the floor.



Figure 63. Leveling of the clay floor.



Figure 64. A clay floor in the process of drying, cracks begin to appear as the floor dries.

The pit house

A small pit house was found in front of the group of larger buildings in the excavation, between them and a road. While it is not entirely certain that this house belongs to the group, it is as likely a solution as any based on the plan, and the house serves as a good illustration of such houses which were an important part of Viking Age building traditions. It was found near what was obviously a road running pass the houses in these areas.



Figure 65. Under its roof of sods and with an embankment of soil around it, this small hut has been an inconspicuous element in the architecture at Ribe Viking Centre. The entrance area is just visible to the left of what seems to be a small knoll of earth.

This little house was constructed in rather rough and heavy timbers, with very little carving being done. This was probably based on the previously constructed houses at The Marked Place (see next chapter). The roof is covered with sods, and an embankment made from the dug up earth

from the pit makes this house look almost like a small mound. The stave walls were laid from largely unworked timbers still with traces of bark on them.

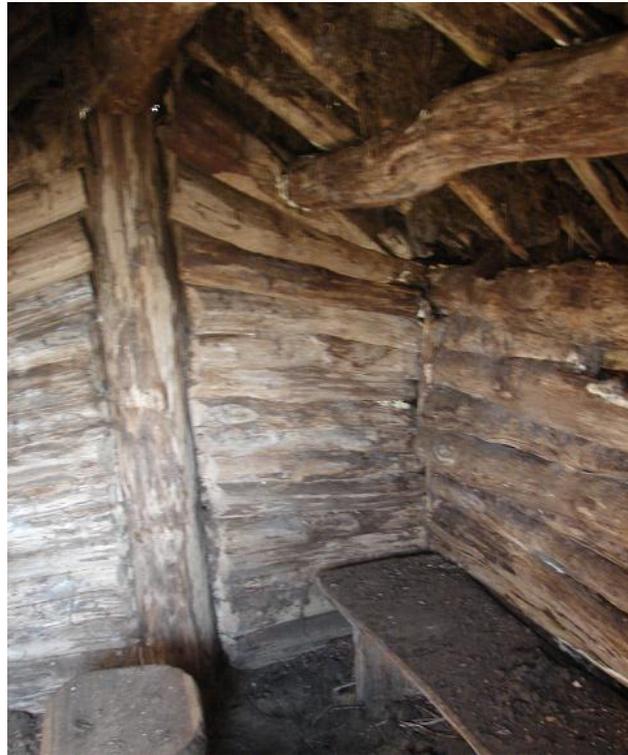


Figure 66. An inside view of the small sunken hut. The very rough nature of the timber work is apparent.

This house showed considerable decay in the roof structure as well as in the walls. Therefore it was completely dismantled and rebuilt in 2013.

The house was very small giving an almost claustrophobic impression. Especially the entrance was narrow and somewhat difficult to pass. While the staff likes to call this the “guard house”, due to the proximity to the road, one could think of several other services that could have been provided to the weary traveller from this house. It may also simply be a storage or working hut randomly placed at a free space near the road. In its present configuration it is somewhat difficult to enter and exit, so storage would be a good use for it, although one should not underestimate the importance of habit.

The three Ribe houses

From another of the Ribe excavations, one house has been replicated thrice, the three houses forming a separate group at the northern part of the town area. Only one of these houses (C) is made with realistic interior and public access. The other two (A and B) have modern interiors, one being a workshop, and the second having toilets and shower facilities for the leisure Vikings living here during the season. Therefore the two latter houses are only interesting for their exterior. Although based on the same archaeological plan, the three houses are exteriorly different.

The basic structure of these houses is taken from the excavation plan of a Viking Age house from excavations at *Tvedgade* in Ribe. The finds inside of the house indicate that this may have

been a silversmith's house. There were finds of both primitive and finely worked silver during the excavation of the house. The houses will be described below overall with their differences outlined.



Figure 67. The three “Ribe houses” labelled A-C.

This house type is a peculiar house design in Viking Age Denmark due to the sloping external buttresses. These houses are constructed of wattle and daub walls built inside of the external load bearing posts. Wattle and daub wall construction is discussed in the section on the “Thing House”. This way the houses have a double structure of external load bearing posts: The upright inner radial split oak posts that sit touching the clay walls and the round oak buttresses which run at an angle to meet the longitudinal wall plates that support the roof.

There is variance between each house in the number of external load bearing posts. This applies to both the radial split and buttresses. All the houses contain six roof bearing structures. In houses A and B rectangular shaped posts were used for the roof bearing structure whilst in house C round posts were used. House C has two crossbeams in the gable wall roof bearing structures. This is due to the height of the gable walls of this house in comparison to House A and B. The height difference is due to the roofing style discussed below. The door framing is not noted here although it adds to the supporting structure of the house. All Houses have two doors; their location in the houses varies.

The Ribe houses are a closed house construction which differs from the other houses in the village which are all open house construction. This is whereby there is a gap between the walls of the house and the roof. In the Ribe houses there is no such gap present. The size of the supporting posts in these house are too wide and it is likely in Viking times they were thinner than those at Ribe Viking Centre, this is backed up by the excavation plan of the site. The posts are placed here in the centre at a depth of 80 cm into the ground. The height of the walls was approximated here by using the distance of the two exterior supporting systems from one another to predict the angle at which they would meet.

The roof bearing structures use a number of joinery types. One type in House C consists of the arcade post being bevelled to fit the bevelled lower cross beam. A tenon from the lower crossbeam is then inserted into the mortise of the arcade post. This is then locked by an oak peg. The post and beam would have been augured so as to be able to lock the joint as damage to the receiving wood or an inability for the peg to penetrate the wood would have occurred. This process of locking the joints was applied to all the joint types in all the Viking Village houses.



Figure 68. Illustrating joinery type of lower crossbeam in the gable walls.

The horizontal beams running from the arcade posts of the roof bearing structures to the exterior walls act as strengtheners for the walls, they are mortise and tenon fastened with the longitudinal beams which sit on the house walls. The tenon of the horizontal beams terminates on the exterior of the house. It is then locked in position by a single peg in house C but by two pegs in house A and B.



Figure 69. Showing locking of the tenon of the exterior protruding crossbeams by two peg in house A & B and locking by one pegs in house C.

Another main joinery type used in House C was a corner bridle joint. This is similar to mortise and tenon joints. This joint type was used for the collar ties on the four interior roof bearing structures and on the upper crossbeams of the roof bearing structures of the gable walls. This joint

type consists of the top ends of the arcade post being recessed to a depth equal to the depth of the collar ties. The crossbeam terminates in a tenon and sits inside this recess in the arcade posts and is locked by a treenail.

This joint type is not used in houses A and B where the rectangular roof bearing structures consist of a tenon in the ends of the arcade posts which fits a corresponding mortise in the crossbeams, these are locked and the crossbeams continue to penetrate the exterior walls where their terminating tenons are fitted through the longitudinal supporting beams of the roof and locked by two pegs as shown above (Figure 69).

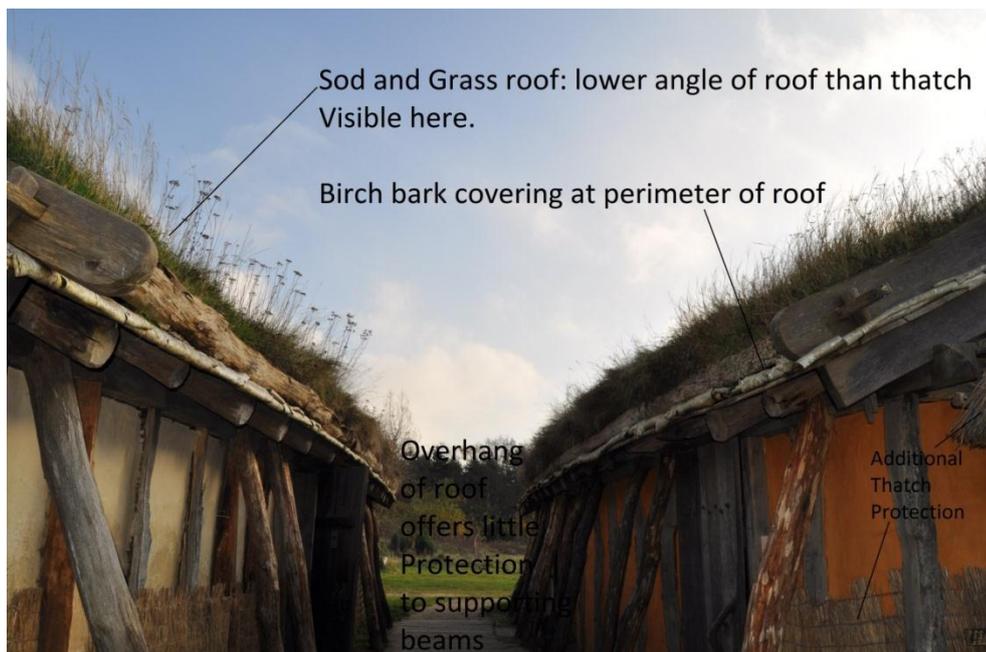


Figure 70. The roof types of the Ribe houses. Above: House C, below: House A and B.

The longitudinal roof bearing beams run the length of the six roof bearing structures in all house. They sit mostly on top of the arcade posts in house C. In house A & B they sit on the crossbeams which have been recessed to receive it in a dado joint fashion. They are locked by treenails in all instances.

There were no traces of the roof construction style found at the excavation site on *Tvedgade* and therefore two different roof styles were adapted at the Ribe Viking Centre. Houses A & B are sod and grass with birch as a lower covering. House C is a thatch roof. The grass roof needs a minimum angle of 20 degree whilst the thatch roof requires a minimum angle of 40 degree. It is felt by the staff that the thatch roof works better than the grass roof (Figure 70).

The overhang distance of the roof has helped to protect the supporting buttresses and walls of house C. The lack of an overhang of the roof on house B has led to wall and buttresses damage due to rain. Therefore in houses A & B thatch protection was added to the upper parts of the gable walls and thatch sheeting was placed around the base of the walls of house A & B (Figure 69). This is an indication of how a greater overhang of the roof functioned in the most utilitarian manner and is presumably in indication for roof style in the Viking age.

The thatch roof of house C follows the norm of the roof types in Ribe Viking Centre. The thatch is either wheat or rye. In house C cow hide is used for fastening of the thatch to the beams and to each other. Lime bast is used for the rope which attaches the thatch to the longitudinal beams. Each side of the roof in house C has a V shaped lateral beam which is composed of three elements, two run diagonal to meet a central beam. This is located above the door on both sides of the house. It adds strength to the roof and disperses the weight evenly. One of the lateral posts on one side terminates in a V shape to accept the beam of the other side. These are all

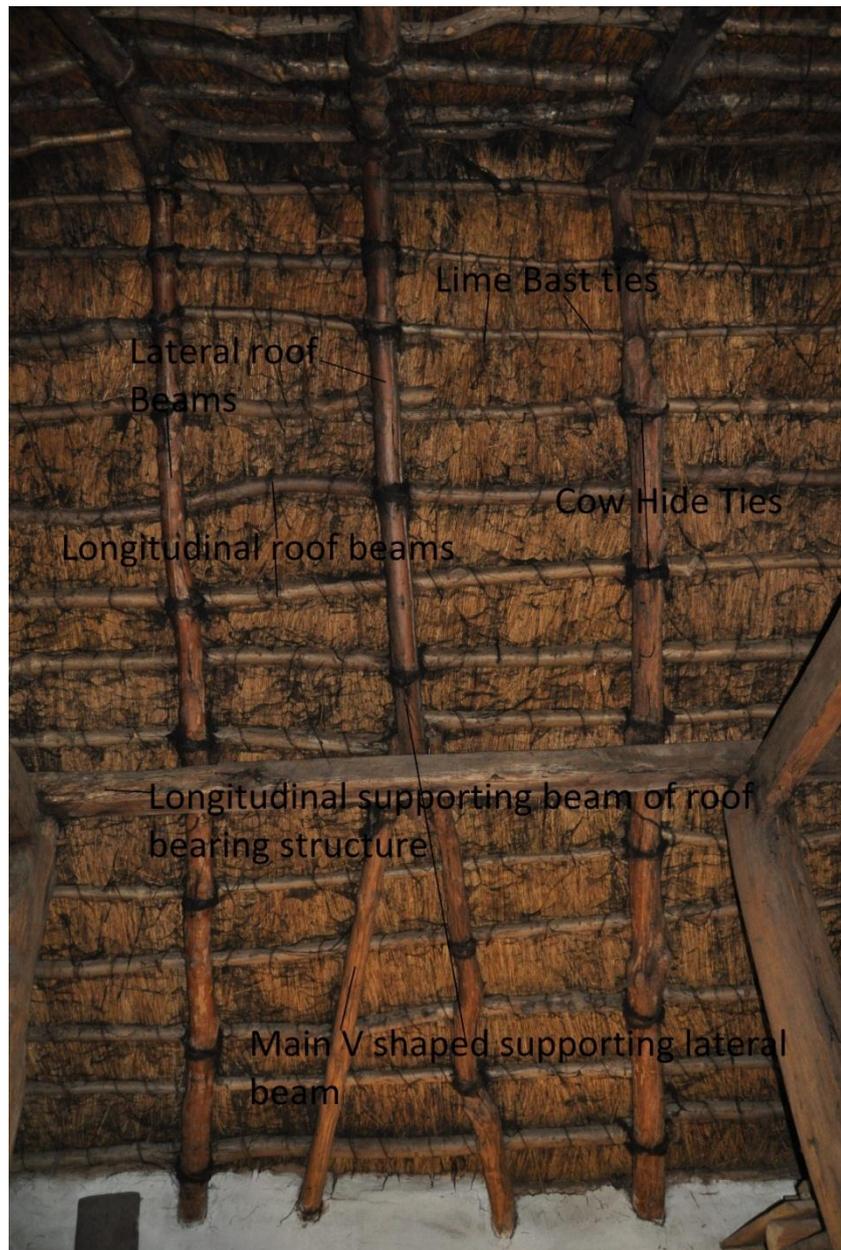


Figure 71. Thatch roofing, House C.

done by using natural branching of the trees. The lateral beams here in the centre of the roof are locked by treenails to each other (Figure 71).

The ventilation in these three houses varies. As the interior of house A and B are not open to visitors, only the ventilation in House C will be discussed. In this house there is a triangular opening in the gable walls. The wall ends short of the roof creating this opening and it is closed off by wattle. Just above the fireplace there is an opening in the main roof structure which is then covered by a silted roof covering above.

House C has an upstairs compartment. This addition was installed to utilize the space within the house. Cow hide suspended on a wooden frame hangs above the fire in houses with a fireplace. It is a dried out hide which helps protect against fire. In house C carpets and leathers were hung on the walls in an effort to protect from the cold inside the house. The actual effect is unknown, but could be controlled by experiments during winter. The floor here is also made of clay as in the other town houses.

Repairs

During the 2011 season, the external buttresses on houses A and B were in the process of being replaced. This gave us a good opportunity to examine them. Being 14 years old, these posts were in dire need of replacement, as their underground parts were heavily degraded.



Figure 72. External buttresses removed from house A and B, underground parts. These were among the most damaged of the lot.

Comparing to the buttresses of house C, there was a marked difference. Although their years started to show, the external timbers were not nearly as degraded in this house, which has a thatched roof with wide eaves. As conditions are otherwise the same for the three houses, wide eaves have a measurable effect on reducing the level of decay. Although placed on higher ground than the houses at The Estate, we do see that the timbers in Ribe Town also degrade very strongly, especially when exposed to the weather. It is clear though, that although we have seen bad examples, the general condition on these houses is better than those at The Estate. They are also slightly younger as well as lying on higher ground.

General discussion

Placed on higher ground, the houses here suffer less from degradation than those of the Estate Area. But the external buttresses had to be replaced, and we had the chance to examine them. Unlike the timbers from The Estate, these generally had a more expected pattern of wood rot, where it is the part just beneath the surface which is degraded the most. As can be seen in Figure 72, some of the poles were severely rotten all the way down, though, so this is not a uniform pattern.

The houses were not originally painted, but it was later decided to paint them for protection and originally they were painted the colour of the clay. The Centre uses natural colorants for the painting of the house such as iron oxide and white paint with clay added for colorant. It is not believed that painting was a feature of Viking time as the protection offered is minimal in comparison to the effort expended in obtaining the paint and painting the houses.

In general these houses work well and form a core part of the Centre and its activities. The three very different Ribe houses is a very good illustration of the difficulties of 'reconstructing' houses based on archaeological plans; even if this point may be missed on a large proportion of the visitors, who will see a well structured area of different houses.

Among the more practical considerations, we can say with confidence that the Wood Working Shop has amply illustrated that in a Danish climate, wattle without daub is not a good idea. It has to be covered with plastic sheets every winter.

Following the discussion on the importance of eaves above, we have also noticed that although the houses generally have wide eaves to protect the sides of the houses, the horizontal timbers of the roof construction protrude very far out from the gables. As a result, they are constantly wet, the wood being dark and slippery. This is probably not a good idea either, and when being asked, the builders had no explanation for it. It just seemed natural during construction.



Figure 73. The wall plate of the wood working shop. All horizontal posts in the roofs extend very far beyond the roof.

5. THE MARKET PLACE, AD 725

The market place reflects the earliest settlement in Ribe, which was a seasonal market place founded just after 700 AD. The area is divided into narrow strips, organized around one central and two connecting roads (Figure 76). These roads are paved with oak planks. Around each strip a narrow ditch is lined with a low wattle fence. Apart from an open shed in the north eastern corner of the area, which is used for firewood and we have not investigated further (Figure 74), there are only three pit houses in this area. Otherwise tents occupy the area during the tourist season.



Figure 74. The shed on a sunny autumn day. In the foreground some of the plots.

With our joint project from 2010, in which we examined flax processing at Ribe Viking Centre (Ejstrud *et al.* 2011), the sunken huts (also called “pit houses” or “grubenhäuser”) are of special interest to us. Such huts are commonly thought to be connected to textile production, not least linen. Their use for many other purposes is also well attested, and in general they must be regarded as work huts, although occasionally with traces of habitation. They become increasingly common on Danish settlements during the first millennium AD and are sometimes found in very large numbers, especially on Viking Age settlements.

In this case, the houses are also used for various crafts. One has been made into a weaver’s hut with an upright loom. A second one is the potter’s hut with a pottery wheel. And finally there is a functioning smithy. As an experiment the three otherwise identical houses were made with three different wall types. The potter’s hut has been made in a stave construction. The weaver’s hut with bole-walls. And finally the smithy is made with wattle and daub walls.



Figure 75. The weaver’s hut. Side view and entrance. The three houses all have the same dimensions. 1:200

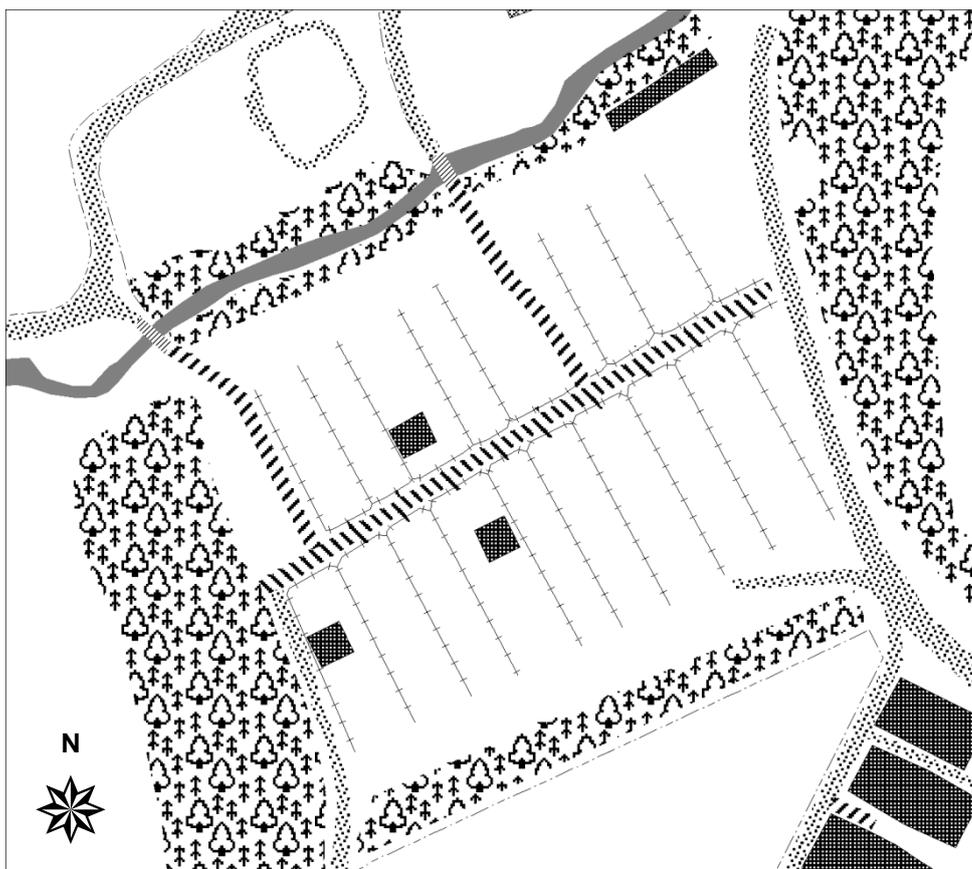


Figure 76. The Market Place. 1:1000.

Archaeological background

The market place is based on the archaeological excavations of the earliest parts of what later became the town of Ribe. The three houses are variations of the same pit house. The original was found by excavations at Jernkærvej in Ribe. There was no indication of wall type, only the size of the pit and the two roof bearing posts at each end is known.



Figure 77. The three sunken huts. From left to right: The smithy, the weaver's hut and the potter's hut.

The houses

The potter's hut

The potter's hut has been made with stave walls, the roof being thatched. There is a pottery wheel inside the hut, and it is used to demonstrate pottery techniques during the tourist season.

The stave walls were replaced in spring 2011. When we looked at them during autumn 2011, they therefore gave a very fresh appearance. In anticipation of this project, the replaced walls were documented by the staff (Figure 78). Pitted against the dirt, the outsides of the wood were naturally degraded. The bearing structure and roof was not replaced at this occasion, but will eventually have to be replaced completely.



Figure 78. The stave wall of the Potter's hut during replacement, 2011. The pottery wheel can be seen inside the house.

The weaver's hut

The weavers hut is made with horizontal "bole" walls. An upright loom is set up inside the house, where weaving can be demonstrated. As these houses are often connected to textile work, it is a natural choice to have these activities in one of the houses at the Centre.

We have not made any experiments with the interior and use of the houses in this report. But it would be interesting to look more into them as microclimate has been a main argument in explaining these huts as especially good for textile production (Zimmermann 1982; Bender Jørgensen 1992; Mökkönen 2009). If we see these houses as early examples of 'environmental architecture', then experiments should be undertaken under different circumstances, and the Centre would be a natural venue for such experiments. As such huts are found in many historical centres a comparative study should be possible.

It may be telling that in the ethnological record, sunken houses are found mainly in the northern hemisphere, generally north of 32°N, with the few remaining examples found in cold mountain ranges (Gonzales 1953). Rather than moisture, the general trend seems to be that sunken huts are used for temperature control.



Figure 79. The potter's hut seen towards SE.

The smithy

The hut originally started with only wattle walls, and only later it was decided to cover the wattle with clay. In terms of maintenance, these walls are apparently the least demanding of the three. They are also considered to give the best weather protection, although it must be remembered that this house is heated, due to its use as a smithy. Nonetheless, the impression of the artisans at Ribe Viking Centre, is that the wattle and daub walls are superior to the other two types.



Figure 80. The Smithy during an earlier reconstruction of the walls. Even the underground parts can be seen.

The house works as a smithy with a hearth and work benches. Such work must always be undertaken under a roof, to better see the colours of the hot iron.



Figure 81. An inside view of the Smithy, the furniture being stowed away for the winter.

The plots

The plots which structure this part of the Viking Centre may not look as the most conspicuous construction at the site. But in fact they represent a very important feature of the early history of Ribe. These plots represent a highly regulated trading site from the early 8th century. As such they are markers of a changing economy but also how this economy was seized by powerful people, who were able to enforce the strict geometrical regulation of the entire site. Taxes were paid to use these plots, their payment - along with the assurance of peaceful trade- being enforced by armed men in the service of a magnate or even a king. There is a very strong (hi)story embedded in these shallow ditches.



Figure 82. Replacing the wattle surrounding the plots at the Market Place.

In spite of the efforts of Ribe Viking Centre to present as realistic an environment as possible, we have to say that in general the area is probably much too tidy, adding that this is probably for the better. Nonetheless, as this area is structured and used much like the original finds in Ribe, it could be interesting to do archaeological field work at the centre, to compare the results to those from Viking Age Ribe.

General discussion

For small houses such as these, the timbers forming the main bearing structure seem very heavy, with diameters around 20 and 30 cm. In fact they would hardly fit into the postholes originally found at the archaeological site in Ribe. Therefore the houses are most likely built too robust compared to the original. There is a simple explanation for this. The houses were the very first constructed at the Centre, and not knowing these constructions very well yet, the carpenters wanted to be absolutely sure that they would stand securely in the ground.

Another obvious comment to them is that they are good illustrations of the general versatility of such small huts. With the same house being made not only in three different techniques but also with three different uses, they present a range of possibilities for the use of these constructions.

Otherwise the significance of this area is to illustrate the earliest layout of the oldest town in Denmark. It did not start as a town, but as a marked place. The division into plots indicate a highly regulated site, and by demonstrate this the Viking Centre makes a tangible and significant image of central economic and political structures during the Viking Age.

6. DISCUSSION

Houses; the ‘Viking’ way?

While studying these houses it became apparent that at least two different paradigms were in play during the construction of the houses in Ribe Viking Centre. This is due to two different professions standing behind their construction, an architect

The architect’s view

The first houses were drawn by architect Holger Schmidt. They are made as part of a series of building projects and are based on a deep knowledge of the Viking Age settlement finds. It has not been possible to discuss the buildings with Holger Schmidt in this project, and therefore his buildings, his publications and the letters in the Centre’s archive has been our source to the views.

There is no questioning the high professional level behind the reconstructions of the houses at The Estate. There is also no questioning that they have been instruments in a continuing experimental process, both including theoretical reconstructions on paper as well as full scale buildings projects. The house at Fyrkat was built in the mid-1980s, not long before work commenced on the houses at Ribe Viking Centre. Although the type of building at Fyrkat is much the same as The Hall in Ribe, its appearance is much different both in detail and overall impression. This is not due to the finds, but in different interpretations made by the same architect.

One feature which is very pronounced in these buildings is the regularity of their construction. Although some alterations were made, the original plans are based on regular spacing of posts, based on averages, not the individual position of the post-holes in the excavation. It was also stressed that the dimensions of all timbers should be regular and to the drawings, not least because this was thought to be a high status building. This led to excessive waste of wood, and therefore to frustrations on the side of the carpenters. The buildings at The Estate are an architect’s vision of Viking Age buildings. Knowing the buildings well, including the stories about their construction, one can also recognize how they are derived from minute scale drawings. All parts are generally very regular, and highly processed.

The carpenter’s view

In many respects in opposition to the architect’s view are those of the carpenters at the Viking Centre. Being responsible for the daily maintenance they have obviously discovered many details of the houses, which could or should have been done differently. Another source of these differences was the very detailed drawings made by the architect for the first houses at The Estate. To get the desired scantlings of timbers, it was often necessary to discard whole timbers. For instance some planks for the stave walls were discarded, because they were only a few cm too narrow to fit the regular pattern of staves. In the opinion of the carpenters, such planks would have been used anyway, and the planking pattern of Viking Age houses should be less driven by small scale rulers.

Behind these discussions one finds an unstated, but also unmistakable primitivism in the approach of the practitioners at Ribe Viking Centre. While one can agree with the uselessness in

discarding oak planks just because they are a few cm too narrow, this doctrine is typically found in that timber designs made by the carpenters are worked as little as possible. Unlike the architect and his highly worked wood, the carpenters preferred round timbers for their building. In fact many pieces still have traces of bark. While this is unproblematic for inner pieces, such as the battens under the roof, the unwillingness to remove sapwood has probably led to the houses decaying faster than necessary. The undesire to carve wood has probably also added unnecessary weight to the constructions.



Figure 83. The protruding wall plate of the small sunken hut in Ribe Town. More or less an unworked pole, the sapwood has largely disappeared over the years. This house is now dismantled and replaced.

While we wrote above that The Estate holds the architect's vision of Viking Age houses, the Barn is the exception. This house is rough around every edge, and is made only from a sketch drawing with few details. The carpenters' view that this is the most authentic house is interesting, but also telling as to the mindset behind its construction.

There are no answers as to which of the two doctrines are right. Timbers are still rare in Viking Age context, and we cannot say whether every plank in a stave wall should be exact the same with of its neighbour, but the general impression is that timbers were worked. Being preserved under wet conditions they almost always appear irregular today, but that is also an effect of warping due to water, pressure and time. We feel that there is room for a middle ground, where timber should be worked to some extent, but where they should not be conceived within the regularity and standardization of modern mass-production. It would also be reasonable to believe that different types of buildings – and different types of builders – would lead to timbers being worked to different degrees.

The archaeologists' view

In fact there is a third interpretation on these houses. In the Museum *Ribes Vikinger*, part of *Sydvestjyske Museer*, the exact same sites and houses are on display in the exhibition as those reconstructed at Ribe Viking Centre. The two institutions are otherwise not affiliated, but have obviously had a close cooperation. Most likely it is the best preserved finds from Ribe that are on display in both instances.

At the museum, the houses are presented in drawings and models, not as full size replicas. Many of the practical problems of house construction are therefore not an issue in these reconstructions. What is typical for these reconstructions is that they are in many respects less regular than both those of the architect and those of the carpenters. For instance, the two houses at the Centre which are reconstructed as the the Wood Working Shop and The Cobbler's House, is reconstructed as one house at the Museum. This house has varying widths at each end, to incorporate the two structures in one. As these two houses are very close, this is another fair interpretation, but generally the houses look more scruffy and irregular in the Museum's drawings and models, that they do at the Centre's full scale replicas.

Archaeologists do not seem to value tidiness in house construction, at least not to the same degree as both architects and carpenters. In fairness the archaeologists view on houses is formed in the sand, mud and rain of archaeological excavation work. Archaeologists do see and document the irregularities of ancient postholes, and although there is most likely an overrepresentation of neatly formed houses in the published material, there are also an abundance of very irregular and downright ugly houses hidden in the archives of every excavating archaeological unit. This could explain some of the difference.

Other comments on the houses

One thing that the carpenters really believe is that there has been an upper floor in most of the Viking houses, or at least the larger ones. The storage and living areas would increase very much, and the idea may be substantiated by references in some of the Icelandic sagas. Unfortunately the sagas are written in a medieval context, where we do have other evidence of an upper floor being added to houses, so these texts cannot be definitive. There is the fact that the heat rises, and in Scandinavian winter time it is not pleasant to sleep in a reconstructed Viking house. If there had been an upstairs storage more heat would probably have been preserved in the living area around the hearth.

The discussions with the carpenters also touched the fact that the living arrangements could have been very different from what we are used to as modern day humans. The use of daylight was undoubtedly on a different level in the Viking Age, and many more activities than we might think could have taken place outdoors on the farms, such as cooking and preparing food. The hearth inside might have been primarily for heating, at least on a fine day. There may have been a more flexible attitude to the living arrangements than we are used to think as 21st century people.

Among the 21st century users of the houses, there was less flexibility about one important aspect: All houses which are regularly used for indoor activities have had windows added. According to the carpenters this was demanded by 'the women'. There is generally a division of labour by gender at the Centre, and it is typical that the indoor work done by women would require some light. This would be cooking or textile related work, both of which is very difficult to do in a house lit only by a fire place and candles. Openings in the walls were considered vital to the performance of daily tasks inside the houses. This is interesting, as direct evidence of windows in prehistoric finds is relatively rare.

An overview look at the houses also reveals the development and experimentation inherent in the entire process of building up a large Centre such as the one in Ribe. This can for instance be seen in the differences between the house reconstructions at Fyrkat and in Ribe. Both of these are done by Holger Schmidt. Both of them represent more or less similar constructions in terms of their archaeological data. Nonetheless their visual expressions are very different.(*cf.* Figure 7 to Figure 49). This is the same architect arriving at very different solutions to the same problems within the same time span. Similarly the other houses at Ribe Viking Centre clearly reflect a development within the staff. Although generally made within the same frame, different solutions have been tried in the houses, in many ways culminating in the *free style* barn at The Estate.

Protecting the houses

The high level of deterioration in some of the houses surprised us somewhat, although with almost 20 years of age the posts are getting within range of the commonly expected life span of oak. The problems were most severe in the former wetland area at the Hviding Estate, suggesting that building houses here may not have been a very good idea after all, or at least that drainage was nowhere near sufficient. But even in the more elevated areas of the centre, the posts have experienced a noticeable decay. This leaves two questions. Firstly what, if anything, was done in the Viking Age to protect the houses from decay? And secondly, what can be done by the Centre today to prevent and delay the further degradation of the wood? Given that the policy at Ribe Viking Centre is to follow original methods as closely as possible, these two questions are in fact not far apart.

The following is an overview on how wood used in Viking longhouses can be treated using traditional methods in order to protect it against the elements. A Viking house consists of many different wooden components that are all subject on a daily basis to the elements. Some components however are more subject to the elements than others which has been observed when examining the longhouse at the Ribe Viking centre. The wood that has suffered the most is the wood that is not visible at first, this wood being the part of bearing structures and wall staves that is placed below the soils surface. After up to 20 years of having untreated oak staves and aisle posts partially placed in the ground the damage has proven to be substantial and in some cases the rot has eaten right through the structure. This is a great problem seeing that the long house in Ribe Viking Centre currently has the weight of its roof and its walls placed upon decaying untreated oak, left for too long and the consequences could be dire. Therefore the centre is now in the process of replacing the timbers.

Charring

The idea behind charring wood is simply to create a layer of charcoal on the outer surface of the wood in order to prevent decay and fungal growth. This is done by placing the wood over fire until a layer of charcoal is present. This method has two flaws however. One being that if the layer of charcoal is made too thick the whole piece of wood will be weakened and in turn may not be strong enough to carry out its desired role. Secondly is the fact that although charring does not allow for the growth of bacteria and fungi it does create surface cracks which exposes the untreated inner part of the wood. This can lead to decay happening at the same speed as uncharred wood even reducing the thickness of the wood, as decay will start further in. This method is not recommended today.

The method has been used historically. The resources to use charring during the Viking Age were at hand and therefore should be considered. This is probably the reason why it has been used for instance at the house reconstruction at Fyrkat.

Wood tar

Although considered, no wood tar was originally applied to any of the houses at Ribe Viking Centre, neither above or beneath the ground. The carpenters' reasoning for this was based on the combining of two bits of common knowledge. Firstly that during the Viking Age wood was worked with axes and adzes. This is virtually impossible on anything but green wood. Secondly that wood tar is best applied to well stored and dry wood. It was therefore not seen as useful to apply tar on these houses, because they had to have been built of fresh and therefore relatively moist oak. In later years wood tar has seen some use at the Centre, not least under the impression

of the increasing decay of the houses. This is less problematic now that the houses are several years old, and the wood will take the tar well.

Based on the experience from several of the Viking ship replicas, which have generally been carved from green oak, and covered in tar compounds, one could also argue that the use of tar on fresh wood is less of a problem than originally envisioned. Tar may therefore be a viable option to protect the houses.

Archaeological evidence of tar

While the evidence of wood tar and pitch is relatively old, stretching back to the Mesolithic, the production sites have been elusive. But a few sites are known.

The oldest site was found during excavations for a new road in mid-eastern Sweden in 2002-2003 (Hennius *et al.* 2005; Hjulström *et al.* 2006). Across several sites, a number of funnel-shaped pits of unknown function were found. There were two types, larger pits dated to 600-1100 AD, and smaller ones dated to 240-540 AD. As their function was not readily understood, soil samples were taken and analysed with gas chromatography-mass spectrometry. These samples were compared to later and historically known tar pits and charcoal production sites were also analyzed. It turned out, that the soil samples from the new site were very similar to those known to be used for tar production. The older and smaller funnels are therefore the oldest known pine tar production sites in the world.

In our context it is the later part of the site, radiocarbon dated to 600-1100 AD which is more important. A TL dating gave a result of 944 ±70 AD, right in the Viking Age. Tar is regularly found in the caulking between ship planks from the Viking Age. It is therefore no surprise that wood tar was produced during the Viking Age. But is it important to examine the nature of some of the production sites. While the Iron Age pits had upper diameters between 0.5 and 1.3 m, the Viking Age pits were 2 m in diameter with a depth of more than 2 m. The entire structure which was surrounded by a small bank was still visible on the surface before the excavation started. These were relatively large constructions.

Considering the widespread use of tar, at least in ship building, the extraction of tar cannot originally have been limited to the Scandinavian forests up north. It must also have happened locally. Experiments could be interesting, also for the public, although health and safety considerations must probably be weighed against the possible output.

Historical evidence of tar

Another important reason to consider tar is the historical evidence for it. In Norway and Sweden stave churches from the Middle Ages still exist. The oldest date back to the 12th century. Interesting is that the Norwegian medieval landscape laws given by Magnus Lagabøter in 1274 as well as the older Gulatings-law directs that the local peasants should tar their churches. According to the Gulatingslaw, this should happen “every three winters”. The oldest parts of Gulatingslaw date back to the 10th century, but this is a later addition. It is still interesting that tar was used consistently on these wooden buildings.

Although the written sources only stretch back to the Middle Age, we are close in time to the Viking Age with the Gulatingslaw, even though all passages regarding Christianity must date to a later period. Tarring churches cannot have been an issue in 10th century Norway.

Other buildings could have been tarred during the Viking Age, though. If we think of the churches as high status buildings, then at least the Hall is a likely candidate for similar treatment. We have, however, no evidence for tarred wood from Danish Viking age or even from the surrounding centuries. Maybe we have still to look for such evidence.

Speaking against the idea of tarring houses is another passage in the Gulatingslaw, which is repeated unchanged in 1274. In an effort to protect the forests it says that no man should make tar, “more than he needs to mend his ship.” So according to these laws the peasants of Norway should not make more tar than necessary for their ships, but still tar their churches every three years. One could argue that tar used for the church is not for personal use, but to preserve a common good, and that therefore the restriction does not apply here. In this reading, tar is reserved the maritime sphere and the preservation of God’s house. Still, the idea to tar churches can hardly have come out of the blue. Other buildings must have had the same treatment before.

How wood tar works

Wood tar was an important compound in ship building for many centuries, and ‘Stockholm tar’ was a product in high demand across Europe and North America (Hjulström *et al.* 2006). It later got commercially marginalized due to the development of coal-tar, and has a comparatively small market today.

Coincidentally there has been much research into how wood-tar works. This is due to Health and Safety regulations instated by the European Union. As tar producers had not been able to produce the necessary product information, wood tar was banned in directive 98/8/EC on Biocidal Products. This was a problem to cultural heritage, as especially the stave churches in Norway and Sweden but also wooden boats across the Nordic countries were treated with wood tar, and had been so for the better part of a millennium. The directive therefore posed a direct threat to significant cultural heritage, for instance the Urnes Church, which has been on the World Heritage List since 1979 (Egenberg *et al.* 2003). In the years just before the directive was to be enforced, the Cultural Heritage Agencies of the Nordic Countries therefore invested heavily in describing wood tar from different perspectives. As the detrimental effect on cultural heritage was unintended, and because documentation was produced, the European ban on wood tar was lifted in 2007. (Nypan 2008).

Investigations showed that the tar does not work like modern wood preservatives (Egenberg *et al.* 2003). It works as a water repellent and a sacrificial layer on top of the wood. The south sides are more heavily worn than the north facing sides. What happens is that the sun breaks down the tar, before it can break down the wood. As already mentioned, and even without tar, we also saw a heavier weather impact on the south facing sides of houses at the Centre.

Therefore wood tar does not function as a biocide, and it had no place in the Biocide directive, which was fortunate for the Scandinavian cultural heritage. Exact product information cannot be provided for this product as the chemical composition varies greatly within the same production run when traditional methods are used (Egenberg *et al.* 2002).

We can therefore say that the penetration of wood tar into the wood is very limited, and that this product is not toxic to bacteria or fungi. It forms a protective coating on the outside of the wood, protecting it against the elements. It will wear off pretty quickly, hence the Gulatingslaw’s demand for repeated treatment every three winters. For this reason, the effect of using tar on underground structures will be very limited, as it washes off even in the ground, and renewal is impracticable or downright impossible (Jermed *et al.* 2011).

Tar does have an effect on the upper parts of the buildings. Tarring seems an archaeologically and historically well founded solution to the problem of protecting exposed wood. We therefore suggest that the houses at Ribe Viking Centre – or at least the wooden part of them – may have the wrong colour, in the sense that they could have been tarred. We also see that tar has been taken up as part of the maintenance during the last couple of years, as decay has become evident. In fact we do not know whether this is a correct solution.

Linseed oil

Linseed oil is used in traditional paints, and was the main ingredient in paints up till the 1950s. Being lighter, the oil has better penetration into wood than tar. In fact tar is mostly mixed with linseed oil to make the solution less viscous before application. The methods may therefore be used in combination.

Under current practice, at least by the Danish government, linseed oil did not receive the same attention as the wood tar being exempt from Directive 98/8/EC. This although it has much the same applications as wood tar, and is mainly used in old buildings.

Charring and Tarring

As already mentioned charring wood creates an outer layer of charcoal which prevents the growth of microorganisms and fungal growth. The drawback is that this method creates cracks and exposes the underlying wood to unwanted decay. If however the wood is tarred after having been charred the spaces will be filled with the tar which will create a complete protective coat around the unchanged internal wood. This could possibly be a good solution, in so far that the tar can close the cracks

Carving

As already mentioned, the carpenters at Ribe Viking Centre have exercised a marked primitivism in their approach to house reconstruction. This primarily entails working the wood as little as possible. In consequence one can often see sapwood and even traces of bark on the logs. Sapwood is the outer living layer of wood on the stem and is much more prone to rot than the heartwood. We do generally like to see sapwood in archaeology, because it gives much more precise dendrochronological results, but it must be considered a doubtful practice to leave it in weather-exposed parts of a wooden construction. Indeed the general impression of the -relatively few-known Viking Age building timbers is that they have mostly been worked to some extent, and that rectangular sections of posts and beams seems to be the rule. Carving the wood removed (most of) the sapwood, making the wood less prone to rot. We recommend this practice to the Centre, and in a sense to find a middle ground between the two dogmas which has lain behind the construction of buildings.

Testing methods

No matter these recommendations, there is only little exact knowledge of what works to delay and prevent decay. In the modern literature there are only few studies on the decay of untreated posts in the ground, and virtually none on the effect of pre-industrial protective agents. The interests of modern wood science and industry lie elsewhere. However, there are standardized testing regimes for examining this problem, in Europe one standard is EN 252 (CEN 1989). This is based on a visual assessment of wood that has been exposed to ground contact. As it is not difficult to use, we will describe this system in some detail here, recommending that it forms the basis of several experiments, not only at Ribe Viking Centre, but also elsewhere. Decay and accelerating maintenance costs must be a common problem to many similar centres.

The following is based on detailed descriptions in Edlund *et al.* (2006). The wood is cut into stakes of 25×50×500 mm. Several (10-20) wood samples with the same treatment are used, along with untreated stakes for reference. These stakes are dug halfway into the ground, mixing different types of treatment randomly among each other. Each stake (marked with a number or other ID-tag) is inspected once every year. The modern standard demands that tests are run for at least five years before any conclusions are made. Although the relatively small dimensions of the wood samples accelerate the test, they ought to continue beyond these five years.

The wood samples are inspected visually according to Table 2, and an average value is calculated for each type of treatment. Multiplying this average by 25 gives an ‘index value’ between 0 and 100, where 100 is the complete decay of all stakes of a certain type. When all stakes reach stage 4, or sufficient time has passed, the experiment can be stopped. In the Nordic tradition of these tests, any given stake cannot change value downwards; If during one year it has been assessed to 2, it cannot be downgraded to 1 in subsequent years, although the inspector may find that it should belong here.

Rating	Classification	Definition of condition
0	No attack	No change perceptible by the means at the disposal of the inspector in the field.
1	Slight attack	Perceptible changes, but very limited in their intensity and their positional or distribution: - changes which only reveal themselves externally by a change in colour or by very superficial degradation, softening of the wood being the most common symptom, to an apparent depth of the order of one millimetre.
2	Moderate attack	Clear changes to a moderate extent according to the apparent symptoms: - changes which reveal themselves by softening of the wood to a depth of approximately 2 to 3 millimetres over all or part of the test piece from the ground level zone and below
3	Severe attack	Severe changes: - marked decay in the wood to a depth of 3 – 5 millimetres over a wide surface (for example soft rot or other type of decay over all the surface of the specimen at the ground line zone or below) or by softening to a greater depth (10 – 15 mm) over a more limited surface area e.g. white rot over a few mm ² .
4	Failure	Impact failure of the stake in field

Table 2. The five classes of wood decay according to EN 252. From Edlund et al. 2006.

Although some experience is probably necessary, we feel that this is a manageable and relatively straight forward way to test different potential treatments of posts. We note that Edlund *et al.* (2006) have several critical remarks on this test, and suggests improvements to it, but still see it as a viable way of doing formal tests. As modern industry would not be interested in historical compounds, such work will have to be done at the historical centres, or maybe even in the back gardens of the many who support these centres and volunteer their help in so many other ways. The only caveat is that one needs to commit an area for many years onward, so institutionalized ground is probably preferable. If it does not distract from the feeling of authenticity at these institutions, that is. We would be most interested in reading about the results of such tests in the future.

7. FINAL REMARKS

The houses at Ribe Viking Centre are not Viking Age houses. They are modern day replicas, and as such are a phenomenon of our time. They represent our perception and interpretation of what Viking houses may have looked like. A hundred years from now, such houses will look different, exactly as our reconstructions look different from those we find in illustrations a hundred years ago.

The Viking Centre is a fascinating place in many respects. From the University we have welcomed this opportunity to go into the details with one aspect of the activities at the Centre. Although we have necessarily, and by training, engaged in a critical discussion of the buildings raised over the past two decades, we also recognize the deep knowledge and commitment that lies behind them, and is embedded in the values of the Centre. We do believe that it is an important task to document the activities at this or similar centres in a systematic form, as much knowledge is accumulated here. Knowledge, which is useful to archaeologists and the public alike. We hope that this report has given an insight into the wonderful and varied buildings at Ribe Viking Centre.

To us it was probably the decay of the posts, which gave most food for thought. Even though archaeologists learn this as part of our training, it is a different thing to look at formerly thick wall planks which have all but vanished in the ground. The cultural significance of these observations is that it is impossible to inherit a house from your father. This cannot be taken too literally of course, for household deaths and house reconstructions need not have occurred in phase. But still every generation would have to build, and rebuild, their own house. As a house reflects a major investment in time and materials this must have had consequences in society, which goes far beyond the choice between different types of joinery of wood.

Those, however, are considerations far beyond the scope of the current project. During this work we have possibly reached a better appreciation of the work and the craftsmanship that has been put into the halls, houses and huts that one can see at Ribe Viking Centre, and by inference into the houses we have seen in so many excavations. We have learned much from the discussion with the carpenters, and hope to have brought some of this understanding and appreciation on through this report.

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